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THE EVOLUTION AND PALAEOBIOGEOGRAPHY OF MESOZOIC PLANKTONIC FORAMINIFERA

by

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A thesis submitted to the University of Plymouth
In partial fulfilment for the degree of

DOCTOR OF PHILOSOPHY

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Faculty of Science

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ABSTRACT

Wendy Hudson

The Evolution and Palaeobiogeography of Mesozoic Planktonic Foraminifera

In the 1960s Oberhauser and Fuchs (palaeontologists working at the Geologische Bundesanstalt in Vienna) described a range of new taxa from the Triassic of Austria that were thought to be the earliest planktonic foraminifera. The first reactions of the palaeontological community were negative but in the subsequent forty years our knowledge of Jurassic planktonic foraminifera has expanded considerably.

A thorough re-evaluation of the Oberhauser and Fuchs collections in Vienna has shown that these species are probably not planktonic and that the first planktonic taxa appeared in the Toarcian. This origination in the centre of Western Tethys was followed by a rapid expansion of planktonic foraminifera throughout Peri-Tethys. This expansion is dominated by the genera *Conoglobigerina* and *Globuligerina* and while some believe that their separation is straightforward (based on apertural characters) analysis of large assemblages shows that this differentiation is not reliable and requires further analysis not only of holotypes, paratypes and topotypes but of large assemblages.

In Southern Poland, Middle Jurassic limestones in the Pieniny Klippen Belt are described as foraminiferal packstones and represent the first evidence of a foraminiferal ooze on the ocean floor. This indicates that, by the mid-Jurassic, there was an oceanic stratification of the Aragonite and Carbonate Compensation Depths and that the modern ocean system had developed, although the depths of these various layers may have been different to those of the present day.

By the Oxfordian a relatively diverse planktonic fauna had expanded throughout Peri-Tethys and, probably, around the globe in the tropics. The fauna expanded further in the early Cretaceous as Gondwana fragmented but data across the important Jurassic to Cretaceous transition is extremely limited and requires further investigation.

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AUTHOR'S DECLARATION

At no time during the registration for the degree of Doctor of Philosophy has the author been registered for any other University award without prior agreement of the Graduate Committee.

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Relevant scientific seminars and conferences were regularly attended at which work was often presented; external institutions were visited for consultation purposes and several papers prepared for publication.

Publications

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Presentations and Conferences Attended

2001 6th International Workshop on Agglutinated Foraminifera. Prague.

2002 Geological Society of London Meeting: Organic-Carbon Burial, Climate Change and Ocean Chemistry (Mesozoic-Paleogene). London.

2002 46th Annual Meeting of the Palaeontological Association. University of Cambridge.

2003 Geological Society of London, South-West Regional Group: ProGeo 2003 – Sustainability. Exeter.

2003 Cardiff University, National Museum of Wales and the Volcanic and Magmatic Studies Group (Mineralogical Society and Geological Society of London): Mantle Plumes - Physical Processes, Chemical Signatures, Biological Effects. Cardiff.

2004 Devon County Council: Devon Living Coasts Conference. Kingsbridge.

2005 7th International Workshop on Agglutinated Foraminifera. Urbino.

2005 Devon County Council: Devon Living Coasts Conference. The Meteorological Office, Exeter.

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Signed..W. Hudson.....................

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CHAPTER 1

INTRODUCTION

1.1 MESOZOIC OCEANS AND THE EVOLUTION OF MODERN PROTISTA

Planktonic foraminifera are marine protozoans that form part of the ocean plankton drifting in the upper layers of the water column. In modern oceans, they have distinctive distributions governed by combinations of abiotic and biotic factors, including temperature, salinity, pressure, light penetration, ocean currents, nutrients, interspecific and intraspecific competition. Occupying an important niche in pelagic ecosystems, planktonic foraminifera are extremely abundant, although the number of species recorded at any given time in geological history has never been very large. They act as a sink for calcium carbonate and the carbonate oozes that have accumulated on the ocean floor over the past 130 million years consist largely of their skeletons (Bé, 1977).

The Mesozoic was an era of evolutionary adaptation for the marine protists. The first planktonic foraminifera evolved from benthonic ancestors probably in the Toarcian or Bajocian (approximately 173 million years ago), although the exact date has still not been established (Simmons *et al.*, 1997; Wernli and Görög, 1999, 2000). All known Palaeozoic foraminifera were benthonic, as are 99% of Recent foraminifera (Knoll and Lipps, 1993). Their migration into the water column might have been an evolutionary adaptation to oceanic stagnation, possibly related to massive methane hydrate releases (Hesselbo *et al.*, 2000; Hart *et al.*, 2003). So far, the earliest examples of planktonic taxa have been recorded from NW Europe (Wernli and Görög, 1999, 2000). The new species evolved very slowly with only 16 new taxa recorded from the following 40 million years and the areal distribution remaining centred on NW Europe and Western Asia (Hart, 2000). Their radiation resulted from a combination of factors and is probably the most comprehensively recorded protistan radiation into pelagic zones.

As the North Atlantic, South Atlantic, Indian and Antarctic Oceans began to form, following the fragmentation of Pangaea (approximately 130 million years ago), the planktonic foraminifera adapted to this changing palaeoceanography, rapidly evolving into over 130 species in more than 30 genera. This first evolutionary phase was terminated by the Cretaceous/Tertiary Boundary Event (65 million years ago) which only 3 species survived. The second evolutionary radiation occurred in the earliest Cenozoic (Blow, 1979; Hart, 1980).

As in the Palaeozoic, planktonic, benthonic and nektonic diversifications and extinctions tended to coincide, possibly as a result of palaeoceanographical circulation, sea-level changes, oxygen profiles in the water column or variations in primary production. During marked heterogeneity of water masses or high productivity, many specialised species lived for part of their life-cycles, at least, within narrow environmental parameters. When oceanic water masses became more homogeneous and less stratified, or productivity dropped, specialised species disappeared. Planktonic foraminifera radiated at least three times from simple, trochospiral ancestors to diverse faunas, dominated by morphologically complex species including flattened, spheroidal or irregularly-shaped forms with keels, elongate chambers, additional apertures and spines (Hart, 1980; Caron and Homewood, 1983; Premoli Silva and Sliter, 1999; Hart, 1999). Recent planktonic foraminifera with complex adult morphologies reproduce at varying depths in the water column. Particular morphologies have evolved to enable foraminifera to exploit specific characteristics of water masses, including distinct ranges of temperature, salinity, pressure, density and nutrient availability. Isotopic analysis of tests has indicated that fossil foraminifera with complex morphologies were similarly specialised for the various strata of vertically structured oceans (Emilani, 1954; Huber *et al.*, 1999).

The earliest Jurassic planktonic foraminifera probably first appeared as tiny, spherical forms with simple trochospiral tests composed of few chambers. These foraminifera continued into the Early Cretaceous, when many more species evolved with more complex tests characterised by keels, elongate chambers, apertural plates and similar structures (Caron and Homewood, 1983; Knoll and Lipps, 1993). The two general morphological groupings (simple trochospiral and more complex forms) alternated in importance throughout the Mesozoic (Caron and Homewood, 1983; Knoll and Lipps, 1993). During the mid-Cretaceous and at the Cretaceous-Tertiary boundary, high diversity planktonic foraminifera abruptly disappeared, with simple trochospiral species surviving to dominate post-extinction biotas. High-latitude modern oceans, characterised by relatively unstratified water columns, are dominated by morphologically simple species and geochemical evidence indicates that palaeoceans dominated by simple, trochospiral forms were also relatively homogeneous, although much warmer than present high-latitude seas. Ocean structure influences planktonic speciation and ecological interactions (not fully understood for extant plankton). According to Knoll and Lipps (1993), theories tend to concentrate on oceanographic changes known to correlate with stratigraphical changes in diversity.

The aim of this study has been to understand the origin and early evolution of planktonic foraminifera and how the Jurassic fauna developed into that of the Cretaceous. To achieve this aim, the following objectives have been undertaken:

1. the re-investigation of the Triassic/Jurassic fauna described by Oberhauser (1960) and Fuchs (1967, 1970, 1973);
2. the investigation of faunas from Hungary, Poland, Switzerland, Sicily, Greece and Britain, in order to document changes during the Jurassic; and
3. an attempt to reconstruct the palaeobiogeography of Jurassic planktonic foraminifera and their Cretaceous descendants.

1.2 THE PRECURSOR OF PLANKTONIC FORAMINIFERA

In a review of Mesozoic planktonic foraminifera in 1977, Masters indicated that the earliest true planktonic forms were of Bathonian age. He indicated that pre-Bathonian strata should be investigated in search of their ancestors. Subsequent research (e.g. Wernli and Görög, 1999, 2000) has indicated that the earliest holoplanktonic forms are Bajocian in age. Very small specimens attributed to the genus "*Globigerina*" have been found in an apparently neritic environment, in assemblages with distinctive fauna. The neritic zone, with the greatest environmental stress and species diversity of any marine habitat, is the most probable ancestral environment. Masters (1977) stated that extant planktonic species are less frequently found in shallow water than in deeper water. He proposed that the early planktonic foraminiferal life-strategy may not have included diurnal migration nor progressive sinking in the water column during ontogeny, due to the very small size of the adult, but an environment similar to that of its ancestor should be expected.

Based upon test morphology, the discorbids were believed to be the possible ancestors of the planktonic taxa (Cushman, 1948). Loeblich and Tappan (1964) described the Discorbidae as being monolamellar although, according to an earlier study (Reiss, 1963), they are bilamellar, as are the Globigerinacea. According to Masters (1977), the evolutionary step would have been too great for the miliolids or agglutinated species to be potential ancestors and the Nodosariacea lacked the appropriate type of aperture and coiling.

1.3 RECENT PLANKTONIC FORAMINIFERA

1.3.1 HISTORICAL BACKGROUND OF RESEARCH

Recent planktonic foraminifera are distributed throughout the major oceans of the world, including tropical, sub-tropical and polar water masses. One species has even been discovered living in Arctic and Antarctic marine ice. There are more than forty Recent species, the precise number depending on the taxonomy used. Although planktonic foraminifera constitute a minor percentage of the total extant marine zooplankton (Hemleben *et al.*, 1989), the constant deposition of empty shells on the ocean floor in regions of high productivity contributes substantially to the sediments and forms the "*Globigerina* ooze" (Murray and Reynard, 1891; Vincent and Berger, 1981). The remains of many other groups of zooplankton have not been preserved, due to their chemistry or to predation.

Planktonic foraminifera were discovered in the first half of the nineteenth century and have been used extensively in palaeoceanography and for biostratigraphical analysis. D'Orbigny (1826, 1839a,b) published the first significant descriptions of foraminifera from beach sands and marine deposits of the Canary Islands, Cuba and other localities but did not realise that they were planktonic. Later Ehrenberg (1861, 1873), Carpenter *et al.* (1862), Wallich (1862), Parker and Jones (1865), amongst others, recorded the presence of planktonic foraminifera shells in the deep-sea sediments from the northern Atlantic Ocean but assumed that all foraminiferal species inhabited the sea floor. In 1867, Owen discovered their planktonic life-strategy but this was overlooked until the Challenger expedition, when Brady (1884) reported that planktonic foraminifera could be readily collected in plankton samples. Murray and Renard (1891) established that many sea floor sediments are largely constituted of planktonic foraminiferal tests and, in 1897, Murray linked the distribution patterns of planktonic foraminifera to climate. Since then, planktonic foraminiferal tests have been widely used for establishing the age of marine sedimentary facies and in palaeoclimatological reconstructions. Rhumbler (1901, 1911) was the first to investigate the biology of planktonic foraminifera, determining the food preferences of spinose and non-spinose species (for copepods and diatoms or small radiolarians, respectively). In 1920, Lohmann described the distribution of plankton in the

Atlantic Ocean, including planktonic foraminifera, but the pattern was not investigated systematically for more than 30 years.

Stable isotopes were used by Emiliani (1954, 1955) to determine the palaeotemperature of the environment in which the foraminifera had lived, based on the oxygen isotope composition of the carbonate shell. Subsequently, this has been used extensively, particularly in palaeoecological investigations. Using this method, Emiliani was able to deduce the depth habitat of extant organisms (stratified plankton tows not being accurate at that time). From studies of Recent planktonic foraminifera, Emiliani (1971) and Bé (1977) observed that diversified faunas occur in sub-tropical and tropical regions where there is a considerable temperature difference between the surface water and the deeper water.

1.3.2 VERTICAL DISTRIBUTION

In the marine environment, particularly in the photic zone where planktonic foraminifera are most abundant, organisms avoid competition by horizontal and vertical migration. At various depths, they are subject to different horizontal currents (Seibold and Berger, 1996). For the Recent fauna, Bé (1977) proposed three vertical zones within the water column (identifiable through oxygen isotopic analysis or stratigraphical data):

- 0-50 m shallow-water fauna;
- 50-100 m intermediate-water fauna; and
- below 100 m deeper-water fauna.

Using this zonation scheme, Hart and Bailey (1979) plotted the predicted water depth of mid-Cretaceous planktonic foraminifera onto their depth curve (constructed using planktonic to benthonic ratios). In all cases, they found that the evolutionary trends were either a continuation horizontally within the same depth zone or downward migration to a lower depth zone: no trends involved upward migration to a shallower depth zone. The spatial and temporal distribution of an individual species was taken to be a function of the water depth.

Emiliani (1971) had demonstrated that in regions with a thermocline, Recent species exhibit a depth migration during their life-cycle, with more complicated test morphologies (imperforate equatorial band, keel, double keel) occurring in progressively deeper water. Low diversity faunas, composed of simple, non-keeled (e.g. globose) forms occur in the uppermost parts of the water column in relatively cold waters (Arctic and Antarctic), shallow seas or even warm, deep seas when there is no thermocline, such as the Gulf of Aqaba - Elat (Reiss, 1977; Wonders, 1980). This model was used by Wonders (1980) to explain the occurrence and distribution of mid- and Late Cretaceous planktonic foraminifera and by Caron and Homewood (1983) for mid-Jurassic to Late Cretaceous planktonics. Stam (1986) felt that the model could explain several observations from his study of the Lusitanian Basin.

1.3.3 MORPHOLOGY

One evolutionary adaptation in early planktonic foraminifera was more globular chambers as, no longer requiring adherence to firm substrates, the flattened adherent side found in certain benthonic foraminifera lost its advantage (Simmons *et al.*, 1997). According to Stam (1986), no planktonic foraminifera were known from the Jurassic with complicated test morphologies, such as raised sutures, keels and double keels. According to Hart (1980), keels appeared each time planktonic foraminifera radiated into deeper water habitats from surface waters. Through convergent evolution, similar types of test morphologies appeared repeatedly at each of the four major radiations (Leckie, 1989), probably evolutionary adaptations to recurring environmental changes. Peripheral carina or keels are believed to have evolved independently, not only at each radiation but also between radiations (Lipps, 1970; Hart, 1980; Caron and Homewood, 1983). Although the majority of foraminifera have relatively simple skeletons, their keels are relatively complex and structurally diverse. Norris (1991) observed five distinct types of keel construction:

1. an imperforate band around a perforate chamber wall;
2. a muricate keel, formed by the growth of muricae over a perforate wall or narrow imperforate band;
3. a masonry keel, formed by the deposition of nodes or sheets of calcite over an imperforate band;
4. two masonry keels, formed at either edge of a wide imperforate band, creating a double keel; and
5. an inflational fold, resulting from the primary organic membrane folding back on itself, followed by the preferential deposition of calcite over it.

Double keels evolved repeatedly in the Cretaceous genera. The phylogenetic distribution of keel structural types suggested to Norris (1991) that parallel evolution of keels had occurred numerous times. Despite the variation in keel types, closely-related lineages evolved similar keel structures, suggesting an inherited bias from their common, unkeeled, ancestor.

1.4 MESOZOIC PALAEOGEOGRAPHY

1.4.1 TRIASSIC

Although the supercontinent formed by the end of the Paleozoic Era was named "Pangaea" ("all land"), it did not include all the landmasses existing at that time (Fig. 1.1). Continents separated from the supercontinent were Cimmeria (parts of Turkey, Iran, Afghanistan, Tibet, Indo-China and Malaya) and North and South China (Scotese, 2000). These Asian fragments were moving northwards towards Eurasia and it was only in the Late Triassic, following their eventual collision with the southern margin of Siberia, that all the landmasses were joined together.

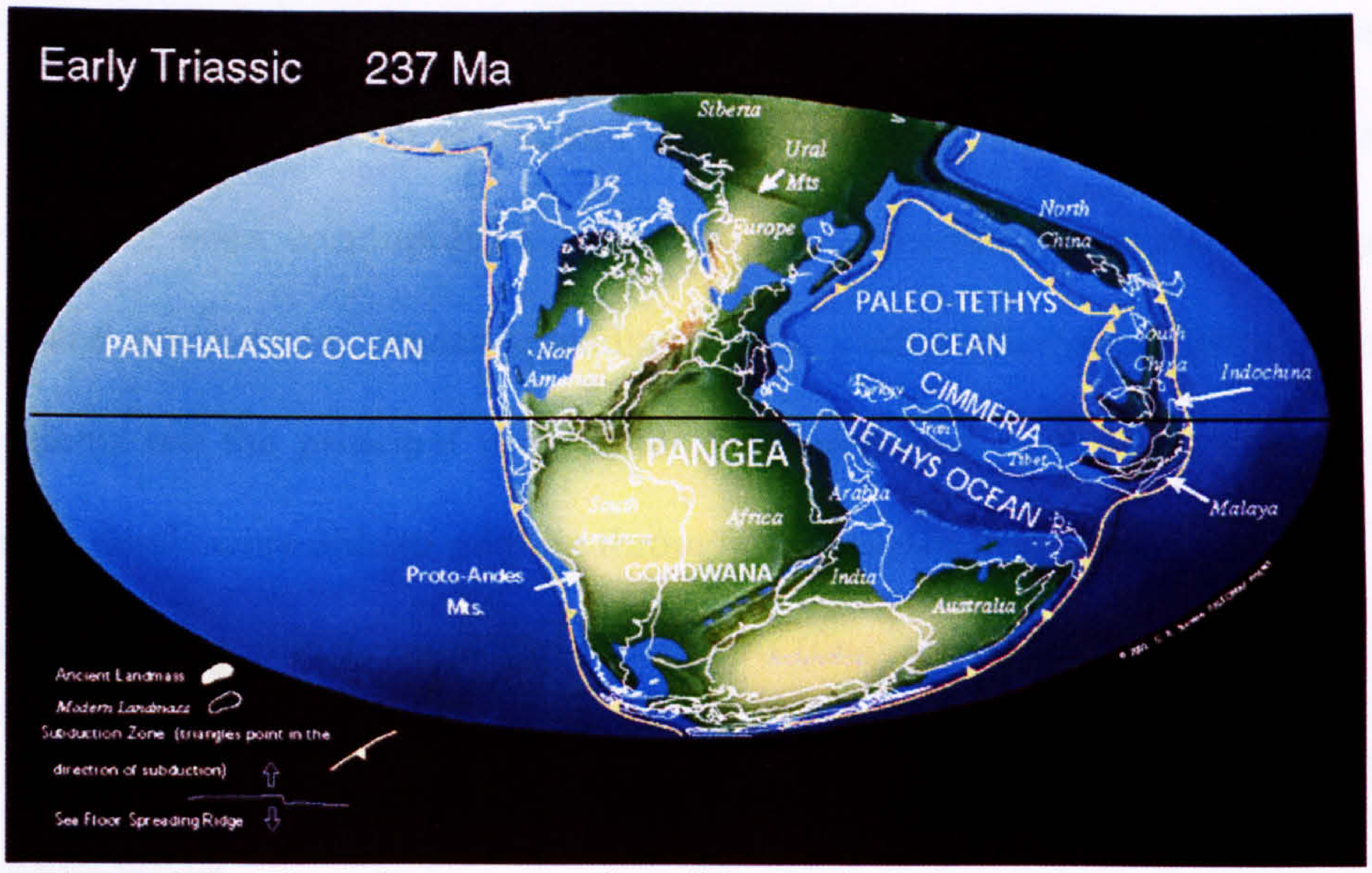


Figure 1.1. The palaeogeography of the Early Triassic (Scotese, 2000).

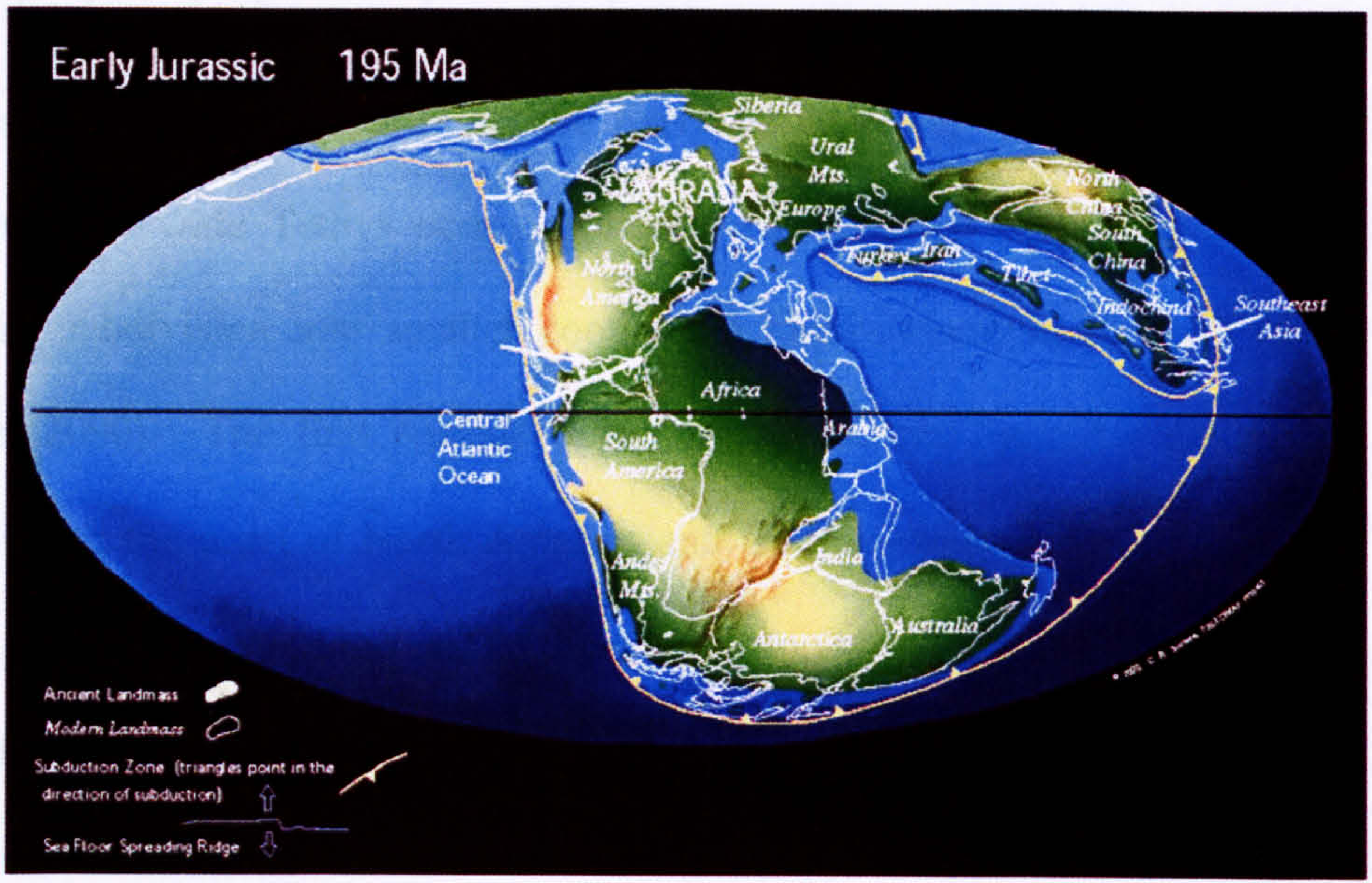


Figure 1.2. The palaeogeography of the Early Jurassic (Scotese, 2000).

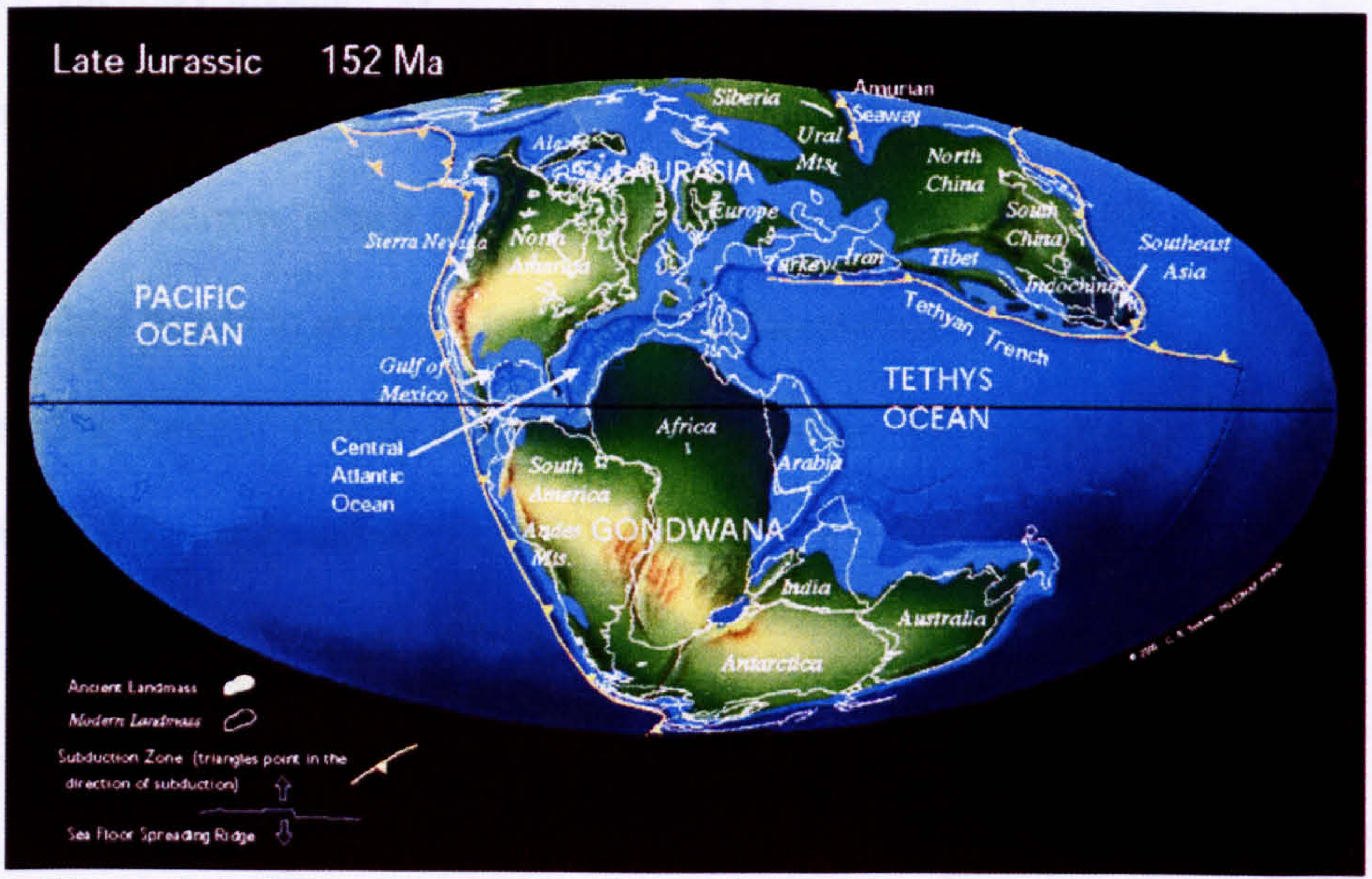


Figure 1.3. The palaeogeography of the Late Jurassic (Scotese, 2000).

The Mesozoic Era began with a gradual recovery and rediversification of flora and fauna following the mass extinction at the end of Permian (Ogg, 2004a). Faunal distribution appears to have been cosmopolitan, with aragonitic-secreting benthonic taxa becoming dominant and warm-water faunas spreading across Tethys (Scotese, 2000). Ammonites and conodonts are the principal proxies for the correlation of Triassic marine deposits. Terrestrial animals were able to migrate throughout Pangaea and, during the latest Triassic, dinosaurs began to dominate terrestrial ecosystems (Ogg, 2004a).

1.4.2 JURASSIC

During the Jurassic, Pangaea began to break up. Just as its formation had occurred in stages, so did its rifting apart. By the Early Jurassic (Fig. 1.2), south-central Asia had assembled. A wide Tethys ocean separated the northern continents from Gondwana. Pangaea's subdivision into smaller continental blocks occurred in three main episodes (Scotese, 2000). The first episode began in the Middle Jurassic. Following igneous activity along the coast of North America and the northwest coast of Africa, the Central Atlantic Ocean opened at the end of the Middle Jurassic (Ogg, 2004b), as North America moved to the northwest. The movement of North America away from South America resulted in formation of the Gulf of Mexico. Concurrently, extensive volcanic eruptions along the adjacent margins of East Africa, Antarctica and Madagascar resulted in the formation of the western Indian Ocean. By the Late Jurassic (Fig. 1.3), the Central Atlantic was a narrow ocean separating Africa from eastern North America. Eastern Gondwana had begun to separate from Western Gondwana by this time. The main fossils for correlating Jurassic marine deposits are ammonites. Dinosaurs spread across Pangaea and dominated the land surface (Ogg, 2004b).

1.4.3 CRETACEOUS

The second episode in the break-up of Pangaea, into the modern drifting continents, began in the Early Cretaceous. North America was still connected to Europe and Australia was still joined to Antarctica (Scotese, 2000). Gondwana continued to fragment as South America separated from Africa, opening the South Atlantic Ocean. The entire South Atlantic Ocean was not formed at the same time but opened progressively from south to north, as evidenced by being wider in the south (Scotese, 2000; Pletsch *et al.*, 2001). India, together with Madagascar, rifted away from Antarctica and the western margin of Australia, opening the eastern Indian Ocean. In the Cenomanian, the North Atlantic was connected to the Pacific through a series of >800 m-deep straits in the Caribbean and was also connected to the South Atlantic and Tethys (Scotese and Golonka, 1992).

Other important plate tectonic events occurred during this time:

- rifting commenced between North America and Europe;
- Iberia rotated anti-clockwise from France;
- India separated from Madagascar and moved rapidly northwards on a collision course with Eurasia;
- Cuba and Hispaniola emerged from the Pacific;
- the Rocky Mountains were uplifted; and
- exotic terranes arrived along the western margin of North America.

In the middle-Late Cretaceous, there was an increase in undersea volcanic activity and spreading-ridge formation, enhancing “super-greenhouse conditions” (Ogg *et al.*, 2004). By the Late Cretaceous, the oceans had widened and India was moving closer to the southern margin of Asia (Figs 1.4, 1.5).

In the warm seas, there was an explosion of calcareous foraminifera and nannofossils,

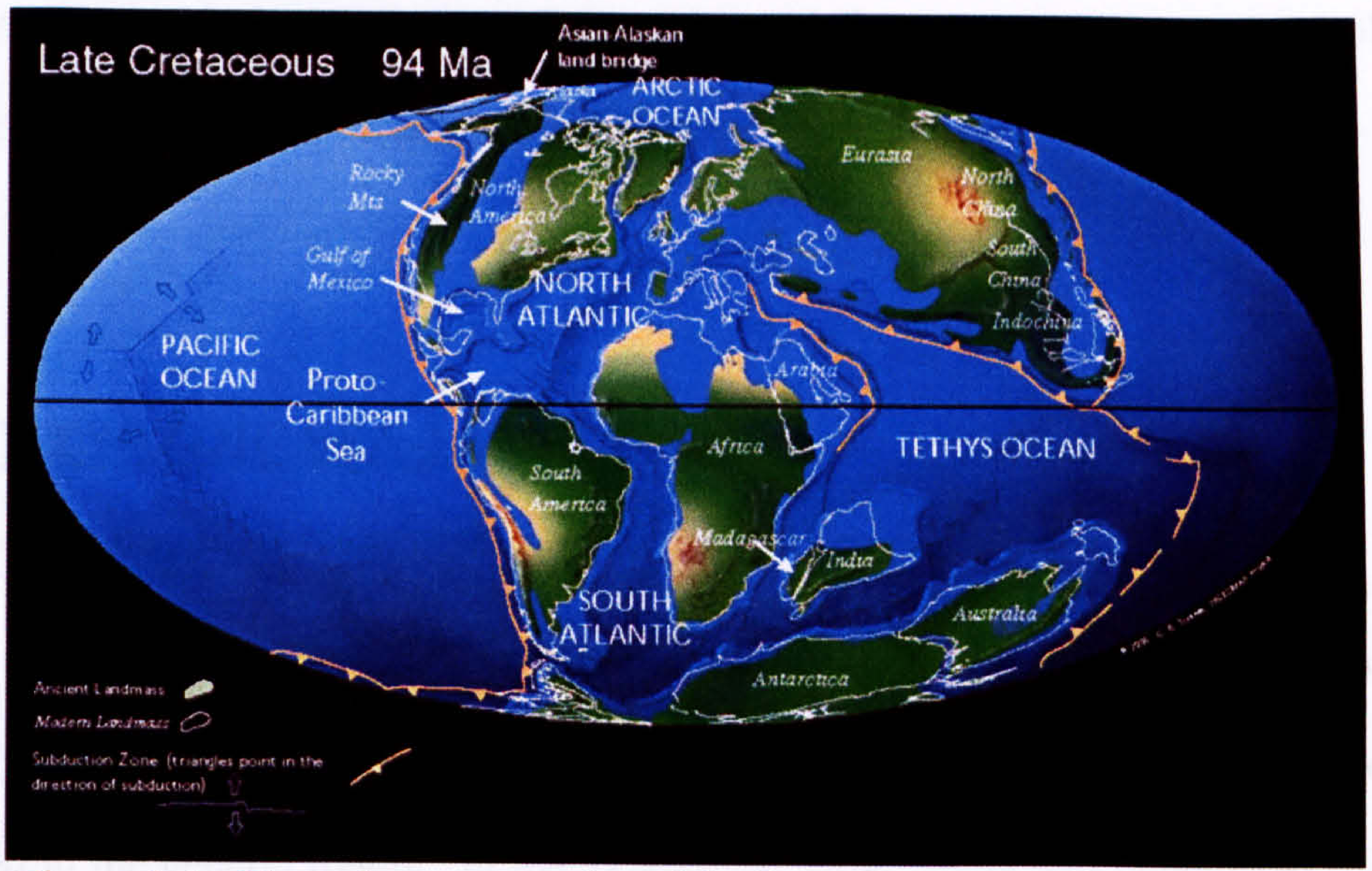


Figure 1.4. The palaeogeography of the Late Cretaceous (Scotese, 2000).

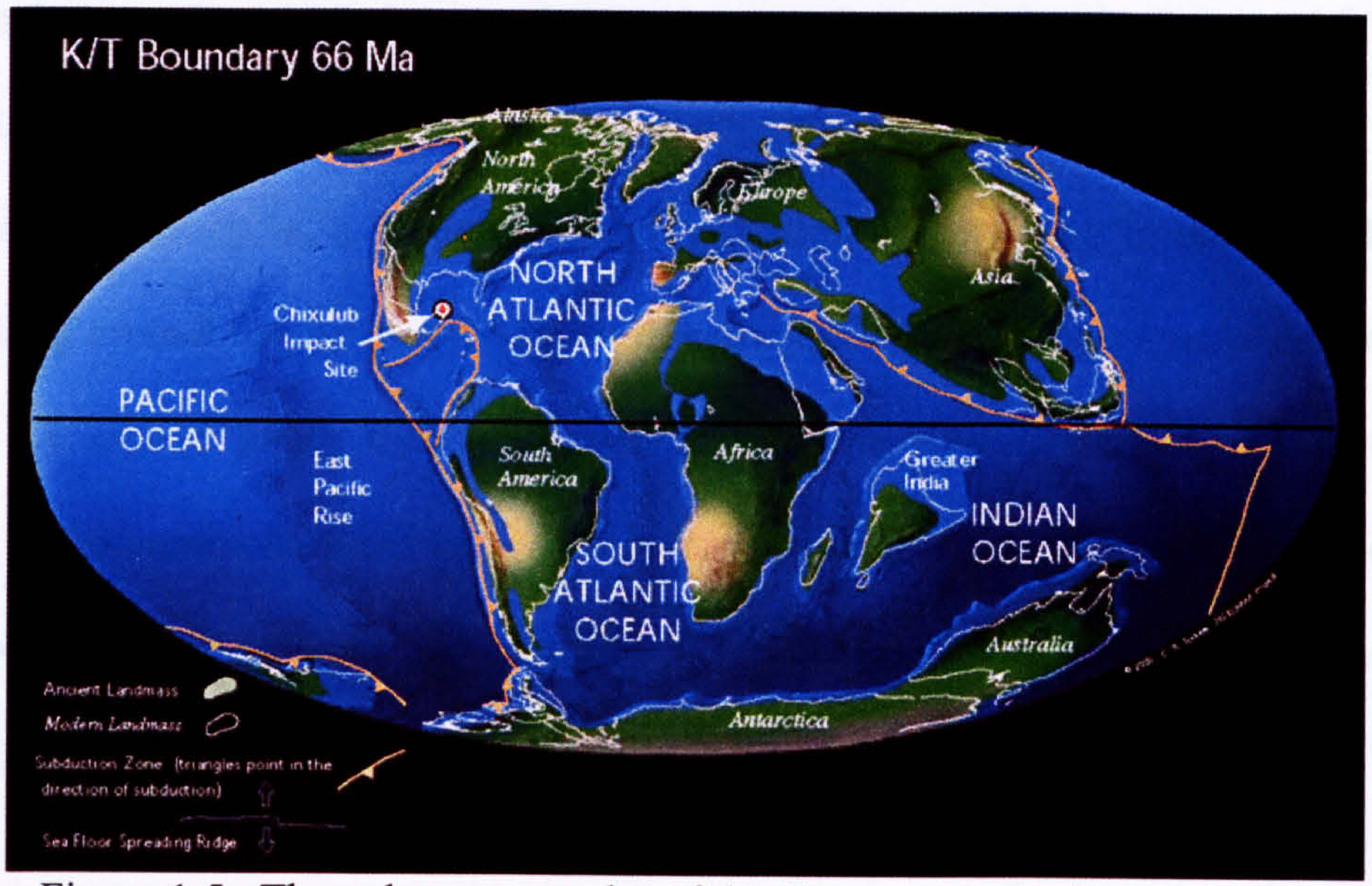


Figure 1.5. The palaeogeography of the Cretaceous-Tertiary Boundary (Scotese, 2000).

resulting in massive chalk deposits. During the mid-Cretaceous, angiosperms evolved on the land, which was dominated by dinosaurs (Ogg *et al.*, 2004).

1.5 MESOZOIC SEA-LEVELS

1.5.1 TRIASSIC

Frakes *et al.* (1992) stated that several compilations of evidence for eustatic sea-level change (including Vail *et al.*, 1977; Hallam, 1984; Haq *et al.*, 1987) differed in detail but concurred in the general trends. In the Triassic, a "slow, slight and punctuated rise" from the latest Permian to the Norian was followed by a "slow, slight and punctuated fall" from the Norian to the Sinemurian. According to Ogg (2004a), the Triassic sea-level trend is dominated by one cycle, a progressive transgression, commencing in the latest Permian and peaking around the Anisian-Ladinian boundary, followed by a regression to the Late Norian. A second major transgression begins in the Rhaetian and peaks in the late Jurassic. The commencement of each major transgression coincides with a major mass extinction (end-Permian and end-Triassic) and widespread anoxic environments on the shelves (Hallam and Wignall, 1999).

Triassic sea-level trends have been compiled for various regions, including, according to Ogg (2004a), Boreal basins (Embry, 1988; Mork *et al.*, 1989; Skjold *et al.*, 1998), the classic Germanic Trias (Aigner and Bachmann, 1992; Geluk and Röhling, 1997), the Dolomites and Italian Alps (de Zanche *et al.*, 1993; Gaetani *et al.*, 1998; Gianolla *et al.*, 1998). Many of these sea-level trends appear to correlate on an inter-basin to global scale (Haq *et al.*, 1988; Hallam, 1992; Embry, 1997; Gianolla and Jacquin, 1998; Jacquin and Vail, 1998).

1.5.2 JURASSIC

According to the general trends observed by Frakes *et al.* (1992), there was a "long, slow and punctuated rise" from the Sinemurian to the Kimmeridgian. According to Ogg (2004b), the main Jurassic sea-level trend is a progressive transgression from the latest Triassic to the latest Kimmeridgian, with a major regressive trend commencing in the Tithonian and reaching a minimum in the Berriasian.

Jurassic sea-level trends have been compiled on a global scale (Hallam, 1978, 1981, 1988, 2001; Haq *et al*, 1988; Hardenbol *et al.*, 1998) and for different basins (Partington *et al.*, 1993; Sahagian *et al.*, 1996; Gygi *et al.*, 1998; Hesselbo and Jenkyns, 1998).

1.5.3 CRETACEOUS

During the Cretaceous, global sea-levels were 100-200 metres higher than today (Hancock, 1976, 1989; Hancock and Kauffman, 1979; Scotese, 2000). Higher sea levels resulted partly from new rifts in the ocean basins that displaced water onto the continents. The Cretaceous was a time of rapid sea-floor spreading, during which sea-levels tend to rise. Due to the broad profile of rapidly spreading mid-ocean ridges, more water is displaced than by slow spreading mid-ocean ridges. Extensive areas of shallow seaways were an important contributory factor to moderate climates through increased evaporation and precipitation (Arthur *et al.*, 1985).

Warm water from the equatorial regions was transported northwards, warming the polar regions (Scotese, 2000). The oceans are believed to have been more stratified than at present, with little vertical mixing and the deposition of large quantities of organic rich sediments in anoxic bottom waters. Evidence of high-resolution biostratigraphical synchroneity of sequences in widely separated regions led Gale *et al.* (2002) to conclude that sea-level changes controlling sequence formation in the Cenomanian were eustatically controlled. One of the possible causes they proposed for these rapid sea-level changes and extensive epicontinental seas was glacioeustacy, particularly the growth and melting of Antarctic ice-sheets. Restricted circulation occurred in the developing Atlantic Oceans, although by the latter part of the Cretaceous more open circulation was established and the deposition of black shales diminished. According to Norris *et al.* (2002) the passages between the basins (Scotese and Golonka, 2002) should have prevented evaporation from making the Atlantic Basin substantially more saline than the Pacific or South Atlantic. Mesozoic sea-levels reached their maximum in the late Cretaceous (Haq *et al.*, 1987). During the latest Cretaceous the seas regressed, exposing larger continental areas and leading to the establishment of more seasonal climates (Hays and Pitman, 1973).

1.6 MESOZOIC CLIMATE

Within the generally warm Mesozoic Era, there appear to have been significant variations. The Jurassic and Cretaceous were regarded as very warm periods, with low temperature gradients, temperate conditions at high latitudes and extensive evaporite deposition. However, more recent work suggests that parts of the Earth may have been quite cool during this period (Frakes *et al.*, 1992, Price, 1999).

1.6.1 TRIASSIC

According to Ogg (2004a), the supercontinent of Pangaea had no known glacial episodes. Its monsoonal climate, modulated by Milankovitch cycles, left a sedimentary record that is valuable for high-resolution correlation. From isotopic analysis and climatic proxies, Frakes *et al.* (1992) regarded the early Triassic as having been comparatively warm, without seasonal ice. Temperatures at low latitudes may have been high, subtropical marine surface temperatures having been estimated at ~38°C (Karhu and Epstein, 1986). Seasonal surface air temperatures, sea ice coverage and snow depth for the Late Triassic are illustrated from the climate models of Sellwood and Valdes (2007, in press, fig. 3) (Fig. 1.6).

1.6.2 JURASSIC TO EARLY CRETACEOUS

At the end of the Aalenian, there was significant cooling (Frakes *et al.*, 1992) with subsequent ice-rafting at high latitudes (Frakes and Francis, 1988). From the Bajocian to the mid-Albian there appears to have been ice at high latitudes, at least seasonally. High-latitude ice-rafted deposits, at intervals during the Bajocian to Albian, suggest freezing conditions in Polar regions and temperate glaciers (Kemper, 1987; Frakes and Francis, 1988, 1990). The Equator-to-Pole temperature gradient appears to have steepened, with marked seasonality. Seasonal surface air temperatures, sea ice coverage and snow depth for the Late Jurassic are illustrated from the climate models of Sellwood and Valdes (2007, in press, fig. 5) (Fig. 1.7).

1.6.3 MID- TO LATE CRETACEOUS

Following a cool Early to mid-Cretaceous, temperatures increased (Frakes *et al.*, 1992). The mid-Albian to the end of the Mesozoic was one of the warmest periods in the late Phanerozoic. There is a lack of ice-rafted deposits recorded for the latter half of the Cretaceous and, during the mid-Cretaceous, conditions globally appear to have been much warmer. The average global temperature is believed to have been about 6°C higher than at present (Barron, 1983; Hart, in press). Without permanent ice in the polar regions, forests and vertebrates were able to survive near both Poles. The absence of seasonal ice at high latitudes from the Cenomanian to the Maastrichtian is suggested by the lack of ice-rafted deposits, in contrast to the mid-Jurassic to early Cretaceous. However, Gale *et al.* (2002) have suggested that globally identified sequence boundaries and sea-level changes (based mainly in S.E. Britain and S.E. India) indicate the presence of ice controlled eustatic changes. The scale of these changes does not indicate a major ice-cap on both poles but a

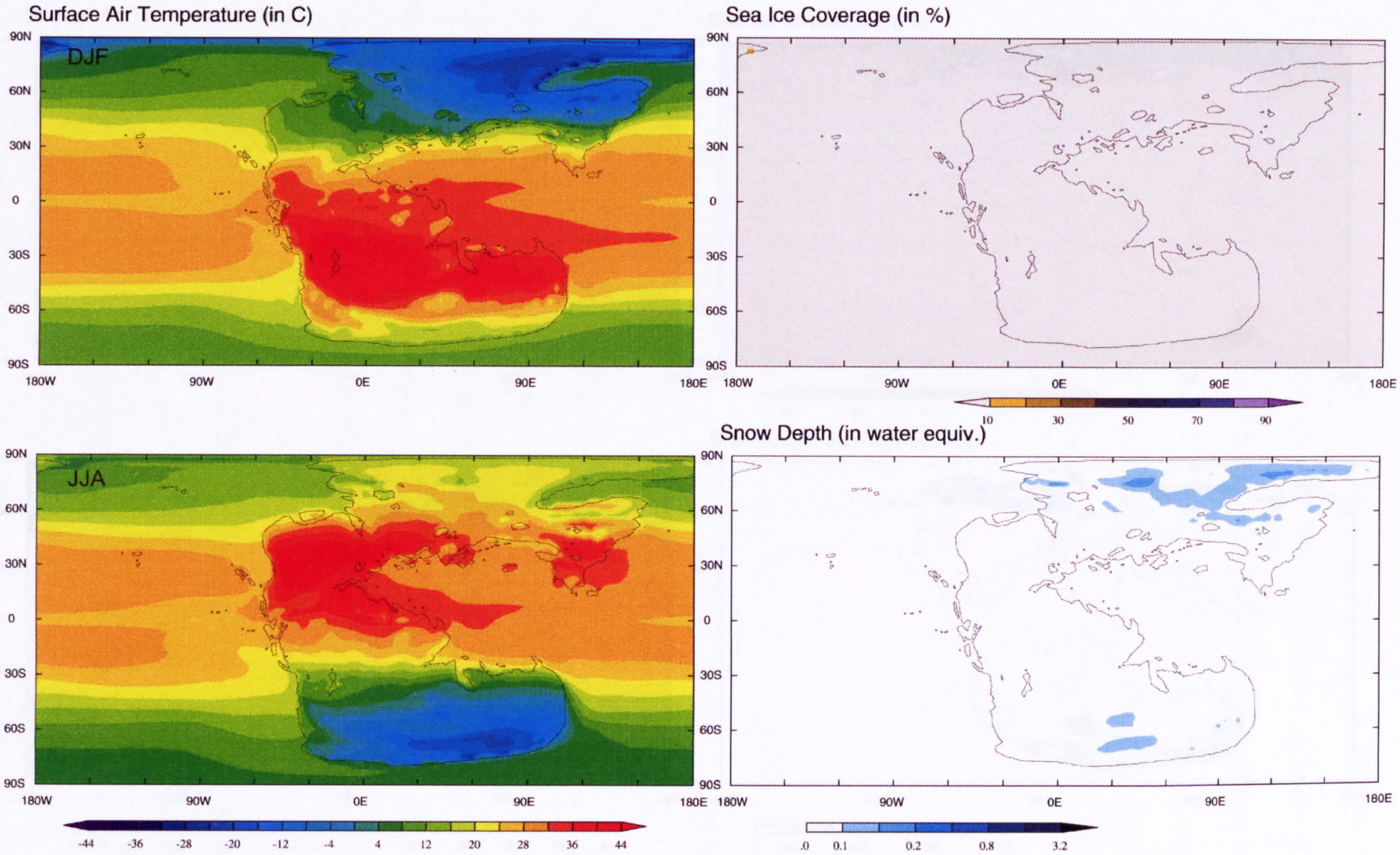


Figure 1.6. Model simulated mean seasonal temperatures for the Late Triassic, for December-January-February (DJF) season and June-July-August (JJA) season. Units are in °C and the contour interval is every 4°C. Modelled Average Late Triassic annual sea ice coverage (%). Modelled Late Triassic annual average snow thickness (in metres of water equivalent) (Sellwood and Valdes, 2007, in press).

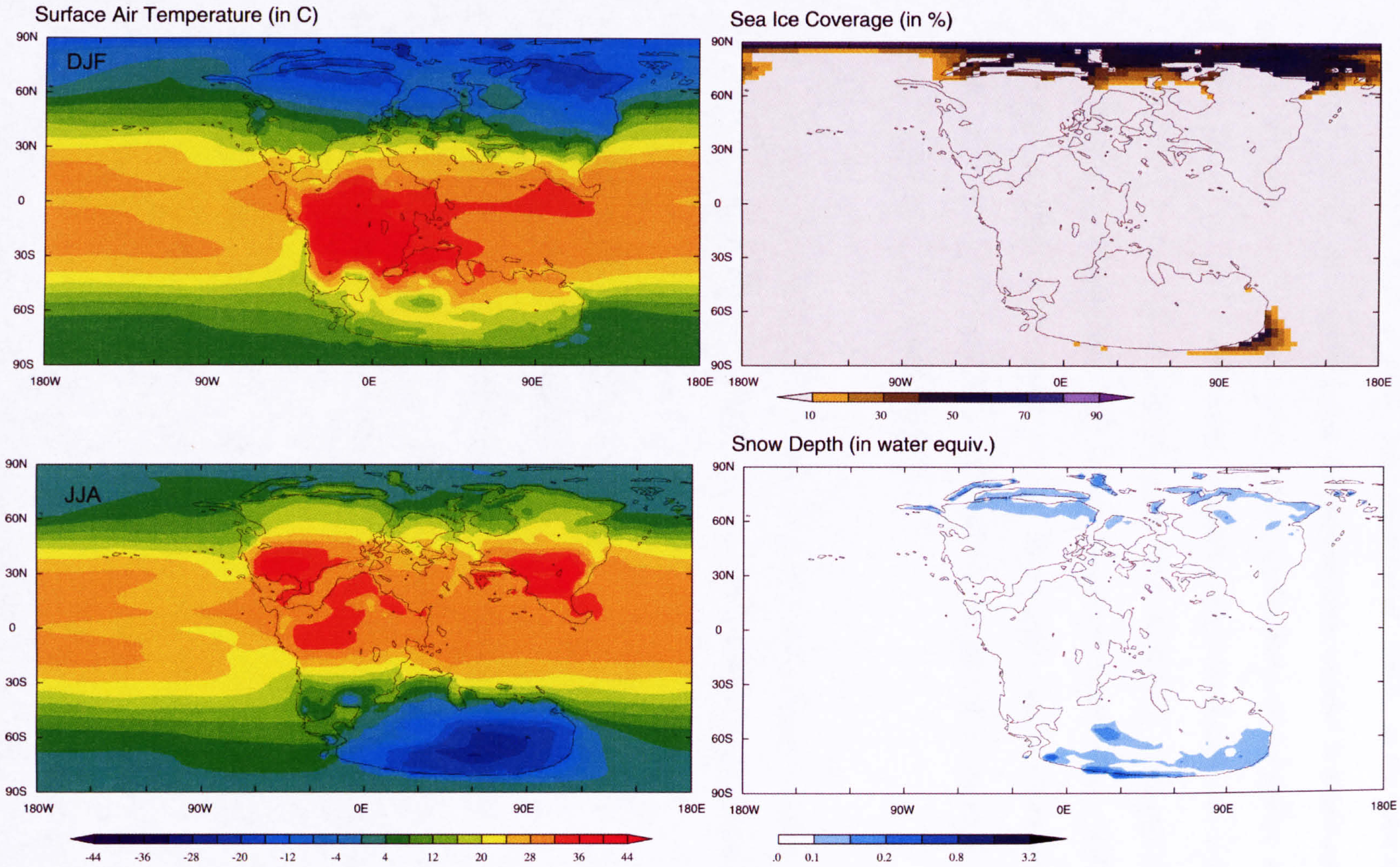


Figure 1.7. Model simulated mean seasonal temperatures for the Late Jurassic, for December-January-February (DJF) season and June-July-August (JJA) season. Units are in °C and the contour interval is every 4°C. Modelled Average Late Jurassic annual sea ice coverage (%). Modelled Late Jurassic annual average snow thickness (in metres of water equivalent) (Sellwood and Valdes, 2007, in press).

"Greenland-sized" ice-sheet may have been present in the Antarctic. While this may have been the case in the Cenomanian, the Early Turonian seems to have been a warm (or even hot) greenhouse period (Huber *et al.*, 2002; Norris *et al.*, 2002). In the latest Cretaceous, Miller *et al.* (1999) have indicated that the simultaneous increase in benthonic and low-latitude planktonic foraminiferal $\delta^{18}O$ values in the early Maastrichtian indicated a decrease in both deep-water and tropical sea-surface temperatures and/or an increase in the $\delta^{18}O$ value of the oceans due to increased continental ice volume. Such high $\delta^{18}O$ values were regarded as incompatible with an ice-free world because they indicated cool conditions in the high-latitude source regions. Isotopic and sequence stratigraphical data suggested that an ice sheet equivalent to 25%-40% of the present Antarctic ice cap caused a 20-40 m glacioeustatic sea-level lowering.

Distinct warmer and cooler phases within the warmer trend of the Mesozoic have been indicated by refined palaeotemperature data and revised thermal tolerances of flora.

1.6.4 FLORA AS PROXIES FOR CLIMATE

1.6.4.1 TRIASSIC TO MIDDLE JURASSIC

For the terrestrial flora (valuable climatic proxies) this was a period of major change. The Gondwanan *Glossopteris* flora disappeared in the latest Permian, being succeeded during the Triassic by the *Dicoidium* flora which, was in turn succeeded by new forms in the Early Jurassic. Cycadophytes, ferns and conifers dominated the Euramerican palaeofloristic region during both the Triassic and Jurassic, indicating warm-temperate to subtropical climates, with some seasonal variation (Barnard, 1973). Growth rings in late Permian and early Triassic fossil wood from Antarctica display frost damage, indicating low temperatures at high latitudes for at least part of the year (Jefferson and Taylor, 1983). A gradual shifting northward of floral province boundaries in the former USSR has been suggested by progressive warming during the Jurassic (Vakhrameev, 1964;

Krassilov, 1981), coinciding with a marked 10° shift of the boundary between the Tethyan and the Boreal faunal realms in the Bathonian and the Callovian (Hallam, 1975). The progressive poleward shift of floral boundaries, evidenced by plant fossils in Asia and North America, might reflect precipitation rates as well as temperature. The early and middle Jurassic experienced progressively more widespread humid climates, which only reversed in the late Jurassic.

Terrestrial flora are valuable, but not precise, proxies for the Jurassic climate, because physiognomic analysis of leaf margins, important for the late Cretaceous and Tertiary, cannot be applied to the non-angiosperm Jurassic plants (Frakes *et al.*, 1992).

1.6.4.2 LATE MIDDLE JURASSIC TO EARLY CRETACEOUS

The distribution and thermal-tolerances of terrestrial flora provide a major source of climatic evidence for this period. Due to the presence of fossil floras at high latitudes, it has been assumed that polar climates were uniformly warm (Jefferson, 1982; Douglas and Williams, 1982). The assemblages appear to have consisted mainly of ferns, cycadophytes and conifers, which occurred across a large global area over a long period of time (at least throughout the late Jurassic and early Cretaceous). These assemblages are characteristic of high latitude regions and have been found in the Gondwanan continents of Antarctica, South America, Australia and India, as well as in northern regions (e.g. Europe - Harris, 1975). The extinct conifer family Cheirolepidiaceae dominated the northern vegetation whereas the southern flora appear to have consisted mainly of types ancestral to the modern southern vegetation, such as the podocarp and araucarian conifers. Each hemisphere, however, contained elements of the other so, as a result of this lack of variation, the stratigraphy is poorly constrained and the climatic interpretations from the flora are broad, compared with the later Cretaceous (Frakes *et al.*, 1992).

In mid-low latitudes, particularly in the northern hemisphere, the vegetation was dominated by the Cheirolepidiacean conifers which might have ranged from small bushes (Batten, 1974) to large forest trees (Francis, 1983). The percentage of *Classopollis* pollen in sediments has been correlated with the intensity of warmth and aridity during the late Jurassic to early Cretaceous (Vakhrameev, 1981). The abundance of *Classopollis* generally decreases away from the equator, probably due to wetter and possibly cooler climates at high latitudes. The late Jurassic has been considered the most arid, due to the maximum abundance of *Classopollis* in its sediments. A warm period in the Toarcian is indicated by an increase in *Classopollis*, followed by an abrupt decrease during the Aalenian to Bajocian. A simultaneous latitudinal expansion of coals has indicated that the climate became significantly cooler and wetter. During the Bathonian and Callovian, *Classopollis* increased in abundance again and reached a peak in the Oxfordian when it appears to have constituted over 90% of many pollen assemblages (Vakhrameev, 1981). During the latter part of the Jurassic, the abundance of *Classopollis* decreased slightly but was still high and Cheirolepidieaceaen conifers were still a dominant part of the flora in some areas (Francis, 1983). By the earliest Cretaceous, however, these conifers formed only a minor part of the vegetation (Batten, 1982). These floras, with a greater percentage of moisture-loving ferns, spread into lower latitudes as the climate, in many areas, became wetter.

The distribution and movement of floral zones has been attributed to climate change. Vakhremeev (1964) divided northern hemisphere floras into a warmer Indo-European and a high-latitude Siberian-Canadian province. These zones separated a mid-latitude arid region from subtropical humid climates to the south and temperate humid areas (possibly with winter temperatures below zero) to the north. The floral zones moved northwards across Eurasia during the late Jurassic and early Cretaceous, possibly reflecting a general warming trend. Using similar evidence, Krassilov (1981) proposed a late Jurassic warming, having previously (Krassilov, 1973) suggested a temperature decrease in eastern Asia from the Berriasian to the Albian, based on the decline of cycadophytes. Many climatic interpretations of fossil floras have been based on the assumption that the cycadophytes required warm temperatures like their extant relatives, the cycads, yet their morphology had been shown to be different (Kimura and Sekido, 1975). Since they were common in Mesozoic high-latitude floras, they were probably well adapted to living in high latitude climates (Spicer and Parrish, 1986).

During most of the Jurassic and early Cretaceous fern, conifer and cycad floras occurred at both high and low latitudes in both hemispheres, interpreted as representing warm temperate climates by their composition and latitudinal distribution (Smiley, 1967; Douglas and Williams, 1982; Jefferson, 1982). However, reinterpretations of floras in Australia suggest that the climate was cool temperate (Dettman, 1986; Drinnan and Chambers, 1986) and extremely seasonal to account for the occurrence of winter ice and forest floras which indicate warm summers (Frakes and Francis, 1988; Rich *et al.*, 1988). These southern hemisphere floras, and possibly northern ones, may therefore represent warm summer climates, rather than year-round warmth.

In the past, floral boundaries, including those delineated by Vakhrameev, were drawn parallel to lines of latitude, on the assumption that climate changes across continents were influenced mainly by latitudinal temperature gradients. However, the climate models of Sloan and Barron (1990) indicated that the interiors of such large continents would have experienced more seasonal extremes than marginal areas.

The seasonality of late Jurassic to early Cretaceous climates has been recorded in the growth rings in fossil wood (Creber and Chaloner, 1985). Tree rings in Cretaceous conifer wood from Alexander Island, Antarctica (Jefferson, 1982) and the northern tip of the

Antarctic Peninsula (Francis, 1986a) show definite annual boundaries, indicating that growth ceased in winter, possibly due to a combination of low temperatures and low light levels at such high latitudes. During the latest Jurassic, southern Britain was forested (palaeolatitude approximately 35°N) and growth rings in the fossil wood, together with associated sedimentary evidence, indicate a Mediterranean-type climate, with warm, wet winters and hot, arid summers (Francis, 1984, 1986b), allowing growth during the wetter and cooler parts of the year. During the early Cretaceous in the same region, the climate remained seasonal though wetter, as reflected in fossil wood (Francis, 1987) and in the sediments (Allen, 1981).

1.6.4.3 MID- TO LATE CRETACEOUS

The mid- to late Cretaceous was a period of major changes in flora, due to the evolution of angiosperms and their increasing dominance. Their great diversification during the mid-Cretaceous corresponded with the onset of a warm interval and their expansion may have resulted from the favourable climatic conditions. In the past, late Cretaceous floras have been broadly interpreted in terms of temperate or tropical climates, supporting evidence from oxygen isotope data that the climate was warm and equable. However, analysis of the physiognomy of fossil angiosperm leaf assemblages has been used as a proxy to assess climate parameters in more detail (Wolfe, 1980, 1985; Spicer and Parrish, 1986, 1990; Spicer *et al.*, 1993). Refined palaeotemperature data and reinterpretation of the thermal tolerances of the flora indicate that there were distinct warmer and cooler phases within the warm trend, particularly evident at high palaeolatitudes. Although floral evidence indicates frost-free conditions on the Antarctic Peninsula during the Albian-Cenomanian (Francis, 1986a), according to Gale *et al.* (2002), both oxygen isotopes and climate modelling support the possibility that limited high-altitude glaciation occurred episodically in the Antarctic during the Late Cretaceous.

Cretaceous palaeogeography and land connections, as much as climate, determined floral provinces, as indicated by global distribution of pollen (Batten, 1984). During the early Cretaceous, two or three broad floral zonations divided the globe into tropical/subtropical climates in the equatorial zone and warm temperate climates at higher latitudes. The northern hemisphere has been divided into a high latitude Siberian-Canadian province and a lower latitude Euro-Sinian province, with the remainder of the equatorial and southern hemisphere region in the Gondwanan floral province (Crane, 1987).

The major Albian transgression isolated four major land provinces that existed until the end of the Maastrichtian: the northern high latitude province; Central Europe and North America; and the two Gondwanan zones. These boundaries were constrained by palaeogeography and marine seaways until a severe global regression in the late Maastrichtian exposed land connections, enabling floral migration and hybridisation, particularly in the northern hemisphere. At the Cretaceous-Tertiary boundary, the magnitude of the floral turnover appears to have varied between locations. The increased percentage of fern spores above the boundary (Tschudy *et al.*, 1984) is comparable to modern recolonisation of devastated areas, including the aftermath of volcanic eruptions.

1.7 SILICEOUS FLORAS AND FAUNAS

From the mass extinctions at the end of both the Permian and the Cretaceous, high survival rates and blooms of at least regional magnitude have been recorded amongst siliceous groups (particularly radiolarians and silicisponges from the Permian and diatoms and radiolarians from the Cretaceous), with a corresponding decline of calcareous organisms. The Palaeozoic epicontinental seas were silica-enriched and oligotrophic, resulting from greatly increased volcanic or hydrothermal activity during major plate-boundary changes that triggered ecosystem perturbations globally. Combined factors favoured siliceous rather than calcareous biotic growth, deposition and preservation:

- a higher rate of input of silica and other nutrients, creating pulses of eutrophication;
- a punctuated greenhouse climatic effect; and
- vigorous oceanic circulation resulting from volcanogenic upwellings and turnovers.

Siliceous communities, adapted to more eutrophic conditions, thrived in the stressed niches, although a stepwise loss of deep-water niches, together with a consequent selective decline of more specialised oligotrophic radiolarians and other pelagic organisms, may have resulted from expanding anoxia and nutrification. However, during the end-Permian mass extinction, driven by factors presumably unfavourable to radiolarian productivity, such as the combination of a drastic volcanic activity with expanding superanoxia, siliceous faunas experienced severe non-selective losses (Racki, 1999). Evolutionary adaptations in silica-secreting plankton have enabled them to use the decreasing dissolved silica in the surface waters of Cenozoic oceans more efficiently, as demonstrated by radiolarians and diatoms.

1.8 OCEANIC ANOXIC EVENTS

During the Mesozoic there are many examples of oceanic anoxia. In 1976, Schlanger and Jenkyns named the time-intervals during which widespread to global deposition of C_{org}-rich sediments occurred "Oceanic Anoxic Events" (OAEs). Three of the Oceanic Anoxic Events (OAEs) were global, the Toarcian OAE, the Early Aptian OAE1a and the latest Cenomanian OAE2, whereas OAE1b, OAE1c and OAE1d were of regional significance (Jenkins, 1999; Erba, 2004).

Carbon isotope excursions, anomalies in the ratios of ^{13}C to ^{12}C in inorganic and organic substances, are often associated with environmental catastrophes and mass extinctions

(Holser *et al.,* 1989; Dickens *et al.*, 1995, Gröcke *et al.*, 1999; Hesselbo *et al.*, 2000). In the Toarcian, massive volcanism, together with intensified rift-related tectonic activity, could have resulted in environmental changes of sufficient magnitude to cause methane-hydrate dissociation in continental margin sediments (Dickens *et al.*, 1995) and a negative $\delta^{13}C$ excursion. If so, this release occurred during a eustatic sea-level rise of 30-90 m over approximately 1.5 Ma (Hallam, 1997; Hesselbo and Jenkyns, 1998), increasing hydrostatic pressure and hydrate stability.

Evolutionary changes have been related to OAE1a in the Early Aptian (Coccioni *et al.,* 1992; Bralower *et al.,* 1994) and OAE2 in the latest Cenomanian (Wonders, 1980; Caron and Homewood, 1983). Both calcareous and siliceous plankton appear to have adapted their assemblage composition and abundance in response to these two major OAEs. The Selli and Bonarelli Levels, the two major episodes of C-org-rich black shale deposition, corresponding to the anoxic events OAE1a and OAE2, respectively, have been studied for their calcareous and siliceous planktonic content, to ascertain the changes in these extreme palaeoceanographic environments. Each episode had its own characteristics but, despite the different reactions of the two groups, similar palaeoceanographic reconstructions have been produced from the common trends of both events.

The Selli Level is characterised by the temporary disappearance of some species of calcareous nannofossils and a decrease in diversity among the planktonic foraminifera and radiolarians. During the Selli Event, planktonic foraminfera decreased in diversity and abundance, with one species dominant at any given time. As the Selli perturbation was less intense overall and did not cause a turnover in the planktonic foraminifera, palaeoenvironmental conditions at the seafloor are inferred to have been merely dysoxic (Racki, 1999; Premoli Silva *et al.*, 1999). Evolution continued without extinctions, assemblages being composed mainly of opportunistic species that subsequently recovered.

The more specialised morphotypes did not evolve until the Late Aptian, with assemblages including the highly specialised rotaliporids that became extinct at the onset of the Bonarelli Event (Jarvis *et al.*, 1988). The Bonarelli Level coincides with a major turnover in the radiolarians and calcareous nannofossils, together with the extinction of the most specialised planktonic foraminifera, the rotaliporids, whereas the opportunist *Heterohelix* proliferates (Leckie, 1985; Leckie *et al.*, 1998; Keller *et al.*, 2004, fig. 7). Although planktonic foraminifera are the most susceptible to dissolution, resulting in sparse records, they also decrease in diversity associated with a relative increase in abundance of *Leupoldina* (Selli) and *Schackoina* (Bonarelli). While the decrease in radiolarian diversity occurs within the black shale levels, the changes in turnover or abundance of calcareous nannoflora and, to a minor extent, of planktonic foraminifera, precede the maximum C-org accumulation (Schlanger and Jenkyns, 1976). Impoverished radiolarian assemblages, characterised by the deeper-dwelling forms, tend to occur in association with maximum organic carbon values and $\delta^{13}C$ positive shift, but also occur in other organic-rich black shales back to the late Hauterivian. The changes in calcareous and siliceous plankton from the OAE levels indicate greater fertility in surface waters, possibly related to increased upwelling. The Bonarelli perturbation was much stronger, resulting in a major turnover in both siliceous and calcareous plankton and leading to anoxia at the seafloor (Premoli Silva *et al.*, 1999). However, siliceous faunas experienced severe non-selective losses. Only the less specialised, more tolerant groups, including the whiteinellids and the more recent dicarinellids (Premoli Silva and Sliter, 1999), together with the opportunistic hedbergellids and heterohelicids, survived.

The respective perturbation magnitude of the two Events is demonstrated by the rate of recovery of the assemblages, rapid after the Selli (with a doubling of species richness and a very high abundance of larger planktonic foraminifera) but much slower after the Bonarelli (with a scarcity or dominance of opportunistic heterohelicids) (Nederbragt and

Fiorentino, 1999). Unstable conditions continued after both events, demonstrated by the fluctuations in abundance from layer to layer. Above the Selli, the leupoldinids and the clavate group alternated with, or were associated with, very diverse assemblages. Above the Bonarelli, heterohelicids and whiteinelids (indicators of increased upwelling) proliferated, indicating that unstable conditions continued well into the Turonian (Nederbragt and Fiorentino, 1999). Palynofacies and organic geochemical data from the Selli confirm that the organic matter was related to pulses in primary production but it was preserved in dysoxic conditions (Erba *et al.*, 1999).

Benthonic foraminifera were present throughout the Selli, indicating that the seafloor was probably dysoxic, not anoxic as it was for most of the Bonarelli. The palaeoecology of benthonic foraminifera and stable carbon isotope variations have been used for reconstructing palaeoecological, palaeoceanographical and palaeoclimatological changes. Species morphologies, together with the ecology of morphologically similar recent forms, have been used to interpret the mode of life of fossil foraminifera and to reconstruct their environments (Koutsoukos and Hart, 1990).

1.9 PLANKTONIC FORAMINIFERA

Planktonic foraminifera, together with calcareous nannoplankton, were responsible for changing Palaeozoic oceans into the modern oceans with a carbonate-based plankton. In order to understand the dynamics of modern oceans, it is essential to establish the evolution and the major developmental steps of the plankton. The origin of planktonic foraminifera is, therefore, fundamental to that process. This thesis will assess the evidence for the origin of planktonic foraminifera in the Jurassic, how the fauna expanded to create the Compensation Depths of the modern oceans and how the fragmentation of Gondwanaland in the Jurassic and Cretaceous led to the colonization of the world's oceans.

CHAPTER 2

RE-ASSESSMENT OF THE POTENTIAL ANCESTORS OF PLANKTONIC FORAMINIFERA

2.1 INTRODUCTION

The planktonic foraminifera are a distinctive and abundant part of the modern oceanic fauna. They are particularly useful in reconstructing past environments and for biostratigraphical correlation. Despite their undoubted importance, the origin of the group is uncertain. In a review of the earliest planktonic foraminifera (Globigerinina) Simmons *et al.* (1997) reported that the origins of the group were "still shrouded in uncertainty". The key issue is the timing of the evolution of a benthonic ancestor into a partially planktonic (meroplanktonic) form and then into a holoplanktonic species/genus. Appendix I contains a chronological tabulation of the records of "planktonic" foraminifera in the Middle to Late Triassic and the Jurassic.

In 1960, Oberhauser described 52 species of foraminifera from the Middle (Fig. 2.1) and Upper (Fig. 2.2) Triassic of the eastern Alps and north-eastern Iran. Between 1964 and 1979, Fuchs described more than 20 species from the Triassic of Austria, northern Italy and the Jurassic of Poland, the majority of which were new. Fuchs considered the Triassic "*Globigerina*-like" forms to be planktonic but, after subsequent examination of his material, other researchers (e.g. Görög and Rögl, pers. comm. to Simmons *et al.*, 1997) have concluded that it consists mainly of badly preserved and recrystallised benthonic specimens. Examination of Fuchs' figured foraminifera, with their flat ventral side, closed umbilicus and lack of planktonic adaptations, has given a strong indication that many of these species probably had a benthonic mode of life. According to Fuchs (1975), the Triassic genus *Oberhauserella* was the direct ancestor of the Jurassic *Conoglobigerina* and the Triassic genus *Schmidita* was the ancestor of the Callovian *Mariannenina*, the

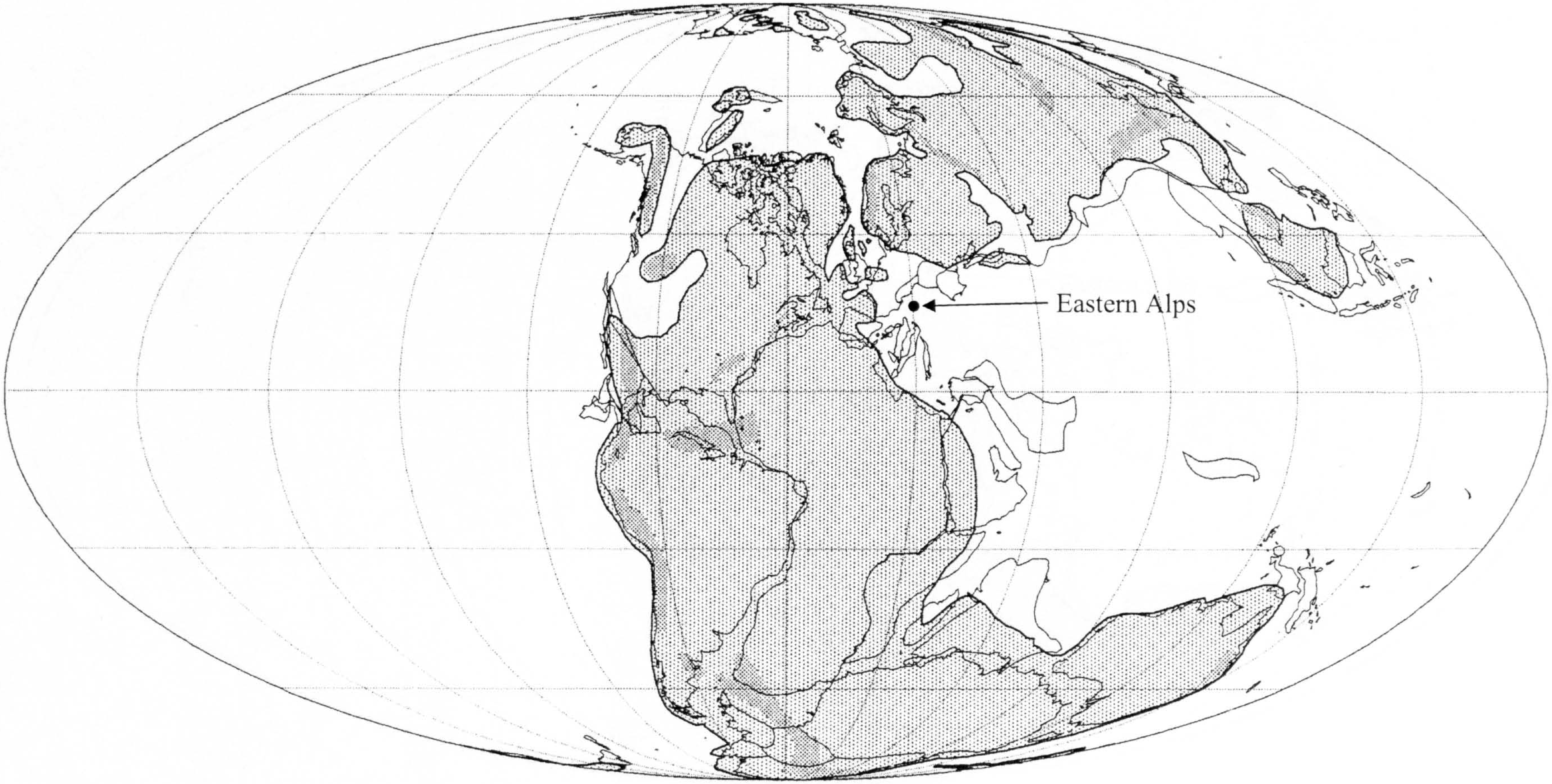


Figure 2.1. Palaeocoastlines of the Anisian-Ladinian (Middle Triassic) 238 Ma (Smith *et al*, 1994). The approximate position of the eastern Alps is indicated.

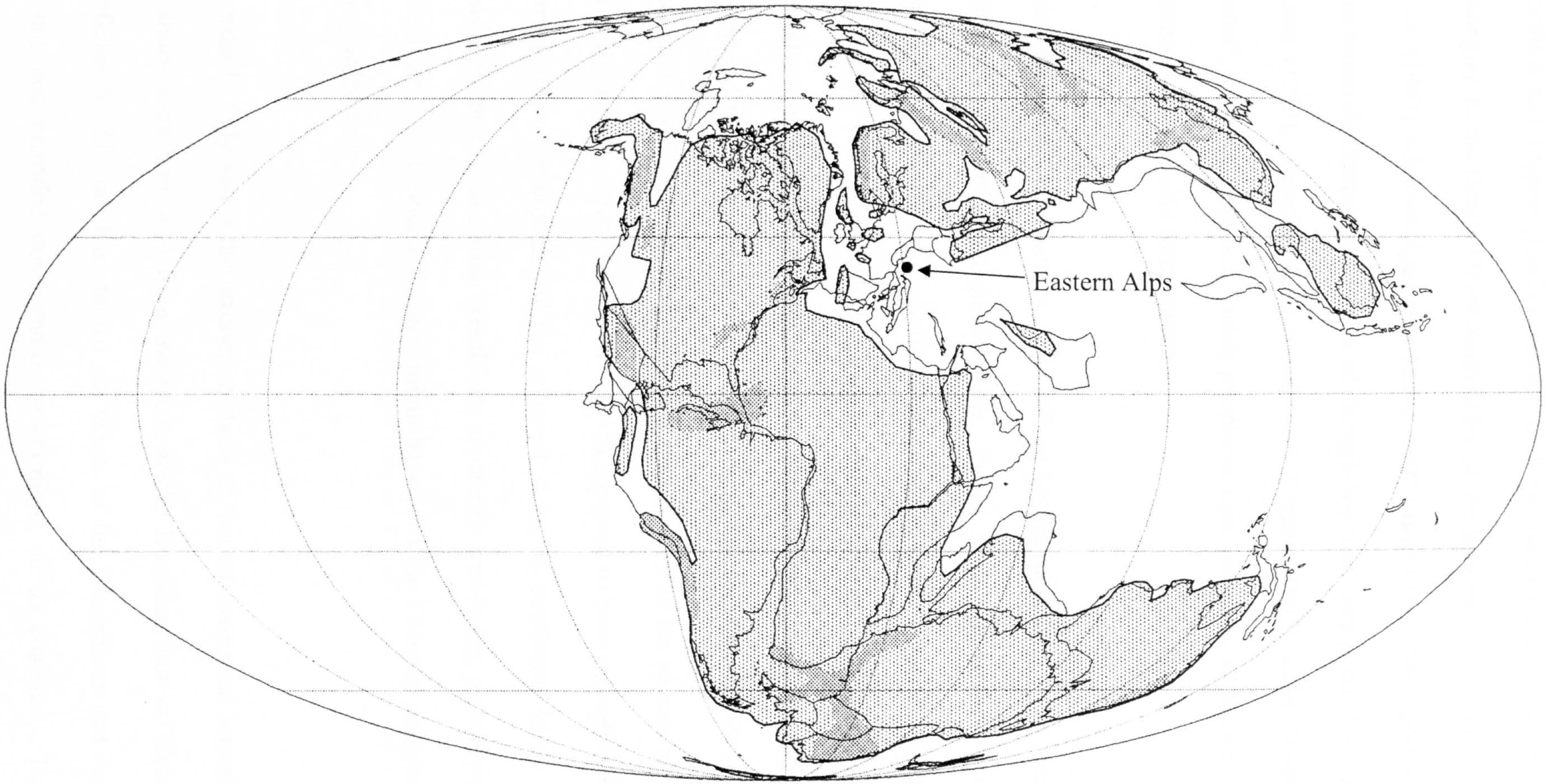


Figure 2.2. Palaeocoastlines of the Carnian-Rhaetian (Late Triassic) 220 Ma (Smith *et al*, 1994). The approximate position of the eastern Alps is indicated.

latter genus then evolving into the holoplanktonic *Hedbergella* (Fig. 2.3). Conversely, Loeblich and Tappan (1987) classified both *Oberhauserella* and *Schmidita* as benthonic, belonging to the family Oberhauserellidae in the Suborder Robertinina. Whilst Simmons *et al.* (1997) acknowledged that Fuchs (1975) might have been partly correct about an oberhauserellid being the ancestor of *Conoglobigerina*, they pointed out that *Mariannenina* Fuchs (1973), classified by Loeblich and Tappan (1987) under "Genera of Uncertain Status", appeared to have a double peripheral keel, absent in all known Jurassic and Early Cretaceous planktonic foraminifera.

Specimens from the Toarcian (Fig. 2.4) of Switzerland, have been identified by Wernli (1995) as *Oberhauserella quadrilobata* Fuchs, 1967 and as the genus *Praegubkinella* Fuchs, 1967. Wernli also included a new species in the latter, *Praegubkinella racemosa* n.sp. that he considered to be morphologically transitional to *Conoglobigerina*. With the extraction of foraminifera from Liassic marls having been recorded only rarely, he considered this to be an important landmark in the "phyletic trends of the first Jurassic Globigerinacea". According to Simmons *et al.* (1997), all the species named by Fuchs and most of the forms figured by Wernli (1995) appeared to have strongly concave or flattened ventral sides, reminiscent of the adherent sides of benthonic forms. However, they considered that *P. racemosa* Wernli was apparently free-living, probably with a convex but umbilicate ventral side, and that it might have been the Toarcian ancestor of the Bajocian *Conglobigerina*.

In order to fully assess the taxonomic status of these Triassic and Jurassic taxa, a number of slides were borrowed from the Geologische Bundesanstalt in Vienna. In addition, Professor M. B. Hart has studied the whole of the Oberhauser and Fuchs collection in Vienna and provided notes and/or observations on its contents. The holotypes and paratypes borrowed from Vienna have been photographed, uncoated, using the

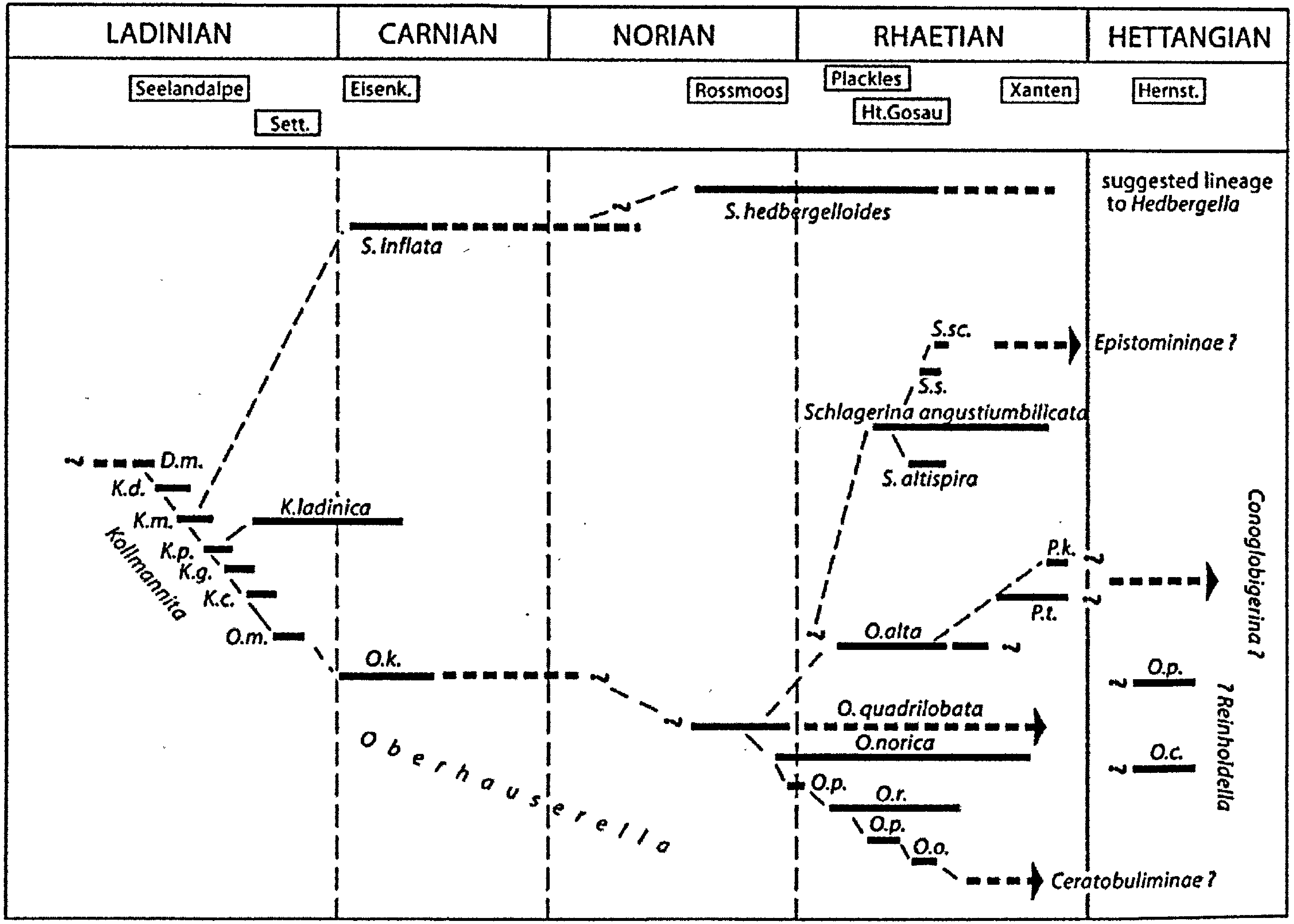


Figure 2.3. Approximate ranges of the Triassic taxa described by Fuchs (1967, 1970) from Austria and Northern Italy.

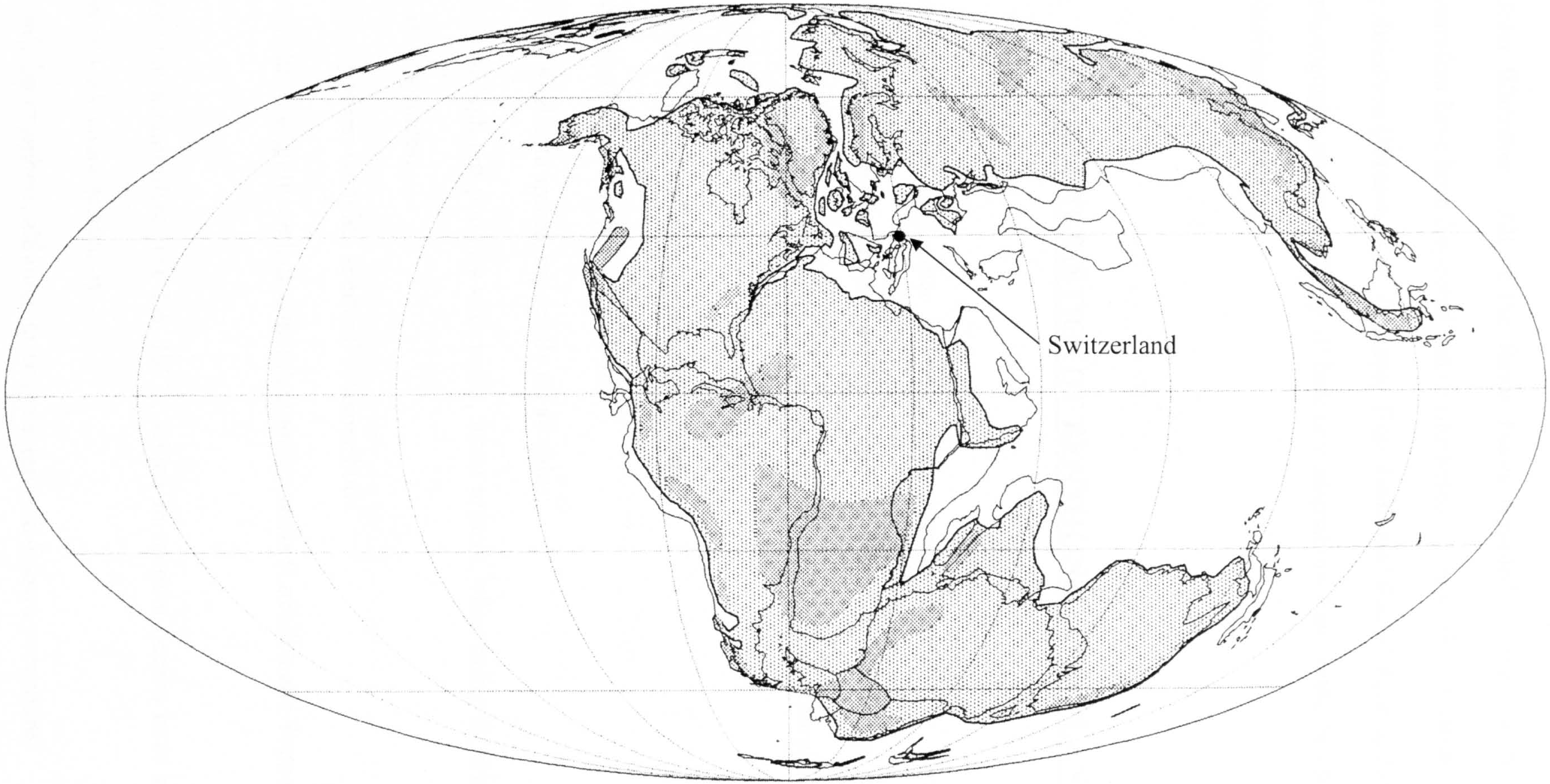


Figure 2.4. Palaeocoastlines of the Toarcian (late Early Jurassic) 180 Ma (Smith *et al*, 1994). The approximate position of Switzerland is indicated.

environmental scanning electron microscope in the Natural History Museum, London, by Dr John Whittaker. All of the forms Fuchs regarded as ancestral to the planktonic foraminifera have been inspected and/or illustrated. This work is currently being prepared for publication (Hudson *et al.*, in prep). Examination of Fuchs' figures, the specimens and the photographs shows that they all lack any adaptations that would be characteristic of a planktonic mode of life.

2.2 CHARACTERISTICS OF BENTHONIC AND PLANKTONIC TAXA

In modern oceans and other environments, there is a relatively clear view of the characteristics of benthonic and planktonic forms. While there are some exceptions to the normal rules, there is probably close agreement on the basic morphological features. Benthonic forms are normally characterised by:

- infaunal, epifaunal or epiphytal mode of life;
- flattened side or sides often present;
- lack of delicate spines, especially on all sides;
- lack of high test porosity with pores, when present, often being different on upper and lower surfaces;
- often possess complex apertural systems; and
- may have agglutinated, calcitic or aragonitic walls (Loeblich and Tappan, 1987).

Planktonic foraminifera (see Bé, 1977), which in modern oceans have a holoplanktonic existence, are characterised by:

- globular chambers, although there are some well-known exceptions;
- calcitic walls with a high density of pores;
- presence of spines which may be long and delicate; and

- relatively simple apertures, although in some taxa there are complex apertural modifications.

Simmons *et al.* (1997) also used the term "meroplanktonic" for transitional forms that may have had a partially benthonic and partially planktonic mode of life. There is no indication as to whether this stage was present in the evolution from a benthonic to planktonic form and, if the juvenile stage was planktonic followed by an adult benthonic form, whether fossil material would preserve this in their visible test morphology. There is also a debate between those working on DNA sequencing (Darling *et al.*, 1996, 1999a,b) as to whether the planktonic foraminifera evolved once (and subsequently evolved from the one lineage) or whether the evolution of the planktonic taxa was polyphyletic.

2.3 SYSTEMATIC DESCRIPTIONS

In the following section is presented an extract of the key facts from the full descriptions provided by the authors, all of which were published in German. The comments are a combination of the published information about the original specimens, as well as interpretation of the material investigated. The materials used by Oberhauser and Fuchs are meticulously curated in the Geologische Bundesanstalt in Vienna. In many cases, the residues from which key specimens were picked are also curated and available for inspection, along with the original field notes.

Oberhauser's material for his 1960 paper came from the Middle and Upper Triassic of the eastern Alps (Fig. 2.5) and north-eastern Iran. Fuchs (1967) also used a range of samples from central and eastern Austria, and the South Tyrol, northern Italy (Fig. 2.6). In a subsequent paper (Fuchs, 1970), new species of *Oberhauserella* were described from Hernstein, a small locality immediately south-west of Vienna. In a later paper

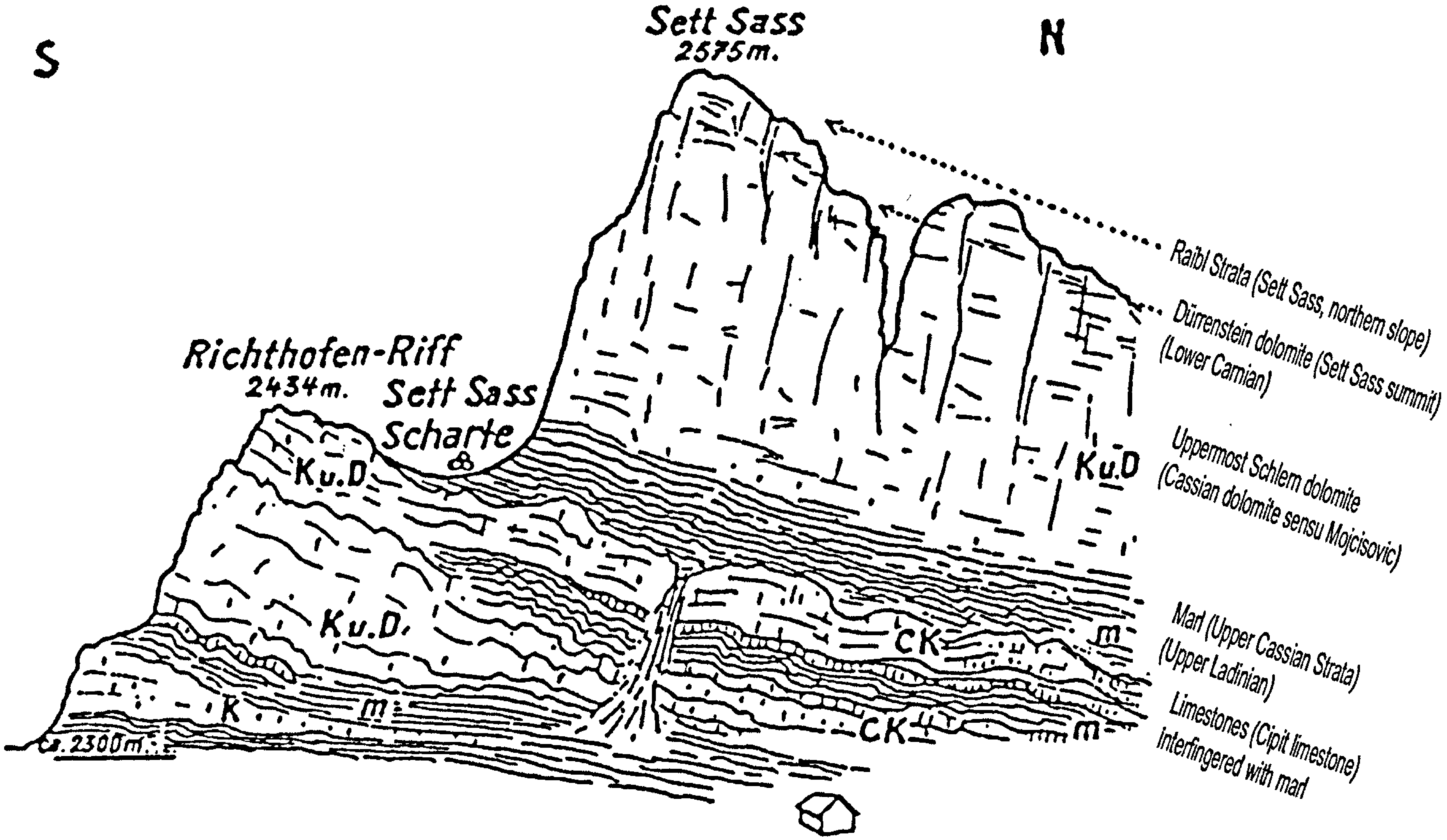


Figure 2.5. Eastern elevation of the Richthofen-Riff, near St Cassian, South Tyrol, northern Italy (Oberhauser, 1960, after Ogilvie Gordon, 1929, supplemented by G. Rosenberg, 1959). Interfingering of the Cassian marl (m) and limestone (K) with thinning out of reef masses of limestone and dolomite (Ku.D), partly merging into Cipit limestone (CK).

Figure 2.6. Locations of samples used by Fuchs (1967, 1970) in his descriptions of new, potentially planktonic taxa.

(Fuchs 1973), material from Poland was described. His samples came from Ogrodzieniec, between Częstochowa and Kraków (Fig. 2.7). Ogrodzieniec is a very important location as Pazdrowa (1969) used material from this area to establish *"Globigerina" bathoniana* (Figs 2.8, 2.9). Her material came from the Middle Bathonian ore-bearing clays of the *Morrisceras morrisi* Zone (Matyja and Wierzbowski, 2006, figs B1.9, B1.10; Fig. 2.10). These clays (Bed 11) are reportedly ~25 m thick in the area and range in age from early to middle Bathonian.

The material used by Fuchs appears to have been collected by Dr M.E. Schmid (of the Geological Survey of Austria, Vienna) during the 10th European Micropalaeontological Colloquium. These meetings often involved collecting trips in the host nation, in order that participants could see famous locations and, potentially, collect some topotype material. All the material described in the paper appears to come from a "glauconitic marl-sandstone" (Bed 21) and a "glauconitic marl" (Bed 26) from the area of Ogrodzieniec. Bed 21 appears to be of late Callovian age, while Bed 26 is recorded as Oxfordian. The Upper Callovian strata are quite condensed (1-4 m) and rich in glauconite (Fig. 2.11). Much of Fuch's material from Ogrodzieniec appears to be glauconitic infillings of foraminifera. In some cases, he refers to specimens as "glauconitkerne" and this mode of preservation is certainly clear from an inspection of the material. In almost all cases, specimens are glauconitic infillings of chambers with the septa between the chambers being shown as a dotted (or solid) pair of lines in the drawings that illustrate the various taxa. These septa show up white against the (generally) pale green glauconite. In some cases, this gives the impression of keels in the drawings but this is certainly not the case. External features, such as keels, would not be preserved in this type of material.

The irregular shapes of some of the "taxa" may indicate that they are no more than mineralogical growths and may not even be foraminifera. Some are clearly foraminifera

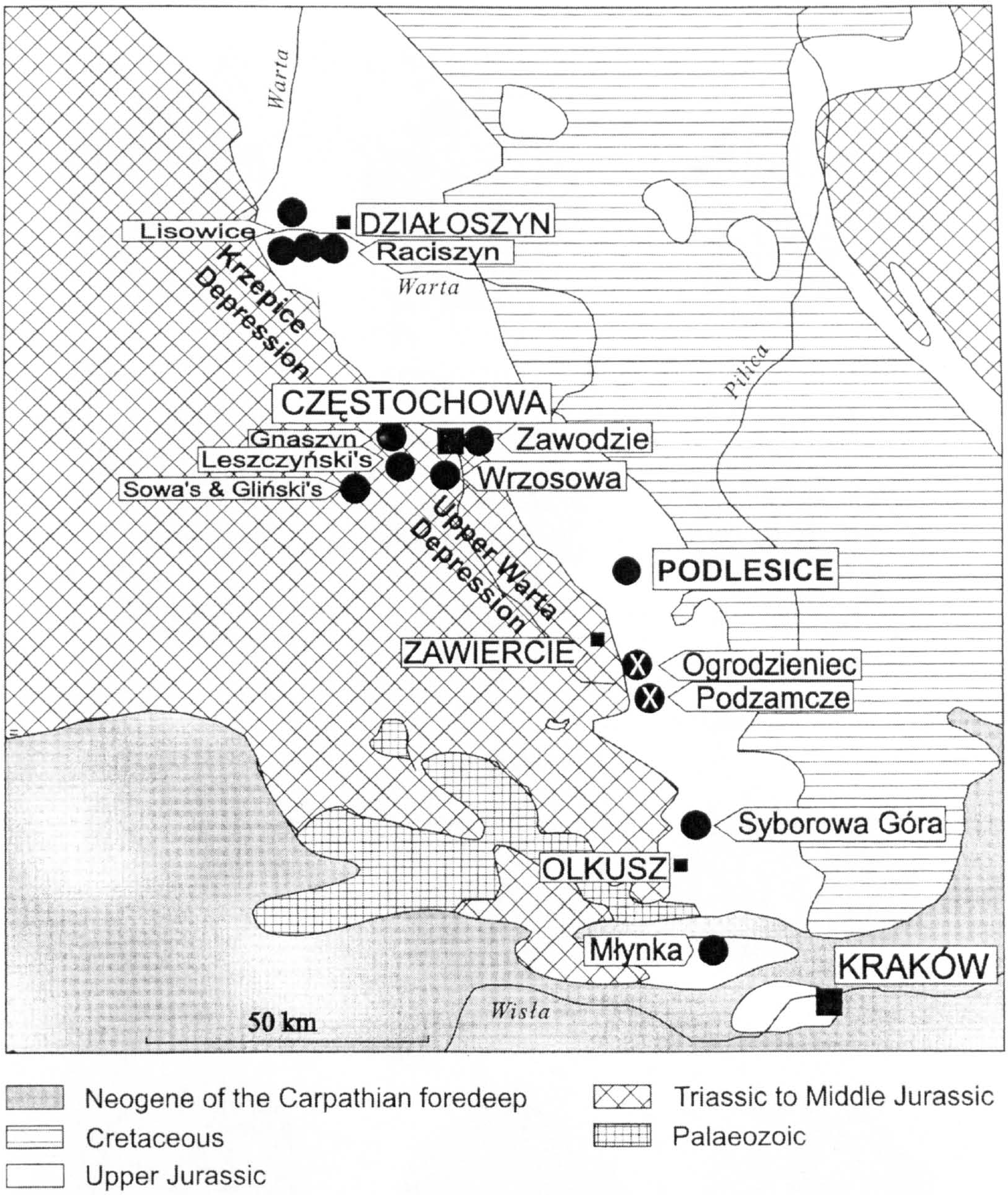


Figure 2.7. Geological map of the Polish Jura Chain showing the position of Ogrodzieniec and Podzamcze, together with other quarries and clay-pits in the area (Matyja and Wierzbowski, 2006).

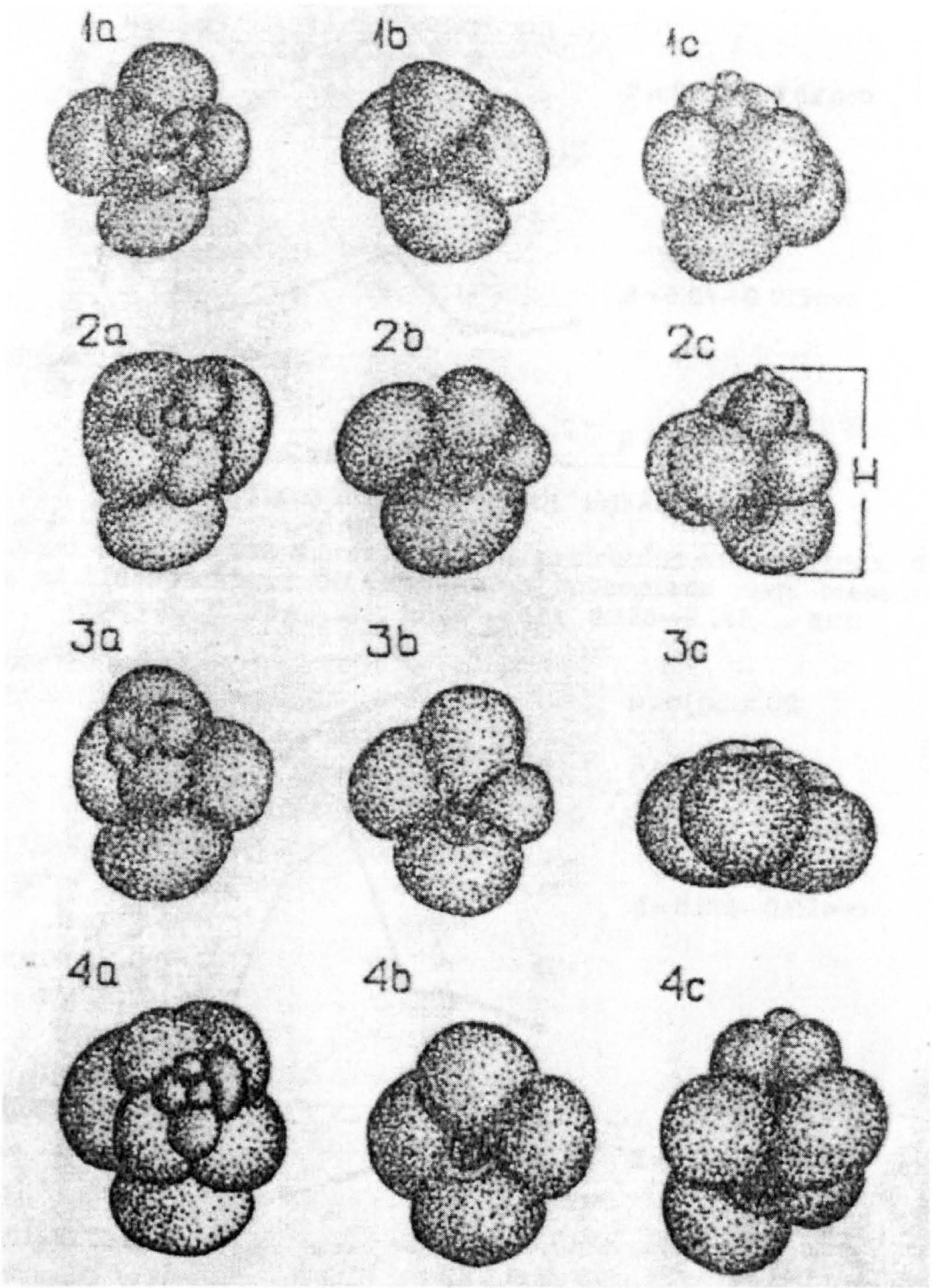


Figure 2.8. The type figures of Pazdrowa (1969, figs 1-4) include a range of morphological types, mostly high-spired but some are low-spired (e.g. fig. 3a-c). All seem to have an aperture that is a low arch. Fig. 1a-c was designated the holotype by Pazdrowa and should, therefore, be regarded as the form she identified as "the species".

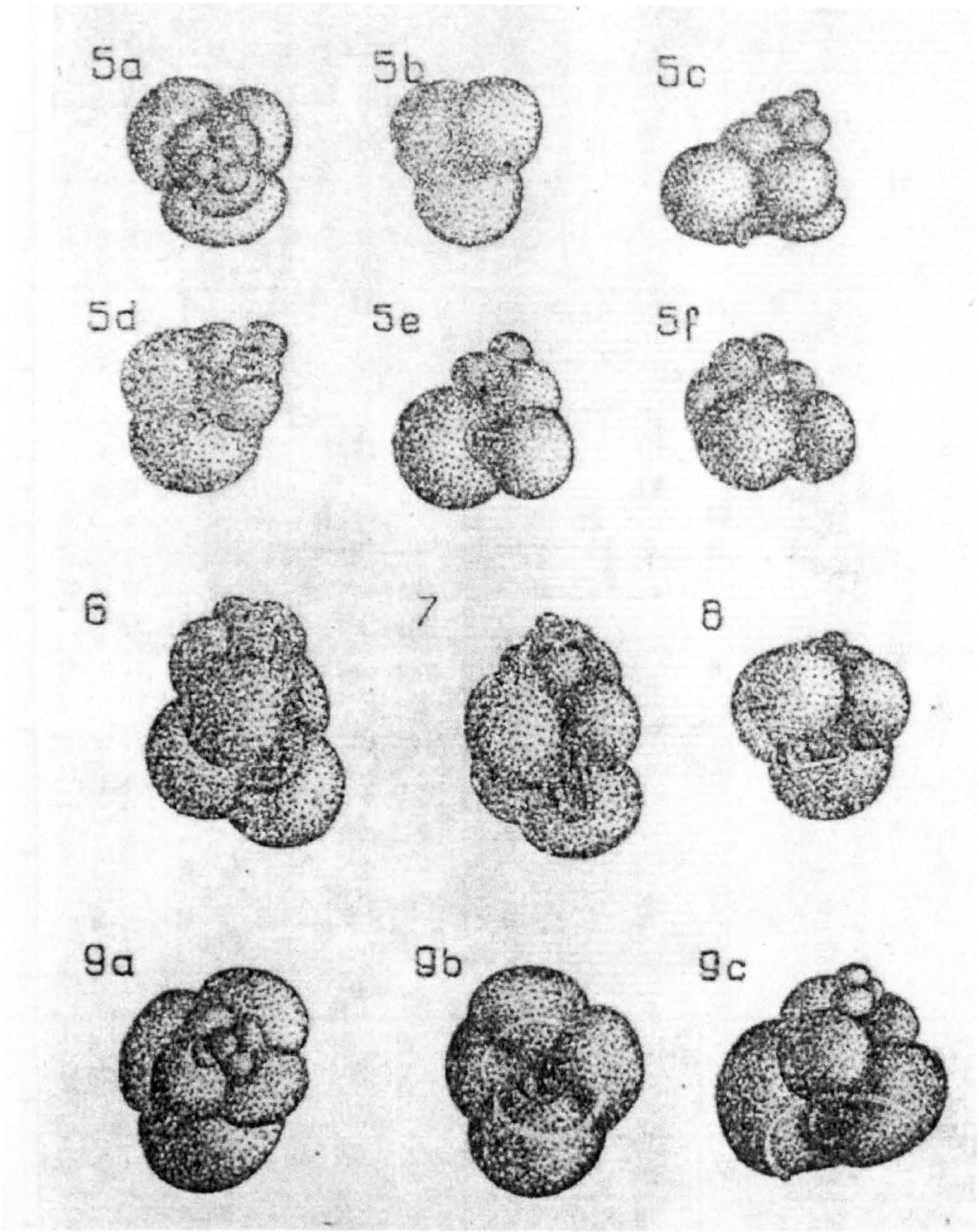


Figure 2.9. Further type figures of Pazdrowa (1969, figs 5-9) include a range of morphological types, mostly high-spired. All seem to have an aperture that is a low arch, but one (fig. 7) has a "loop-shaped" aperture.

STRATIGRAPHICAL CLASSIFICATION		NORTHERN REGION CZĘSTOCHOWA		SOUTHERN REGION OGRODZIENIEC - OLKUSZ		
Callovian	Upper	stromatalite bed 0.15 m	Glauconite Beds	marls with intercalations of glauconitic sands ~2.7 m	marls and limestones with glauconite 1-2 m	marls with phosphate concretions ~4 m
		glauconitic marl with phosphate - calcareous concretions (nodular bed) 0.10-0.20 m				
	Lower	arenaceous limestones and marls with oolites in the bottom 24 m		oolite marls ~1 m	arenaceous limestones with oolites in the bottom ~15 m	marls, oolite limestones, ferruginous oolites 0.30 m
Bathonian	Upper	clays, marls and oolite limestones, marly sandstones 10 m	Częstochowa Oolitic Limesone	clays with oolites ▥	▥	Parczów Conglomerate 0.08 - 15 m
	Middle	arenaceous clays, clayey shales, siltstones with sandstone and clayey siderite intercalations ~150 m	Częstochowa Ore-Bearing Clays	clays with spherosiderites ~25 m	clays and ferruginous sands 6-7 m	▥
	Lower					

Figure 2.10. Lithostratigraphical table of the Bathonian to Callovian in the Pieniny Klippen Belt: Częstochowa to Ogrodzieniec (extracted from Dayczak-Calikowska and Kopik, 1976).

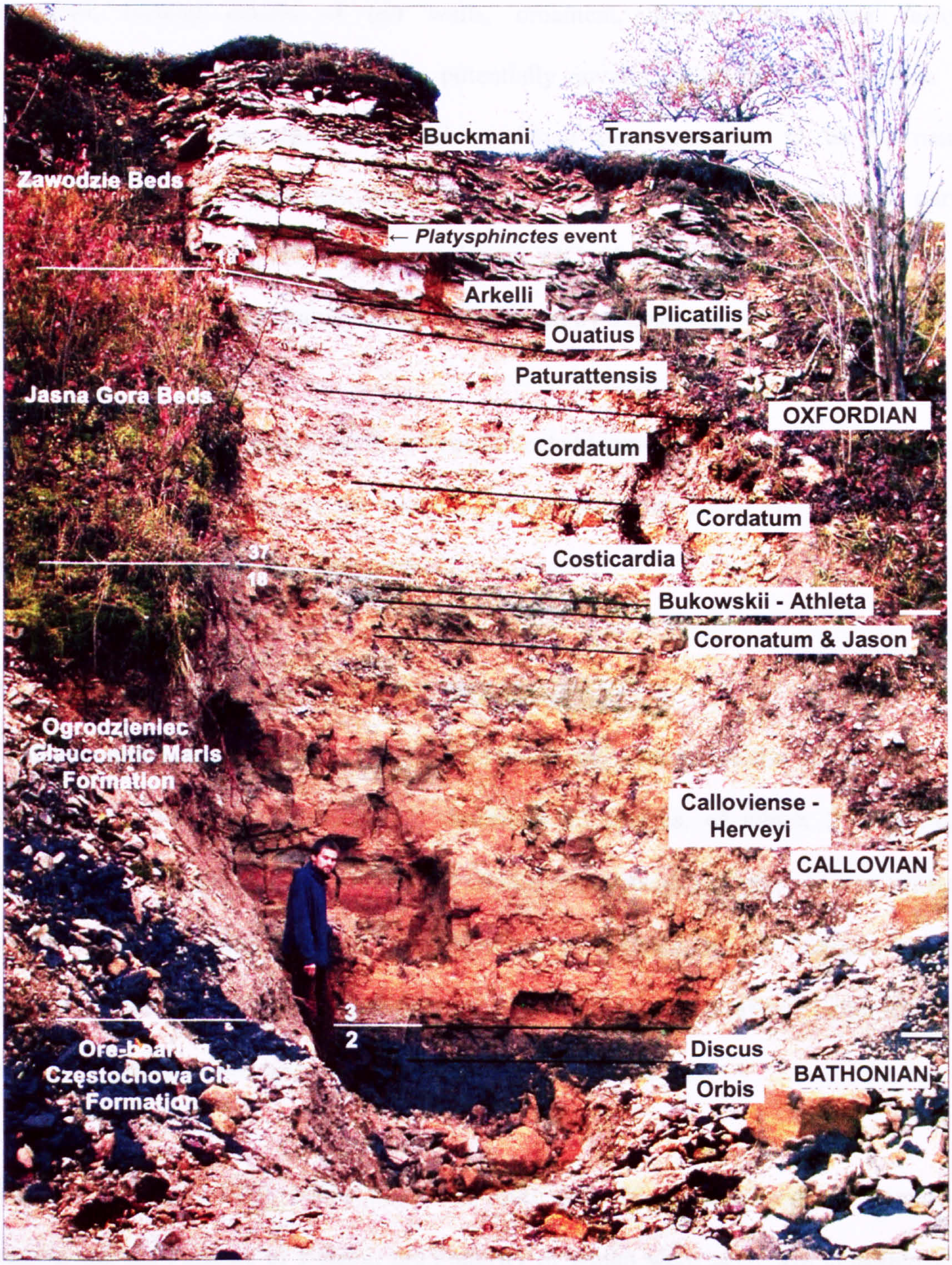


Figure 2.11. Lithostratigraphy and chronostratigraphy of the Bathonian to lowermost Middle Oxfordian in the Ogrodzieniec Quarry: ranges of zones and subzones are indicated (Dembicz et al., 2006). The glauconitic marls (Beds 18 and immediately below) in the uppermost Callovian are the location of the important planktonic fauna described by Fuchs (1973) and discussed later (p. 91).

but preserve no details of the wall structure, surface textures or the apertural characteristics. New taxa (genera or species) described from glauconitic infillings and, therefore, lacking details of test walls, ornament, aperture and other features (e.g. presence/absence of keels) are potentially invalid although ICZN Article 72, Recommendation 72A, specifically allows for a type specimen to be “a natural replacement, natural impression, mould or natural cast of an animal or colony, or part of either”. ICZN Article 73, Recommendation 73C (data on the holotype), does not specifically indicate what features must be displayed by a holotype.

Samples from this area of Poland have been collected (some by Dr Kevin Page) during the 7th International Congress on the Jurassic System (Kraków, 2006) and that material is discussed in this chapter and Chapter 5.

2.3.1 EARLY DESCRIPTIONS OF THE FAUNA

From his study of foraminifera from the Ladinian and Carnian of the eastern Alps and north-eastern Iran, Oberhauser (1960) described 52 species, of which 27 were new, together with two new genera. Of the two *Globigerina* species recorded, *G. mesotriassica* was described as having “bulbous” chambers and *G. ladinica* having “slightly inflated” chambers. Subsequently, these species were reclassified by Fuchs (1967), being attributed to his new genera *Oberhauserella* and *Kollmannita*, respectively.

Between 1964 and 1979, Fuchs described more than 20 species from the Triassic of Austria and the Jurassic of Poland, the majority of which were new. He considered the Triassic "*Globigerina*-like" forms to be planktonic.

Subsequently, the systematic position of the Triassic foraminifera has been in doubt. The genera “*Globigerina*”, *Diplotremina, Kollmanita, Oberhauserella, Praegubkinella,* *Schlagerina* and *Schmidita* may not be planktonic but benthonic, possibly belonging to the conorboidid or epistominid groups (Fuchs, 1975; Grigelis and Gorbatchik, 1980a; Stam, 1986; Riegraf, 1987a,b).

The Late Hettangian or Early Sinemurian *Globuligerina geczyi*, from the Ammonitico Rosso of Nagypisznice Hill in the Gerecse Mountains, Hungarian sector of the Transdanubian Central Range, was proposed by Görög (1994) as one of the earliest planktonic foraminiferal species recorded. Prior to this, from the middle of the nineteenth century, many papers had been published on early planktonic foraminifera but, in almost all cases, these species had been described using light microscopes. Often the specimens were in thin-sections or appeared to be internal moulds, so essential details for identification, including wall-structure, surface ornamentation, porosity and morphology of the aperture, could not be distinguished. Görög (1994) believed that a re-examination of these species using electron microscopy was essential for determining whether they really were planktonic. Similar examinations of a limited number of mid- and Late Jurassic species had already led to their reclassification (Masters, 1977; Grigelis and Gorbatchik, 1980a; Stam, 1986; Riegraf, 1987). Using the Lethiers and Crasquin-Soleau (1988) concentrated acetic acid method of extraction, Görög (1994) was able to separate specimens previously unobtainable from the indurated Ammonitico Rosso limestone. However, this proposal was subsequently rejected, the species not being accepted as planktonic.

The Sinemurian *Oberhauserella crassa, Oberhauserella planiconvexa* and *Schlagerina orbis*, from Lower Austria, were described as planktonic by Fuchs (1970) but later rejected (Riegraf, 1987a,b). The Pliensbachian "*Globigerina*-like" forms, from the Ammonitico Rosso of Bakonycsernye in the Bakony Mountains, Hungary, illustrated from thin-sections by Géczy (1961), were rejected by Görög (1994) as "not adequately described and illustrated". The Late Pliensbachian *Globigerina liasina* from Lorraine, eastern France, described as planktonic by Terquem and Berthelin (1875), was regarded by Riegraf as probably an internal mould of a benthonic foraminifera, a pyritic concretion or "a contamination from younger horizons". Added to other discrepancies, Riegraf (1987a) felt that a revision of the entire Terquem collection was necessary.

Further to re-sampling at Schick's (1903) locations in the Swabian Alps, South-West Germany (1979-1984), and finding no planktonic foraminifera present in the limestone, Riegraf (1987a) considered the Earliest Jurassic "*Globigerina* sp." illustrated from a thin section, more likely to be a transverse section of a gastropod or juvenile ammonite. Seibold (1966) had stated that the original slide "seems to be lost". Similarly, Riegraf (1987a) considered Tamajo's (1960) Early Jurassic "Globigerinidi", from Sicilian limestones, to be illustrations of sections probably of rotaliid foraminfera.

Toarcian and Aalenian "Protoglobigerinids" from the Ammonitico Rosso of Domuz Dag, Western-Taurus, Turkey, illustrated from thin sections by Wernli (1988), were rejected by Görög (1994) as "not adequately described and illustrated". According to Görög in 1994, "well documented planktonic foraminifera from the Lower Jurassic are not known at present", citing Masters (1977), Stam (1986), Riegraf (1987a,b), Loeblich and Tappan (1987).

Until comparatively recently, some authors doubted that the Globuligerinidae had evolved before the Late Bajocian (Masters, 1977; Vincent and Berger 1981; Caron and Homewood, 1983; Caron, 1985; Riegraf, 1987a,b). Following Stam's (1986) revision of the Jurassic, Riegraf (1987a) recognised only the genus *Globuligerina* as truly planktonic and three species:

- Late Bajocian to Late Bathonian - *Globuligerina balakmatovae* (Morozova, 1961);

- Late Bathonian to Early Valanginian - *Globuligerina oxfordiana* (Grigelis, 1958) and *Globuligerina bathoniana* (Pazdrowa, 1969).

Early planktonic foraminfera from the mid-Late Jurassic have been reviewed by various authors (Morozova and Moskalenko, 1961; Fuchs, 1973, 1975; Grigelis, 1974; Masters, 1977; Grigelis and Gorbatchik, 1980a; Gorbachik and Kuznetsova, 1983; Stam, 1986; Riegraf, 1987a,b; Loeblich and Tappan, 1987; Simmons *et al.*, 1997). According to Riegraf (1987a,b) the majority of the well-dated occurrences of Globuligerinidae had been restricted to the Northern Hemisphere:

- Bajocian to Callovian – palaeolatitudes 20-30°N;
- Oxfordian – palaeolatitudes 10-40°N;
- Kimmeridgian – palaeolatitudes 10-50°N;
- Tithonian – palaeolatitudes 20-30°N.

Whilst authors differ over systematics and the validity of species, the majority divide forms into two groups, high-spired and low-spired, using the height to diameter ratio (H:D) of the test morphology. Some classify the high-spired forms as *Conoglobigerina* and the low-spired forms as *Globuligerina* (Grigelis and Gorbatchik, 1980a; Loeblich and Tappan, 1987).

Exactly when the planktonic foraminifera evolved from their benthonic ancestors has not yet been established. Previous studies have suggested that this may have occurred during the Mid-Triassic (Oberhauser, 1960), Late Triassic (Kristan-Tollmann, 1964; Fuchs, 1967, 1968, 1969, 1973, 1975), Early Jurassic (Wernli, 1995) or mid-Jurassic (Wernli and Görög, 1999, 2000). In addition, the cause of their evolution into a planktonic life-style has yet to be identified. Amongst the palaeoceanographical changes involved could be those due to an Oceanic Anoxic Event (OAE), possibly connected to a massive dissociation of gas hydrates, such as that of the Toarcian. No longer requiring adherence to firm substrates, planktonic foraminifera tended to have tests with more globular chambers than those of their benthonic forebears, in which the more flattened adherent side was probably an evolutionary adaptation.

2.3.2 TAXONOMY OF THE OBERHAUSER AND FUCHS COLLECTIONS

With such a range of opinions on the first appearance of planktonic taxa, the re-description of the Oberhauser and Fuchs collections has been undertaken to assess the status of the various species *vis à vis* the origins of the lineage leading to a planktonic taxon. Data from Oberhauser (1960) and Fuchs (1967, 1970, 1973) have been incorporated with the Loeblich and Tappan (1987) classification wherever possible. In the following sections, the data provided for each species are a combination of direct translations from the original, somewhat obscure, Austro-German used by Oberhauser and Fuchs, plus "interpretation" of their meaning. The "Remarks" are mainly those of the original authors, in addition to which the "Comments" are based on Professor Hart's examination of the types in Vienna. While it is accepted that some of the diagnoses and descriptions read somewhat disjointedly and with strange terminology, it is hoped that they, nevertheless, convey the original intent of the authors. The related Plates are to be found in Appendix II.

Order **FORAMINIFERIDA** Eichwald, 1830

Suborder **ROBERTININA** Loeblich and Tappan, 1984

Superfamily **DUOSTOMINACEA** Brotzen 1963

Family **OBERHAUSERELLIDAE** Fuchs 1970

Genus *OBERHAUSERELLA* **Fuchs, 1967**

DERIVATION OF NAME: In honour of Dr R. Oberhauser (Geologische Bundesanstalt, Vienna) in gratitude.

GENOTYPE: *Oberhauserella mesotriassica* (Oberhauser, 1960).

GENUS DIAGNOSIS: Test free, a little to distinctly trochospiral, umbilical side conspicuously concave. Rounded periphery. All chambers of the spire are seen on the dorsal side, always including only approximately two whorls. On the ventral side only those of the younger whorls are visible. Sutures a little to markedly depressed, the outline at the suture junction mostly somewhat cut in. Umbilicus distinctly drawn inwards, narrow to fairly wide, roundish to oval, the minor bulges are mouth-relics of the older chambers. In the final whorl all chambers are obviously distended particularly on the ventral side. Aperture a long semicircular fissure, intruding more or less deeply from the chamber base in the ventral wall of the chamber, emphasized through the indentations of the surrounding chamber-wall surface. Shell hyaline and smooth.

RELATIONSHIPS: This genus was thought to have evolved morphologically from *Kollmannita*, from which it is distinguished by the distended chambers that give the test a certain resemblance to the Tertiary genus *Globigerina*, through the deepened, pronounced and mostly fairly wide umbilicus and the simple slit-shaped mouth-opening.

REMARKS: This genus displays a wide range of forms and evolutionary capacity, both of which, apart from the phylogenetic links indicated, perhaps may be of great stratigraphical usefulness.

RANGE: Range of occurrence known from the Upper Ladinian to Rhaetian.

Oberhauserella mesotriassica (Oberhauser, 1960)

Pl. 1 , Figs 1a-c, 2a-d.

Globigerina mesotriassica Oberhauser, 1960, pp. 42, 43, pl. 5, figs 18a-c, 19a-c.

DERIVATION OF NAME: In accordance with Oberhauser's view that this species represented the early occurrence of *Globigerina* in the Middle-Triassic.

HOLOTYPE: Oberhauser, 1960, pl. 5, fig. 18a-c.

DEPOSITORY: Geologische Bundesanstalt, Vienna, Inv. No. 0104 (single form).

PARATYPE: Oberhauser, 1960, pl. 5, fig. 19a-c.

DEPOSITORY: Geologische Bundesanstalt, Vienna, Inv. No. 0105 (single form).

TYPE LOCALITY: St. Cassian, Settsass-Scharte, N. Richthofen-Riff (Fig.2.5).

TYPE STRATUM: Middle Triassic, Ladinian Stage, Upper Cassian Strata (very rare).

DIAGNOSIS: A stockily built, four to five-chambered in the final whorl, species of the genus *Globigerina* Orbigny 1826.

TRANSLATION OF ORIGINAL DESCRIPTION: The holotype shows, in the final whorl, a four-chambered morphology with elongated, bulbous chambers and a many-chambered *Discorbis*-like initial spiral. The last chamber appears distinctly stretched out underneath. The umbilical opening is simply round. With the reservation put here, the paratype (in the manner of internal moulds) is considerably larger and many-chambered (with respect to the holotype). Nevertheless the opinion is justifiable, that this larger form is just a different generation or growth form of our new species, particularly as the morphology in the chamber construction is very similar. The umbilicus is, however, in the case of the larger form, irregularly stellate like *Globigerina ladinica*.

DIMENSIONS OF THE HOLOTYPE: Diameter approximately 0.25 mm.

RELATIONSHIPS: Oberhauser appears convinced that this form was certainly referable to *Globigerina* (though not justifiable in an acid test in the case of the two existing specimens) and looked very similar to the Cretaceous and Tertiary forms of this genus. Possibly established through the relatively large variability of our two Triassic forms, which even from the less available material distinctly appears, to allow easy distinction from the Cretaceous and Tertiary forms. Our Triassic forms also differ from the Cretaceous *Rugoglobigerina* and from the Tertiary forms of that genus through the lack of spines and fine sculpture.

COMMENTS: The holotype (Slide 1960/4/106) is gold-coated and is a quite high spired form with globular chambers and depressed sutures. It is quite like the individual figured by Oberhauser (1960, pl. 5, figs 18, 19) but it is very unclear as to what it represents. The slide [2/7 16], marked as "O. Ladin, Settsass" appears to contain no specimen.

Oberhauserella alta Fuchs, 1967

Pl. 1, Fig 3a-d.

Oberhauserella alta Fuchs, 1967, pp. 150, 151, pl. 4, figs 5, 6; pl. 5, figs 3, 7.

DERIVATION OF NAME: Altus (Lat.) = high.

HOLOTYPE: Fuchs, 1967, pl. 5, fig. 7.

DEPOSITORY: Geologische Bundesanstalt, Vienna, Inv. No. 0310.

TYPE LOCALITY: Hinterer Gosausee, Upper Austria (Fig. 2.6).

TYPE STRATUM: Upper Triassic, Rhaetian.

DIAGNOSIS: A species of the genus *Oberhauserella*, with the following distinctive features: spire distinctly drawn upwards, but consisting of approximately only two whorls; chamber ends extend differently, deep in the wide umbilicus.

TRANSLATION OF ORIGINAL DESCRIPTION: Test very small, with circular-lobate outline. Dorsal side pointedly trochospiral, ventral concave and umbilicate. Rounded periphery. Both whorls show four chambers, however, later in time, specimens with somewhat more chambers in the whorls are seen (e.g. in Fuchs, 1967, pl. 5, fig. 3 this may already be the case, the initial part could not be undeniably resolved in its details even by transmitted light examination). The hardly detectable sutures are barely depressed, inclined slightly to the back. The four most recent chambers, but also even the older ones, are strikingly inflated, arranged around a wide but – by deeply extending chamber ends - strongly divided umbilicus. Chamber growth in the final whorl noticeably more rapid. The aperture, open in all chambers surrounding the umbilicus, is poorly developed. Test hyaline and smooth. Common.

DIMENSIONS OF THE HOLOTYPE: Maximum diameter 0.25 mm, height 0.15 mm.

RELATIONSHIPS: The high spire and the divided umbilicus provide the essential characteristics of the species in comparison with the other species.

OCCURRENCE: Aside from the Hinterer Gosausee type-locality, this species was also recorded in the marls of Plackles.

REMARKS: This species forms a low trochospire with a slowly increasing number of chambers in each whorl. In some forms the umbilicus reduces in size, perhaps leading to the genus *Praegubkinella* Fuchs, 1967.

COMMENTS: The holotype (No. 0310; also marked as [5/7 25]) is from Hinterer Gosausee and of Rhaetian age. The specimen has a very rough granular appearance and the spiral side has previously been gold-coated making it difficult to see the chamber arrangement. There are four chambers in the final whorl.

The specimen in slide [4/5 28], from the Rhaetian at Plackles, is also gold-coated and now appears to be broken. The spire height is quite low, very like the holotype. There are two and a half whorls and all the chambers are inflated with depressed sutures. This specimen is slightly higher spired than the holotype and more inflated than illustrated by Fuchs (1967, pl. 4, figs 5, 6). The specimen in slide [5/3 26] is also broken into two pieces and few features are visible. It is also from the Rhaetian of Hinterer Gosausee.

***Oberhauserella crassa*, Fuchs, 1970**

Oberhauserella crassa, Fuchs, 1970, p. 112, pl. 9, fig. 10.

1949 *Discorbis* cf. *dreheri* Bartenstein – Cushman and Glazevski, p. 11, pl. 3, figs 6, 7.

1959 *Discorbis dreheri* Bartenstein – Cifelli, p. 336, pl. 7, figs 23-25.

1967 *Reinholdella dreheri* (Bartenstein) – Störmer and Weinholz, p. 564, pl. 9, fig. 82.

DERIVATION OF NAME: Crassus (Lat.) = thick.

HOLOTYPE: Fuchs, 1970, pl. 9, fig. 10.

DEPOSITORY: Geologische Bundesanstalt, Vienna, Inv. No. 0341. (1970/3/130)

TYPE LOCALITY: Hernstein, Lower Austria.

TYPE STRATUM: Lower Jurassic, Lias alpha, Fleckenmergel. Lower Liassic, α_3. Associated with this material are three slides labelled "Plö. Hernstein". As the samples used by Fuchs were collected by H. Mostler, R. Oberhauser and B. Plöchinger (in 1967) it is quite likely that these are the samples from which the types were extracted. All three slides (9.6.66./2; 14.6.66./1; 7.6.66./1) contain lenticulinids, *Cyclogyra* spp. and the distinctive ostracod *Ogmoconcha*. This agrees with comments in the paper on the Hernstein locality (Fuchs, 1970).

DIAGNOSIS: A species of the genus *Oberhauserella* Fuchs, 1967, with the following distinctive features: test biconvex with narrow, deeply depressed umbilicus.

TRANSLATION OF ORIGINAL DESCRIPTION: Test small, the nearly circular outline somewhat constricted by the sutures only between the youngest chambers. Dorsal side strongly curved, spire unstressed, all chambers visible; ventral side faintly convex and umbilicate, only the last four to five chambers visible. Periphery round. Globular proloculus, followed by nine gradually expanding chambers in approximately two whorls. Sutures indistinct, slightly depressed between the final chambers, otherwise smooth, slightly inclined backwards. Umbilicus very narrow and deep, lobate in the region of the base curvature of the final chambers (see Fuchs, 1969). Aperture, situated on the bottom of the distal chamber segment, concealed by a sediment plug in the umbilicus. Smooth shell, rather poorly preserved. Very rare.

DIMENSIONS OF THE HOLOTYPE: Maximum diameter 0.35 mm, height 0.15 mm.

RELATIONSHIPS: Fuchs thought that this taxon was probably derived from *Oberhauserella alta* Fuchs, 1967, separated from it by the divided outline at the suture joins and the wide umbilicus. *Oberhauserella alta* Fuchs, 1967, is distinguished by its distinctly constricted test outline in the area of the sutures and the large umbilicus. It is also similar to *Discorbis tyoplovkaensis* Dain, 1948, from the Russian Callovian. The distinctly constricted test outline, expanded chambers and depressed sutures allow it to be separated from this species. The concave ventral side, the broad, obviously depressed sutures between the youngest chambers and the sharp-edged periphery separate this species from *Conorboides paulus* Pazdro, 1969, from the Bathonian of Poland.

COMMENTS: The specimen is definitely recrystallised but appears biconvex, deeply umblicate and with a spiral view identical to that shown by Fuchs (pl. 9, fig. 10, left).

Oberhauserella karinthiaca Fuchs, 1967

Pl. 2 , Fig. 1a-c.

Oberhauserella karinthiaca Fuchs, 1967, pp. 149,150, pl. 3, fig. 3.

DERIVATION OF NAME: First found in the Province of Kärnten.

HOLOTYPE: Fuchs, 1967, pl. 3, fig. 3.

DEPOSITORY: Geologische Bundesanstalt, Vienna, Inv. No. 0308.

TYPE LOCALITY: Eisenkappel, Kärnten.

TYPE STRATUM: Upper Triassic, Lower Carnian, lower Julian, Raibl strata.

DIAGNOSIS: A species of the genus *Oberhauserella* with the following distinctive features: in the older whorl only four chambers; umbilicus somewhat broader; the aperture more distinct and moved away a short distance from the middle of the chamber base.

TRANSLATION OF ORIGINAL DESCRIPTION: Test very small, with strongly lobed but still circular outline, dorsal side curved without apparent disruption of the older part, ventral side concave and umbilicate. Periphery rounded. Both whorls have only four chambers visible. Sutures indistinct, slightly inclined to the rear and hardly depressed. Umbilicus somewhat wider and open. The slightly bulbous chambers expand rapidly on the perimeter. The aperture, moved away from the middle of the chamber base, is a larger opening lying in a depression. So far as the poor state of preservation allows, the apertural openings of the preceding chambers can also be observed. Shell hyaline and smooth. Very rare.

DIMENSIONS OF THE HOLOTYPE: Maximum diameter 0.20 mm, height 0.10 mm.

RELATIONSHIPS: This species differs from *O. mesotriassica* (Oberhauser) through the number of the older chambers reduced to four, the widening of the umbilicus and the larger asymmetrically situated aperture.

COMMENTS: The holotype (No. 0308 [3/3 17]), from the Upper Karnian of Eisenkappel, has previously been gold-coated. The spiral side is quite inflated, probably more than indicated by Fuchs (1967, pl. 3, fig. 3). There are four to four and a half chambers in the final whorl, ten to eleven chambers in total in the two whorls. The appearance is very like that shown by Fuchs in his lower figure but it appears to have a higher spire than indicated.

Oberhauserella norica Fuchs, 1967

Pl. 2, Fig. 2a-d.

Oberhauserella norica Fuchs, 1967, pp. 151,152, pl. 3, fig. 7; pl. 6, figs 2, 6.

DERIVATION OF NAME: From its first appearance in the Upper Norian of Rossmoos.

HOLOTYPE: Fuchs, 1967, pl. 3, fig. 7.

DEPOSITORY: Geologische Bundesanstalt, Vienna, Inv. No. 0311.

TYPE LOCALITY: Rossmoos, Upper Austria.

TYPE STRATUM: Upper Triassic, Upper Norian, lower Sevat, Zlambach marl.

DIAGNOSIS: A species of the genus *Oberhauserella* with the following distinctive features: rapid chamber growth in the final whorl; aperture distinct and deeply depressed in the chamber wall, asymmetrically situated.

TRANSLATION OF ORIGINAL DESCRIPTION: Test very small, broad-oval, deeply lobate outline. Dorsal side a little curved, spire inconspicuous, ventral side concave and umbilicate. Periphery rounded. Four to five chambers in each whorl; in the second the size increases strikingly rapidly. The delicate backward-inclined sutures more or less clearly apparent and somewhat depressed. On the umbilical side the bulbous chambers surround a fairly wide, open umbilicus. The large, broad, semicircular aperture extends asymmetrically, and often very strikingly, into the part of the chamber adjacent to the older part of the test. The open apertures of the preceding chambers give the umbilicus the slightly lobate appearance. Shell hyaline and smooth. Rare.

DIMENSIONS OF THE HOLOTYPE: Maximum diameter 0.20 mm, height 0.10 mm.

RELATIONSHIPS: The rapid enlargement of the chambers of the second whorl and the large, distinct asymmetrically-positioned aperture distinguish the species from *O. quadrilobata*.

OCCURRENCE: Aside from the type-location of Rossmoos the species has also been recorded in residues from Hinterer Gosausee and Xanten.

REMARKS: Fuchs also noted that the gradual increase in the number of chambers from 4:4 in the Upper Norian, to 4:5 in the Rhaetian of Hinterer Gosausee and to 5:5 at the Rhaetian level from Xanten could be analysed stratigraphically in the future.

COMMENTS: The specimen (No. 0311 [3/7 27]), from the Upper Norian of Rossmoos, is quite domed in appearance, much more than indicated for the holotype in Fuchs (1967, pl. 3, fig. 7).

There are four plus chambers in the final whorl, with only slightly depressed sutures. The final whorl occupies most of the spire height. The apertural face has previously been gold-coated and the specimen illustrated by Fuchs (1967, pl. 3, fig. 7, left-hand illustration) is an accurate representation, with the last chamber quite inflated and extending right along the left margin of the test as viewed. The centre of the umbilical depression may have some material in it.

A specimen from the Upper Rhaetian at Xanten [6/6 29] is gold-coated and broken with only half of the specimen remaining. In this fragment the chambers appear inflated and the sutures are quite depressed.

Oberhauserella ovata Fuchs, 1967

Oberhauserella ovata Fuchs, 1967, pp. 154,155, pl. 4, fig. 7.

DERIVATION OF NAME: Ovatus (Lat.) = egg-shaped.

HOLOTYPE: Fuchs, 1967, pl. 4, fig. 7.

DEPOSITORY: Geologische Bundesanstalt, Vienna, Inv. No. 0314.

TYPE LOCALITY: Plackles, Höhe Wand, Lower Austria.

TYPE STRATUM: Upper Triassic, Rhaetian.

DIAGNOSIS: A species of the genus *Oberhauserella* with the following distinctive features: egg-shaped outline of the test, with hollows in the region of the suture junctions; chambers on the ventral side distinct, on the dorsal side a little inflated; fairly obvious, narrow, slit-shaped aperture in the proximity of the final suture.

TRANSLATION OF ORIGINAL DESCRIPTION: Test very small, with egg-shaped, undivided outline. The older part of the shell, consisting of the spherical proloculus and approximately four chambers, lying in a depression and surrounded by the second whorl which is composed of about seven chambers that expand rapidly. The chambers are particularly inflated on the ventral side. Umbilical side concave and umbilicate. Periphery rounded. Sutures indistinct, inclined to the rear and hardly depressed. Umbilicus moderately broad. The striking, narrow, slit-shaped aperture lies near the septum of the final chamber, the larger part of which is deeply depressed and so characterises the ventral view of this species. The relict apertures of the earlier chambers surrounding the umbilicus can still be observed. Shell hyaline and smooth. Very rare.

DIMENSIONS OF THE HOLOTYPE: Maximum diameter 0.25 mm, height 0.05 mm.

RELATIONSHIPS: The egg-shaped outline, the long, narrow aperture of the final chamber and the moderately broad umbilicus separate this species from *O. rhaetica* (Kristan-Tollmann, 1964) and *O. parviforamen.*

REMARKS: Fuchs appears to have been convinced that the three described species of *Oberhauserella* might eventually be of significance as ancestors of the first representatives of the *Ceratobulimininae* Cushman, 1927, members of which appear in the Jurassic. It was suggested that examination of the inner construction of the test of the Triassic forms might provide the necessary evidence.

COMMENTS: The holotype (No. 0314 [4/7 35]), from the Rhaetian at Plackles, has previously been gold-coated and the final chamber broken. It is, therefore, impossible to see the extended chamber shown in Fuchs (1967, pl. 4, fig. 7). The other chambers are not really inflated and the sutures are only very slightly depressed.

Oberhauserella parviforamen Fuchs, 1967

Oberhauserella parviforamen Fuchs, 1967, pp. 153, 154, pl. 5, fig. 2.

DERIVATION OF NAME: Parvus (Lat.) = small, foramen (Lat.) = opening.

HOLOTYPE: Fuchs, 1967, pl. 5, fig. 2.

DEPOSITORY: Geologische Bundesanstalt, Vienna, Inv.-No. 0313.

TYPE LOCALITY: Plackles, Höhe Wand, Lower Austria.

TYPE STRATUM: Upper Triassic, Rhaetian.

DIAGNOSIS: A species of the genus *Oberhauserella* with the following distinctive features: the chambers are inflated on both sides of the test, as a result of which the small spire of the older section of the test appears to be nearly submerged in the later chambers; insignificant slit-shaped aperture occurring close to the preceding chamber; umbilicus very wide.

TRANSLATION OF ORIGINAL DESCRIPTION: Test small, outline broad to narrow oval, barely lobate outline. Sutures only deeply indented between the last chambers.

Older part of the spire lying deeply embedded surrounded by the rapidly enlarging chambers, both dorsally and ventrally. Chambers bulbous, umbilical side concave and umbilicate. Periphery rounded. On the umbilical side seven chambers are always observable while on the dorsal side the round proloculus and four chambers are visible in the inconspicuous initial part of the shell. The slightly inclined sutures, apart from in the early whorl, are always distinct and slightly depressed. From the broad, open umbilicus the inconspicuous slit-shaped aperture penetrates only slightly into the chamber wall, always situated near to the suture separating the earlier chamber. With only slight difficulty the apertures of the earlier chambers can also be seen. Shell hyaline and smooth. Very rare.

DIMENSIONS OF THE HOLOTYPE: Maximum diameter 0.30 mm, height 0.10 mm.

RELATIONSHIPS: The small lobate circumference, the bulbous chambers on both sides, the nearly concave dorsal view and the small aperture allow this species to be separated easily from *O. rhaetica* (Kristan-Tollman, 1964).

COMMENTS: The holotype (No. 0313 [5/2 34]), from the Rhaetian at Plackles, is quite a large specimen that has previously been gold-coated. There appear to be seven chambers in the final whorl, all of which expand in size slowly. The chambers are less well-defined on the apertural side. There is a deep umbilicus with little sign of an aperture. Fuchs (1967, pl. 5, fig. 2, left) shows the final chamber dominating the specimen with the others less well-defined.

Oberhauserella planiconvexa Fuchs, 1970

Oberhauserella planiconvexa Fuchs, 1970, p. 113, pl. 9, fig. 7.

DERIVATION OF NAME: Named after the curved dorsal side and flat ventral side.

HOLOTYPE: Fuchs, 1970, pl. 9, fig. 7.

DEPOSITORY: Geologische Bundesanstalt, Vienna, Inv. No. 0342. (1970/3/131)

TYPE LOCALITY: Hernstein, Lower Austria.

TYPE STRATUM: Lower Jurassic, Lias alpha, Fleckenmergel. Lower Liassic, α_3.

DIAGNOSIS: A species of the genus *Oberhauserella* Fuchs, 1967, with the following distinctive features: curved dorsal side, flat ventral side, sharp-edged test periphery, narrow umbilicus.

TRANSLATION OF ORIGINAL DESCRIPTION: Test small, outline a broad-oval and not divided by the suture joins. Dorsal side strongly curved with all chambers seen, on the smooth spire; on the flat, umbilicate ventral side only approximately six chambers of the final whorl are identifiable. Periphery distinct, sharp-edged. Spherical proloculus and eight additional chambers are seen in approximately one and a half whorls. Distinctive size increase of the chambers. Sutures clearly visible, not depressed, strongly curved backwards. Umbilicus narrow and deep, filled with sediment. Only the arch of the last chamber is seen, that separates the last part of the chamber base, extending down into the umbilicus, here part of the chamber base from the previous chambers. Aperture at the base of the last chamber area is concealed by sediment (regarding the latest details see Fuchs, 1969). The poorly preserved test is smooth. Rare.

DIMENSIONS OF THE HOLOTYPE: Maximum diameter 0.40 mm, height 0.15 mm.

RELATIONSHIPS: *Conorboides marginata* Lloyd, 1962, differs by the round periphery, divided on the suture joins, the broad sunken sutures as well as the distinct, submarginal rib on the ventral side. *Rosalina paraspis* Schwager, 1867, has a narrow–oval outline, rounded test margin, only slightly less curved dorsal side and concave inclined ventral side. Depressed sutures and the obviously divided test outline are used to separate this species from the otherwise very similar form *Discorbis speciosus* Dayn, 1958, from the Oxfordian of Ukraine. *Oberhauserella ovata* Fuchs, 1967, possesses a narrow-oval outline, round periphery somewhat indented in the area of the sutures and displays a conspicuously rapid increase in the chamber size.

COMMENTS: The specimen is now broken and fixed onto the slide which is marked "not for removal". It appears cemented to a glass shard or solidified glue. There is an almost glassy appearance and it is also transparent. Being unable to do more than tilt the whole slide there appears to be a faint edge or keel but this cannot be checked. The chambers are impossible to identify. It is impossible to confirm the type figure, although the sutures do appear to be curved.

Oberhauserella praerhaetica Fuchs, 1967

Oberhauserella praerhaetica Fuchs, 1967, pp. 152, 153, pl. 3, fig. 8; pl. 5, figs 5,6.

DERIVATION OF NAME: Presumed to be the precursor of *O. rhaetica* (Kristan-Tollmann, 1964).

HOLOTYPE: Fuchs, 1967, pl. 5, fig. 6.

DEPOSITORY: Geologische Bundesanstalt, Vienna, Inv.-No. 0312.

TYPE LOCALITY: Hinterer Gosausee, Upper Austria.

TYPE STRATUM: Upper Triassic, Rhaetian.

DIAGNOSIS: A species of the genus *Oberhauserella* with the following distinctive features: gradual increase in the number of rapidly enlarging chambers of the second whorl; in the region of the aperture distinctly lobed umbilicus.

TRANSLATION OF ORIGINAL DESCRIPTION: Test very small; broad oval, outline indented by the sutures. Dorsal side delicately curved, spire however unmarked, ventral side concave and umbilicate. Periphery rounded. In the older whorls three to four chambers are present whilst in the younger whorl there are five to six chambers that become strikingly larger, divided by inconspicuous, shallow and backward-inclined sutures. The large last chamber dominates, particularly the view on the umbilical side. Apertures are seen as slits more or less deeply extending into the chamber wall around the umbilicus. Ventral side has distinctive bulbous chambers. Shell hyaline and smooth. Rare.

DIMENSIONS OF THE HOLOTYPE: Maximum diameter 0.25 mm, height 0.05 mm.

RELATIONSHIPS: Separated from *O. norica* through a lower number of chambers in the first whorl, and an increase in the number of chambers in the second whorl.

OCCURRENCE: Besides the type-locality at Hinterer Gosausee it is also known from Rossmoos (Upper Norian).

REMARKS: The forms from Rossmoos and Hinterer Gosausee represent morphologically the intermediate forms from *O. norica* to *O. rhaetica* (Kristan-Tollmann, 1964). For future purposes of stratigraphical evaluation, the presence of up to five chambers in the final whorl in the Upper Norian and of up to six chambers in the final whorl in the Rhaetian may be useful.

COMMENTS: The holotype (No. 0312 [J/6 32]), from Hinterer Gosausee, has previously been gold-coated and broken in half. The fragments show the inflated chambers and depressed sutures but that is all. The margin appears less indented than shown in Fuchs (1967, pl. 5, fig. 7).

A specimen in slide [5/5 31], also from Hinterer Gosausee, has four to four and a half chambers in the final whorl and is inflated both spirally and dorsally. The final chamber comprises almost 40% of the umbilical view and no aperture is visible. This specimen has a quite granular appearance and is probably re-crystallised.

The paratype figured by Figured by Fuchs (1967, pl. 3, fig. 8) from Rossmoos, central Austria. Upper Norian. Geologische Bundesanstalt, Vienna, no. 1967/5/32 was also borrowed but the specimen was found to be badly broken, most of the test being missing.

Oberhauserella quadrilobata Fuchs, 1967

Pl. 2 , Fig. 3a-d.

Oberhauserella quadrilobata Fuchs, 1967, p. 150, pl. 3, figs 5, 6; pl. 4, fig. 8; pl. 6, figs 1, 7.

1964 *Globigerina* cf. *mesotriassica* Oberhauser - Kristan-Tollmann, p. 167, pl. 39, fig. 16.

DERIVATION OF NAME: The open umbilicus and the quadruple-lobed appearance are characteristic of this species.

HOLOTYPE: Fuchs, 1967, pl. 4, fig. 8.

DEPOSITORY: Geologische Bundesanstalt, Vienna, Inv. No. 0309.

TYPE LOCALITY: Plackles, Höhe Wand, Lower Austria.

TYPE STRATUM: Upper-Triassic, Rhaetian.

DIAGNOSIS: A species of the genus *Oberhauserella* with the following distinctive features: the four most recent, ventrally inflated chambers, dominate the appearance; the wide, open umbilicus displays four distinct lobes, as a result of the apertures of the final chambers.

TRANSLATION OF ORIGINAL DESCRIPTION: Test very small, the circular outline in the area of the sutures are more or less deeply incised. Dorsal side low, curved, with an insignificant spire; ventral side concave and umbilicate. Periphery rounded. As a rule, the four chambers per whorl are divided from one another by quite indistinct sutures, which are inclined slightly backwards and only a little depressed. The inflated chambers become rapidly larger in the final whorl, surrounding a wide and depressed umbilicus. Aperture an oval-semicircular terminal slit, lying either in the middle of the chamber base or varyingly strongly asymmetrically. The open apertures of the final chambers give the umbilicus a quite characteristic appearance. Test hyaline and smooth. Common.

DIMENSIONS OF THE HOLOTYPE: Maximum diameter 0.20 mm, height 0.10 mm.

RELATIONSHIPS: Easily separable from *O. karinthiaca* as a result of the wide umbilicus and the very characteristic apertural view.

OCCURRENCE: Aside from the type-locality at Plackles, this species has already been found in the Upper Norian of Rossmoos and in the Rhaetian strata from Hinterer Gosausee and Xanten.

REMARKS: The Norian forms show a strikingly deep aperture in the final chamber. The representatives of "Discovery Site 7" (Xanten) show five chambers in both whorls. The striking, morphological similarity of these tests towards *Oberhauserina* Fuchs, 1967, discovered in the upper part of the Lower Cretaceous in Holland is noted.

COMMENTS: The holotype (No. 0309) from the Rhaetian of Plackles has been gold-coated but only on the apertural face. The specimen clearly shows four inflated chambers in the final whorl and all the sutures are depressed (possibly more than illustrated). The spiral side, which is not gold-coated has a granular appearance and may be re-crystallised.

A specimen in slide [3/5 19] has very inflated chambers and markedly depressed sutures. The specimen in slide [6/1 21] is also granular in appearance but has four distinct chambers in the final whorl. The specimen has a quite high spire of two to two and a half whorls with the final whorl making up most of the spire. This specimen is marked as being of Rhaetian age and from Hinterer Gosausee.

The specimen from the Upper Rhaetian of Xanten [6/7 22] has five chambers in the final whorl, all of which are inflated with depressed sutures. There are 12 chambers visible on the spiral side of the specimen.

The specimen (Slide 25) from Schichte (Bed) 26 of the Oxfordian of South Poland is very small and preserved as a mineral steinkern. It may possibly be an *Oberhauserella* but the range of the taxon cannot be extended into the Oxfordian on the basis of this specimen,

Oberhauserella rhaetica (Kristan-Tollmann, 1964)

Oberhauserella rhaetica (Kristan-Tollmann, 1964), p. 153, pl. 5, fig.1.

1964 *Globigerina rhaetica* Kristan-Tollmann, p. 166, pl. 39, figs 13-15.

DIAGNOSIS: A species of the genus *Oberhauserella* with the following distinctive features: moderately trochospiral form with seven, particularly on the ventral side, markedly inflated chambers, surrounding a fairly wide umbilicus and in the last of which a large, slit-shaped aperture intrudes, moved more closely to the older parts of the shell.

TRANSLATION OF ORIGINAL DESCRIPTION: Test small, from broad to slender-oval outline, in the sutures appearing strikingly lobed. The small spire somewhat raised up, ventrally concave and umbilicate. Round shell rim. On the umbilical side, as a rule, seven chambers are countable, as well as approximately a further four in the initial section (without the round proloculus). Sutures at the start less, then, however, very distinct, somewhat deepened and from time to time inclined strongly backwards. Umbilicus wide and open, surrounded by bulbous chambers, becoming rapidly voluminous, of which the last dominates particularly ventrally. Aperture a distinct slit, situated in the half of the chamber base turned away from the ventral wall. Through small lobes of the wide umbilicus, the mouth-openings of the older chambers are also still to be seen. Shell hyaline-smooth. Rare.

RELATIONSHIPS: The multi-chambered nature of the final whorl, looked at ventrally, the large aperture and the high spire are the essential distinguishing features compared with *O. praerhaetica*.

OCCURRENCE: So far only discovered in the Rhaetian of Fischerwiese and of Plackles.

REMARKS: The detailed description of this species given in 1964 by Kristan-Tollmann was only to be corrected, i.e. completed slightly as a result of the better state of preservation of the specimens to hand. Their illustrations inform about the outline-variation.

COMMENTS: The specimen in slide [5/1 33], from the Rhaetian at Plackles, is difficult to reconcile with Fuchs (1967, pl. 5, fig. 1) as it is now broken in half.

Genus ***DIPLOTREMINA*** Kristan-Tollman, 1960

Diplotremina multifimbriata Fuchs, 1967

Diplotremina multifimbriata Fuchs, 1967, pp. 141,142, pl. 1, fig. 1.

DERIVATION OF NAME: multus (Lat.) = many, fimbriatus (Lat.) = frayed; so named owing to the strongly lobed umbilical view.

HOLOTYPE: Fuch, 1967, pl. 1, fig. 1.

DEPOSITORY: Geologische Bundesanstalt, Vienna, Inv.-No. 0300.

TYPE LOCALITY: Seelandalpe, Prags Dolomites, South Tyrol.

TYPE STRATUM: Middle-Triassic, Upper Ladinian, Upper Cordevolian, Upper Cassian Strata.

DIAGNOSIS: A species of the genus *Diplotremina* Kristan-Tollmann, 1960, with the following distinctive features: small test with an intensely furrowed umbilicus.

TRANSLATION OF ORIGINAL DESCRIPTION: Test small, low trochospiral: outline broad-oval on the suture joins faintly hollowed. Umbilical side only slightly convex. Shell-rim rounded. Dorsally all the whorls, always more than two, can be seen, ventrally only the seven chambers of the final whorl. Gradual and regular increase in the chamber-size; the youngest chambers, first and foremost the end chamber on the ventral side, not infrequently somewhat distended. In the dorsal view, only sutures of the final chambers rather obvious, normally merely a moderate indication of them can be observed. The umbilical side displays uneven, strongly lobed termination of the chamber ends, in the course of which parts often appear already completely isolated from the centre of the umbilicus. About half the chamber length in front of a hollow deepening this furrowing ends. From the divided base of the final chamber stretch ventrally the two approximately oblong and semicircular ending apertures separated by a fairly broad lobe, from which slight hollows extend up the chamber wall. Shell granular-rough. Rare.

DIMENSIONS OF THE HOLOTYPE: Maximum diameter 0.35 mm, height 0.15 mm.

RELATIONSHIPS: Closely related to *D. astrofimbriata* Kristan-Tollmann, 1960, distinguished however from this species through the moderate size of the low trochospiral test and the more accentuated divided umbilicus.

Genus *KOLLMANNITA* Fuchs, 1967

DERIVATION OF NAME: Dedicated to Dr. K. Kollmann (Rohöl-AG.) in gratitude

GENOTYPE: *Kollmannita ladinica* (Oberhauser, 1960)

GENUS DIAGNOSIS: Test free, only slightly trochospiral, umbilical side slightly to markedly concave, periphery rounded. On the spiral side all the chambers of about two whorls are recognisable. On the ventral side only those of the final whorl are visible. Sutures mostly depressed, the outline distinctly lobate. With increasing evolution the ends of the chambers extend more, and become more simple and less divided up into the shallow umbilicus. The final chambers, in particular the youngest on the ventral side, are slightly distended. The double aperture situated on the ventral side is more or less clearly developed. Shell calcareous, granular to hyaline and smooth.

RELATIONSHIPS: The small test, with a very low spire, its distinctive two whorls and the shallow, slightly concave umbilicus, allows this new genus to be separated without difficulty from *Diplotremina* Kristan-Tollmann, 1960. *Schmidita* differs in having distended chambers in the final whorl and the shape and position of the umbilicus and aperture.

REMARKS: Fuchs suggested a transition running from the granular calcareous *Diplotremina* to the hyaline calcareous *Kollmannita.* This was based not only on morphology but also based on the shell composition.

RANGE: As yet, only known from the Upper Ladinian.

Kollmannita ladinica (Oberhauser, 1960)

Pl. 2, Figs 4a-c, 5a-e.

Globigerina ladinica Oberhauser, 1960, pp. 43, 44, pl. 5, figs 12a-c, 14a-c, 16a-c.

DERIVATION OF NAME: Named after this species' occurrence in the Ladinian Stage of the southern Alpine Middle Triassic.

HOLOTYPE: Oberhauser, 1960, pl. 5, fig. 14a-c.

DEPOSITORY: Geologische Bundesanstalt, Vienna, Inv. No. 0106.

PARATYPE: Oberhauser, 1960, pl. 5, figs 12a-c, 16a-c.

DEPOSITORY: Geologische Bundesanstalt, Vienna, Inv. No. 0107, 0108.

TYPE LOCALITY: St. Cassian, Settsass-Scharte, N. Richthofen-Riff (Fig. 2.5).

TYPE STRATUM: Middle Triassic, Ladinian Stage, Upper Cassian Strata (rare).

DIAGNOSIS: A *Discorbis*-like, intensely flattened species of the genus *Globigerina* Orbigny, 1826.

TRANSLATION OF ORIGINAL DESCRIPTION: Test free, calcareous hyaline (quickly dissolving in acid with little residue). Rounded to slightly lobate outline. The test consists of a low trochospiral of slightly inflated chambers, of which five to six lie in the final whorl. The test shows no visible spines or other fine sculpture. The umbilicus, in the case of the smaller forms, tends to be large and generally lobed in the direction of the chamber sutures, so that an irregular, stellate appearance evolves. Additional apertures are not detectable. One paratype (fig. 16) shows a slit running into the wall of the final chamber, which was interpreted as damage.

DIMENSIONS: Maximum diameter approximately 0.25 to 0.5 mm.

RELATIONSHIPS: Oberhauser certainly questioned the possibility of this being a precursor of *Globigerina* close to the genus *Discorbis*; a transition only previously known from the Upper Jurassic. In spite of their rare occurrence the appearance of these forms in Triassic samples is not doubted. In addition, Oberhauser knew of small *Globigerina*-like forms from the Rhaetian Zlambach strata. *Discorbis pristina* Tappan, 1951, from the Triassic of Alaska was thought to be this form, although it does not show *Globigerina*-like inflation of the chambers. Several Liassic forms (cf. Usbeck, 1953) known under names such as *Trochammina globigeriniformis* (Parker and Jones) were also thought to be related.

COMMENTS: The holotype (Slide 1960/4/108 is gold-coated, large and looks to be the specimen illustrated by Oberhauser (1960, pl. 5, fig. 16).

The specimen in slide [2/5 7], from the Upper Ladinian of Settsass, appears to be missing.

A specimen in slide [3/2 9] from the Upper Karnian of Eisenkappel, has four to four and a half chambers in the final whorl, all of which are quite inflated with slightly depressed sutures. The specimen seems to have a slightly higher spire than the figure given by Fuchs (1967).

Slide [2/6 8] in the Fuchs (1967) collection (with similar writing to the other slides) is marked as *Kollmannita ladinica* (Oberhauser). It is also marked in red as *K. tirolica* Fuchs n. sp. (1975). The specimen is quite robust with four and a half chambers in the final whorl visible on the apertural side. The sutures are quite depressed, giving an almost star-shaped appearance. The umbilicus contains a sediment infilling which obscures any features.

Kollmannita cordevolica, Fuchs, 1967

Kollmannita cordevolica, Fuchs, 1967, p. 146, pl. 2, fig. 3.

DERIVATION OF NAME: After the first find in the Upper-Cordevol.

HOLOTYPE: Fuchs, 1967, pl. 2, fig. 3.

DEPOSITORY: Geologische Bundesanstalt, Vienna, Inv. No. 0305.

TYPE LOCALITY: Seelandalpe, Prags Dolomites, South Tyrol.

TYPE STRATUM: Middle Triassic, Upper Ladinian, Upper Cordevolian, Upper Cassian Strata.

DIAGNOSIS: A species of the genus *Kollmannita* with the following distinctive features: in the final whorl ventrally only four chambers, umbilicus not denticulate and only one slit-shaped aperture developed.

TRANSLATION OF ORIGINAL DESCRIPTION: Test very small, of approximately circular outline, the suture joins are only a little indented. Spiral side somewhat curved, without the spire itself appearing particularly in evidence; ventral surface concave.

Rounded periphery. Ventrally only four chambers are to be seen, dorsally another seven can be made out, without the initial chamber, after immersing in water. The indistinct sutures more or less inclined backwards. In the second, the younger whorl, the chambers become suddenly larger and are fairly slightly bulbously curved on the umbilical side. Umbilicus shallow and not lobate. Of the two slit-shaped mouth-openings of this genus, here only one has developed, the other has become completely suppressed. A shallow hollow in the ventral wall of the end chamber somewhat continues the aperture and extends the apertural area. Shell calcareous-granular to hyaline-smooth. Very rare.

DIMENSIONS OF THE HOLOTYPE: Maximum diameter 0.20 mm, height 0.10 mm.

RELATIONSHIPS: This species provides the connecting link between the genera *Kollmannita* and *Oberhauserella.*

COMMENTS: The holotype (No. 0305 [2/3 12]), from the Upper Ladinian of Seelandalpe, is partly gold-coated. This is a small form with four to five chambers visible. There is a rather sunken umbilicus, the margin of which is raised making chambers difficult to see. This species appears quite different from the other species of *Kollmanita.* The spiral side is quite inflated and sutures depressed. The chambers do not appear to be accurate in shape.

Kollmannita diplotreminaeformis, Fuchs, 1967

Kollmannita diplotreminaeformis, Fuchs, 1967, pp. 142, 143, pl. 1, fig. 2.

DERIVATION OF NAME: The great resemblance *to Diplotremina* suggested this name.

HOLOTYPE: Fuchs, 1967, pl. 1, fig. 2.

DEPOSITORY: Geologische Bundesanstalt, Vienna, Inv. No. 0301.

TYPE LOCALITY: Seelandalpe, Prags Dolomites, South Tyrol.

TYPE STRATUM: Middle Triassic, Upper Ladinian, Upper Cordevolian, Upper Cassian Strata.

DIAGNOSIS: A species of the genus *Kollmannita* with the following distinctive features:

Diplotremina-like; chambers deeply slit; umbilicus narrow and hardly sunken in.

TRANSLATION OF ORIGINAL DESCRIPTION: Test very small, extremely low trochospiral; outline broad-oval, at the junction points with the sutures slightly indented. The umbilical side flat or insignificantly inclined inwards. Periphery rounded. Ventrally seven chambers visible, dorsally in the older shell section a further seven identifiable after immersing in water. Chambers gradually becoming larger, the youngest on the ventral side somewhat distended. Sutures approximately radial and, apart from the oldest rather distinct. The furrowing of the chamber ends towards the narrow umbilicus markedly more insignificant than in *Diplotremina multifimbriata*. In front a small hollow after about half the length the chambers are linked again close to one another). A part, separated from the chamber base, sits, like a plug, the middle of the umbilicus. Aperture completely identical with that of *Diplotremina*, ventrally two longish slit-shaped apertures, separated by a broad lobe, in the extension of which a slight hollow extends up the ventral wall of the end chamber. Shell granular-rough. Very rare.

DIMENSIONS OF THE HOLOTYPE: Maximum diameter 0.25 mm, height 0.10 mm.

RELATIONSHIPS: A certain resemblance to *Diplotremina* separates this form from all other species of the genus *Kollmannita*. The modest test-size, the flat to slightly concave umbilicus and the very low spire, always limited to two whorls, distinguish it obviously, however, from *Diplotremina*.

COMMENTS: The holotype (No. 0301 [1/2 2]), from the Upper Ladinian of Seelandalpe, has been gold-coated on the umbilical side. The chambers are quite distinct (perhaps six to seven) with the sutures only slightly depressed. The margin is almost smooth in outline, as indicated by Fuchs (1967, pl. 1, fig. 2, left). The specimen appears more plano-convex than indicated in Fuchs (1967, pl. 1, fig. 2). The spiral side is gold-coated and chambers appear much less distinct than shown by Fuchs (1967, pl. 1, fig 2, right).

Kollmannita gemmaeformis, Fuchs, 1967

Kollmannita gemmaeformis, Fuchs, 1967, p. 145, pl. 1, figs 5, 6.

DERIVATION OF NAME: Gemma (lat.) = gem.

HOLOTYPE: Fuchs, 1967, pl. 1, fig. 6.

DEPOSITORY: Geologische Bundesanstalt, Vienna, Inv. No. 0304.

TYPE LOCALITY: Seelandalpe, Prags Dolomites, South Tyrol.

TYPE STRATUM: Middle Triassic, Upper Ladinian, Upper Cordevolian, Upper Cassian Strata.

DIAGNOSIS: A species of the genus *Kollmannita* with the following distinctive features: broad, stocky test, denticulate umbilicus with "plug" and gradual reduction of the mouth to a crack

TRANSLATION OF ORIGINAL DESCRIPTION: Test very small, with stocky, broad-oval outline, only a little divided on the suture positions. Spire somewhat high-curved. Ventral side slightly concave. Shell-rim rounded. About seven chambers compose the first whorl, the round proloculus not included in the calculation, always six in the second whorl. The sutures inclined backwards and in the initial area indistinct. The younger chambers gaining rapidly on the perimeter and are on the umbilical side moderately curved. Below the small hollow, the septae divide without complication, the chamber ends extend markedly forward in the shallow and narrow umbilicus, an isolated piece of which is always found in the centre ("plug"). A well-developed slit-shaped aperture, oblong, semicircular enclosed, separated by a more or less broad inter-lobe, from the second most inconspicuously developed aperture. Shell calcareous-granular to hyaline-smooth. Very rare.

DIMENSIONS OF THE HOLOTYPE: Maximum diameter 0.25 mm, height 0.10 mm.

RELATIONSHIPS: The stocky shape, the reduction in the chamber number and the simpler umbilical situation separate this species from *K. diplotreminaeformis* from which it is certainly derived, and from *K. multiloculata.*

COMMENTS: The holotype (No. 0304 [1/6 11]), from the Upper Ladinian of Seelandalpe, is partly gold-coated. There appears to be five chambers in the final whorl with depressed sutures. The margin is undulating, giving a quite "lumpy" appearance. The umbilicus is slightly depressed, with nothing visible.

A specimen in slide [1/S 10], from the Upper Ladinian of Seelandalpe, appears to be missing.

Kollmannita multiloculata, Fuchs, 1967

Kollmannita multiloculata, Fuchs, 1967, pp. 143, 144, pl. 1, figs 3, 4.

DERIVATION OF NAME: Ventrally in the final whorl up to eight chambers visible.

HOLOTYPE: Fuchs, 1967, pl. 1, fig. 4.

DEPOSITORY: Geologische Bundesanstalt, Vienna, Inv. No. 0302.

TYPE LOCALITY: Seelandalpe, Prags Dolomites, South Tyrol.

TYPE STRATUM: Middle Triassic, Upper Ladinian, Upper Cordevolian, Upper Cassian Strata.

DIAGNOSIS: A species of the genus *Kollmannita* with the following distinctive features: umbilical side distinctly concave, umbilicus faintly divided and narrow.

TRANSLATION OF ORIGINAL DESCRIPTION: Test very small, with broad-oval outline, on the suture joins obviously constricted. Spire hardly noticeably raised up, ventral side hollowed in the region of the umbilicus. Shell-rim rounded. On the umbilical side six to eight chambers can be counted, dorsally, sometimes even without examination of the older whorls in transmitted light, still a further seven to eight also. The chambers following the globular proloculus, separated by poorly to easily visible, approximately radially running septae, becoming gradually, but steadily larger, the youngest are somewhat curved on the ventral side. The small, moderately sunken umbilicus in a simple way only reaches up to the dimple approximately halfway up the chamber length, yet in its middle is still found the "plug"-like detached part of a chamber base. The aperture evolved from the *Diplotremina*-like (fig. 3) to one in which one apertural slit gets obviously more and more suppressed and pushed out towards the periphery (fig. 4). Also here hollows, continuing the apertural grooves in the chamber wall, accentuate the aperture area. Shell granular-rough to hyaline-smooth. Very rare.

DIMENSIONS OF THE HOLOTYPE: Maximum diameter 0.25 mm, height 0.10 mm.

RELATIONSHIPS: Considered purely morphologically, this species leads to *K. praeladinica*, though it is probably also to be considered simultaneously as the ancestral form of the genus *Schmidita* appearing in the Lower Carnian.

COMMENTS: The holotype (No. 0302 [1/4 4]), from the Upper Ladinian of Seelandalpe, is gold-coated. The apertural view agrees with the figure of Fuchs (1967, pl. 1, fig. 4, left) and the number of chambers is in agreement with the other figures. The sutures are depressed and slightly curved. The apertural face is slightly depressed but the aperture is not visible.

A specimen [1/3 3], also from the Upper Ladinian of Seelandalpe, appears to be missing.

Kollmannita praeladinica, Fuchs, 1967

Kollmannita praeladinica, Fuchs, 1967, p. 144, pl. 2, figs 1, 2.

DERIVATION OF NAME: The precursor of *K. ladinica* (Oberhauser, 1960).

HOLOTYPE: Fuchs, 1967, pl. 2, figs 1-2.

DEPOSITORY: Geologische Bundesanstalt, Vienna, Inv. No. 0303.

TYPE LOCALITY: Seelandalpe, Prags Dolomites, South Tyrol.

TYPE STRATUM: Middle Triassic, Upper Ladinian, Upper Cordevolian, Upper Cassian Strata.

DIAGNOSIS: A species of the genus *Kollmannita* with the following distinctive features: umbilical side concave, chamber ends extending only slightly lobed, wedge-shaped into the umbilicus, which does not exhibit a "plug" anymore.

TRANSLATION OF ORIGINAL DESCRIPTION: Test very small, broad-oval outline, indented in the area of the sutures. Spire only insignificantly raised up, ventral side concave. Periphery rounded. The final whorl is formed, from the umbilical view, of five to seven chambers, dorsally seven further chambers can be identified after immersing in water in the older section of the whorl. Sutures rather indistinct, inclined backwards. Chamber size increase within the younger whorl more rapid, the final chambers ventrally slightly bulbous. Below the dimple the septae divide in a simple way, the bases of the chambers penetrate wedge-shaped moderately deeply into the umbilical region, isolated parts missing (no "plug"). Mostly one slit-shaped aperture always obviously developed, while the other, often separated by very broad inter-lobe, is less easily seen. Shell calcareous-granular to hyaline-smooth. Rare.

DIMENSIONS OF THE HOLOTYPE: Maximum diameter 0.20 mm, height 0.10 mm.

RELATIONSHIPS: Distinguished rather easily from the forms so far described by the simple shape of the umbilicus, the lack of a "plug", the reduction in chamber number of the end whorl and the further development of the mouth.

COMMENTS: The holotype (No. 0303 [2/2 5]), from the Upper Ladinian of Seelandalpe, has been partly gold-coated. It is a flattened specimen with a quite irregular margin. The sutures are depressed but the specimen appears to lack any of the characteristics associated with a planktonic mode of life.

A slide marked [2/1 6], from the Upper Ladinian of Seelandalpe, contains no specimen.

Genus *PRAEGUBKINELLA* Fuchs, 1967

DERIVATION OF NAME: Probably the precursor of *Gubkinella* Suleymanov, 1955, which first appears in the Dogger (Middle Jurassic).

GENOTYPE: *P. kryptumbilicata* Fuchs, 1967.

GENUS DIAGNOSIS: Test free, dorsal distinctly trochospiral, ventral obviously concave and more or less narrowly umbilicate. Rounded periphery. On the spiral side all chambers become gradually larger and increase in number in more than two whorls, on the ventral side only the last four to five are seen. Outline markedly lobate, the clearly visible sutures are somewhat inclined to the back and only a little depressed. All chambers, but particularly those of the last whorl, are inflated. Umbilicus narrow to almost disappearing and distinctly drawn inwards. Amongst the early forms indications of the slit-shaped apertures of the final chambers are still observable, with the more highly evolved almost totally reduced and transition to a slightly inclined slit-shaped aperture running almost parallel to the end of the chamber. Test hyaline-smooth.

RELATIONSHIPS: *Praegubkinella* was thought to have developed from *Oberhauserella alta*, with which it appears related through morphological transitions. This new genus was also thought to be the link to *Gubkinella* Suleymanov, 1955, which Fuchs regarded as the first true Middle Jurassic planktonic form.

REMARKS: Fuchs thought that the chamber arrangement of *Praegubkinella* indicated a free-floating lifestyle in the sea. He thought that the palaeoecology of sample-point 6, Hinterer Gosausee, pointed to its planktonic nature, suggesting the conquest of the open sea already by a representative of *Oberhauserella.*

RANGE: So far only recorded in the highest Rhaetian.

Praegubkinella kryptumbilicata Fuchs, 1967

Pl. 5, Fig. 1a-c.

Praegubkinella kryptumbilicata Fuchs, 1967, p. 159, pl. 7, fig. 3.

DERIVATION OF NAME: Kryptos (Gk.) = hidden, umbilicatus (Lat.) = umbilicate.

HOLOTYPE: Fuchs, 1967, pl. 7, fig 3.

DEPOSITORY: Geologische Bundesanstalt, Vienna, Inv. No. 0320.

TYPE LOCALITY: Xanten, Salzburg.

TYPE STRATUM: Upper Triassic, higher Rhaetian.

DIAGNOSIS: The type-species of the genus *Praegubkinella* with the following distinctive features: umbilicus close to disappearing; aperture a slightly curved slit, more or less parallel to one of the chamber bases.

TRANSLATION OF ORIGINAL DESCRIPTION: Test very small, outline almost circular, somewhat lobate by the sutures. The high dorsal spire allows all the gradually increasing chambers, in somewhat more than two whorls, to be identified. Umbilical view concave, four to five particularly inflated chambers can be counted. Test margins rounded. Sutures nearly radial, distinct and hardly depressed. Umbilicus very narrow, aperture a slender, slightly inclined slit situated on the base of the last chamber. The aperture of the penultimate chamber may also be seen. Shell hyaline and smooth. Very rare.

DIMENSIONS OF THE HOLOTYPE: Maximum diameter 0.20 mm, height 0.25 mm.

RELATIONSHIPS: The strikingly narrow umbilicus and the apertural slit parallel to the chamber base mark this species compared with *P. turgescens*. Fuchs thought that *P. kryptumbilicata* was probably only a small step away from *Gubkinella* Suleymanov, 1955.

REMARKS: The strong septa with the wall surfaces lying in between are a distinct ornamentation of the initial part of the spire.

COMMENTS: The holotype is a very conical form with four rounded chambers in the final whorl. The high spire has a quite prominent ornamentation, with raised sutures. The proloculus and early chambers are hidden by the ornamentation. The chambers in the last whorl are quite different, appearing rounded with depressed sutures. In Fuchs' illustration (1967, pl. 7, fig. 3) the middle illustration shows the raised sutures indicated by a dotted line but these are much more prominent in the specimen.

Praegubkinella turgescens Fuchs, 1967

Pl. 5 , Fig. 2a-c.

Praegubkinella turgescens Fuchs, 1967, pp. 158, 159, pl.6, figs 4, 5, 8; pl. 7, figs 1, 2.

DERIVATION OF NAME: Turgescens (Lat.) = swelling-up, because of the distinctly inflated chambers, arranged in a raised-up spiral.

HOLOTYPE: Fuchs, 1967, pl. 7, fig 2.

DEPOSITORY: Geologische Bundesanstalt, Vienna, Inv. No. 0319.

TYPE LOCALITY: Xanten, Salzburg.

TYPE STRATUM: Upper Triassic, Upper Rhaetian.

DIAGNOSIS: A species of the genus *Praegubkinella* with the following distinctive features: umbilicus narrow, but still distinct; by the open slit-shaped apertures of the older chambers that are quite prominent.

TRANSLATION OF ORIGINAL DESCRIPTION: Test very small, the circular outline only slightly indented at the suture joins. Dorsally a raised-up spiral, containing somewhat more than two whorls, ventrally only the last four to five particularly bulbous chambers can be made out. Umbilical side concave and umbilicate. Round periphery. The chambers, moderately increasing in volume, are separated by somewhat inclined to the rear and only slightly deepened sutures. Umbilicus narrow, however still open and divided by the slit-shaped apertures of the surrounding chambers. The aperture itself is a short, inconspicuous slit at the base of the last chamber. Test hyaline and smooth. Common.

DIMENSIONS OF THE HOLOTYPE: Maximum diameter 0.20 mm, height 0.20 mm.

RELATIONSHIPS: Distinguishable from their probable ancestral form *Oberhauserella alta* through the higher spire, the more strongly inflated chambers (which also includes those of the older whorls) and the narrower umbilicus.

REMARKS: Fuchs reported that the tests of these forms are no longer uncrystallised. The "ornamentation" of the initial sections of the spire in some specimens proved to be a special state of preservation. In these cases the thin chamber walls are apparently worn away, while the thicker, and more rigid, septa have put up greater resistance to the wearing away.

In some shells the spherical proloculus is large, while in the majority of forms it is small, which perhaps suggests the presence of both generations.

COMMENTS: The holotype (Fuchs, 1967, pl. 7, fig. 2) shows that all the chambers are inflated, although the sutures do not all appear to be depressed (especially in apical view). The holotype has, unfortunately, been coated in gold for S.E.M. analysis. It is a conical form with a depressed apertural face, although the aperture is not visible. It has to be assumed that it sits in the depressed area. Another slide in the collections marked [6/8 47] contains a specimen that is very rounded in appearance and high spired. Another specimen in slide [6/4 44] is also gold-coated but is lower in terms of spire height. The chambers are rounded and with depressed sutures the specimen is approaching the appearance of a low-spired *Oberhauserella*. Slide [6/5 45] appeared to be empty. The specimen in slide [7/1 46] is very rounded, inflated with the sutures in the early whorls not depressed, although the chambers are clearly visible. The outline looks like that illustrated by Fuchs as (1967, pl. 6, fig. 5) and which shows there are probably three whorls present.

P. kryptumbilicata appears to be a high-spired ornamented form with *P. turgescens* being of similar proportions but lacking the strong ornamentation. *P. turgescens* includes a range of forms with variable spire height, probably merging with *O. alta*, which itself is transitional to *O. quadrilobata*. This range of morphotypes may well have led Loeblich and Tappan (1987) to place *Praegubkinella* in synonymy with *Oberhauserella*. *P. kryptumbilicata* is recorded as present in the uppermost Rhaetian, probably derived from *P. turgescens*. Professor A. von Hillebrand (pers. comm. to Professor Hart) has indicated the presence of transitional forms with *P. turgescens*, although P. *kryptumbilicata* is always less common. Records of *Praegubkinella* in Jurassic strata all appear to be the form identified as *P. turgescens* (Wernli, 1995).

DERIVATION OF NAME: Dedicated to Senior Teacher Dr. M. Schlager (Salzburg) in gratitude.

GENOTYPE: *S. angustiumbilicata* Fuchs, 1967.

GENUS DIAGNOSIS: Test free, mostly low trochospiral, umbilical side slightly concave to slightly convex, rounded periphery. On the spiral side all chambers of the two whorls are seen, while ventrally only those of the last whorl are visible. The slightly depressed sutures only divide the circumference a little. Umbilicus very narrow, slit-shaped, partially cut off or already closed and separated by the open, slit-shaped, apertures. Chambers somewhat distended. Aperture a slit starting at the umbilicus, rarely separated by the complete closing of the umbilicus and lying in a distinct indentation. Shell hyaline and smooth.

RELATIONSHIPS: The present genus could very well have evolved from *Oberhauserella norica* through the gradual narrowing down and eventual complete closure of the umbilicus.

REMARKS: The most highly developed link in this lineage appears in the aperture-to-umbilicus ratio, which is highly reminiscent of that in the case of *Epistomininae* Wedekind, 1937, which are recorded in the Jurassic.

RANGE: Only found in the Rhaetian.

Schlagerina angustiumbilicata Fuchs, 1967

Pl. 6, Figs 1a-c, 2a-c.

Schlagerina angustiumbilicata Fuchs, 1967, p. 155, pl. 3, figs 9, 10; pl. 6, fig. 3.

DERIVATION OF NAME: Angustus (Lat.) = narrow, umbilicatus (Lat.) = umbilicate.

HOLOTYPE: Fuchs, 1967, pl. 3, fig. 9.

DEPOSITORY: Geologische Bundesanstalt, Vienna, Inv. No. 0315.

TYPE LOCALITY: Plackles, Höhe Wand, Lower Austria.

TYPE STRATUM: Upper Triassic, Rhaetian.

DIAGNOSIS: The type-species of the genus *Schlagerina* with the following distinctive features: through the development at the end of each chamber of a slit-like constricted, but still open umbilicus, with a distinct slit-shaped aperture emerging from it.

TRANSLATION OF ORIGINAL DESCRIPTION: Test very small with an almost circular outline, lobate at the suture intersections. Dorsally, weakly domed, with approximately two whorls each containing from four to six moderately increasing chambers, that are ventrally somewhat bulbously distended. Umbilical side concave and with umbilicus. Rounded test margin. The slightly backward inclined sutures in the initial section hardly visible, otherwise rather distinct and slightly depressed. The umbilicus owing to step by step penetration of the chamber ends very narrow and irregularly formed, however still entirely or at least partially open. The distinct slit-shaped aperture, beginning in the umbilicus, lies in a conspicuous depression. Indications of the apertures of the older chambers also still exist. Shell hyaline and smooth. Rare.

DIMENSIONS OF THE HOLOTYPE: Maximum diameter 0.20 mm, height 0.05 mm.

RELATIONSHIPS: This form appears to be derived morphologically from *Oberhauserella norica*.

OCCURRENCE: Besides the Plackles type-locality it is also known from the Upper Rhaetian locality at Xanten.

REMARKS: This species shows a distinct increase in the number of chambers with higher spire development in forms of a younger stratigraphical age. This may be interesting for future stratigraphical resolution.

COMMENTS: All the slides in the collection are marked as coming from Plackles, Rhaetian. The slide containing the holotype (No. 0315) contains a specimen in at least two fragments. The broken edges appear granular and recrystallised. The chambers are rounded and the sutures depressed. The final chamber appears to have been quite large, possibly more inflated than indicated in Fuchs (1967, pl. 3, fig. 9). Slide [3/90 37] contains a more normal specimen with rounded chambers, all of which are inflated. The trochospire is clearly visible with four to five chambers in the final whorl. The earlier whorls on the spiral side are "glassy" calcite and it is quite difficult to count the number of chambers.

The specimen in slide [6/3 38] has been gold-coated. The sutures in this specimen are quite depressed as indicated in Fuchs (1967, pl. 3, figs 9, 10).

Schlagerina altispira Fuchs, 1967

Pl 6 , Fig. 3a-c.

Schlagerina altispira Fuchs, 1967, p. 156, pl. 4, fig. 1.

DERIVATION OF NAME: Altus (Lat.) = high.

HOLOTYPE: Fuchs, 1967, pl. 4, fig 1.

DEPOSITORY: Geologische Bundesanstalt, Vienna, Inv. No. 0316.

TYPE LOCALITY: Plackles, Höhe Wand, Lower Austria.

TYPE STRATUM: Upper Triassic, Rhaetian.

DIAGNOSIS: A species of the genus *Schlagerina* with the following distinctive features: approximately two whorls in the pronounced trochospiral; the chambers are dorsally somewhat inflated; umbilicus to a large extent narrow, still open, but already reduced by the slit-shaped apertures.

TRANSLATION OF ORIGINAL DESCRIPTION: Test very small, roundish perimeter, slightly lobate. Dorsally the conspicuously raised spire consists of approximately two whorls, the number of chambers in the initial part not clear but at least four. On the ventral side of the last whorl four chambers can also be counted; umbilical side concave and umbilicate. Rounded test margin. The noticeably increasing chambers dorsally and ventrally bulbous. Sutures only visible if the specimen is placed in water or immersed in oil, inclined to the back and not depressed. The umbilicus through the projection of the chamber ends already markedly narrowed down, in the area of the older chambers, seen from the ventral side, isolated but still open slit-shaped apertures are present. From this bulged umbilicus in the end chamber a elongated, slender slit-shaped aperture comes off, resting in a conspicuous depression. Shell hyaline and smooth. Very rare.

DIMENSIONS OF THE HOLOTYPE: Maximum diameter 0.20 mm, height 0.15 mm.

RELATIONSHIPS: The high spire and the more advanced reduction of the umbilicus are the characteristic features of this species when compared with *S. angustiumbilicata.*

COMMENTS: The holotype (No. 0316) from the Rhätian at Plackles has been gold-coated. It has a medium to high spire but not as its specific name implies. The pattern on the apertural face is difficult to reconcile with the illustration in Fuchs (1967, pl. 4, fig. 1).

Schlagerina orbis Fuchs, 1970

Pl. 6 , Fig. 4a-c.

Schlagerina orbis Fuchs, 1970, p. 114, pl. 9, fig. 9.

DERIVATION OF NAME: Orbis (Lat.) = disc

HOLOTYPE: Fuchs, 1970, pl. 9, fig. 9.

DEPOSITORY: Geologische Bundesanstalt, Vienna, Inv. No. 0343. (1970/3/132)

TYPE LOCALITY: Hernstein, Lower Austria.

TYPE STRATUM: Lower Jurassic, Lias alpha, Fleckenmergel. Lower Liassic, α_3.

DIAGNOSIS: A species of the genus *Schlagerina* Fuchs, 1967, with the following distinctive features: umbilicus still open owing to two narrow slits, into which the apertures of the last chambers are seen to open. The aperture of the final chamber already completely independently in marginally situated hollow.

TRANSLATION OF ORIGINAL DESCRIPTION: Test small, with circular margin, hardly indented at the suture joins. Dorsal side slightly curved, ventral side nearly flat. The spire is constructed of approximately two whorls, of which the second contains approximately eight chambers. Distinct increase in chamber size. Rounded periphery.

Sutures dorsally are identified with difficulty, on the ventral side clearly defined, not depressed and inclined backwards. Umbilicus open only owing to two narrow fissures, in which the apertures of the older chambers are embedded. The aperture of the final chamber is situated in a long, hollow parallel to the margin, isolated from the umbilical region. Shell smooth. Very rare.

DIMENSIONS OF THE HOLOTYPE: Maximum diameter 0.30 mm, height 0.10 mm.

RELATIONSHIPS: Fuchs (1970) derived this species from the upper Triassic form *Schlagerina subcircularis* Fuchs, 1967.

COMMENTS: On the apertural face the sutures are curved backwards as indicated in the drawing of Fuchs (1970, pl. 9, fig, 9, right). The broken last chamber is also shown in the drawing. The other side of the specimen appears to have an overgrowth of calcite on the surface.

Schlagerina scissumbilicata Fuchs, 1967

Pl. 7 , Fig. 1a-c.

Schlagerina scissumbilicata Fuchs, 1967, p. 157, pl. 4, fig. 2.

DERIVATION OF NAME: Scissus (Lat.) = split, umbilicatus (Lat.) = umbilicate.

HOLOTYPE: Fuchs, 1967, pl. 4, fig. 2.

DEPOSITORY: Geologische Bundesanstalt, Vienna, Inv. No. 0318.

TYPE LOCALITY: Plackles, Höhe Wand, Lower Austria.

TYPE STRATUM: Upper Triassic, Rhaetian.

DIAGNOSIS: A species of the genus *Schlagerina* with the following distinctive features: the closed, slightly convex surface of the former umbilicus is only in the older parts interrupted by close to the sutures, in the younger sections by slit-shaped apertures directed towards the periphery.

TRANSLATION OF ORIGINAL DESCRIPTION: Test very small, perimeter a broad-oval, a little inflated. On both sides slightly convex. The dorsal low spire displays roughly four to five chambers in the first whorl, while in the second whorl, looked at from the ventral side, six chambers that are rapidly increasing and only a little inflated. Test margin rounded. Sutures indistinct, inclined backwards and not depressed. Umbilicus closed due to the advance of the ends of the chambers, only isolated by the short slit-shaped apertures which in the older part run roughly parallel to the sutures and which are still open. The deep depression in *S. subcircularis* extending out from the aperture as far as the chamber wall is here in the two youngest chambers already the aperture, but likewise detached from every link to the original umbilicus. Test hyaline and smooth. Very rare.

DIMENSIONS OF THE HOLOTYPE: Maximum diameter 0.25 mm, height 0.10 mm.

RELATIONSHIPS: The completely closed umbilicus and the peculiar arrangement of the open slit-shaped apertures separate this species from *S. subcircularis.*

REMARKS: The architecture of the umbilicus and aperture points perhaps in the direction of representatives of the *Epistomininae* Wedekind, 1937, which definitely appears only in the Jurassic.

COMMENTS: The holotype (No. 0318) from the Rhätian at Plackles has a more rounded outline than the type figure and also appears to have a higher spire.

All the species of *Schlagerina* appear to be variable in terms of spire height, although all appear to have a rounded outline and inflated chambers. All of the species in the collection are quite close to the definition of *Oberhauserella.*

Schlagerina subcircularis Fuchs, 1967

Pl. 7, Fig. 2a-c.

Schlagerina subcircularis Fuchs, 1967, pp. 156, 157, pl. 4, fig. 4; pl. 5, fig. 4.

DERIVATION OF NAME: Because of the almost circular outline.

HOLOTYPE: Fuchs, 1967, pl. 4, fig. 4.

DEPOSITORY: Geologische Bundesanstalt, Vienna, Inv. No. 0317.

TYPE LOCALITY: Plackles, Höhe Wand, Lower Austria.

TYPE STRATUM: Upper Triassic, Rhaetian.

DIAGNOSIS: A species of the genus *Schlagerina* with the following distinctive features: conspicuous increase in the number of chambers in the second whorl; curved slit-shaped umbilicus already with partially isolated apertural slits.

TRANSLATION OF ORIGINAL DESCRIPTION: Test very small to small, nearly circular and with only a slightly indented perimeter. Dorsal side a little to somewhat curved, the umbilicate ventral side a little concave to nearly flat. The spire contains approximately five chambers in the first whorl, in the second up to seven with a marked increase in size, ventrally slightly inflated. Periphery round. Sutures indistinct, inclined backwards and not deepened. Umbilicus extensively restricted due to the advance of the chamber ends, so that the older slit-shaped apertures are already isolated. Aperture a short conspicuous fissure starting at the umbilicus, which extends in a deep depression far up the chamber wall. In the umbilicus, the small bulges of the apertures of the older chambers are always apparent. Test hyaline and smooth. Very rare.

DIMENSIONS OF THE HOLOTYPE: Maximum diameter 0.25 mm, height 0.10 mm.

RELATIONSHIPS: Different from the so far described species of this genus by the number of chambers in the final whorl and the peculiar umbilical arrangement.

OCCURRENCE: Besides the Plackles type-locality it has also been detected in the Rhaetian marls of the Hinterer Gosausee locality.

COMMENTS: The holotype (No. 0317), from the Rhaetian at Plackles, has an outline very like that shown in Fuchs (1967, pl. 4, fig. 4). The margins are only slightly indented and the specimen appears slightly more domed than in the figures. The sutures are only faintly depressed and it is difficult to judge if more than two whorls are present. A specimen in slide [5/4 41] has three to four chambers in the final whorl and has a higher spire than indicated in the figures. Again, only two whorls appear to be present and the outline of the specimen is quite circular, as the name implies. There is a very flat apertural face and the sutures are barely visible, possibly as a result of re-crystallisation.

Genus *SCHMIDITA* Fuchs, 1967

DERIVATION OF NAME: Dedicated to Dr M.E. Schmid (Geol. B.-A., Vienna) with thanks.

TYPE SPECIES: *Schmidita hedbergelloides* Fuchs, 1967.

GENUS DIAGNOSIS: Test free, a little to slightly trochospiral, ventral side more or less rounded, distinctively deep umbilicus. Test margin round. On the spiral side all the chambers of the two whorls are recognisable, while on the ventral side only those of the last whorl are visible. Sutures slightly depressed, the perimeter of the test slightly lobate. The splitting up of the sutures of the chambers towards the umbilicus can only still be noticed amongst the primitive forms, otherwise the observable, minor "denticulation" of the chamber ends can be put down to the apertures of the older chambers still partially lying open. The chambers of the final whorl ventral and also dorsal markedly inflated. The aperture is a more or less conspicuously developed, long, semi-circular slit extending from the middle of the base to less high in the ventral wall of the final chamber. Test hyaline and smooth.

RELATIONSHIPS: Purely based on external characteristics, the possibility emerges that *Schmidita* can be regarded as the natural development from the architecture of *Kollmannita multiloculata.* However, an analysis of the exact shell composition and the internal structure of more specimens of these such baffling *Hedbergella*-like foraminiferal tests will confirm these relationships.

RANGE: So far detected from the Lower Carnian into the Rhaetian.

Schmidita hedbergelloides Fuchs, 1967

Pl. 7 , Figs. 3a-c.

Schmidita hedbergelloides Fuchs, 1967, pp. 147, 148, pl. 3, fig. 4; pl. 4, fig. 3

DERIVATION OF NAME: Because of the great resemblance to *Hedbergella.*

HOLOTYPE: Fuchs, 1967, pl. 4, fig 3.

DEPOSITORY: Geologische Bundesanstalt, Vienna, Inv. No. 0307.

TYPE LOCALITY: Plackles, Höhe Wand, Lower Austria.

TYPE STRATUM: Upper Triassic, Rhaetian.

DIAGNOSIS: The type-species of the genus *Schmidita* with the following distinctive features: distinctive inflated chambers; narrow, deepened umbilicus; aperture a very short slit situated approximately in the middle of the chamber base.

TRANSLATION OF ORIGINAL DESCRIPTION: Test very small, outline almost circular, conspicuously indented at the suture joins. The older part of the spire barely standing out. Dorsal side slightly convex, ventral concave with narrow, open umbilicus. Rounded periphery. On the umbilical side seven chambers are visible, from the other side in the first whorl again roughly seven. Sutures more or less distinct, somewhat inclined backwards and barely depressed. Umbilicus narrow, open, without chamber projections, the dimple at half the chamber-length however still detectable, only the remaining relict apertures of the older chambers divide its outline a little. The inflated chambers increase in size uniformly and without haste. From the middle of the chamber base extends a very short semicircular bordering slit-shaped aperture, not depressed. Test hyaline and smooth. Very rare.

DIMENSIONS OF THE HOLOTYPE: Maximum diameter 0.20 mm, height 0.05 mm.

OCCURRENCE: Apart from that of the type-location Plackles, a rather poor-quality, crumpled specimen with perhaps an even narrower umbilicus turned up in the sieved residue of the Upper Norian site of Rossmoos Upper Austria, but which is included in this species owing to the limited material.

REMARKS: Fuchs thought that the appearance of forms, that anticipate the structure of *Hedbergella*, in broad outline, already in the Upper Triassic, deserved special interest. How wide the family connection extends, or can be verified, the future will show.

COMMENTS: The holotype (No. 0307 [4/3 15], from the Rhaetian of Plackles has an apertural view that has been gold-coated. The end of the last chamber is broken and this shows that the specimen is probably re-crystallised. There are six to seven chambers in the final whorl on the umbilical side. The umbilicus appears to be complicated but no details are visible. The simple chamber appearance shown by Fuchs (1967, pl. 4, fig. 3, left) is not evident.

The chambers are inflated, giving a quite "robust" appearance, rather than the quite thin drawing indicated in Fuchs (1967, pl. 4, fig. 3, middle). The spiral side is also gold-coated and, although the early whorls are indistinct, the chambers look as illustrated by Fuchs (1967, pl. 4, fig. 3, right).

A slide marked [3/4 14] appears to have no specimen present. This was reportedly from the Upper Norian of Rossmoos, and may have been the specimen noted by Fuchs.

Schmidita inflata Fuchs, 1967

Pl. 7, Fig. 4a-d.

Schmidita inflata Fuchs, 1967, p. 147, pl. 3, fig. 1.

DERIVATION OF NAME: Inflatus (Lat.) = inflated.

HOLOTYPE: Fuchs, 1967, pl. 3, fig. 1.

DEPOSITORY: Geologische Bundesanstalt, Vienna, Inv. No. 0306.

TYPE LOCALITY: Eisenkappel, Kärnten.

TYPE STRATUM: Upper Triassic, Lower Carnian, lower Julian, Raibl strata.

DIAGNOSIS: A species of the genus *Schmidita* with the following distinctive features: slightly inflated chambers in the final whorl, distinctly depressed narrow umbilicus with traces of overlapping of the chamber ends, a slit-shaped aperture.

TRANSLATION OF ORIGINAL DESCRIPTION: Test very small, with an approximately circular outline, noticeably indented at the position of the sutures. The older parts of the spire on the dorsal side are virtually embedded in the younger chambers. Ventral side concave with distinct, narrow umbilicus. Shell margin rounded. On the ventral side, eight chambers can be counted, the first whorl still contains seven, although these are only identified after immersion in water. Sutures roughly radial, barely depressed. The chamber ends in this species extend only a little into the umbilicus, the division of the chamber septa is visible only below the dimple here described. Rather, it is the remains of the apertures of preceding chambers that are responsible for the denticulate appearance of the umbilicus. Chamber-growth gradual and uniform, the younger chambers are conspicuously inflated on both sides. A slit-shaped aperture extends from the middle of the chamber base less high up the ventral wall, no pronounced indentation is found in the aperture space. Test hyaline and smooth. Very rare.

DIMENSIONS OF THE HOLOTYPE: Maximum diameter 0.20 mm, height 0.05 mm.

RELATIONSHIPS: Fuchs thought it easy to separate from its probable ancestral form, *Kollmannita multiloculata*, based on the more distinctly distended chambers, the simplification of the aperture and the less deep denticulation of the umbilicus.

OGRODZIENIEC

The following taxa were described by Fuchs (1973), following examination of samples collected near Ogrodzieniec in Poland. It is not clear as to whether Dr M.E. Schmid (Geological Survey of Austria, Vienna) was asked by Fuchs to collect specific horizons (e.g. the Morissi Zone clays from which "*Globigerina*" *bathoniana* Pazdrowa, 1969, was first described) or just collect what was part of the Colloquium itinerary. The area near Ogrodzieiec contains a range of important Jurassic sections, including the massive limestones of the Upper Oxfordian (Fig. 2.12). As part of the Field Excursion associated with the 7th International Congress on the Jurassic System (Wierzbowski *et al.*, 2006), the important Bathonian-Oxfordian succession in Ogrodzieniec Quarry (Fig. 2.11) was re-opened. In the upper part of the Ogrodzieniec Glauconitic Marls Formation (uppermost Callovian) are two distinct glauconitic horizons. These are, almost certainly, the horizons

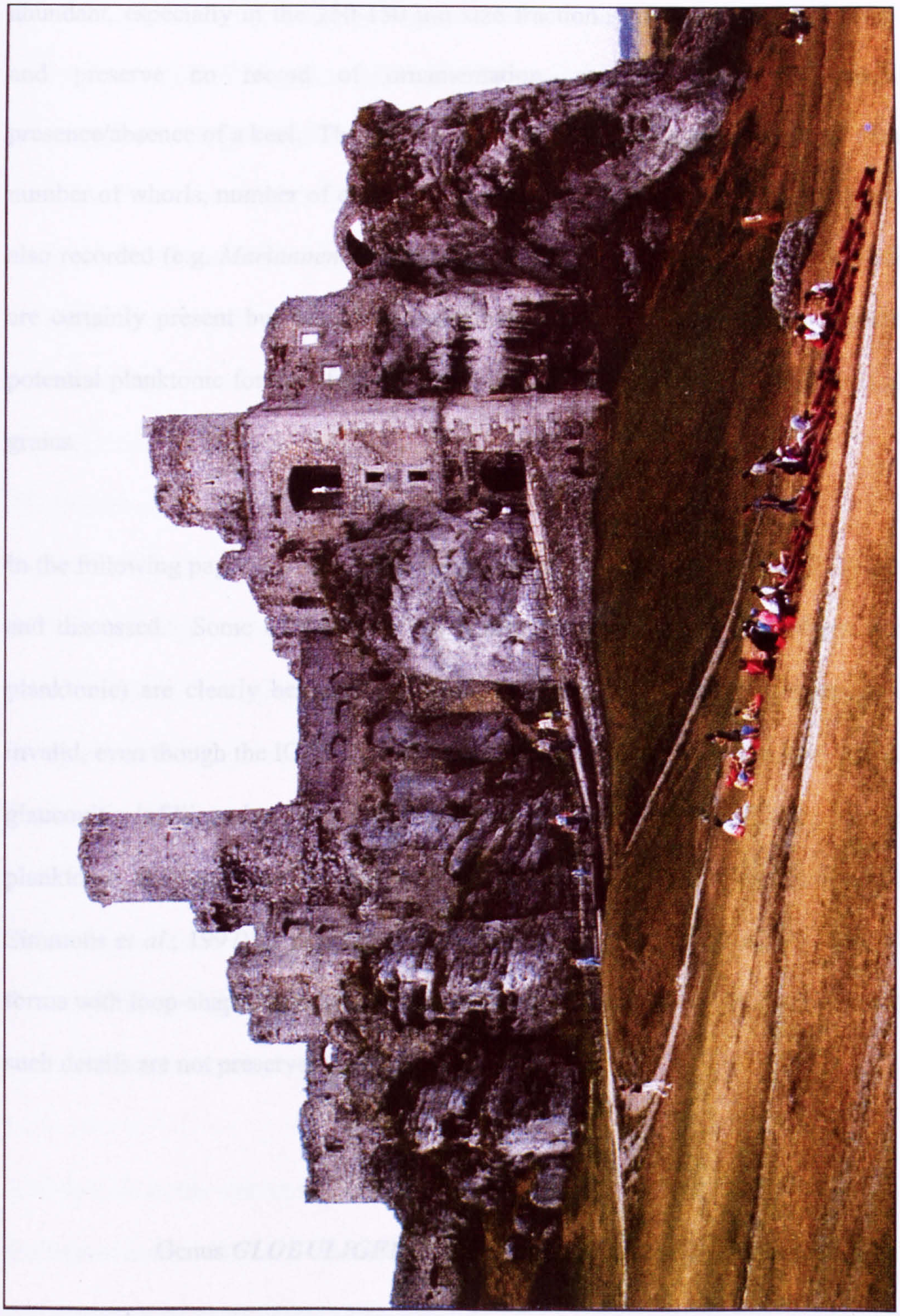


Figure 2.12. Upper Oxfordian massive limestones at Podzamcze, on which are perched the ruins of Ogrodzieniec Castle (Matyja and Wierzbowski, 2006).

collected by Schmid and used by Fuchs in his 1973 paper. Residues from these beds contain, especially Bed 18, an abundant fauna of foraminifera, all of which is preserved as glauconite infillings (glauconitkerne of Fuchs). Planktonic foraminifera are extremely abundant, especially in the 250-150 µm size fraction. All specimens lack shell material and preserve no record of ornamentation, aperture (type and location) and presence/absence of a keel. The spiral sides of almost all specimens preserve details of the number of whorls, number of chambers and spire height. A number of benthonic taxa are also recorded (e.g. *Mariannenina*), some of which are probably epistominids. Other taxa are certainly present but cannot be identified. There are also abundant "specimens" of potential planktonic foraminifera that may, in fact, be no more than clusters of glauconite grains.

In the following pages, the new genera and species identified by Fuchs (1973) are reported and discussed. Some of the "new" taxa may be planktonic, while others (reported as planktonic) are clearly benthonic. Most, if not all, of the new genera/species may be invalid, even though the ICZN rules do allow moulds to be type specimens. Many of these glauconitic infillings have been identified and illustrated (Pls 8, 9, 10). In none of the planktonic foraminifera can an aperture be seen and the identification (following Simmons *et al.*, 1997) to genus is impossible. Fuchs (1973, pl. 2, figs 4, 6) did illustrate forms with loop-shaped apertures indicated but the illustrations in Plates 8 and 9 show that such details are not preserved.

Genus ***GLOBULIGERINA*** Bignot and Guyader, 1971, emend

GENOTYPE: *Globuligerina frequens* Fuchs, 1973.

GENUS DIAGNOSIS: Test free, dorsally trochospiral, ventrally more or less concave, with or without umbilicus. Round, lobate periphery. On the dorsal side all chambers visible, arranged in two to three whorls; on the ventral side only the last four chambers are observed. Sutures at the beginning hardly depressed and difficult to see, later however distinct and depressed, dorsally always slightly inclined backwards, ventrally straight-radial. Initial whorl low, inconspicuous, then sudden enlargement of the chambers, with almost globular shape. Aperture, according to Bignot and Guyader, 1971, *Virgulina*-like with small lip, according to the interpretation of Fuchs an arch (see Fuchs, 1969) or at least relics of it could be hidden in it. Shell surface, according to scanning photographs by the two French researchers, covered with very small pustules, numerous fine pores lying between them.

RELATIONSHIPS: Morphologically, Fuchs related this genus to the Triassic "Globigerines" with upper Rhaetian representatives of the form *Oberhauserella norica* Fuchs, 1967.

REMARKS: Bignot and Guyader (in 1971) placed their finds from the Oxfordian of North West France in the new sub-genus *Globuligerina* of the genus *Globigerina* Orbigny. At the species level they traced *Globigerina* back to *G. oxfordiana* Grigelis. Fuchs, however, indicated that the Jurassic "Globigerines" show no link to the Tertiary genus *Globigerina* and that the species *"Globigerina" oxfordiana* Grigelis on the generic level has to be defined in a totally different way. The form portrayed by the two French authors is, therefore, a new species of the sub-genus *Globuligerina,* which is raised to genus by Fuchs. Its appearance is restricted to the Jurassic.

It is clear from the comments of Fuchs that he thought that Bignot and Guyader (1971), in the emendation of their new genus, had moved away from what Grigelis (1958) intended in his definition of Globigerina oxfordiana, which was the type species of their new genus. This is why he created *Globuligerina frequens*, including within its synonymy all references to *Globigerina oxfordiana* by Bignot and Guyader.

RANGE: Proven so far from the French Oxfordian and the Polish Upper Callovian to Lower Oxfordian.

At this time (1973), Fuchs seems to be unaware of the many references to Callovian/Oxfordian planktonic foraminifera in the earlier literature. It is difficult to understand why he had not looked at some of this literature (see Chapter 9).

Globuligerina frequens Fuchs, 1973

Globuligerina frequens Fuchs, 1973, pp. 465, 466, pl. 2, fig. 6: pl. 5, fig. 2.

1966 *Globigerina oxfordiana* Grigelis – Bignot and Guyader, p. 105, pl. 1, figs 3-10.

1971 *Globigerina (Globuligerina) oxfordiana* Grigelis – Bignot and Guyader, p. 80, pl. 1, figs 1-4; pl. 2, figs 3, 4.

DERIVATION OF NAME: Frequens (Lat.) = frequent.

HOLOTYPE: Fuchs, 1973, pl. 5, fig. 2.

DEPOSITORY: Geologische Bundesanstalt, Vienna, Inv.-No. 0411.

TYPE LOCALITY: Wiek Limestone Quarry near Ogrodzieniec, Poland.

TYPE STRATUM: Stratum 26, Lower Oxfordian, Malm.

DIAGNOSIS: The type-species of the genus *Globuligerina* Bignot & Guyader, 1971, with the following distinctive features: moderately trochospiral, relatively strong test.

TRANSLATION OF ORIGINAL DESCRIPTION: Test small with round, strongly lobate periphery. Dorsal side moderately raised-up trochospirally, all chambers of the two to three whorls are seen. Ventral side slightly concave, composed of the four final chambers, without umbilicus. Septa in the inconspicuous initial whorl determinable with difficulty, later clear and lying in depressions, dorsally somewhat bent backwards, ventrally radial. Chambers of the final whorl globular, distended and distinctly larger than the preceding ones. Apertural region *Virgulina*-like, according to the French authors (however Fuchs believed, that behind it hides an arch or yet at least remains of it), terminated by narrow lip.

Shell surface pustulose, fine pores lying in between. Very frequent.

DIMENSIONS OF THE HOLOTYPE: Maximum diameter 0.25 mm, Height 0.20 mm.

RELATIONSHIPS: Fuchs indicated that the wide and large umbilicus and the broad crescent-shaped high aperture separate this species from *Globigerina oxfordiana* Grigelis. He regarded this species as different from the new species *Globuligerina parva and G. umbilicata*, due do the relatively coarse test and the lack of an umbilicus, respectively.

OCCURRENCE: Apart from the Oxfordian of North-West France, frequent in the Upper Callovian and very frequent in the Lower Oxfordian of Poland. Fuchs' view that this species occurs frequently in the samples from Ogrodzieniec is certainly true. Globuligerinids (or conoglobigerinids) are certainly abundant in the glauconitic marls but all are glauconitic infillings.

COMMENTS: The holotype (No. 0411, Slide 19) from Schichte (Bed) 26 of the Lower Oxfordian is preserved as a mineral infilling. It is a high spired form but, because of the preservation, there is no aperture visible: certainly not as indicated by Fuchs (1973, pl. 5, fig. 2, left). The apertural view shows the typical four-chambered appearance with no sign of an aperture.

The specimen in Slide 18 (?) from Schichte (Bed) 21 of the Upper Callovian at Wiek seems to be that illustrated by Fuchs (1973, pl. 5, fig. 2, left) as there is a distinctive groove up the face of the last chamber. This is thought to be a result of the preservation and, therefore, of no taxonomic significance.

Globuligerina parva Fuchs, 1973

Globuligerina parva Fuchs, 1973, p. 466, pl. 4, fig. 6.

DERIVATION OF NAME: Parvus (Lat.) = small.

HOLOTYPE: Fuchs, 1973, pl. 4, fig. 6.

DEPOSITORY: Geologische Bundesanstalt, Vienna, Inv. No. 0412.

TYPE LOCALITY: Wiek Limestone Quarry near Ogrodzieniec, Poland.

TYPE STRATUM: Stratum 26, lower Oxfordian, Malm.

DIAGNOSIS: A species of the genus *Globuligerina* Bignot & Guyader, 1971, with the following distinctive features: small, very fragile and flat trochospiral test.

TRANSLATION OF ORIGINAL DESCRIPTION: Test small, outline round and distinctly lobate. Dorsal side very low trochospirally coiled in approximately two and a half whorls. Ventral side a little concave, showing four chambers, without umbilicus. Septa initially faint, later distinctly visible and depressed. Chambers at first very small and gradually increasing, in the final whorl becoming rapidly larger and spherical. "*Virgulina*"–like aperture (see above remarks in the Genus Diagnosis). Common.

DIMENSIONS OF THE HOLOTYPE: Maximum diameter 0.25 mm, height 0.15 mm.

RELATIONSHIPS: The fragile small test distinguishes this species from *G. frequens* Fuchs, 1973, the lack of an umbilicus from *G. umbilicata* Fuchs,1973.

OCCURRENCE: Frequently found in the Upper Callovian and Lower Oxfordian of the Polish type-locality.

COMMENTS: The holotype (No. 0412, Slide 20) from Schichte (Bed) 26 of the Lower Oxfordian is preserved as a mineral infilling. It is broken but may have looked like Fuchs' illustration. In the samples from Ogrodzieniec, there are many examples of small forms, many of which are probably juveniles. The illustration of Fuchs (1973, pl. 4, fig. 6 lower) is shown to have almost an extra-umbilical apertural position. Specimens similar to this have been illustrated in Plate 9, Figures 9-11 and ascribed to *Haeuslerina helvetojurassica.*

Globuligerina umbilicata Fuchs, 1973

Globuligerina umbilicata Fuchs, 1973, pp. 466, 467, pl. 2, fig. 4.

DERIVATION OF NAME: Umbilicatus (Lat.) = umbilicate.

HOLOTYPE: Fuchs, 1973, pl. 2, fig. 4.

DEPOSITORY: Geologische Bundesanstalt, Vienna, Inv. No. 0413.

TYPE LOCALITY: Wiek Limestone Quarry near Ogrodzieniec, Poland.

TYPE STRATUM: Stratum 21, Upper Callovian, Dogger.

DIAGNOSIS: A species of the genus *Globuligerina* Bignot & Guyader, 1971, with the following distinctive features: fragile test with small umbilicus.

TRANSLATION OF ORIGINAL DESCRIPTION: Test small. Periphery round and drawn into constrictions at the suture junctions. On the dorsal side low trochospiral, roughly two and a half whorls. Ventral side slightly concave, the four final globular chambers surround a small open umbilicus. On the spiral side, the sutures are determinable with difficulty in the inconspicuous juvenile stage, but then distinct and depressed, on the ventral side radial. Initially, the chambers become only gradually larger, but in the end their volume increases quite considerably. As to the "*Virgulina*"-like aperture, Fuchs refers once again to his generic diagnosis. Rare.

DIMENSIONS OF THE HOLOTYPE: Maximum diameter 0.25 mm, height 0.15 mm.

RELATIONSHIPS: Fuchs noted that this umbilicate species of the genus *Globuligerina* particularly impressively showed the morphological descent from the forms of *Oberhauserella norica* Fuchs, 1967, found in the Upper Rhaetian locality of Xanten in Salzburg. The coarse test distinguishes it from *Globuligerina frequens* and the lack of the umbilicus from *G. parva*.

OCCURRENCE: Only recorded in the Upper Callovian of the Polish type-locality.

COMMENTS: The holotype (No. 0413, Slide 21) from Schichte (Bed) 21, of the Upper Callovian of Wiek is comparable to the form illustrated by Fuchs (1973, pl. 2, fig. 4, right) in umbilical view. The final chamber is quite extended. The preservation as a mineral infilling of the chambers makes it impossible to see any features of the aperture. There is a moderate spire with two whorls visible.

Genus *POLSKANELLA* Fuchs, 1973

DERIVATION OF NAME: In honour of the host-country of the Tenth European Micro-Colloquium, Poland (= Polska).

GENUS TYPE SPECIES: *Globigerina oxfordiana* Grigelis, 1958

GENUS DIAGNOSIS: Test free, moderate to high trochospiral, ventral side concave and distinctly umbilicate. Perimeter round and lobate. On the dorsal side all chambers are visible, arranged mostly in two and a half to three whorls. Initial whorl flat, the following chambers globular. On the ventral side there are four chambers around large and deep umbilicus. Septa at the start less pronounced, not depressed, in later test stages, however, distinctly depressed, on the dorsal side slightly curved, ventrally straight. Aperture a large, semicircular, interiomarginal umbilical arch, according to Grigelis provided with slender lip.

RELATIONSHIPS: Fuchs suggested that *Polskanella* arises morphologically from the Upper Rhaetian Triassic "Globigerine" genus *Praegubkinella* Fuchs, 1967, and evolves by distension of the chambers of the juvenile test section in the Cretaceous to *Iuliusina* Fuchs, 1971. This genus is no longer used but, when first described, was restricted to the Barrêmian. The umbilicus, described as narrow to not existing at all, and the lower, less conspicuous aperture were the differentiating characteristics from *Conoglobigerina* Morozova, 1961. A distinctly developed tegillum distinguishes *Tectoglobigerina.* The *Virgulina*-like aperture looks, in many cases, to be the remains of an arch, which separates this form from *Globuligerina* Bignot and Guyader, 1971. In none of the specimens from Ogrodzieniec can the form of the aperture be identified. Many have a quite large, open, umbilicus in which an arch (*Conoglobigerina*) or a loop-shaped aperture (*Globuligerina*) could be accommodated without difficulty.

RANGE: So far reported from the Upper Callovian to Lower Oxfordian.

Polskanella altispira Fuchs, 1973

Polskanella altispira Fuchs, 1973, p. 457, pl. 2, fig. 5.

DERIVATION OF NAME: Named on account of the high spire.

HOLOTYPE: Fuchs, 1973, pl. 2, fig. 5.

DEPOSITORY: Geologische Bundesanstalt, Vienna, Inv. No. 0404.

TYPE LOCALITY: Wiek Limestone Quarry near Ogrodzieniec, Poland.

TYPE STRATUM: Stratum 21, Upper Callovian, Dogger.

DIAGNOSIS: A species of the genus *Polskanella*, with the following distinctive features: conspicuously high and slender spire with three whorls, the two younger of which are characterised by spherical chambers.

TRANSLATION OF ORIGINAL DESCRIPTION: Test small; with indentations where the sutures join the lobate outline. Dorsal side very high-spired and slender, three whorls identifiable, the first flat and inconspicuous, both the others always consisting of four spherical chambers, at first abruptly, then gradually becoming larger. Four chambers surround the large and wide umbilicus on the umbilical side. The sutures in the younger stages recognizable with difficulty, separating approximately five chambers, later distinctly picked out by constrictions, on the spiral side bent slightly backwards, on the ventral side almost radial. Large high arched, umbilical aperture, the mouth openings of both the penultimate chambers may remain open. Very rare.

DIMENSIONS OF THE HOLOTYPE: Maximum diameter 0.25 mm, height 0.30 mm.

RELATIONSHIPS: It is distinguished from *Polskanella megastoma* by its fragile and slender test, by four chambers in the end whorl and by the uniformly gradual increase in the volumes of the globular chambers.

OCCURRENCE: As yet only known from the Upper Callovian of the type-locality. In the material collected from the glauconitic marls at Ogrodzieniec, such high spired forms have not been recorded. Fuchs indicates that it was very rare in his material.

COMMENTS: The holotype (Slide 4, 0404), from Schichte (Bed) 21 of the Upper

Callovian, is a dark grey/green mineral infilling (steinkern). The specimen is very irregular in form and it is difficult to see if it is partly an artifact of the preservation.

Polskanella bisphaerica Fuchs, 1973

Polskanella bisphaerica Fuchs, 1973, p. 458, pl. 3, fig. 5.

DERIVATION OF NAME: Named on account of the test consisting of only two chambers.

HOLOTYPE: Fuchs, 1973, pl. 3, fig. 5.

DEPOSITORY: Geologische Bundesanstalt, Vienna, Inv. No. 0405.

TYPE LOCALITY: Wiek Limestone Quarry near Ogrodzieniec, Poland.

TYPE STRATUM: Stratum 26, lower Oxfordian, Malm.

DIAGNOSIS: A species of the genus *Polskanella*, with the following distinctive features: test consists of merely two relatively large globular chambers.

TRANSLATION OF ORIGINAL DESCRIPTION: Test small, consisting of merely two relatively large spherical chambers, outline at the suture distinctly indented. Mouth area of the younger chamber concave, aperture an almost semi-circular, high arch in interiomarginal umbilical position. Rare.

DIMENSIONS OF THE HOLOTYPE: Length 0.35 mm, breadth 0.20 mm, thickness 0.15 mm.

OCCURRENCE: Quite often encountered in the lower Oxfordian (Stratum 26), only very rarely in the upper Callovian of Stratum 21.

REMARKS: Fuchs regarded his new species as problematic. He placed it in *Polskanella* on the basis of its large aperture. In the material collected from the glauconitic marls at Ogrodzieniec, one finds a great many different aggregates of "globular" glauconite. Some may have been foraminifera and had additional growths of mineral during diagenesis. Others, much like this "species", comprise one or two grains joined together, as shown by Fuchs (1973, pl. 3, fig. 5). The so-called aperture illustrated by Fuchs is thought to be an artefact.

COMMENTS: The holotype (No. 0405, Slide 5), from Schichte (Bed) 26 of the Oxfordian is a green/grey steinkern. It is probable that this may not even be a foraminiferid.

Polskanella megastoma Fuchs, 1973

Polskanella megastoma Fuchs, 1973, pp. 458, 459, pl. 5, fig. 5.

DERIVATION OF NAME: Mega (Gk) = large, stoma (Gk) = opening.

HOLOTYPE: Fuchs, 1973, pl. 5, fig. 5.

DEPOSITORY: Geologische Bundesanstalt, Vienna, Inv. No. 0406.

TYPE LOCALITY: Wiek Limestone Quarry near Ogrodzieniec, Poland.

TYPE STRATUM: Stratum 26, lower Oxfordian, Malm.

DIAGNOSIS: A species of the genus *Polskanella*, with the following distinctive features: high, broad-conical test with wide, open umbilicus and crescent-shaped aperture.

TRANSLATION OF ORIGINAL DESCRIPTION: Test small, outer rim round and lobed. Spiral side high and broad-conical, approximately three whorls identifiable. Initial whorl flat and inconspicuous, consisting of around five chambers, possessing sutures only a little depressed and distinguishable with difficulty. Later however, the chambers inflate rapidly, become noticeably larger and globular, sutures in deep grooves, curved slightly backwards. Ventral side concave, the wide and deep umbilicus surrounded by three and a half chambers, separated from one another by depressed, almost radial running septa. The aperture a crescent-shaped arch, reaching up high in the chamber-wall, the mouth-opening of the penultimate chamber remains likewise still visible. Very rare.

DIMENSIONS OF THE HOLOTYPE: Maximum diameter 0.30 mm, height 0.35 mm.

RELATIONSHIPS: Fuchs easily distinguished this species from *Polskanella altispira* by its broad-conical test and the high apertural arch. *Globuligerina conica* Iovcheva and Trifonova, 1961, from the Bulgarian Tithonian, possesses no umbilicus. Material from Ogrodzieniec shows no apertural features, certainly not as indicated in the type figure.

OCCURRENCE: Only detected in the lower Oxfordian of the type-locality as yet.

COMMENTS: The holotype (No. 0406), from Schichte (Bed) 26 of the Oxfordian is a mineral steinkern. It is an irregular conical form that is clearly illustrated by Fuchs (1973, pl. 5, fig. 5, middle).

Polskanella oxfordiana (Grigelis, 1958)

Polskanella oxfordiana (Grigelis, 1958), pp. 458, 459, pl. 1, fig. 7; pl. 5, fig. 1.

TRANSLATION OF ORIGINAL DESCRIPTION: Test small with round and lobate periphery. Low trochospiral dorsal side coiled in two and a half to three whorls of which the first whorl is hardly visible. The four chambers of the final whorl, however, large and spherical, surround a wide, open umbilicus on the faintly concave curved ventral side. Septa in the younger section difficult to recognize, later clear and depressed, dorsally somewhat inclined backward, on the ventral side straight-radial. Aperture broadly curved, situated interiomarginal umbilical, the opening of the preceding chambers still being visible. Common.

RELATIONSHIPS: Fuchs identified this species by its low spire, which is different from the other species of the genus *Polskanella*. Fuchs related it to the ancestral form the Cretaceous genus *Iuliusina* Fuchs, 1971.

OCCURRENCE: First reported from the Lower Oxfordian of Lithuania, now also the occurrence in the Upper Callovian to Lower Oxfordian of Poland is proved.

In the material collected from Ogrodzieniec, this is the most common morphotype (Pls 8, 9, 10). In many cases, the spire is low but there is a complete range through to forms with very high spires in which it is quite easy to count a large number of chambers (9-12).

REMARKS: The multiple discoveries published from Western European researchers on "*Globigerina oxfordiana* Grigelis" refer to morphologically completely diverse type-forms (without umbilicus, different apertural proportions; cf. Premoli-Silva, 1966; Bignot and Guyader, 1966 and 1971).

COMMENTS: The specimen in "Slide 7", from Schichte (Bed) 21 of the Upper Callovian, is preserved as a grey/green mineral steinkern. The sutures show as white mineral and are indicated by Fuchs (1973, pl. 5, fig. 1) with a faint line. The specimen is higher spired than illustrated by Fuchs. The apertural side shows four clearly marked, inflated chambers. The apertural area is broken and, in any case, no aperture would be visible without the original test wall being preserved.

The specimen in "Slide 8" from Schichte (Bed) 26 of the Oxfordian shows the same preservation and the same four chambers in apertural view.

Genus *EOHETEROHELIX* Fuchs, 1973

DERIVATION OF NAME: Ancestral form of the Cretaceous genus *Heterohelix* Ehrenberg.

GENUS TYPE SPECIES: *Eoheterohelix prima* Fuchs, 1973.

GENUS DIAGNOSIS: Test free, periphery round and somewhat lobate. Trochospiral test-section low, dorsal consisting of one to one and a half whorls, chambers subspherical, indistinctly separated from each other. Ventral side faintly concave and non-umbilicate, surrounded by approximately four chambers. Size increase of the chambers very gradual. In the end, and out of the coiling-plane, three globular, distinctly larger, biserially arranged chambers, separated by distinctly sunken in sutures, detach from the spirally constructed test. Aperture most probably an interiomarginal slit but not locatable in more detail.

RELATIONSHIPS: Fuchs thought that this genus has its ancestry in *Woletzina*, as is suggested by the observed irregularities in the construction of the final whorl. It is distinguished from *Woletzina* by the small, but clearly developed biserial test-section. At the Jurassic-Cretaceous transition, this morphological group evolved into the Cretaceous genus *Heterohelix* Ehrenberg, from which it is separated by the dominant alternate biserial chamber-succession and the later barely planispirally constructed or completely suppressed juvenile stage.

REMARKS: The apparent irregularities of the chamber arrangement in the final whorl, however, suggest that it seems more reasonable to derive *Eoheterohelix* morphologically and phylogenetically from *Woletzina* than from *Mariannenina.* The specimens in the collections of the Geologische Bundesanstalt attributed to this genus are clearly *Conoglobigerina* or *Globuligerina,* with two highly inflated final chambers. Fuchs records that the morphotype is rare or very rare and this is a further pointer to the specimens being "deformed". The forms illustrated by Fuchs as *Eoheterohelix prima* have nothing in common with Cretaceous *Heterohelix* which appear in the Albian.

RANGE: For the time being, only found in the type-locality in Poland (lower Oxfordian).

Eoheterohelix prima Fuchs, 1973

Eoheterohelix prima Fuchs, 1973, p. 464, pl. 3, fig. 4: pl. 4, fig. 3.

DERIVATION OF NAME: Primus (Lat.) = the first.

HOLOTYPE: Fuchs, 1973, pl. 4, fig. 3.

DEPOSITORY: Geologische Bundesanstalt, Vienna, Inv. No. 0410.

TYPE LOCALITY: Wiek Limestone Quarry near Ogrodzieniec, Poland.

TYPE STRATUM: Stratum 26, lower Oxfordian, Malm.

DIAGNOSIS: The type-species of the genus *Eoheterohelix*, with the following distinctive features: in the adult stage three biserial alternately arranged chambers breaking away from the trochospiral test by a change of the coiling-plane.

TRANSLATION OF ORIGINAL DESCRIPTION: Test small, perimeter round and faintly lobed. Initial section low trochospiral, size increase of the chambers slight, approximately one and a half whorls are seen on the dorsal side, sutures flat and indistinct, on the ventral side somewhat concave and without umbilicus. The last three chambers markedly larger than the others, globular and asymmetrically removed from the coiling-plane, forming a biserial alternate chamber succession. Sutures clear and somewhat depressed. Aperture an interiomarginal, not precisely definable slit. Very rare.

DIMENSIONS OF THE HOLOTYPE: Length 0.25 mm, breadth 0.20 mm, thickness 0.15 mm.

RELATIONSHIPS: Fuchs thought that this genus/species showed a transition to a biserial growth form and could, therefore, be separated from other taxa such as *Woletzina*. These are regarded as aberrant forms and not a new taxon.

OCCURRENCE: Only known from a few specimens recorded in the lower Oxfordian of the type-locality.

COMMENTS: The holotype (No. 0410, Slide 17) from Schichte (Bed) 26 in the Lower Oxfordian is preserved as a green mineral (glauconite?) infilling. The chamber pattern is less clear than Fuchs' illustration and it is impossible to suggest any affinities other than it is probably a deformed *Globuligerina*.

Genus *JURASSOROTALIA* Fuchs, 1973

DERIVATION OF NAME: Name combination, that should recall the occurrence of the Globorotalian-like relatives of the "Globigerines" in the Jurassic.

GENUS TYPE SPECIES: *Jurassorotalia grandis* Fuchs, 1973.

GENUS DIAGNOSIS: Test free, low trochospiral, with lobate periphery, rounded off in the suture joins, ventrally narrowly umbilicate. On the spiral side all chambers of the two to three whorls are seen, the size increase taking place gradually. Septa, apart from the juvenile section, easily observable, slightly depressed and somewhat inclined backwards. On average six chambers surround the narrow umbilicus, separated by distinct, radial, but slightly curved sutures. Chambers on the dorsal side almost flat, on the ventral side a little distended. Aperture an interiomarginal extraumbilical-umbilical slit.

RELATIONSHIPS: Phylogenetically, *Jurassorotalia* is separated from *Mariannenina* through relocation of the aperture slit to the extraumbilical umbilical position probably in the upper Lias to lower Dogger.

REMARKS: In 1953 forms of this kind were presented for the first time by Balakhmatova as *Globorotalia* sp. from the Upper Bajocian to the Bathonian of Turkmenia and in 1961 were assigned to the genus *Planorotalia* Morozova, 1957, by Morozova in Morozova and Moskalenko. Fuchs thought that these "interesting Jurassic foraminifera" had a direct relationship to the Tertiary genus *Globorotalia* Cushman, 1927 (*Planorotalia* is synonymous with it according to Loeblich and Tappan, 1964), as the Jurassic "Globigerines" to *Globigerina* Orbigny. Single-keeled planktonic foraminifera appear in the mid-Cretaceous and, after the end-Cretaceous extinction event, re-appear in the Cenozoic. There is no evidence of any keeled planktonic taxa in the Jurassic and, indeed, the forms illustrated by Fuchs as species of this genus do not have a keel despite an "edge" being illustrated in his plates.

RANGE: From the Upper Bajocian in Russia to the Bathonian of Turkmenia, now also described from the Upper Callovian to the Lower Oxfordian of Poland.

Jurassorotalia grandis Fuchs, 1973

Jurassorotalia grandis Fuchs, 1973, pp. 473, 474, pl. 1, fig. 1.

1953 *Globorotalia* (?) sp. Balakhmatova, p. 88, fig. 3.

1953 *Globorotalia* sp. Balakhmatova, p. 89, fig. 4.

1961 *Planorotalia* sp. Morozova – Morozova and Moskalenko, p. 22, fig. 9, fig. 1-6.

DERIVATION OF NAME: Grandis (Lat.) = large.

HOLOTYPE: Fuchs, 1973, pl. 1, fig. 1.

DEPOSITORY: Geologische Bundesanstalt, Vienna, Inv. No. 0420.

TYPE LOCALITY: Wiek Limestone Quarry near Ogrodzieniec, Poland.

TYPE STRATUM: Stratum 21, Upper Callovian, Dogger.

DIAGNOSIS: The type-species of the genus *Jurassorotalia* with the following distinctive features: striking Globorotalian-like appearance.

TRANSLATION OF ORIGINAL DESCRIPTION: Test small, low trochospiral, with rounded periphery, that appears indented at the suture joins, very narrow umbilicus. On the dorsal-side roughly two whorls are visible, chambers flat, continuously increasing in size, septa at first poorly, then easily detectable, slightly depressed and somewhat inclined backwards. Around the narrow umbilicus are to be found six chambers, triangular, here faintly distended, separated by clear, depressed, less curved radial sutures. Aperture distinctly interiomarginal extraumbilical – umbilical, slit-shaped. Rare.

DIMENSIONS OF THE HOLOTYPE: Maximum diameter 0.35 mm, height 0.15 mm.

OCCURRENCE: Fuchs lists this taxon from the Upper Bajocian of Russia to the Bathonian of Turkmenia and from the Upper Callovian of Poland.

REMARKS: Fuchs claims that these glauconitic moulds differ conspicuously from such genera as *Epistomina, Garantella*, etc. However, it is quite clear that this, and all the other jurassorotalids are benthonic taxa and that *Epistomina* or *Garantella* are the most likely genera in which to place them. Samples of comparable age from the Dorset Coast contain pyrite infillings of *Epistomena*, together with the pyrite steinkerns of planktonic foraminifera.

COMMENTS: The holotype (No. 0420 [32]), from the Upper Callovian, is damaged with only 30% of the original specimen present. It appears to be a mineral infilling (glauconite?) with the sutures looking white between the dark infilling material. This would have been a large specimen if complete and probably high spired. It is difficult to reconcile this fragment with the figure of Fuchs (1973, pl. 1, fig. 1).

Jurassorotalia curva Fuchs, 1973

Jurassorotalia curva Fuchs, 1973, p. 473, pl. 5, fig. 3.

DERIVATION OF NAME: Curvus (Lat.) = curved.

HOLOTYPE: Fuchs, 1973, pl. 5, fig. 3.

DEPOSITORY: Geologische Bundesanstalt, Vienna, Inv. No. 0419.

TYPE LOCALITY: Wiek Limestone Quarry near Ogrodzieniec, Poland.

TYPE STRATUM: Stratum 26, lower Oxfordian, Malm.

DIAGNOSIS: A species of the genus *Jurassorotalia*, with the following distinctive features: chambers of the final whorl becoming suddenly somewhat larger in comparison with the others, the outline is irregularly deeply lobate.

TRANSLATION OF ORIGINAL DESCRIPTION: Test small, low trochospiral coil. Outer rim pointed, but rounded, in the suture areas increasingly deeply indented, narrow umbilicus. The chambers of the dorsal side becoming at first only gradually larger, those of the final whorl, however, increase rapidly. Septa in the initial section indistinct, but then clear, slightly depressed, and somewhat inclined backwards. The narrow umbilicus is surrounded by five to six chambers with depressed curved sutures running radially. Chambers on the dorsal side flat, on the ventral side, however, somewhat distended. Interiomarginal, extraumbilical – umbilicate slit-shaped mouth. Very rare.

DIMENSIONS OF THE HOLOTYPE: Maximum diameter 0.30 mm, height 0.10 mm.

OCCURRENCE: Only known so far from the Lower Oxfordian of the Polish type-locality.

COMMENTS: The holotype (No. 0419 [31]) is in a marked slide with a "red dot" but there are two fossils on the slide. The green mineral infilling appears similar to many of the other specimens in the collection for this locality. It does, however look nothing like the published figure (Fuchs, 1973, pl. 5, fig. 3) unless the last chamber has been broken off, thereby explaining the two "fossils" on the slide.

Jurassorotalia multispiralis Fuchs, 1973

Jurassorotalia multispiralis Fuchs, 1973, p. 474, pl. 4, fig. 5.

DERIVATION OF NAME: Named owing to the multi-coiled spiral side.

HOLOTYPE: Fuchs, 1973, pl. 4, fig. 5.

DEPOSITORY: Geologische Bundesanstalt, Vienna, Inv. No. 0421.

TYPE LOCALITY: Wiek Limestone Quarry near Ogrodzieniec, Poland.

TYPE STRATUM: Stratum 26, lower Oxfordian, Malm.

DIAGNOSIS: A species of the genus *Jurassorotalia*, with the following distinctive features: the spiral side displays three whorls.

TRANSLATION OF ORIGINAL DESCRIPTION: Test small, low trochospirally constructed, perimeter pointed, but rounded, in the suture areas slighty indented, very narrow umbilicus. On the dorsal side the chambers become only very gradually larger, arranged in three whorls, flat and enclosed by septa that are slightly depressed and inclined backwards. Six to seven chambers surround the very narrow and small umbilicus, here bulbous and separated by radially curved, somewhat depressed sutures. Slit-shaped aperture interiomarginal extraumbilical. Very rare.

DIMENSIONS OF THE HOLOTYPE: Maximum diameter 0.25 mm, height 0.10 mm.

OCCURRENCE: Only known up to now from Lower Oxfordian of the Polish type-locality.

COMMENTS: The holotype (No. 0421 [33]) is a green mineral (glauconite?) infilling with a spiral view indicating two to three whorls. The sutures are slightly depressed. The edge of the specimen appears sharp, as if there could have been a keel present on the specimen. There are six chambers visible on the apertural side but the sutures appear to be straighter than indicated by Fuchs.

Looking almost like a globorotalid, there are no other species like this in the Jurassic planktonic foraminifera. As a biconvex form there are few benthonic species in the Callovian that are possibly related to this taxon.

Genus *MARIANNENINA* Fuchs, 1973

DERIVATION OF NAME: Intended for my dear mother Marianne in grateful admiration.

TYPE SPECIES: *Mariannenina pulchra* Fuchs, 1973.

GENUS DIAGNOSIS: Test free, low trochospiral, with rounded, lobate periphery, ventrally umbilicate. On the spiral side all chambers in two to three whorls are visible, while on the ventral side barely those of the last whorl. Septa slightly depressed, a little distinct in the early stage. Chamber size increases very gradually, on the umbilical side always even more distended than on the dorsal side (compare with *Schmidita* Fuchs, 1967). Aperture an interiomarginal umbilical to umbilical-extraumbilical slit. The internal architecture is not thought to be preserved.

RELATIONSHIPS: In 1967 Fuchs had discovered in the upper Triassic *Hedbergella*-like representatives of the Triassic "Globigerines" (*Schmidita* Fuchs) and already at that time referred to their phylogenetic significance for the Cretaceous genus *Hedbergella* Brönnimann and Brown. Now with his discovery of *Mariannenina* Fuchs, 1973, he thought that the evolutionary missing link was fortunately found, after Fuchs already in 1971, on the grounds of the marked, generic differentiation of the genus *Hedbergella* in the lower Middle Barremian, had drawn attention to its many earlier appearances, which he considered necessary. The new genus is distinguished from *Schmidita* by the obvious lack of external characteristics, which could indicate still existing remains of an internal structure, from *Hedbergella* through the partial still purely umbilical aperture and the little distended chambers on the spiral side.

OCCURRENCE: Found in Poland in the Upper Callovian to Lower Oxfordian.

REMARKS: In thin-sections *Hedbergella*-like cross-sections were repeatedly encountered by Fuchs, yet only in the Russian literature had such forms been introduced, in three dimensional preservation as *Globorotalia* sp. (Balakhmatova, 1953) and *Planorotalia* sp. (Morozova in Morozova and Moskalenko, 1961) respectively. *Mariannenina*, like

Jurassorotalia, is quite clearly a benthonic taxon probably related to forms of *Epistomina* or *Garantella*. In material from Ogrodzieniec, benthonic taxa form about 20-25% of the assemblage which is dominated by planktonic foraminifera.

Mariannenina pulchra Fuchs, 1973

Mariannenina pulchra Fuchs, 1973, p. 472, pl. 2, fig. 1.

DERIVATION OF NAME: Pulcher (Lat.) = beautiful.

HOLOTYPE: Fuchs, 1973, pl. 2, fig. 1.

DEPOSITORY: Geologische Bundesanstalt, Vienna, Inv. No. 0418.

TYPE LOCALITY: Wiek Limestone Quarry near Ogrodzieniec, Poland.

TYPE STRATUM: Stratum 21, Upper Callovian, Dogger.

DIAGNOSIS: The type-species of the genus *Mariannenina* with the following distinctive features: slit-shaped aperture situated entirely interiomarginal umbilical.

TRANSLATION OF ORIGINAL DESCRIPTION: Test small, low trochospiral, narrowly umbilicate, lobate rounded periphery. On the spiral side approximately two and a half whorls are observed, chambers flat, gradually becoming larger. Sutures slightly depressed. The narrow umbilicus is surrounded by six bulbous chambers on the ventral side, deep sutures, straight to slightly curved. Slit-shaped aperture interiomarginal umbilical. Rare.

DIMENSIONS OF THE HOLOTYPE: Maximum diameter 0.25 mm, height 0.10 mm.

RELATIONSHIPS: Fuchs certainly thought that this species displays the morphological features linking the characteristics of *Schmidita* from the Rhaetian to the Cretaceous *Hedbergella*. It is, however, almost certainly an epistominid and not a planktonic taxon.

OCCURRENCE: Only known from the Upper Callovian of the Polish type-locality.

COMMENTS: The holotype (No. 0412, Slide 30) from Schichte (Bed) 21, Upper Callovian from Wiek is a biconvex form with a distinct edge (keel?). It is not a planktonic taxon and is preserved as a mineral infilling.

Mariannenina multiloculata Fuchs, 1973

Mariannenina multiloculata Fuchs, 1973, p. 470, pl. 2, fig. 2.

DERIVATION OF NAME: Named as a result of the high number of chambers.

HOLOTYPE: Fuchs, 1973, pl. 2, fig. 2.

DEPOSITORY: Geologische Bundesanstalt, Vienna, Inv. No. 0415.

TYPE LOCALITY: Wiek Limestone Quarry near Ogrodzieniec, Poland.

TYPE STRATUM: Stratum 21, Upper Callovian, Dogger.

DIAGNOSIS: A species of the genus *Mariannenina* with the following distinctive features: in three whorls there are numerous chambers following each other.

TRANSLATION OF ORIGINAL DESCRIPTION: Test small with low spire, rounded, barely lobate periphery and narrow umbilicus. On the dorsal side all chambers visible, sutures clear, a little depressed, inclined somewhat backwards; on the ventral side seven to eight chambers are visible, distinctly inflated. Increase in chamber size is gradual. Slit-shaped aperture interiomarginal extraumbilical. Very rare.

DIMENSIONS OF THE HOLOTYPE: Maximum diameter 0.25 mm, height 0.15 mm.

RELATIONSHIPS: The large number of chambers distinguishes this species from others of the genus. Epistominids rarely have this number of chambers but, as Fuchs records this species as very rare, it may just be an exceptional form.

OCCURRENCE: Only known so far from the Upper Callovian of the Polish type-locality.

COMMENTS: The holotype (No. 0415, Slide 26) from Schichte (Bed) 21 of the Upper Callovian is a very large biconvex form preserved as a mineral filling. The sutures may have been depressed and the specimen may originally have had a keel, although this could be an artifact of preservation. Two whorls are visible on the spiral side, which is quite high. The specimen looks like that illustrated by Fuchs (1973, pl. 2, fig. 2) but it is almost certainly not a planktonic form.

Mariannenina nitida Fuchs, 1973

Mariannenina nitida Fuchs, 1973, p. 471, pl. 3, fig. 3; pl. 4, fig. 1.

DERIVATION OF NAME: Nitidus (Lat.) = dear little, sweet.

HOLOTYPE: Fuchs, 1973, pl. 3, fig. 3.

DEPOSITORY: Geologische Bundesanstalt, Vienna, Inv. No. 0416.

TYPE LOCALITY: Wiek Limestone Quarry near Ogrodzieniec, Poland.

TYPE STRATUM: Stratum 26, lower Oxfordian, Malm.

DIAGNOSIS: A species of the genus *Mariannenina* with the following distinctive features: small and very fragile test.

TRANSLATION OF ORIGINAL DESCRIPTION: Test very small to small, almost flat to very low trochospiral, narrowly umbilicate, the barely lobate outer margin pointed, but rounded. All the chambers on the spiral side visible, arranged in two to two and a half whorls, sutures clear, somewhat depressed and curved backwards. Six chambers surround the open umbilicus, also only the ventral-side chambers are inflated. Chamber size increasing gradually. Aperture is an interiomarginal umbilical slit. Very rare.

DIMENSIONS OF THE HOLOTYPE: Maximum diameter 0.20 mm, height 0.10 mm.

RELATIONSHIPS: The smallness of the test, the relatively low chamber number and the almost flat spire are the distinguishing features of this form compared with the other species. This makes it more typically epistominid in character.

OCCURRENCE: So far only described from the Lower Oxfordian of Poland.

COMMENTS: The specimen (no. 0416, Slide 28) from Schichte (Bed) 26, Lower Oxfordian at Wiek is preserved as a mineral infilling but is broken. It is probably that figured by Fuchs (1973, pl. 3, fig. 3).

Mariannenina pseudoplanispiralis Fuchs, 1973

Mariannenina pseudoplanispiralis Fuchs, 1973, pp. 471, 472, pl. 2, fig. 3.

DERIVATION OF NAME: So named owing to the almost planispiral coiling of the test.

HOLOTYPE: Fuchs, 1973, pl. 2, fig. 3.

DEPOSITORY: Geologische Bundesanstalt, Vienna, Inv. No. 0417.

TYPE LOCALITY: Wiek Limestone Quarry near Ogrodzieniec, Poland.

TYPE STRATUM: Stratum 21, Upper Callovian, Dogger.

DIAGNOSIS: A species of the genus *Mariannenina* with the following distinctive features: test almost planispirally coiled.

TRANSLATION OF ORIGINAL DESCRIPTION: Test small, with almost planispiral evolute coiling, pointed, however rounded and lobate periphery, with wide, flat umbilicus. On the spiral side all chambers are seen, the size of which gradually increases, sutures depressed, somewhat inclined backwards, indistinct in the juvenile stage. The umbilical view is characterised by six chambers with clear, slightly curved sutures. Chambers on the ventral side slightly curved. Apertural slit interiomarginal, extraumbilical. Very rare.

DIMENSIONS OF THE HOLOTYPE: Maximum diameter 0.30 mm, height 0.10 mm.

RELATIONSHIPS: Fuchs records that the almost planispirally constructed test clearly separates this species from the rest of the genus.

OCCURRENCE: Only known from the Upper Callovian of the Polish type-locality.

COMMENTS: The holotype (No. 0417, Slide 29) from Schichte (Bed) 21, Upper Callovian from Wiek, looks like Fuchs' figure (1973, pl. 2, fig. 3) but is less obvious than the drawing. It is a mineral infilling and almost certainly not planktonic

Genus *TECTOGLOBIGERINA* Fuchs, 1973

DERIVATION OF NAME: Tectus (Lat.) = covered; named on account of the covered umbilicus and the Globigerine-like appearance of these forms.

GENUS TYPE SPECIES: *Tectoglobigerina calloviana* Fuchs, 1973

GENUS DIAGNOSIS: Test free, trochospiral dorsal side, ventrally flat concave, umbilicus covered by tegillum. Lobate, round periphery. On the spiral side two and a half whorls, all chambers visible. First whorl low, inconspicuous; septa indistinct, later the chambers increase rapidly and become globular, sutures clear and depressed, somewhat inclined backwards. Four chambers, separated by straight sutures, surround the umbilicus, which is covered by a tegillum starting at the base of the end chamber. Aperture concealed.

RELATIONSHIPS: Fuchs records that this new genus goes back, morphologically, to the Upper Rhaetian "Globigerine" genus *Praegubkinella* Fuchs, 1967.

REMARKS: Fuchs was convinced that the "flap" of glauconite over where the aperture would have been was evidence of a tegillum or some form of apertural modification. He reports that the development of apertural coverings can be seen in many planktonic foraminifera. Bars and Ohm (1968) had already described forms like this from the upper Bajocian to Lower Bathonian of the Trient province as *Globigerina spuriensis*.

RANGE: Only reported from the type-locality of the Upper Callovian of Poland for the time being.

Tectoglobigerina calloviana Fuchs, 1973

Tectoglobigerina calloviana Fuchs, 1973, p. 460, pl. 1, fig. 4.

DERIVATION OF NAME: Named after its occurrence in the Callovian.

HOLOTYPE: Fuchs, 1973, pl. 1, fig. 4.

DEPOSITORY: Geologische Bundesanstalt, Vienna, Inv. No. 0407.

TYPE LOCALITY: Wiek Limestone Quarry near Ogrodzieniec, Poland.

TYPE STRATUM: Stratum 21, Upper Callovian, Dogger.

DIAGNOSIS: The type-species of the genus *Tectoglobigerina* with the following distinctive features: relatively large, flat trochospiral coiled test, umbilicus completely covered by broad tegillum.

TRANSLATION OF ORIGINAL DESCRIPTION: Test small; outer-rim round and deeply indented in the suture-joins. Dorsal side low trochospiral, roughly two and a half whorls recognisable. Initial whorl flat, inconspicuous, the chambers hardly sub-spherical, subsequently rapidly becoming larger and conspicuously globular. Umbilicus wide, in its entirety covered by broad tegillum and surrounded by four chambers. On the spiral side septa at first a little depressed and with difficulty detectable, later embedded in constrictions, always somewhat inclined backwards, on the ventral side depressed, straight-radial. Aperture concealed under the tegillum. Common.

DIMENSIONS OF THE HOLOTYPE: Maximum diameter 0.35 mm, height 0.25 mm.

RELATIONSHIPS: Fuchs regarded the development of a tegillum as clearly separating this from otherwise morphologically similar Jurassic taxa. He was certain that this form was related to *Globigerina spuriensis* Bars and Ohm, 1968, from the upper Bajocian and lower Bathonian of the vicinity of Trient.

OCCURRENCE: Quite frequently to be found in the Upper Callovian of the type-locality. In the lower Oxfordian, however, this species is observed no more.

COMMENTS: The holotype (slide 0407), from Schichte (Bed) 21 of the Upper Callovian looks identical to that figured by Fuchs (1973, pl. 1, fig. 4). It is a very irregular form and may not even be a foraminiferid. If it is a genuine taxon then it is possible that some additional "chambers" may have been added by the mineralisation. It is very difficult to imagine an internal mould replacing a tegillum. Fuchs claims that this feature is found quite frequently, although this is not the case in the material from Ogrodzieniec that we have studied.

Genus *WOLETZINA* Fuchs, 1973

DERIVATION OF NAME: Dedicated to Dr Gerda Woletz (Geologische Bundesanstalt, Vienna) in gratitude.

GENUS TYPE SPECIES: *Woletzina jurassica* (Hofman, 1958).

GENUS DIAGNOSIS: Test free, dorsal side more or less high trochospiral, ventral side concave to convex, without umbilicus. Periphery always round, in the suture joins more or less lobate. On the spiral side all chambers in approximately two and a half to three whorls detectable, the first always very low and inconspicuous, the following chambers then rapidly gaining size and spherically shaped. Septa at first flat, identifiable with difficulty, later depressed and a little bent backwards. On the ventral side always four chambers to be seen, the arrangement of which shows certainly irregularities, the sutures here straight and distinct. No or at least no clearly developed umbilicus existing. Aperture interiomarginal slit-shaped, not to be observed. According to Hofman, 1958, the shell is microporous.

RELATIONSHIPS: *Praegubkinella* Fuchs, 1967, is also assessed as the ancestral form for this genus. Fuchs used the features of his generic diagnosis to separate this from *Conoglobigerina,* although subsequent authors (e.g. Simmons, *et al.*, 1997) regard it as synonymous. The relationship with *Eoheterohelix*, also suggested by Fuchs, is again unlikely.

REMARKS: The species *Globigerina jurassica* Hofman, 1958, and *G. gaurdakensis* Balakhmatova and Morozova, 1961, were, on the basis of their distinctive trochospiral form, classified by Morozova in her sub-genus *Conoglobigerina.*

RANGE: In Russia and now also recorded in Poland, occurring stratigraphically from the Upper Bajocian to the Lower Oxfordian.

Woletzina jurassica (Hofman, 1958)

Woletzina jurassica (Hofman, 1958), p. 463, pl. 2, fig. 7; pl. 5, fig. 4.

1958 *Globigerina jurassica* Hofman, p. 125, fig. 1.

TRANSLATION OF ORIGINAL DESCRIPTION: Test small with round outer rim deeply indented in the suture joins. Dorsal side high spired, composed of two and a half to three whorls. Initial section small, flat, with the following chambers becoming inflated. Septa in the juvenile section not depressed and identifiable with difficulty, then depressed and clear, always somewhat bent in the direction of the proloculus. Ventral side concave, consisting of four roughly equal large and globular chambers not quite regularly situated in their position, which surround an insignificant umbilicus. Sutures depressed and straight. Aperture probably an interiomarginal slit, not observable. According to Hofman the shell wall is matt and microporous. Common.

OCCURRENCE: Described from the Bathonian to the Lower-Callovian of the Crimea, detected in the Upper-Callovian and the Lower Oxfordian in Poland.

COMMENTS: The specimen in Slide 14 from Schichte (Bed) 21 of the Upper Callovian is a mineral infilling and, while it looks like Fuchs' illustration its affinity is not known.

The specimen in Slide 15 from Schichte (Bed) 26 in the Lower Oxfordian may be planktonic but is more akin to an irregular cluster of infilled chambers. It is probably the individual illustrated by Fuchs (1973, pl. 5, fig. 4) but does not have such a distinctive shape. All of the specimens are unlikely to be *Conoglobigerina jurassica* of Hofman.

Woletzina cylindrica Fuchs, 1973

Woletzina cylindrica Fuchs, 1973, pp. 461, 462, pl. 3, fig. 2; pl. 4, fig. 4.

DERIVATION OF NAME: Cylindricus (Lat.) = cylinder-shaped.

HOLOTYPE: Fuchs, 1973, pl. 3, fig. 2.

DEPOSITORY: Geologische Bundesanstalt, Vienna, Inv. No. 0408.

TYPE LOCALITY: Wiek Limestone Quarry near Ogrodzieniec, Poland.

TYPE STRATUM: Stratum 21, Upper Callovian, Dogger.

DIAGNOSIS: A species of the genus *Woletzina* with the following distinctive features: high-spired, cylinder-shaped test, end chamber lying in the coil axis.

TRANSLATION OF ORIGINAL DESCRIPTION: Test small with round, faintly lobed periphery. Dorsal side pronounced trochospiral raised up in somewhat more than three whorls. First whorl hardly visible, low, sutures indistinct, flat, later, however, the chambers become gradually larger, dilating, and the sutures distinctly depressed, are always slightly inclined backwards. On the ventral side four chambers visible, while the final chamber is almost or directly lying in the coil axis. Suture here straight and sunken in. No umbilicus. Aperture an indistinct interiomarginal slender slit, drawn to the outer-rim. In Fuchs (1973, pl. 4, fig. 4) the portrayed specimen shows shell preservation, white, calcareous and finely porous. In the aperture area, the shell is broken open and the glauconite-core visible. Rare.

DIMENSIONS OF THE HOLOTYPE: Maximum diameter 0.25 mm, height 0.30 mm.

OCCURRENCE: Proved in both the Upper Callovian as well as in the Lower Oxfordian of Wiek near Ogrodzieniec.

COMMENTS: The holotype (No. 0408), from Schichte (Bed) 21 of the Upper Callovian, is preserved as a mineral steinkern. It appears to be the specimen illustrated by Fuchs (1973, pl. 3, fig. 2) but it may not be a foraminiferid.

The specimen in "Slide 11" from Schichte (Bed) 26 of the Oxfordian could not be examined properly as it was stuck to the slide cover slip by static. It is another mineral steinkern that appears as a globular "lump" with a crazed surface.

Woletzina gaurdakensis (Balakhmatova & Morozova, 1961)

Woletzina gaurdakensis (Balakhmatova & Morozova, 1961), p. 462, pl. 3, fig. 1.

1953 *Globigerina* sp. Balakhmatova, p. 88, fig, 2.

1961 *Globigerina (Conoglobigerina) gaurdakensis* Balakhmatova and Morozova – Morozova and Moskalenko, p. 25, fig. 6, fig. 1-3

TRANSLATION OF ORIGINAL DESCRIPTION: Test small with round, broad, faintly lobate periphery. On the dorsal side a high trochospiral consisting of approximately two and a half whorls, juvenile section low and inconspicuous, the sutures flat and hardly distinguishable, chamber size increase gradual. In the end whorl rapid increase in the volume of the chambers, conspicuously lengthened and distended in the direction of the coil-axis, septa depressed and clearly apparent. The convex arched ventral side is formed by the four narrow, final chambers expanding only slightly, separated from each other by straight sutures. Aperture presumably an interiomarginal slit, spreading outwards from the centre. Shell, according to Balakhmatova and Morozova, calcareous, finely porous, matt and somewhat rough. Very rare.

OCCURRENCE: Fuchs described this form as well known from the Upper Bajocian to Lower Bathonian in Russia, appearing as single specimens in the Upper Callovian and in the Lower Oxfordian in his Polish material.

COMMENTS: The specimen in "Slide 12" from Schichte (Bed) 21 of the Upper Callovian is a mineral steinkern. It is impossible to reconcile this with the chambered form illustrated by Fuchs (1973, pl. 3, fig. 1). *Globigerina gaurdakensis* Balakhmatova and Morozova was originally claimed to be of Late Bajocian age but its surface morphology indicates a Cenozoic age. (Simmons et al., 1997, p. 20). In the material from Ogrodzieniec, forms were found that probably represent the taxon described by Fuchs. On the basis of these internal moulds. On the basis of these internal moulds, identification is impossible.

Woletzina irregularis Fuchs, 1973

Woletzina irregularis Fuchs, 1973, pp. 462, 463, pl. 1, fig. 6.

DERIVATION OF NAME: Irregularis (Lat.) = irregular.

HOLOTYPE: Fuchs, 1973, pl. 1, fig. 6.

DEPOSITORY: Geologische Bundesanstalt, Vienna, Inv. No. 0409.

TYPE LOCALITY: Wiek Limestone Quarry near Ogrodzieniec, Poland.

TYPE STRATUM: Stratum 21, Upper Callovian, Dogger.

DIAGNOSIS: A species of the genus *Woletzina* with the following distinctive features: the final chambers gradually breaking away from the coiling-plane in a very twisted spiral; small, indistinctly developed pseudoumbilicus.

TRANSLATION OF ORIGINAL DESCRIPTION: Test very small, with round, somewhat lobed outline. Dorsal side low trochospiral in two detectable whorls. First whorl flat, chambers a little distended, the sutures between them unclear and not depressed. In the second whorl the chambers are inflated, but extended somewhat in the direction of the coiling axis, sutures here distinctly depressed, in the entire spiral section always slightly inclined backwards. The chambers of the final whorl are markedly out of the coiling-plane, the "ventral" view shows four chambers, one of which, however, belongs to the first whorl. Chamber septa lying deep and clear, with a small inconspicuous pseudoumbilicus in their midst. Aperture probably interiomarginal slit-shaped, not visible. Very rare.

DIMENSIONS OF THE HOLOTYPE: Maximum diameter 0.20 mm, height 0.15 mm.

RELATIONSHIPS: Fuchs records that this species appears to be close to *Woletzina gaurdakensis* (Balakhmatova and Morozova), but is distinguished from it by the final whorl being out of alignment with the coiling-plane and the development of a small pseudoumbilicus.

OCCURRENCE: So far only reported in single specimens from the type location.

COMMENTS: The holotype (No. 0409, Slide 13) from Schichte (Bed) 21 of the Upper Callovian appears to be a "hooked shaped" cluster of infilled chambers. It may not be a Foraminiferid, although it may be a "deformed" internal mould of a benthonic taxon.

Genus *CONOGLOBIGERINA* Morozova, 1961, emend.

GENOTYPE: *Globigerina (Conoglobigerina) dagestanica* Morozova, 1961.

GENUS DIAGNOSIS: Test free, dorsally moderately to pronouncedly trochospiral, ventrally more or less concave, narrow umbilicus, frequently also non-umbilicate. Round periphery. On the spiral side all chambers visible, in two and a half to three whorls partially even arranged in rows, on the ventral side barely the last three to four chambers observable. Sutures in the initial stage only a little deepened, therefore in most cases poorly perceptible, later however situated in distinct constrictions, dorsally slightly inclined, ventrally approximately radial. The first whorls being not much in evidence, arranged flat trochospiral, chambers hardly sub-spherical, gradually becoming larger. The chambers of the end whorl (in the case of high-spired forms those of the last two whorls also) abruptly increasing in size and globular. Mouth-opening a simple, narrow to moderately curved slit, interiomarginal umbilical to extraumbilical. Shell, according to Morozova, thin, finely porous; its upper surface smooth to slightly wrinkled.

REMARKS: Fuchs records that Morozova interpreted *Conoglobigerina* only as a sub-genus of *Globigerina* Orbigny and assembled into it all high-spired forms not only of the Jurassic, but also the morphologically similar true globigerinids of the Cenozoic. Fuchs, therefore, raised the sub-genus *Conoglobigerina* Morozova, 1961 to a genus and restricted it chronologically to the Jurassic. In addition only forms with very narrow or no umbilicus at all and more or less faintly curved apertural-arch belong to this genus.

RELATIONSHIPS: Fuchs, in a lengthy exposition, outlined how *Conoglobigerina* was derived from the upper Rhaetian genus *Praegubkinella* Fuchs, 1967, by adapting the Lower Jurassic shell architecture to new ecological conditions. He also explained the relationship to the Cretaceous genera *Guembelitria* Cushman, 1933 and *Gubkinella* Suleymanov, 1955. He distinguished *Polskanella* from *Conoglobigerina* by its wider umbilicus and the distinct, high aperture. *Tectoglobigerina* was identified by the tegillum that covered the umbilicus. Fuchs also noted that the *Virgulina*-like aperture of *Globuligerina* was distinctive, as was the irregular chamber arrangement of *Woletzina*.

RANGE: Recorded from the Upper Bajocian to the Tithonian.

Conoglobigerina dagestanica (Morozova, 1961)

Conoglobigerina dagestanica (Morozova, 1961), pl. 1, fig. 5.

1961 *Globigerina* (*Conoglobigerina*) *dagestanica* Morozova - Morozova and Moskalenko, p. 26, pl. 1, figs 13-15; pl. 2, figs 14-19; t.fig. 7, figs 1-24.

1969 *Globigerina bathoniana* Pazdrowa, pars, p. 45; p. 47, fig. 5.

TRANSLATION OF ORIGINAL DESCRIPTION: Test small, high-spired with mostly flat beginning, ventrally concave, hardly umbilicate. Lobate and round periphery. The first whorl lies around the proloculus in about five hardly distended chambers, the second and third whorls contain approximately three each, more rarely four chambers of distinctly globular form, increasing rapidly in volume compared with those of the initial whorl, but only gradually one beneath the other. Septa initially slightly sunken-in, later clearly deepened. Aperture crescent-shaped situated on the umbilical side of the chamber base, that of the penultimate chamber occasionally still remains visible.

OCCURRENCE: Reported for the first time from the Upper Bajocian and Bathonian of Russia, now also recorded in the Upper Callovian of Poland.

COMMENTS: The specimen in "Slide 3" from Schichte (Bed) 21 in the Upper Callovian has quite globose chambers but these may be accentuated as a result of the steinkern preservation. It is quite comparable to the form illustrated by Simmons *et al.* (1997, pl. 2.3, figs 5, 8).

Conoglobigerina avarica (Morozova, 1961)

Conoglobigerina avarica (Morozova, 1961), pl. 3, fig. 6.

1961 *Globigerina (Conoglobigerina) avarica* Morozova – Morozova and Moskalenko, p. 28, pl. 2, figs 1-13, 20; t.fig. 8, figs 1-21.

1971 *"Globigerina" avarica* Morozova – Brönnimann and Wernli, p. 123, pl. 2, figs 1-4; pl. 4, figs 3, 4

TRANSLATION OF ORIGINAL DESCRIPTION: Test small, high conical high spiral side, ventral side hardly umbilicate. Outline indented at the suture positions. Dorsally the initial chamber is clearly evident, the chambers following immediately afterwards of the first whorl low, poorly recognisable owing to the shallow-lying sutures, the chambers of the second and third whorls gaining rapidly in size and becoming increasingly more globular. Ventrally only the last three chambers visible. Sutures initially poorly, later rather well distinguishable and sunken, on the spiral side always a little inclined, ventrally almost radial. Aperture a narrow, hardly definable, interiomarginal umbilical slit. Very rare.

OCCURRENCE: Observed in single specimens both in the Upper Callovian and also in the Lower Oxfordian. Known in Russia from the upper Bajocian.

COMMENTS: The specimen, from Schichte (Bed) 26 in the Oxfordian, is preserved as a mineral infilling. It is a very conical form (fide. Simmons *et al.*, 1997, pl. 2.4, fig. 1) and the chambers are inflated. The triangular shape is quite angular in appearance. The sutures have been given a double line in the illustrations of Fuchs, just as in those of *Jurassorotalia.*

Conoglobigerina bathoniana (Pazdrowa, 1969)

Conoglobigerina bathoniana (Pazdrowa, 1969), pl. 1, fig. 2.

1969 *Globuligerina bathoniana* Pazdrowa, pars, p. 45: p. 46, figs 1, 2, 4.

TRANSLATION OF ORIGINAL DESCRIPTION: Test small, with high, truncated conical spire and concave ventral side. On the suture joins the round periphery is distinctly lobate. The first whorl surrounding the proloculus is very flat, the chambers only a little spherical, the chambers of the following two whorls rapidly increasing in size and globular. Ventrally barely the last three and a half chambers recognizable. Sutures at the beginning shallow and indistinct, slightly inclined, in the adult stage in deep constrictions and nearly straight. Aperture relatively large, almost semicircular, situated interiomarginally umbilicate. The aperture of the penultimate chamber remains visible. Rare.

REMARKS: In 1969, Pazdrowa obviously brought together morphologically diverse types into her species, amongst them low-spired or high-spired and almost conical forms. Fuchs confined the species to specimens corresponding to the holotype. It is clear that Pazdrowa

(1969) included a complete spectrum of forms in her definition of *Globigerina bathoniana*. Fuchs is quite correct in drawing attention to this and in wishing to limit the concept of *bathoniana* to the holotype. It is clear, however, that the Morissi Zone clays of Ogrodzieniec, from which the species was described, contains a diverse assemblage with a variety of morphotypes. This should be fully investigated and a view taken on the range of taxa present. One of the forms illustrated by Pazdrowa has a loop-shaped aperture and, following Simmons *et al.* (1997), extends the range of *Globuligerin*a into the mid-Bathonian. This requires further clarification if the stratigraphy of the Jurassic planktonic foraminifera is to be fully understood.

RELATIONSHIPS: Fuchs reports that this taxon is very similar *Globigerina conica* Iovcheva and Trifonova, 1961, but differs in the higher spire, beginning pointedly, and the high-curved aperture. *Globigerina avarica* Morozova, 1961, has apart from the distinctly prominent initial stage of the test a clearly constructed aperture. *Globigerina dagestanica* Morozova, 1961, has somewhat more chambers in the initial whorl and in most cases an already pronounced serial arrangement of chambers on the dorsal side.

OCCURRENCE: Fuchs described this species for the first time from the Bathonian of Poland and also recorded it from the Upper Callovian and Lower Oxfordian (here certainly somewhat rarer).

COMMENTS: The specimen in "Slide 2", from Schichte (Bed) 21 in the Upper Callovian is preserved in the same mineral infilling with no external wall visible. The aperture is not as clear as indicated by Fuchs (1973, pl. 1, fig. 2). It is a high-spired form but the appearance is irregular, possibly due to it being a steinkern.

2.4 IMPLICATIONS FOR JURASSIC MICROPALAEONTOLOGY

The investigation and (re)-illustration of the Oberhauser and Fuchs collections housed in the Geologische Bundesanstalt (Vienna) has clarified several aspects of Triassic and Jurassic micropalaeontology.

Previous investigations of the collections (e.g. Dr F. Rögl, formerly of the Natural History Museum, Vienna) have concluded that all the Triassic forms had a benthonic mode of life, which this investigation has confirmed. Using the data in Fuchs (1967), it is possible to plot an evolutionary pathway (Fig. 2.3) that explains most of the relationships. Many of Fuchs' taxa are reportedly rare or very rare and the subdivisions of *Kollmannita* and *Oberhauserella* may be excessive. Despite the name, *Schmidita hedbergelloides* does not develop into *Hedbergella*. Although there is some uncertainty, the present evidence suggests that *Oberhauserella quadrilobata* evolved into *O. alta* and *Praegubkinella turgescens*. Wernli (1995) demonstrated that, in the Toarcian sediments of Teysachaux (Switzerland), a diverse assemblage of *Oberhauserella* and *Praegubkinella* morphotypes show transitional characters with *Conoglobigerina*. The problem with this transition is that it has to be decided at what point the morphology is that of a planktonic foraminiferid, and this is not straightforward. Many of the forms illustrated by Wernli (1995, pls 1, 2) appear to have concave or flattened ventral sides, which were probably the attached sides of benthonic taxa. *P. racemosa* Wernli, however, does appear to have been (potentially) free-living. If this is true, then the origin of the planktonic foraminifera may have been in the Toarcian and occurred in the area of Western Tethys (see Chapter 9). The relationship to the Toarcian Oceanic Anoxic Event and/or the sea level changes at this level is difficult to assess.

If the earliest planktonic foraminifera are of latest Toarcian age then the migration throughout Western and Peri-Tethys of the early conoglobigerinids by the Bajocian was quite rapid and well within the time frame of more recent migration events (Kucera and Malmgren, 1988; Kim, 1999; Olsson *et al.*, 2001), some of which appear to require times of only >100 Ka to expand distributions over several degrees of latitude and longitude.

Fuchs' (1970) paper on the Hernstein succession shows that Hettangian strata contained no planktonic taxa, being characterised by an oberhauserellid fauna. Fuchs' (1973) paper on the material from Ogrodzieniec, collected by a colleague, is problematic. Fuchs created a number of new species and genera on the basis of glauconitic casts - a dubious practice. In some cases Fuchs recognised that these were steinkerns, yet illustrates features (e.g. apertures) that could not be preserved without the calcite or aragonite test. In this paper Fuchs does seem to recognise a problem in the status of *Globuligerina* and its type species *G. oxfordiana*. The designation of *Polskanella*, however, did not resolve the issue.

According to Simmons et al. (1997), the aperture is the key to generic discrimination with *Conoglobigerina* having an interiomarginal low arch while *Globuligerina* has a high, loop-shaped, aperture. This, apparently simple, separation of the genera is slightly problematic. The holotype of *Globuligerina* (given by Simmons *et al.* 1997) is *Globigerina oxfordiana* Grigelis, 1958 and the three views given by the author in the original figures (especially fig. 1c) shows four gradually expanding chambers in the final whorl with an interiomarginal low arch for an aperture. In a later paper, Grigelis (1985) re-figured the holotype and the drawings do seem to represent the same specimen (and views). The aperture remains a low arch, but is shown with a bordering lip. Later Bignot and Guyader (1966) illustrated forms of *Globuligerina oxfordiana* with more elongate chambers and a more loop-shaped aperture which looks quite different from that in the original figure of Grigelis (1958). These later interpretations of *Globuligerina oxfordiana* by Bignot and Guyader (1966, 1971) are a significant problem, according to Huddleston (1982). In a probing taxonomic analysis, Huddleston (*op. cit.*) argues that the majority of workers have overlooked the fact that "...Bignot and Guyader (1971) specifically designated *Globuligerina oxfordiana* Grigelis, 1958 emend. Bignot and Guyader 1966, emend. 1971, and not *Globigerina oxfordiana* Grigelis, 1958" as the type species of *Globuligerina*. If this is correct, then it calls into question the current interpretation of *G. oxfordiana* (and, perhaps, its relationship with *G. bathoniana*) as well as the status of the genus *Globuligerina*. In their analysis of *Globuligerina*, Simmons *et al.* (1997) appeared to have been unaware of the views presented by Huddleston in 1982, which also considered the status of the genus *Polskanella* Fuchs and the Family Favusellidae. Stam (1986) also attempted an emendation of *Globuligerina* that was not fully endorsed by Simmons *et al.* (1997). In 1984, Bignot and Janin described the planktonic foraminifera found in the Bajocian of the Falaise des Hachettes (Normandy) succession. While some of the fauna is illustrated in thin section, a few isolated specimens are figured (Bignot and Janin, 1984, pl. 1, figs 3, 5-8). These individuals (especially figs 3, 8) show the four chambers in the final whorl (which expand slowly and are not elongated) and an aperture that is more like the low arch of the original *G. oxfordiana*. Bignot and Janin (1984) appear to equate *G. oxfordiana* with *G. bathoniana* of Pazdrowa (1969). With this level of confusion, it is not surprising that the separation of *G. oxfordiana* from *G. bathoniana* in thin-section is almost impossible, with only a slightly higher spire being the discriminating feature. During the examination of the thin-sections of the Polish samples (see Chapter 5), these two taxa could not be separated, therefore, nor the position adjudicated on of *G. calloviensis*, which may be the ancestor of *G. oxfordiana* or an ecophenotype of sub-specific taxonomic status. It would be expected that the specimens seen in the sample from the Lower Bathonian of the Niedzica Limestone Formation should be closely related, if not identical, to those of the type *G. bathoniana* of Pazdrowa (1969). In some of the thin sections, high-spired forms were occasionally observed.

While some of Fuchs' conclusions may have been inaccurate (in hindsight), many of his species and genera are valid taxa and remain well-curated in the Geologische Bundesanstalt (Vienna). In subsequent chapters, faunas from Poland, Hungary, Switzerland, Italy, Greece and the British Isles have been investigated and slotted into the overall evolution of the planktonic foraminifera. In Chapter 9, the information on the whole of the Jurassic planktonic fauna is summarised in a series of palaeobiogeographical maps that detail the migration of various taxa as Gondwana fragmented during the Jurassic and Cretaceous.

CHAPTER 3

THE TOARCIAN

3.1 TOARCIAN OCEANIC ANOXIC EVENT

Mero-planktonic foraminifera may have resulted from the perturbation caused by the Early Toarcian gas hydrate dissociation and the ensuing Oceanic Anoxic Event (OAE) (Hart *et al.*, 2002, 2003), from which the planktonic foraminifera themselves later evolved (Wernli, 1995). The timing is certainly suggestive of a relationship.

The Early Toarcian Oceanic Anoxic Event appears to be associated with high palaeotemperatures, significant mass extinction and exceptionally high rates of organic carbon burial (Jenkyns, 1988; Vakhrameev, 1991; Jenkyns and Clayton, 1997; Harries and Little, 1999). Despite this, from carbon-isotope analyses of fossil wood, Hesselbo *et al.*, (2000) reported that isotopically light carbon dominated all the upper oceanic, atmospheric and biospheric carbon reservoirs. Over a period of ~80 Ka, the negative $\delta^{13}C_{carb}$ excursion varied in size, recorded in marine carbonate as a 2‰ to 5‰ negative shift and in marine and terrestrial organic matter as a 4‰ to 7‰ shift. They proposed that this resulted from voluminous and extremely rapid release of methane from the dissociation of hydrate contained in marine continental–margin sediments. Extensive carbonate dissolution during the negative excursion was considered to result from oxidation of this released methane.

Massive volcanism, together with intensified rift-related tectonic activity, could have resulted in environmental changes of sufficient magnitude to cause methane-hydrate dissociation in continental margin sediments (see Jenkyns, 1988; Dickens *et al.*, 1995; Hesselbo *et al.*, 2000) and a negative $\delta^{13}C$ excursion. If so, this release occurred during a eustatic sea-level rise of 30-90 m over approximately 1.5 Ma (Hallam, 1997; Hesselbo and

Jenkyns, 1998), increasing hydrostatic pressure and hydrate stability. Hydrate dissociation is believed to have been triggered by raised sea-floor temperatures and consequent realignment of the temperature gradient in the fault-disrupted sediment. A change in global thermohaline circulation may have increased bottom-water temperatures, with a shift in bottom-water formation from high to low latitudes, and governed the flow through the north-western European seaway. With the low-latitude deep-water formation driving the southward flow, its salinity has been calculated as 3-5‰ less than that of the northward flow. North-West European data indicate that salinity reduction is synchronous with the start of both black-shale deposition and the negative carbon-isotope excursion (Hesselbo *et al.*, 2000). The introduction of cool, nutrient-rich, northern bottom waters could have been an influencing factor in the organic enrichment in the north-west European seaway. The release and oxidation of methane in large quantities would have reduced oceanic oxygen, promoting organic-carbon burial regardless of nutrient redistribution. The oceanic carbonate balance would have been disrupted, increasing carbonate solubility. In deep-water Tethyan locations, the absence of primary carbonates with the negative carbon-isotope signal is a predicted consequence of gas-hydrate dissociation.

3.2 THE POSIDONIENSCHIEFER, SOUTH-WEST GERMANY

The Posidonienschiefer, near the village of Holzmaden in Baden Württemberg, South-West Germany is a Toarcian laminated, oxygen-depleted, black shale famous for its "stagnation Lagerstätten", the preservation of its marine fossils in the shale sequence. According to Hartgers *et al.* (1995), the Posidonian shale was deposited in an epicontinental sea under exaerobic conditions (dysaerobic/anaerobic boundary at the sediment-water interface; Bottjer and Savrda, 1993) over much of northwest Europe and southwards to the margins of the Tethys Ocean. There was substantial regional extinction in the early Toarcian, contemporaneous with a global transgression and the onset of black shale deposition. A positive carbon excursion in the shallow marine carbonates indicates a change in carbon cycling in the oceans, probably resulting from the widespread storage of carbon in bottom sediments. Despite decades of intensive studies, it is still uncertain whether conditions in the bottom waters were oxic or anoxic. Various theories have been advanced, including:

- anoxia in the bottom waters, evidenced by the exceptional fossil preservation (Seilacher *et al.*, 1985), together with the geochemistry (a high pyrite and organic content <15%) of the finely laminated sediment - undisturbed by burrowers;
- a boundary between anoxic and oxic conditions close to the sediment-water interface, with oxic bottom waters prevailing for long periods (Kauffman, 1981); and
- a sea-floor affected at intervals by storm-generated currents but with anoxic bottom conditions prevalent.

According to Brenchley and Harper (1998), on balance, the geochemical and much of the biotic evidence suggest that anoxia generally prevailed but the environment was episodically disturbed by more dysaerobic events.

3.3 TOARCIAN FAUNAL CHANGE IN BRITISH "JET ROCK"

The British Jurassic contains three major sequences of organic-rich shales.

1. The Jet Rock Formation (Lower Toarcian), with the highest organic carbon content, was probably deposited in very poorly oxygenated bottom waters. Within the sediment, reducing conditions extended up to the sediment surface, thereby preserving a higher organic carbon content. The changes to the foraminiferal assemblage across this stratigraphical interval have been described by Hilton and Hart (2000). In the Port Mulgrave succession, there is a "flood" of inflated *Oberhauserella* in the base of the Falciferum Subzone, just above the anoxic layer and the negative $\delta^{13}C$ excursion

(Fig. 3.1). The same changes were also reported in the Tilton and Holwell successions, though not at the famous Toarcian succession at Dotterhausen, Germany (see Hylton, 2000).

2. The Lower Oxford Clay (Callovian), with the lowest average organic carbon content, was probably deposited in mildly oxygenated bottom waters. The sediment profile consists of a thin upper oxidizing layer, with reducing conditions occurring a few centimetres below the sediment surface.
3. The Kimmeridgian Clay (Kimmeridgian) has a much wider variation in organic carbon content than the two other sequences, indicating accumulation in an environment which fluctuated periodically between mildly oxygenated and totally anoxic.

In addition, minor sequences are found in the Blue Lias Formation and the Shales-with-Beef Formation (Hettangian-Sinemurian) (Morris, 1980).

3.4 PRÉALPES MÉDIANES, SOUTH-WESTERN SWITZERLAND

Wernli (1995) studied the Lower Toarcian of the Préalpes Médianes, south-western Switzerland (see Chapter 2, section 2.1). His material came from an excavation on a forestry road near Teysachaux (Fribourg Alps), just above the anoxic event in the Falciferum Zone of the Toarcian and, therefore just above the negative carbon isotope excursion. The Creux de l'Ours section of Teysachaux is a famous fossil locality (including a specimen of a nearly complete ichthyosaur in the Bern Natural History Museum). Following a summer storm, a large number of trees had to be felled and, in order to access the woodland (Fig. 3.2a), the forestry road was widened. The fossiliferous sample studied by Wernli (1995) was collected by colleagues of Dr M. Weidmann (Lausanne Museum of Geology) and the site has now degraded. A section was opened up near to the "anoxic event" exposed in the river section (Fig. 3.2b) but samples from this trench proved to be barren (Fig. 3.2c).

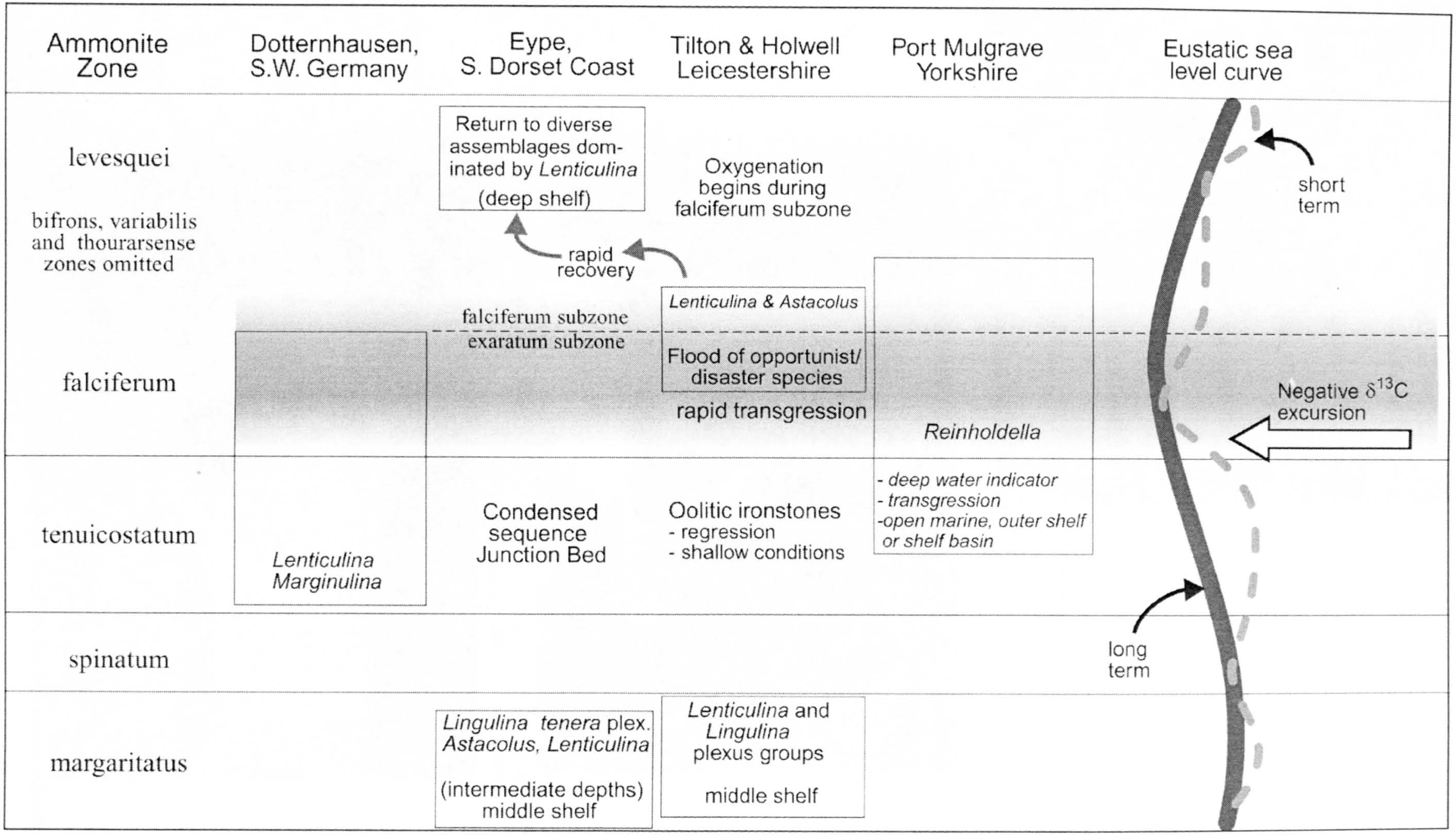


Figure 3.1. Model of the foraminiferal response to the early Toarcian extinction event (modified after Hylton and Hart, 2000). The positioning of the isotope excursion is based on Hesselbo *et al*. (2000) (Hart *et al*., 2003).

(a) View of the Fribourg Alps near Teysachaux. The river section up to the Toarcian "anoxic event" is in the wooded valley in the distance between the two buildings.

(b) Black mudstone of the Torcian "anoxic event" is localised in the bank of the Creux de l'Ours (coordinates 565.07/154.30 on the 1:25,000 geological map of Châtel-Saint Denis).

(c) Trench section excavated from the level of the "anoxic event" in the Falciferum Subzone. Samples proved to be barren.

Figure 3.2. Teysachaux location from which Wernli's (1995) samples were collected (Hart, 2001).

Wernli (1995) illustrates a number of *Oberhauserella quadrilobata* comparable to specimens in the Geologische Bundesanstalt, Vienna (see Chapter 2). He also illustrates (Wernli, 1995, pls 1, 2) a number of forms of *Praegubkinella turgescens*, some of which are not as inflated or developed as *Oberhauserella alta* (Pl. 1, Fig. 3a-d) or *Praegubkinella turgescens* (Pl. 5, holotype Fig. 2a-c and paratypes Figs 3a-c, 4a-c).

All of this information clearly indicates that, in the samples just above the Falciferum Subzone "anoxic event", the *Oberhauserella* and *Praegubkinella* faunas diversify, develop more inflated chambers and produce forms very similar to high-spired *Conoglobigerina*. The question remains, however, are these inflated oberhauserellids developing a planktonic mode of life or are they still benthonic? In the British Isles, at exactly the same level, there is a flood of inflated *Oberhauserella quadrilobata* immediately above the black mudstones of the Falciferum Zone (Hylton, 2000). Wernli (1988) described the same transition to a "protoglobigerinid" in the Toarcian-Aalenian in the Taurus Mountains, Turkey.

Prior to these changes in the mid-Toarcian, there are no records of definite planktonic foraminifera. Some early records are in doubt (sample contamination) and the specimens described by Görög (1994) as *Globuligerina geczyi* are also thought to be Cenozoic contaminants (see Simmons *et al.*, 1997, p. 20). Detailed work by Hillebrandt *et al.* (2006) in the Northern Calcareous Alps has described a Hettangian fauna that includes *Oberhauserella* and *Praegubkinella turgescens* but no other planktonic taxa (Fig. 3.3). Current evidence, therefore, suggests that it is in the Toarcian where the first changes to a planktonic mode of life occurred within the foraminifera, although the direct association with the anoxic event has yet to be tested (Hart *et al.*, 2003).

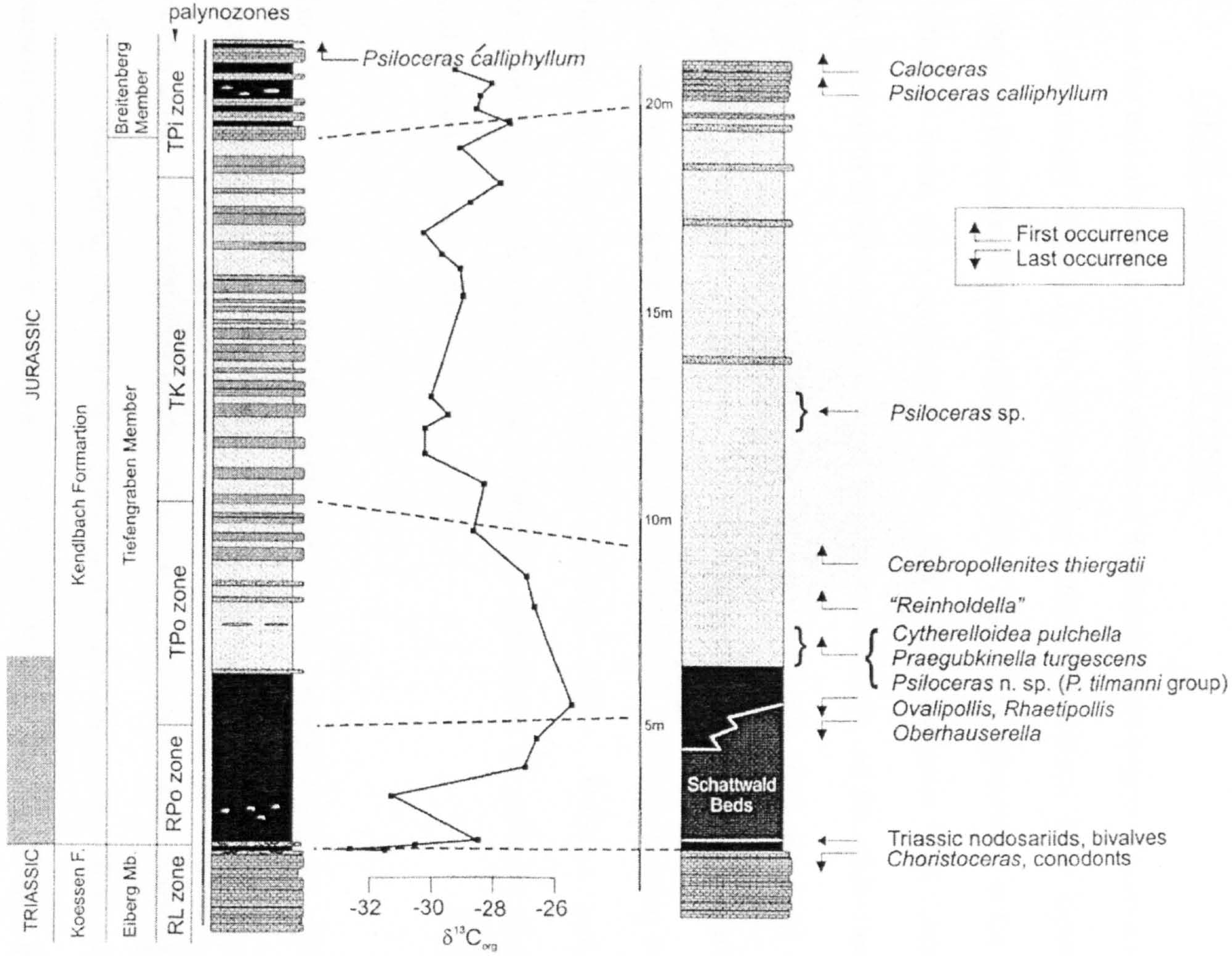


Figure 3.3. Triassic-Jurassic transition in Austria provided by Hillebrandt and Krystyn (Krystyn, pers. comm. to Professor Hart, April 2006). This records the presence of *Oberhauserella* and *Praegubkinella* in the boundary interval but there are no records of other, more likely, planktonic taxa.

CHAPTER 4

SOMHEGY, BAKONY MOUNTAINS, NORTH-WESTERN HUNGARY

4.1 GEOLOGICAL SETTING

Since the mid-nineteenth century, studies of the Bajocian outcrops and excavations of Som Hill (Somhegy) (Fig. 4.1), in the northern Bakony Mountains, have appeared in the Hungarian literature (Wernli and Görög, 1999). The Bakony Mountains, at the edge of the Pannonian Basin, are a continuation of the Alps towards the inner West Carpathians and are believed to have been a transitional area between Tethys and the epicontinental region (Galácz, 1976; Monostori, 1995). The Jurassic sediments were deposited on oceanic heights and inter-seamount grabens, each having distinct lithological, stratigraphical and palaeontological characteristics (Wernli and Görög, 1999). Somhegy belongs to a group of discontinuous or "seamount" sequences (Galácz, 1976). Detailed geological and palaeontological studies have been undertaken, particularly of molluscs (Galácz, 1976; Szabó, 1990; Szente, 1995).

The oldest rock on Somhegy, the Hettangian, yellow, oolithic, Dachstein-type Kardosrét Limestone Formation, is overlain by red, nodular, Bajocian Ammonitico Rosso limestone, clearly dated by the ammonite fauna. Within the former, there are "gradually attenuated S-fissures parallel to the bedding, approximately 180 cm thick, filled with reddish, manganiferrous, micritic limestone", containing Bajocian fossils (Wernli and Görög, 1999). Szabó (1990) distinguished six beds in the fissure-infilling. Using the ammonite zonation, Galácz (1976) established that the lower three beds belonged to the Humphriesianum Zone (Lower Bajocian) and the upper three to the Niortense Zone (Upper Bajocian) (Fig. 4.2). According to Wendt (1971), a submarine dyke was suggested by the faunal assemblages and their state of preservation. A relatively deep-water environment

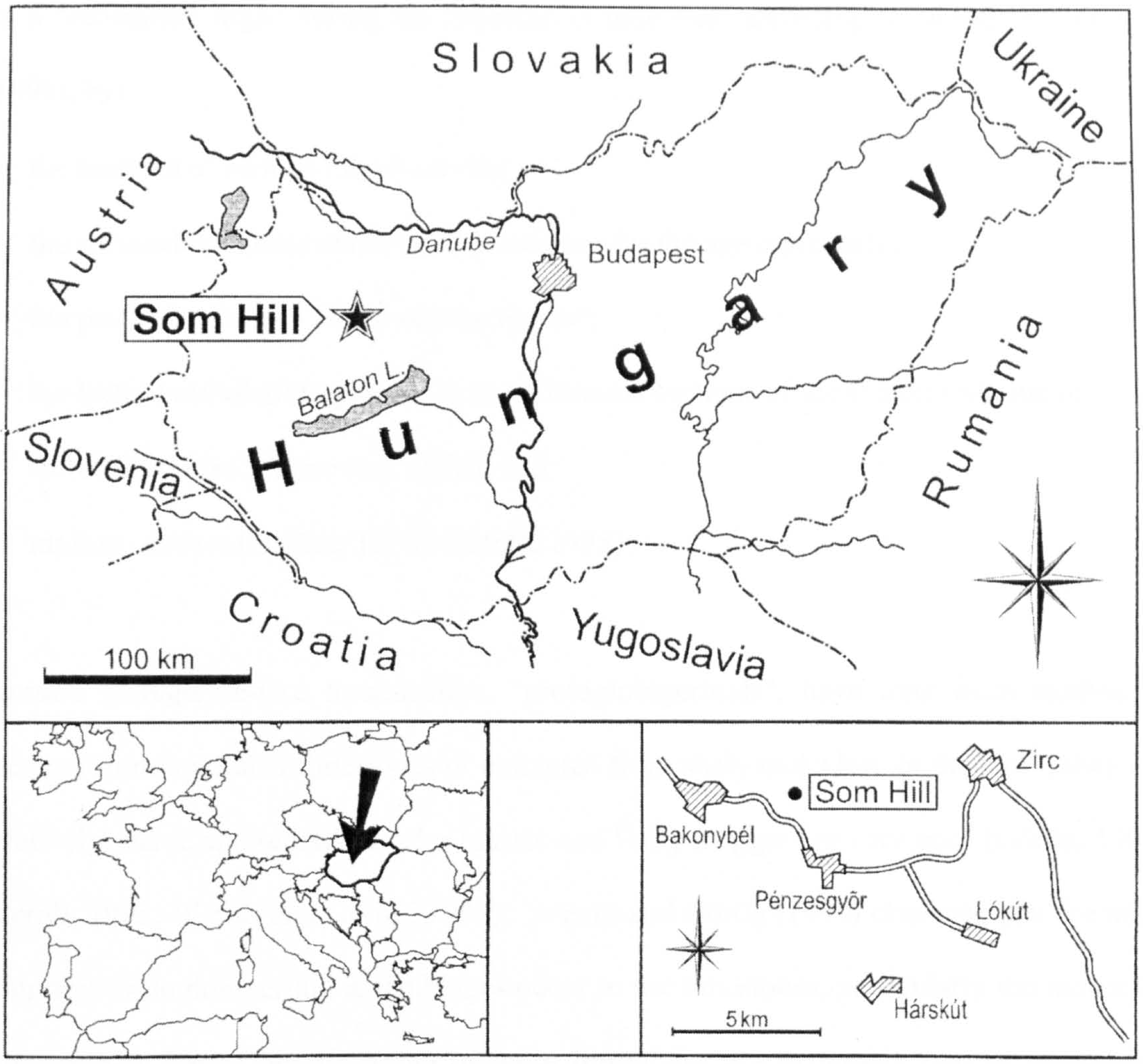


Figure 4.1. Sketch map of the locality of the studied Bajocian section on Somhegy in the Bakony Mountains, Hungary (Wernli and Görög, 1999).

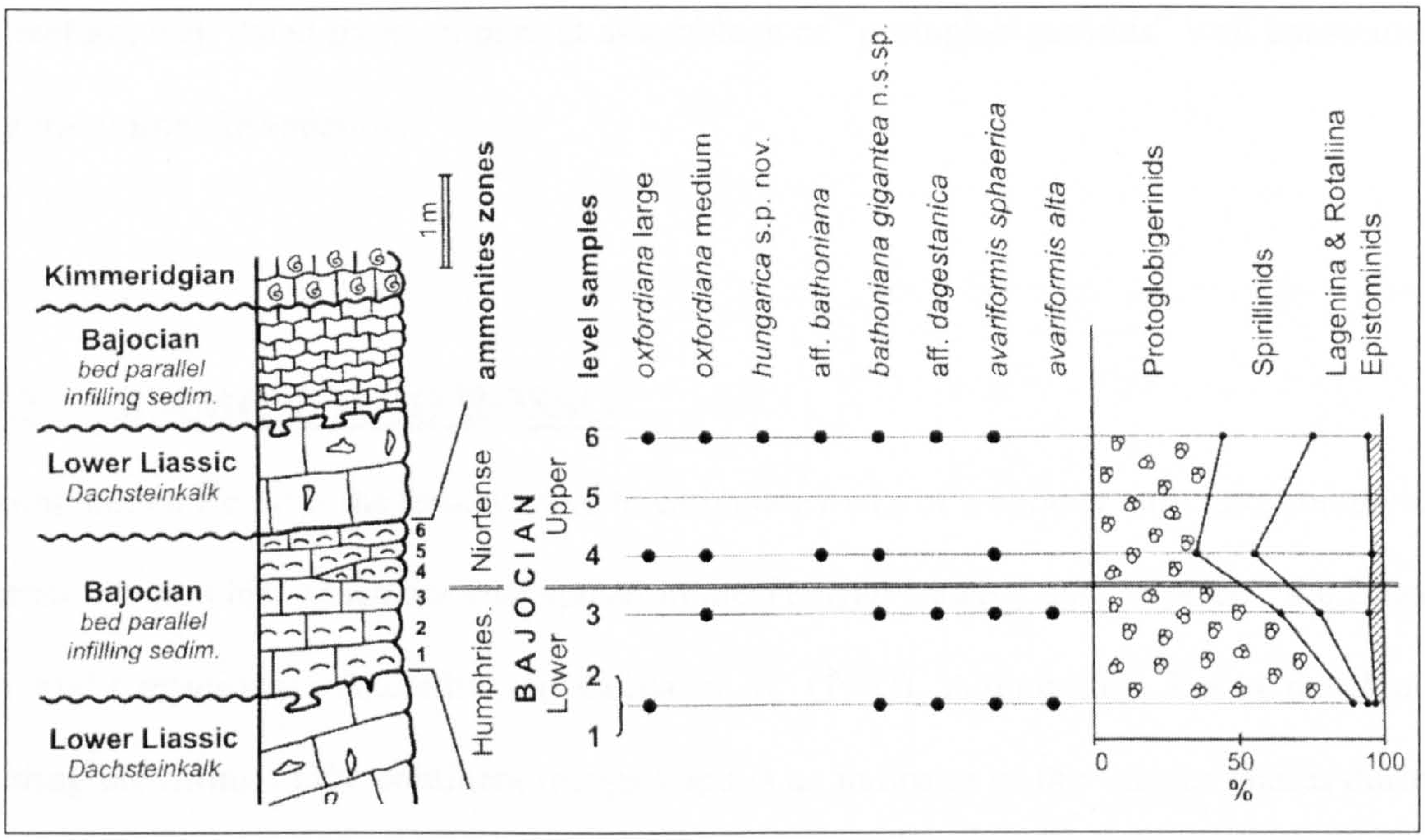


Figure 4.2. Simplified stratigraphical sequence on the top of Somhegy with the distribution of protoglobigerinid taxa and the abundances of the characteristic foraminiferal groups. The studied beds are numbered (Wernli and Görög, 1999).

on a "submarine high" during the Bajocian is indicated, according to Wernli and Görög (1999), by:

- the hiatuses at various time intervals;
- the reduced thickness of the rock succession for the age represented;
- the particular facies - "Ammonitico Rosso";
- the lack of radiolarites, present in most Jurassic sections of the Bakony Mountains;
- ostracod studies (Monostori, 1995); and
- mollusc studies (Galácz, 1976; Szente, 1995).

Jurassic globigerine-like foraminifera, "protoglobigerinids", have long been studied in sections from indurated limestones or extracted from shaly rocks but, in the latter, they are relatively scarce and records for the Liassic and Early Dogger are very poor (Görög, 1994; Wernli, 1995; Wernli and Görög, 1999). Wernli and Görög (1999) observed that the most abundant protoglobigerinid assemblages occur in the limestones, particularly the indurated Ammonitico Rosso facies. Some of these limestones are extremely rich in specimens, which often appear as “blooms”. The Bajocian Ammonitico Rosso of Somhegy is, therefore, well dated by an important assemblage of “protoglobigerinids” well constrained by the ammonite zonation.

4.2 AMMONITICO ROSSO

Ammonitico Rosso is the term applied to carbonate rocks of a nodular structure, containing ammonite moulds, which are widespread in the Tethyan Jurassic and, in places, the Lower to mid-Cretaceous. According to Cecca *et al.* (1992), Ammonitico Rosso developed during the rifting of the continent margins and is an indicator of the various phases during the opening of Tethys. It developed particularly in areas of complex palaeogeography, being found on the tops and slopes of tilted-blocks, and in the related basins. Their palaeoenvironmental reconstructions indicated that the Ammonitico Rosso disappeared in the late Berriasian. Despite having some common properties, these facies differ in various significant respects (di Stephano *et al.*, 2002). Typically red, Ammonitico Rosso may also be grey or green, often as a result of late diagenesis. The nodular structure is composed of rounded pieces of almost pure limestone in a matrix of dark red marls or marly limestone. Ammonitico Rosso is typically pelagic, often lacking the carbonate grains indicative of a shallow-water platform environment and terrigenous sediments. Sedimentation rates are very low, most of the sediment being biogenic, with frequent stratigraphical discontinuities.

Aubouin (1964) used the relative proportions of the nodules and matrix to differentiate initially between basinal, marly Ammonitico Rosso and more calcareous, swell-zone facies, the latter being further differentiated into "flaserkalke", indicating slow, continuous sedimentation, modified by late diagenesis, and "knollenkalke", indicating discontinuous sedimentation, evidenced by hardgrounds.

The differing natures and origins of nodules have been the subject of various studies. The nodular structure can result from a combination of factors, including bioturbation, winnowing, early cementation and pressure dissolution (di Stephano *et al.*, 2002). Based on an assumption that the pre-Ammonitico Rosso sediment was a fairly homogeneous mixture of clay minerals, calcareous nannofossil ooze and aragonite, Jenkyns (1974), from his study of Western Sicily, proposed that nodules were formed by calcite precipitation through the dissolution of the less-stable aragonite grains, during a period of minimal sedimentation rates and "in an environment that is not commonly found today".

According to di Stephano *et al.* (2002), points on which authors agree include:

- in its more calcareous facies, Ammonitico Rosso tends to result from sedimentation on top of fault blocks resulting from the rifting and drowning of carbonate platforms;

- detached from the continent and surrounded by deeper basins, the only source of sediments, apart from a benthonic component, is slow pelagic sedimentation, typically resulting in condensed facies;
- currents were intermittently active, as evidenced by intraclasts, taphonomically reworked ammonites, frequent erosional discontinuity surfaces and traction laminae preserved within neptunian dykes; and
- bottom conditions were highly oxygenated, indicated by the red colouration of the rock.

Conversely, the depth at which Ammonitico Rosso sediments were deposited is controversial. Winterer and Bosellini (1981) estimated a depth of approximately 1000 m for the Ammonitico Rosso Veronese in their study of the Southern Alps. More recent studies in this region and the Central Apennines, however, have suggested relatively shallow depths, on the basis of sedimentological and palaeontological evidence. Hummocky cross-stratified beds, interbedded within various Ammonitico Rosso facies of differing ages have been described by Cecca *et al.* (1990), Monaco (1992), Santantonio (1993) and Zempolich, (1993). Ammonitico Rosso sedimentation could have occurred at a wide range of depths, including the photic zone, as is the case with other typical Tethyan Jurassic pelagic lithofacies.

Martire (1996) distinguished eight facies in the Ammonitico Rosso Veronese of north-eastern Italy, differing from each other in structure, (bedding, style, presence and type of nodularity) and texture (nature of components, compaction). He subdivided it into three units:

- lower Ammonitico Rosso (Upper Bajocian-Lower Callovian), massive and nodular;
- middle Ammonitico Rosso (Upper Callovian-Middle Oxfordian), well-bedded, non-nodular and cherty; and
- upper Ammonitico Rosso (Lower Kimmeridgian-Tithonian), richer in clay and

typically nodular.

Cecca *et al.* (2001) distinguished three subfacies within the Ammonitico Rosso of Western Sicily: nodular, pseudo-nodular and intraclastic nodular. The latter two suggest formation by hydrodynamic processes, since their characteristic intraclasts are principally formed by mechanical abrasion.

According to Görög and Wernli (2002), Bathonian Ammonitico Rosso facies occur in two "megatectonic" units of Hungary, the Transdanubian Central Range of the Pelso Unit and the Mecsek Mountains (Southern Hungary) of the Tisia Unit. During the mid-Jurassic, these areas belonged to different provinces of the Tethyan Realm, the Transdanubian Central Range to the Mediterranean Province and the Mecsek Mountains (like North-West Europe) to the Submediterranean Province. Bathonian and Callovian Ammonitico Rosso facies are rare in the Mediterranean Province because of the prevalence of radiolarites during these stages. In the Transdanubian Central Range, the only series of Bathonian Ammonitico Rosso so far discovered is in the Gyenespuszta area (Galacz, 1980). Its rich, diverse protoglobigerind assemblages contrast with a lack of protoglobigerinids in the marly limestone Ammonitico Rosso series of the Middle Jurassic in the Mecsek Mountains (Görög, 1995). Apart from Gyenespuszta, similar facies are known only from Southern Poland (Wierzbowski *et al.*, 1999) (see Chapter 5) and Sicily (Görög and Wernli, 2002) (see Chapter 6).

4.3 EARLY RECORDS OF PLANKTONIC FORAMINIFERA

Although the occurrence of Jurassic planktonic foraminifera has been known since the middle of the nineteenth century, there were few studies undertaken until recent years, when more material became available for analysis. Details of the test sculpture and porosity for each species were not visible using light microscopes in the earlier studies but, since the advent of electron microscopes, important new distinguishing features have been observed. As a result, Grigelis and Gorbatchik (1980a) believed that the holotypes or topotypes of all previously identified species of globigerine-like foraminifera needed to be studied by electron microscopy. Due to the comparative scarcity of protoglobigerinids, the stratigraphical ranges are not well-established and the taxonomy at both specific and generic level is unsatisfactory, the definitions of taxa in the literature varying considerably. Görög and Wernli (2002) considered a good knowledge of these to be fundamental, with accurate diagnostic keys being required to define evolutionary trends in the first planktonic foraminifera and their phyletic relationships with the Cretaceous groups whose expansion appears to have begun in the Barremian.

Phyletic relationships have been challenged following the discovery of large and "giant" species in the Bajocian by Wernli and Görög (1999), contradicting the usual evolutionary pattern, where small species generally precede the larger ones. This occurrence of very large and thick-walled species early in the evolution of the protoglobigerinids, at present apparently restricted to the Mediterranean Province, is believed to be due to the palaeogeography (Fig. 4.3) and palaeoceanographical conditions. The protoglobigerinid assemblages also vary considerably in morphology, the majority of taxa demonstrating a range of transitional forms, and there tends to be ambiguity in the features of the "globigerine" morphology. Many extant rotaline genera become planktonic just before and during reproduction, in order to disperse their water-borne gametes over greater areas (Simmons *et al.*, 1997). Wernli and Görög (1999) queried whether the considerable intraspecific variability (general morphology, size, etc.) observed in the well-diversified Early Bajocian protoglobigerinid assemblages of Somhegy resulted from evolutionary adaptation to ecological factors or from generational dimorphism. Despite details of the juvenile stages being insufficiently visible in their thin sections to determine the existence of generational dimorphism, they subsequently confirmed (Görög and Wernli, 2002) that

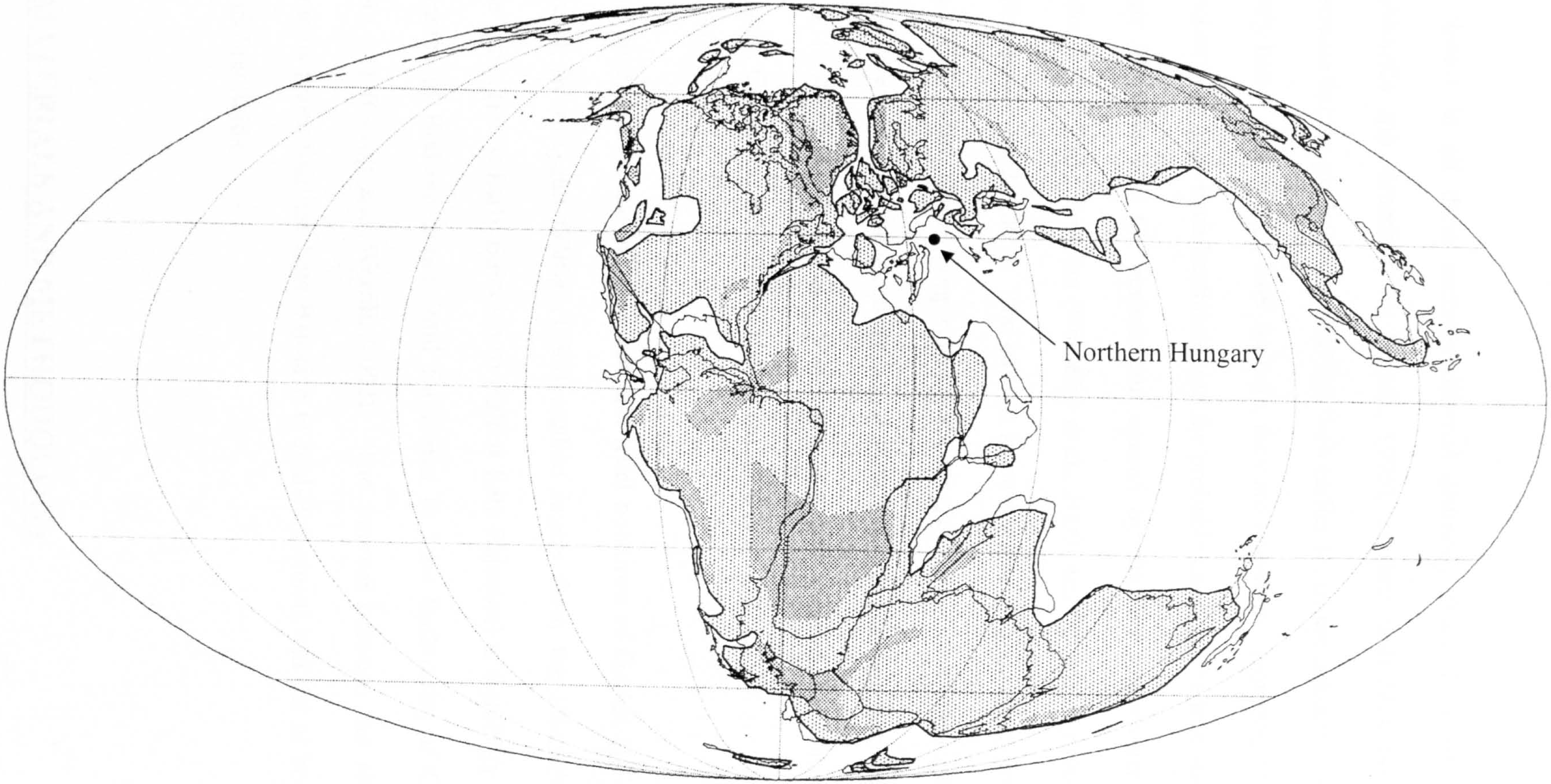


Figure 4.3. Palaeocoastlines of the Bajocian (Middle Jurassic) 170 Ma (Smith *et al*, 1994). The approximate position of northern Hungary is indicated.

the small species present were not juvenile forms of the larger ones.

The specimens in all these sections differed distinctly from those of the Toarcian (*Praegubkinella* spp. described by Wernli, 1995), in size, wall-thickness and general characteristics but the phyletic relationships with earlier forms are unknown and, even with the slightly better documented later Jurassic, they are uncertain. However *Praegubkinella* is now believed to have been benthonic and the probable cause of the transition to a meroplanktonic life-style was the perturbation caused by massive underwater gas hydrate dissociation in the Early Toarcian (Hesselbo et al., 2000) and the ensuing Oceanic Anoxic Event (Hart et al., 2002, 2003). The earliest known typically planktonic foraminfera are probably the Bajocian *Conoglobigerina* which, up until now, have apparently only been recorded from eastern Europe (northern and central Tethys): *Conoglobigerina avariformis* Kasimova, 1984, *C. balahmatovae* (Morozova, 1961), *C. dagestanica* Morozova, 1961, and, possibly, *C. avarica* Morozova, 1961 (Simmons *et al.*, 1997).

Using the biostratigraphical subdivisions and level notations of Galácz (1976 and 1980, respectively), Wernli and Görög (1999) studied layers from the Humphriesianum to Niortense zones (latest Early Bajocian to earliest Late Bajocian) at Somhegy and then the Subcontractus to Hodsoni zones (mid Bathonian to Late Bathonian) at Gyenespuszta (Figs 4.4, 4.5) (Görög and Wernli, 2002). The interval between the Niortense and Subcontractus zones (earliest Late Bajocian to mid-Bathonian) had yet to be investigated for protoglobigerinids.

4.4 MATERIALS AND METHODOLOGY

Samples of limestone from the Humphriesianum, Niortense and Parkinsoni zones of Somhegy were collected by Professor M.B. Hart, under the guidance of Professor

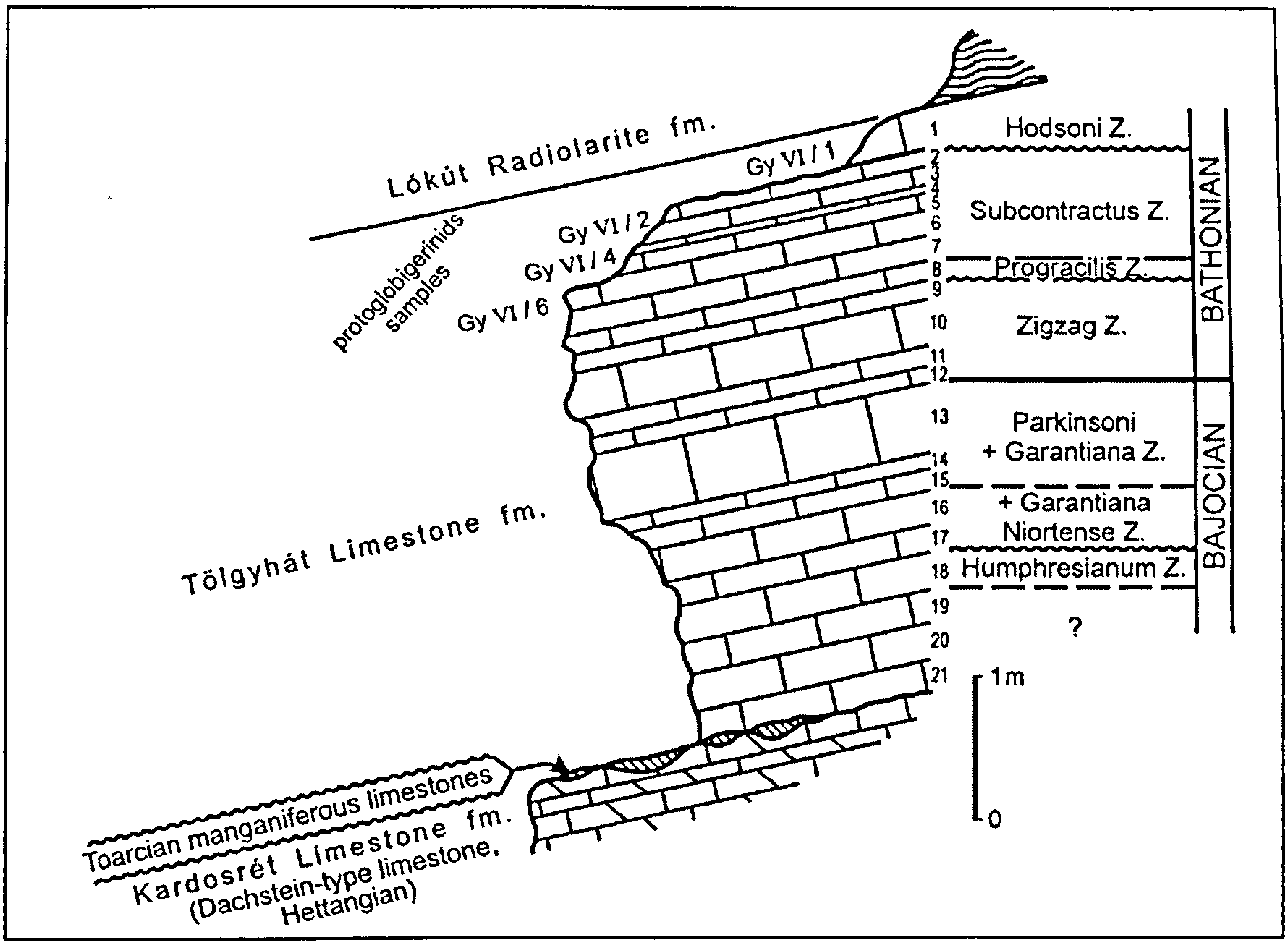
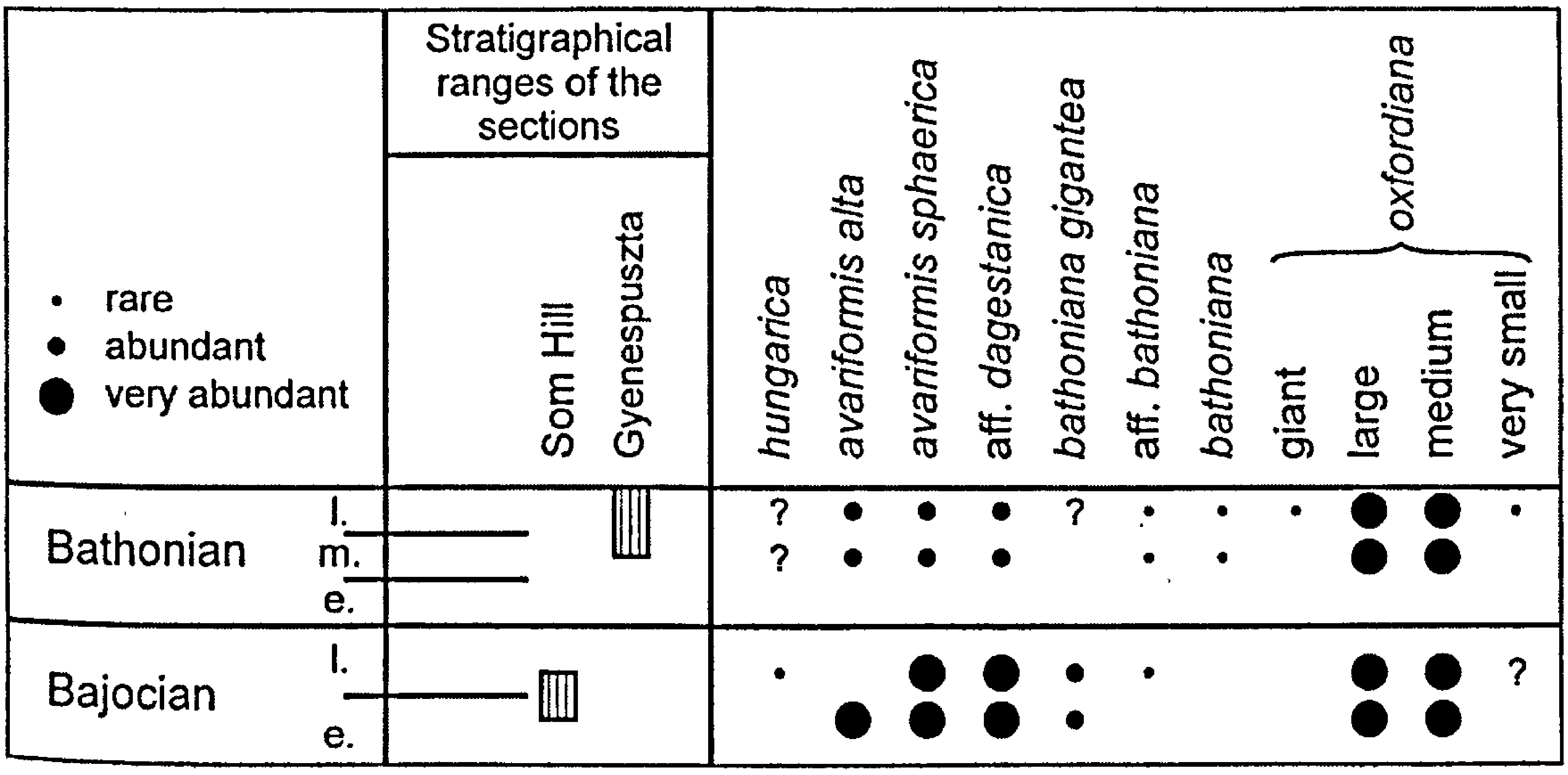


Figure 4.4. Lithostratigraphy and ammonite biozonation of Gyenspuszta section VI, after Galácz. Sampling locations Gy VI – 1,2,4,6 (Görög and Wernli, 2002).



• rare ● abundant ⬤ very abundant		Som Hill	Gyenespuszta	hungarica	avariformis alta	avariformis sphaerica	aff. dagestanica	bathoniana gigantea	aff. bathoniana	bathoniana	oxfordiana giant	oxfordiana large	oxfordiana medium	oxfordiana very small
Bathonian	l.		▥	?	●	●	●	?	•	•	•	⬤	⬤	•
	m.			?	●	●	●		•	•		⬤	⬤	
	e.													
Bajocian	l.	▥		•		⬤	⬤	●	•			⬤	⬤	?
	e.				⬤	⬤	⬤	●				⬤	⬤	

Stratigraphical ranges of the sections

Figure 4.5. Stratigraphical distribution and relative abundance of protoglobigerinids at Somhegy (Wernli and Görög, 1999, 2000) and Gyenespuszta (Görög and Wernli, 2002) in the Bakony Mountains.

R. Wernli and J. Szabó. Present outcrops of limestone are very poorly exposed in quite dense, tick-infested woodland at the top of the hill (Fig. 4.6), much of it in the remains of a trench excavated in the 1990s. The samples used by Wernli and Görög (1999) were collected from this trench. Much of this excavation is now overgrown but parts can still be uncovered. The section illustrated in Wernli and Görög (1999, fig. 2) is not really visible and the succession is difficult to piece together. Ammonites are abundant and can be used for age correlation.

Thin sections from the three zones were examined under an Olympus Vanox Universal Research Microscope fitted with a biological stage. Using the "Provisional Determination Key" established by Wernli and Görög (2000), the planktonic foraminifera present were identified (see Appendix III). The maximum diameters and test thicknesses of the specimens were measured using a calibrated graticule. For each layer, the number of chambers visible for each specimen was plotted against its maximum diameter. The data were then separated into two categories, for thick-walled and thin-walled specimens, respectively. For each category, the abundance of specimens was plotted against maximum diameter and the results of the two categories compared.

4.5 RESULTS AND DISCUSSION

4.5.1 ANALYSIS OF THIN SECTIONS

While “larger” foraminifera are frequently analysed in thin-section and subjected to biometric analysis, this is not normally the case for “smaller” benthonic foraminifera or planktonic foraminifera. In the case of protoglobigerinids, most sections are random slices through the approximately four chambers that form the final whorl of the test. The interpretation of such data is, therefore, rather subjective.

In many of the thin-sections from Somhegy, the planktonic foraminifera are noted as

(a) View of Somhegy.

(b) Outcrop at Somhegy.

(c) Close-up of limestone.

Figure 4.6. Somhegy sampling location (Hart, 2001).

having both thin-walled and thick-walled forms while all other characters appear comparable. This was also noted by Görög and Wernli (2002) and is discussed in a later section (4.6)

4.5.1.1 LATE EARLY BAJOCIAN: HUMPHRIESIANUM ZONE

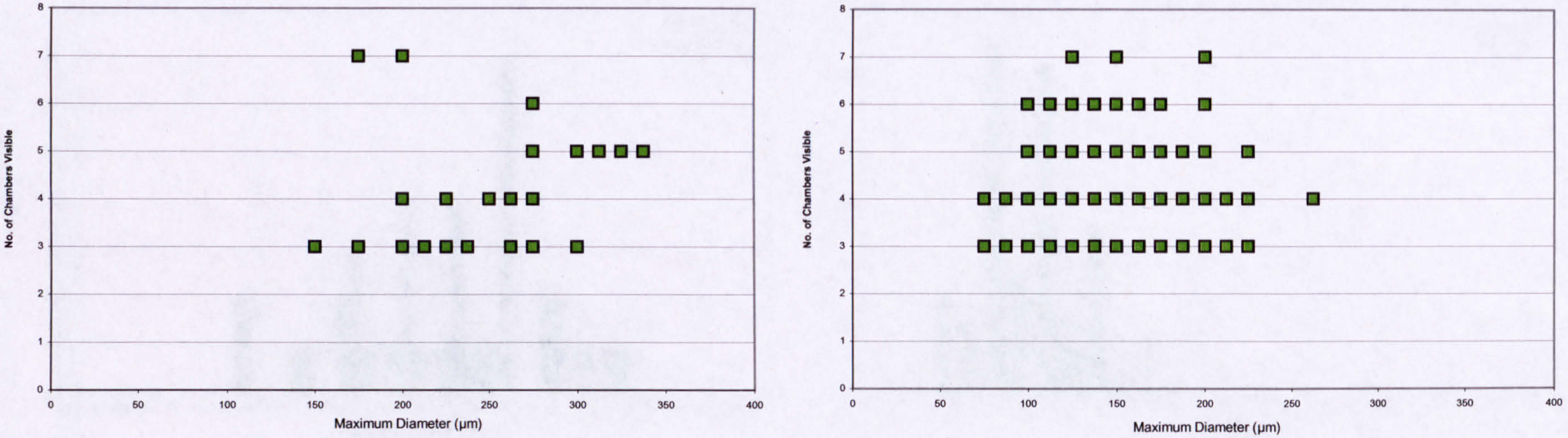
From the Humpriesianum Zone, thin sections from four layers were examined (Figs 4.7, 4.8).

HUMPHRIESIANUM: BASAL LAYER

In this sample, taken from the lowest level of the Humphriesianum Zone, planktonic foraminifera were sparse, so comparison between thick- and thin-walled specimens could only be superficial. Maximum diameters ranged from 150-337.5 µm, the thick-walled specimens ranging from 175-325 µm and the thin-walled specimens present throughout the total range. The maximum number of chambers visible was 7, at maximum diameters of 175 µm and 200 µm, both relating to thin-walled specimens. Whilst the thick-walled specimens had slightly less variation in their maximum diameters, there tended to be more individuals per diameter, with a maximum at 275 µm. Conversely, the thin-walled specimens had slightly more variation in diameter. The percentage ratio of thick-walled specimens to thin-walled specimens was 63% : 37%.

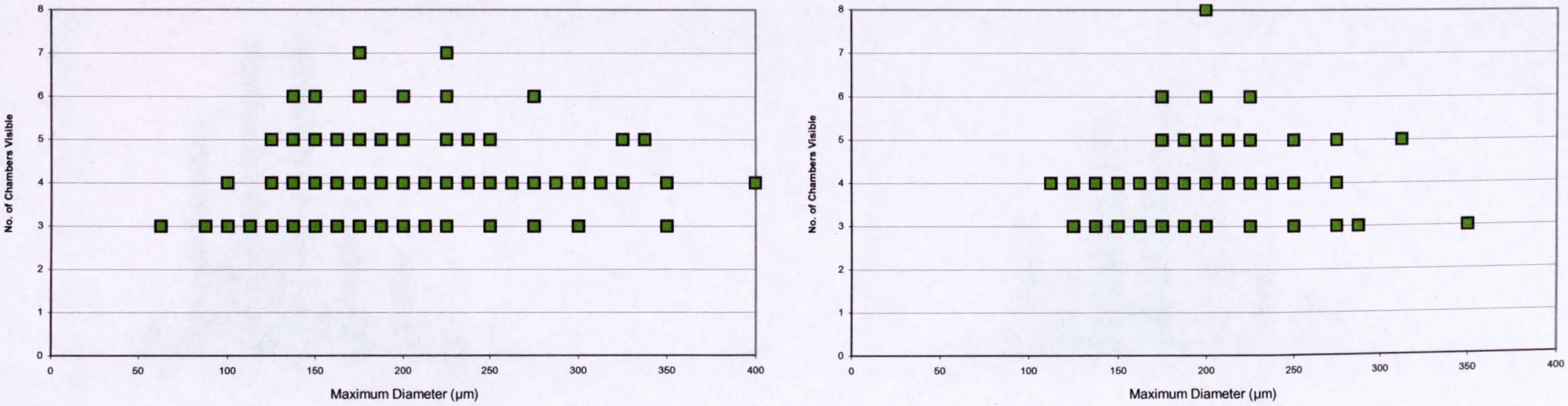
HUMPHRIESIANUM: LAYER 1

This sample demonstrated a marked increase in abundance. Maximum diameters ranged from 75-262.5 µm, with the thick-walled specimens again having a reduced range of 100-225 µm. The maximum number of chambers visible was 7, at maximum diameters of 125 µm, 150 µm and 200 µm, all of which related to thin-walled specimens. In addition to this reduced range, the thick-walled specimens were an order of magnitude lower in abundance, the maximum number of individuals occurring at a diameter of 150 µm,



Humphriesianum - Basal

Humphriesianum - 1



Humphriesianum - 2

Humphriesianum - 4

Figure 4.7. Comparison of the chambers visible in planktonic foraminifera from Somhegy: Humphriesianum Zone.

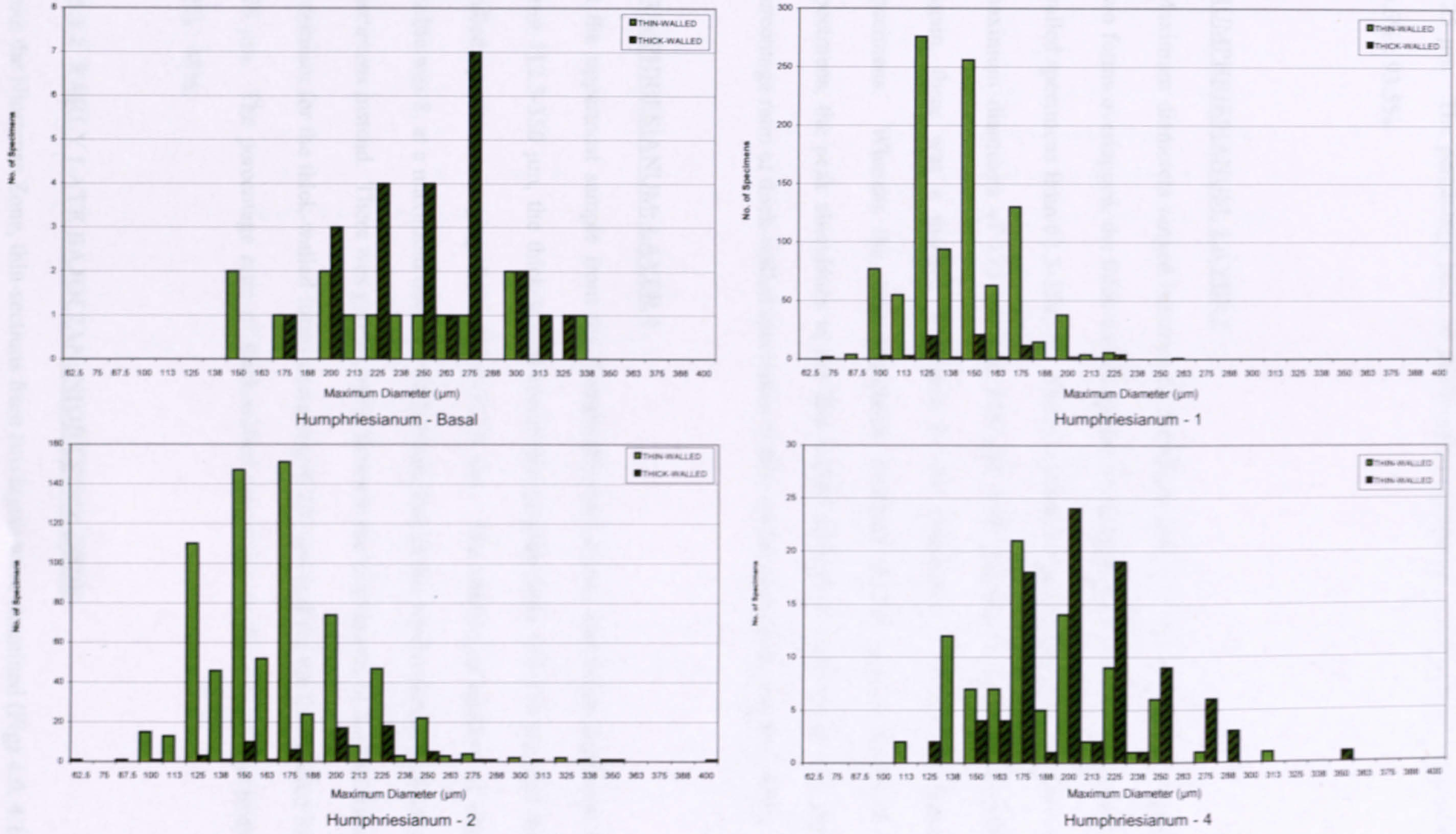


Figure 4.8. Comparison of the abundances of thick-walled and thin-walled planktonic foraminifera from Somhegy: Humphriesianum Zone.

whereas the maximum abundance for the thin-walled specimens occurred at a diameter of 125 µm. The percentage ratio of thick-walled specimens to thin-walled specimens was 6.5% : 93.5%.

HUMPHRIESIANUM: LAYER 2

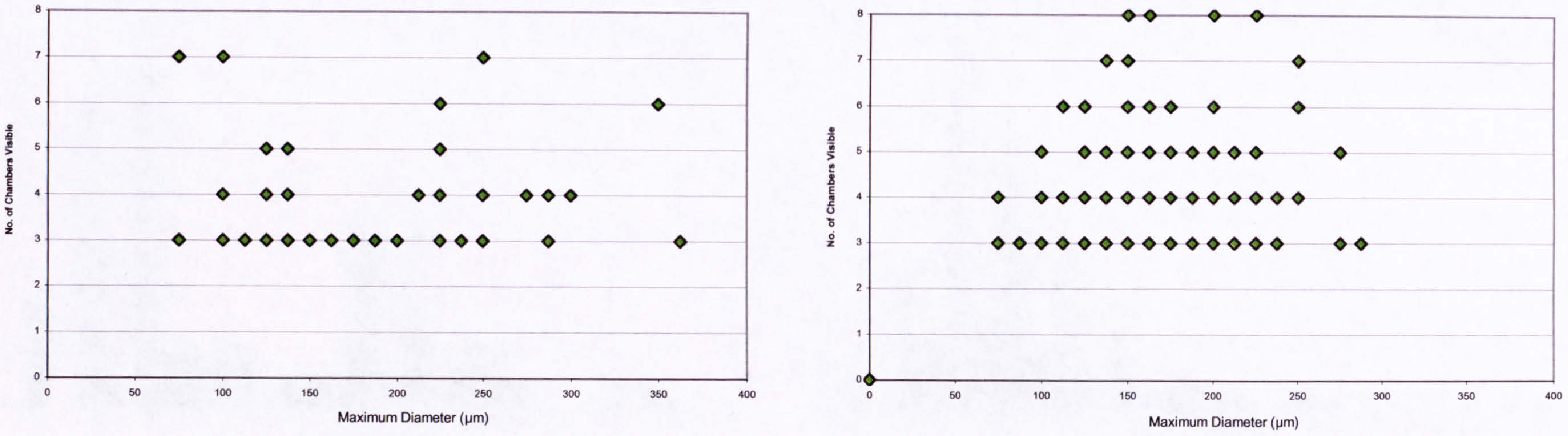
Maximum diameters ranged between 62.5-400 µm and, in this sample, the ranges of the two forms overlapped, the thick-walled specimens ranging from 100-400 µm and the thin-walled specimens from 62.5-350 µm. The maximum number of chambers visible was 7, at maximum diameters of 175 µm and 225 µm, both relating to thin-walled specimens. Again, there was a marked difference in the abundance of thick and thin-shelled specimens. Whereas the peak abundance occurred at 225 µm in the thick-walled specimens, the peak abundance in the thin-walled specimens occurred at 175 µm. The percentage ratio of thick-walled specimens to thin-walled specimens was 8% : 92%.

HUMPHRIESIANUM: LAYER 4

In the uppermost sample from the Humphriesianum Zone, maximum diameters ranged from 112.5-350 µm, the thick-walled specimens ranging from 125-350 µm and the thin-walled specimens ranging from 112.5-312.5 µm. The maximum number of chambers visible was 8, at a maximum diameter of 200 µm, but, at this level, relating to thick-walled specimens instead. There was greater parity between the abundances of the two forms, the maximum for the thick-walled forms occurring at 200 µm and for the thin-walled forms at 175 µm. The percentage ratio of thick-walled specimens to thin-walled specimens was 52% : 48%.

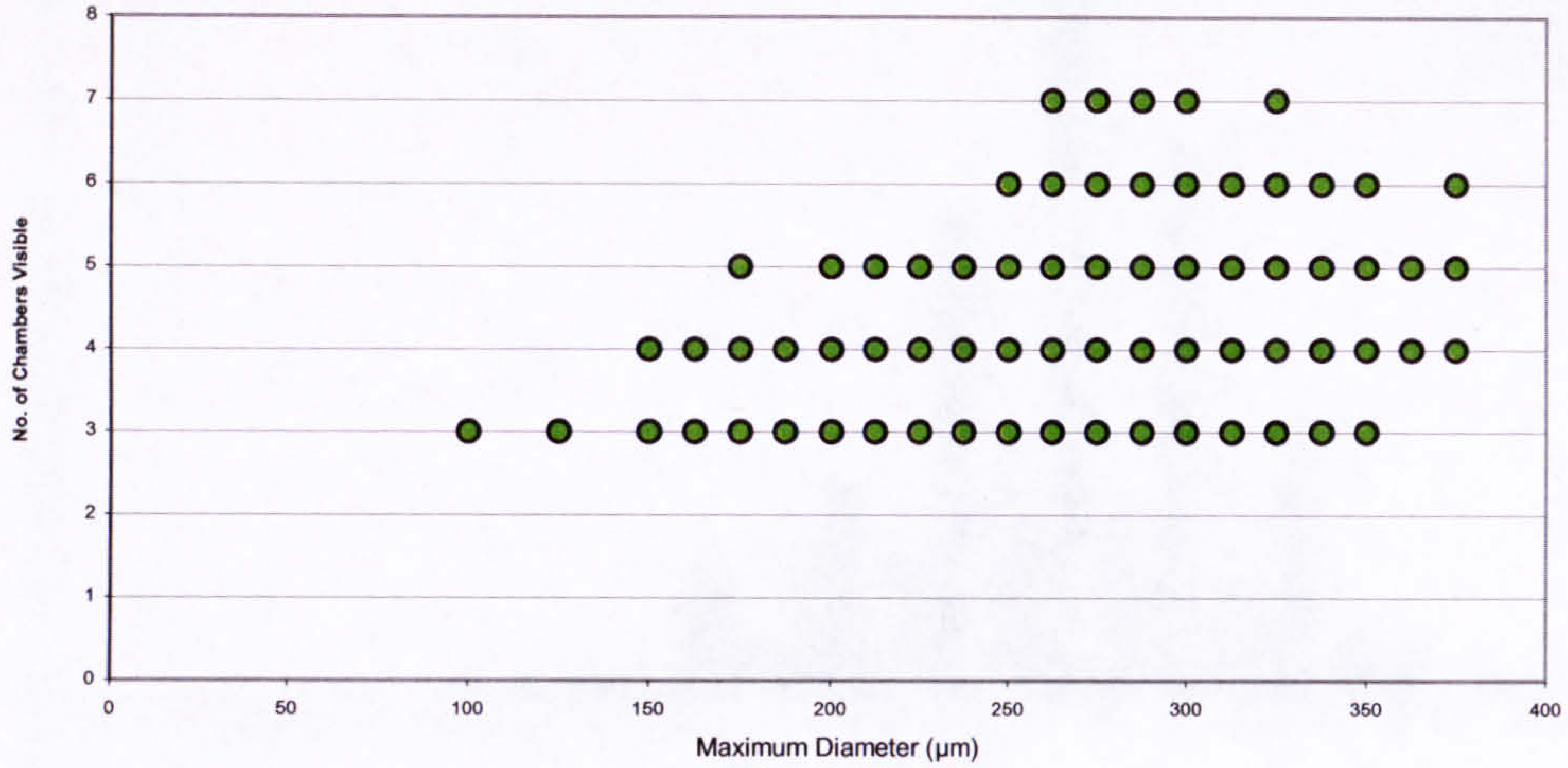
4.5.1.2 EARLY LATE BAJOCIAN: NIORTENSE ZONE

From the Niortense Zone, thin-sections from two layers were examined (Figs 4.9, 4.10).



Niortense - 1

Niortense - 2



Parkinsoni

Figure 4.9. Comparison of the chambers visible in planktonic foraminifera from Somhegy: Niortense and Parkinsoni zones.

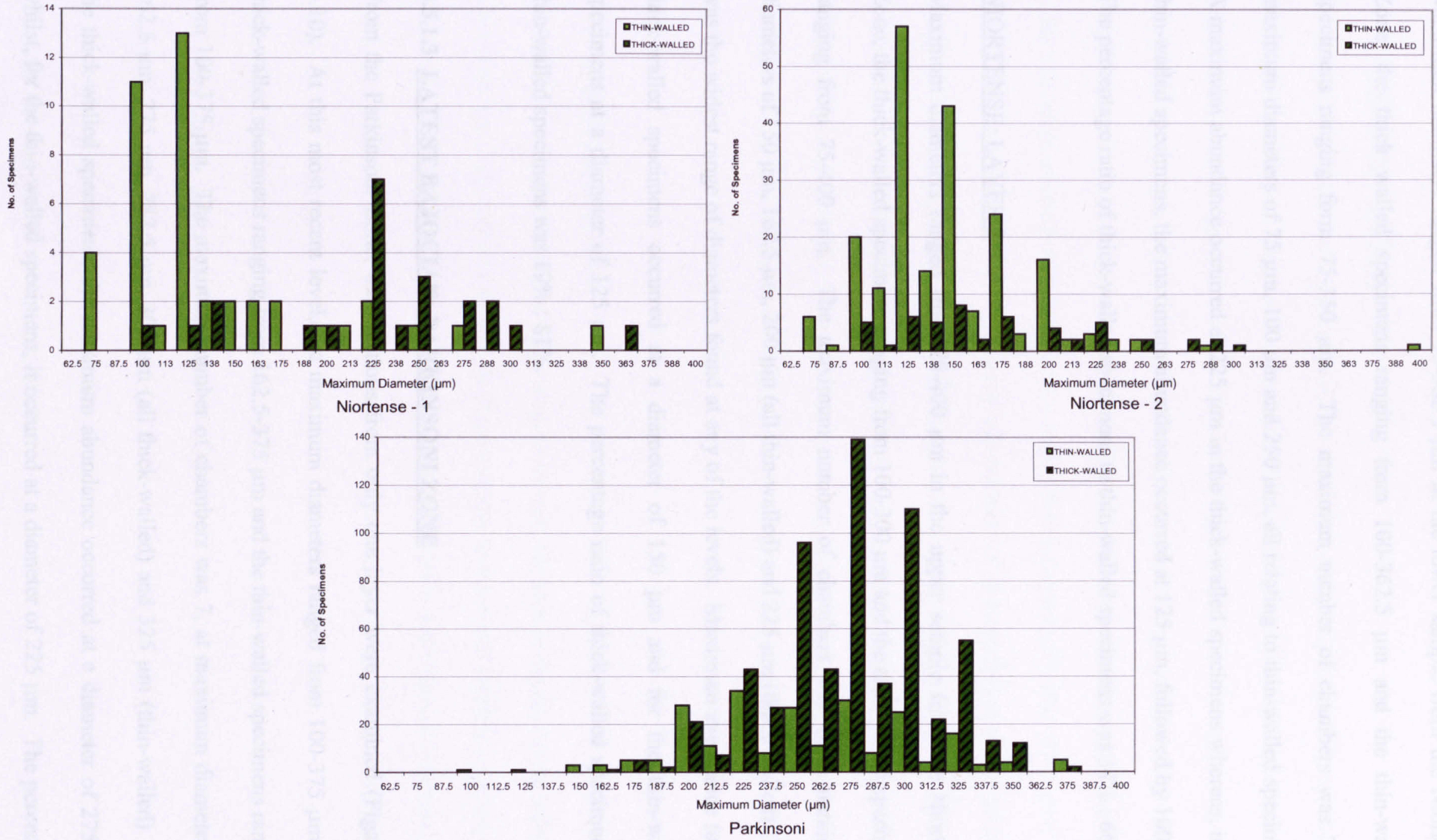


Figure 4.10. Comparison of the abundances of thick-walled and thin-walled planktonic foraminifera from Somhegy: Niortense and Parkinsoni zones.

NIORTENSE: LAYER 1

Maximum diameters ranged from 75-362.5 µm in the lower sample from the Niortense Zone, the thick walled specimens ranging from 100-362.5 µm and the thin-walled specimens ranging form 75-350 µm. The maximum number of chambers was 7, at maximum diameters of 75 µm, 100 µm and 250 µm, all relating to thin-walled specimens. A maximum abundance occurred at 225 µm in the thick-walled specimens whereas, in the thin-walled specimens, the maximum abundance occurred at 125 µm, followed by 100 µm. The percentage ratio of thick-walled specimens to thin-walled specimens was 34% : 66%.

NIORTENSE: LAYER 2

Maximum diameters ranged from 75-400 µm in the upper sample from the Niortense Zone, the thick-walled specimens ranging from 100-300 µm and the thin-walled specimens ranging from 75-400 µm. The maximum number of chambers was 8, at maximum diameters of 150 µm, 162.5 µm, 200 µm (all thin-walled) and 225 µm (thick-walled). This was the widest range of diameters found at any of the levels. Maximum abundance for the thick-walled specimens occurred at a diameter of 150 µm and for the thin-walled specimens at a diameter of 125 µm. The percentage ratio of thick-walled specimens to thin-walled specimens was 19% : 81%.

4.5.1.3 LATEST BAJOCIAN: PARKINSONI ZONE

From the Parkinsoni Zone, thin sections from only one layer were examined (Figs 4.9, 4.10). At this most recent level, the maximum diameters ranged from 100-375 µm, the thick-walled specimens ranging from 162.5-375 µm and the thin-walled specimens ranging from 100-375 µm. The maximum number of chambers was 7, at maximum diameters of 262.5 µm, 275 µm, 287.5 µm, 300 µm (all thick-walled) and 325 µm (thin-walled). For the thick-walled specimens, the maximum abundance occurred at a diameter of 275 µm whilst, for the thin-walled specimens, it occurred at a diameter of 225 µm. The percentage ratio of thick-walled specimens to thin-walled specimens was 73% : 27%.

4.5.2 GENERAL TRENDS

There appears to be a disparity in maximum abundance peaks between thick-walled and thin-walled specimens. The lower parts of the Humphriesianum Zone have the narrowest range of sizes and, in general, tend to be smaller (Figs 4.7, 4.8). In the upper part of the Humphriesianum Zone and in the Niortense and Parkinsoni zones, there is a wider range of overall size, while the maximum numbers vary in their size. In the Niortense Zone Layer 1, the maximum numbers of thick and thin-walled forms show their widest divergence and, while this is coincident with the lowest percentages of protoglobigerinids (Wernli and Görög, 1999), no explanation for this can be offered. Graphs of the mean and range of size of planktonic foraminifera were attempted on the basis of thin sections from seven stratigraphical levels but failed to show any meaningful relationship to Bajocian sea-level changes. Sea-level changes in the Bajocian are well known and are discussed in a later section (4.8).

4.5.3 SPECIES PRESENT

In many thin sections it is almost impossible to identify the taxa involved, unless presented with a full view through the spire. Dr Ágnes Görög spent many months experimenting with acid reductions using the acetic acid method of Lethiers and Crasquin-Soleau (1988) and Lirer (2000). Using isolated specimens, Wernli and Görög (1999) identified the following taxa:

Conoglobigerina avariformis Kasimova, 1984;

Conoglobigerina aff. *dagestanica* Morozova, 1961;

Globuligerina bathoniana gigantea ssp. nov.;

Globuligerina aff. *bathoniana* (Pazdrowa, 1969);

Globuligerina oxfordiana (Grigelis, 1958).

In particular, Wernli and Görög (1999) noted the large size of many of the specimens, identifying a new sub-species of *G. bathoniana gigantea*. This is particularly interesting in that the Bajocian limestones are considerably older than the Bathonian type horizon of *G. bathoniana* as well as being significantly older than the type level of *G. oxfordiana*, which is also identified(?) in the ?succession (Wernli and Görög, 1999, pl. 1, figs 1-4, 7-10).

4.5.4 CAUSES OF DISCREPANCY

With the intermediate sizes, it was often difficult to differentiate between species with similar outlines. For instance, it was difficult to distinguish *Globuligerina oxfordiana* (Grigelis) medium forms (Wernli and Görög, 2000, pl. I, figs 5 and 8) from *Conoglobigerina* aff. *dagestanica* (Morozova) (pl. I, fig. 21) or *Globuligerina* aff. *bathoniana* (Pazdrowa) (pl. I, fig. 25). Similarly, it was difficult to distinguish *Globuligerina oxfordiana* (Grigelis) medium form (pl. I, fig. 7) from *Conoglobigerina* aff. *dagestanica* (Morozova) (pl. I, fig. 20).

However, this is in accordance with Wernli and Görög's (2000) "Provisional Determination Key", in which they state that, generally, only axial sections give sufficient information and that the medium sections (180-250 µm) with thin-walled tests "can not be surely determined. They can belong to either to *C.* aff. *dagestanica*, *G.* aff. *bathoniana*, or *G. oxfordiana*, but also to juvenile forms of the previous species". They also attributed:

- large sections (300-320 µm) with thin-walled, apparently consecutively-built tests to *Globuligerina bathoniana gigantea*;
- very large sections (300-320 µm) with thick-walled, concurrently-built tests to *Conoglobigerina avariformis* sensu lato, the two forms (*sphaerica* and *alta*) being indistinguishable in oblique sections.

4.5.5 VARIATION IN TEST SIZE

Bradshaw (1957) discovered that both temperature and salinity affect the rate of growth and reproductivity in benthonic species but this has been found to be equally applicable to planktonic taxa (Bijma *et al.*, 1990). According to Masters (1977), the final size of an individual is limited by its death or its reproduction. In species or individuals where the supply of protoplasm is exhausted during reproduction, the parent test is discarded, thereby terminating growth. Unlike most other organisms, foraminifera may become larger under less favourable environmental conditions. If environmental parameters delay onset of reproduction, the individual will continue to grow until either those parameters become more suitable for reproduction or they kill the organism. The size of an individual is not, therefore, necessarily directly related to reproductive maturity but more likely to the amount of food consumed by the organism during its lifetime (Bé, 1982).

4.6 THICK AND THIN TESTS

4.6.1 CONSECUTIVELY- AND CONCURRENTLY-BUILT TESTS

Test thickness appears to be a significant feature in the planktonic foraminifera from the Bajocian of Somhegy. Wernli and Görög (2000) believed that wall thickness, of both the septum and the external wall of the juvenile whorls, was an important diagnostic characteristic. The taxonomic importance of test growth, concurrently or consecutively, needed to be evaluated. In concurrently-built tests, the wall of each new chamber is added on top of the previously built test, whereas in consecutively-built tests this does not occur. The difference can only be clearly identified in axial or sub-axial sections because, in transverse sections, the thickness of the external wall only increases slightly from chamber to chamber (Wernli and Görög, 2000). Both types of test building and wall thickness were visible amongst the Bajocian protoglobigerinids from Somhegy examined. Only *Conoglobigerina avariformis* sensu lato clearly demonstrates a concurrently-built test, with a relatively thin septum (~8 μm) but a very thick external wall (~40 μm) on the juvenile whorls, through ontogenic additions. *Conoglobigerina* aff. *dagestanica, Globuligerina bathoniana gigantea*, G. aff. *bathoniana* and *G. oxfordiana,* however, have relatively thin walls throughout their tests, which therefore appear to be consecutively-built.

4.6.2 WALL STRUCTURE

Opinions have differed as to whether structural differences are taxonomic or due to the state of preservation of the tests. Reiss (1957) had recognised a two-layered wall structure in most planktonic groups, both extinct and extant. He stated that the chamber walls were double, "formed by an outer lamella, one per instar (new chamber) covering the whole test, and by an inner one, lining each chamber and confined to it". This "bilamellar" test structure was subsequently recorded by various authors, including Reiss (1958, 1963), Bé and Ericson (1963), Bé and Lott (1964), Bé (1965, 1977), Premoli Silva (1966), McGowran (1968), Pessagno and Miyano (1968), Hemleben (1969), Bé and Hemleben (1970).

Bé and Lott (1964) illustrated differences in wall thickness in cross-sections of *Globorotalia truncatulinoides* specimens of approximately equal size, one with a calcite crust and one without (Fig. 4.11). The thin-walled specimen has a bilamellar test and is in the first phase of calcification, whereas the thick-walled specimen demonstrates a clear structural difference between the bilamellar test and the calcite crust in the second phase of calcification. The calcite crust can add more than 50% $CaCO_3$ by weight to the tests of *Globorotalia truncatulinoides, G. menardii* and other species (Bé, 1977).

With the use of scanning electron microscopy, Bé and Hemleben (1970) discovered that the outer and inner lamellae were composed of many more layers than first described by

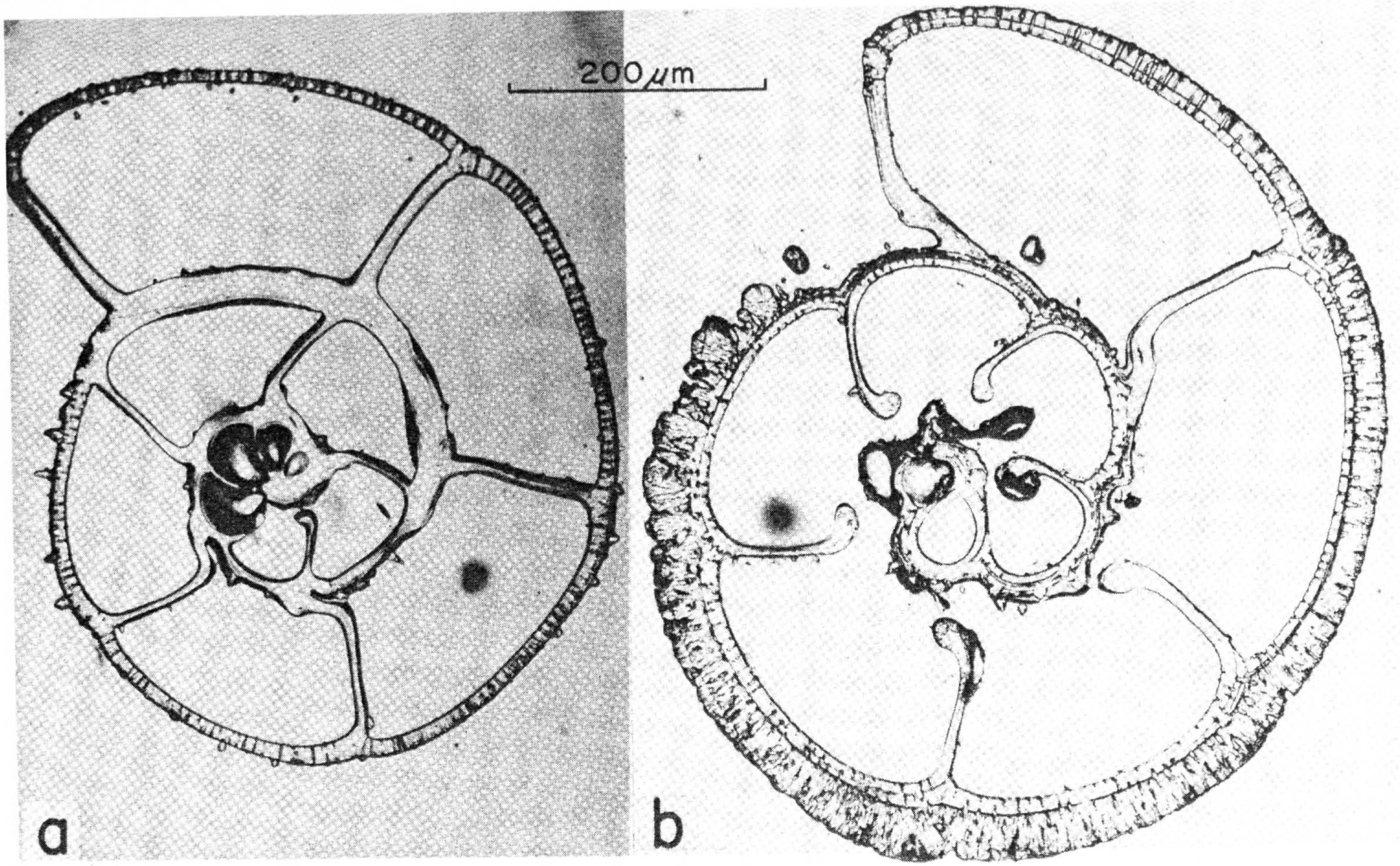


Figure 4.11. Contrast in wall thickness in two horizontal sections of *Globorotalia truncatulinoides*. The left specimen, collected alive in 0-180m plankton tow in the central North Atlantic (35°04'N, 47°59'W), has a thin "bilamellar" test of uniform thickness. The right specimen, from the surface sediment of the central North Atlantic (35°06'N), 45°56'W 3190m depth), has an additional calcite crust secreted over the "bilamellar" test (Be and Lott, 1964).

Reiss (1957). This was also confirmed for some of the Cretaceous planktonic foraminifera (Bé, 1977). Contrary to Reiss' observations, Bé and Hemleben suggested that chamber calcification occurred continually and independently of a new chamber being formed. They believed that a lamina was deposited in patches, rather than being a continuous sheet over the last whorl. In either case, the wall thickness of the earlier chambers in the last whorl became thicker than that of the later ones. This is marked in species such as *Globigerina washitensis* Carsey, which has a rather thick primary organic membrane separating the outer and inner lamellae.

4.6.3 TEST GROWTH

In 1965, Bé had discovered what he and Hemleben (in Bé and Hemleben, 1970) referred to as the two main phases of wall calcification during the test growth of most species of Recent planktonic foraminifera. The first phase consisted of the bilamellar growth of the entire test to normal adult size and the second phase was the superimposition of a calcite crust over the adult test, concealing surface ornamentation. The development of a calcite crust was not, at that time, recognised in Mesozoic planktonic species. From further observations during his comprehensive study of Recent planktonic foraminifera, Bé (1977) put forward his hypothesis on test growth.

CALCIFICATION PHASE 1

Calcification is primarily involved in rapid test construction during which the walls of the previous chambers thicken slightly. In the final chamber, two main structural units, separated by a primary organic membrane (POM), are visible in the bilamellar wall. From the existing test, protoplasm is exuded to create a new chamber. The POM is produced just outside the cytoplasm, followed by an outer and inner organic layer on the distal and proximal sides of this membrane. These three organic layers govern calcification and the shape of the test wall, constituting the organic matrix "compartment" within which calcite is secreted. The initial chamber wall consists of two thin calcite layers, which are secreted between the central POM and the outer and inner organic layers respectively.

Calcification "episodes" on both the distal and proximal sides of the new chamber wall increase its thickness. With the formation of each new chamber, an additional calcite layer is secreted from an organic layer present on both the outer and inner test surfaces. This calcite layer is deposited upon the organic outer surface of the earlier chambers of the test, resulting in alternate thin organic layers and thicker calcite layers. Wall thickening is considerably greater on the outer side of the POM than on its inner side so, as the test wall thickens, the POM is increasingly proximal. In many species, this distinct organic layer is located in the inner third or quarter of the chamber wall.

CALCIFICATION PHASE 2

A thick calcite crust and, in some species, an additional cortex over the entire outer surface of the bilamellar test is formed. This wall-thickening over the chambers of the last whorl occurs, in mature individuals, with few, if any, new chambers being added.

4.7 WATER DEPTH

Test thickness often appears to be an indicator of the depth in the water column at which the organism lived, the thickening process, in many species, being an adaptation to increasingly deeper habitats (Bé and Ericson, 1965). Whilst investigating vertical distribution, Bé (1977) delineated three depth zonations for Recent planktonic foraminifera:

♦ 0-50 m	shallow water fauna;
♦ 50-100 m	intermediate water fauna; and
♦ below 100 m	deep water fauna (but with the juveniles inhabiting the surface waters).

Those inhabiting the surface waters tended to smaller and thinner-walled than those living further down in the water column. Those from deeper water usually possessed a thicker, calcite test, whilst those from the bathypelagic zone usually showed an overgrowth of calcitic material over an initially thick-walled test. This could be due to their life-cycles, as many species are believed to inhabit the epipelagic zone during their juvenile stages, migrating to deeper habitats in their later stages (Bé and Ericson, 1963; Bé, 1965). In addition, many species migrate diurnally within the water column.

Modern oceanic sediments do not provide a record of the habitat depth of the species contained in them, whereas shelf sediments may, since deeper-water species can only invade an extensive shelf area when there is sufficient water depth (Hart and Bailey, 1979). From their studies of the vertical distributions of Albian to Santonian planktonic foraminifera in North-Western Europe, they believed that a species which is abundant in deep water during its adult stages is unlikely to be found frequently in shelf sediments deposited at much shallower depths. Juveniles carried onto a shelf by surface water currents were unlikely to attain full maturity, as at least part of their life-cycle would be curtailed by the insufficient depth. This reflected Murray's (1976) demonstration of the inability of Recent planktonics to cross the present North West European Continental Shelf.

Hart and Bailey (1979) concluded that depth, together with water temperature, were the principal controls on distribution for mid-Cretaceous planktonic foraminifera, amongst other influencing factors. Prior to their study, there had been little investigation into control by water depth but they believed that the implications were very important in stratigraphical correlation. If species are geographically restricted by water depth, then the appearance in the succession of many species might be due to water depth not evolution. Tracing evolutionary developments more accurately would require sediment from oceans, in which the evolution of species had been unrestricted spatially and temporally. They further believed that depth control on distribution has taxonomic implications. With a slow and progressive evolutionary trend to a deeper water habitat, problems arise with morphological boundaries and the reliable subdivision of lineages, usually resulting in multiple names being proposed and adopted.

This migratory trend in mid-Cretaceous planktonic foraminfera was confirmed by Hart (1980) in his water depth model, with evolution either proceeding horizontally within the same depth zone or migrating downwards to a deeper zone but with no known upward migration to a shallower zone. The conservative shallow-water taxa hardly changed throughout the Cretaceous, implying that this could have been the case with their Jurassic ancestors (Hart, 1999). From their studies of planktonic foraminiferal evolution during the Cretaceous, Premoli Silva and Sliter (1999) stated that the various depth preferences were characterised by distinct changes in morphology and surface ornamentation. They believed that shell calcification occurred mainly in the upper hundred metres, although it continued with growth whilst sinking deeper than 100 metres, even below the thermocline.

4.8 SEA-LEVEL FLUCTUATION

The correlation between sea-level fluctuations and major evolutionary changes has been suggested by various authors, including Hallam and Wignall (1999), O'Dogherty *et al.* (2000), Sandoval *et al.* (2001). In the absence of many modern plankton groups in the early to mid-Jurassic, the data on ammonite distribution and evolution may provide an indication of what is occurring in the water column of the oceans/seas. From their study of ammonites in the Betic Cordillera, southern Spain (westernmost Tethys), O'Dogherty *et al.* (2000) proposed that extinction events might be the result of eustatic falls, whereas diversification and radiation might result from eustatic rises. Their ammonite turnover curve (Fig. 4.12) is very similar to Hallam's (1988) curve of eustatic fluctuations and largely coincides with the higher-order cycles of the Exxon curve (Haq *et al.* 1987, 1988).

4.8.1 EARLY BAJOCIAN

Between the Aalenian and the earliest Bajocian, one of the most important Mesozoic ammonitic turnovers occurred (O'Dogherty *et al.*, 2000). An extinction apparently affected all of the dominant ammonite groups in the Aalenian and has been linked to a eustatic sea-level fall. This was followed by a phase of appearances and radiations of new groups, corresponding to a eustatic rise (Hallam, 1988, Embry, 1993) during the earliest Bajocian. A progressive increase in diversity (eustatic rise) was terminated near the boundary between the Propinquans and Humphriesianum zones by a turnover identified as important by Sandoval *et al.* (2001). This turnover was attributed to an abrupt eustatic fall followed by a considerable rise, Hallam's (1988) eustatic curves and the Exxon curve (Haq *et al.*, 1988) indicating eustatic rises almost to the Humphriesianum Zone. Near the boundary between Early and Late Bajocian (Humphriesianum-Niortense zones), there was another significant turnover, again corresponding with a eustatic fall followed by a considerable rise to the maximum eustatic level of the mid-Jurassic.

4.8.2 LATE BAJOCIAN

Hardenbol *et al.* (1998) identified a regressive interval which includes the upper part of the Humphriesianum Zone and the lower part of the Niortense Zone, with a relative transgressive maximum in the middle of the Niortense Zone. In some sectors of the Subbetic, these changes resulted in a stratigraphical break, with Upper Bajocian rocks lying directly above the sedimentary rocks of the Propinquans Zone (O'Dogherty *et al.*, 2000). According to Sandoval *et al.* (2001), a discontinuity occurs in many areas of the Subbetic swells which, depending on the palaeogeography, ranges from the upper part of the Humphriesianum Zone to the lower part of the Niortense Zone, whereas the remainder of the Niortense and part of the Garantiana Zone are transgressive. They felt that this

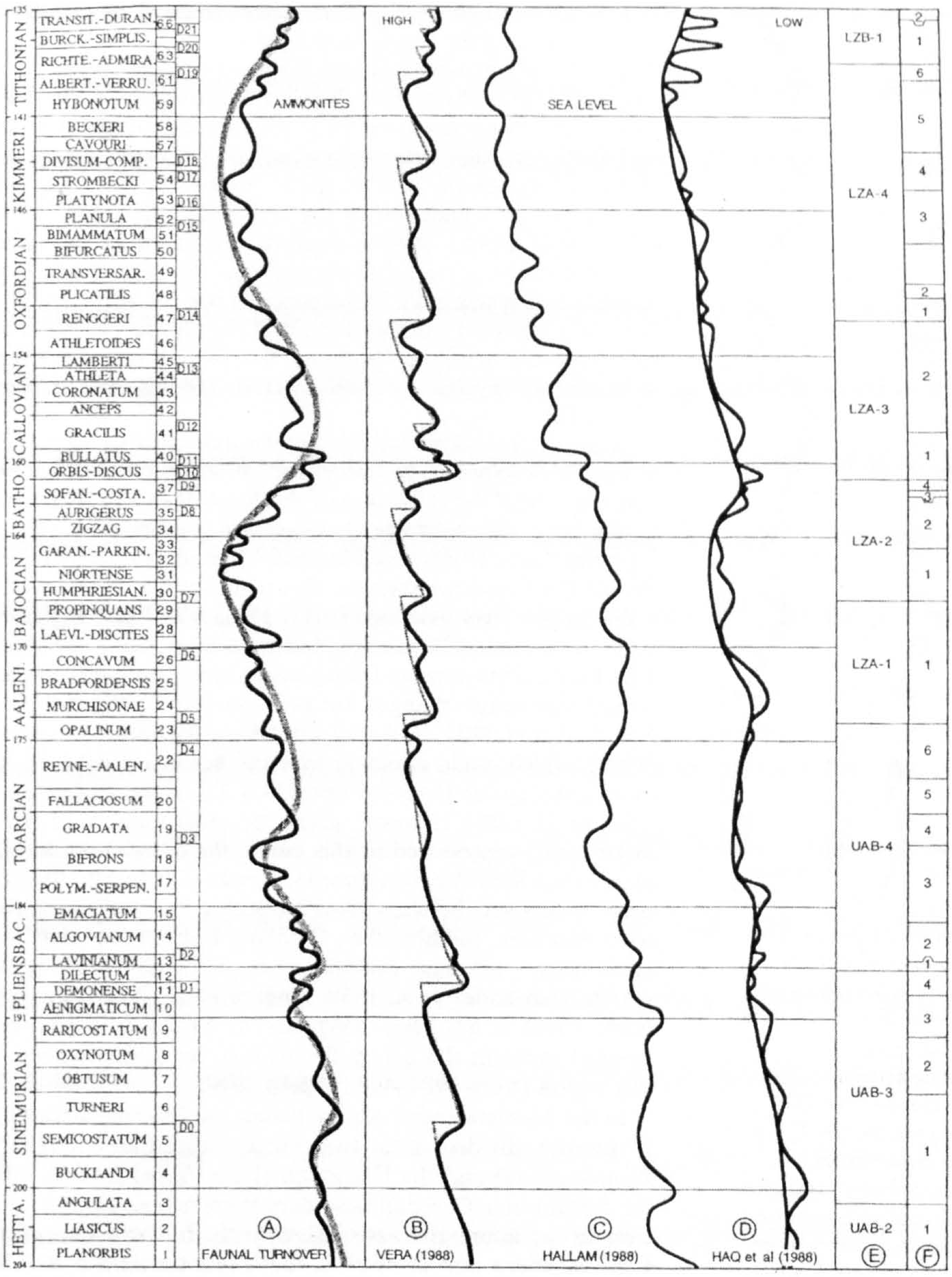


Figure 4.12. Graphs comparing the proposed ammonite turnover curve, interpreted as a curve of global sea-level changes (A), with that previously proposed for relative sea-level curves for the Betic Cordillera (B) (Vera 1988). In B the thin grey line corresponds to the original curve; the thick black line corresponds to the modified version, where the changes are gradual. Also shown for comparison are Hallam's (1988) curve (C) and the Exxon curve (D) (Haq *et al.* 1988). (E) Second-order cycles of the Exxon curve (Haq *et al.* 1988). (F) Third-order cycles of the Exxon curve (Haq *et al.* 1988). The 22 stratigraphical discontinuities recognised in the Betic Jurassic are marked (D0-D21), indicating the minimum extension of the hiatus in each case. Numbers 1-67 correspond with each ammonite zone (O'Dogherty *et al.*, 2000).

transgressive phase would help to explain the connecting of the Central European Basins with Tethys (and Tethys with the Eastern Pacific, via the Hispanic Corridor), which permitted frequent migration between the palaeobiogeographical realms and provinces.

During the remainder of the Bajocian and throughout the Bathonian, eustatic falls were the general trend (O'Dogherty *et al.*, 2000). However, according to Hardenbol *et al.* (1998), a transgressive phase occurred in the lower part of the Parkinsoni Zone. The extinctions and appearances or radiations of the ammonites also indicated that one of the most significant turnovers within the Late Bajocian to Bathonian occurred in the Parkinsoni Zone.

From their comparisons of the temporal distribution of ammonite families and subfamilies, O'Dogherty *et al.* (2000) showed that there was only a slight increase in numbers with time from the Humphriesianum to the Parkinsoni zones. In each case, the majority of the families were shown as "Abundant" but there appeared to be a slight increase in diversity within the abundance, with more "Common" and "Scarce" families in the Parkinsoni. Comparing the number of genera, they observed relative maxima at both the Humphriesianum and Niortense zones but, when comparing the number of species, there was only a relative maximum at the Niortense Zone.

4.9 SUMMARY

The considerable diversity of the specimens from Somhegy, possibly amongst the earliest recorded fully-planktonic foraminifera, suggests their evolution must have occurred earlier in the Bajocian or pre-Bajocian. While it is difficult to be absolutely certain that any organism had a planktonic mode of life, the appearance of these forms in thin section (and the acid reductions illustrated by Wernli and Görög, 1999) indicates that these were genuinely holoplanktonic forms. The marked variation in size, wall thickness and consecutively- or concurrently-built tests indicates evolutionary adaptations to expand into a range of niches, particularly those deeper in the water column. This could have been in response to changing palaeoceanographical conditions and possibly to the connection of the Central European Basins with Tethys which enabled subsequent migration between the palaeobiogeographical provinces (see Chapter 9). There would appear to be a correlation between sea-level fluctuations and faunal turnovers. *Conoglobigerina avariformis* and *Globuligerina bathoniana gigantea* are recognisable in thin-sections and could possibly be selected as reliable biomarkers.

CHAPTER 5

THE PIENINY KLIPPEN BELT, SOUTHERN POLAND AND WESTERN SLOVAKIA

5.1 GEOLOGICAL SETTING

The Carpathians form part of the mountain arc that extends from the Eastern Alps to the Balkan chain (<1300 km) (Fig. 5.1). The Pieniny Klippen Belt (PKB) is situated in the Northern Carpathians, along the boundary between the older Inner Carpathians and the younger Outer (Flysch) Carpathians (Książkiewicz, 1977). Following the Carpathian suture, it is a narrow, elongated tectonic unit, approximately 800 km in length and from 1-20 km in width (Oszczypko *et al.*, 2004). The present confines of the Pieniny Klippen Belt are strictly tectonic (Krobicki and Golonka, 2006). The Pieniny range consists of:

- Spiš Pieniny, highest point 879 m (Żar);
- Pieniny *sensu stricto* (Pieniny proper), highest point 982 m (Okrąglica, Trzy Korony);
- Małe Pieniny (Small Pieniny), highest point 1052 m (Wysoka).

The Polish sector extends from west of the River Orva, via the Spiš Pieniny, the Czorsztyn Pieniny and the Pieniny *sensu stricto*, to the Małe Pieniny. The Slovakian sector is comprised of the northern and central parts of the Klippen Belt to the east of the Pieniny *sensu stricto*, from near the River Biała Woda, east of Szczawnica (Birkenmajer, 1976).

5.1.1 STRUCTURE

One of the most complex tectonic structures in the Carpathians, the Pieniny Klippen Belt is composed of several successions of mainly deep- and shallower-water limestones, ranging in age from Early Jurassic to Late Cretaceous (Andrusov, 1938, 1959; Birkenmajer, 1958, 1976, 1977, 1986, 1988; Andrusov *et al.*, 1973; Mišík, 1994; Golonka and Krobicki, 2001, 2004; Krobicki and Golonka, 2006). Due to Late Cretaceous and subsequent orogenic movements, most of the successions constituting the various tectonic units were uprooted

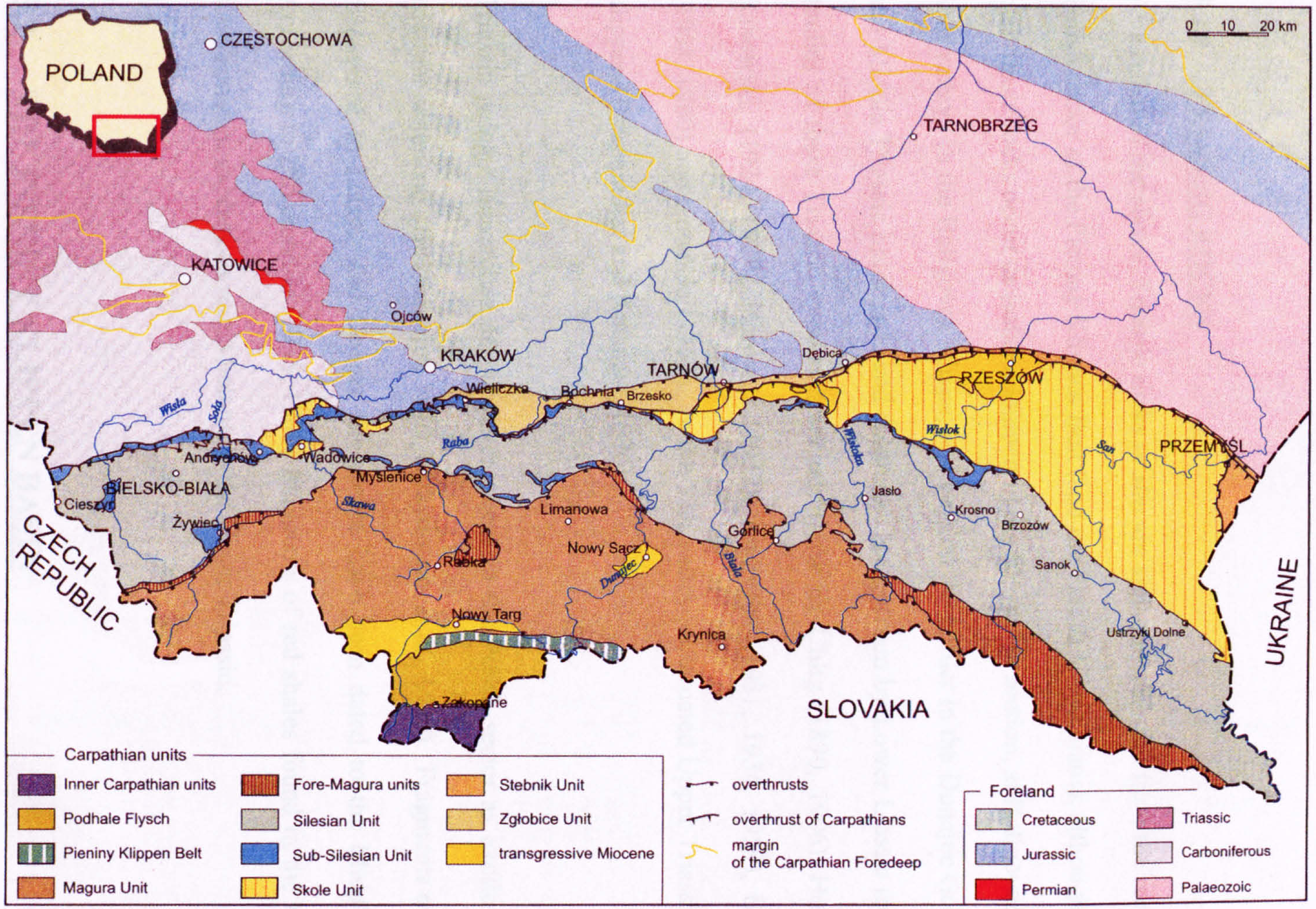


Figure 5.1. Geological Map of the Polish Carpathians and Foreland, showing the position of the Pieniny Klippen Belt (Golonka and Krobicki (2006), simplified from Żytko *et al.* (1989)).

from their pre-Liassic or pre-Dogger basements, making reconstruction of the Lias transgression and the development of its sediments in the various Klippen successions extremely difficult.

5.1.2 TRIASSIC ROCKS

As a result of the above, Triassic rocks *in situ* are apparently absent from the records of the Polish sector of the Pieniny Klippen Belt (and the Flysch Carpathians), although exposures of Triassic rocks occur as isolated klippen in the Slovakian section, at Haligovce and in the Váh valley. In the Haligovce Klippe, just beyond the border in the Dunajec Gorge, Lower and Middle Triassic limestones and dolomites are overlain by Lower Liassic rocks. Early studies of these Triassic exposures include those by Uhlig (1890, 1906), Horowitz and Rabowski, (1924, 1929), Horowitz (1937), Andrusov (1931, 1934, 1959), Birkenmajer (1958, 1960) and Kotański (1963). In the Váh valley are situated Upper Triassic (Keuper) klippen (Birkenmajer and Kotański, 1976).

Triassic pelagic limestones do, however, occur in the Polish sector as exotic pebbles in younger sediments (Birkenmajer, 1976; Birkenmajer *et al.*, 1990). Fragments of dolomites discovered in Liassic and Dogger limestones have been dated to the Middle Triassic. According to Birkenmajer (1958, 1960) fragments of red shales found in the Bajocian of the Czorsztyn succession might belong to the Upper Triassic.

5.2 THE PIENINY KLIPPEN BASIN

5.2.1 FORMATION

The Pieniny Klippen Basin (Fig.5.2) was formed by rifting and spreading in the Alpine-Carpathian area during the mid-Late Jurassic, with rapid subsidence and very condensed sedimentation. In the trough itself, the first deposits were believed to be clastic sediments

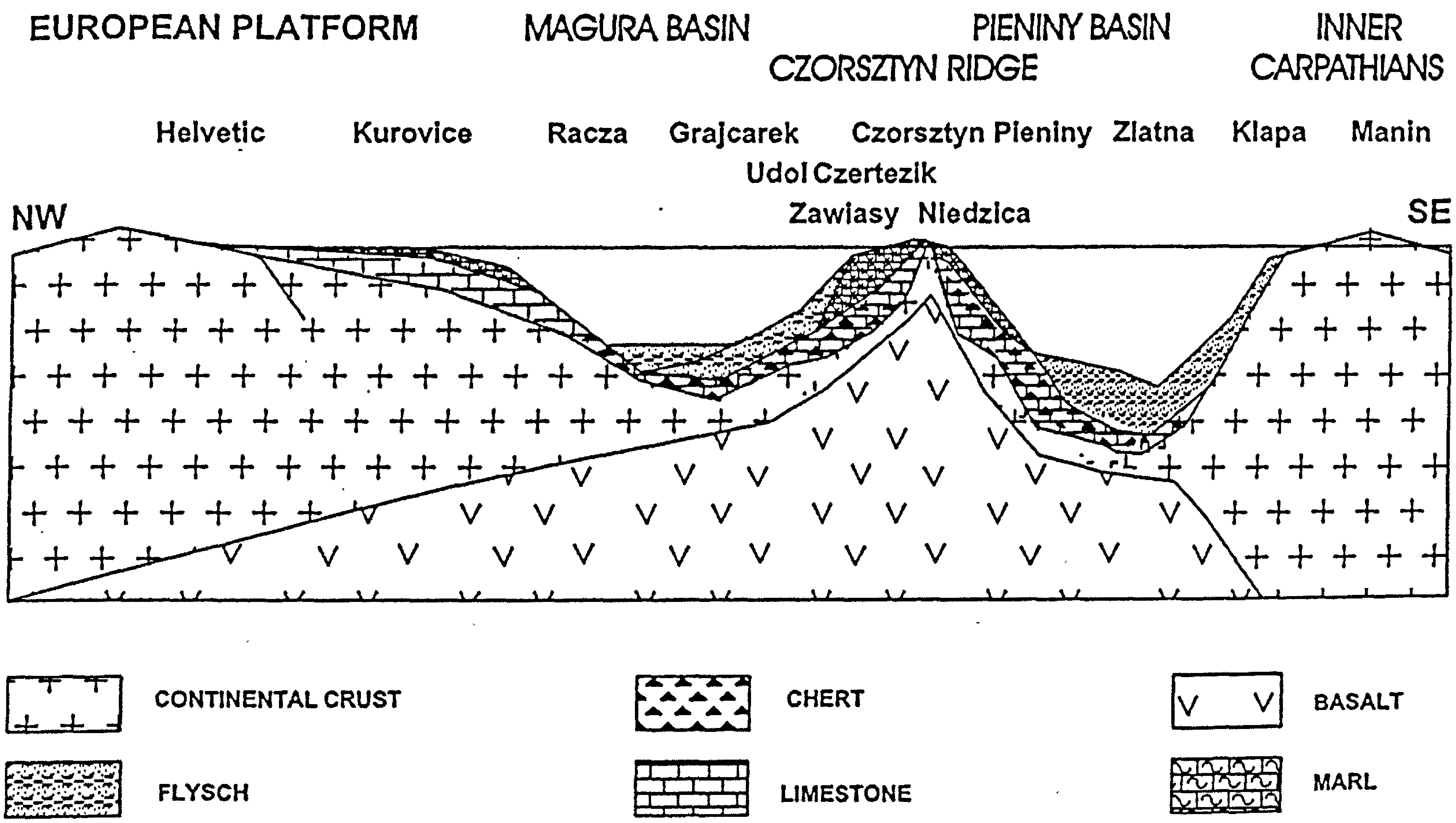


Figure 5.2. Highly schematic cross-section (not to scale) showing the Pieniny and Magura basins during the Albian (Oszczypko-Clowes, 2001).

of the Gresten facies that were subsequently replaced by facies of limestone and spotty marls as the basin became deeper and the Lias transgression became more widespread. Seafloor movements in the Lower Dogger may have resulted in euxinic clayey sediments containing carbonate and sulphate ferruginous concretions. The abrupt change in the sedimentary conditions between the Murchisonae Beds and the white crinoid limestone could have been the result of the collapse of part of the Klippen Basin along a system of dislocations parallel to its axis. The Jurassic transgression may not have occurred until the Late Bathonian or Callovian (Fig. 5.3), when the sea encroached onto denuded Triassic rocks. The appearance of red nodular limestone was connected with the further deepening of the sea which, considering the wide expanse of the Callovian transgression, may have been an indicator of eustatic sea-level change (Birkenmajer, 1976).

5.2.2 DEEPENING OF THE BASIN

The appearance of red crinoid limestone was associated with the deepening of the Klippen Basin and the northward shift of the northern coastal zone. The "Pieniny Ocean" was subsequently divided into two sub-basins by the Czorsztyn Ridge, the north-western Magura Basin and the south-eastern Pieniny Basin. Sequences were deposited on the slopes below the ridge. The deepest parts of both basins are documented by deep water, extremely condensed, Jurassic – Early Cretaceous pelagic limestones and radiolarites (Sikora, 1971; Golonka and Sikora, 1981; Golonka *et al.*, 2002). The deposition of black shales, marls and turbidites (Birkenmajer, 1986; Tyszka, 1994) during the Early Jurassic and the Albian-Cenomanian (Oszczypko *et al.*, 2004) indicate anoxic conditions in this restricted basin.

The Czorsztyn succession zone was subjected to vertical movements, which probably accounts for gaps in the sedimentation, hardgrounds and sedimentary breccias at the transition from the mid-Late Jurassic, mainly in the Callovian. In the sedimentary zone of

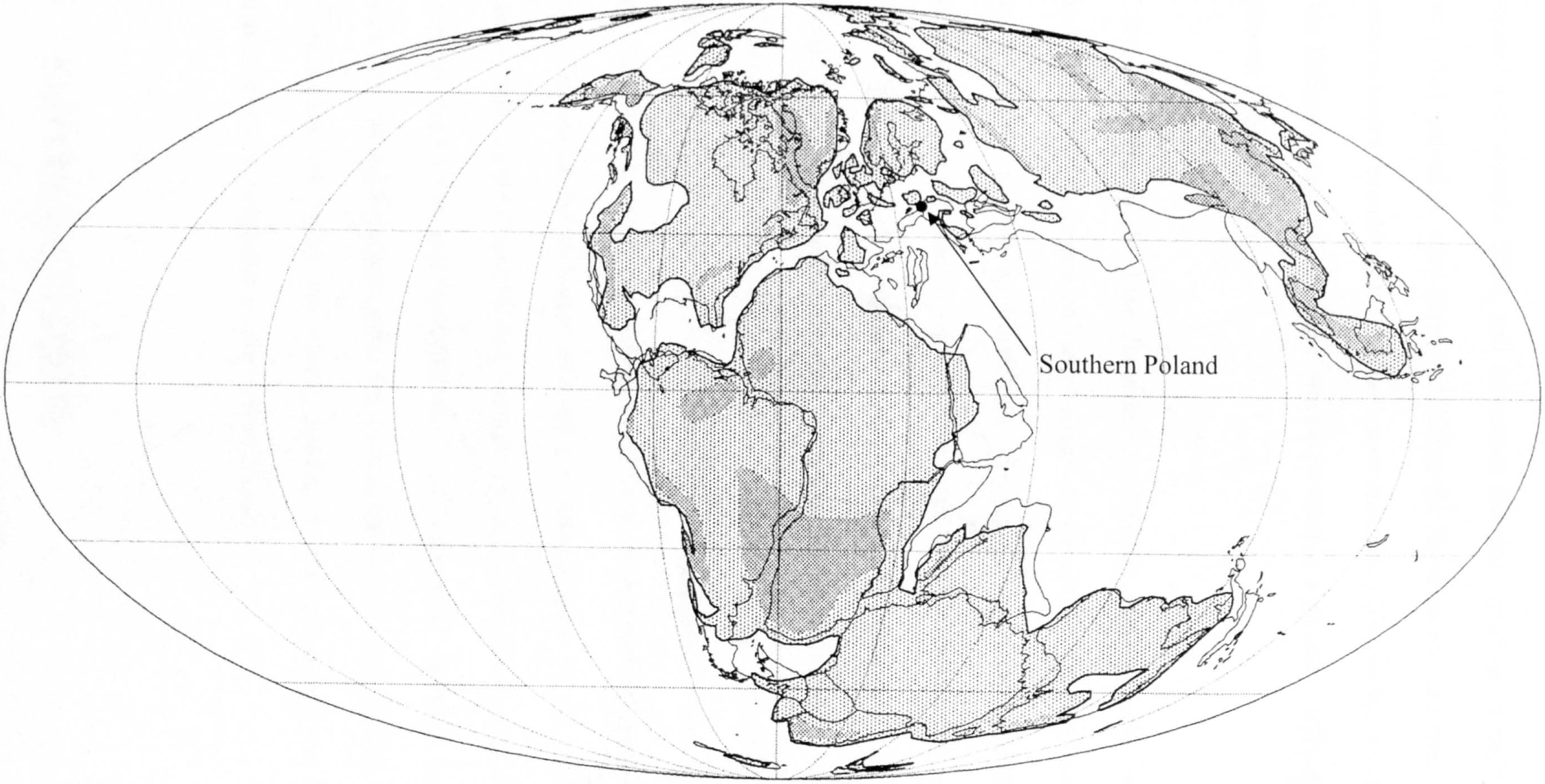


Figure 5.3. Palaeocoastlines of the Callovian (late Middle Jurassic) 160 Ma (Smith *et al.*, 1994). The approximate position of Southern Poland is indicated.

the Klippen trough, these movements were hardly perceptible at all (Birkenmajer, 1976; Krobicki and Golonka, 2006, and references therein). Shaly-marl and calcareous rocks, mostly dark coloured, were deposited during the Bajocian and the Bathonian, in a spotty limestone facies resembling that of the Lower Jurassic. Conversely, the mid-Jurassic rocks of the Haligovce succession, where crinoid limestones with cherts were deposited, indicate shallower sedimentation.

At the beginning of the Late Jurassic, the Klippen basin reached its greatest depth, indicated by the appearance of radiolarites. At the end of the Oxfordian (Fig. 5.4) and more markedly in the Kimmeridgian (Fig. 5.5), when the radiolarian sediments disappeared to be replaced by nodular limestones, tectonic movements reduced the depth of the Klippen basin (Birkenmajer, 1976; Krobicki and Golonka, 2006, and references therein). These movements are most obvious in the Czorsztyn succession where, during the Tithonian (Fig. 5.6) and Early Cretaceous, a variety of organogenic sediments, strongly influenced by bottom currents, were formed. Horsts and grabens were also formed at this time. These events occurred in several stages at the boundary between the Jurassic and the Cretaceous, whilst the tectonics affected the sedimentation in the Czorsztyn zone and adjacent zones of the Czertezik and Niedzica successions (causing gaps in sedimentation), sometimes right up to and including the Late Cretaceous. In other parts of the basin, especially in its southern part, open sea sedimentation continued and, by the beginning of the Cretaceous, the basin was clearly tending to become deeper, as indicated by the formation of thick complexes of cherty limestones.

5.3 KLIPPEN SUCCESSIONS

During the Jurassic, the SW-NE trending Klippen successions were deposited in the marine basin situated south of the main basin of the Flysch Carpathians and north of the

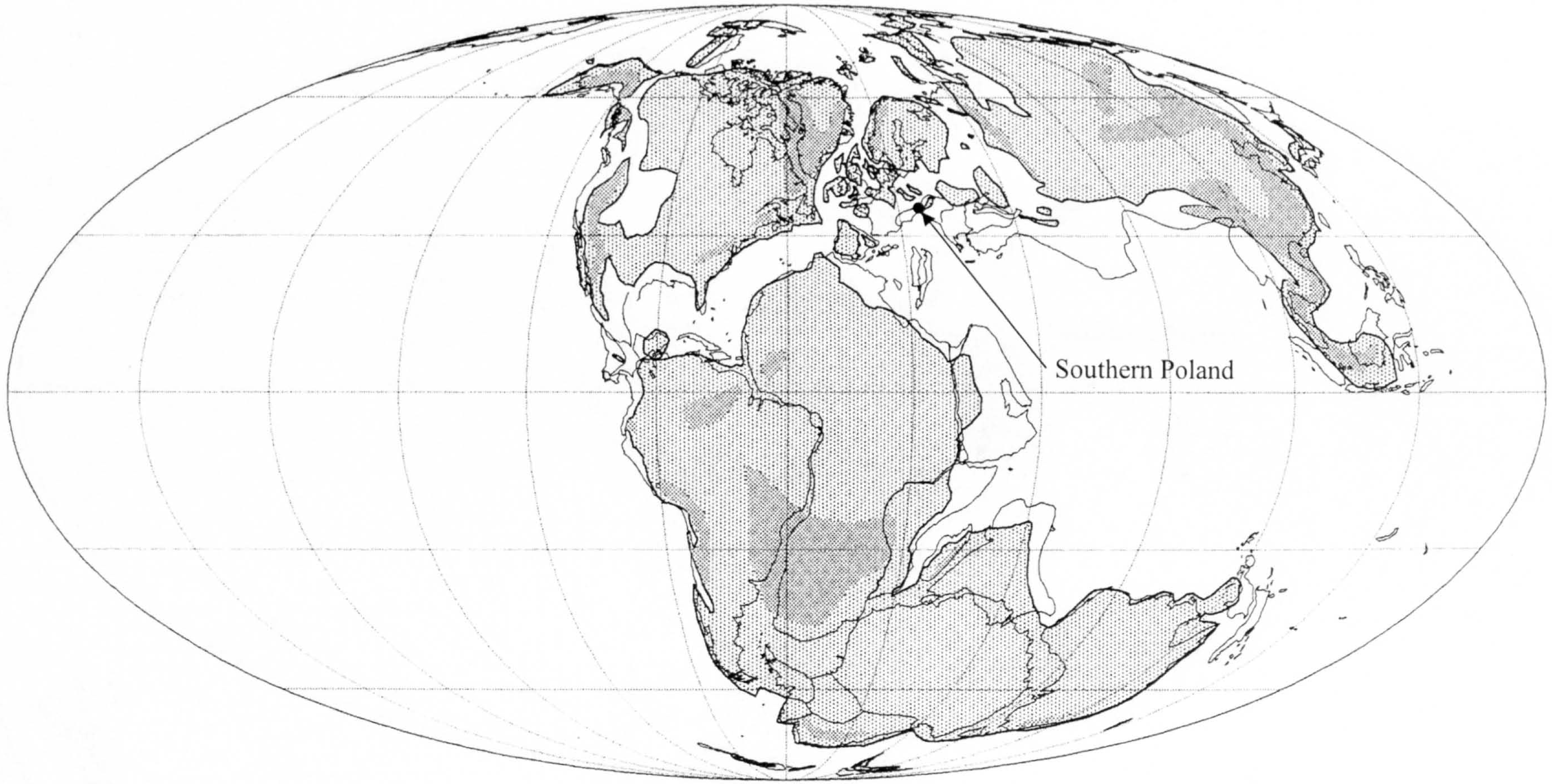


Figure 5.4. Palaeocoastlines of the Oxfordian (early Late Jurassic) 155 Ma (Smith *et al.*, 1994). The approximate position of Southern Poland is indicated.

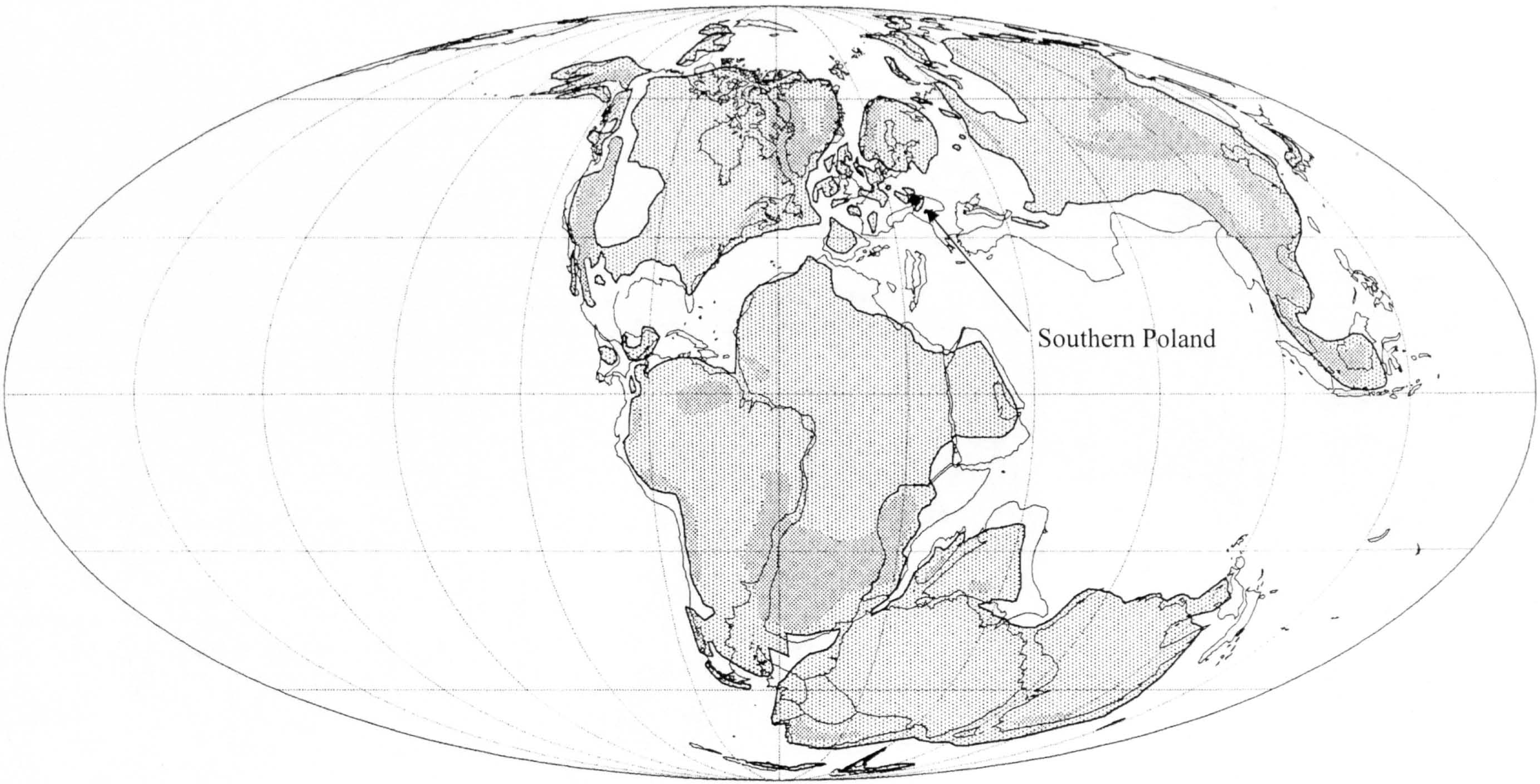


Figure 5.5. Palaeocoastlines of the Kimmeridgian (mid-Late Jurassic) 153 Ma (Smith *et al.*, 1994).). The approximate position of Southern Poland is indicated.

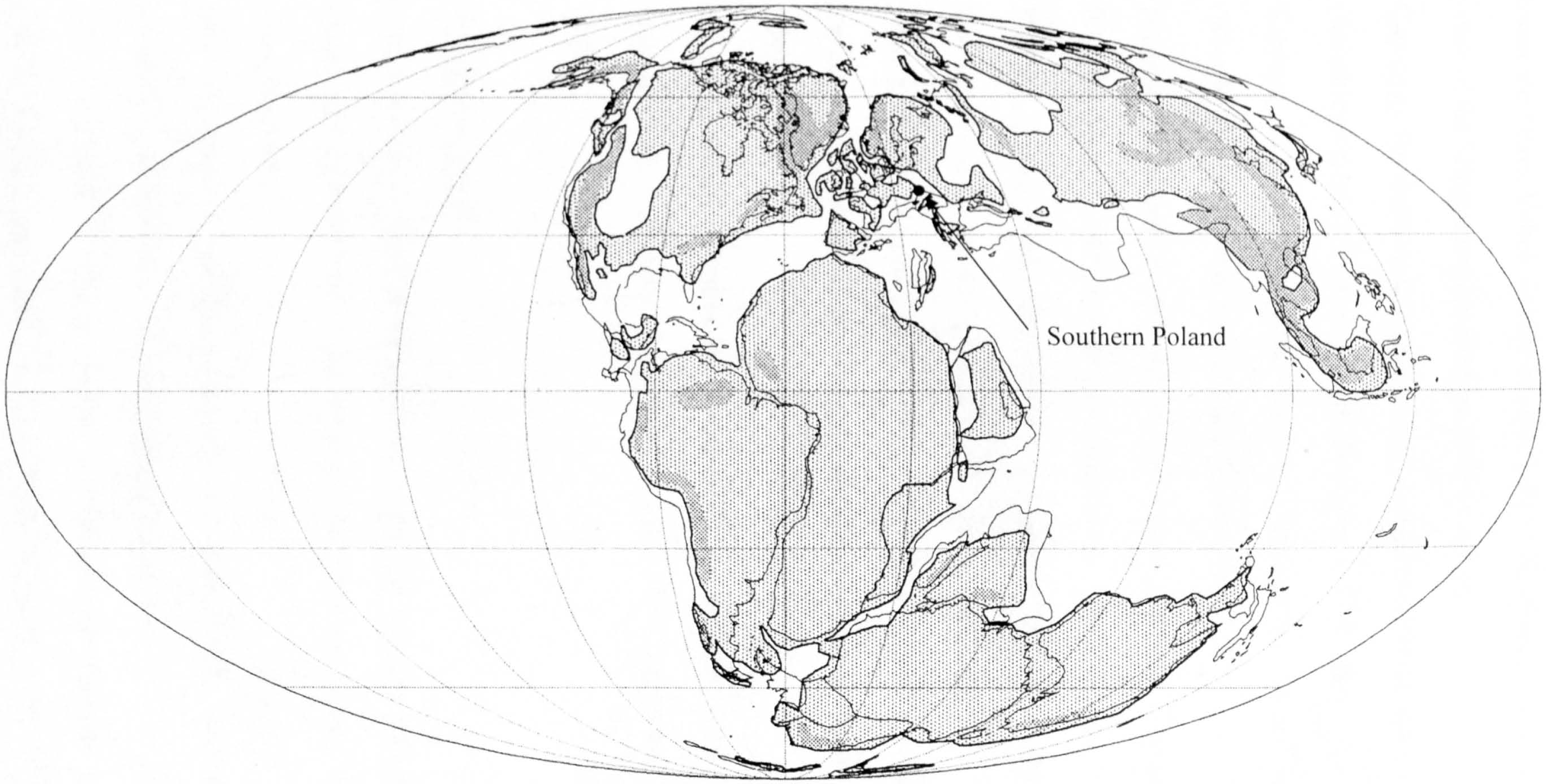


Figure 5.6. Palaeocoastlines of the Tithonian (latest Jurassic) 48 Ma (Smith *et al.*, 1994). The approximate position of Southern Poland is indicated.

basin of the Sub-Tatra successions and High Tatra succession (Birkenmajer, 1976). Between the Orava Valley and the Poprad Valley (the Pieniny sector *sensu stricto*), the sequence of the Klippen successions from north to south is:

- Czorsztyn, the shallowest ridge sequence, displaced and thrust over the Grajcarek Unit (Książkiewicz, M., 1977; Golonka and Rączkowski, 1984; Jurewicz, 1997).
- Czertezik, a transitional slope sequence between the basinal and ridge units (Wierzbowski *et al.*, 2004; Krobicki and Golonka, 2006);
- Niedzica, deposited in the trough and thrust over the Czorsztyn Succession (Książkiewicz, M., 1977; Golonka and Rączkowski, 1984; Jurewicz, 1997);
- Branisko-Kysuca, a somewhat shallower sedimentary zone deposited in the trough and located close to the central furrow (Krobicki and Golonka, 2006);
- Pieniny, like the Branisko Succession, also a somewhat shallower sedimentary zone deposited in the trough and located close to the central furrow (Krobicki and Golonka, 2006);
- Haligovce, a shallower succession that formed the southern rim of the trough, near the southern "exotic" Andrusov Ridge (Birkenmajer, 1977, 1986, 1988: Aubrecht *et al.*, 1997).

DIFFERENTIATION

The differentiation of the Klippen successions was first recognised by Neumayr (1871) who found that the Middle and Upper Jurassic rocks of this part of the Carpathians formed two separate groups:

1. poor in fossils - cherty limestones and shales with Aptychi ("*fossilarme, hornsteinreiche Schichten - hochkarpathische Facies*");
2. rich in fossils - shales, marls, ammonite and crinoid limestones, etc. ("*versteinerungsreiche Facies - subkarpathische Facies*").

In the fossil-rich facies he distinguished a type specific to the Klippen Belt – the *"subkarpathische Cephalopodenfacies"*.

Uhlig (1890) recorded the differences between these facies. Tectonic significance was given to this division in 1902-3, when Lugeon introduced his nappe theory to explain the geological structure of the Tatras and the Pieniny Mountains. Apart from the "sub-Pieniny Series" (the Czorsztyn succession, corresponding generally to Uhlig's fossil-rich facies) and the "Pieniny Series" (forming part of Uhlig's cherty limestone facies), Andrushov (1927) introduced a "Transition Series", based on the facies passages between the Jurassic sediments already ascertained by Uhlig. Andrushov differentiated several types of facies that were subsequently regarded as independent successions. From studying the Orava Klippen, Oppenheimer (1926-7) believed that only one Klippen succession had been deposited originally, separated into different Klippen successions as a result of subsequent foldings. Further to Andrusov's "Transition Series", Birkenmajer (1953, 1954) introduced a new division of the Klippen Belt in Poland into Klippen successions.

The Klippen successions are distinguished by stratigraphical succession and facies differences (Fig. 5.7), particularly towards the end of the mid-Late Jurassic, when the Klippen basin was at its deepest (Birkenmajer, 1953-1965), and correspond to the varying facies and depths of the marine sediments - the ridges and troughs of the sea floor. Each of these successions represents a section of the sedimentary basin but the facies are both parallel to the axis of the basin and transverse, the Czorsztyn succession being the best documented differentiation (Birkenmajer, 1963).

The later tectonic units, however, do not necessarily correspond to these successions and not all the successions recorded in the Polish Klippen Belt have exact equivalents in the remaining sections of the Carpathian Klippen Belt (Birkenmajer, 1976). The Western Slovakian sector, whilst sharing many common features with the Polish sector, does differ

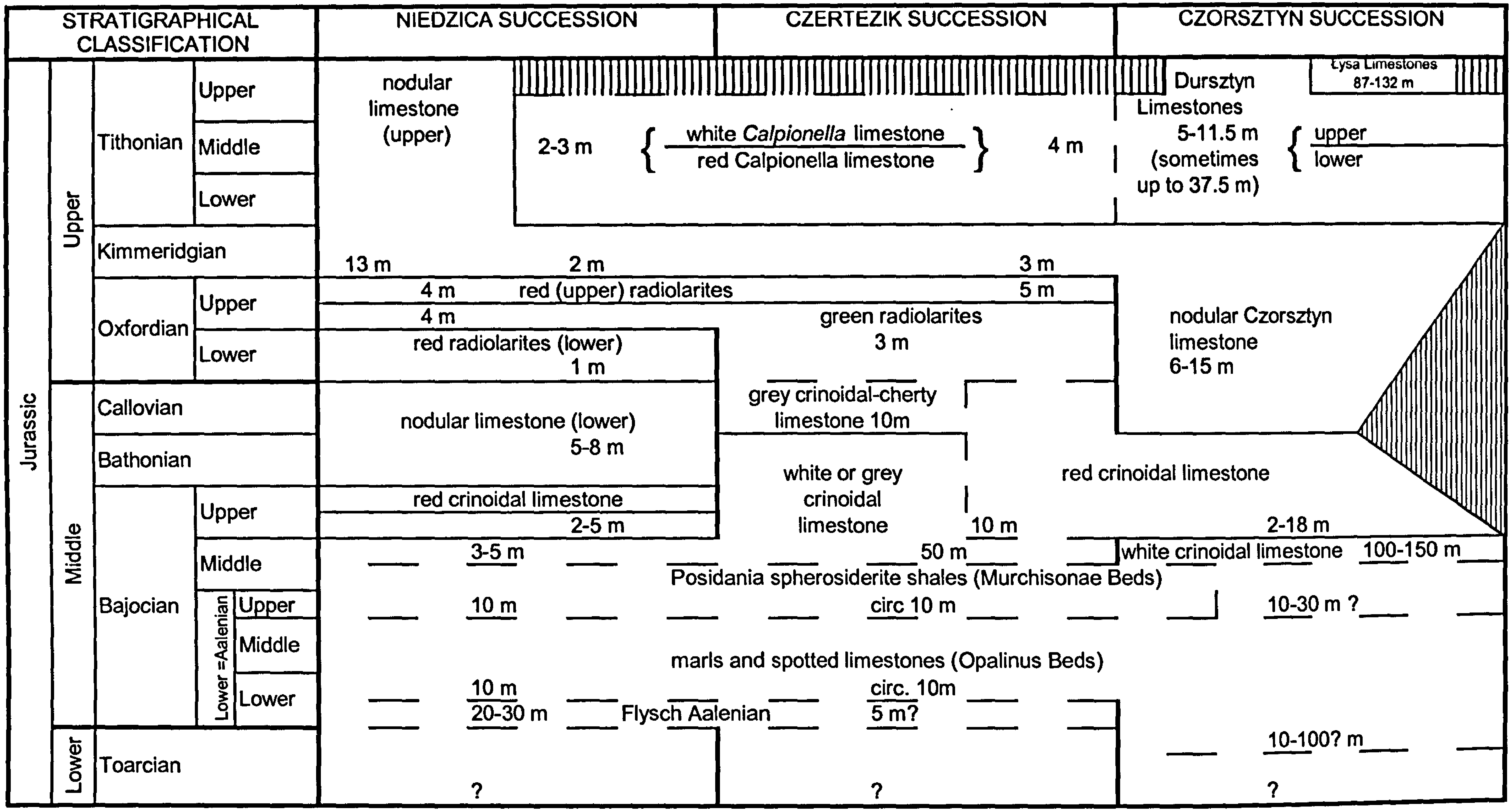


Figure 5.7. Lithostratigraphical table of the Jurassic in the Pieniny Klippen Belt (extracted from Birkenmajer, 1976).

(Albrecht *et al.*, 1997). The successions mainly correspond to those on the Polish side, apart from minor differences (the Kysuca Succession/Unit corresponding to the Branisko Succession, *etc.*). However, some successions or units do not have counterparts, as with the Orava (Podbiel) Succession (Podbiel-Červená Skala and Orava Castle), characterised by the occurrence of nodular limestones from the latest Pliensbachian to the Toarcian (Adnet Formation). Some outcrops in Western Slovakia display a full sequence of deposits that are usually poorly or incompletely exposed in Poland, as evidenced by the Bajocian to the Oxfordian of the deep-water Pieniny Succession at Halečková Klippe (Krobicki and Golonka, 2006). According to Krobicki and Golonka (2006), the Western Slovakian sector is essential to the palaeogeographical and sedimentological reconstruction of some of the unusual deposits attributed to the Czorsztyn Succession, including:

- the coral biotherms from the early Middle Jurassic, only located in Vršatec Klippen;
- the stomatactis mud mounds from the late Middle Jurassic in the Slávnické Podhorie Klippe;
- cross-bedded crinoidal limestones from the Bajocian in Hatné Klippe.

5.4 SAMPLING LOCATIONS

5.4.1 NIEDZICA SUCCESSION - NIEDZICA LIMESTONE FORMATION

The dominant lithology is dark red nodular limestone, often with an admixture of haematite-rich marl. Thin red crinoid limestone intercalations occur sometimes in the lowest part of the Formation. Limestone pebbles with algae (possibly Anisian) have been discovered in the Niedzica succession, including in the Bathonian of the Czajakowa Skala. Grey dolomites (Ladinian) also occur (Birkenmajer and Kotański, 1976).

5.4.1.1 NIEDZICA PODMAJERZ (BED 2 - LOWER BATHONIAN)

The western klippe displays an almost complete sequence of the Jurassic deposits of the

Niedzica Succession (Birkenmajer and Znosko, 1955; Birkenmajer, 1977; Wierzbowski *et al.*, 1999). Being one of the most important sites of the succession (Figs 5.8, 5.9, 5.10), this is the type-locality of the nodular limestones (formerly known as "lower nodular limestone") of the Niedzica Limestone Formation and of the Podmajerz Radiolarite Member, both typical of the Niedzica Succession (Birkenmajer, 1977). The sequence is exposed in both a north-western and a south-eastern section of the klippe. The north-western section displays the older strata of the sequence in the normal order and inclined towards the north-east, whereas the south-eastern section displays the younger strata inverted. The deposits of the two parts of the klippe are in contact along a fault plane steeply inclined to the north-west (Birkenmajer and Znosko, 1955).

5.4.1.2 CZAJAKOWA SKAŁA (BED 4 - UPPERMOST CALLOVIAN/OXFORDIAN)

The Czajakowa Skała Klippe near Jaworki is the type location for the Czajakowa Radiolarite Formation, as the Formation is well exposed there (Fig. 5.11). The Klippe displays a complete sequence of the Jurassic deposits of the Niedzica Succession (Birkenmajer, 1977; Wierzbowski *et al.*, 1999). The dominant lithology consists of radiolarian cherts (either calcareous or non-calcareous) and siliceous radiolarian limestones, in bands 3-20 cm thick, alternating with argillaceous or marly shales usually thinner than the cherts. The predominant colouration of either red or green was used to differentiate the three members into which the formation has been subdivided (Birkenmajer, 1977).

5.4.2 CZORSZTYN SUCCESSION - CZORSZTYN LIMESTONE FORMATION

The Czorsztyn succession was deposited in the shallowest part of the marine basin, on the shelf and submarine slope of a landmass that, in the mid-Jurassic, extended further north. It contains the shallowest ridge sequences, in which fragments of red shales found in the Bajocian (Birkenmajer, 1958, 1960) may belong to the Late Triassic. Spotty-marl facies

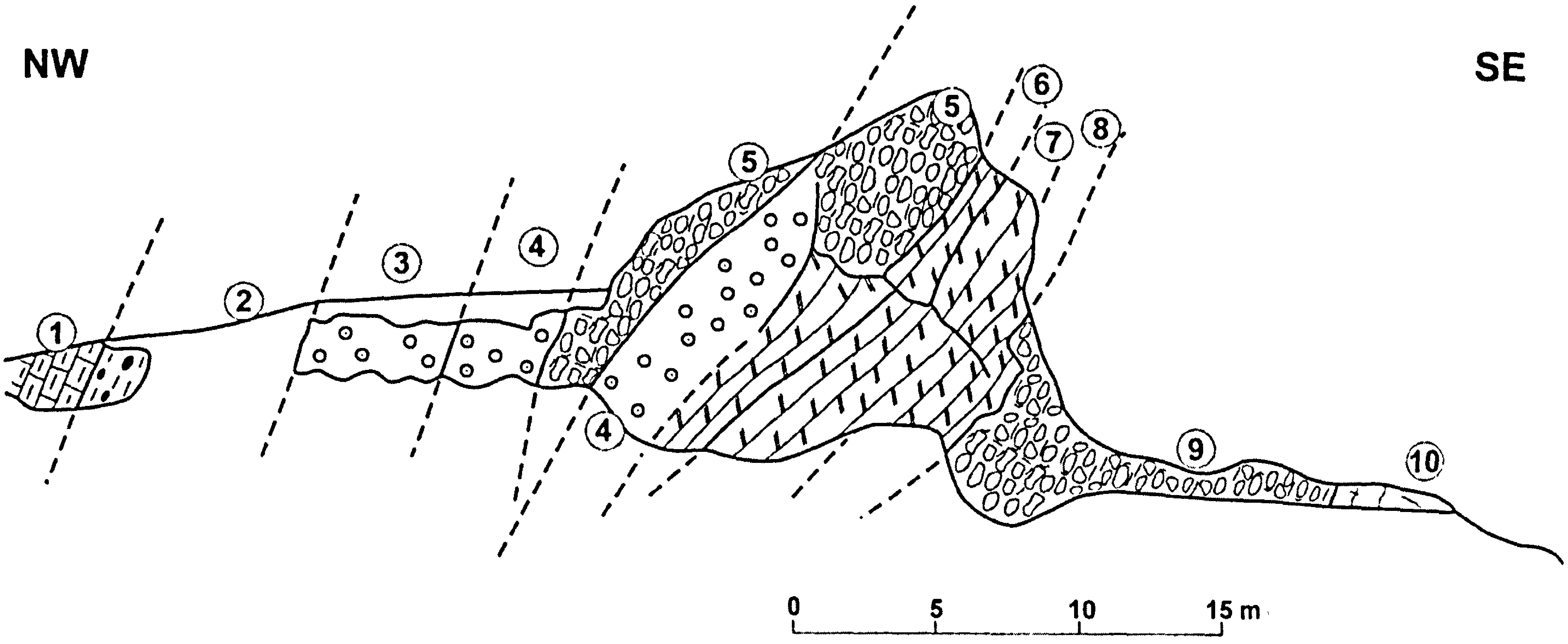


Figure 5.8. Geological section of the Niedzica-Podmajerz Klippe (after Krobicki *et al.* (2006), modified from Birkenmajer (1979)). Niedzica Succession: 1 - Krempachy Marl Fm. (spotty limestones/marls); 2 - Skrzypny Shale Fm. (black shales with spherosiderites); 3 - Smolegowa Limestone Fm. (grey crinoidal limestones); 4 - Krupianka Limestone Fm. (red crinoidal limestones); 5 - Niedzica Limestone Fm. (red nodular limestones of the Ammonitico Rosso-type facies); 6-8 - Czajakowa Radiolarite Fm. (6 - Kamionka Radiolarite Mbr. - red radiolarite; 7 - Podmajerz Radiolarite Mbr. - green radiolarite; 8 - Buwałd Radiolarite Mbr. - red radiolarite); 9 - Czorsztyn Limestone Fm. (red nodular Ammonitico Rosso-type limestones); 10 - Korowa Limestone Mbr. of the Dursztyn Limestone Fm. (pinkish micritic limestones).

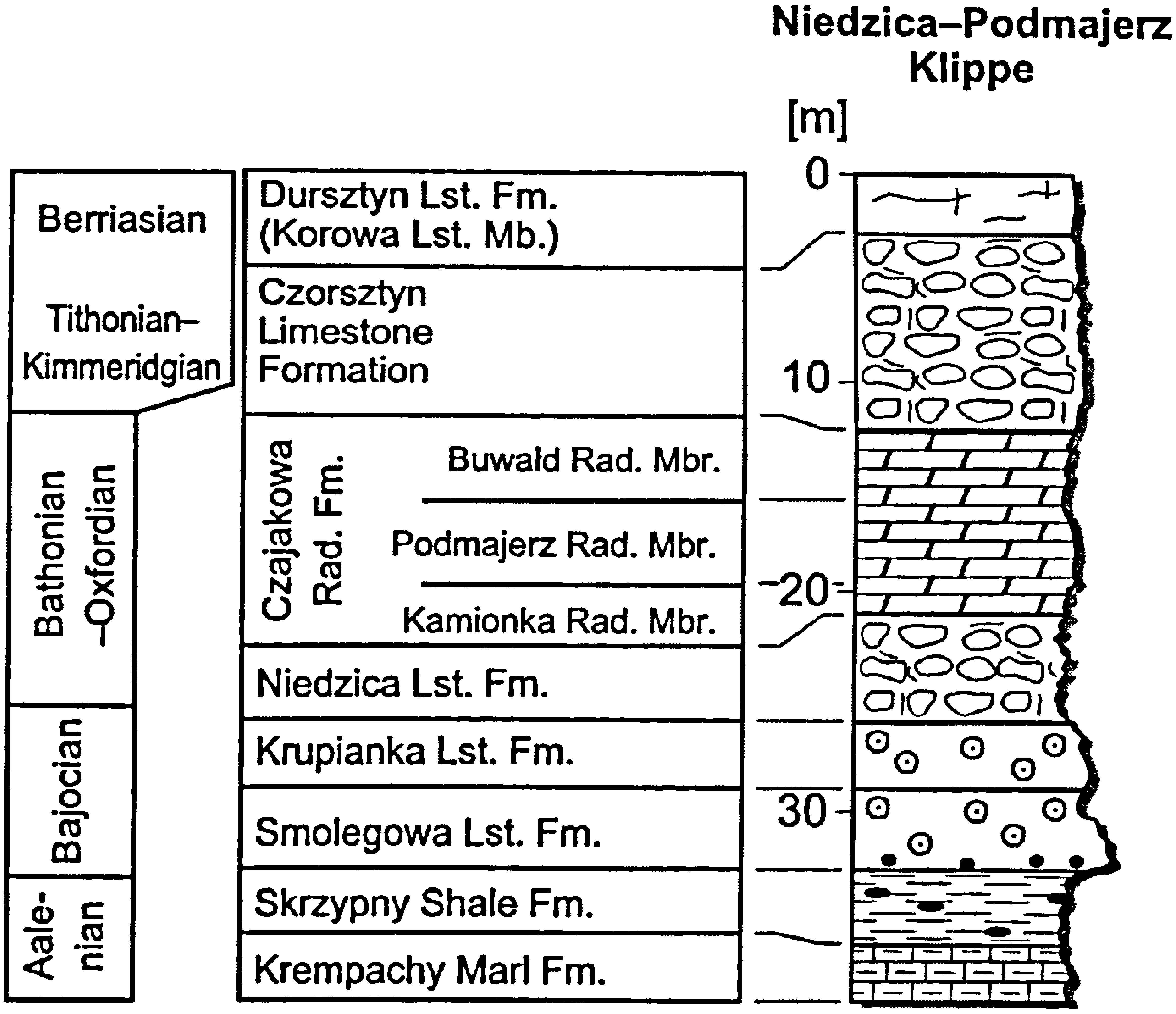


Figure 5.9. Lithostratigraphical column of the Niedzica Succession, Niedzica-Podmajerz (after Krobicki *et al.* (2006), modified from Birkenmajer (1977)).

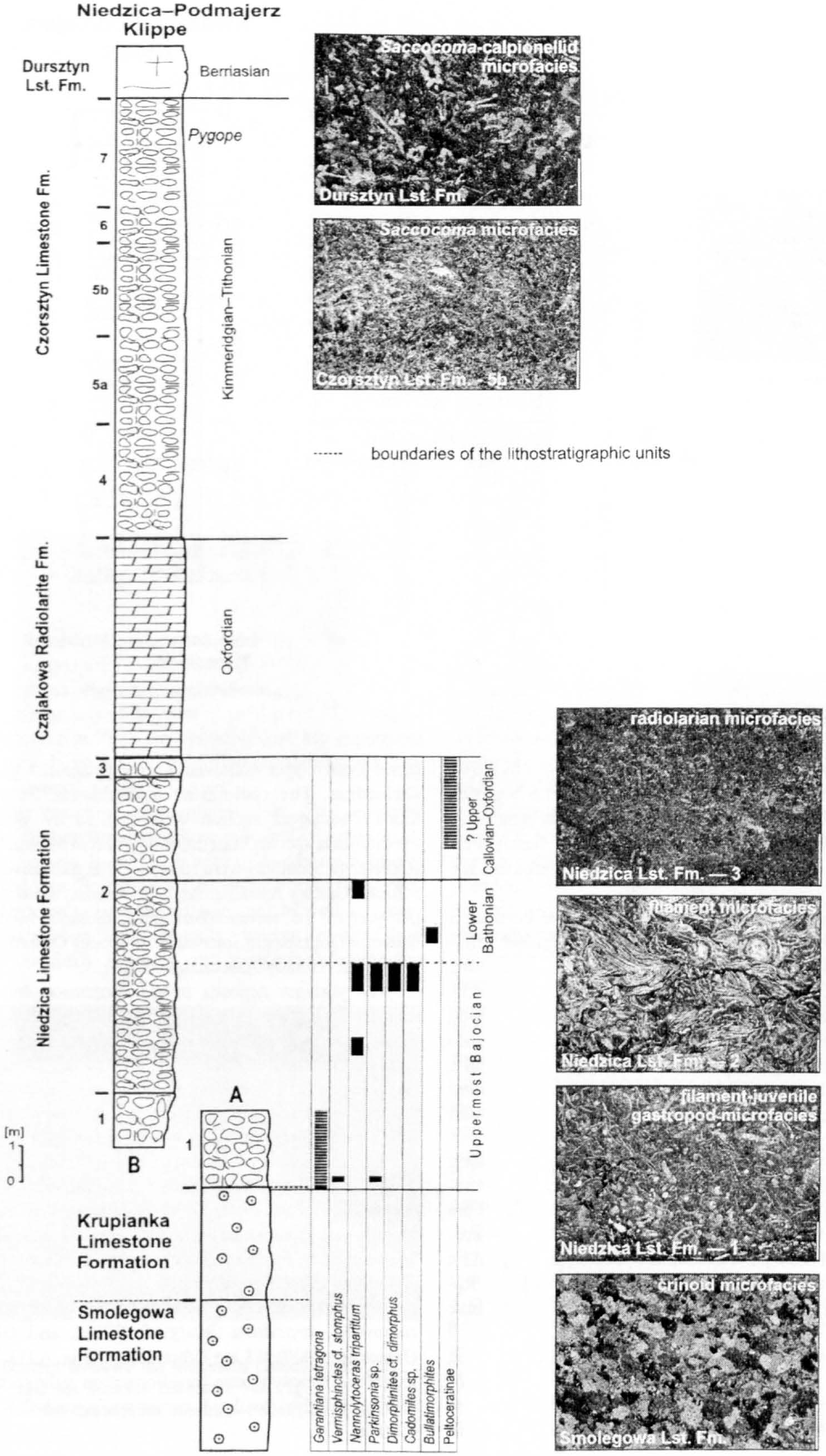


Figure 5.10. Ammonite ranges and chronostratigraphical interpretation of a section of Niedzica-Podmajerz (Niedzica Succession) with change of microfacies record (after Krobicki *et al.* (2006), supplementing Wierzbowski *et al.* (1999)).

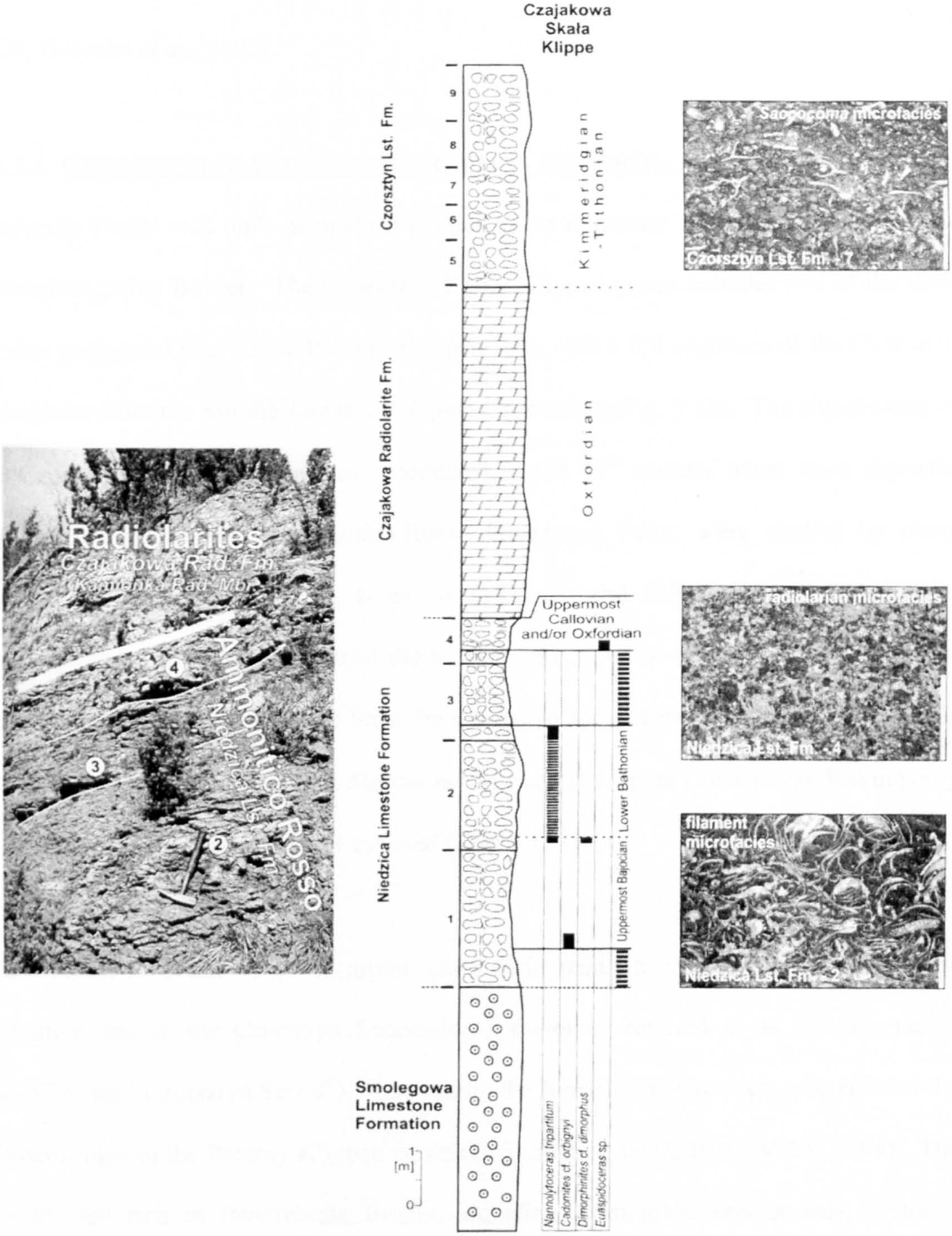


Figure 5.11. Ammonite ranges and chronostratigraphical interpretation of a section of the Czajakowa Skała Klippe (Niedzica Succession) with change of microfacies record (after Krobicki *et al.* (2006), based on Wierzbowski *et al.* (1999)).

lasted until the end of the Aalenian. Dark grey Lower Jurassic deposits and *Bositra* ("*Posidonia*") marls, are overlain by mid-Jurassic to lowermost Cretaceous crinoidal and nodular limestones and Upper Cretaceous pelagic, variegated marl facies (Birkenmajer, 1976; Golonka *et al.*, 2002).

5.4.2.1 CZORSZTYN CASTLE KLIPPE (BED 5 - OXFORDIAN)

Czorsztyn Castle was built in medieval times as an important fortification guarding the Polish-Hungarian Border. The Czorsztyn Castle Klippen group includes one of the most famous geological sites of the Pieniny Klippen Belt, with a full sequence of the Czorsztyn Succession from the Middle Jurassic to Upper Cretaceous (Fig. 5.12). The significance of the Czorsztyn Castle Klippen was recognised in the 19th century when these deposits, amongst which nodular Ammonitico-Rosso limestones occur, were studied by many authors, including Zittel (1870), Neumayr (1871a,b) and Uhlig (1890). Birkenmajer (1963) provided a full description of the section. Regrettably, due to the construction of dams across the Dunajec River to form the Czorsztyn Lake reservoirs, the majority of this sequence was drowned (the lower Middle Jurassic and the Upper Cretaceous), leaving only the Bajocian to Berriasian interval exposed (Figs 5.13, 5.14).

The Czorsztyn Castle Klippen group gave their name to the Czorsztyn Limestone Formation and to the Czorsztyn Succession (previously referred to as the "Czorsztyn Facies" or the "Czorsztyn Series"), representing the Jurassic and Cretaceous deposits of the northern ridge of the Pieniny Klippen Basin (Birkenmajer, 1977, 1986; Mišik, 1994). The deposits are rich in invertebrate fossils, including ammonites, brachiopods, crinoids, calpionellids and foraminifera. These fossils had been described and illustrated by various authors since the beginning of the 19th century, including Staszic, Zejszner, Suess, Neumayr, Zittel and Uhlig, 1890; Birkenmajer, 1963, 1977, 1979, 1983; Barczyk, 1972a,b; Głuchowski, 1987; Wierzbowski and Remane, 1992; Krobicki, 1994, 1996; Wierzbowski

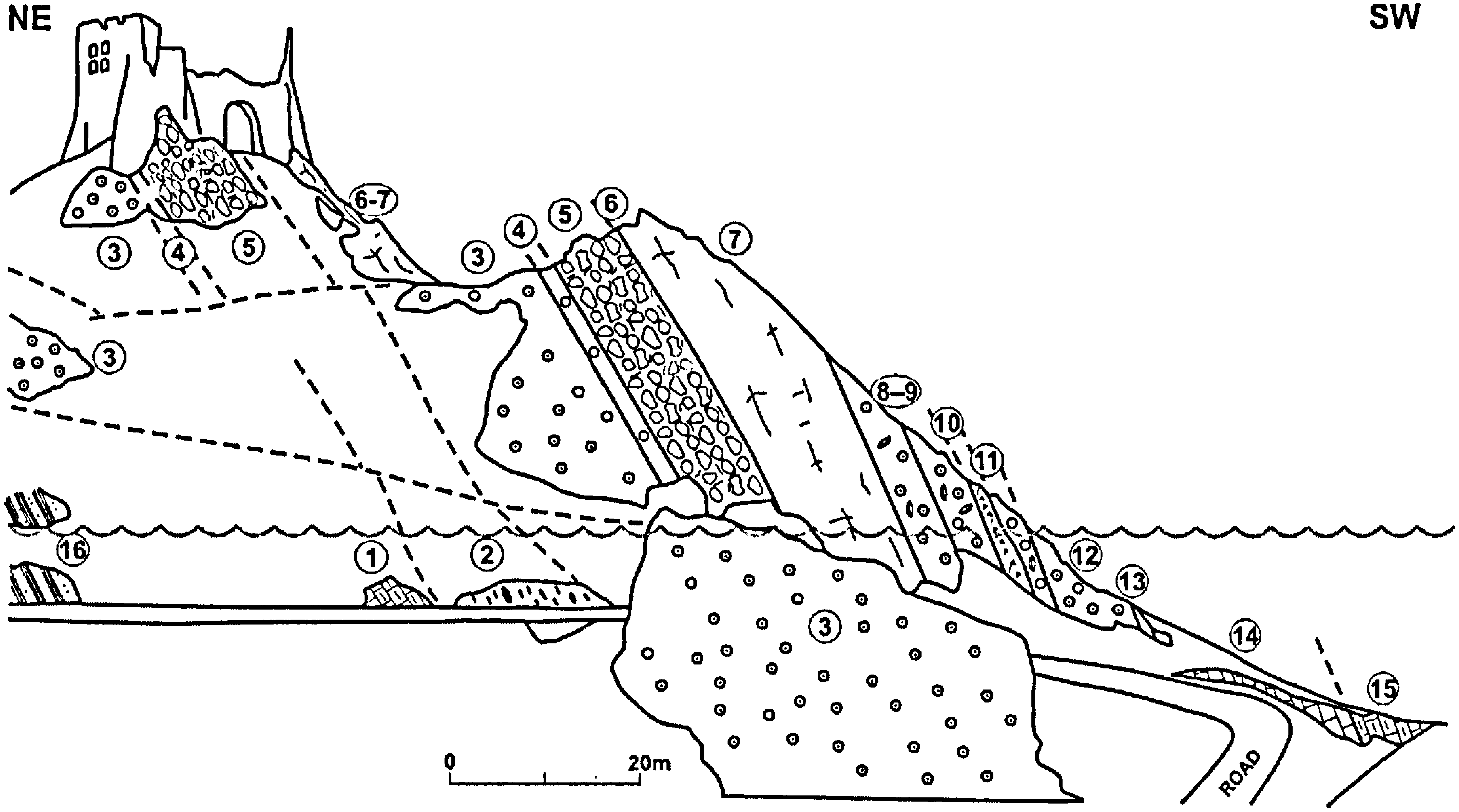


Figure 5.12. Geological section of the Czorsztyn Castle Klippe and Sobótka Klippe, Czorsztyn (after Krobicki *et al.* (2006), modified from Birkenmajer (1963, 1979)). The wavy line indicates the water level, following construction of the Czorsztyn Lake reservoir dams.

Czorsztyn Succession: 1 - Krempachy Marl Fm. (spotty limestones/marls); 2 - Skrzypny Shale Fm. (black shales with spherosiderites); 3 - Smolegowa Limestone Fm. (white crinoidal limestones); 4 - Krupianka Limestone Fm. (red crinoidal limestones); 5 - Czorsztyn Limestone Fm. (red nodular limestones of the Ammonitico Rosso-type facies); 6,7 - Dursztyn Limestone Fm. (6 - Korowa Limestone Mbr. (pink micritic limestones); 7 - Sobótka Limestone Mbr. (white micritic limestones)); 8-11 - Łysa Limestone Fm. (8, 9 - Harbatowa Limestone Mbr. (brachiopod-crinoidal limestones); 10 - Walentowa Breccia Mbr. (sedimentary limestone breccia); 11 - Kosarzyska Limestone Mbr. (crinoidal-brachiopod limestones)); 12 - Spisz Limestone Fm. (red crinoidal limestones); 13 - Chmielowa Fm. (violet limestones); 14 - Pomiedznik Fm. (marls/limestones); 15 - Jaworki Fm. (variegated marls). Magura Succession (Grajcarek Unit): 16 - Szlachtowa Fm. (black flysch).

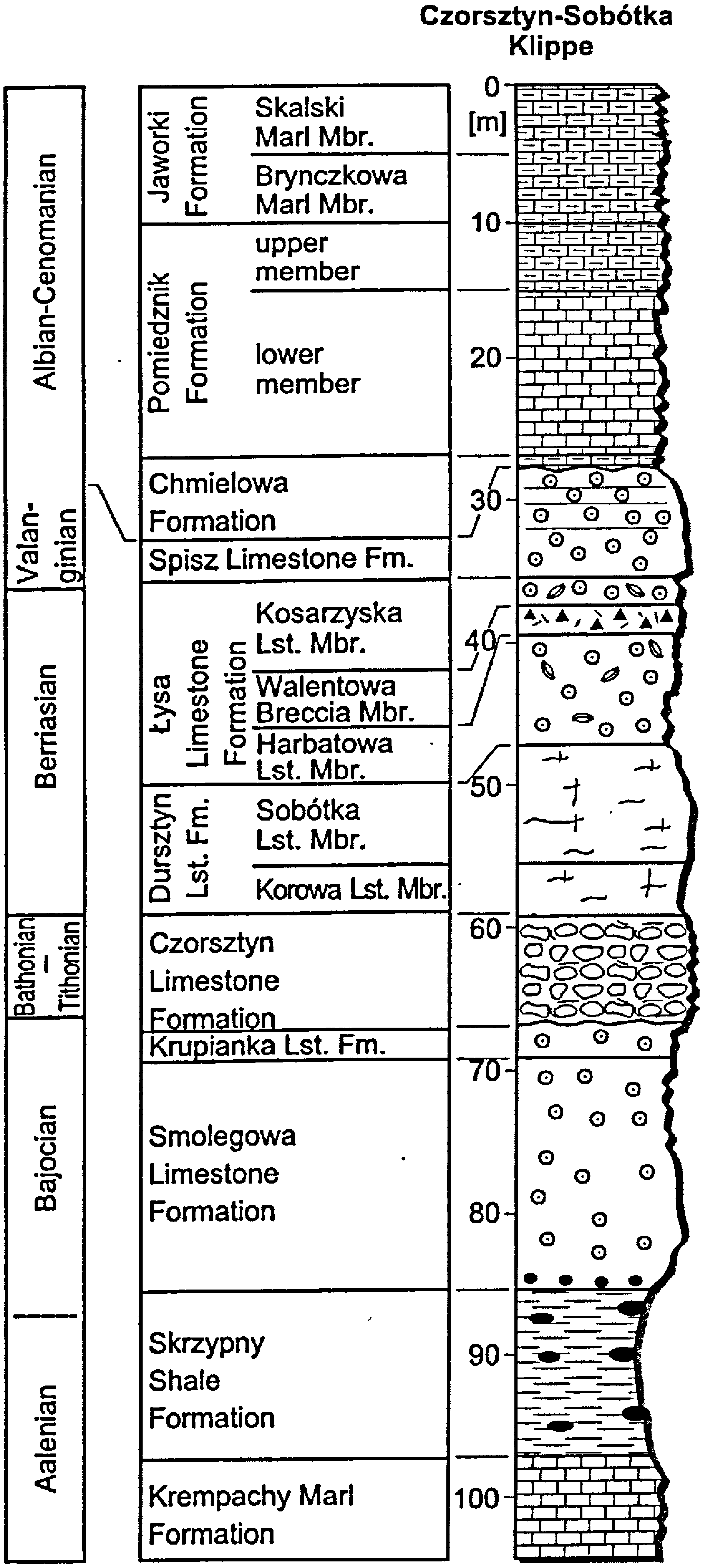
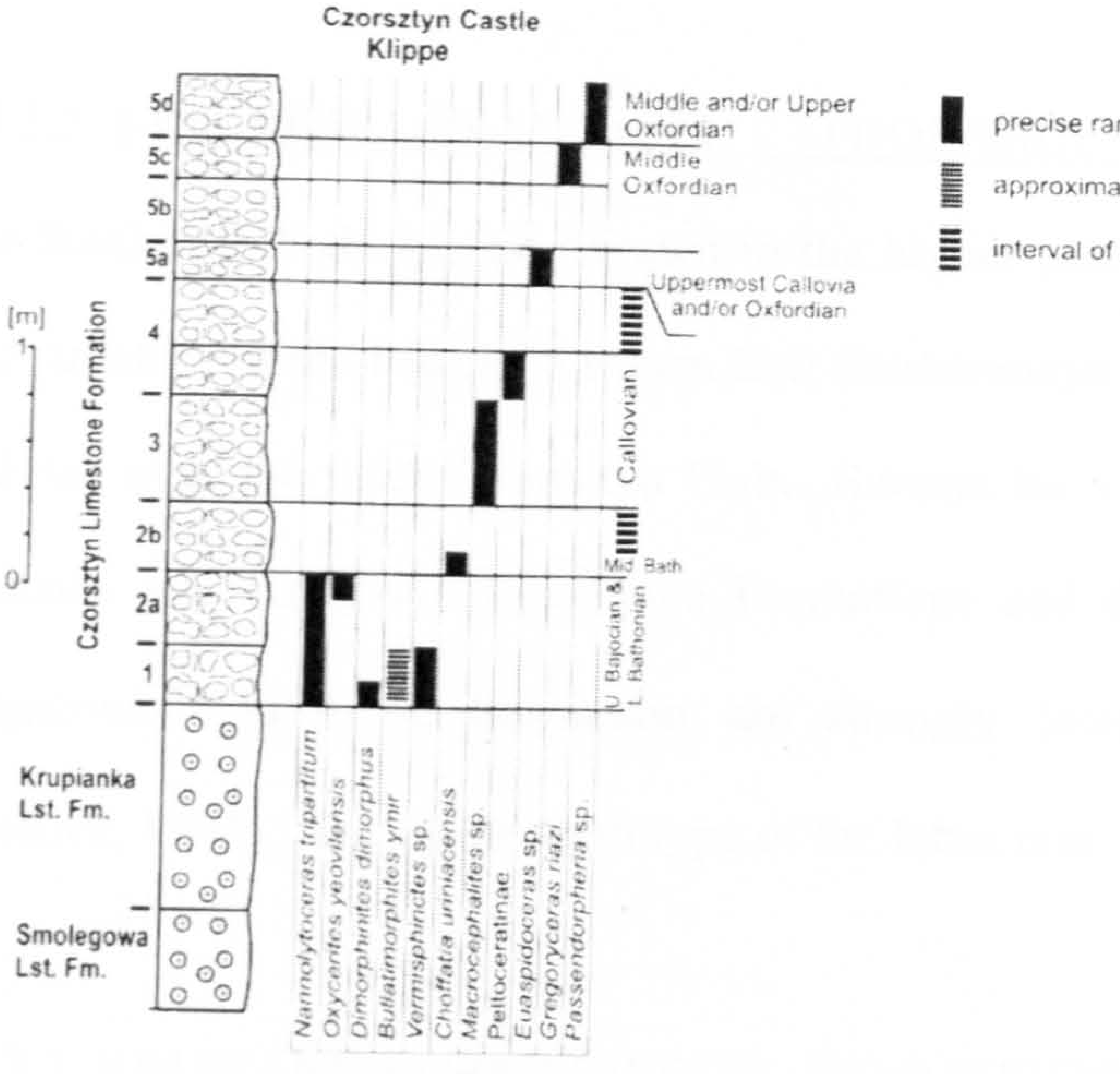
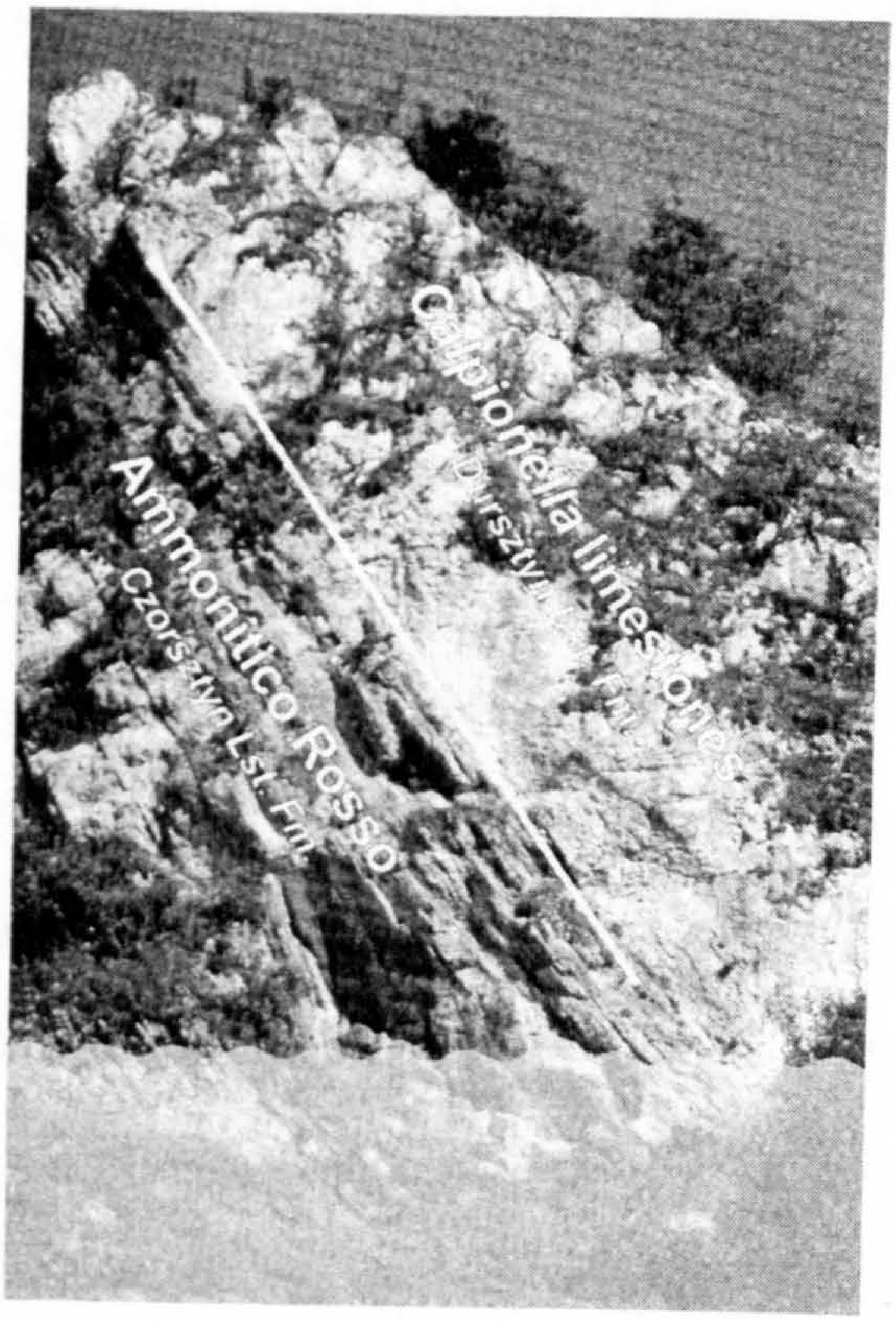


Figure 5.13. Lithostratigraphical column of the Czorsztyn Succession, Czorsztyn Castle Klippe (after Krobicki *et al.* (2006), modified from Birkenmajer (1963, 1977)).





Deatailed view of the Jurassic/Cretaceous boundary in the Sobótka Klippe, Czorsztyn.

Figure 5.14. Ammonite ranges and chronostratigraphical interpretation of a section of the Czorsztyn Castle Klippe (Czorsztyn Succession) with change of microfacies record (after Krobicki *et al.* (2006), supplementing Wierzbowski *et al.* (1999)).

et al., 1999, Krobicki *et al.*, 2006).

5.4.2.2 STANKOWA SKAŁA (BED 2 - PROBABLY OXFORDIAN)

The Stankowa Skała Klippe, located in the higher part of the Homole Gorge is a famous fold structure of the Pieniny Klippen Belt (Birkenmajer 1970, 1979). The Niedzica Nappe is thrust over the thick Czorsztyn Unit. Several beds of both nodular limestones of the Niedzica and Czorsztyn Limestone Formations and the intercalated radiolarites of the Czajakowa Radiolarite Formation are strongly internally folded (Birkenmajer,1970; Jurewicz, 1994). This is the stratotype of the latter unit.

5.4.2.3 KRUPIANKA CREEK (BED 6 - KIMMERIDGIAN)

The klippen on both sides of the Krupianka stream near Jaworki are the type locality of the Krupianka Limestone Formation (named after them), due to the best exposures of the limestone. The dominant lithology is fine to medium-grained crinoidal limestone, usually distinctly bedded, predominantly red in colour but sometimes yellowish or greenish and sometimes shaly. Also present are clastic fragments of quartz and finer-grained Triassic carbonates (as in the Smolegowa Limestone Formation), with the concentration of haematite pigment increasing towards the top of the Formation (Birkenmajer, 1977). Although in the neighbouring units both the Bajocian white crinoidal limestones of the Smolegowa Limestone Formation and the overlying Bajocian red crinoidal limestones of the Krupianka Limestone Formation have thicknesses of up to 100 m, the equivalent strata in the Krupianka stream are only up to 10 m thick (Krobicki and Wierzbowski, 2004). These drastic variations in thickness indicate morphological variation on the sea-floor following Meso-Cimmerian tectonic movements (Golonka *et al.*, 2003; Golonka and Krobicki, 2004).

5.5 MATERIALS AND METHODOLOGY

Thin sections from the Lower Bathonian to the Oxfordian of the Niedzica Succession and the Oxfordian to the Kimmeridgian of the Czorsztyn Succession were examined under an Olympus Vanox Universal Research Microscope fitted with a biological stage. The maximum diameters and test thicknesses of the specimens were measured using a calibrated graticule (see Appendix III).. For each layer, the number of chambers visible for each specimen was plotted against its maximum diameter. The data were then separated into two categories, for thick-walled and thin-walled specimens, respectively. For each category, the abundance of specimens was plotted against maximum diameter and the results of the two categories compared. The thin sections for the Niedzica Succession (Pls 14, 15) and the Czorsztyn Succession (Pls 16, 17) were also photographed, using a Nikon Coolpix 4500 camera mounted on the microscope.

5.6 RESULTS AND DISCUSSION

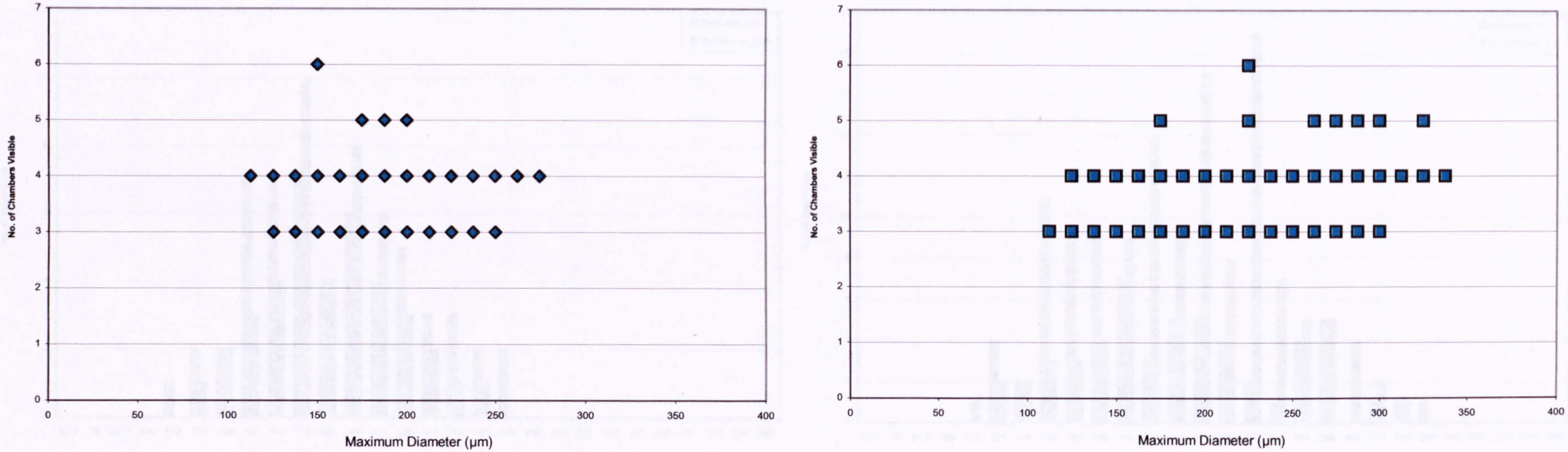
5.6.1 ANALYSIS OF THIN SECTIONS

5.6.1.1 NIEDZICA SUCCESSION: NIEDZICA LIMESTONE FORMATION

From the Niedzica Succession, thin sections from two sampling locations were examined (Figs 5.15, 5.16).

NIEDZICA PODMAJERZ – SAMPLE NP - B/2

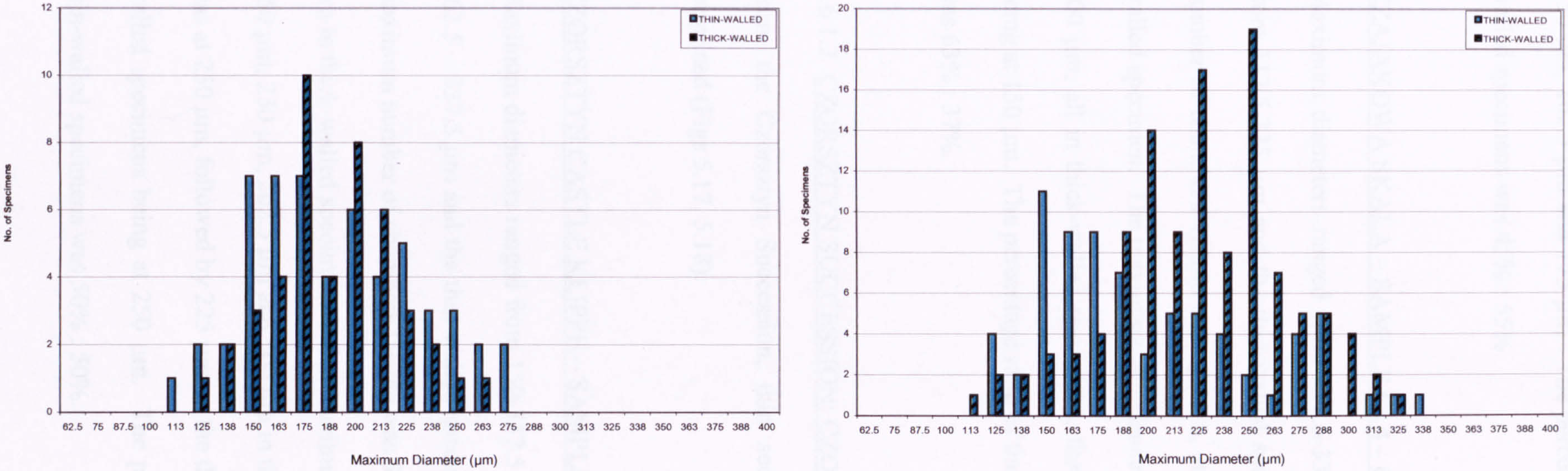
Maximum diameters ranged from 112.5-275 µm, the thick-walled specimens ranging from 125-262.5 µm and the thin-walled specimens present throughout the total range. The maximum number of chambers visible was 6, at a maximum diameter of 150 µm, in a thin-walled specimen. Whilst the thick-walled specimens had slightly less variation in their maximum diameters, they had the highest abundance, at 175 µm. Conversely, the thin-walled specimens had slightly more variation in diameter and there tended to be a greater



Niedzica Podmajerz - Bed 2

Czajakowa Skala - Bed 4

Figure 5.15. Comparison of the chambers visible in planktonic foraminifera from the Niedzica Succession.



Niedzica Podmajerz - Bed 2

Czajakowa Skala - Bed 4

Figure 5.16. Comparison of the abundances of thick-walled and thin-walled planktonic foraminifera from the Niedzica Succession.

number of individuals at more diameters, the maximum abundance being at diameters of 150 µm, 162.5 µm and 175 µm. The percentage ratio of thick-walled specimens to thin-walled specimens was 45% : 55%.

CZAJAKOWA SKAŁA – SAMPLE Cs 4 – 0,4

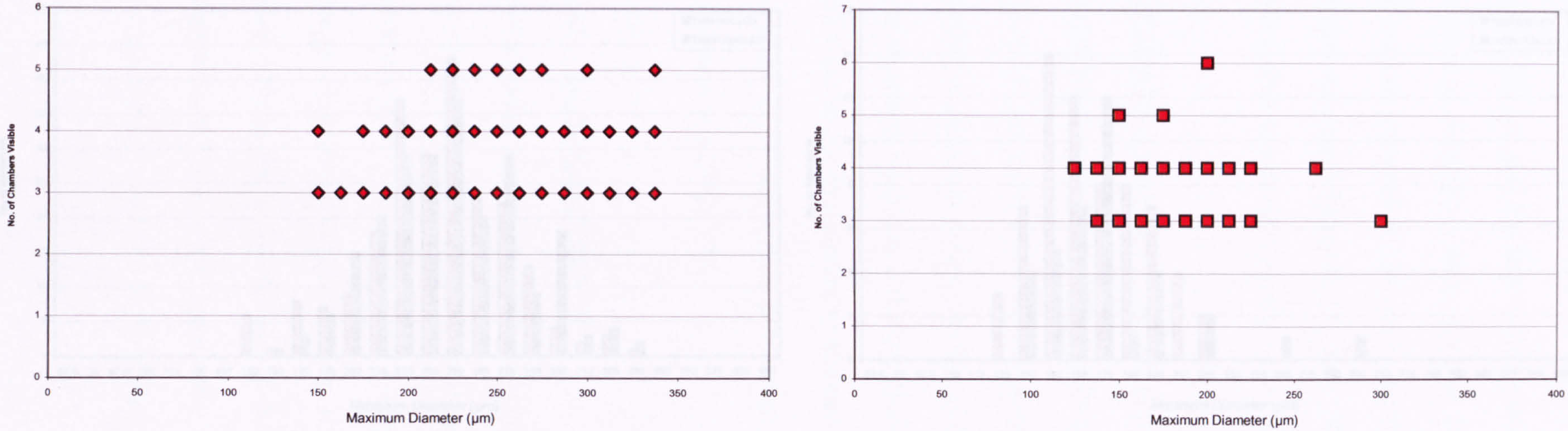
Maximum diameters ranged from 112.5-337.5 µm, the thick-walled specimens ranging from 112.5-325 µm and the thin-walled specimens from 125-337.5 µm. The maximum number of chambers visible was again 6, at a maximum diameter of 225 µm, in a thick-walled specimen. The maximum abundance occurred at 250 µm, followed by 225 µm and 200 µm, all in thick-walled specimens, the highest abundance in thin-walled specimens being at 150 µm. The percentage ratio of thick-walled specimens to thin-walled specimens was 63% : 37%.

5.6.1.2 CZORSZTYN SUCCESSION: CZORSZTYN LIMESTONE FORMATION

From the Czorsztyn Succession, thin sections from three sampling locations were examined (Figs 5.17, 5.18).

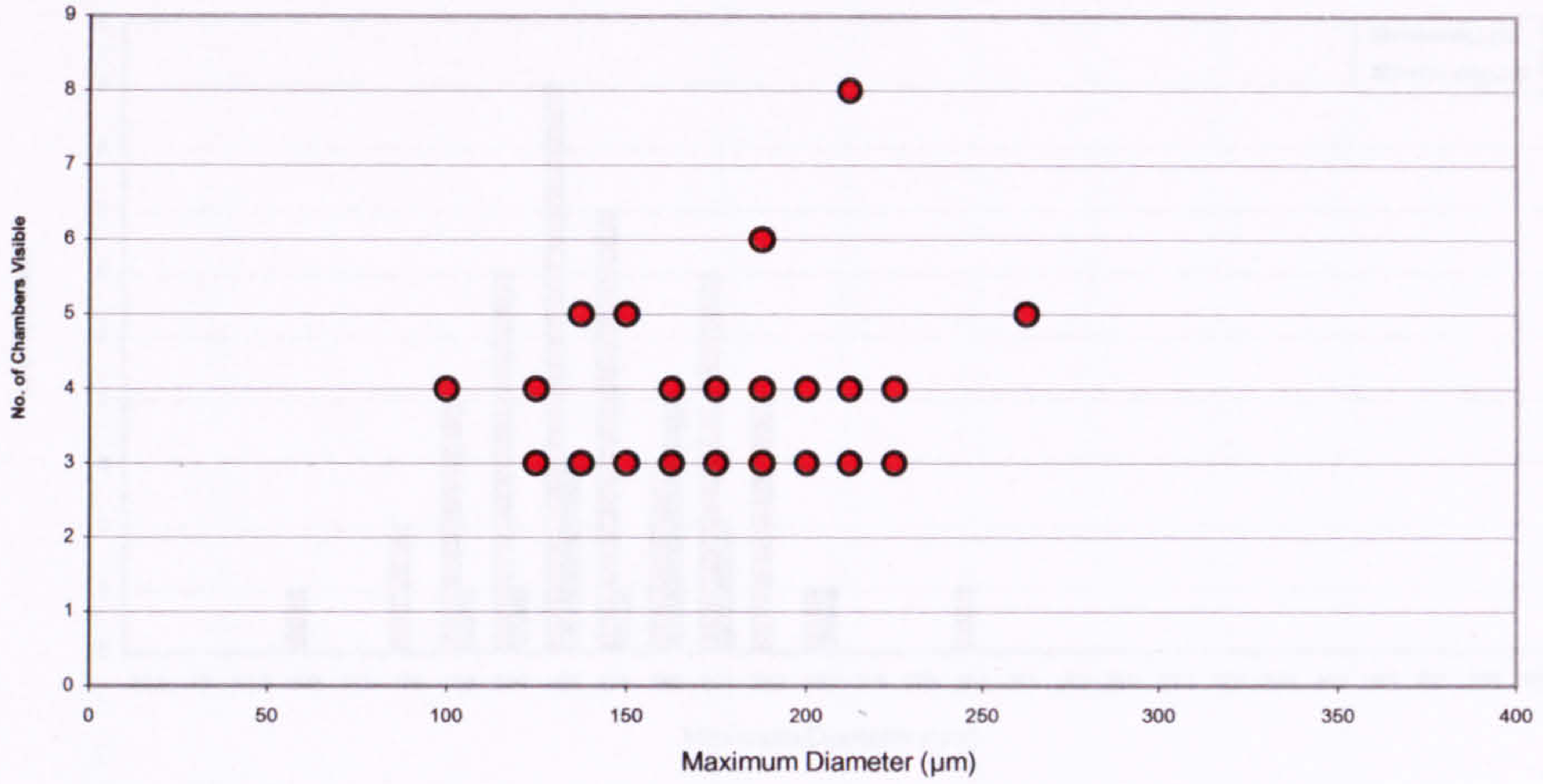
CZORSZTYN CASTLE KLIPPE – SAMPLE CzZ 5b

Maximum diameters ranged from 150-337.5 µm, the thick-walled specimens ranging from 162.5 – 337.5 µm and the thin-walled specimens present throughout the total range. The maximum number of chambers visible was 5, at maximum diameters of 275 µm and 337.5 µm in thick-walled specimens and at maximum diameters of 212.5 µm, 225 µm, 237.5 µm, 250 µm, 250 µm, 262.5 µm and 300 µm in thin-walled specimens. The highest abundance was at 250 µm, followed by 225 µm, in the thin-walled specimens, the maximum for thick-walled specimens being at 250 µm. The percentage ratio of thick-walled specimens to thin-walled specimens was 50% : 50%.



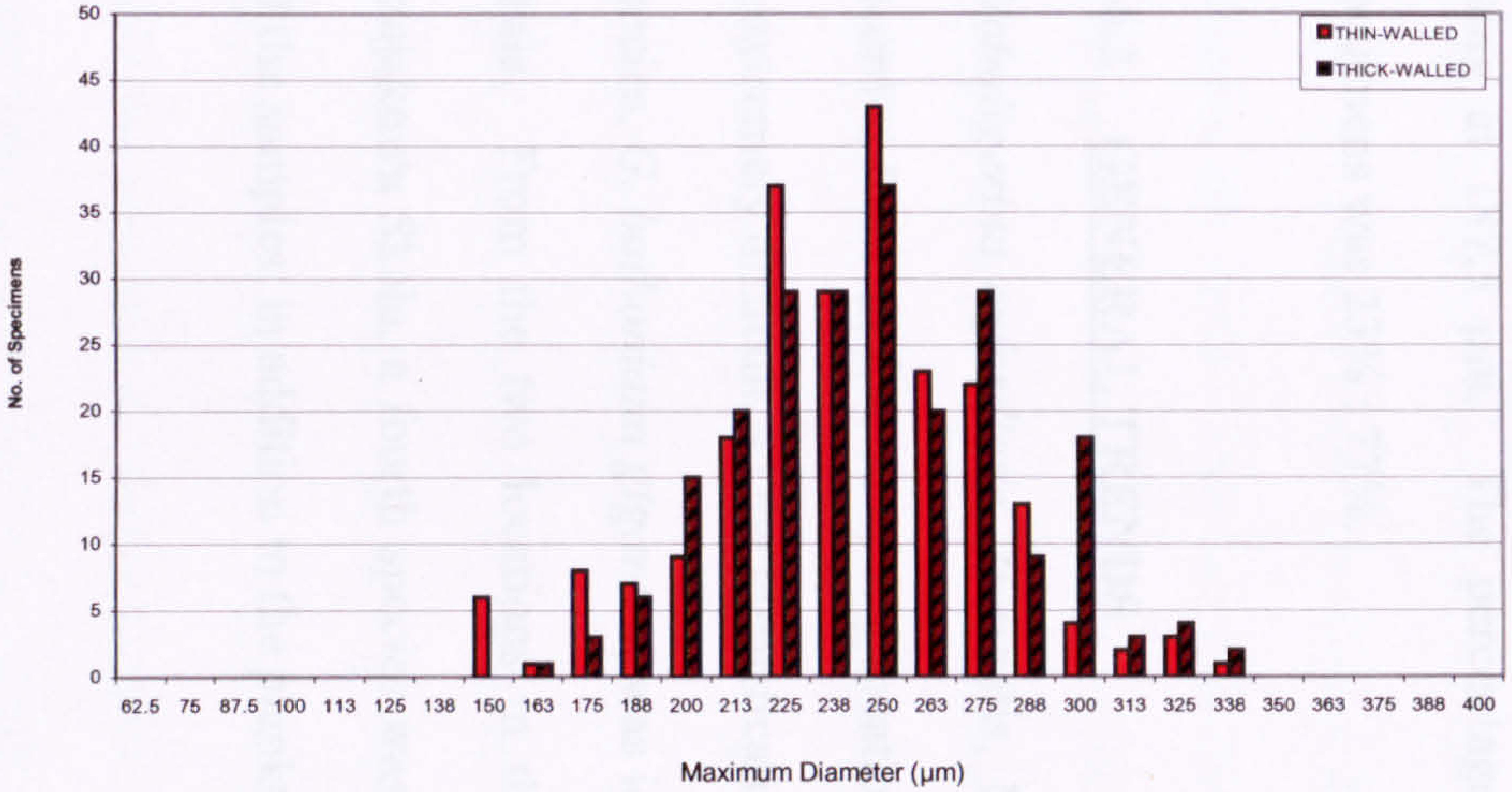
Czorsztyn Castle Klippe - Bed 5

Stankowa Skala - Bed 2

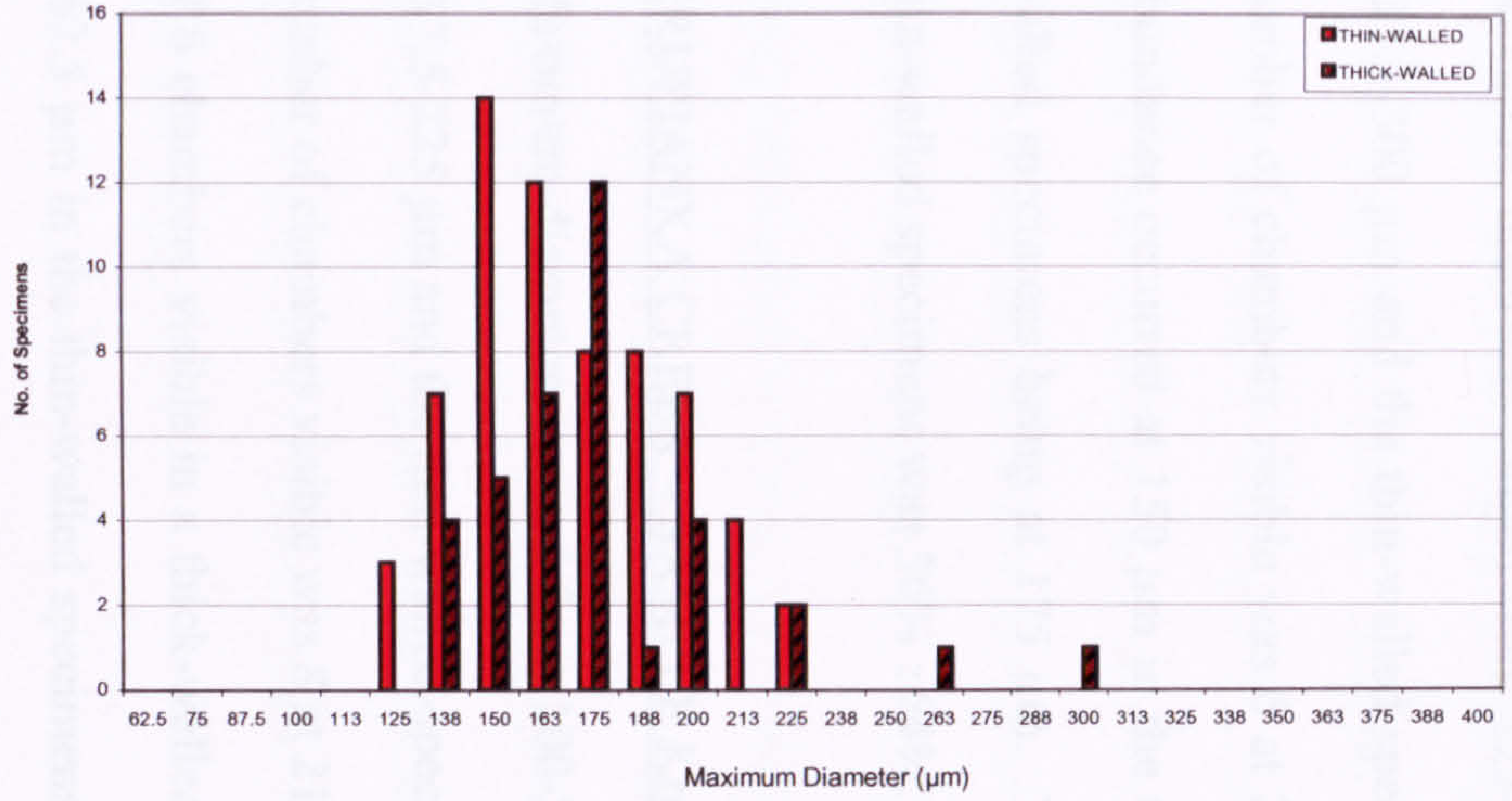


Krupianka Creek - Bed 6

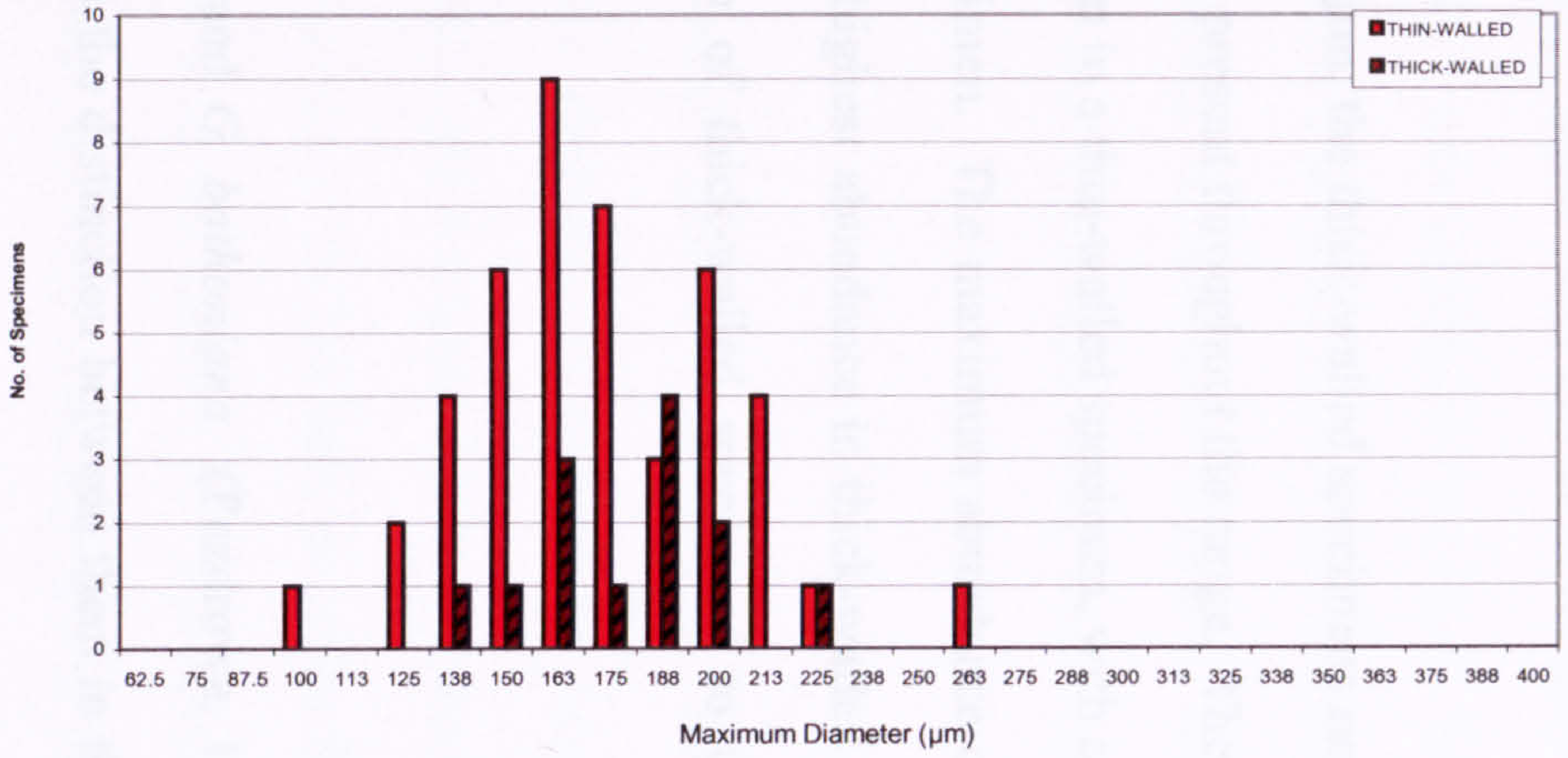
Figure 5.17. Comparison of the chambers visible in planktonic foraminifera from the Czorsztyn Succession.



Czorsztyn Castle Klippe - Bed 5



Stankowa Skala - Bed 2



Krupianka Creek - Bed 6

Figure 5.18. Comparison of the abundances of thick-walled and thin-walled planktonic foraminifera from the Czorsztyn Succession.

OXFORDIAN: STANKOWA SKAŁA – SAMPLE SkS 2

Maximum diameters ranged from 125-300 µm, the thick-walled specimens ranging from 137.5-300 µm and the thin-walled specimens ranging from 125-225 µm. The maximum number of chambers visible was 6 at 200 µm in a thin-walled specimen. The maximum abundance occurred at 150 µm in the thin-walled specimens, the maximum for the thick-walled specimens being at 175 µm. The percentage ratio of thick-walled specimens to thin-walled specimens was 36% : 64%.

KRUPIANKA CREEK – SAMPLE Krp 6

Maximum diameters ranged from 100-226.5 µm, the thick-walled specimens ranging from 137.5-225 µm and the thin-walled-specimens present throughout the range. The maximum number of chambers visible was 8 at 212.5 µm in a thin-walled specimen, with a maximum of 6 chambers visible in a thick-walled specimen. The maximum abundance occurred at 162.5 µm in the thin-walled specimens, the highest abundance in thick-walled specimens being at 187.5 µm. The percentage ratio of thick-walled specimens to thin-walled specimens was 23% : 77%.

5.6.2 GENERAL TRENDS

Globuligerina oxfordiana (Grigelis, 1958) and *G. bathoniana* (Pazdrowa, 1969) were recorded from all five sampling locations but the distinction between them in thin-section is extremely difficult, so the identification of these species is therefore speculative. A third species, *G. bathoniana gigantea*, was identified from all of the locations except Stankowa Skała. From the two locations in the Niedzica Succession, Niedzica Podmajerz and Czajakowa Skała, a fourth species was identified, *Conoglobigerina* aff. *dagestanica*. In all the samples, in addition to the planktonic foraminifera, *Bositra* were abundant.

5.7 *BOSITRA*

From the Czorsztyn Succession, during their study of the early stages of the development of the Carpathian Basins, Golonka *et al.* (2006) described "Early Jurassic *Bositra* ("*Posidonia*") marls", followed by Middle Jurassic to lowermost Cretaceous crinoidal and nodular limestones and the Late Cretaceous pelagic marl facies. From the Babiarzowa Klippe at Maruszyna village near Nowy Targ, one of the most famous Jurassic localities in the Polish Pieniny Klippen Belt, Wierzbowski *et al.* (2004) reported the red limestone as being filamentous wackestones to packstones. "Apart from thin *Bositra* shells, there are numerous crinoidal and bivalve fragments, smooth-shelled ostracods and benthic foraminfers." From the High Tatric Succession, Łuczyński (2002) described the micritic parts of the Smolegowa Formation as containing "the so-called filaments, interpreted as scattered fragments of thin-shelled *Bositra* bivalve (Oschmann, 1994, Wierzbowski, 1994) and rare foraminifers".

Bositra (originally *Posidonia*) are characteristically present in black shales but may also occur in shallow-water limestones that were deposited in sufficiently fine grains to preserve the shells. They are thin-shelled with only two shell layers and there has been considerable controversy regarding their life strategy. It has been proposed that *Bositra* and their relatives may have been nektoplanktonic, the absence of a byssal notch during their ontogeny being advanced as evidence that they were never attached at any stage of their life cycle (Clarkson, 1998). Specimens are usually preserved with both valves open, which Jefferies and Minton (1965) demonstrated could only happen if their normal opening angle exceeded 60° between swimming contractions. Further experiments and calculations indicated that such a swimming bivalve would not have sunk rapidly. Their arguments for the "earlier Jurassic thin shelled, equivalve bivalve *Bositra*", together with "marked anterior and posterior gapes in *Bositra*, suitable for the expulsion of water jets", were subsequently referred to by Kelly and Doyle (1991) in suggesting that the bivalve

Aulacomyella from the Early Tithonian of Antarctica was free-swimming. *Bositra* may have exploited an ecological niche by being nektoplanktonic which, following the extinction of this genus in the Cretaceous, later bivalves have failed to do (Clarkson, 1998).

Dense bedding plane assemblages of *Bositra* have been recorded during the intensive studies of the Posidonienschiefer. Oschmann (1994) reinterpreted these assemblages as being opportunistic benthonic colonisation, not accumulations of pseudoplankton. In subsequent analyses of the life strategy of *Bositra*, it was observed that, in addition to the accumulation of large specimens, in some parts of the sequence there were accumulations of only small specimens. These were interpreted as pelagic larval forms which precociously matured sexually, remaining pelagic and escaping the bottom water conditions unfavourable to a benthonic lifestyle. From the Toarcian Posidonia Shale of southern Germany, Hartgers *et al.* (1995) observed "abundant fossils of the bivalves *Posidonia* (*=Bositra*) *radiata* and *Pseudomytiloides dubious* that are typically assigned to a benthic life habit." From his studies of the Aalenian Opalinium Clay of Northern Switzerland, Etter (1995, 1996, 2004) described the fauna as "dominated by ammonites and small epibenthic bivalves (*Bositra buchi*) and of low diversity". In their study of the same area, Favre *et al.*, (1996) also re-evaluated the life-style of *Bositra buchi.* Based on their statistical analyses, it appeared that this species was "truly benthic and probably byssally attached to the substrate". They dismissed previous suggestions of a chemosymbiotic life style for *Bositra*, concluding that it was "an erratic opportunist capable of rapidly colonising a variety of fine-grained sediments and reached its peak abundances in severely oxygen-depleted palaeo-environments". Etter's (1996) conclusion, based on non-random specimen distribution and taphonomic evidence indicative of in situ preservation of *Bositra*, was that they were benthonic, highly tolerant to low oxygen levels and employed opportunistic dispersal strategies to rapidly colonise severely dysoxic environments. The distribution of *Bositra* shell pavements along a palaeo-oxygenation gradient in the Yukon, Canada was thought by Clapham *et al.* (2002) to support this hypothesis.

Numerous fossil impressions of *Bositra buchi* (Römer) were observed by Steiner *et al.* (1998), previously identified by Rothe (1968) as *Posidonia bronni.* The fossil impressions usually displayed separated valves lying horizontally with the concave side facing down. They were 2-10 mm long and only 0.05 mm thick. They displayed "neomorphic syntaxial rims that grew perpendicularly (less often tangential) to the shell, thus reflecting the structure of the prismatic and respectively lamellar layers of the *Bositra* shells (e.g. Kälin and Bernoulli, 1984, plate 1)". The shells were closely packed (up to 80% of the thin section) and were found in both the calcareous and argillaceous beds.

OCCURRENCE

The occurrence of *Bositra* has been recorded in the literature from various locations including Poland, Southern Germany, Switzerland, Italy, Turkey, Bulgaria, Portugal, the Canary Islands, Morocco and Canada.

In their study of a Lower Bajocian – Kimmeridgian hiatus in the Umbria-Marche Appenines, Bartolini and Cecca. (1999) recorded that the microfacies which preceded the break, of which the start coincided with a positive $\delta^{13}C$ peak, were characterised by "oligotypical associations at high density, alternatively dominated by *Bositra buchi*, crinoids and protoglobigerinids". Occurrences of *Bositra* at several levels of the Monte Inici Formation, Western Sicily, were recorded Savary *et al.* (2003). "Red clasts of *Bositra* de Gregorio, 1886" were found in orange micritic sediment, unspecified *Bositra* in wackestones and, in the Ammonitico Rosso, "the valves of the *Bositra,* not flattened by the compaction". Amongst grey calcareous pseudo-nodules of the lower to middle Callovian level, they observed *Bositra*, "of which the concentric arrangement is an index of bioturbation". The lower middle Oxfordian level of calcareous pseudo-nodules was again "rich in *Bositra* of which the arrangement indicates an important bioturbation of the sediment". At the middle Oxfordian level, Savary *et al.* (2003) recorded that "the *Bositra* disappear and are replaced by the protoglobigerinids in infillings frequently mineralised".

From the Beyşehir-Hoyran Nappe of the Taurus tectonic units, Turkey, Varol and Tunay (1996) recorded that the Jurassic was represented by "filament-type and ammonite bearing limestones". The filament-bearing limestones were described as red, sandy, soft and having a "matrix appearance". At the beginning of the condensed sequences, wackestone-packstone-bearing filament limestone microfacies were dominant. The filaments as "massive files" were deposited along the layers and filaments also filled the "micro-cracks surrounded by iron and manganese". Varol and Tunay (1996) commented that so far there had been no palaeontological description of these filaments but some similar forms had been defined as shell fragments of *Bositra* species by Jenkins (1971). In their studies of the limestones of Western Bulgaria, Koleva-Rekalova *et al.* (2002) recorded that those of the Callovian at Gorni Lozen, south-east of Sofia, consisted of filamentous wackestones and packstones, the filaments aligned parallel to the bedding plane and comprising about 10% of the wackestones and 75-80% of the packstones. The authors described the filaments, often broken, as thin-shelled bivalves of the genus *Bositra* and noted, "*Bositra buchi* (Romer) is a pectinacean of Toarcian to Oxfordian age (Jefferies and Minton, 1965)". They did not record *Bositra* from their studies of the Upper Jurassic–Lower Cretaceous sections of the Glozhene Formation, to the north-west of Sofia.

During their studies of the Lower Jurassic marly limestones of the S. Gião Formation, northern sector of the Lusitanian Basin, Portugal, Duarte *et al.* (2003) recorded that the maximum flooding surface of a Toarcian transgressive event (top of the Levisoni Zone) was shown by "thin-shelled, bivalve-rich (*Bositra* sp.) horizons". Also from the Coimbra area, in the Maria Parès section, Gahr, (2005) noted that further evidence for oxygen deficiency was provided by the "*Bositra buchi*-assemblage" occurring in the Bifrons Subzone (Middle Toarcian). From their study of sea-floor spreading in the central Atlantic, Steiner *et al.* (1998) used *Bositra* as a biostratigraphic marker for the Toarcian to Oxfordian in Fuerteventura. It is found in large quantities only in a few typical facies, including lower Toarcian bituminous shales, (Jefferies and Minton, 1965; Bernoulli and Kälin, 1984) and Aalenian to upper Bajocian bioclastic facies, (Baumgartner *et al.*, 1995). In the Ketama unit of the external Rif and in the Eastern High Atlas of Morocco, limestone beds with an identical filament microfacies occur as a very distinct interval dated by ammonites as middle Aalenian to middle Bajocian age (Favre, 1992), constrained by Bajocian - mid-Callovian Posidonia marlstones (Choubert and Faure-Muret, 1962; Favre, 1992).

From the Laberge Group of the northern Whitehorse Trough, Yukon, Canada, Clapham *et al.* (2002) observed that shell pavements of "closely packed, articulated *Bositra buchii* specimens" had a spatially widespread, but temporally limited, distribution (Middle and Upper Toarcian or Early Aalenian strata), suggesting that periodic, basin-wide anoxia was prevalent. These *Bositra* shell pavements suggested that anoxia and decreased sediment supply might possibly be linked to a rapid transgression.

5.8 SUMMARY

Planktonic foraminifera (including *Compactogerina* and *Globigerina*) are extremely abundant in some of the limestones of the Pieniny Klippen Belt. In places, they are >95% of the foraminiferal assemblage, the sediments almost being referable to a "foraminiferal ooze" (*Globigerina* Ooze sensu Murray and Reynard, 1891). While Wierzbowski *et al.* (1999) refer to these sediments as the "Globuligerina microfacies", they do appear to represent a genuine oceanic/foraminiferal ooze. Normally, in the modern oceans, foraminiferal ooze forms in water depths greater than (?)500 m down to the level of the carbonate lysocline and compensation depth. The situation in the mid-Late Jurassic is more complicated. If planktonic foraminifera are composed of aragonite, rather than calcite, then the aragonite compensation depth (ACD) would have been much higher in the water column. This makes depth calculation almost impossible. Deeper water, more basinal areas, are reportedly (Wierzbowski *et al.*, 1999) characterised by radiolarian-rich sediments. This would be predicted but the aragonite to silica transition would have been at an indeterminate depth in the mid-Jurassic ocean. The nature of the mid-Jurassic ocean is discussed in a later section (Chapter 8).

CHAPTER 6

TETHYS AND PERI-TETHYS

6.1 INTRODUCTION

Records of Jurassic planktonic foraminifera are known from various locations in Tethys and Peri-Tethys including:

- Germany;
- Switzerland and Northern Italy;
- Sicily;
- Greece;
- Turkey;
- Balearic Islands;
- Morocco;
- Canary Islands;
- Portugal;
- Newfoundland.

Material from some of these locations (e.g. Switzerland, Northern Italy, Sicily, Greece) has been investigated while others (e.g. Morocco, Fuerteventura) are known only from a very limited literature base. It has not been possible to obtain samples from all these sites. Material from all these locations would be useful, especially those where the published information is quite general in nature (e.g. Fuerteventura).

The Globuligerinidae had originally inhabited the marginal Tethyan regions (see Chapter 9), where they were abundant in pelagic areas unaffected by detritus. Their tests have been discovered in assemblages that included abundant radiolarians, algal filaments, calpionellids and ostracods in marly limestones (Cita and Pasquare, 1959; Colom and

Rangheard, 1966; Mišík, 1966; Beaudoin, 1967; Fenniger and Holzer, 1972). Apart from some patchy occurrences in the southern hemisphere, at palaeolatitudes of 10°-40°S, they were restricted to the northern hemisphere, mainly at latitudes of 20°-30°N but sometimes extending to 10°-50°N. They are very rare in sediments from the Jurassic deep ocean basins, suggesting that planktonic foraminifera had not normally inhabited the surface waters of the open seas or were incapable of being preserved in such environments.

During the Bajocian and Bathonian, then the Kimmeridgian to Berriasian, planktonic foraminifera had mainly occupied the marginal Tethys regions. During the Callovian-Oxfordian transgression they had expanded over the adjacent shelf areas. The northward expansion of these sub-tropical to tropical planktonic foraminifera from Tethys was assisted by warm currents during transgressions (Gordon, 1970, Riegraf, 1987a,b) and upwelling from the marginal Tethys, as indicated by the abundance of radiolarians, even in the shallow shelf basins. The distributions of the planktonic foraminifera are patchy and non-continuous but often abundant, followed stratigraphically, or replaced, by radiolarian assemblages (Colom, 1955; Cita *et al*, 1959). If the majority of Jurassic oceans and shelf seas were of uniform salinity, temperature may have controlled the distribution of the globuligerinids (Gordon, 1970). During extensive regressions, the globuligerinids were restricted to the marginal Tethys.

6.2 GERMANY

From his comprehensive compilation of the global distributions of the Globuligerinidae, ranging from the Bajocian to the Barremian, Riegraf (1987a) reported that Jurassic, Globuligerinidae were known from the Callovian and lower Oxfordian of North-West and South-West Germany and Franconia (Fig. 6.1). Their most frequently recorded occurrences were associated with the Callovian/Oxfordian transgression. Callovian

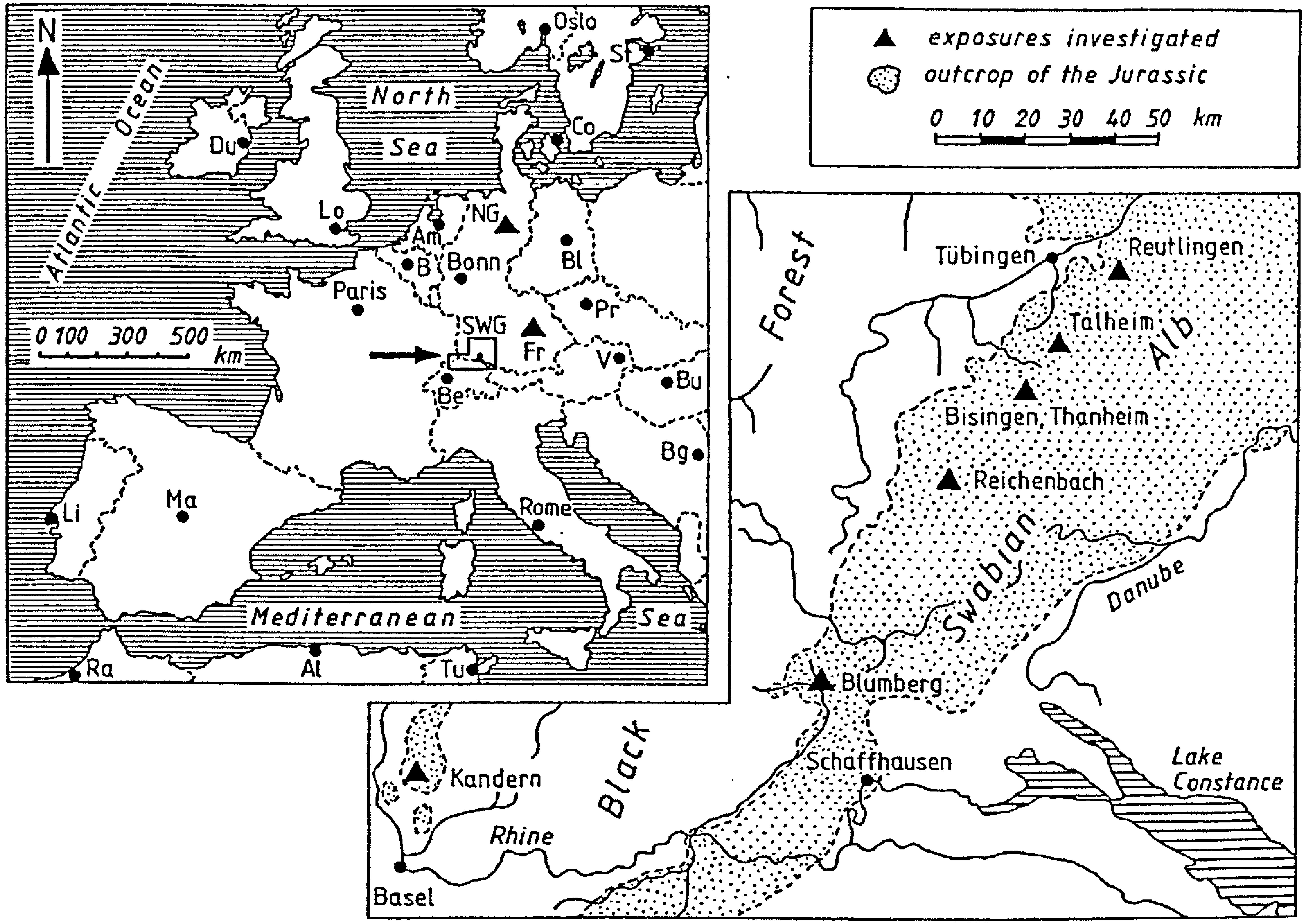


Figure 6.1. Map of Europe showing locations of exposures investigated (left); enlargement showing in detail the locations of Southwest German exposures (right). Al = Algiers; Am = Amsterdam; B = Brussels; Be = Bern; Bg = Belgrade; Bl = Berlin; Bu = Budapest; Co = Copenhagen; Du = Dublin; Fr = Franconia; Li = Lisbon; Lo = London; Ma = Madrid; NG = Northern Germany; Pr = Prague; Ra = Rabat; St = Stockholm; SWG = Southwest Germany; Tu = Tunis; V = Vienna (Riegraf, 1987a).

occurrences have been recorded in studies of Lower Saxony (Bartenstein and Brand, 1937), Baden-Württemberg (Riegraf, 1987a) and Franconia (Munk, 1978). Oxfordian occurrences have also been recorded from the same regions: Lower Saxony (Bartenstein and Brand, 1937), Baden-Württemberg (Ströbel, 1944; Buck, 1951; Seibold and Seibold, 1960a,b; Riegraf, 1987a) and Franconia (Groiss, 1966; Knitter, 1980; Flügel and Steiger, 1981). In addition, occurrences have been recorded from the Bavarian Alps in the Oxfordian (Diersche, 1980) and the Tithonian (Eggert, 1977). Reigraf (1987a) regarded *Globuligerina* Bignot and Guyader, 1971, emend. Stam, 1986, as the only valid genus of the family Globuligerinidae Loeblich and Tappan, 1984, in the Jurassic and Early Cretaceous.

During the Callovian-Oxfordian transgression, planktonic foraminifera had expanded over the adjacent shelf areas, including those of Germany to the north. Here they exhibit a typically patchy, non-continuous distribution but abundant occurrences. The concurrent occurrence of Tethyan radiolarians and widespread coral-reef facies in the middle and late Jurassic appeared to confirm that these assemblages were sub-tropical to tropical (Riegraf, 1987b). In general, each expansion of planktonic foraminifera onto the shelf areas of Germany was followed, or accompanied, by the occurrence of radiolarians (in the Callovian, Barremenian, Albian, Santonian and Campanian). Reigraf (1987b) suggested that the marked contrast between the low diversity recorded from the late Jurassic to early Cretaceous and the occurrence of abundant planktonic foraminiferal taxa in the late Cretaceous might explain the restricted geographical distribution in the late Jurassic and early Cretaceous seas.

6.2.1 NORTH-WESTERN GERMANY

Jurassic planktonic foraminifera were recorded from both the Callovian and Oxfordian of

Lower Saxony by Bartenstein and Brand in 1937. Subsequently, there appears to have been less Jurassic data recorded for Northern Germany than for Southern Germany. However, in his comparisons between the distribution of planktonic foraminifera in the Jurassic and the Cretaceous, Reigraf (1987b) used examples from North-West Germany to support the hypothesis that their occurrences were principally governed by temperature and only to a minor degree by bathymetry or facies. In the Ruhr region and in the Baumberge area north-west of Munster, Westphalia, *Globotruncana* and *Heterohelix* were recorded in sandstones deposited in a Late Cretaceous shallow-water environment. In the Campanian, particularly the lower part, the shallow-water of Westphalia was characterised by relatively large planktonic foraminiferal tests, with a planktonic to benthonic percentage ratio of at least 90%:10%. These faunas were found in assemblages with Mediterranean rhyncholites, frequent radiolarians and scattered larger foraminifera.

6.2.2 SOUTHERN GERMANY

In Southern Germany, planktonic foraminifera range from the Callovian to the Oxfordian (Macrocephalus to early Bimammatum zones). During the Callovian, their frequent occurrence is accompanied by a highly diverse Tethyan radiolarian fauna and abundant sponge spicules. As the earliest genera of planktonic foraminifera originally had aragonite tests, these assemblages were discovered as pyritized tests or internal moulds preserved in phosphoritic concretions. The most important factor in the environmental conditions that facilitated this preservation through pyrite segregation and phosphate enrichment was probably enriched organic matter (Reigraf, 1987b). In rare cases, glauconitic internal moulds have been recorded in Callovian to Oxfordian deposits. Calcite test preservation is extremely rare.

Callovian (Jason to Lamberti zones) phosphoritic concretions from South-West Germany contained well-preserved specimens of *Globuligerina bathoniana* (Pazdrowa). The tests, of which the most important structures were visible, were pyritised or baritized and accompanied by a rich Tethyan radiolarian assemblage (Reigraf, 1987a,b). Although well-preserved, these Callovian tests were not in as good a state (Riegraf, 1987a) as those known from French samples (Bignot and Guyader, 1971) and Russian samples (Grigelis and Gorbachik, 1980b; Gorbachik, 1983). Previously, frequent but badly preserved glauconitic internal moulds of Globuligerinidae had been discovered in the Callovian claystones of eastern Franconia and in the Lower Oxfordian (Cordatum to Transversarium zones) marlstones of South-West Germany.

6.2.3 PRESERVATION

With the exceptions of Ströbel (1944) and Seibold (1960a,b), in previous studies the German Jurassic assemblages had not been illustrated due to the poor state of preservation. The tests of the German Jurassic Globulidgerinidae appear to have been preserved only under special diagenetic conditions, such as those that led to the formation of the Callovian phosphoritic nodules (Reigraf, 1987a). Phosphoritic nodules seem to preserve microfossils which are dissolved in other sediments and those of South-West Germany have yielded a large number of species of agglutinated foraminifera, pyritized sponge spicules and radiolarians (Riegraf, 1986) that were not known previously from the pyritic claystone enclosing the nodules. Before being enclosed in phosphoritic nodules, calcitic tests were replaced by pyrite and later by barite (Berger, 1976). In the parent rock (fine-clastic, pyrite-rich, dark claystones), the aragonitic shells of gastropods and cephalopods were compressed and dissolved by early diagenesis, so it has been assumed that the tests of Globuligerinidae were chemically dissolved, in contrast to the preservation of the benthonic foraminifera. Knitter (1980), for instance, had found no planktonic foraminifera in the Oxfordian marls of Franconia, probably because the tests were dissolved, yet he obtained internal moulds from limestones of the same interval. Since the Callovian phosphoritic nodules were investigated by Käss (1954), there appears to have been little data published.

Preservation of globuligerinids as pyritized or baritized tests or glauconitic internal moulds is known from a few Callovian beds in South-West Germany and also from Franconia (Munk, 1978) but layers of phosphatic nodules are restricted to a few horizons in the Callovian in South-West Germany and are very rare in Bajocian or Bathonian clays and marls. Whether Globigerinidae appeared in Germany for the first time in the Callovian or existed much earlier is uncertain due to the preservation conditions. For this reason, Riegraf (1987a) stated that all Globuligerinidae so far known from Germany insufficiently represent their true stratigraphical and geographical distribution.

6.3 SWITZERLAND AND NORTHERN ITALY

6.3.1 GEOLOGICAL SETTING

In the Oxfordian, Laurasia and Gondwana finally separated significantly, opening a seaway through the proto-Atlantic between the equatorial Tethyan and the Panthalassan Oceans. Padden *et al.* (2001, 2002) studied the bulk-carbonate and bulk-organic records from the northern continental margin of the Tethyan Ocean, including sections along a carbonate-ramp transect in Switzerland. In the Transversarium Zone of each of their four studied sections, including Auenstein and Nissibach (Fig. 6.2), they found negative $\delta^{13}C_{carb}$ excursions. Regarding this excursion as "widespread and short-lived", they attributed it to a sudden addition of isotopically-light carbon to the global carbon cycle. Increasing atmospheric CO_2 levels in the Oxfordian are also indicated by the expansion of conifer forests (van Aarssen *et al.*, 2000). Following a period of deep-water anoxia, rapid oceanic turnover might have repartitioned ^{12}C–enriched waters from the deep-water to surface waters and the atmosphere but there was a lack of evidence for extensive anoxia in the Tethyan-Atlantic Ocean of the Oxfordian.

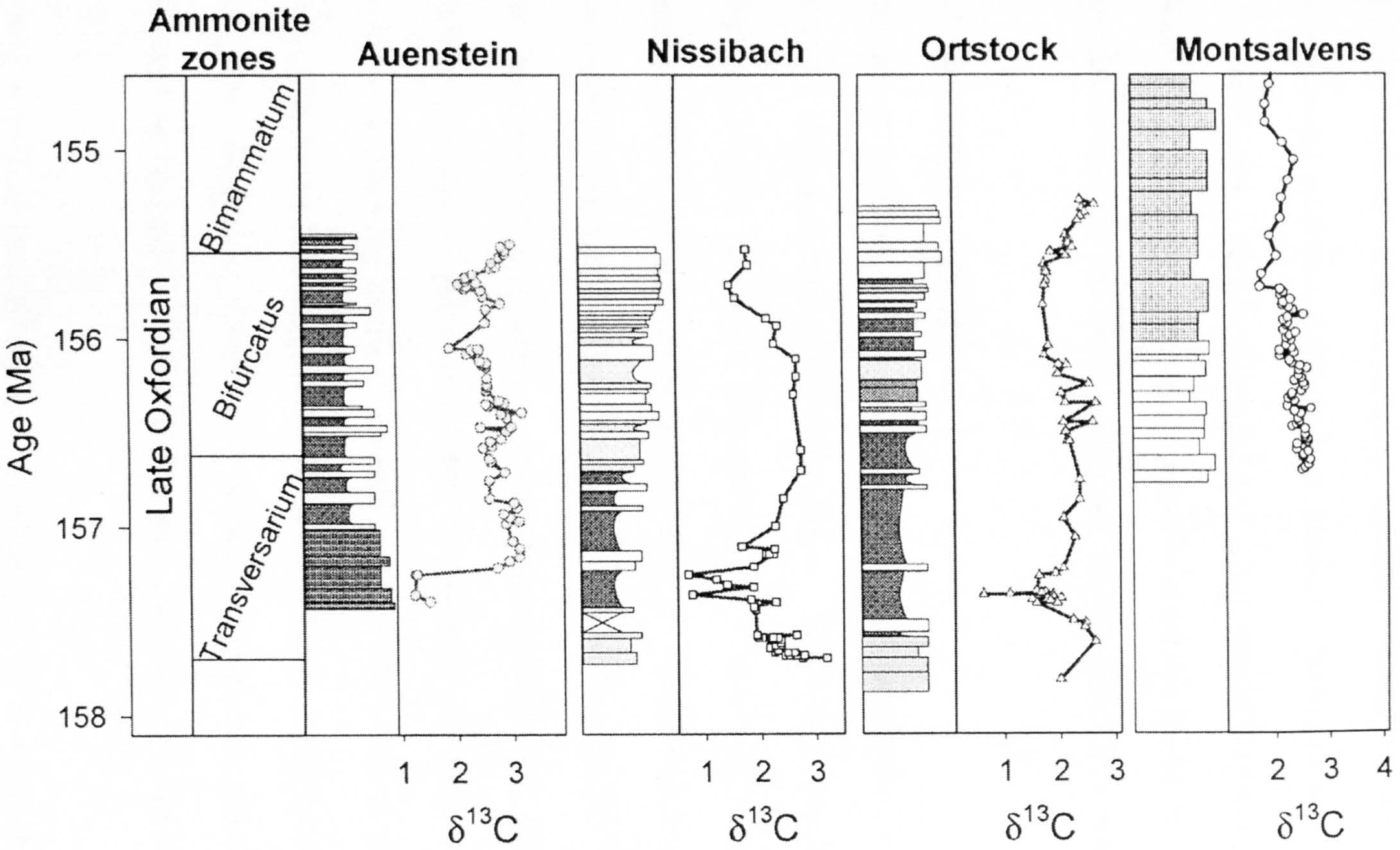


Figure 6.2. Oxfordian lithological sections with $\delta^{13}C$ stratigraphy. The lithology and $\delta^{13}C$ are plotted against time. White = limestone, light grey = marly limestone, dark grey = marl, check pattern = hardground, wavy pattern = nodular limestone, speckles = calcareous sandstone (Padden *et al.*, 2002).

As the Toarcian and Aptian Events, which were of similar duration and magnitude to the Oxfordian negative excursion, had previously been attributed to a massive release of frozen methane hydrate along continental margins, Padden *et al.* (2001) felt that this was also the most reasonable explanation for the findings from their locations. Hesselbo *et al.* (2000) had attributed extensive carbonate dissolution during the Toarcian negative $\delta^{13}C_{carb}$ excursion to the oxidation of this released methane. Finding no decrease in the carbonate content across the Late Jurassic negative $\delta^{13}C_{carb}$ excursion at any of their study sites, Padden *et al.* (2001) observed that the negative excursion at Auenstein occured in a very condensed interval and that Oxfordian pelagic deposits tended to be siliceous.

6.3.2 CANTON AARGAU

A number of localities in Canton Aargau, northern Switzerland, are important in any discussion of Jurassic planktonic foraminifera. Haeusler (1881a,b) described a new species of Jurassic planktonic foraminiferid as *Globigerina helvetojurassica*, listing (Haeusler, 1881b) the type level as the zone of *"Ammonites transversarius"* of the Birmensdorfer Schichten (Jurassic) near Büren (Canton Aargau) (Fig. 6.3). In his doctoral thesis (Haeusler, 1881a), however, no type locality was identified. Büren is located north-west of Zürich close to the town of Mönthal. One kilometre north-west of Mönthal, in a wooded, hilly area is the famous Eisengraben section which Oesterle (1968) designated the type locality for all of the species described in that area by Haeusler. As Büren is also close to the Eisengraben section this is probably a reasonable suggestion. In 1969, Gygi designated the Eisengraben section as the type locality for the Birmensdorfer Schichten.

Oesterle (1969) revised the work of Haeusler and, after re-sampling the Eisengraben succession, found only badly preserved (recrystallised?) specimens of what was presumed to be Haeusler's *"helvetojurassica"*. In 1984, Stam re-sampled the Eisengraben succession using Oesterle's logs and sampling locations. Stam (1986, p. 111) found

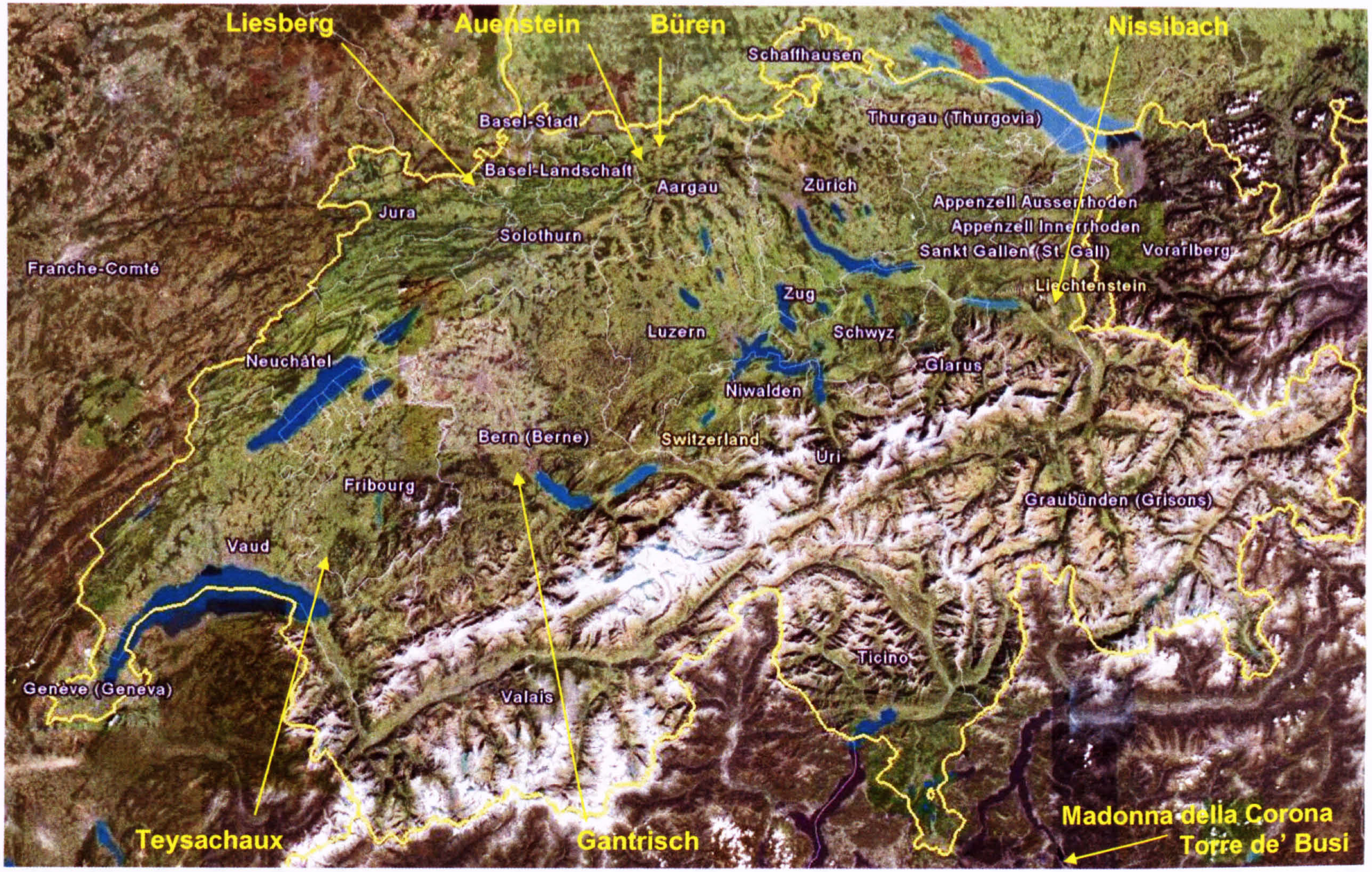


Figure 6.3. Sampling locations of Haeusler (1881b), Oesterle (1969), Stam (1986), Wernli (1995) and Rais (pers. comm. 2004).

numerous small specimens which he illustrated (Stam, 1986, pl. 7, figs 6-12, pl. 8, figs 1-3). All of these show a low trochospire and are quite distinctly "spinose". Stam was convinced that these specimens from the Eisengraben succession were best placed in *Globuligerina oxfordiana* (Grigelis). Despite noting that the aperture was slightly different, Stam placed *G. helvetojurassica* in the synonymy of *G. oxfordiana*, despite the former taxon having been described by Haeusler in 1881, well in advance of the work of Grigelis in 1958. Stam justified this use of a later name by claiming that *G. helvetojurassica* should be regarded as a *nomen oblitum* (forgotten name, ICZN, Article 23b). As far as is known (Simmons *et al.*, 1997, p. 29) this was never accepted as an argument by the ICZN and, as a result, the original name should stand.

Oesterle (1969) re-described some of Haeusler's fauna by using comparable material from Liesberg (south-west of Basel) where clays of Oxfordian age are exposed in a series of quarries that are still being worked. Unfortunately the specimens of planktonic foraminifera from the Reuggeri Tonen (Liesberg) are pyrite steinkerns (internal moulds) and quite unsuitable for taxonomic work. Masters (1977, pp. 459, 460, pl. 21, figs 2-4) discussed the problem of preservation of *G. helvetojurassica* and illustrated forms that were clearly re-crystallised (or steinkerns).

Simmons *et al.* (1997, p. 29) are convinced that *G. helvetojurassica*, on the basis of Stam's well-preserved material, should be retained as a species and used as the genotype for the new genus *Haeuslerina*. Their generic diagnosis is based almost entirely on the position of the aperture (intraumbilical to extraumbilical) near the periphery of the penultimate whorl and the depressed sutures. The topotypes figured by Simmons *et al.* (1997, pl. 2.6, figs 1-8) show the "spinose" surface, the intraumbilical-extraumbilical aperture and a low trochospiral coil with 4 chambers in the final whorl. In all the illustrated specimens the spire height appears to be low.

Riegraf (1987a, p. 192) followed Stam and listed *G. helvetojurassica* as a *nomen oblitum* while some later authors have also questioned the validity of the species and the genus *Haeuslerina* (e.g. Georgescu, pers. comm. to Professor Hart). Few micropalaeontologists have identified this species in their samples and it remains problematic.

6.3.3 SAMPLING LOCATIONS

Samples from the Oxfordian of three locations in Switzerland (Auenstein, Nissibach and Gantrisch) and one in Northern Italy (Madonna della Corona, Torre de' Busi) were kindly provided by Dr. P. Rais from the Geological Institute/ETH, Zurich.

The Auenstein and Nissibach sections formed along a carbonate-ramp transect, according to Padden *et al.* (2001, 2002) who recorded bulk-carbonate and bulk organic $\delta^{13}C$ ($\delta^{13}C_{org}$) data from the northern continental margin of Tethys. They found no decrease in carbonate content across the negative $\delta^{13}C$ excursion at either of these sections, although the negative excursion occurred in a very condensed interval at Auenstein.

6.3.3.1 AUENSTEIN

Situated in the Jura Mountains of Northern Switzerland (Aargau Canton) on an inner carbonate ramp, Auenstein is characterised by a series of marine hardgrounds followed by a thick series of alternating marl and thin micritic limestone beds. This section is well-dated, age being constrained by extensive ammonite assemblages (Gygi and Persoz, 1987). Within the Transversarium Zone, Padden *et al.* (2001, 2002) observed a negative $\delta^{13}C_{carb}$ excursion from 3‰ to 1‰ which coincided with an episode of reduced carbonate sedimentation, the resulting decrease in platform growth being evidenced by several marine hardgrounds. A less precisely dated Oxfordian negative excursion is also found in the more continuous alpine section of Nissibach.

6.3.3.2 NISSIBACH

Situated in the Helvetic Nappes of North-Eastern Switzerland (St Gallen Canton), Nissibach is characterised by outcrops of the hemipelagic Oxfordian Schilt Formation, deposited in an outer ramp environment (Kugler, 1987). According to Padden *et al.* (2001, 2002), this consists of sandy limestone, succeeded by an extensive marly interval with isolated micritic limestone beds. Higher in the section, the marly intervals become thinner and less frequent, the uppermost Schilt Formation comprising thin-bedded micritic limestones with relatively few marl stringers. Biostratigraphic dating could only be tentative, due to the scarcity and poor preservation of indicator fossils. The most negative $\delta^{13}C_{carb}$ value recorded at this site was 0. 6‰ (Padden *et al.*, 2001, 2002).

6.3.3.3 GANTRISCH

Gantrisch is situated in the Klippen of the eastern Préalpes Romandes, central Switzerland (Bern Canton). Also known as the Préalpes Médianes, the Klippen are the largest and best-exposed unit of the Pre-Alpine nappes. During the Alpine orogeny, the Klippen nappe was incorporated into the accretionary wedge of the closing Piedmont Ocean, detached from the basement along an evaporite horizon and transported more than 100 km onto the foreland (Masson, 1976). The stratigraphy alters significantly parallel and perpendicular to strike, resulting in structural changes from mainly fold structures in the north to large imbricates in the south. Wissing and Pfiffner (2002) have described the structure of the Klippen between Gantrisch, Schwarzee and Spillgerte.

6.3.3.4 MADONNA DELLA CORONA, NORTHERN ITALY

Madonna della Corona is situated near Torre de' Busi (Province of Lecco, Lombardy) which is approximately 11 km south-east of Lecco, 20 km north-west of Bergamo and 40 km north-east of Milan.

6.3.4 MATERIALS AND METHODOLOGY

Thin sections from Auenstein, Nissibach, Gantrisch and Madonna della Corona were examined under an Olympus Vanox Universal Research Microscope fitted with a biological stage and then photographed using a Nikon Coolpix 4500 camera mounted on the microscope (Pls 18, 19, 20). The maximum diameters and test thicknesses of the specimens were measured using a calibrated graticule (see Appendix III). For each layer, the number of chambers visible for each specimen was plotted against its maximum diameter. The data were then separated into two categories, for thick-walled and thin-walled specimens, respectively. For each category, the abundance of specimens was plotted against maximum diameter and the results of the two categories compared.

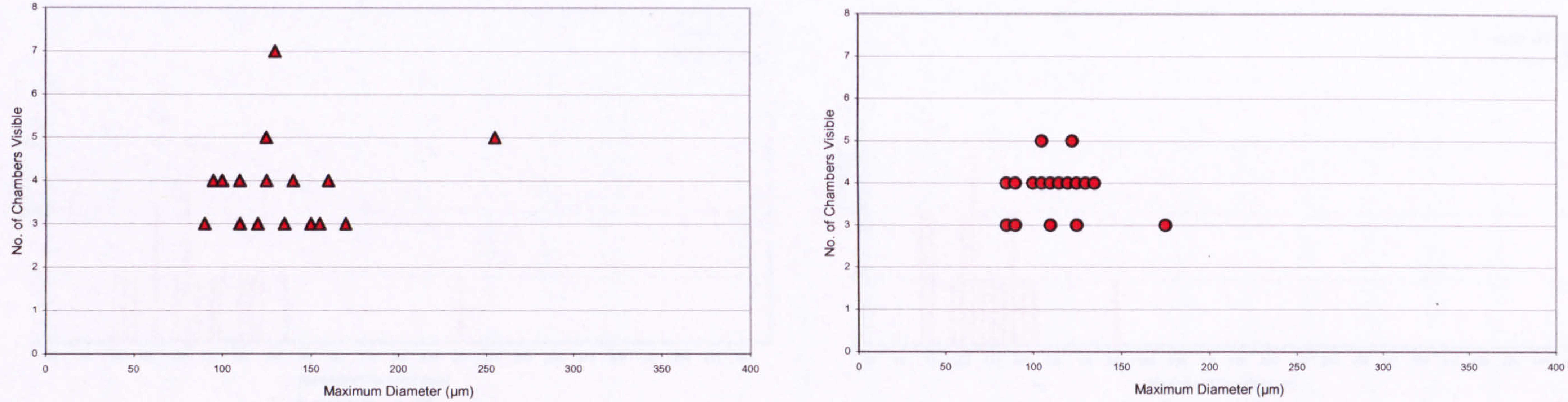
6.3.5 RESULTS AND DISCUSSION

6.3.5.1 ANALYSIS OF THIN SECTIONS

From the Transversarium and Transversarium/Bifurcatus zones, thin sections from four sampling locations were examined (Figs 6.4, 6.5).

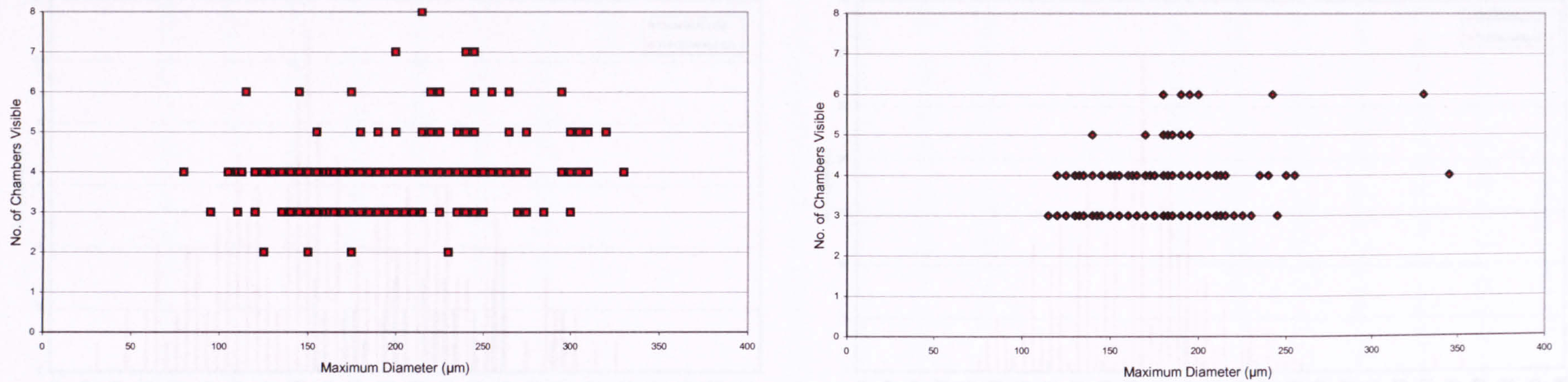
AUENSTEIN – SAMPLE Au26

In this sample, planktonic foraminifera were sparse, so comparison between thick- and thin-walled specimens could only be superficial. Maximum diameters ranged from 90-255 μm, the thick-walled specimens occurring at 135 μm and 170 μm, respectively, and the thin-walled specimens present throughout the range. The maximum number of chambers visible was 7, at a maximum diameter of 130 μm in a thin-walled specimen. The largest specimen, with a 255 μm maximum diameter, was something of an outlier, the next largest diameter being 170 μm, in a thick walled specimen. The maximum abundance occurred at a diameter of 125 μm in the thin-walled specimens. The percentage ratio of thick-walled specimens to thin-walled specimens was 12% : 88%.



Auenstein - Au26

Gantrisch - Ga8



Nissibach - Ni10

Madonna della Corona - Mc3

Figure 6.4. Comparison of the chambers visible in planktonic foraminifera from Switzerland and Northern Italy.

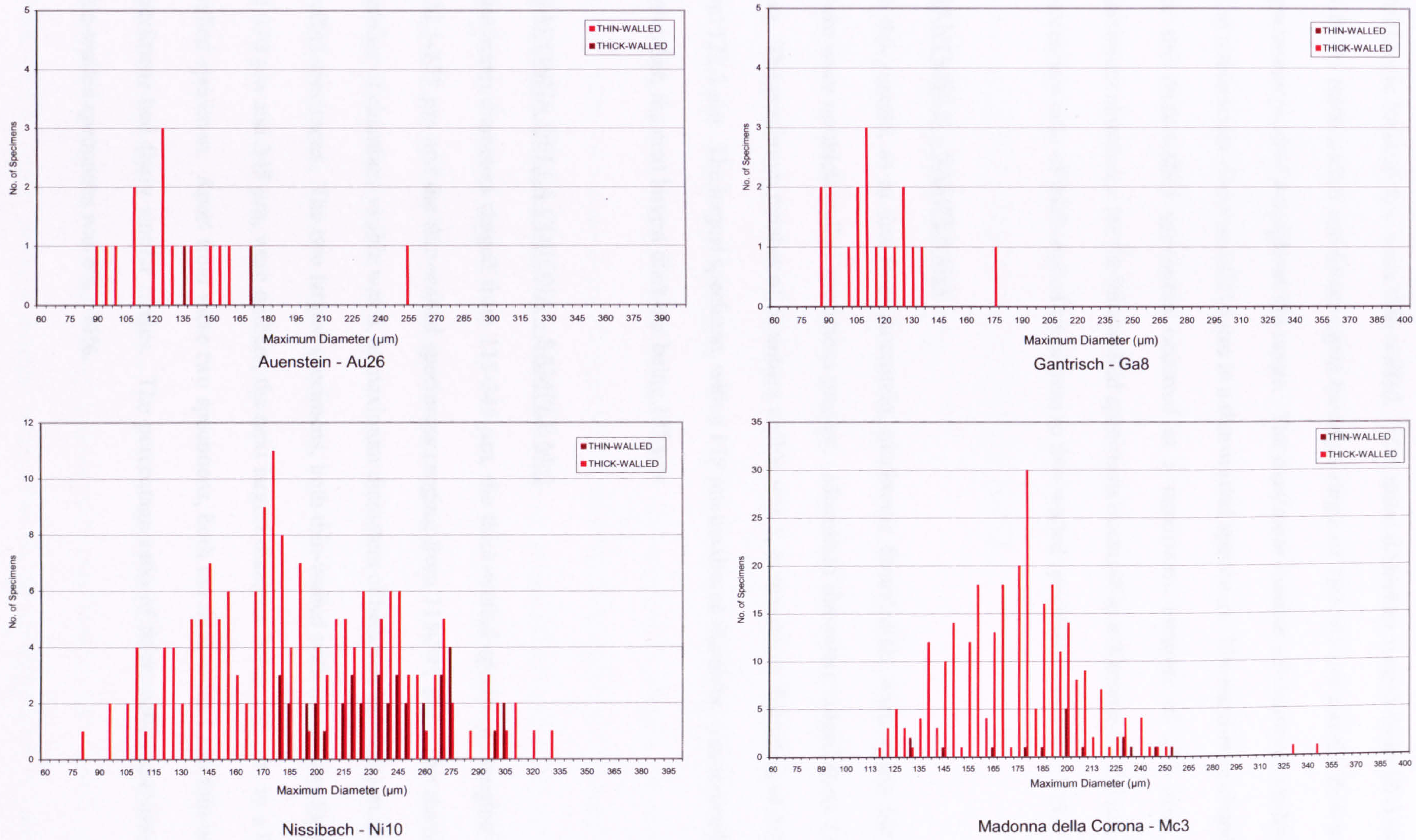


Figure 6.5. Comparison of the abundances of thick-walled and thin-walled planktonic foraminifera from Switzerland and Northern Italy.

NISSIBACH – SAMPLE Ni10

This sample demonstrated a marked increase in abundance but again, the majority of the planktonic foraminifera were thin-walled. Maximum diameters ranged from 80-330 µm, with the thick-walled specimens again having a range of 180-305 µm and the thin-walled specimens present throughout the range. The maximum number of chambers visible was 8, at a maximum diameter of 215 µm in a thin-walled specimen. The maximum abundance for the thick-walled specimens occurred at a maximum diameter of 275 µm. The maximum abundance for the thin-walled specimens occurred at a diameter of 175 µm. The percentage ratio of thick-walled specimens to thin-walled specimens was 18% : 82%.

GANTRISCH – SAMPLE Ga8

In this sample, as in that from Auenstein, planktonic foraminifera were sparse but here there were no thick-walled specimens present. Maximum diameters ranged from 85-175 µm. The maximum number of chambers visible was 5, at maximum diameters of 105 µm and 122.5 µm. The largest specimen, with a 175 µm maximum diameter, was somewhat of an outlier, the next largest diameter being 135 µm.

MADONNA DELLA CORONA – SAMPLE Mc3

Maximum diameters ranged from 115-345 µm, the thick-walled specimens ranging from 132.5-255 µm and the thin-walled specimens ranging from 115-345 µm. The maximum number of chambers visible was 6, at maximum diameters of between 180-330 µm in thin-walled specimens. The two largest specimens, both thin-walled with maximum diameters of 330 µm and 345 µm, were outliers, the next largest diameter being 255 µm, in a thick-walled specimen. Apart from these two specimens, both the thick-walled and thin-walled specimens had fairly similar ranges. The percentage ratio of thick-walled specimens to thin-walled specimens was 6% : 94%.

6.3.4.2 GENERAL TRENDS

There was a great variation in the occurrences of planktonic foraminifera between the four sampling locations. At Auenstein and Gantrisch, specimens were rare, whereas there was considerably more abundance at Nissibach and Madonna della Corona. Only one species of planktonic foraminifera was identified in the thin sections from Auenstein and Gantrisch, *Globuligerina oxfordiana*, whereas an additional species, *G.* aff. *bathoniana,* was identified at Nissibach and Madonna della Corona.

6.4 MONTE KUMETA, WESTERN SICILY

6.4.1 GEOLOGICAL SETTING

Monte Kumeta is located in the central zone of the east-west trending Kumeta Ridge which extends for approximately 20 km in western Sicily (Fig. 6.6). This ridge belongs to a major structural unit of the Sicilian-Maghrebian chain in the southern sector of the Palermo Mountains (di Stefano and Mallarino, 2002). Amongst the Jurassic outcrops of the Trapani region of western Sicily, Monte Kumeta is a well-established example of complex synsedimentary dynamics along a stepped pelagic escarpment adjacent to a structural high. According to di Stefano and Mallarino (2002), due to an approximate correlation between the palaeoescarpment and the present southern slope of the mountain, the discontinuous Jurassic facies distribution on an articulate palaeotopography, continuously rejuvenated by tectonic and gravitational synsedimentary deformation, is exposed. Jurassic pelagic units are well-exposed in a relatively small area on top of Monte Kumeta and on its southern slope, most of these units tapering northwards.

The Jurassic palaeogeographical history of western Sicily has been summarised by several authors, including Wendt (1964, 1969a), Jenkyns (1970) and Jenkyns and Torrens (1971). Wendt (1964, 1969a) provided detailed information on the stratigraphy of the Jurassic

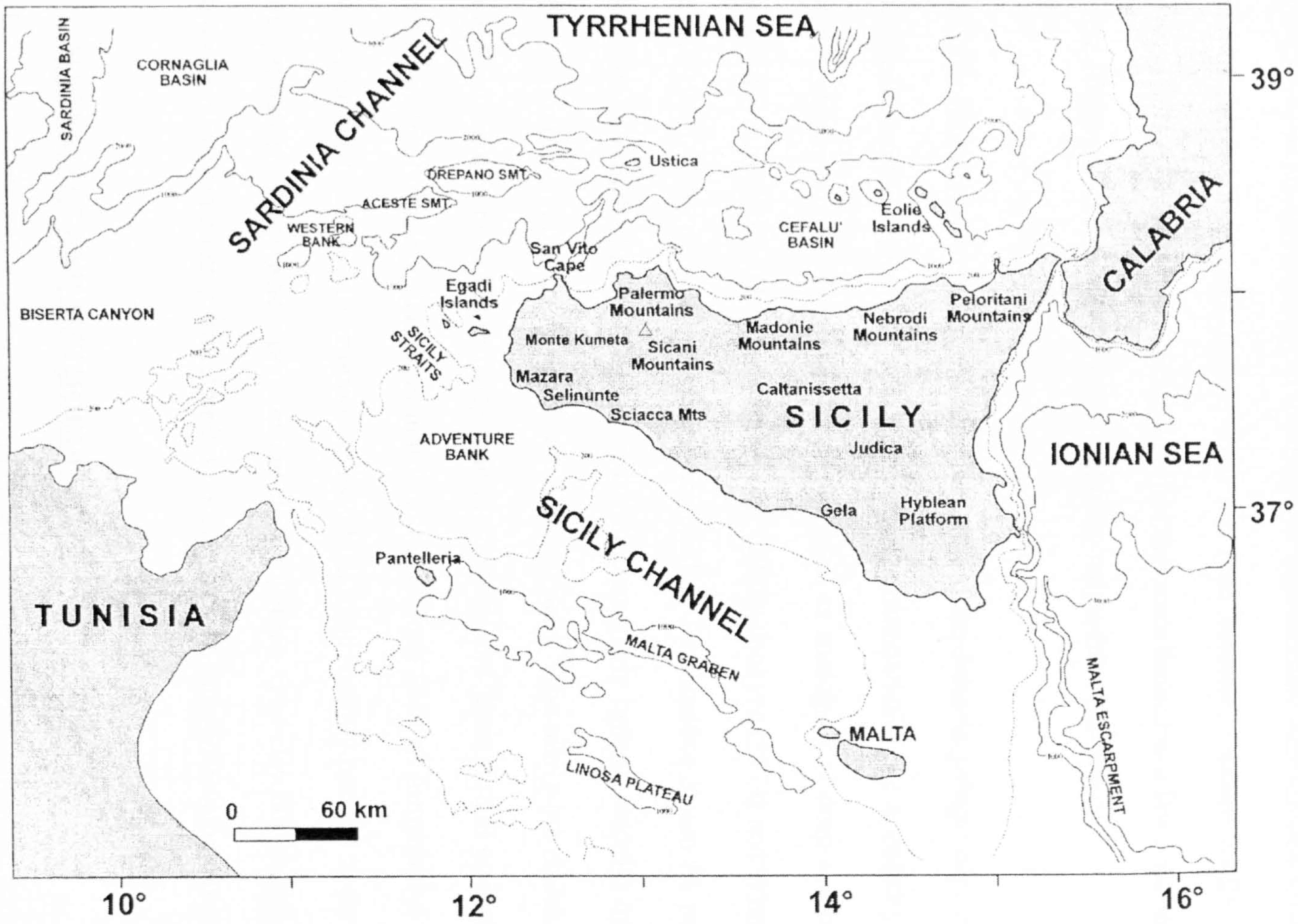


Figure 6.6. Location of Monte Kumeta and the principal mainland localities (after Catalano *et al.*, 2002).

strata. During the mid-Jurassic, extending into the Callovian, a series of stratigraphically condensed limestones were laid down, including condensed calcareous "Ammonitico Rosso" (Wendt, 1964, 1965). Monte Kumeta was one of the localities investigated by Jenkyns (1974) in his classic study of the origin of Knollenkalke Ammonitico Rosso in the Jurassic of the Mediterranean region. By the Late Jurassic, western Sicily was the depositional site of shallow-water pelagic oolites that were limited to a few structural highs (Jenkyns, 1972) and deeper-water facies, including red nodular limestones.

Red nodular limestones are particularly widespread in the Jurassic pelagic deposits of the Alpine-Mediterranean region and the two principal characteristics are nodularity and the abundance of ammonites. They have been proposed as analogues of deep-sea sediments by some authors, including Garrison and Fischer (1969), Jenkyns (1974) and Winterer and Bosellini (1981). The nodules of the western Sicilian Ammonitico Rosso lie parallel to and elongated along the bedding, interleaved with more marly layers. Nodules may grade laterally into more continuous, irregularly-sculptured beds. The marly interstices of these rocks always seem to be richer in fauna than the nodules and fauna do not generally cross the nodule-matrix boundary. The marl matrix of the western Sicilian Ammonitico Rosso is crossed by thin red strands of ferruginous clay which trend roughly parallel to the bedding and are particularly dense where nodules are close together. The clay mineral assemblage of the western Sicilian nodular limestones is consistent with an open oceanic environment.

6.4.2 MATERIALS AND METHODOLOGY

Samples from the Bajocian of Monte Kumeta were collected by Dr Kevin Page during a field-trip organised in connection with the 6th International Congress on the Jurassic System held in Palermo, Sicily. Thin sections from the samples were examined under an Olympus Vanox Universal Research Microscope fitted with a biological stage. The maximum diameters and test thicknesses of the specimens were measured using a calibrated graticule (see Appendix III). For each layer, the number of chambers visible for each specimen was plotted against its maximum diameter. The data were then separated into two categories, for thick-walled and thin-walled specimens, respectively. For each category, the abundance of specimens was plotted against maximum diameter and the results of the two categories compared.

6.4.3 RESULTS AND DISCUSSION

6.4.3.1 ANALYSIS OF THIN SECTIONS

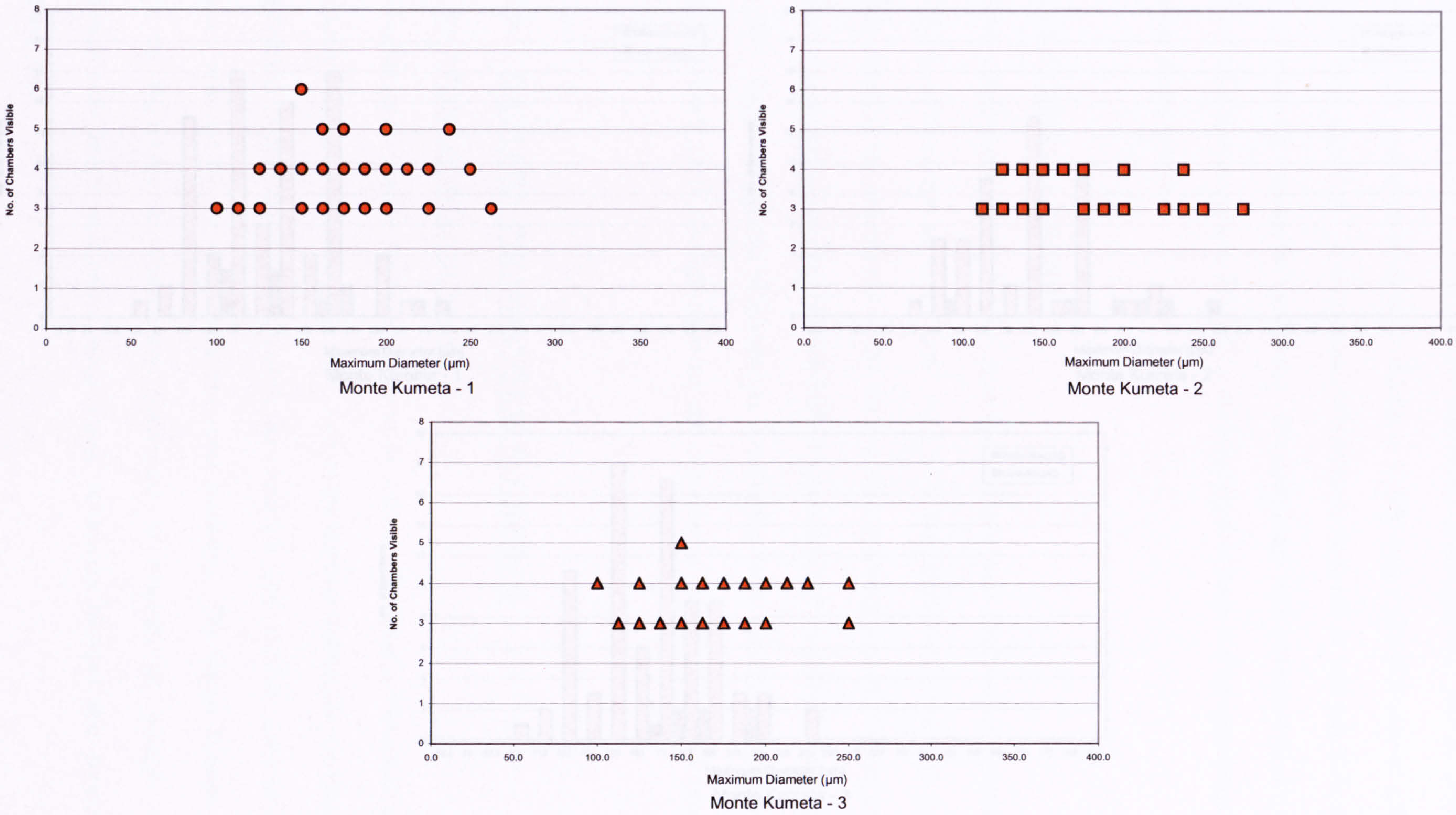
From the Bajocian, thin sections were examined (Figs 6.7, 6.8).

MONTE KUMETA - 1

Maximum diameters ranged from 100-262.5 μm, the thick-walled specimens ranging from 150-262.5 μm and the thin-walled specimens ranging from 100-237.5 μm. The maximum number of chambers visible was 6 at a diameter of 150 μm, in a thin-walled specimen. The maximum abundances occurred at 150 μm and 200μm, in thin–walled specimens. The percentage ratio of thick-walled specimens to thin-walled specimens was 12% : 88%.

MONTE KUMETA - 2

The maximum diameters ranged from 112.5-275 μm, the thick-walled specimens ranging from 137.5-275 μm and the thin-walled specimens ranging from 112.5-237.5 μm. The maximum number of chambers visible was 4, at diameters ranging from 125-237.5 μm in both thick and thin walled specimens. The maximum abundance occurred at a diameter of 175 μm, in thin-walled specimens. Throughout their range, the thin-walled specimens considerably outnumbered the thick-walled specimens, except at a diameter of 225 μm where the abundances were equal. The percentage ratio of thick-walled specimens to thin-walled specimens was very similar to that of Monte Kumeta 1, 11% : 89%.



Monte Kumeta - 1

Monte Kumeta - 2

Monte Kumeta - 3

Figure 6.7. Comparison of the chambers visible in planktonic foraminifera from Monte Kumeta.

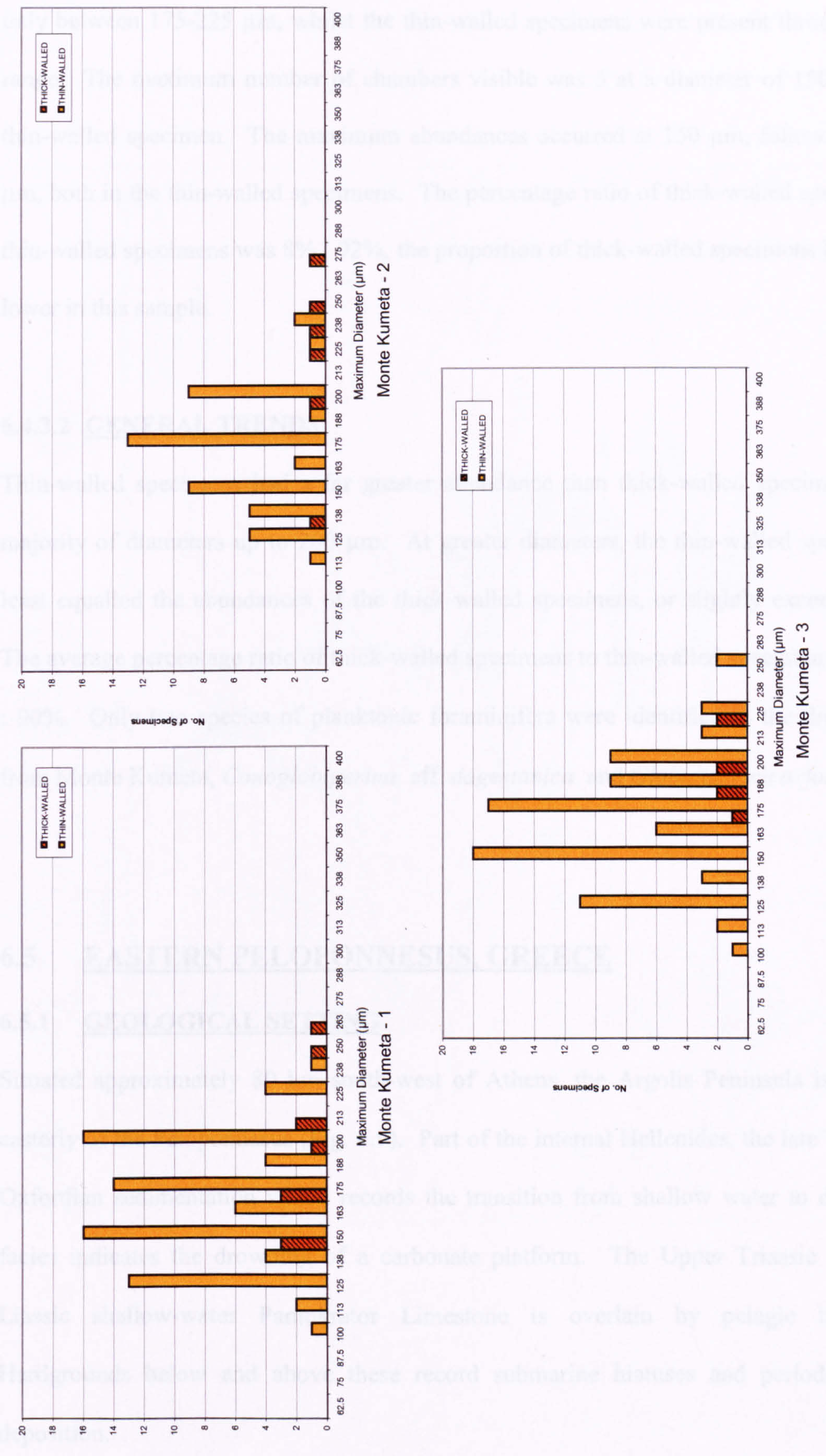


Figure 6.8. Comparison of the abundances of thick-walled and thin-walled planktonic foraminifera from Monte Kumeta.

MONTE KUMETA - 3

The maximum diameters ranged from 100-250 µm, the thick-walled specimens ranging only between 175-225 µm, whilst the thin-walled specimens were present throughout the range. The maximum number of chambers visible was 5 at a diameter of 150 µm, in a thin-walled specimen. The maximum abundances occurred at 150 µm, followed by 175 µm, both in the thin-walled specimens. The percentage ratio of thick-walled specimens to thin-walled specimens was 8% : 92%, the proportion of thick-walled specimens being even lower in this sample.

6.4.3.2 GENERAL TRENDS

Thin-walled specimens had a far greater abundance than thick-walled specimens at the majority of diameters up to 200 µm. At greater diameters, the thin-walled specimens at least equalled the abundances of the thick-walled specimens, or slightly exceeded them. The average percentage ratio of thick-walled specimens to thin-walled specimens was 10% : 90%. Only two species of planktonic foraminifera were identified in the thin sections from Monte Kumeta, *Conoglobigerina* aff. *dagestanica* and *Globuligerina oxfordiana*.

6.5 EASTERN PELOPONNESUS, GREECE

6.5.1 GEOLOGICAL SETTING

Situated approximately 80 km south-west of Athens, the Argolis Peninsula is the most easterly of the Peloponnesus (Fig. 6.9). Part of the internal Hellenides, the late Triassic to Oxfordian sedimentation which records the transition from shallow water to deep water facies indicates the drowning of a carbonate platform. The Upper Triassic to Middle Liassic shallow-water Pantokrator Limestone is overlain by pelagic limestones. Hardgrounds below and above these record submarine hiatuses and periods of slow deposition.

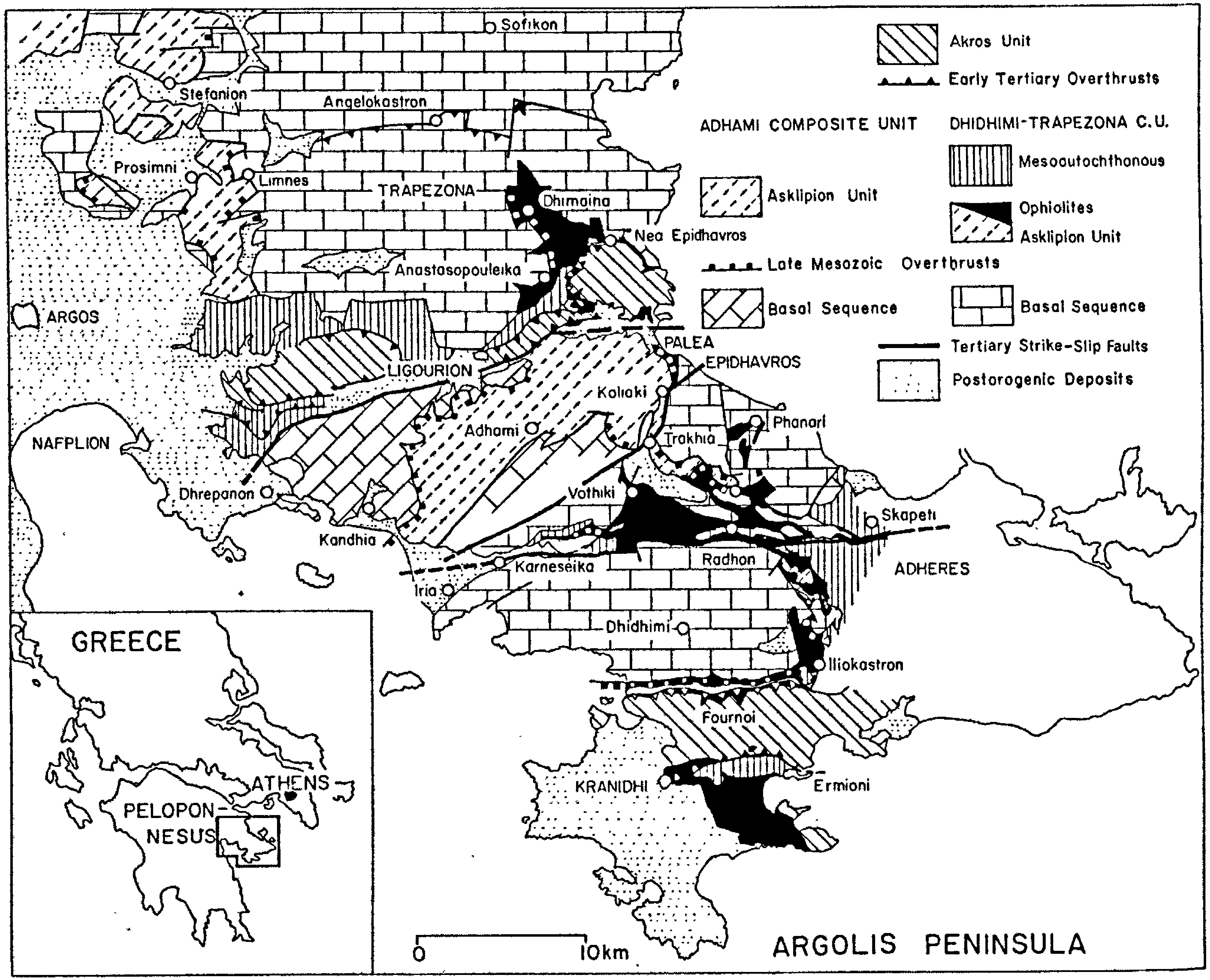


Figure 6.9. Tectonic map of the Argolis Peninsula showing the principal tectonic units (Baumgartner, 1985).

The Peloponnesus, and specifically the Argolis Peninsula, has been the setting for various studies, including those of Renz (1906, 1940, 1955), Brunn (1956), Aubouin (1958, 1973), Bender *et al.* (1960), Dercourt (1964, 1970), Jacobshagen (1967), Süsskoch (1967), Bannert and Bender (1968), Aubouin *et al.* (1970), Clément (1971), Celet and Clément (1971), Bernouilli and Laubscher (1972), Bernouilli *et al.* (1974), Celet *et al.* (1974, 1976, 1977), Bachmann and Risch (1976, 1979), Baumgartner and Bernouilli (1976), Charvet *et al.* (1976), Jacobshagen *et al.* (1976a,b), Kalkreuth *et al.* (1977), Celet and Ferrière (1978), Vrielynck (1978a,b, 1980), Baumgartner (1980, 1984a,b, 1985) and Baumgartner *et al.* (1980).

DHIDHIMI-TRAPEZONA COMPOSITE UNIT

The Pantokrator Limestone of the Dhidhimi-Trapezona Basal Sequence extends to the Middle Liassic and is overlain by a hardground and, possibly, a few metres of condensed pelagic limestones topped by another hardground (Fig. 6.10). The Angelokastron Chert rests on top of the limestone, consisting of thin-bedded radiolarian chert, siliceous limestones and occasional limestone breccias containing clasts reworked from underlying formations. This formation, dated using radiolarians, is believed to be late Oxfordian-early Kimmeridgian in age (Baumgartner *et al.*, 1980; Baumgartner, 1984a,b). The overlying Dhimaina Formation is characterised by brittle clay-rich, siliceous radiolarian mudstones with interbedded fine-grained lithic arenites containing chrome spinel and volcanic debris. Graded volcanic arenites increase in abundance and thickness, forming several coarsening and thickening-upwards cycles. Coarse ophiolite breccias interpreted as channel deposits occur in the topmost part of the formation (Baumgartner, 1985).

6.5.2 SAMPLING LOCATIONS

Samples from the Argolis Peninsula area were kindly provided by Professor A. Zambetakis-Lekkas from the Geological Department of the University of Athens.

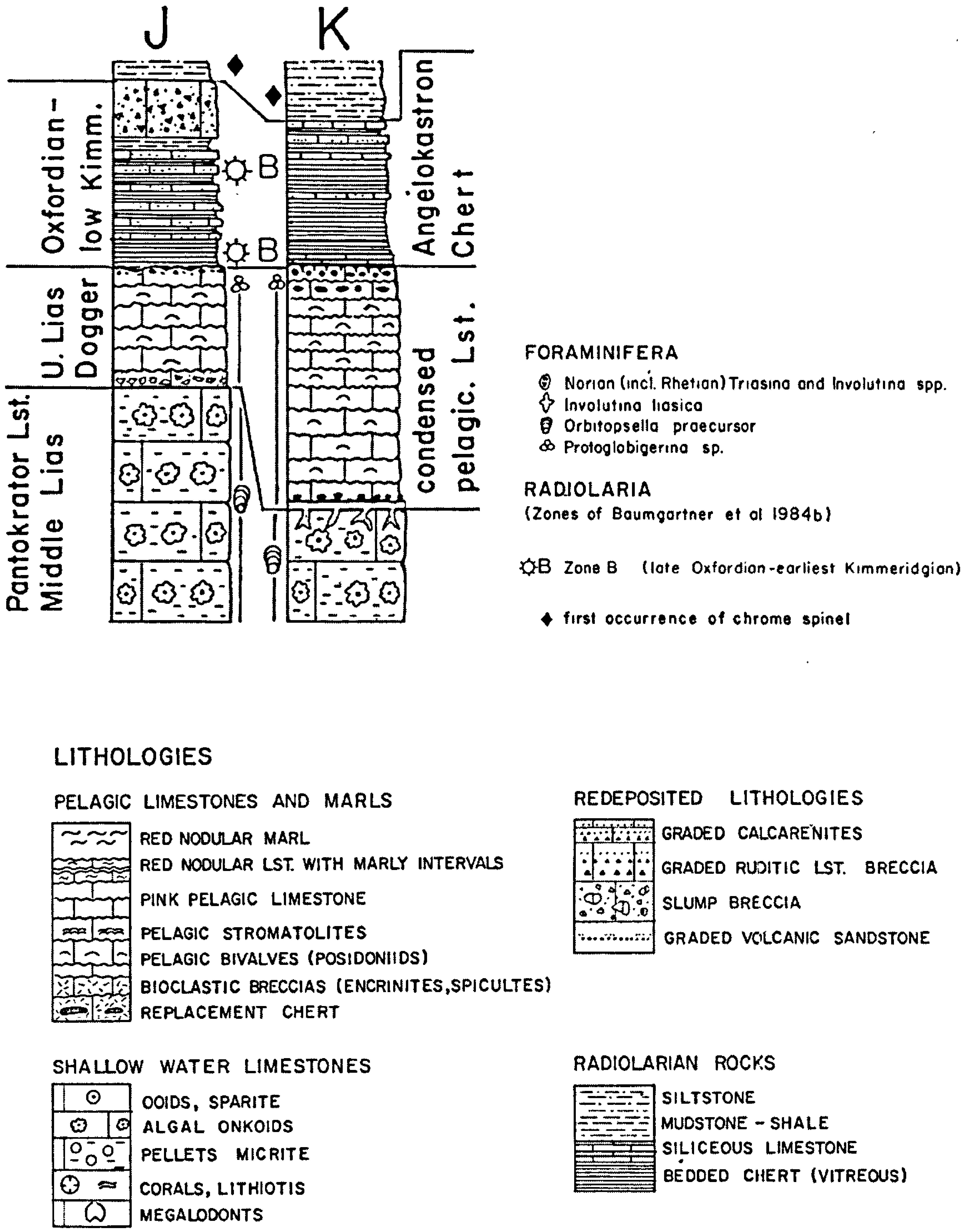


Figure 6.10. Transition from carbonate platform to deep water facies Jurassic of the basal sequences, Central Argolis Peninsula (extracted from Baumgartner, 1985).

SALAMIS ISLAND

Samples AZ05 1, AZ05 2 and AZ05 27 were collected from Salamis Island but unfortunately, according to Professor Zambetakis-Lekkas, their stratigraphical position is uncertain because the outcrops are severely affected by faults.

ARGOLIS PENINSULA

The remainder to the samples were collected from the Argolis Peninsula itself. Samples AZ05 45-56 were collected from a "continuous stratigraphic series", AZ05 56 being the oldest. According to Professor Zambetakis-Lekkas, it overlies a middle Liassic carbonate series, dated by *Orbitopsella praecursor* (Gümbel) and *Paleodasycladus mediterraneus*. The same fossils are found in the overlying series, mainly in the breccia elements. Pelagic facies is also intercalated between the breccia elements. Rare protoglobigerinids are found in this facies with filaments, radiolarians and ammoniods.

6.5.3 MATERIALS AND METHODOLOGY

The thin-sections from Salamis Island and the Argolis Peninsula were photographed using a Nikon Coolpix 4500 camera mounted on an Olympus Vanex Universal Research Microscope fitted with a biological stage (Pls 21, 22). Some of the thin sections contained very large *Orbitopsella praecursor* (Pl. 22), some of which were larger than the field of view. The overlying limestones contain rare protoglobigerinids with typical 4-chambered appearance. In the logs of the section (Fig. 6.10), there is some doubt about the age of the condensed pelagic limestones. The planktonic foraminifera are almost certainly Bajocian or Bathonian in age as no known Upper Lias succession contains this assemblage (Wernli, 1995).

6.6 TAURUS MOUNTAINS, TURKEY

The Ammonitico Rosso limestones of the Taurus Mountains of Turkey were described by Wernli (1988). This infrequently quoted paper is highly significant as the fauna is reportedly of Toarcian and Aalenian age. The material appears to have been discovered by Poisson (1977) and described only in a doctoral thesis of the University of Paris. The Middle Toarcian fauna (Wernli, 1988, fig. 1) contains a range of taxa illustrated in thin-section:

1. the typical 3 or 4-chambered sections of protoglobigerinids;
2. low-spired forms with rounded chambers; and
3. high-spired forms with 3 or 4 whorls of chambers.

In the Aalenian fauna there is a range of high to low-spired forms, but many of the individuals appear to have a thicker wall.

This Toarcian-Aalenian fauna does not appear to have been researched further since the work of Wernli (1988). This is surprising as Wernli (1995) was later to describe the evolution of *Conoglobigerina* from *Praegubkinella* in the early Toarcian, immediately following the Toarcian Oceanic Anoxic Event and the end-Pliensbachian extinction event. The high-spired fauna from the Toarcian of Turkey (Wernli, 1988, fig. 1. 1-15) is very reminiscent of the *Praegubkinella – Conoglobigerina* transition.

6.7 BALEARIC ISLANDS

Oxfordian "protoglobigerinids" are known from the Ammonitico Rosso limestones of Ibiza and Majorca. Rangheard (1962) described a fauna from Ibiza, noting that this extended the range of planktonic foraminifera into the Jurassic of that area. Later Colom & Rangheard (1966) described a similar fauna from the Bathonian-Oxfordian of Majorca, as well as illustrating faunas from the Oxfordian of Ibiza and mainland Spain (Caravaca, Murcia). In most cases the specimens illustrated are low-spired and thin-walled and are sometimes associated with bivalve "filaments" (possibly *Bositra*, though they were identified as *Halobia* by the authors). The Ibiza fauna (Rangheard, 1962) was from the Transversarium Zone of the Oxfordian. In many of the samples described by Colom and Rangheard, there was an associated fauna of benthonic foraminifera, including *Lenticulina, Lagena* and *Ophthalmidium.* Colom (1955, p. 5, fig. 13) also illustrated an abundant fauna of planktonic foraminifera of Tithonian age from "reddish limestones" in Majorca There appear to have been no further publications on these faunas.

6.8 ALTAS MOUNTAINS, MOROCCO

From the mountains south-east of Ouezzane, Wernli (1987) has described "protoglobigerinids" from the ammonitico rosso of the Lower Bajocian. While many of the thin-sections show the typical 4-chambered appearance (Wernli, 1987, fig. 2, pls 1, 2), some of the specimens are clearly high-spired. This was particularly highlighted by Wernli, who also noted that some of the specimens had thicker walls (although they appear to have been recrystallised). Although Wernli (1987, fig. 2) describes the fauna as unidentifiable he compares it to *Globuligerina oxfordiana* or *Globigerina bathoniana.*

6.9 FUERTEVENTURA, CANARY ISLANDS

Fuerteventura, the largest of the seven islands of the Canary archipelago, is the closest to the mainland of Africa. Its present geological position results mainly from the opening and evolution of the central Atlantic. A first rifting phase from the Anisian to the Hettangian (Jansa and Wiedmann, 1982: Favre and Stampfli, 1992), created confined basins. Sinnemurian-Pliensbachian to earliest Toarcian deposits (transgressive carbonate platform, nodular limestones with black shales) indicate a sudden deepening of the depositional environment (Jansa, 1986; Favre *et.al*, 1991), corresponding to a final stage of rifting (Lancelot and Winterer, 1980; Favre and Stampfli, 1992). Seafloor spreading in the central Atlantic is thought to have started during the Bajocian (Jansa and Wiedmann, 1982: Klitgord and Schouten, 1986), preceded, or accompanied during the Toarcian, by the thermal uplift of the rift shoulders (Favre and Stampfli, 1992).

The sediments of Fuerteventura have been studied since at least the middle of the nineteenth century (von Fritsch, 1868; Gagel, 1910). For age correlation and constraints on the opening of the central Atlantic Ocean, Steiner *et al.* (1998) compared the Mesozoic stratigraphy of Fuerteventura with existing palaeogeographical data from the northwestern African continental margin and the Tethyan basins. The Mesozoic sequence is strongly influenced by the proximity of the African continental margin and by sea level fluctuations. A considerable thickness of Jurassic and Cretaceous sediments is exposed, the succession extending from the Toarcian to the mid- and Upper Cretaceous. The Cretaceous sequences are biostratigraphically well dated and the Jurassic age is defined by the presence of the biostratigraphic marker *Bositra buchi* (Römer) (Toarcian-Oxfordian) (Jefferies and Minton, 1965; Bernouilli and Kälin, 1984). The Jurassic sedimentary succession consists of oceanic and clastic deposits, the latter derived from the southwestern Moroccan continental margin. At the base of the sequence, normal mid-ocean ridge basalt (N-MORB) flows and breccias indicate sea-floor spreading events in the central Atlantic. These N-MORB outcrops represent the only Early Jurassic oceanic basement described up until then in the central Atlantic. Steiner *et al.* (1998) proposed a Toarcian age for the Atlantic oceanic floor in this region, on the basis of clastic deposits reflecting tectono-eustatic events (e.g. late Toarcian to mid-Callovian erosion of the rift shoulder) and of the presence higher up in the sequence of the *Bositra buchi* filament microfacies (Aalenian to middle Bajocian). The latter were dated through comparisons with northwestern Atlantic deep-water limestone facies and identical filament microfacies, dated by ammonites, in the

Ketama unit of the external Rif, Morocco (Favre, 1992).

Within the sedimentary sequence, there is a pelagic bivalve limestone unit, the base of which consists of a pelagic limestone facies of alternate layers of shelly or nodular limestones and green marls. According to Steiner *et al.* (1998), the green colouration could indicate deposition in an oxygenated environment as the facies association is typical of open circulation in a deep-water, marine environment. The marls contain numerous fossil impressions of *Bositra buchi* (Römer). In the lithological logs (Steiner *et al.*, 1998, fig. 4), *Bositra* filaments are recorded from the Bajocian to Callovian strata whilst planktonic foraminifera are recorded from the Kimmeridgian to Berriasian although these have neither been described nor illustrated.

6.10 PORTUGAL

6.10.1 GEOLOGICAL SETTING

Portugal rotated in an anti-clockwise direction during the mid-Cretaceous. In its pre-rotational position, the Iberian Meseta had sedimentary basins on its northwest-facing side and southwest facing side. In the Jurassic, these were the Lusitanian Basin and the Algarve Basin, respectively.

6.10.2 LUSITANIAN BASIN

The Lusitanian Basin, in western Central Portugal (Fig. 6.11), is one of the marginal basins associated with the development of the North Atlantic Ocean. It has an area of over 23,000 km^2 and extends northwards along the coastline of Portugal for over 300 km, from the Serra da Arrábida, south of Lisbon, to Aveiro, the northern margin being ill-defined. The major part is situated onshore with its eastern boundary coinciding with the Porto-Coimbra-Tomar Fault (Pinheiro *et al.*, 1996). The Basin is one of two structural settings in

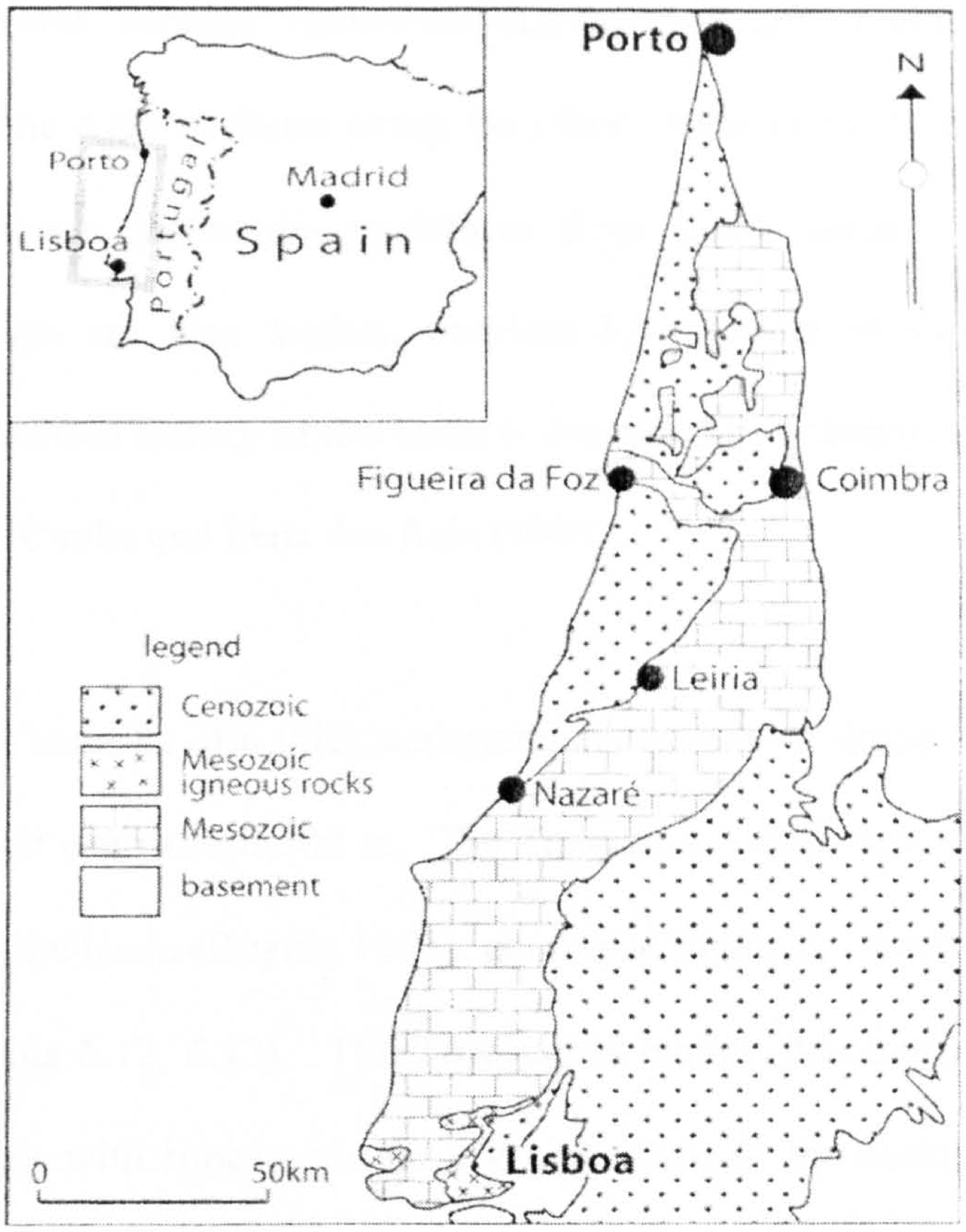


Figure 6.11. Outline geological map of the Lusitanian Basin (Hart *et al.*, 2005).

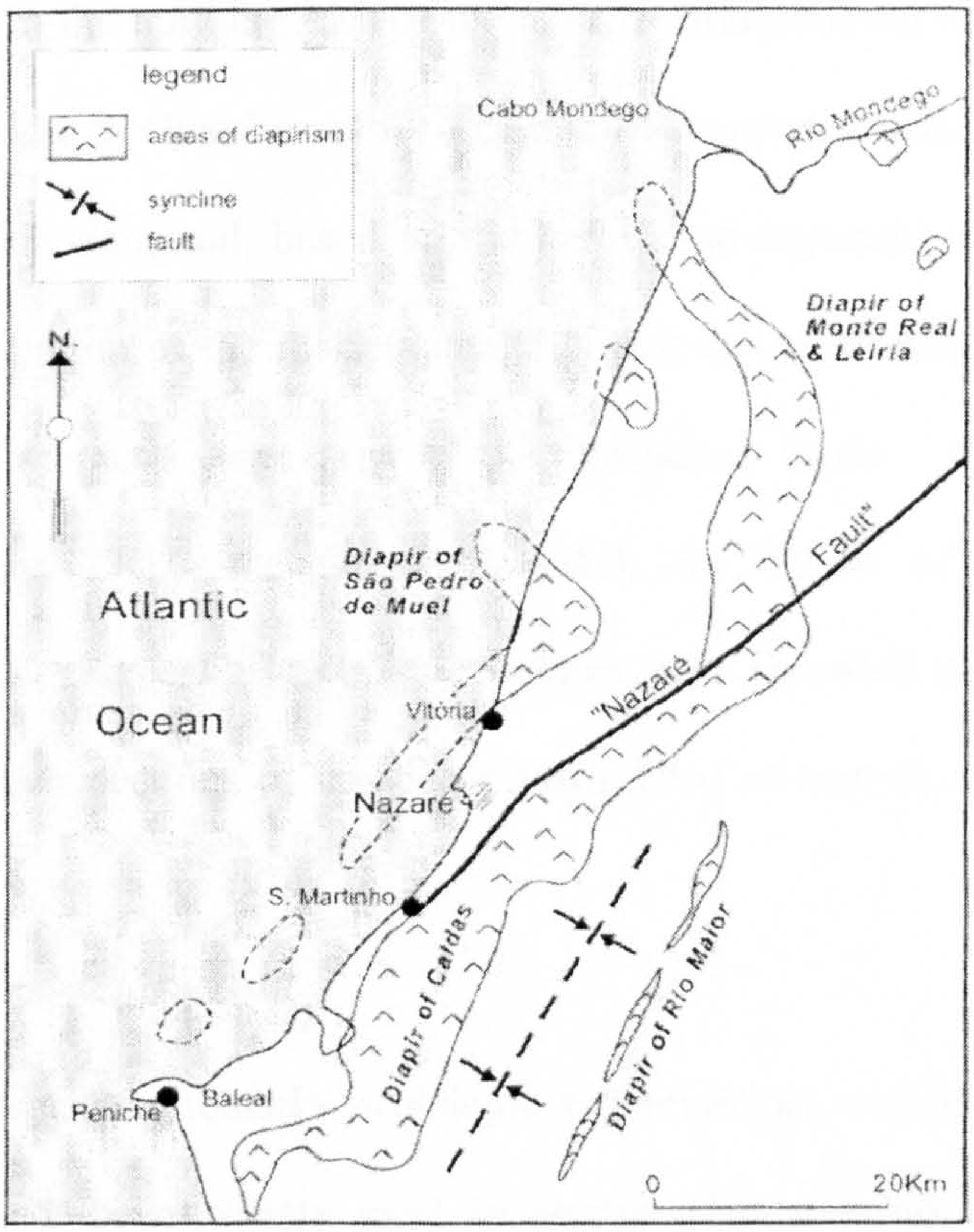


Figure 6.12. Location of Nazaré and the Rio Mondego. The approximate position of salt diapirs associated with the Nazaré-Leiria-Pombal flexure/fault (the Nazaré Fault of Berthou, 1984a) are indicated (Hart *et al.*, 2005).

Portugal where Lower Jurassic sediments outcrop and are bounded by the Iberian Hercynian Massif, the Algarve Basin being the other. Most of the basin fill is Jurassic in age but Upper Triassic sediments are known from a few areas. Lower and Upper Cretaceous sediments are also known, overlain by a cover of Cenozoic continental sediments. The structural history of the basin is described by Ribeiro *et al.* (1979), Wilson (1988) and Proença Cunha and Pena dos Reis (1995).

The Lower Jurassic consists of a thick carbonate succession of dolomites, limestones and marly limestones that can exceed 500 m. The Toarcian is continuous and well-exposed at several locations in the basin (Duarte, 1997), notably at Peniche, a prominent headland just south of Nazaré (Figs 6.12, 6.13). The Toarcian is mainly dominated by marl or marly limestone alternating with limestone, usually characterised by necktonic and benthonic macrofauna (Duarte, 1995, 1997; Duarte *et al.*, 2001). The succession studied by Duarte *et al.* (2004) outcrops in the northern part of the basin (Coimbra area) where the Toarcian is thicker. It is part of the S. Gião Formation (Duarte and Soares, 2002), ranging in age from the Early to Late Toarcian, and, based on the vertical arrangement of the facies and the stratigraphical distribution of the macrofauna, this unit can be divided into five members easily recognisable across a large area of the Lusitanian Basin. In the Thin Nodular Limestones Member (TNL), the facies of which are typical of the TNL Member throughout the Basin, tempestitic-turbiditic features were recorded which had previously been observed in other sections of the Basin and related to tectonic trigger mechanisms. (Duarte, 1997).

With similar sediments, particularly in pelagic environments, carbon and oxygen stable isotope analyses have been widely used in stratigraphy and palaeoceanographical or palaeoclimatical reconstructions (Scholle and Arthur, 1980; Shackleton and Hall, 1984; Weissert, 1989; Föllmi *et al.*, 1994; Weissert *et al.*, 1998; Jenkyns *et al.*, 2002). The

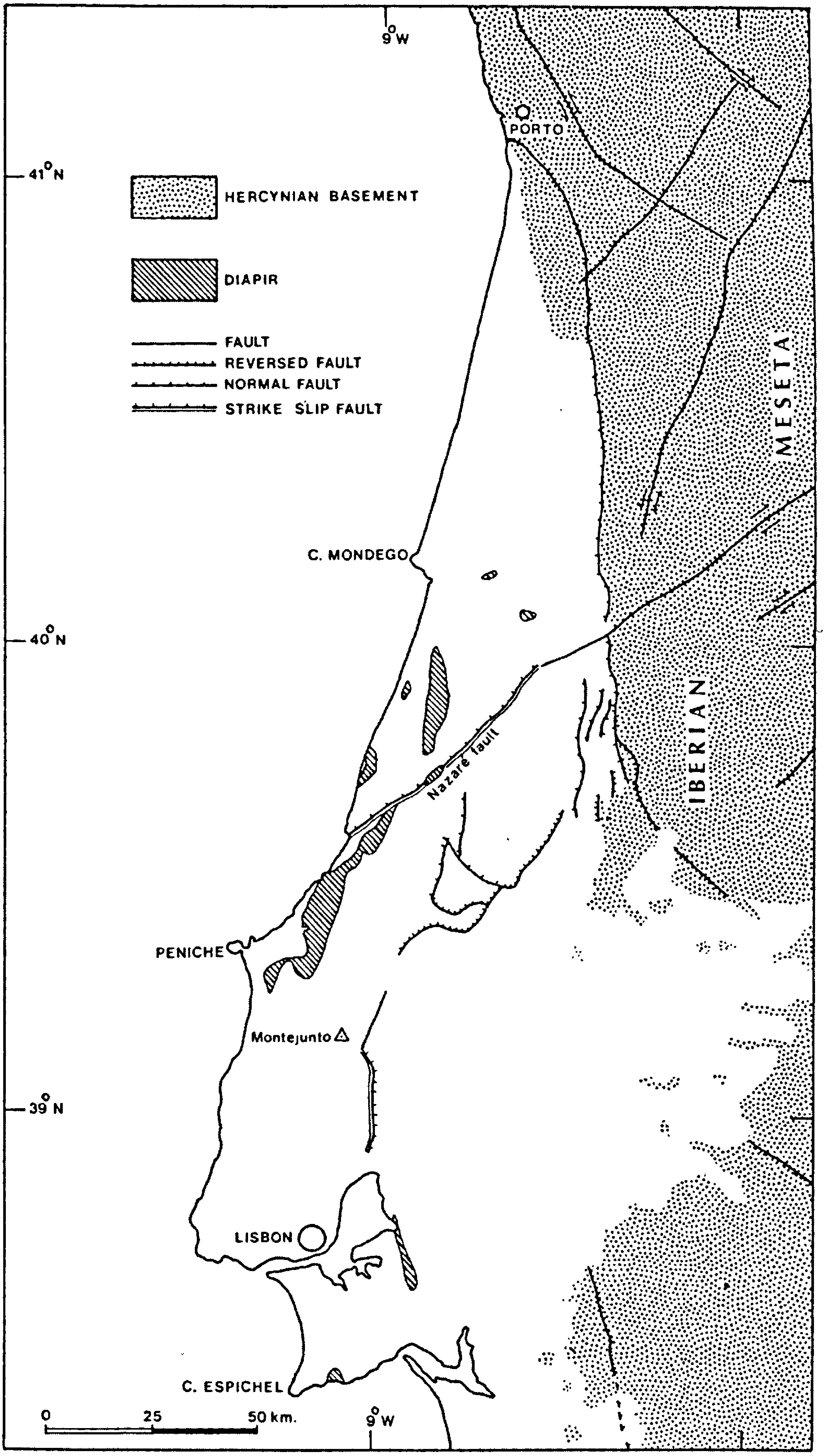


Figure 6.13. Sketch map outlining the Lusitanian Basin, with some of the major faults (Stam, 1986 after Ribeiro *et al.*, 1972).

hemipelagic sediments of the Lusitanian Basin, well constrained by ammonite and calcareous nannofossil dating (Elmi *et al.*, 1989; Perilli and Duarte, 2003), were subjected to isotopic analysis to identify the major transgressive-regressive cycles and sequence evolution, through recognition of the main discontinuities and flooding surfaces (Duarte *et al.*, 2003). The carbon-isotope ($\delta^{13}C$) analysis confirmed the trends for other regions of the Basin (Duarte, 1998), with the isotopic variation curve showing noticeable changes at the boundaries between the depositional sequences. The large positive fluctuation corresponded to transgressive periods whereas the increase of the lighter ^{12}C isotope in the carbonate sediments again confirmed the continentally-derived deposition of a regressive phase. There is a correlation between some of these events (positive and negative excursions) and those recorded in certain other European basins (Jenkyns and Clayton, 1986: Jenkyns *et al.*, 1994, 2002; Jiménez *et al.*, 1996; Hesselbo *et al.*, 2000; Beerling *et al.*, 2002). Recent sampling of a Toarcian succession at Peniche should lead to a better understanding of the microfauna, although no planktonic foraminifera have ever been recorded in the area (Duarte, pers. comm. to Professor Hart). The most important successions are located immediately north of Figueira da Foz, at Cabo Mondego (Figs 6.13, 6.14). Recent work in this area has focused on two successions; Murtinheira on the coast (of Aalenian age) and Brenha, an inland section 6 km to the east (of Middle Bajocian age) (Fig. 6.14). Stam (1986) studied both of these successions but did not record planktonic foraminifera from the Murtinheira section and only a "pyritized cast" from Brenha. Recent work by Henriques and co-workers (pers. comm. to Professor Hart) on the Aalenian succession has recorded no planktonic taxa.

Approximately 50 km north of Lisbon, an almost complete, but folded and faulted, sequence of Bathonian to Kimmeridgian marine sediments is exposed on the top and flanks of Montejunto, a 664 m high mountain (Fig. 6.13). From the samples collected from the Tojeiro Formation, Stam (1986) observed that the planktonic to benthonic ratio indicated

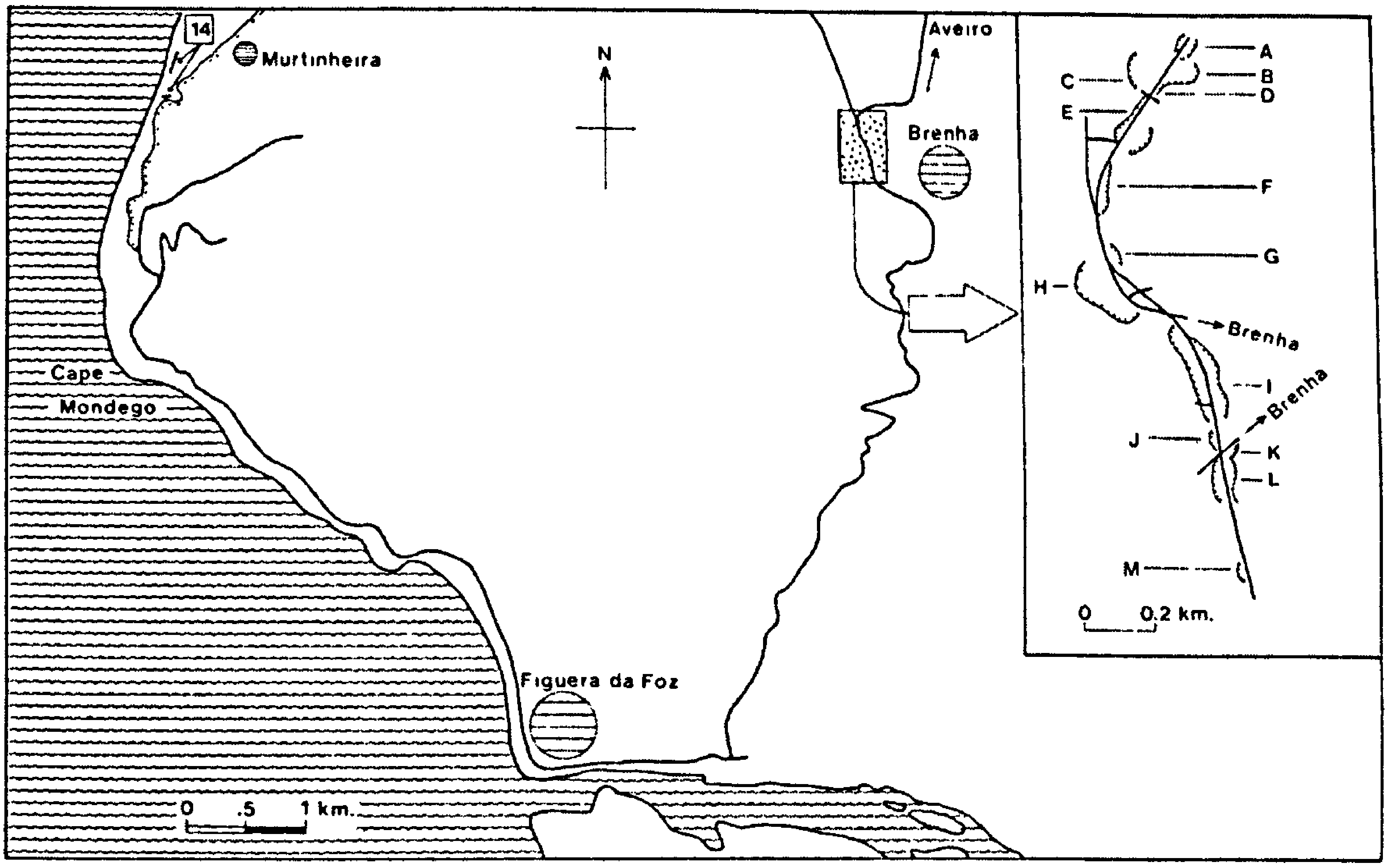


Figure 6.14. Location map of the Murtinheira and Brenha sections, Cape Mondego area, Lusitanian Basin (Stam, 1986).

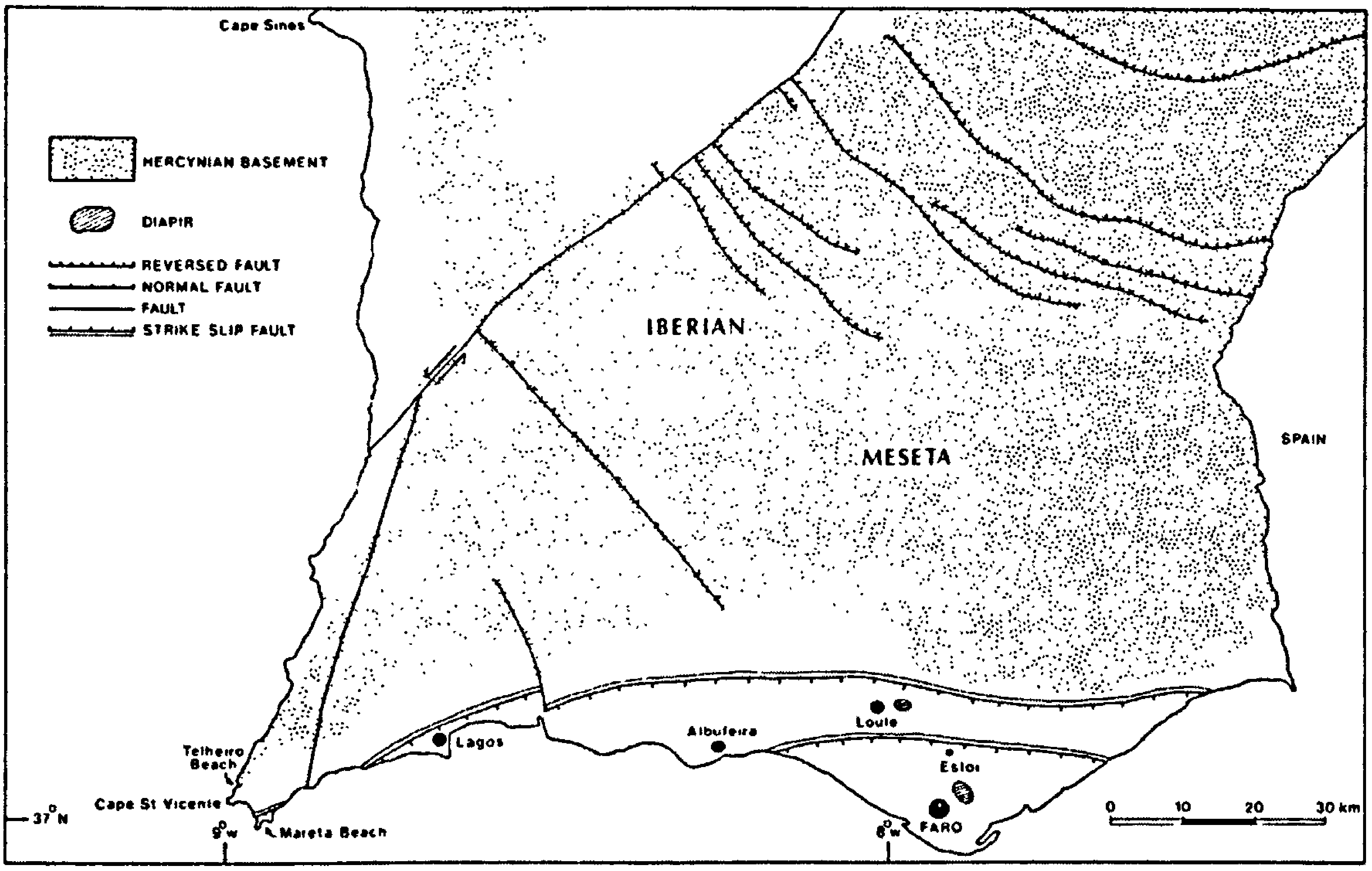


Figure 6.15. Sketch map outlining the Algarve Basin, with some of the major faults (Stam, 1986 after Ribeiro *et al.*, 1972).

that planktonic foraminifera were relatively abundant throughout the Tojeira 1 section and the upper part of the Tojeiro 2 section. The planktonic fauna had a low diversity (probably only a few species) and consisted entirely of simple globose forms "similar to the Recent genus *Globigerina*". Planktonic foraminifera very similar to "typical *Globigerina bathoniana*" (such as the one figured by Gradstein, 1978, pl. 3, fig. 1a,b) were present throughout the Oxfordian to Kimmeridgian of both Tojeira sections (Stam, 1986).

The Emiliani (1971) distribution model indicated to Stam (1986) either:

- a boreal fauna, unlikely in view of palaeogeographical constructions and the Tethyan ammonite fauna;
- a sub-tropical/tropical fauna inhabiting waters with no thermocline (which causes a deepening of the well-mixed upper water layer) or with restricted environmental conditions (Wonders, 1980).

The absence of a thermocline or restricted environmental conditions indicated that water circulation was reduced at the very least. This reduction in circulation was most likely to have occurred in the deeper parts of the basin and it could have affected the occurrence and abundance of individual benthonic species but the relative diversity of the rich benthonic microfauna and the absence of lamination indicated that bottom conditions were not hostile. During periods of reduced water circulation, due to the increased food supply and the high reproductive potential of simple, globose planktonic foraminifera (Caron and Homewood, 1983), their abundance increased relative to benthonic foraminifera. An increase in the planktonic to benthonic ratio is linked to water depth and was seen by Stam (1986) to explain the positive correlation between the P:B ratio and the deep-water foraminifera recorded in his study.

6.10.3 ALGARVE BASIN

The Algarve Basin is an east-west elongated basin, stretching from Cape St. Vincent in the

West to near the Portuguese-Spanish border in the east and bordered to the north by the Iberian Meseta (Fig. 6.15). Lower, Middle and Upper Jurassic sediments are exposed. Like the Lusitanian Basin, the Algarve Basin originated in the Late Triassic as a result of movements along Hercynian basement faults. Based on the distribution of Jurassic sediments, three areas can be recognised: the western Algarve, west of Lagos; the central and eastern Algarve; and the north-central Algarve, between the Hercynian basement and the first strike-slip fault to the south. In the western Algarve, the Mareta Beach section was sampled in detail by Stam (1986) and, in the central Algarve, the Albufeira section. Additional samples were collected from the eastern Algarve.

Only the samples from the Mareta Beach section were used by Stam (1986) for quantitative foraminiferal analyses as the samples from the central and eastern Algarve contained too few foraminifera. The Mareta Beach section is exposed along the beach directly south of Sagres and ranges from the Late Bajocian to Kimmeridgian. Pyritized casts of planktonic foraminifera were present in various samples from this section but in very low numbers, so Stam (1986) did not use the P:B ratio in his analyses. Planktonic foraminifera very similar to "typical *Globigerina bathoniana*" (such as the one figured by Gradstein, 1978, pl. 3, figs. 1a,b) were present throughout the Bathonian and Callovian of the Mareta Beach section (Stam, 1986).

In the central and eastern Algarve, outcrops in the vicinity of Albufeira, Loule and Estoi were sampled because of the occurrence of pelagic Oxfordian and Kimmeridgian strata in these areas (Mouterde et al., 1972) although no exact localities were known. The microfauna from these samples were to be used in a comparison with the microfauna from the Oxfordian-Kimmeridgian strata of the Lusitanian Basin, particularly of the planktonic foraminifera. A pyritized cast of a planktonic foraminifera was recorded in the Albufeira section but no planktonic foraminifera were recorded from Loule or Estoi.

As planktonic foraminifera very similar to "typical *Globigerina bathoniana*" were present throughout the Bathonian and Callovian of the Mareta Beach section and in the Oxfordian to Kimmeridgian of both Tojeira sections, Gradstein's "*Globigerina*" *bathoniana* Zone was not recognised in the Portuguese sections (Stam, 1986). Only three of the species of Jurassic planktonic foraminifera so far described could be recognised by Stam (1986) in the Portugese and Grand Banks strata.

1. *Globuligerina bathoniana*, ranging from the Late Bajocian to the Early Valanginian, occurred in Portugal at Brenha, both Tojeira sections and Mareta beach; and in the Grand Banks' wells Bittern M-62, Eider M-75, Cormorant N-83 and Murre G-67.
2. *Globuligerina oxfordiana*, ranging from the Middle-Late Bajocian to the Early Valanginian, occurred in Portual in both Tojeira sections and in the Grand Banks' wells Bittern M-62 and Murre G-67.
3. *Globuligerina balakhmatovae*, ranging from the Late Bajocian to the Late Bathonian or possibly the Early Kimmeridgian, occurred possibly in Portugal at Tojeira 1 section and in the Grand Banks' wells Eider M-75 and Murre G-67.

The morphology of *Globuligerina balakhmatovae*, with its flattened chambers and occasional imperforate equatorial band, or even a weakly developed keel, was suggested by Stam (1986) as the first Jurassic sign pointing towards the occurrences of more complicated test morphologies in progressively deeper water.

6.11 GRAND BANKS, NEWFOUNDLAND

6.11.1 GEOLOGICAL SETTING

The Grand Banks are situated off the south-east coast of Newfoundland (Fig. 6.16). More than 6,000 m of Jurassic sedimentary strata accumulated in several grabens and half-grabens created by block faulting. There are five sub-basins: from east to west, the Carson, Jeanne d'Arc, Horseshoe, Whale and South Whale (Fig.6.16). General tectonic and

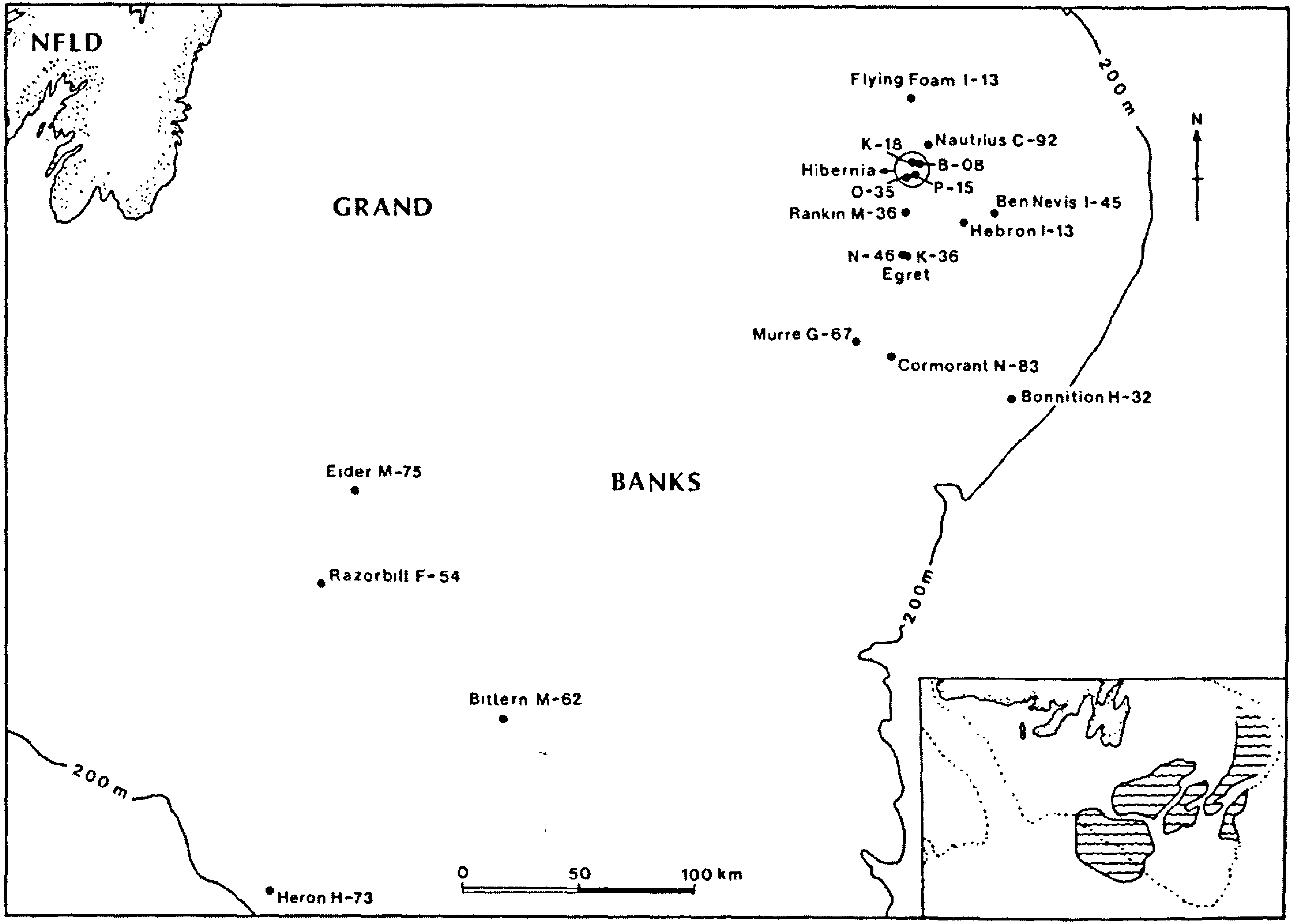


Figure 6.16. Location map of the Grand Banks area. The sub-basins are, from east to west, the Carson, Jeanne d'Arc, Horseshoe, Whale and South Whale (Stam, 1986).

lithostratigraphical overviews of the Grand Banks have been provided by various authors, including Bartlett and Smith (1971), and Jansa and Wade (1975a,b). Studies of the biostratigraphy include those undertaken by Bartlett (1969), Gradstein (1977, 1978), Barss *et al.* (1979) and Jansa *et al.* (1980). Palaeogeographical reconstruction of the North Atlantic continental margins suggest that, prior to the commencement of seafloor-spreading, the Lusitanian and Algarve basins of Portugal, and the Grand Banks basin south of Newfoundland were in close proximity. Although the various reconstructions indicate different initial distances between these basins, it is generally accepted that active spreading did not take place before the Early Cretaceous. The Algarve, Lusitanian and Grand Banks basins might therefore have a similar tectonic, sedimentary and faunal history during the Jurassic. Exton and Gradstein (1984) undertook a detailed study of the stratigraphical, sedimentary and biostratigraphical history of the Early Jurassic conjugate basin and concluded that the Triassic-Lower Jurassic lithostratigraphy of the Lusitanian and Grand Banks basins was very similar. They demonstrated that the foraminiferal and ostracod assemblages had a comparable composition, with three recognisable zones, allowing indirect integration of the Early Jurassic microfossil assemblages of the Grand Banks with the standard European ammonite zones.

6.11.2 MIDDLE AND LATE JURASSIC FORAMINIFERA

Stam (1986) studied the micropalaeontology of Middle and Upper Jurassic sections of the Grand Banks. Eighteen of the wells located in the five Grand Banks sub-basins were sampled, one in the Carson, thirteen in the Jeanne d'Arc, one in the Horseshoe, two in the Whale and one in the South Whale. In most wells, Upper Jurassic or Lower Cretaceous strata are unconformably overlain by Upper Cretaceous or younger sediments. This "Avalon unconformity" resulted from continental blocks tilting during the break-up of the Grand Banks from Portugal in the Albian (Stam, 1986). Simple, globose planktonic foraminifera, similar to those recorded in Portugal, were discovered from five of the wells.

- From the Murre G-67 and Cormorant N-83 wells in the Jeanne d'Arc sub-basin, planktonic foraminifera were recorded from the Bathonian to Callovian. The low-spired *Globuligerina balakhmatovae* and the higher-spired *G. bathoniana* were common in the deep-water Bajocian-Bathonian interval of Murre G-67 (Stam, 1986).
- From the Bittern M-62 well in the Horseshoe sub-basin, planktonic foraminifera were recorded "sometimes in large numbers" in the Callovian to Oxfordian, indicating relatively deep water (Stam, 1986). A shallowing occurred during the Late Oxfordian/Kimmeridgian, indicated by the disappearance of planktonic foraminifera.
- From the Eider M-75 and Razorbill F-54 wells in the Whale sub-basin, "many" planktonic foraminifera were recorded by Stam (1986) in an interval in the Eider M-75 well dated as Bajocian-Bathonian (Gradstein, 1978; Barss *et al.*, 1979). Again, the low-spired *Globuligerina balakhmatovae* and the higher-spired *G. bathoniana* were common in the deep water Bajocian-Bathonian interval of Eider M-75 (Stam, 1986). In the upper Bathonian level (Gradstein, 1978), planktonic foraminifera were rare, indicating a shallower water depth (Stam, 1986). Although Jurassic planktonic foraminifera were recognised in the Razorbill F-54 well, the interval in which they occurred could not be determined with any certainty due to considerable contamination (Stam,.1986).

Gradstein (1977, 1978) recognised six informal foraminiferal zones in the Middle and Upper Jurassic sediments of the Grand Banks. The "*Globigerina*" *bathoniana* Zone (Late Bathonian) was based on the highest stratigraphical occurrence of this species. In practice, this zone was recognised by the highest stratigraphical occurrence of high-spired planktonic foraminifera. An examination of Bajocian to Kimmeridgian planktonic foraminifera from Portugal, together with available Middle and Upper Jurassic material from other localities, in addition to a study of the relevant literature had shown that high-spired planktonic foraminifera could occur throughout the Middle and Upper Jurassic.

6.12 MEXICO

Jurassic planktonic foraminifera have not been described from Mexico, although there has recently been a report of planktonic taxa in thin sections (Pl. 23) from the Oxfordian of an off-shore borehole in the Sonda de Campeche (Campeche Basin), South-East Mexico (Carmen Rosales Dominguez, pers. comm. to Professor Hart).

6.13 SUMMARY

Data from the above locations, plus others in the literature, have been used to construct the palaeobiogeographical maps presented in Chapter 9. Some areas (e.g. Greece, Middle East, Indian Subcontinent) clearly need more research as information is currently limited or completely lacking.

CHAPTER 7

THE BRITISH ISLES

7.1 INTRODUCTION

Redcliff Point near Weymouth (Dorset, South-West Britain) exposes one of Europe's most complete Callovian/Oxfordian boundary sequences and has been the subject of rigorous multidisciplinary research (Figs 7.1, 7.2). The boundary sequence, which has been proposed as a candidate GSSP (Global Stratotype, Section and Point) for the base of the Oxfordian Stage (Page *et al.*, 2007, in press), lies entirely within the clay facies of the Oxford Clay Formation. Ammonites, in particular, are conspicuous and in some cases retain their aragonite shell. By convention the stage boundary is drawn at the first occurrence of the genus *Cardioceras*, which has been interpreted as corresponding to the transition between *"Quenstedtoceras" paucicostatum* (Lang) and *Cardioceras* ex gr. *scarburgense* (Young and Bird), specifically at the first occurrence of *C. woodhamense* Arkell *sensu* Callomon (*non* Marchand). This transition is recorded at Redcliff and provides the primary means through which the boundary can be correlated.

Samples for micropalaeontological analysis were collected throughout the boundary sequence. Splits of these samples were provided to Dr Paul Bown (University College, London) for an investigation of the calcareous nannofossils while the bulk of these samples were prepared for an analysis of the foraminifera and ostracoda by Professor Malcolm Hart at the University of Plymouth. All the samples were disaggregated using the "Solvent Method" described by Brasier (1980). This disaggregates the samples gently causing minimal (if any) damage to the fauna. Samples were washed on a 63 µm stainless steel sieve, dried in a cool (<40°C) oven and inspected in splits of >500 µm, 500-250 µm, 250-125 µm and 125-63 µm.

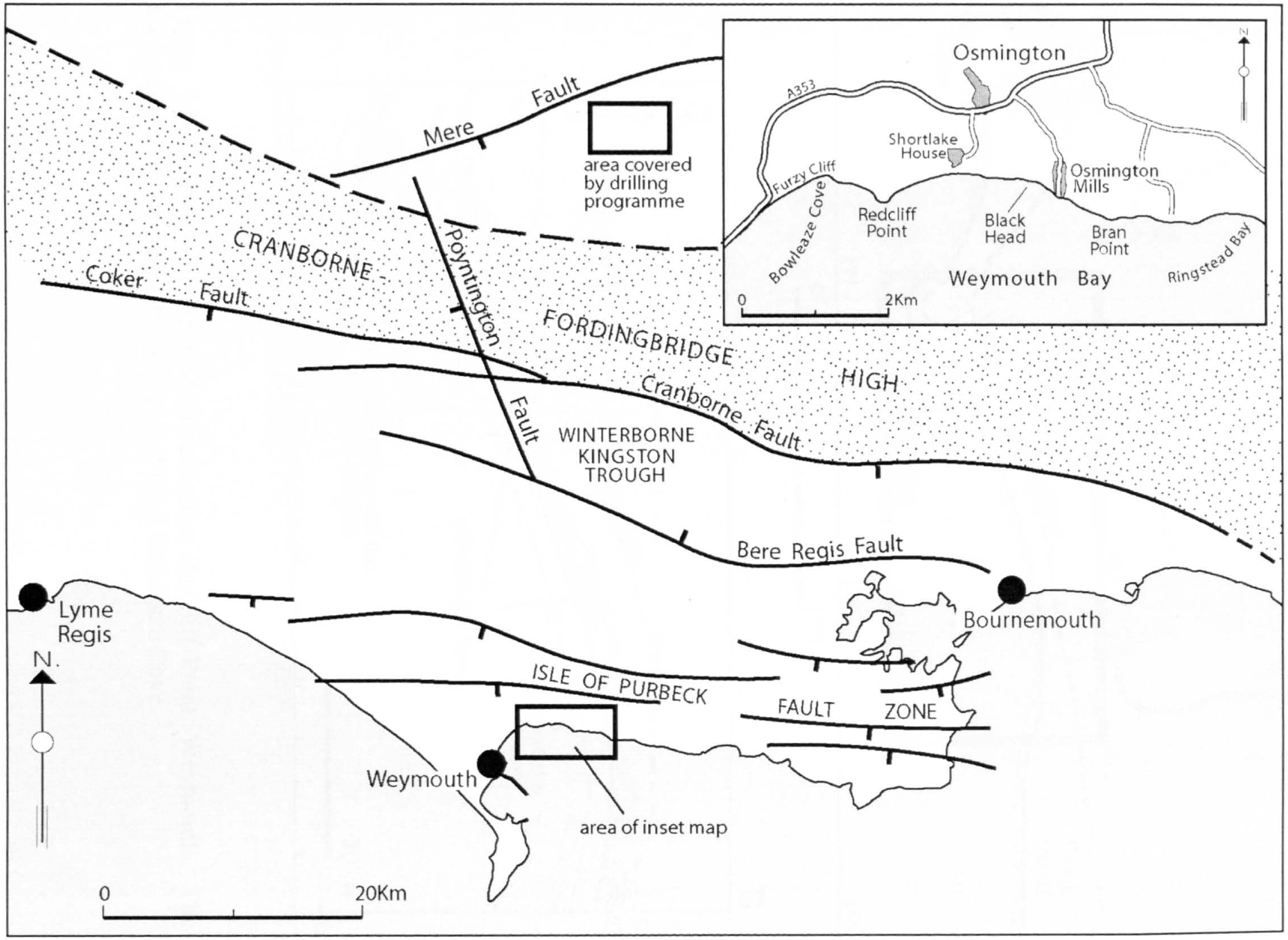


Figure 7.1. Location map and general structural features of Dorset (after Page *et al.*, 2003).

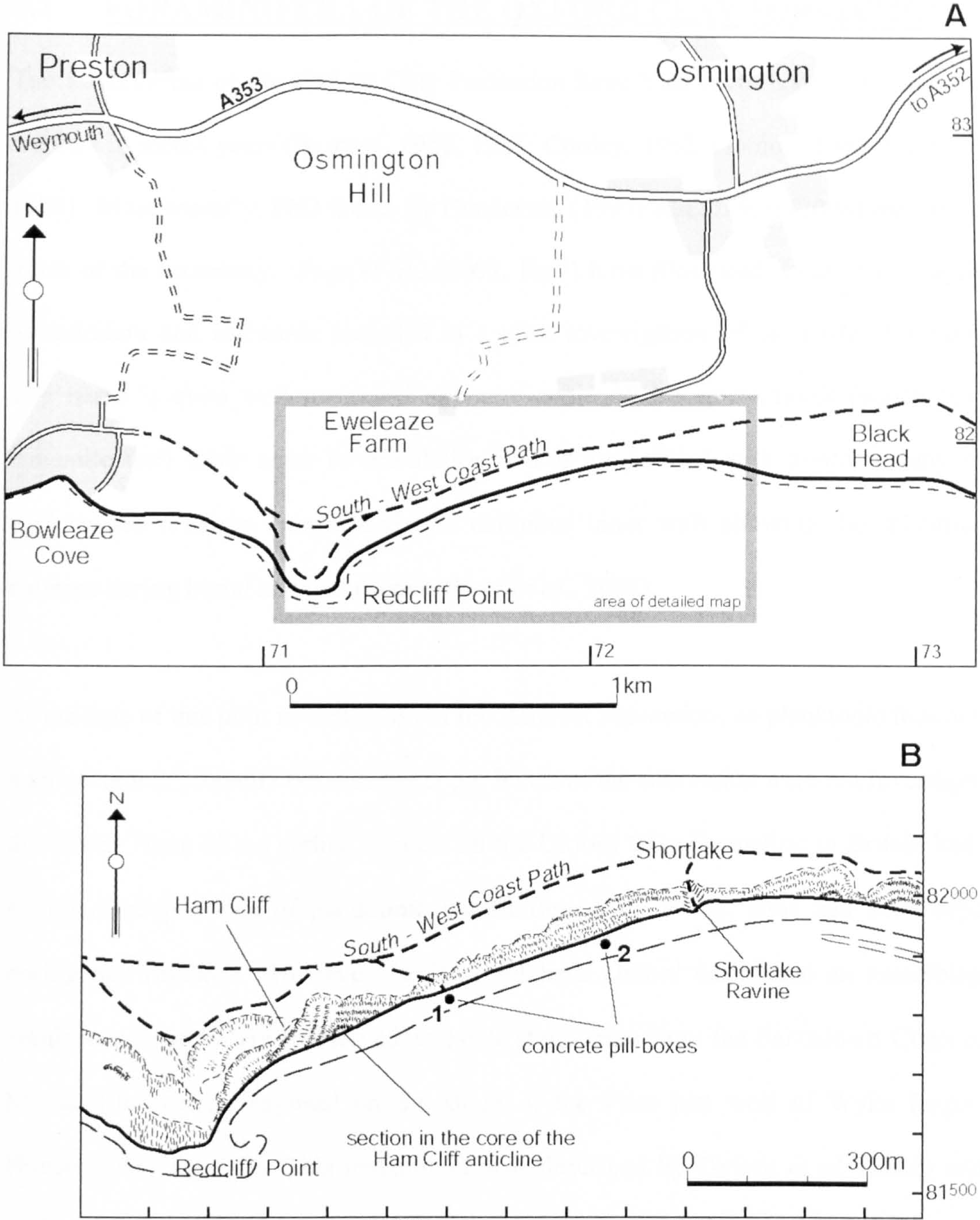


Figure 7.2. Location of the studied section at Redcliff Point, Weymouth. The easiest access is via the coastal path walking east from Bowleaze Cove.

7.2 FORAMINIFERA OF THE OXFORD CLAY FORMATION

The foraminifera of the Oxford Clay Formation have been investigated by a number of workers in recent years (Barnard, 1952, 1953; Cordey, 1962; Gordon, 1965; Shipp, 1978, 1989). More recently, PhD theses by Henderson (1997) and Oxford (2004) have up-dated much of the taxonomy. Page *et al.*, (2003, fig.7) have illustrated some of the species of foraminifera and ostracoda recorded in a pilot investigation of the Redcliff succession. The fauna is quite well preserved although some of the epistominids (which have an aragonite test) show signs of dissolution and/or are infilled with pyrite. Many of the agglutinated taxa are compressed, the chitinous inner wall allowing the specimens to collapse during burial and compaction (Page *et al.*, 2003).

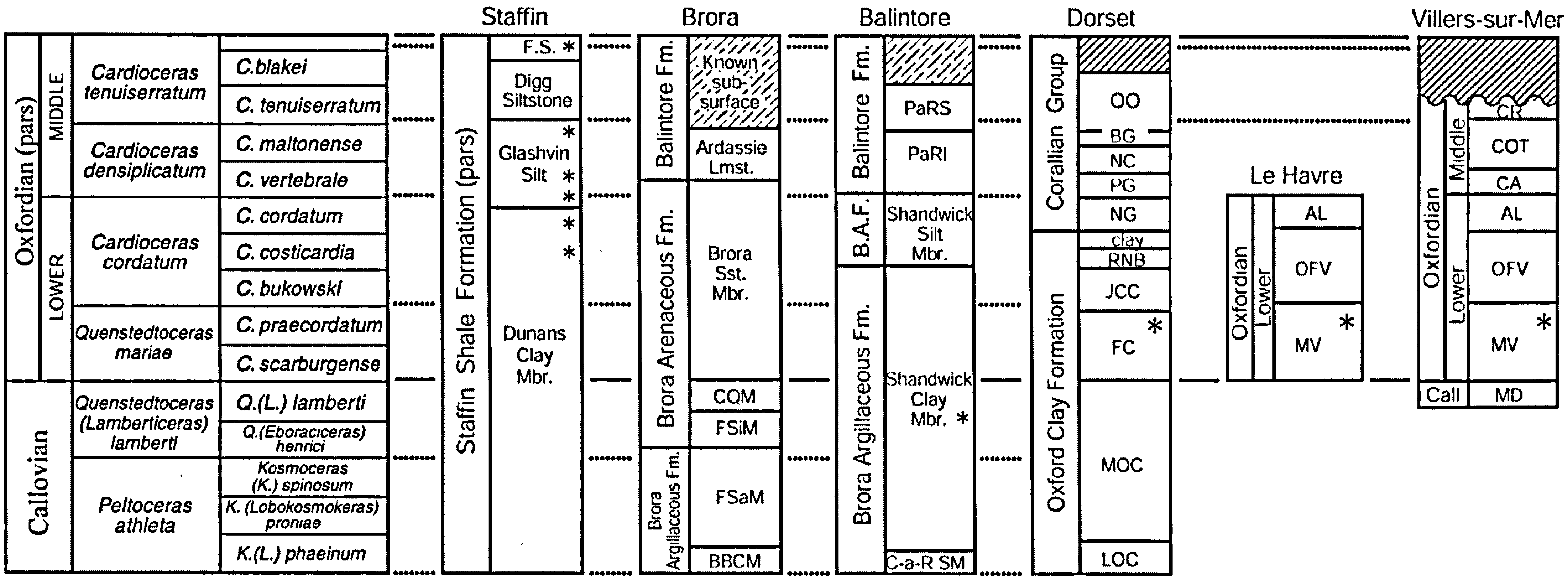
At the time of this pilot investigation of the Redcliff succession, no planktonic foraminifera were recorded, probably because the upper levels of the succession were not investigated at that time. None of the earlier workers on the Oxford Clay Formation in Britain had ever recorded the presence of planktonic foraminifera and, indeed, none had been expected during that research. However, in 2001, Melissa Oxford discovered an assemblage of planktonic foraminifera (preserved as pyrite steinkerns) from the Furzedown Clays of the Mariae Chronozone exposed on the shore of the Fleet just west of Wyke Regis (see House, 1993; fig. 14). This assemblage was described by Oxford *et al.* (2002) and the problems of its preservation discussed.

7.3 JURASSIC PLANKTONIC FORAMINIFERA

Over the last 50 years, knowledge of early planktonic foraminifera has changed markedly. In their review, Simmons *et al.* (1997) described 16 species from the late Bajocian to early Valanginian interval. The majority of these taxa were first described from Eastern Europe and parts of the Former Soviet Union (Grigelis, 1958, 1974, 1975; Hofman, 1958;

Morozova and Moskalenko, 1961; Pazdrowa, 1969; Fuchs, 1967, 1970, 1973, 1975; Grigelis *et al.*,1977; Grigelis and Gorbatchik, 1980a; Kuznetsova and Gorbatchik, 1980, 1985; Kasimova and Aliyeva, 1984; Gorbatchik, 1986). *Globuligerina oxfordiana* is, almost certainly, one of the most widely recorded of the Jurassic species, although this could be illusory as this is invariably the name used for almost "any" Jurassic planktonic forms. It was, therefore, something of an anomaly that *Globuligerina oxfordiana* was well known from the Marnes de Villers of the "Vaches Noires" cliffs of Normandy (Bignot and Guyader, 1966, 1971; Samson *et al.*, 1992) and yet had not been found in coeval strata of similar facies in Britain. Work by Melissa Oxford (2004), Malcolm Hart and Matthew Watkinson on the Normandy coast sections between Villers-sur-Mer and Houlgate confirmed the presence of *Globuligerina oxfordiana* in the uppermost part of the Marnes de Villers Formation, uppermost Scarburgense Subchronozone, Mariae Chronozone (Oxfordian). These specimens can be favourably compared with the illustrations of Bignot and Guyader (1971, figs 1-4) and Samson *et al.* (1992, pl. IV). It was this work in Normandy that prompted the sampling of the Mariae Chronozone of the Dorset Coast and led to the discovery of the fauna described by Oxford *et al.* (2002). It was, however, a surprise that this work recorded three possible species (*Globuligerina oxfordiana, Haeuslerina helvetojurassica* and *Compactogerina stellapolaris*) rather than the one species that was expected. None of the other taxa had been recorded by Bignot and Guyader (1966, 1971) and Samson *et al.* (1992) in the Normandy succession.

In the Redcliff succession the planktonic foraminifera have been recorded as pyrite steinkerns and are mainly found in the lowermost part of the Mariae Chronozone (Scarburgense Subchronozone). This is slightly older than the records from the shores of the Fleet and in Normandy but is in line with other known 'floods' at, or about, this level (Fig. 7.3). In Poland, the glauconitic sands and clays exposed at Ogrodzieniec (north-west of Krakow) also record floods of such forms, although in that succession the preservation



abbreviations

BAF	Brora Arenaceous Fm.	SCM	Shandwick Clay Mbr.	NG	Nothe Grit	OFV	Oolithe Ferrugineuse de Villers
CQM	Clynelish Quarry Mbr.	C-a-R	Cadh-an-Righ Shale Mbr.	RNB	Red Nodule Beds	MV	Marnes de Villers
FSiM	Fascally Siltstone Mbr.	FS	Flodigarry Shale	JCC	Jordan Cliff Clays	CR	"Coral Rag"
FSaM	Fascally Sandstone Mbr.	OO	Osmington Oolite	FC	Furzedown Clays	COT	Calcaire Oolithique de Trouville
BBCM	Brora Brick Clay Mbr.	BG	Bencliff Grit	MOC	Middle Oxford Clay	CA	Calcaire d'Auberville
P-a-RS	Port-an-Righ Siltstone	NC	Nothe Clay	LOC	Lower Oxford Clay	MD	Marnes de Dives
P-a-RI	Port-an-Righ Ironstone	PG	Preston Grit	AL	Argilles · *L. gregarea*		

Figure 7.3. The uppermost Callovian to Middle Oxdordian succession, based on data in Cope *et al.* (1980), Bignot and Guyader (1966), Rioult *et al.* (1991) and Samson *et al.* (1992). The locations of planktonic foraminifera are indicated by * (size relative to numbers of specimens present). The occurrences in Northern France and Dorset are very close to the maximum sea-level highstand recorded within Jurassic Sequence 8 of Jacquin *et al.* (1988, fig. 2) (Oxford *et al.*, 2002).

of the fauna is in the form of glauconitic moulds (see Fuchs, 1973).

The newly discovered Redcliff assemblage of planktonic foraminifera (Aze, 2005) is abundant and contains a variety of taxa (Pl. 11). Dominant are the typically 4-chambered *Globuligerina oxfordiana* morphotypes. The generic determination of this species is, however, problematic as a series of emendations by Bignot and Guyader (1966, 1971) have almost certainly changed the initial concept of the taxon, although Grigelis and Gorbatchik (1980a) have attributed this to the "better preservation of the French material". Simmons *et al.* (1997), following these emendations, identify *Globuligerina* on the basis of its loop-shaped aperture (as distinct from the low arch which is characteristic of *Conoglobigerina*). This separation is, however, only partly successful as any assemblage contains a range of forms with both arched and loop-shaped apertures as well as a range of spire heights. When dealing with the glauconitic moulds of Ogrodzieniec and the pyrite steinkerns of Redcliff this differentiation is impossible as the original test material is not present. Some of the Redcliff specimens are also irregular in form and this is probably a result of the preservation process.

Some of the other Redcliff specimens are attributed to *Compactogerina stellapolaris.* This determination is following Simmons *et al.* (1997), despite some workers (e.g. Riegraf, 1987a,b) placing this species in the synonymy of *Globuligerina oxfordiana.* The other Oxfordian species, *Haeuslerina helvetojurassica,* with its umbilical-extraumbilical aperture may also be present but the mode of preservation makes its identification very difficult.

One problem that remains unresolved is the presence of some low trochospiral forms with 5-7 chambers in the final whorl and an almost extraumbilical aperture. Such forms (Pl. 11, Fig. 6) are almost hedbergellid in appearance and the nearest genus might be

Praehedbergella. There are two problems in such a determination. Firstly, the specimen shown in Plate 11, Figure 6 shows a quite unusual surface ornamentation. This is, of course, not an 'external' feature but preserves an internal feature of the chamber wall, now lost in the steinkern preservation. Secondly, there is the problem of age. *Praehedbergella* appears in the early Cretaceous (Hauterivian) according to BouDagher-Fadel *et al.* (1997) and there are no confirmed records of any praehedbergellids being found in Jurassic strata, although a similar unidentified species has been found in the clays of the Wootton Basset Mud Springs by Dr A. Henderson (pers. comm. to Professor Hart). It is impossible to consider a change in the range of *Praehedbergella* on the basis of these few specimens as they do not show any of the typical morphology of the test. On the other hand the preservation does not allow for the creation of a 'new' taxon, as none of the generic and specific features of the calcareous (probably aragonite) test are preserved. This problem can only be resolved if an assemblage containing this fauna is discovered elsewhere in normal preservation. As planktonic foraminifera have not previously been reported from Jurassic strata in Southern Britain despite over a century of research, it is only just possible that fresh material may be found elsewhere with the aragonite test preserved. Material from the Jurassic of Scotland described by Gregory (1986, 1989) remains unpublished.

7.4 SEQUENCE STRATIGRAPHY AND PALAEOGEOGRAPHY

The occurrence of this planktonic fauna in the Scarburgense Subchronozone is distinctive and confirms the Mariae Chronozone as a flooding horizon across Dorset, Normandy and Bavaria. The Mariae Chronozone is close to the maximum sea-level highstand recorded within Jurassic Sequence 8 of Jacquin *et al.* (1988). This is also the same stratigraphical level as the abundant planktonic fauna at Ogrodzieniec (Poland). The sequence stratigraphy model of Emery and Myers (1996, fig. 6.14a) would predict that such 'floods' of planktonic taxa should be associated with maximum flooding surfaces (or events). The sea level highstand in the Early Oxfordian is also supported by Pearce *et al.* (2005, fig.2) who show the maximum sea levels in the Mariae Chronozone. This interpretation appears to be largely based on the work of Hesselbo and Coe (2000). This highstand event appears to conflict with the climate evidence provided by oxygen isotopes (Tremolada *et al.,* 2006) and the occurrence of glendonite in northeastern Asia (Chumakov and Frakes, 1997), both of which suggest a cooling at this time and the possible presence of polar ice. This evidence indicates that temperatures began to fall, in Europe, in the latest Callovian (Athleta Chronozone) and lasted into the earliest Oxfordian (Dromart *et al.*, 2003). The stable isotope data from belemnite guards indicate a cooling of some 6°–7°C in Russia, Poland and Britain (Podlaha *et al.*, 1998; Barskov and Kiyashko, 2000; Jenkyns *et al.*, 2002). Further evidence of a cooling at this time comes from cool gymnosperm floras in the upper Callovian and lower Oxfordian of Germany and France (Philippe and Thevenard, 1996) and palynomorphs of cool aspect in the North Sea Basin (Abbink *et al.*, 2001). The most striking feature appears to be an influx of 'Boreal' ammonites (cardioceratids and kosmoceratids) in southeastern France (e.g. Fortwengler, 1989) and elsewhere in N. W. Europe (Page, pers. comm. to Professor Hart). The palaeogeography at the time (Fig. 7.4) certainly shows a connection between Britain, France, Germany, Poland and areas in Russia such as the Pechora Basin, from which *Compactogerina stellapolaris* was first described. Even if a cold-water connection to the north can be demonstrated at the time of the Callovian/Oxfordian boundary, this does not appear to support the view that the Mariae Chronozone marks a highstand which allows the migration of planktonic foraminifera into the Wessex Basin. In modern oceans, aragonite is preferentially preserved in cooler (glacial) intervals with, for example, floods of pteropods preserved in Marine Isotope Stages 2 and 6 (Chen, 1968; Gardulski *et al.*, 1990; Wang *et al.*, 1997). If there was a "cooling" episode associated with the latest Callovian and earliest Oxfordian then this might also account for the relatively widespread preservation of planktonic foraminifera at this stratigraphical level.

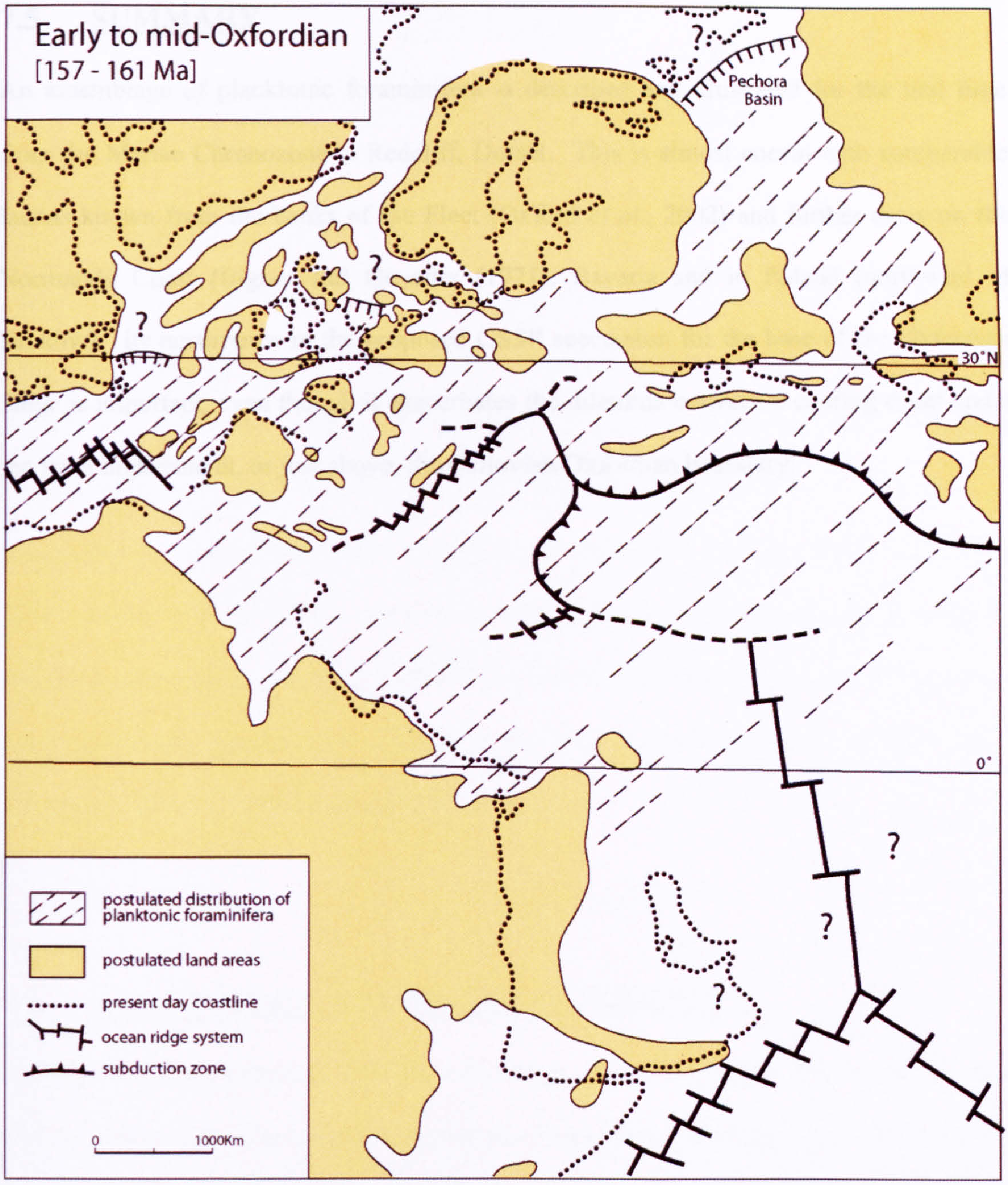


Figure 7.4. Oxfordian palaeogeography of Peri-Tethys (after Enay *et al.*, 1993; Norling and Grigelis, 1999; Thierry, 2000b,c).

7.5 SUMMARY

An assemblage of planktonic foraminifera is described and illustrated for the first time from the Mariae Chronozone at Redcliff, Dorset. This is almost coeval with comparable faunas known from the banks of the Fleet (Oxford *et al.*, 2002) and further away on the Normandy Coast (Bignot and Guyader (1971), Bavaria and in Poland (northwest of Kraków). Its occurrence in the proposed GSSP succession for the base of the Oxfordian Stage is important, even though it exacerbates the dilemma between a cooling event and a sea level highstand at, or just above, the Callovian/Oxfordian boundary.

CHAPTER 8

THE ARAGONITE-CALCITE TRANSITION

8.1 INTRODUCTION

Early in the Mesozoic there was an aragonite-dominated ocean system and the early planktonic foraminifera were aragonitic. Precisely when the transition to calcitic planktonic foraminifera occurred is uncertain. It has been assumed that most of the Jurassic forms were also aragonitic whereas Cretaceous taxa appear to be calcitic, as are all extant species. Because aragonite is relatively unstable and tends to dissolve or alter to calcite easily, it is not always apparent whether a fossil consisting of calcite originally consisted of calcite or aragonite. Studies have demonstrated a general, but not precisely time-constrained, change in the mid-Mesozoic from aragonite to calcite (Hardie, 1996; Stanley and Hardie, 1998; Stanley, 2006; Erba, 2006).

8.2 ARAGONITE AND CALCITE INTERVALS

In 1979, Sandberg proposed that the mineralogy of ancient oolites underwent a single transition from calcite to aragonite during the Phanerozoic, resulting from an increase in the Mg:Ca ratio of seawater during the Mesozoic. The rise of calcareous nannoplankton and planktonic foraminifera, secreting calcitic skeletons, was suggested as having caused the selective removal of calcium ions from the oceans. Subsequently, from more extensive data on the primary mineralogy of ancient marine oolites and early marine carbonate cements, Sandberg (1983) revised his proposition and divided the Phanerozoic into three intervals of "aragonite seas" and two intervals of "calcite seas" (Fig. 8.1):

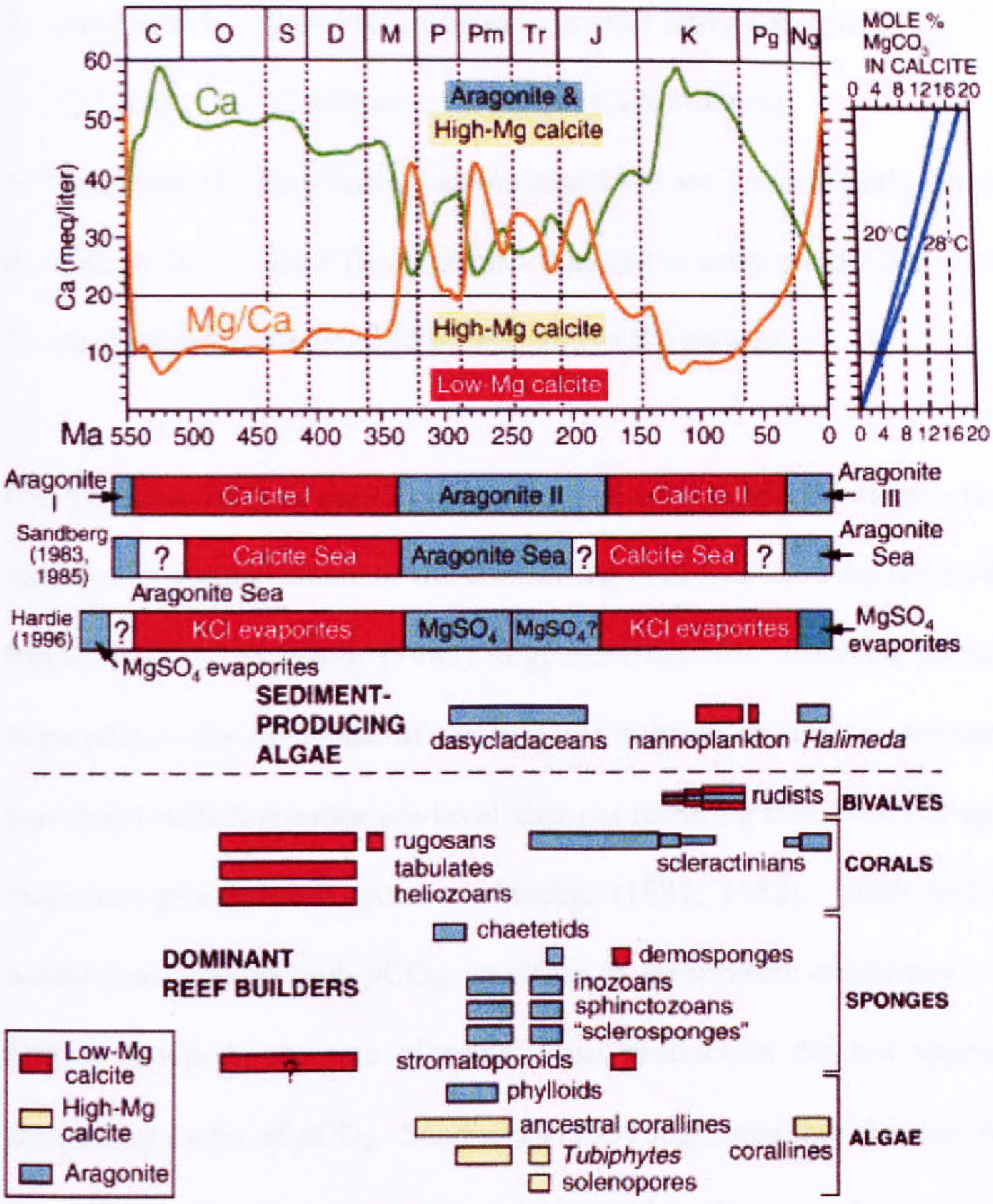


Figure 8.1. Comparison of the temporal distribution of mineralogies for important hypercalcifying marine taxa and mineralogies for non-skeletal marine carbonates and evaporates. The large upper diagram shows nucleation fields with respect to the Mg:Ca molar ratio of seawater for low-Mg calcite, high-Mg calcite and aragonite. The graph at the upper right illustrates the incorporation of Mg in non-skeletal calcite as a function of the ambient Mg:Ca ratio at two temperatures (Füchtbauer and Hardie, 1976, 1980). Also shown are the temporal oscillations in the geological record between calcitic and aragonitic non-skeletal carbonates and the temporal oscillations between KCl and $MgSO_4$ marine evaporates, which correlate with them. Both oscillations are predicted from estimates of global rates of ocean crust production and the effects of these rates on seawater chemistry (Hardie, 1996). (Stanley, 2006, modified from Stanley and Hardie, 1998, 1999, Stanley *et al.* 2002).

1.	Aragonite I	Late Precambrian to at least Early Cambrian;
2.	Calcite I	Cambrian to late Early Carboniferous;
3.	Aragonite II	late Early Carboniferous to Late Triassic/Early Jurassic;
4.	Calcite II	Late Triassic/Early Jurassic to early/middle Cenozoic; and
5.	Aragonite III	early/middle Cenozoic to the present.

On the basis of this oscillating pattern, plankton-driven changes in the Mg:Ca ratio of seawater were discounted as the controlling factor. Following the study by Mackenzie and Pigott, (1981), Sandberg (1983) suggested that the observed mineralogical oscillations were principally the result of tectonically induced changes in atmospheric $p\mathrm{CO}_2$, as they correlated with first-order sea-level changes resulting from seafloor-spreading and with the "icehouse-greenhouse" cycles of Fischer (1981, 1982). High mid-ocean ridge activity would have caused high $p\mathrm{CO}_2$, resulting in greenhouse conditions. According to Berner (1994), however, the rate of ocean crust production did not appear to be the primary controlling factor of $p\mathrm{CO}_2$. Sandberg (1983) suggested that elevated pCO2 would not only lower the carbonate concentration but could perhaps produce a marine system "below aragonitc saturation but still supersaturated with respect to calcite".

8.3 SEAWATER CHEMISTRY

8.3.1 MID-OCEAN RIDGE (MOR) ACTIVITY

Hardie (1996) explained the correlation between Sandberg's oscillations and those in the mineralogies of marine non-skeletal limestones and potash evaporites by secular shifts in the Mg:Ca ratio of seawater, governed by changes in spreading rates along mid-ocean ridges. He proposed that these coupled changes were the result of secular variation in seawater chemistry, controlled primarily by fluctuations in the mid-ocean ridge hydrothermal brine flux, which were in turn driven by fluctuations in the rate of ocean crust production.

Mid-ocean ridges act as vast ion exchange systems in which the conversion of basalt to greenstone releases Ca^{2+} into seawater and removes Mg^{2+} (Stanley and Hardie, 1998). Increases in the rate of ocean crust production therefore lower the Mg:Ca ratio of seawater, whilst simultaneously increasing the absolute concentration of Ca^{2+}. During periods of low ocean crust production rates, as from the mid-Early Carboniferous to the mid-Jurassic (and at present), the Mg:Ca ratio was relatively high, the absolute concentration of Ca was relatively low and aragonite plus high-Mg calcite were precipitated (Stanley and Hardie, 1998; Erba, 2006). At such times sea-levels were relatively low (Stanley, 2006). When ocean crust production rates were high, as from the mid-Jurassic to the early Paleogene interval, the Mg:Ca ratio decreased and low-Mg calcite was precipitated (Stanley and Hardie, 1998; Erba, 2006). At such times, sea levels rose substantially because igneous activity elevates the seafloor (Stanley, 2006).

Significant variation in the overall rate of seafloor spreading with time was challenged by Rowley (2004) but, even without variations in the mean rate, fluctuations might have been large enough to influence seawater chemistry significantly. During the Mid-Cretaceous super-plume episode, greatly increased ocean crust production probably caused a major sea level rise that reached a maximum for the Mesozoic (Larson, 1991a,b). The super-plume episode also correlates with a minimum in the Mg:Ca ratio that, although not considered responsible for the middle Cretaceous crises in carbonate platform evolution, could have favoured calcite dominated biota when carbonate production resumed (Steuber, 2002). Kominz and Scotese (2004) demonstrated that spreading rates during the Cretaceous were substantially higher than at any time during the past 50 Ma. Seawater chemistry is influenced not only by spreading rates and sea-levels but also by the production of plateau basalts (Stanley, 2006).

8.3.2 MARINE EVAPORITES

In the potash evaporites, intervals of aragonite seas were synchronised with magnesium sulphate ($MgSO_4$) evaporites and intervals of calcitic seas were synchronised with potassium chloride (KCl) evaporites. The major ion chemistry of seawater, rather than remaining constant, has oscillated significantly through geological time (Hardie, 1996). Using Hardie's model, the correlation between the observed and predicted intervals of aragonitic seas and calcitic seas has been extremely close. It also predicted that high-Mg calcite should precipitate with the aragonite, as it does in present oceans.

8.3.3 DOMINANT REEF-BUILDERS

The dominancy of particular groups of corals, sponges and algae as reef-builders appears to have been governed by the Mg:Ca ratio of the ambient seawater. During the calcite seas of the early and middle Paleozoic (Calcite I), reefs had been dominated by calcitic tabulate, heliolitid and rugose corals, together with calcitic stromatoporoids. During the aragonite seas of the late Paleozoic to early Mesozoic (Aragonite II), aragonitic groups of sponges, scleractinian corals and phylloid algae were the principal reef-builders, but also high-Mg calcitic red algae. The most obvious exception to the trend was the persistence of aragonitic scleractinian corals into the Late Jurassic and Early Cretaceous. This discrepancy might have resulted from the Mg:Ca ratio of seawater remaining close to the boundary between aragonite and calcite seas, in addition to the absence of serious competition early in Calcite II (Stanley, 2006). During the Late Cretaceous, at the peak of Calcite II, massive rudists displaced aragonitic hermatypic corals. In the present aragonitic seas (Aragonite III), scleractinian corals are again dominant reef-builders, together with high-Mg calcitic coralline algae.

8.3.4 CALCAREOUS NANNOPLANKTON

The appearance of nannofossils in the Carnian (Late Triassic) is thought to have affected the marine carbonate system, the global carbon cycle and ocean-atmosphere CO_2 (Fig. 8.2). According to Erba (2006), their global distribution, production of calcite plates and ability to bloom in both coastal and oceanic waters makes this phytoplanktonic group the most effective producer of calcite on Earth. Since the Jurassic, the history of seawater composition has been influenced by the development and diversification of coccolithophores and, later, planktonic foraminifera. These groups produced vast quantities of biogenic $CaCO_3$ that was eventually buried in the deep sea (Erba, 2006). Following a decrease in the Mg:Ca ratio to a very low level and an increase in calcium absolute concentration to a very high level in the Late Cretaceous (Calcite II), calcitic nannoplankton formed massive coccoliths in the warm shallow waters (Stanley and Hardie, 1998). Late Cretaceous chalks, which consist largely of coccoliths, are globally far more widespread and have a greater volume than chalks of any other interval in geological history. Late Cretaceous chalk accumulated at depths of ~100-500 m in warm epicontinental seas (Scholle, 1977).

The calcium carbonate compensation depth in the oceans was shallower during the Cretaceous than at present (van Andel, 1975) which, despite a warmer deep sea, might have reflected the high atmospheric concentration of CO_2. Estimates of atmospheric pCO_2 for the Late Cretaceous, based on stomatal densities of conifers, range from approximately twice to four times its present level (Haworth *et al.*, 2005) (Fig. 8.3). Subsequently, as the Mg:Ca ratio of seawater rose, the volume of chalk production decreased, as did the size of individual coccoliths (Late Cretaceous species were approximately twice as large as extant species). Although some organisms have considerable control over their biomineralisation, seawater chemistry has affected the skeletal control of many taxa. Organisms that secrete high-Mg calcite in the modern aragonitic sea incorporate progressively less Mg into their skeletons with a reduction in the ambient Mg:Ca ratio, producing low-Mg calcite in "Cretaceous" seawater (Stanley, 2006).

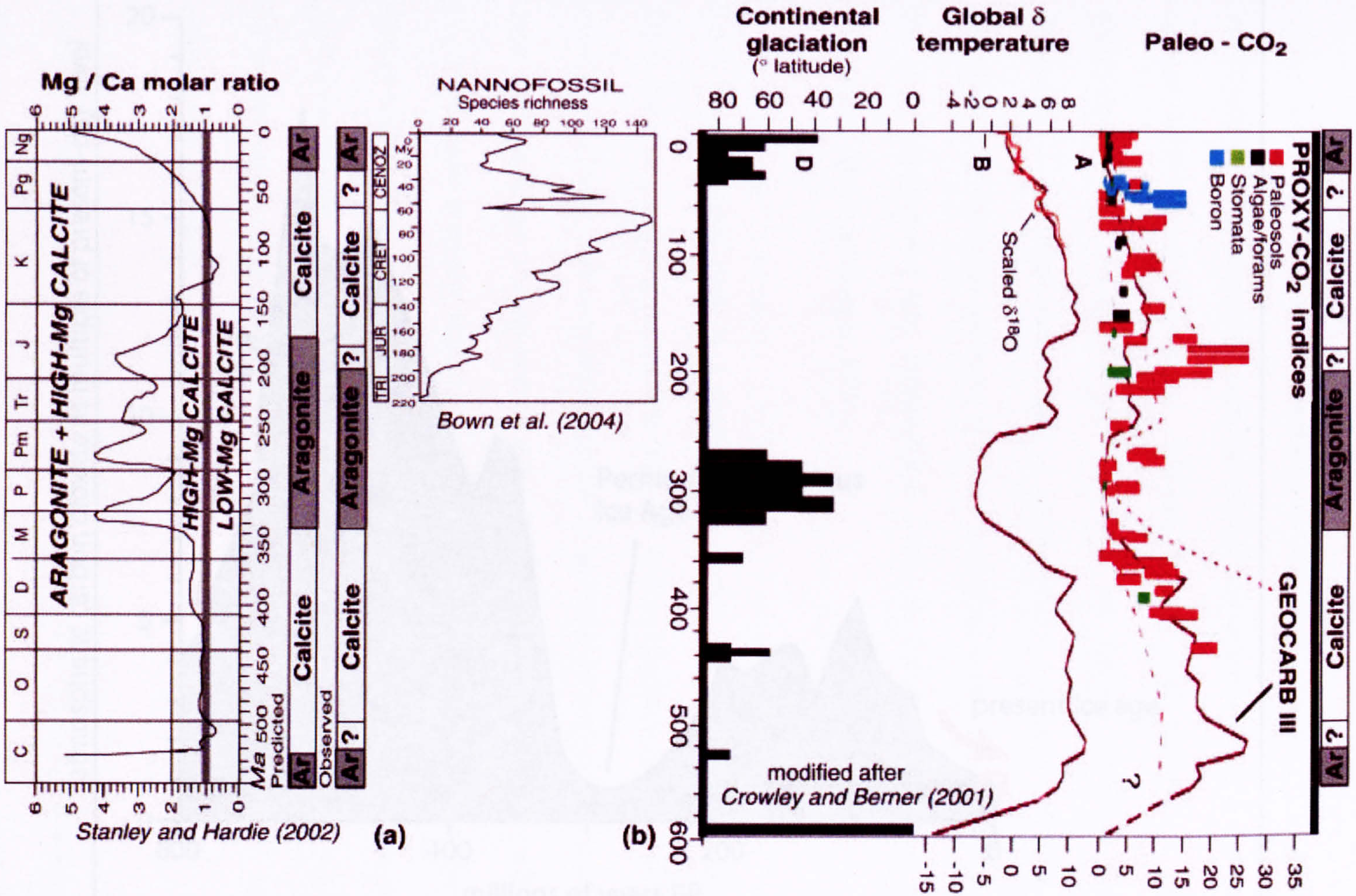


Figure 8.2. Nannofossil diversity (species richness) compared to (a) secular variation in Mg:Ca ratios of sea water and subdivision into "calcite" and "aragonite" seas, and (b) CO_2 concentration and climate changes during the Phanerozoic (Erba. 2006).

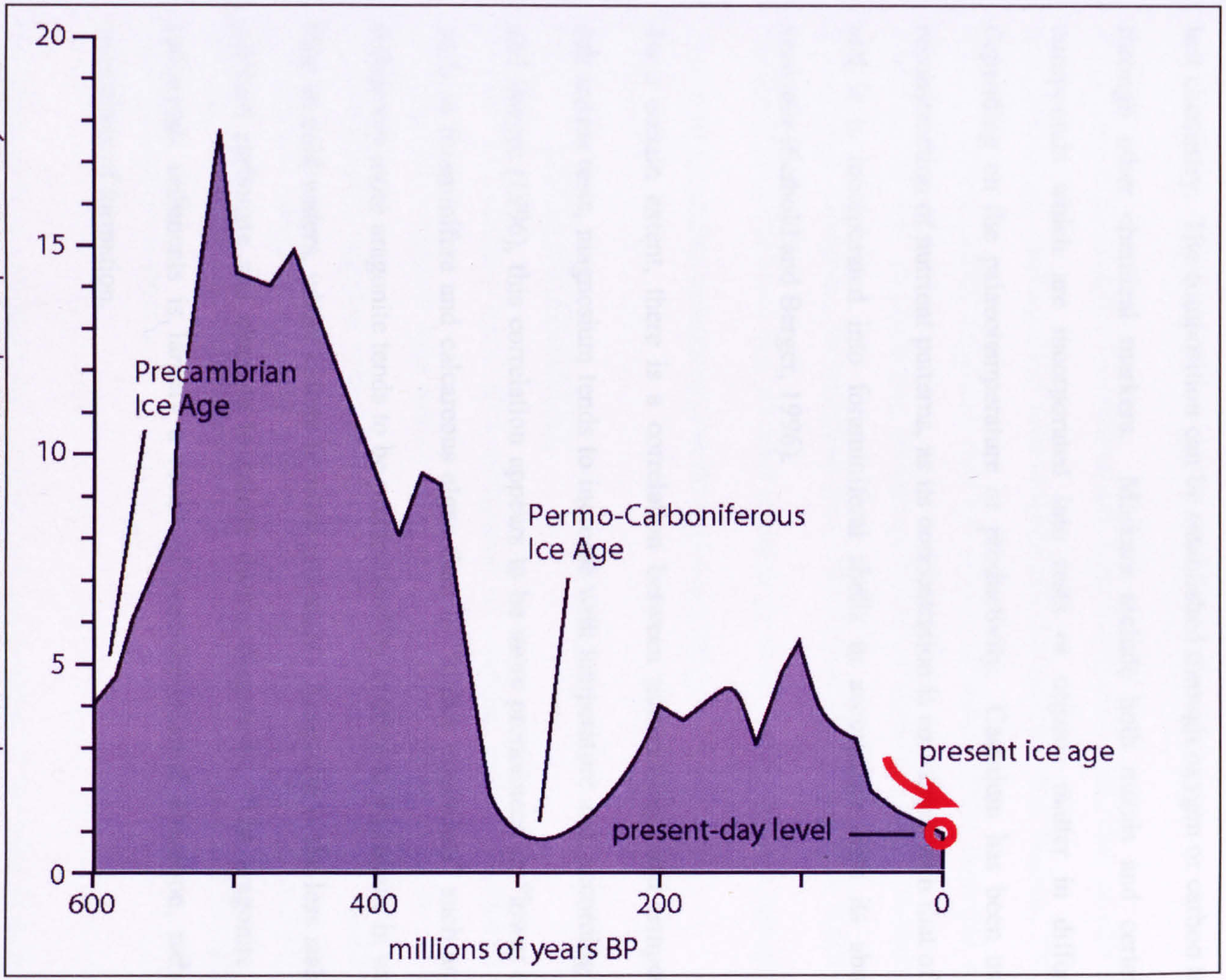


Figure 8.3. The concentration of carbon dioxide in the atmosphere through the Phanerozoic. The low levels of CO_2 during glacial intervals is quite evident, as is the difference between the Mesozoic and the Palaeozoic (Hart, 2005, after Berner, 1994, 1997).

8.4 TEST CHEMISTRY AND CRYSTALLOGRAPHY

8.4.1 PALAEOCEANOGRAPHICAL AND PALAEOCLIMATICAL INDICATORS

Changing palaeoceanographical and palaeoclimatical conditions can be inferred from various methods, including the abundance and diversity gradients of proxy species or their test chemistry. The composition can be established through oxygen or carbon isotopes, or through other chemical markers. Markers include both metals and certain organic compounds which are incorporated into tests or organic matter in different ways, depending on the palaeotemperature or productivity. Cadmium has been used for the reconstruction of nutrient patterns, as its concentration is correlated with that of phosphate and it is incorporated into foraminiferal shells in accordance with its abundance in seawater (Seibold and Berger, 1996).

To a certain extent, there is a correlation between mineralology and temperature. In calcareous tests, magnesium tends to increase with temperature and, according to Seibold and Berger (1996), this correlation appears to be more pronounced in "lower organisms" such as foraminifera and calcareous algae than in "higher organisms" such as barnacles. Relatively more aragonite tends to be precipitated by benthonic organisms in warm waters than in cold waters, where calcite is more prevalent. Aragonite is the less stable form of calcium carbonate and changes to calcite during diagenesis. The aragonite content of calcareous sediments is largely a result of post-depositional alteration, rather than of conditions of formation.

Changes in seawater chemistry might not have affected the biomineralization of all marine biota to a great extent because the degree of biological control over their skeletal minerology almost certainly varied between taxa, with some exerting considerable control. The skeletal mineralogy of biologically simple organisms might have been altered by changes in the chemistry of the ambient seawater. The most likely alteration would appear to be a correlation between the Mg:Ca ratio of the ambient seawater and the percentage of magnesium substituted for calcium in a calcite skeleton (Stanley and Hardie, 1998, 1999). According to Stanley, 2006, a shift from aragonite to calcite, or vice-versa, would be less likely.

Foraminifera are complex biomineralisers and, in modern oceans, they exhibit many forms of calcification, altering their tests extensively (Lowenstam and Weiner, 1989; Stanley, 2006). Martin (1995) suggested that the origins of foraminiferal taxa had entailled the evolution of test mineralogies reflecting those of contemporary non-skeletal marine carbonates. However, foraminifera have constituted major sediment producers in the Mesozoic and Cenozoic and yet their mineralogy does not correspond strongly to that of non-skeletal marine carbonates (van de Poel and Schlager, 1994).

8.4.2 CRYSTALLOGRAPHY

Hyaline foraminifera have tests composed of calcium carbonate crystals that build microgranules, aligned into rows. According to BouDagher-Fadel *et al.* (1997), the crystallography, together with the understanding that the tests were calcitic, were the fundamental diagnostic criteria used by Loeblich and Tappan (1987) to define Globigerinina. In addition, Hemleben *et al.* (1989) either assumed or stated that all Globigerinina were calcitic.

Analyses of the crystallography and chemical composition of the tests of early planktonic foraminifera have been very limited. Gorbachik and Kuznetsova (1986) X-rayed specimens of *Hedbergella trocoidea* (Gandolfi) and *Conoglobigerina meganomica* (Kuznetsova) from the Crimea, *Globuligerina oxfordiana* (Grigelis) from the Russian Plate and *Favusella washitensis* (Carsey) from Algeria. They found that *H. trocoidea* was calcitic, *G. oxfordiana* was aragonitic and *F. washitensis* was a mixture of aragonite and calcite. In the latter, the aragonitic shells were partially infilled with secondary calcite, suggesting that the Favusellacea were aragonitic. BouDagher-Fadel *et al.* (1997) felt that this would confirm their distinction, based primarily on morphology, between the two Superfamilies. Accordingly, tests of *Globuligerina oxfordiana* (Grigelis) from Russia and France, and *G. bathoniana* from Poland were analysed by X-ray diffraction at the Natural History Museum, London. These were found to be aragonitic. Topotypical specimens of *F. washitensis* (Carsey) from Texas, regarded as recrystallised and with an internal infilling of secondary calcite, only gave results for calcite, which the authors attributed to inversion of the original aragonite to secondary calcite during the recrystallisation. *Conoglobigerina dagestanica* (Morozova) and C. *avarica* (Morzova) from Dagestan, and the topotype of *Haeuslerina helvetojurassica* (Haeusler) from the Stam collection were calcitic but this again could have been secondary calcite, recrystallised from original aragonite during fossilisation.

Fractured chamber walls of *Globigerina oxfordiana* from the Oxfordian of the Moscow region, the best preserved specimens, were studied using high-resolution scanning electron microscopy. BouDagher *et al.* (1997) observed that the aragonitic wall appeared to have "an innermost layer made with much smaller microgranules, and the perforations appear very thin and sinuous in vertical section". Suggesting that the chemical composition and crystallographic structure of test walls could be the most fundamental criteria for classification, the authors stressed the need for further studies on better material from clays and marls, where recrystallisation could be discounted.

From their results and those of Gorbachik and Kuznetsova (1986), BouDagher *et al.* (1997) formed the opinion that the Globigerinacea were calcitic whereas the Favusellacea were aragonitic. Due to the instability of aragonite, aragonitic fossils are highly susceptible to dissolution and they are unlikely to be recovered unless there were high sedimentation rates or rapid sealing of sediments soon after deposition. BouDagher *et al.* (1997) suggested that this could explain the relatively rare occurrence of Jurassic favusellian taxa. That many benthonic foraminiferal families are consistently calcitic whereas others are consistently aragonitic demonstrated that the preferred mineralogy was genetically controlled and not influenced by the environment they cohabited. In the mid-Late Jurassic, planktonic foraminifera are often associated with epistominids, which also have an aragonitic test. Preservation in, for example, the Oxford Clay Formation of Dorset, is often similar for both groups (pyrite steinkerns). In Britain and Poland (e.g. Ogrodzieniec), preservation as mineral infillings is quite normal, suggesting loss of the original test material.

They concluded that if Loeblich and Tappan's (1964, 1987) system of classification were to be followed, aragonitic planktonic foraminifera would have to be diverted to a separate Suborder or Superfamily, as in the case of aragonitic benthonic foraminifera. Pending further studies, BouDagher *et al.* (1997) chose to emend their definition of the Globigerinina, in the interim, to include both aragonitic and calcitic genera.

8.5 IMPLICATIONS OF FORAMINIFERAL STUDIES

In Palaeozoic oceans, the plankton was either organic-walled (chitinozoans, acritarchs, dinoflagellates) or silica-based (radiolaria). With high atmospheric CO_2 levels (Fig. 8.3), the oceans (aside from shelf-based carbonate "factories") were probably quite carbonate-deficient. Organic-rich sediments and radiolarites are known but no oceanic carbonate is recorded.

In order to change the oceans into the carbonate-rich environment of the present day required the evolution of the calcareous nannoplankton and the planktonic foraminifera (Prokoph *et al.*, 2004). The calcareous nannoplankton appeared in the Carnian (Triassic) and, despite a major extinction event in the end-Triassic, progressively expanded in diversity during the Jurassic (Bown *et al.*, 1992). The first "foraminiferal ooze" is recorded in the Bajocian/Bathonian of Hungary (Chapter 4) and Poland (Chapter 5). The oldest planktonic foraminiferal packstone (sediment >95% planktonic foraminifera) is the "*Globuligerina*" microfacies of the Pieniny Klippen Belt (Wierzbowski *et al.*, 1999). By this time in the evolution of the calcareous nannoplankton and planktonic foraminifera, the water column of the oceans must have developed the typical profile of:

- Aragonite lysocline (ALy), where there is a marked increase in aragonite dissolution in the water column;
- Aragonite compensation depth (ACD), at which level aragonite supply equals the rate of dissolution (1,000 - 3,000 m in modern oceans);
- Carbonate lysocline (CLy), the level at which there is a marked increase in the rate of dissolution of biogenic carbonate (3,000 – 4,500 m in modern oceans); and
- Carbonate compensation depth (CCD), the level at which the rate of calcite dissolution equals the rate of supply (4,000 – 5,000 m in modern oceans).

Below the CCD, there is a silica compensation depth (SCD).

All of the carbonate and aragonite dissolution levels are complex, strongly influenced by oceanic fertility and productivity. In areas of high production, the CCD is depressed below the regional average. Estimating the ALy, ACD, CLy and CCD in the Jurassic is fraught with difficulty (Bosellini and Winterer, 1975; Winterer and Bosellini, 1981; Prokoph, *et al.*, 2004). In the Tethys area, Bosellini and Winterer (1975) attempted to relate the ALy, ACD, CLy and CCD to the various facies of the Ammonitico Rosso (e.g. nodular/marly limestones deposited between the ALy and ACD). Winterer and Bosellini (1981, fig. 27) showed the Oxfordian ALy at ~450 m and the ACD at ~900m.

The *Globuligerina* microfacies of the Pieniny Klippen Belt was clearly deposited above the ACD (and probably the ALy) but the depth of deposition at that time is uncertain. Arguments can be very circular but Dr Michał Krobicki (pers. comm. to Professor Hart) suggests that the nodular limestones of the Czorsztyn Succession may have been deposited near to 1000 m. The comparable strata in the Niedzica Succession is represented by radiolarites that must have been below the CCD.

The vertical spacing of the ALy, ACD, CLy and CCD may have been very different from the present day, especially if all the planktonic foraminifera were composed of aragonite rather than calcite. The calcareous nannoplankton would be the only difference between a foraminiferal ACD and a coccolith controlled CCD. The estimates for the depth of the ALy and ACD (Winterer and Bosellini, 1981) before the evolution of the planktonic foraminifera must be regarded as highly speculative.

The problem facing those engaged in this work in Southern Poland, Hungary, Greece and Italy is that these are tectonically complex areas where the construction of depth/subsidence curves is extremely complex. What is clear is the fact that most of the work, to date, on this subject has not had information on the planktonic foraminifera to use in models, despite them being the main producers of oceanic aragonite.

CHAPTER 9

THE PALAEOGEOGRAPHY OF EARLY PLANKTONIC FORAMINFERA

9.1 INTRODUCTION

Planktonic foraminifera are an extremely abundant, important and successful group of marine protists. They are especially useful in reconstructing ancient environments and for biostratigraphical correlation (both local, regional and global). Despite their undoubted importance, the origin of the group is uncertain. In a review of the earliest planktonic foraminifera (Globigerinina), Simmons *et al.* (1977) reported that the origins of the group were "…..still shrouded in uncertainty".

In 1960 Oberhauser described 52 species of foraminifera from the Middle and Upper Triassic of the eastern Alps and then, between 1967 and 1973, Fuchs described more than 20 new species from the Triassic of Austria, northern Italy and Poland, the majority of which were new (Fig. 9.1). Fuchs considered his Triassic "*Globigerina*-like" forms to be planktonic but after subsequent examination of his material, other researchers (e.g. Görög and Rögl, pers comm. to Simmons *et al.*, 1997) have concluded that it consists mainly of badly preserved and recrystallised benthonic specimens. Over the last four years, all of the available type specimens in the Geologische Bundesanstalt in Vienna have been examined and all the key specimens have been photographed using an environmental SEM at the Natural History Museum (London) (see Chapter 2). This work is currently being prepared for publication (Hudson *et al.*, *in prep.*). Examination of Fuchs' figures, the specimens and the latest photographs shows that they all lack any adaptations that would be characteristic of a planktonic mode of life.

According to Fuchs (1975), the Triassic genera *Oberhauserella* Fuchs and *Schmidita* Fuchs

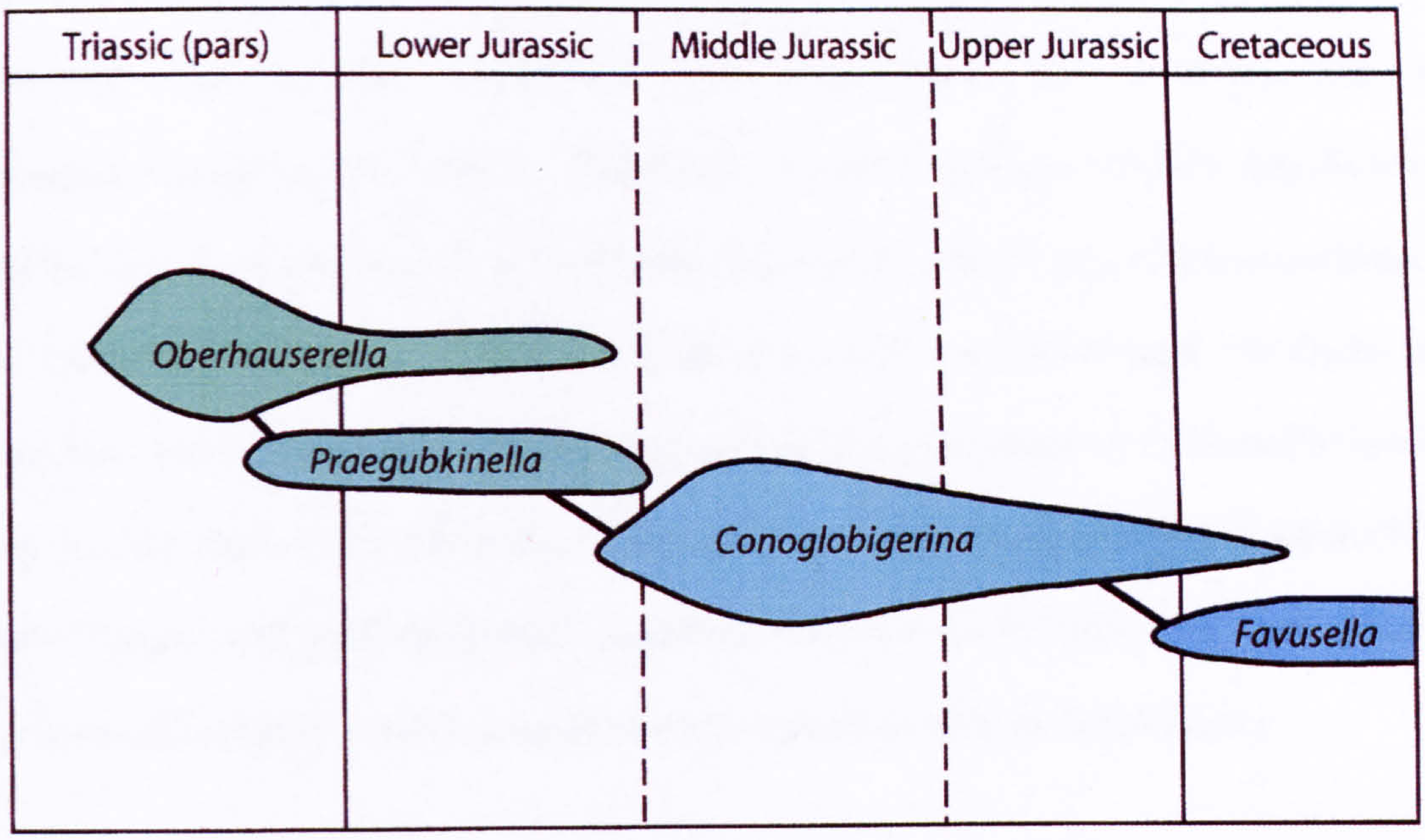


Figure 9.1. Outline evolution of the Jurassic planktonic foraminifera. This proposed evolution of *Oberhauserella – Praegubkinella – Conoglobigerina* is different from that shown in Hart *et al.* (2003, fig. 2), as subsequent work from the Geologische Bundesanstalt has shown a more direct link from *Oberhauserella* to *Praegubkinella* and not from *Oberhauserella* to *Conoglobigerina.*

were the direct ancestors of the Jurassic *Conoglobigerina* and the ancestors of the Callovian *Mariannenina*, respectively, the latter genus then evolving into the holoplanktonic genus *Hedbergella*. Conversely, Loeblich & Tappan (1987) classified both *Oberhauserella* and *Schmidita* as benthonic, belonging to the family Oberhauserellidae in the Suborder Robertinina. Whilst Simmons *et al.* (1997) acknowledged that Fuchs may have been partly correct about an oberhauserellid being the ancestor of *Conoglobigerina*, they pointed out that *Mariannenina* Fuchs (1973), classified by Loeblich & Tappan (1987) under "Genera of Uncertain Status", appeared to have a double peripheral keel, a feature that is notably absent in Jurassic and Early Cretaceous planktonic foraminifera.

Specimens from the Toarcian of Switzerland were identified by Wernli (1995) as *Oberhauserella quadrilobata* Fuchs 1967 and as the genus *Praegubkinella* Fuchs 1967. Wernli also included a new species in the latter, *P. racemosa*, which he considered to be morphologically transitional to *Conoglobigerina*. According to Simmons *et al.* (1997), all the species named by Fuchs and most of the forms figured by Wernli (1995) appear to have strongly concave or flattened sides, reminiscent of the adherent sides of benthonic foraminifera. However, they considered that *P. racemosa* Wernli was apparently free living, probably with a convex but umbilicate ventral side, and that it might have been the Toarcian ancestor of the Bajocian *Conoglobigerina* (Fig. 9.1). Wernli's material came from an excavation on a forestry road near Teysachaux (Fribourg Alps), just above the anoxic event in the Falciferum Zone of the Toarcian and, therefore, just above the negative carbon isotope excursion. In Britain, at exactly the same level there is a flood of inflated *Oberhauserella quadrilobata* immediately above the black mudstones of the Falciferum Zone (Hylton, 2000; Hart *et al.*, 2003). Wernli (1988) described the same transition to a "protoglobigerinid" in the Toarcian – Aalenian succession in the Taurus Mountains of Turkey.

Prior to these changes in the mid-Toarcian, there are no records of definite planktonic foraminifera. Some early records are in doubt (sample contamination) and the specimens described by Görög (1994) as *Globuligerina geczyi* are also thought to be possible Cenozoic contaminants (see Simmons *et al.*, 1997, p. 20). Detailed work by Hillebrandt *et al.* (2006) in the Northern Calcareous Alps has described a Hettangian fauna that includes *Oberhauserella* sp. and *Praegubkinella turgescens* but no other potentially planktonic taxa. Current evidence, therefore, suggests that it is in the Toarcian when the first changes to a planktonic mode of life occurred within the foraminifera, although the direct association with the anoxic event has yet to be tested (Hart *et al.*, 2003).

9.2 PALAEOBIOGEOGRAPHICAL MAPS

9.2.1 TOARCIAN

The Toarcian palaeogeographical map of Europe (Fig. 9.2) shows an extended shelf, dotted with islands, and with no effective connection through the North Sea Basin to the north and the Atlantic Ocean to the west. To the east, the shelf area opens into the Tethys Ocean (Bassoullet *et al.*, 1993; Thierry, 2000a). The two reference points from which the earliest *Globigerina* have been described were provided by Wernli (1988, 1995), although Hylton (2000) recorded a dramatic influx of inflated *Oberhauserella* in the upper part of the Falciferum Zone immediately above the anoxic event (Hart *et al.*, 2003, fig. 1, p. 341). Both Teysachaux and the Taurus Mountains in Turkey are located at the edge of the shelf area, on opposite sides of the western margin of Tethys and this would, on several grounds, appear to be a suitable location for the change to a planktonic mode of life, especially if associated with the formation of widespread anoxia in the Exartum Subzone (Hart *et al.*, 2003, fig. 1, p. 341).

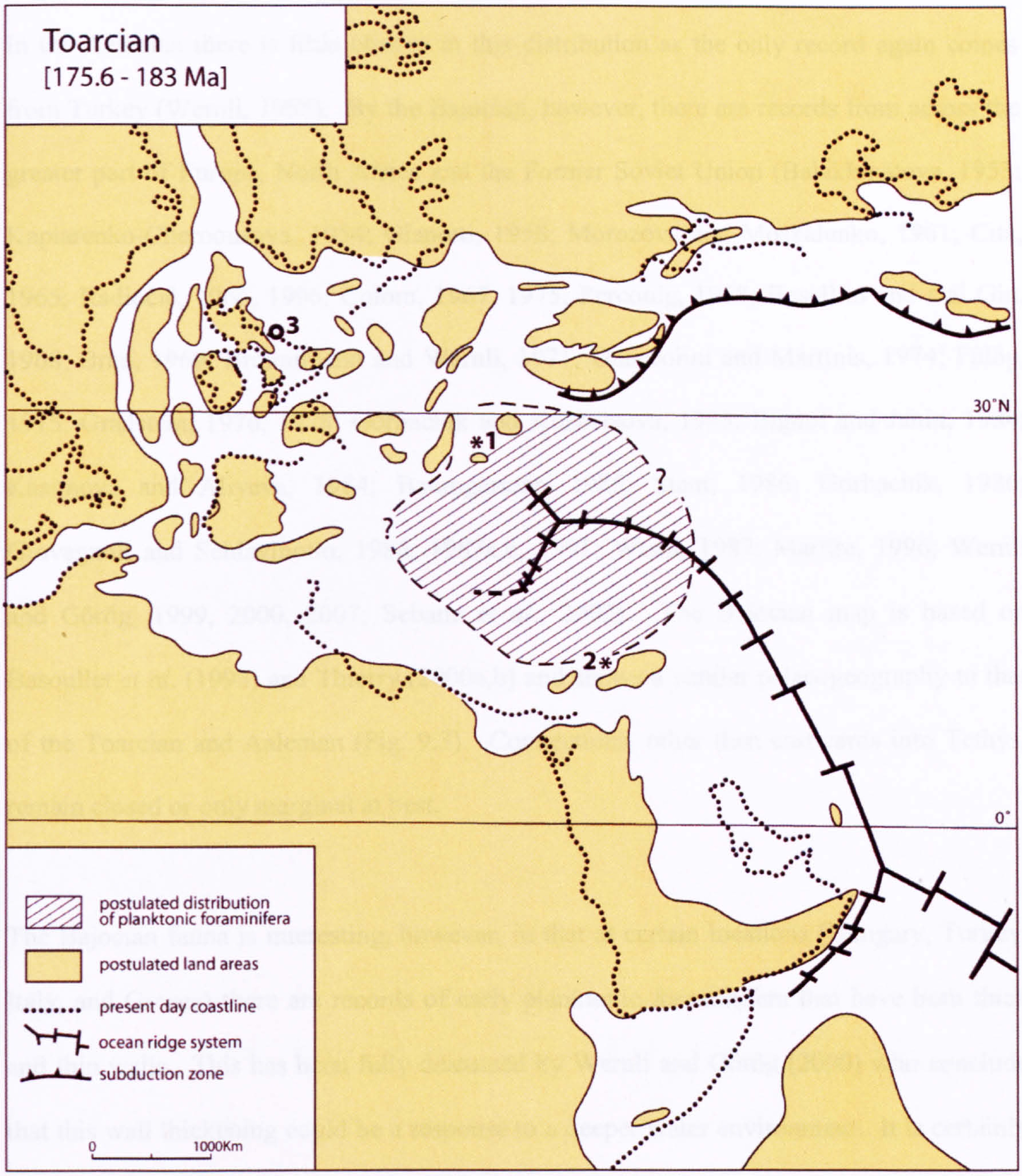


Figure 9.2. Toarcian palaeogeography of Peri-Tethys (after Bassoullet *et al.*, 1993; Thierry, 2000a). 1 = Teysachaux (Fribourg Alps); 2 = Taurus Mountains, Turkey; and 3 = Yorkshire Coast.

9.2.2 BAJOCIAN

In the Aalenian there is little change in this distribution as the only record again comes from Turkey (Wernli, 1988). By the Bajocian, however, there are records from across the greater part of Europe, North Africa and the Former Soviet Union (Balakhmatova, 1953; Kaptarenko-Chernousova, 1954; Gianotti, 1958; Morozova and Moskalenko, 1961; Cita, 1965; Radiočić, 1966, 1996; Colom, 1967, 1975; Perconig, 1968; Bosellini and Dal Gin, 1968; Brun, 1969; Brönnimann and Wernli, 1971; Gnaccolini and Martinis, 1974; Fülöp, 1975; Gradstein, 1976, 1978; Gorbachik and Kuznetsova, 1983; Bignot and Janin, 1984; Kasimova and Aliyeva, 1984; Baumgartner, 1985; Stam, 1986; Gorbachik, 1986; Giovagnoli and Schiavinotto, 1986, 1987a,b, 1991; Wenli, 1987; Martire, 1996; Wernli and Görög, 1999, 2000, 2007; Sebane *et al.*, 2002). The Bajocian map is based on Basoullet *et al.* (1993) and Thierry (2000a,b) and shows a similar palaeogeography to that of the Toarcian and Aalenian (Fig. 9.3). Connections, other than eastwards into Tethys, remain closed or only marginal at best.

The Bajocian fauna is interesting, however, in that at certain locations (Hungary, Turkey, Italy, and Greece) there are records of early planktonic foraminifera that have both thick and thin walls. This has been fully discussed by Wernli and Görög (2000) who conclude that this wall thickening could be a response to a deeper water environment. It is certainly clear that the locations where the wall-thickening is recorded are found, off the shelf, in deeper water settings.

The other distinctive feature of many Bajocian locations (e.g. Hungary, Poland) is the abundance of the planktonic foraminifera in the pelagic limestones (of Ammonitico Rosso-type) of the Middle (and Upper) Jurassic in different parts of European Tethys (e.g. Wierzbowski *et al.*, 1999; Hudson *et al*, 2005). The evolution of the planktonic foraminifera (in the Toarcian?) and their rapid expansion across Europe in the Bajocian

	AUTHORS	DATES	LOCATIONS
	Balhakhmatova	1953	Dagestan, Azerbaijan, FSU
	Kaptarenko-Chernousova	1954	[taxonomic discussion]
1	Gianotti	1958	Sicily, Italy
	Morozova and Moskalenko	1961	Dagestan, FSU
3	Cita	1965	Southern Alps, N Italy
2	Radiočić	1966, 1996	Dinarides, former Yugoslavia
	Colom	1967	[taxonomic discussion]
	Colom	1975	Mallorca, Balearic Islands
	Perconig	1968	Cantabrian Mountains, Spain
	Bosellina and Dal Cin	1968	Trento Plateau, Italy
	Brun	1969	Atlas Mountains, Morocco
	Brönimann and Wernli	1971	Jura and Lorraine, France
	Gnaccolini and Martinis	1974	NE Italy
	Fülöp	1975	Gerecse Mountains, Hungary
	Gradstein	1976, 1978	Grand Banks, Canada
	Gorbachik and Kuznetsova	1983	[taxonomic discussion]
	Bignot and Janin	1984	Normandy, France
	Kasimova and Aliyeva	1984	Azerbaijan, FSU
5	Baumgartner	1985	Argolis Peninsula, Greece
	Stam	1986	Lusitanian Basin, Portugal
	Gorbachik	1986	Central Dagestan, FSU
	Giovagnoli and Schiavinotto	1986, 1987a,b, 1991	Central Apennines, Italy
	Wernli	1987	Rif, Morocco
3	Martire	1996	Altopiano di Asigo, Italy
4	Wernli and Görög	1999, 2000	Somhegy, Hungary
	Wernli and Görög	2007	South Jura Mountains, France
	Sebane *et al.*	2002	Atlas Mountains, Algeria
	Apthorpe	2002, 2003	Offshore NW Australia

Table 1. Data used in the construction of the Bajocian palaeobiogeographical map.

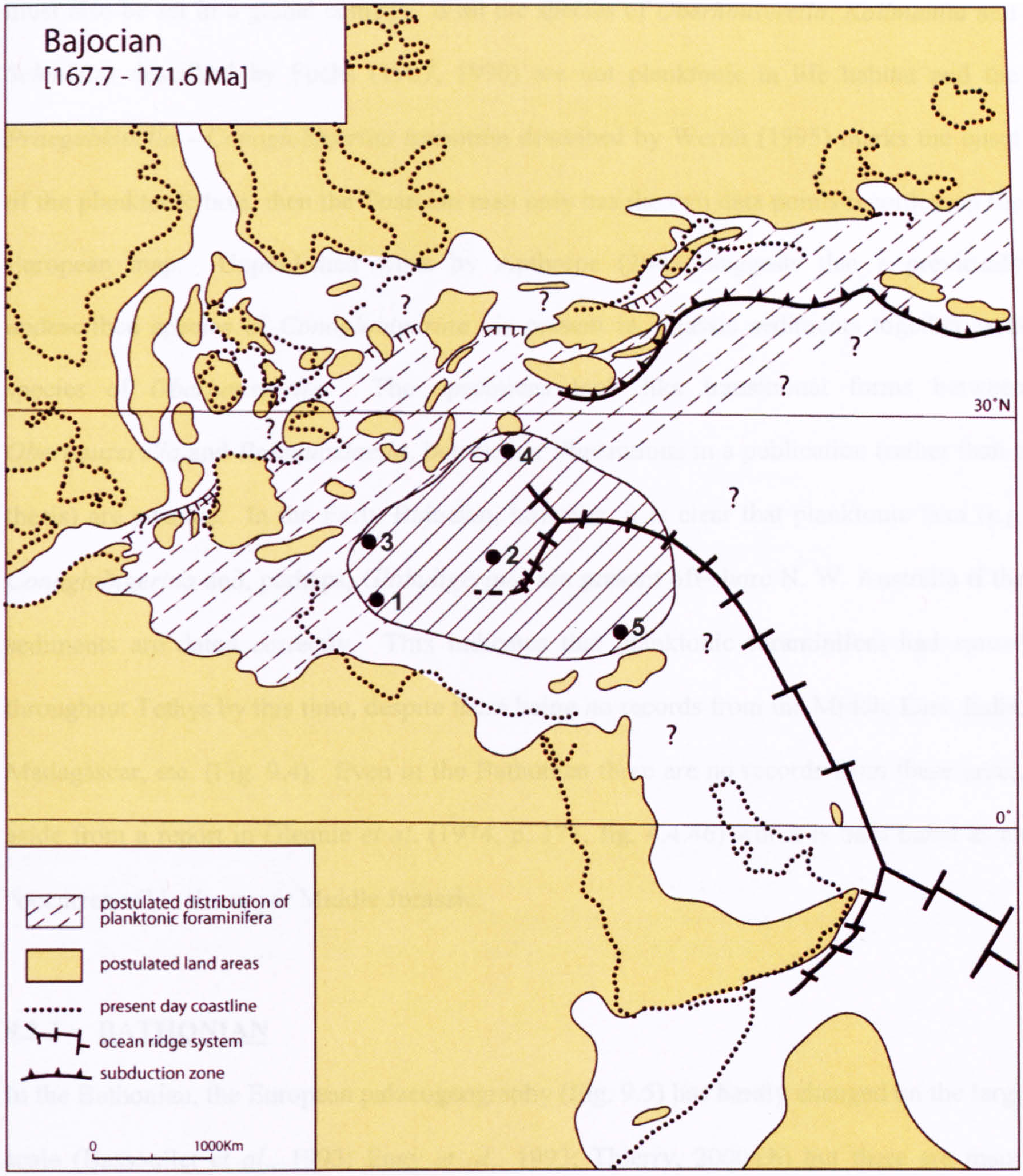


Figure 9.3. Bajocian palaeogeography of Peri-Tethys (after Bassoullet *et al.*, 1993; Thierry, 2000a,b). The inner area shows the distribution of the planktonic foraminifera with thickened tests. 1 = Sicily (Gianotti, 1958); 2 = Dinarides (Radiočić, 1966, 1996); 3 = N. Italy (Cita, 1965; Martire, 1996); 4 = Somhegy, N.W. Hungary (Wernli and Görög, 1999, 2000); 5 = Peloponnesus, Greece (Baumgartner, 1985).

must also be set in a global context. If all the species of *Oberhauserella*, *Kollmanita* and *Schmidita* described by Fuchs (1967, 1970) are not planktonic in life habitat and the *Praegubkinella* - *Conoglobigerina* transition described by Wernli (1995) marks the onset of the planktonic taxa, then the Toarcian map only has the two data points recorded on the European map. Unpublished work by Apthorpe (2003) suggests that a previously undescribed species of *Conoglobigerina* is present in Triassic sediments together with species of *Oberhauserella.* The specimens look like transitional forms between *Oberhauserella* and *Praegubkinella*, but further illustrations in a publication (rather than a thesis) are awaited. In the Early Bajocian, however, it is clear that planktonic taxa (e.g. *Conoglobigerina* and, perhaps, *Globuligerina*) are present off-shore N. W. Australia if the sediments are dated correctly. This indicates that planktonic foraminifera had spread throughout Tethys by this time, despite there being no records from the Middle East, India, Madagascar, etc. (Fig. 9.4). Even in the Bathonian there are no records from these areas, aside from a report in Glennie *et al.* (1974, p. 171, fig. 4.4.46) which is only listed as an "occurrence" in the upper Middle Jurassic.

9.2.3 BATHONIAN

In the Bathonian, the European palaeogeography (Fig. 9.5) has hardly changed on the large scale (Bassoullet *et al.*, 1993; Enay *et al.*, 1993; Thierry, 2000a,b) but there are many additional records of planktonic foraminifera (e.g. Terquem, 1886, Colom, 1947, 1955; Zanmatti-Scarpa, 1957; Gianotti, 1958; Hofman, 1958; Leischner, 1959; Wall, 1960; Pazdrowa, 1960, 1967, 1969; Tamajo, 1960; Szulczewski, 1963a,b; Colom and Rangheard, 1966; Sidó, 1966; Bismuth *et al.*, 1967; Bars and Ohm, 1968; Borza, 1969; Wendt, 1969b; Ascoli, 1976; Masters, 1977; Bielecka *et al.*, 1980; Alekseeva and Gorbachik, 1981; Kuznetsova *et al.*, 1996; Hudson *et al.*, 2005). Despite this further expansion of the fauna, there are only thin-walled taxa recorded. This is surprising in that the same deeper-water areas still existed in the Western Tethys.

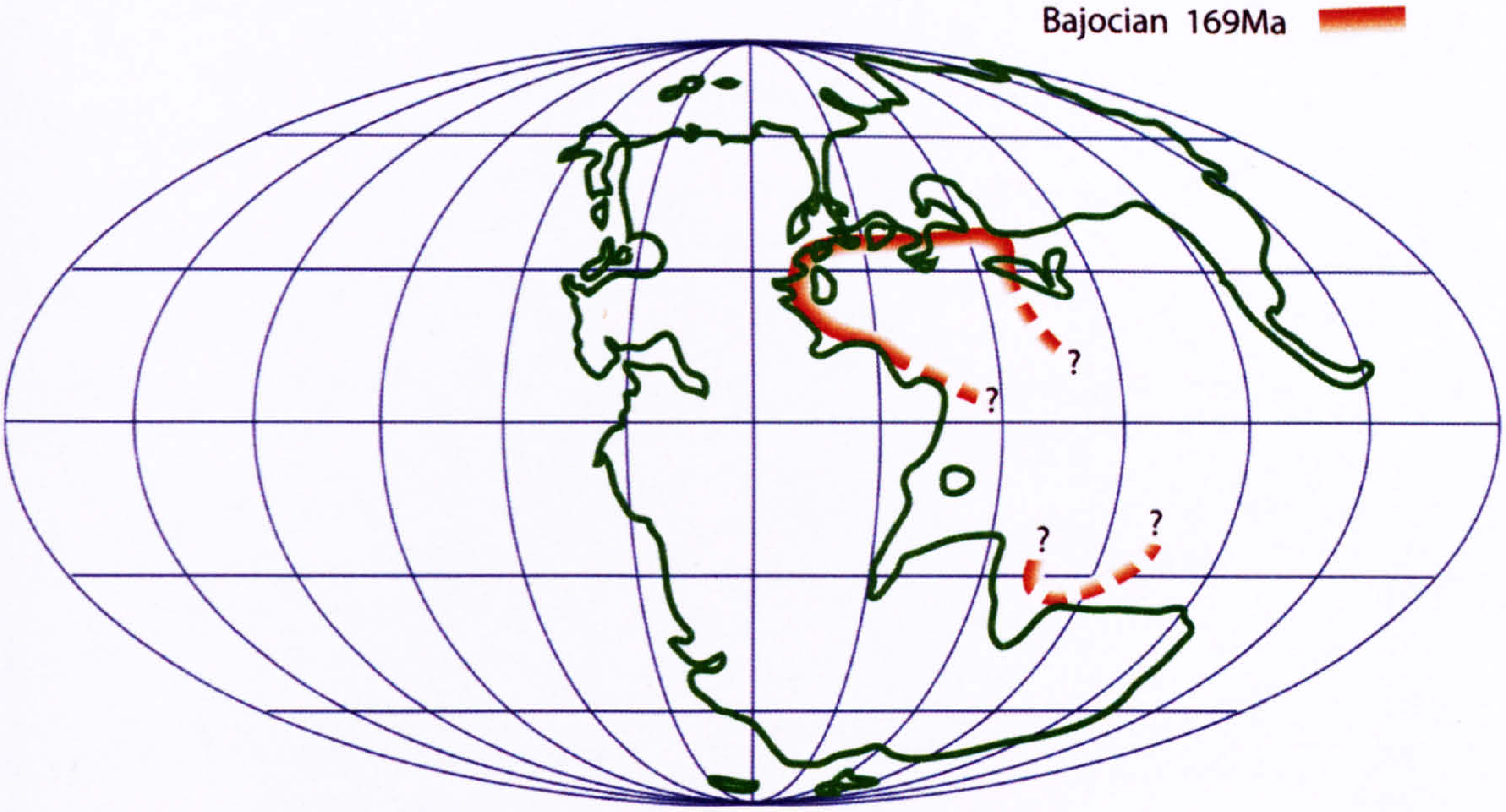


Figure 9.4. Bajocian distribution of planktonic foraminifera (map after Smith *et al.*, 1994). The details of the Western Tethys distribution are shown in Figure 9.3. No records of planktonic foraminifera are known from the Atlantic Ocean (Fuerteventura, Mexico, etc.) or the Far East, China and Japan. In the Southern Tethys, no planktonic taxa have been recorded from the Middle East, Madagascar, India (including Rajasthan) and Nepal. The only record is in the very north-western corner of the Carnarvon Basin in Australia (Apthorpe, 2002, 2003). No other localities are known in Australia, despite well-exposed Middle Jurassic strata being known near Geraldton, Western Australia.

	AUTHORS	DATES	LOCATIONS
	Terquem	1986	Southern Poland
	Colom	1947	Balearic Islands, Spain
	Colom	1955	Western Mediterranean
	Zanmatti-Scarpa	1957	Brescia, Italy
	Gianotti	1958	Sicily, Italy
	Hofman	1958	Crimea, Ukraine, FSU
	Leischner	1959	Salzburg Alps, Austria
	Wall	1960	Canada
	Pazdrowa	1960, 1967, 1969	Ogrodzieniec, Poland
	Tamajo	1960	Sicily, Italy
	Szulczewski	1963a,b	Tatra Mountains, S Poland
	Colom and Rangheard	1966	Ibiza, Mallorca, Spain
	Sidó	1966	Zengörvarkony, Hungary
	Bismuth *et al.*	1967	Northern Tunisia
	Bars and Ohm	1968	Central Italy
	Borza	1969	Western Carpathians, Slovakia
	Wendt	1969	Austria and Bavaria
	Glennie *et al.*	1974	Middle East [poor age control]
	Ascoli	1976	Scotian Shelf, Canada
	Masters	1977	[taxonomic discussion and maps]
	Bielecka *et al.*	1980	Southern Poland
	Alekseeva and Gorbachik	1981	[taxonomic discussion]
	Kuznetsova *et al.*	1996	Eastern Mediterranean
	Hudson *et al.*	2005	Pieniny Klippen Belt, Poland

Table 2. Additonal data used in the construction of the Bathonian palaeobiogeographical map.

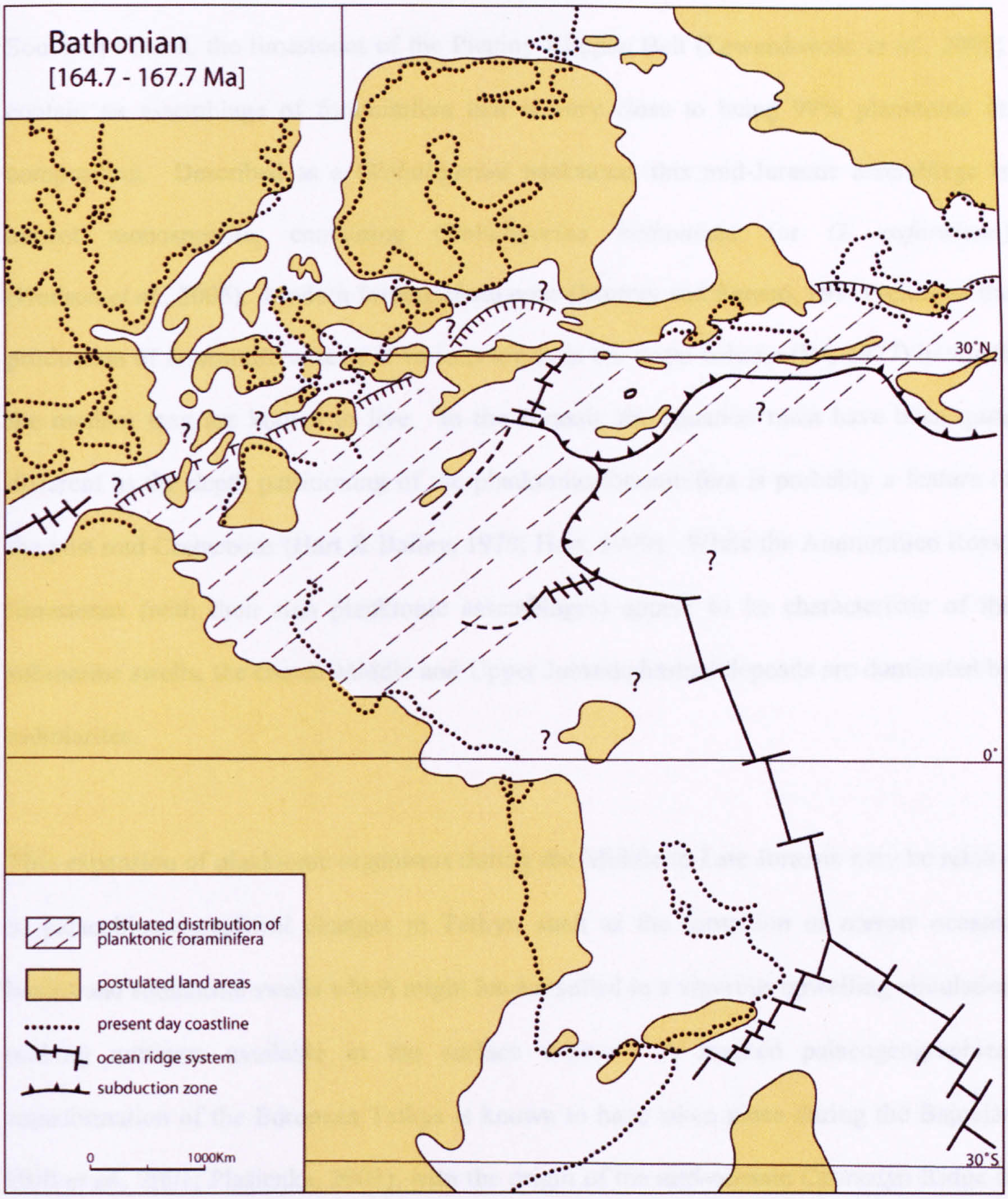


Figure 9.5. Bathonian palaeogeography of Peri-Tethys (after Bassoullet *et al.*,1993; Enay *et al.*, 1993; Thierry, 2000a,b).

In the Czorsztyn Limestone Formation (Birkenmajer, 1963; Hudson *et al.*, 2005) of Southern Poland, the limestones of the Pieniny Klippen Belt (Lewandowski *et al.*, 2005) contain an assemblage of foraminifera that is very close to being 99% planktonic in composition. Described as a *Globuligerina* packstone, this mid-Jurassic assemblage is almost monospecific, containing *Globuligerina bathoniana* (or *G. oxfordiana*) (Hudson *et al.*, 2005). Modern foraminiferal ooze (Murray and Renard, 1891) relies on the production of foraminiferal tests at various levels in the water column (Bé, 1977) in which the modern taxa are known to live. In the Jurassic the situation must have been quite different as the depth partitioning of the planktonic foraminifera is probably a feature of the post mid-Cretaceous (Hart & Bailey, 1979; Hart, 1999). While the Ammonitico Rosso limestones (with their rich planktonic assemblages) appear to be characteristic of the submarine swells, the coeval Middle and Upper Jurassic basinal deposits are dominated by radiolarites.

This expansion of planktonic organisms during the Middle to Late Jurassic may be related to palaeobiogeographical changes in Tethys, such as the formation of narrow oceanic basins and submarine swells which might have resulted in a vigorous upwelling circulation making nutrients available in the surface waters. A marked palaeogeographical transformation of the European Tethys is known to have taken place during the Bajocian (Bill *et al.*, 2001; Plašienka, 2003), with the origin of the mid-oceanic Czorsztyn Ridge in the Pieniny Klippen Basin during the Early Bajocian (Krobicki and Wierzbowski, 2004).

9.2.4 CALLOVIAN

By the Callovian (Fig. 9.6), the European and World maps are again relatively unchanged (aside from detailed issues of local palaeogeography) and the base map is provided by Enay *et al.* (1993) and Theirry (2000b). New records of planktonic foraminifera are provided by Bartenstein and Brand (1937), Mosna (1963), Farinacci and

	AUTHORS	DATES	LOCATIONS
	Bartenstein and Brand	1937	NW.Germany
	Mosna	1963	Southern Alps, N Italy
	Farinacci and Radiočić	1964	Central Italy and Dinarides
	Fuganti and Mosna	1965	Central Italy
	Busson	1967	Sahara, N Africa
	Mihailova-Ivočeva and Trifonova	1967	NE Bulgaria
	Grigelis	1975	[taxonomic discussion]
	Jansa *et al.*	1976	Grand Banks, Canada
	Munk	1978	Southern Germany
	Diersche	1980	Northern Calcareous Alps
	Kuznetsova and Uspenskaja	1980	Crimea, Ukraine, FSU
	Riegraf	1987a,b	SW Germany
	Kalia and Chowhury	1983	Rajasthan, India

Table 3. Additional data used in the construction of the Callovian palaeobiogeographical map.

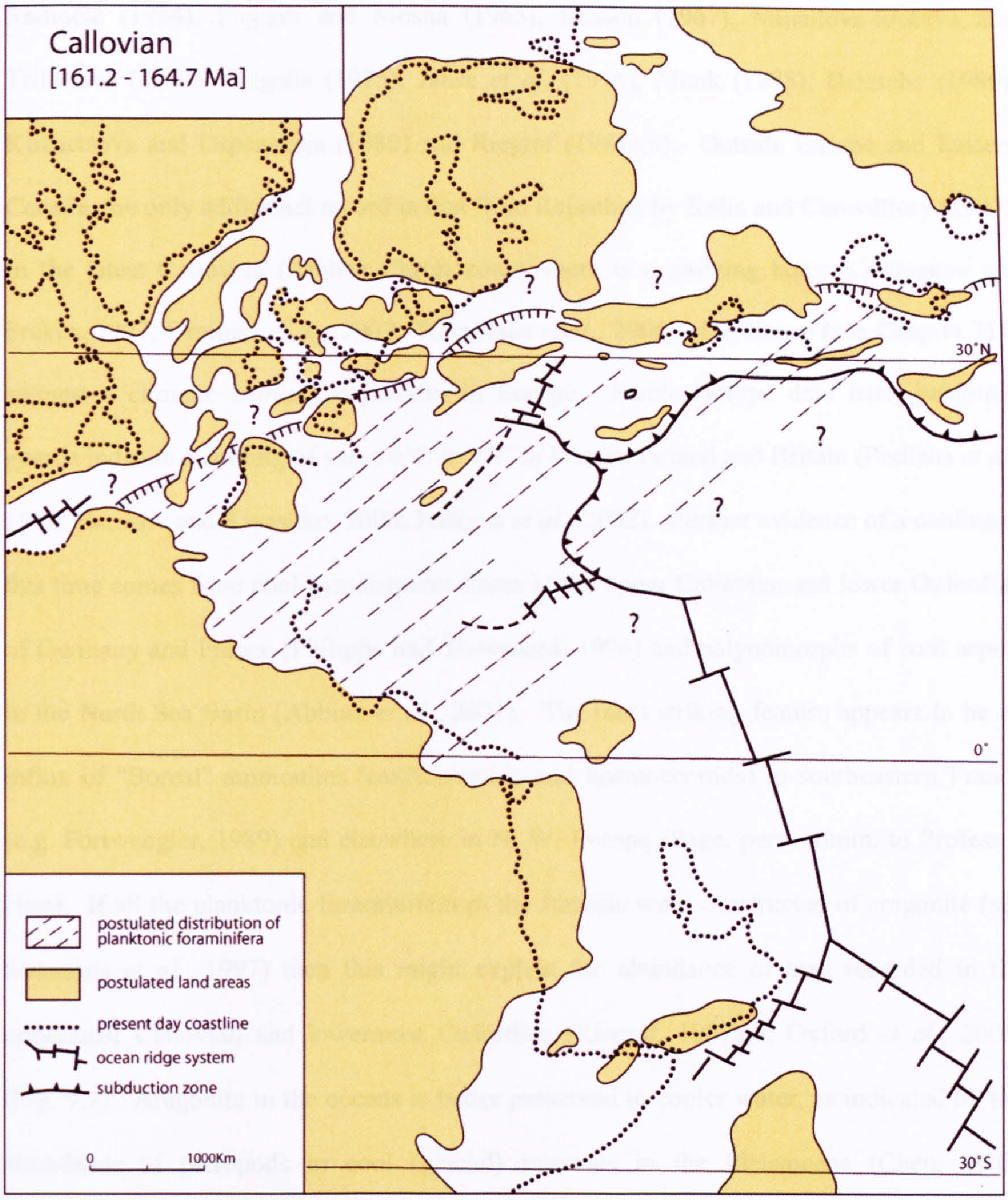


Figure 9.6. Callovian palaeogeography of Peri-Tethys (after Enay *et al.*, 1993; Norling and Grigelis, 1999; Thierry, 2000a,b).

Radiočić (1964), Fuganti and Mosna (1965), Busson (1967), Mihailova-lovčeva and Trifonova (1967), Grigelis (1975), Jansa *et al.* (1976), Munk (1978), Diersche (1980), Kuznetsova and Uspenskaja (1980) and Riegraf (1987a,b). Outside Europe and Eastern Canada, the only additional record is that from Rajasthan by Kalia and Chowdhury (1983). In the latest Callovian (Athleta Chronozone), there is a growing body (Chumakov and Frakes, 1997; Dromart *et al.*, 2003; Tremolada *et al.*, 2006) of evidence (see Chapter 7) to suggest a climatic cooling, especially in Europe. Stable isotope data from belemnite guards indicate a cooling of some 6°C to 7°C in Russia, Poland and Britain (Podlaha *et al.*, 1998; Barskov and Kiyashko, 2000; Jenkyns *et al.*, 2002). Further evidence of a cooling at this time comes from cool gymnosperm floras in the upper Callovian and lower Oxfordian of Germany and France (Philippe and Thevenard, 1996) and palynomorphs of cool aspect in the North Sea Basin (Abbink *et al.*, 2001). The most striking feature appears to be an influx of "Boreal" ammonites (cardioceratids and kosmoceratids) in southeastern France (e.g. Fortwengler, 1989) and elsewhere in N. W. Europe (Page, pers. comm. to Professor Hart). If all the planktonic foraminifera in the Jurassic were constructed of aragonite (see Simmons *et al.*, 1997) then this might explain the abundance of taxa recorded in the uppermost Callovian and lowermost Oxfordian (Riegraf, 1987a,b; Oxford *et al.*, 2002) (Fig. 9.7). Aragonite in the oceans is better preserved in cooler water, as indicated by the abundance of pteropods in cool (glacial) intervals in the Pleistocene (Chen, 1968; Gardulski *et al.*, 1990; Wang *et al.*, 1997).

9.2.5 OXFORDIAN

The earliest Oxfordian is, as noted above, marked by a widespread "flood" of planktonic foraminifera across N. W. Europe (Figs 9.8, 9.9). In addition to reports already listed for previous Jurassic stages, new information is provided by Haeusler (1881a,b), Colom (1935, 1955, 1969), Dufaure (1958), Grigelis (1958, 1974, 1975), Ruggieri (1959), Seibold and Seibold (1960a), Fernet (1960), Delcey-Leduc (1961), Magne and Mascle (1962),

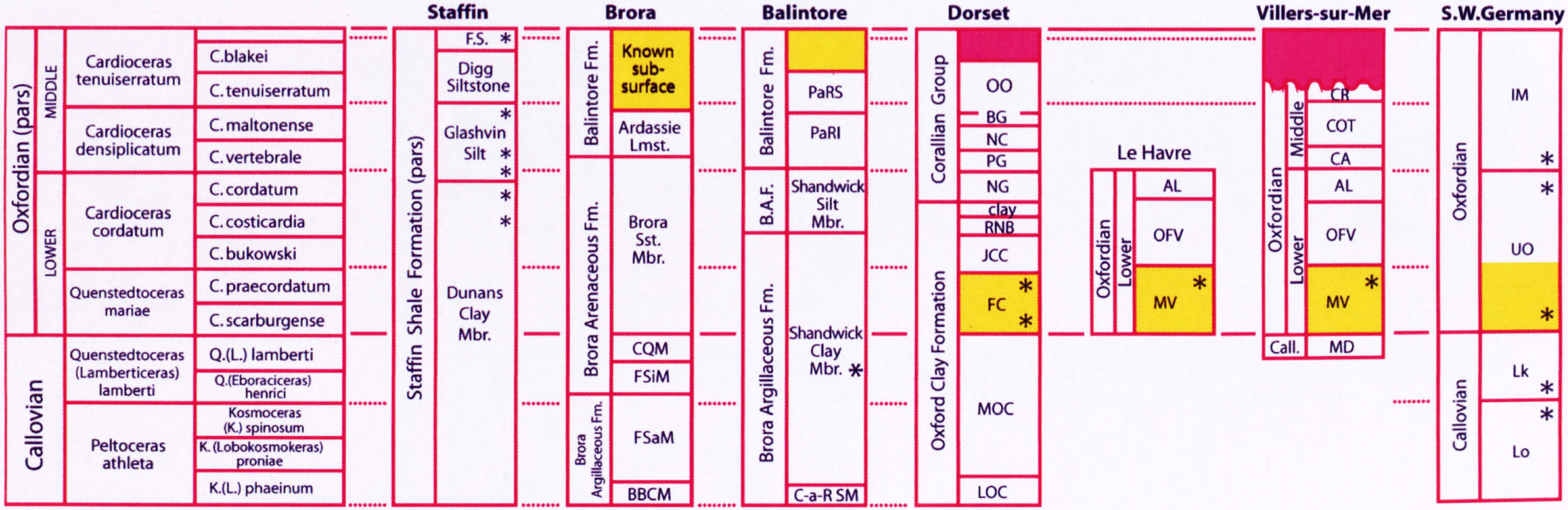


Figure 9.7. The uppermost Callovian to Middle Oxfordian succession and occurrences of planktonic foraminifera (indicated by *) after Oxford *et al.* (2002) and the information on S.W. Germany provided by Riegraf (1987a).

	AUTHORS	DATES	LOCATIONS
	Haeusler	1881a,b, 1890	N Switzerland
	Colom	1935	Mallorca, Balearic Islands
	Colom	1955	Western Mediterranean
	Colom	1969	Spain
	Dufaure	1958	Aquitaine and Provence, France
	Grigelis	1958	Crimea and Lithuania, FSU
	Grigelis	1974, 1975	Lithuania, FSU
	Ruggieri	1959	Central Apennines, Italy
	Siebold and Siebold	1960	Southern Germany
	Fernet	1960	Charente, France
	Decley-Leduc	1961	Ardeche, France
	Magné and Mascle	1962	Jura, France
	Fourcade	1963	Aquitaine, France
	Manivit	1964	Isère, France
	Bignot and Guyader	1966, 1971	Seine Maritime and Normandy, France
	Misik	1966	Western Carpathians
	Premoli Silva	1966	Crimea, FSU
	Beaudoin	1967	France
	Bonnefous	1967	Northern and Central Tunisia
	Fenninger and Holzer	1972	Salzburg Alps, Austria
	Fuchs	1973	Ogrodzieniec, Poland
	Renz *et al.*	1975	Continental Slope, Morocco
	Dragastan *et al.*	1975	Moësian Platform, Romania
	Grigelis *et al.*	1977	Pechora Basin, Russia
	Grigelis and Gorbachik	1980	[systematic discussion]
	Farinacci *et al.*	1981	Central Apennines, Italy
	Gradstein	1983	Portugal, Blake-Bahama Basin, Grand Banks (Canada)
	Jansa *et al.*	1984	Off-shore Morocco
	Wernli and Kindler	1986	Haute Savoie, France
	Grigelis and Norling	1999	Lithuania, Baltic Sea
	Oxford *et al.*	2002	Dorset Coast, GB
	Maria del Carmen Rosales Dominguez	pers. comm.	Campeche Basin, off-shore Mexico

Table 4. Additional data used in the construction of the Early Oxfordian palaeobiogeographical map.

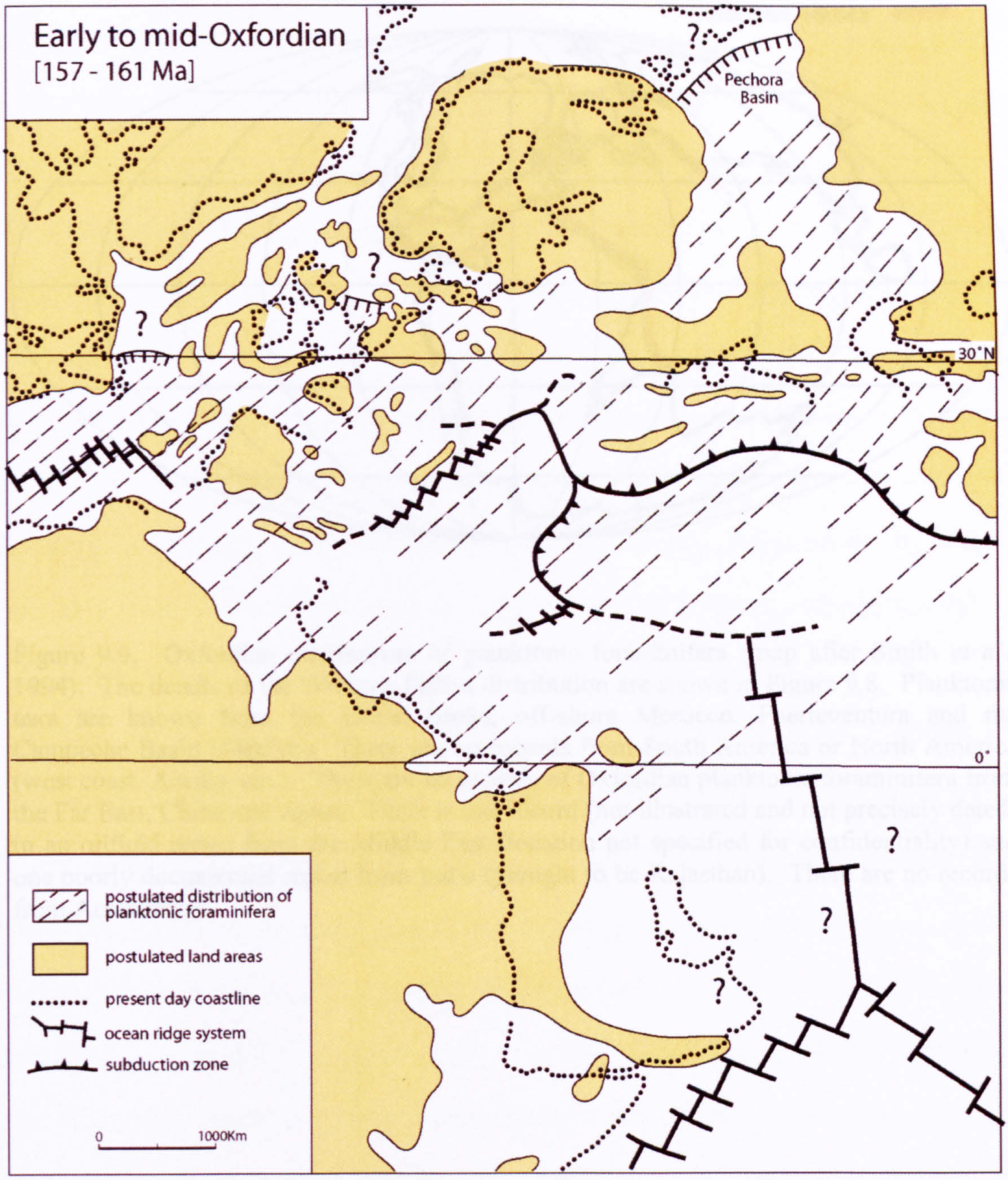


Figure 9.8. Oxfordian palaeogeography of Peri-Tethys (after Enay *et al.*, 1993; Norling and Grigelis, 1999; Thierry, 2000b,c).

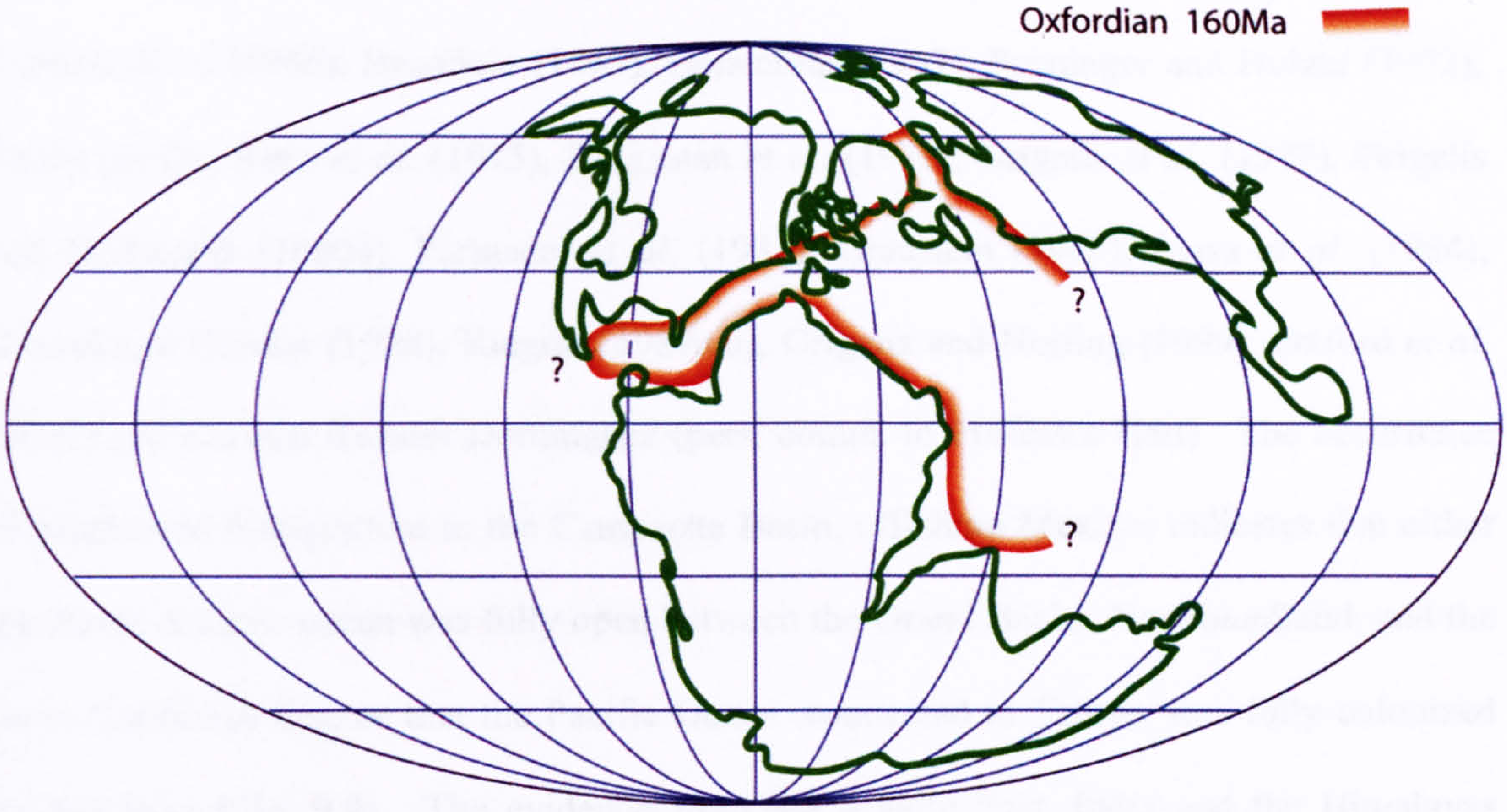


Figure 9.9. Oxfordian distribution of planktonic foraminifera (map after Smith *et al.*, 1994). The details of the Western Tethys distribution are shown in Figure 9.8. Planktonic taxa are known from the Grand banks, off-shore Morocco, Fuerteventura and the Campeche Basin (Mexico). There are no records from South America or North America (west coast, Alaska, etc.). There are no records of Oxfordian planktonic foraminifera from the Far East, China and Japan. There is one record (not illustrated and not precisely dated) in an oilfield report from the Middle East (location not specified for confidentiality) and one poorly documented report from India (thought to be Rajasthan). There are no records from Australasia.

Fourcade (1963), Manivit (1964), Bignot and Guyader (1966, 1971), Mišík (1966), Premoli Silva (1966), Beaudoin (1967), Bonnefous (1967), Fenninger and Holzer (1972), Fuchs (1973), Renz *et al.* (1975), Dragastan *et al.* (1975), Grigelis *et al.* (1977), Grigelis and Gorbachik (1980a), Farinacci *et al.* (1981), Gradstein (1983), Jansa *et al.* (1984), Wernli and Kindler (1986), Riegraf (1987a,b), Grigelis and Norling (1999), Oxford *et al.* (2002) and Carmen Rosales Dominguez (pers. comm. to Professor Hart). The occurrence of planktonic foraminifera in the Campeche Basin, off-shore Mexico, indicates that either the North Atlantic ocean was fully open between the Grand Banks, Newfoundland, and the proto-Caribbean Sea, or that the Pacific Ocean ,connected to Tethys, was fully colonized by this time (Fig. 9.9). The evidence from the Middle East, India and the Himalayas (Gradstein *et al.*, 1989) for such a widespread distribution is, however, currently lacking.

The mid-Late Jurassic fauna is dominated, at least in the literature, by *Globuligerina oxfordiana.* This may be an artefact of misidentification or else it may be a genuine belief (e.g. Riegraf, 1987a, p. 192) that many other taxa are synonymous with this taxon. The separation of *Conoglobigerina* and *Globuligerina* is equivocal, being based almost exclusively on the shape of the aperture (Simmons *et al.*, 1997). Forms with a really prominent loop-shaped aperture (Simmons *et al.*, 1997, pl. 2.9, figs 7, 10, 13-15) are quite rare and even the author of the taxon (Grigelis) has recently illustrated specimens (Norling & Grigelis, 1999, pl. 5, figs 5, 6) with a more arch-shaped aperture more reminiscent of *Conoglobigerina.* The other members of the Late Jurassic fauna, *Haeuslerina* and *Compactogerina*, are also less well known and not used by all workers. In Britain, both genera associated with *G. oxfordiana* in the clays of the Mariae Chronozone (Fig. 9.7) were found on the Dorset Coast near Weymouth (Oxford *et al.*, 2002). *Compactogerina stellapolaris* is a species first described from the Pechora Basin (Fig. 9.8) and this may indicate that it is a cool, or cold, water indicator (Simmons *et al.*, 1997, p. 29).

9.2.6 LATE JURASSIC AND EARLY CRETACEOUS

Some of the Oxfordian records extend into the Kimmeridgian but there are fewer records of planktonic foraminifera at this level and in the overlying Tithonian (Görög and Wernli, 2004). None of these latest Jurassic records are outside the area recorded by the Oxfordian maps. Indeed a global map of the distribution of favusellids in the earliest Cretaceous (Fig. 9.10) shows no real extension to the distribution of planktonic taxa. It is only in the mid-Cretaceous (Fig. 9.11), with the fragmentation of Gondwana, that there is a major expansion of the planktonic foraminifera into the newly developing seaways (Hart, 2000; Hart *et al.*, 2002). By this time the planktonic foraminifera appear to have changed to the development of a calcareous test, rather than the aragonite tests which appear to characterise the Jurassic. This change in biomineralization has yet to be fully documented, but it may also explain the wider distribution of taxa as calcareous tests are much more preservable than those made of aragonite.

9.3 SUMMARY

The planktonic foraminifera appear to have first evolved on the shelf edge of the Western Tethys in the mid-Toarcian. This is after the extinction event in the latest Pliensbachian and earliest Toarcian (Hylton, 2000; Hylton & Hart, 2000) and just after the anoxic event in the Exartum Subzone, the sea level highstand and the $\delta^{13}C$ excursion. By the Bajocian, the planktonic foraminifera had migrated all around the Peri-Tethys area and, in the Bathonian, there is evidence of real abundance in the water column with deposition of the first “foraminiferal ooze”. By the Bajocian/Bathonian, there is evidence of migration as far as N.W. Australia but it may well be the Oxfordian before there is a global distribution in tropical palaeolatitudes. The major expansion of the planktonic foraminifera is mid-Cretaceous in age with the fragmentation of Gondwanaland and the colonisation of the full water column; as indicated by the development of a wide range of morphotypes (Hart & Bailey, 1979; Hart, 1999).

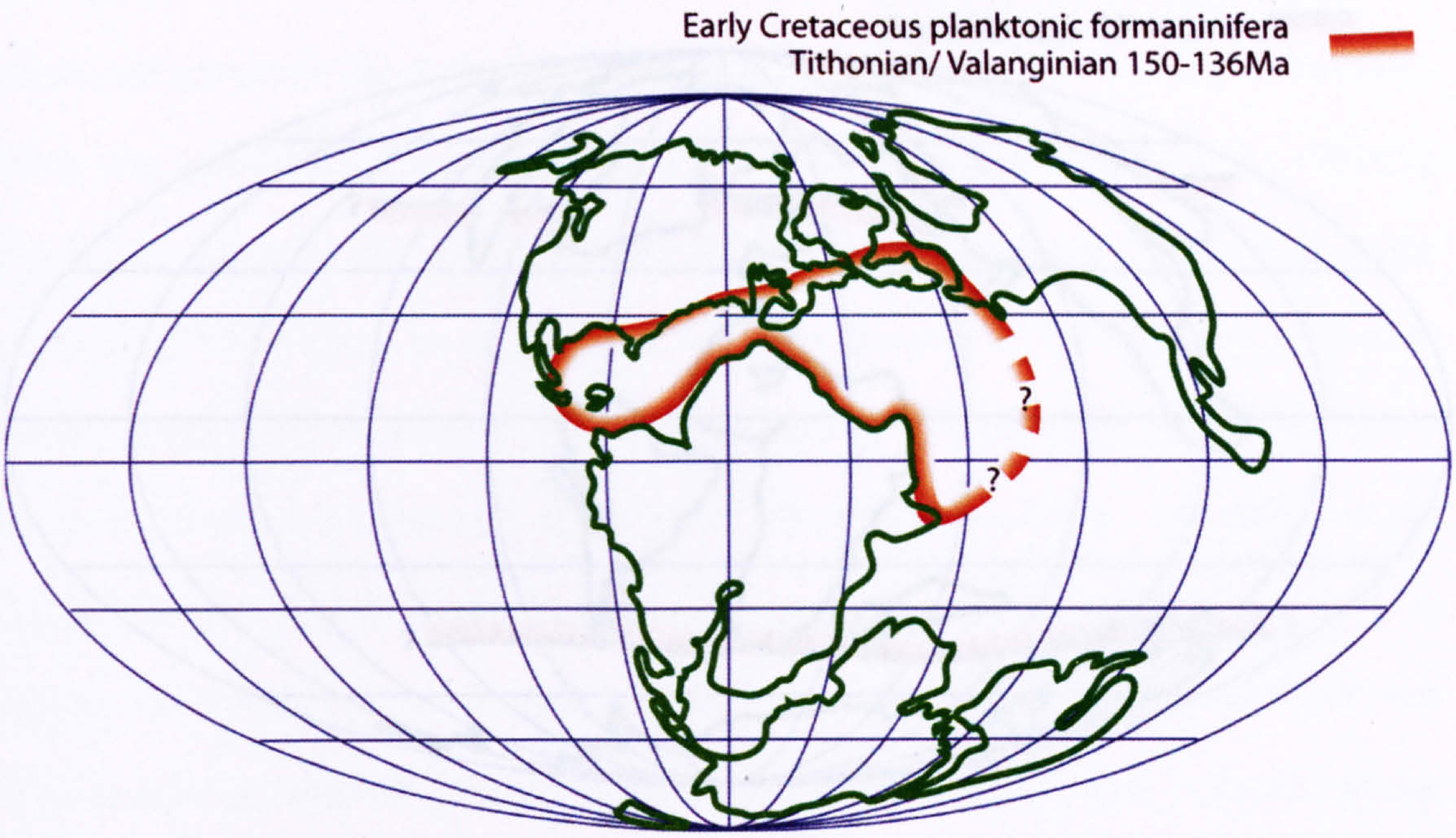


Figure 9.10. Distribution of planktonic foraminifera in the Tithonian-Valanginian interval (map after Smith *et al.*, 1994). The distribution of planktonic taxa is much restricted, as a result of lowered sea-level across the Jurassic/Cretaceous boundary. Planktonic taxa (especially Early Cretaceous forms) are known from the Gulf of Mexico and Texas, the Atlantic Ocean and the south of Europe (only Early Cretaceous). There are no records in the Eastern and Southern Tethys. Lowermost Cretaceous sediments in the Carnarvon Basin in western Australia have not yielded planktonic taxa (Hart, pers.comm.).

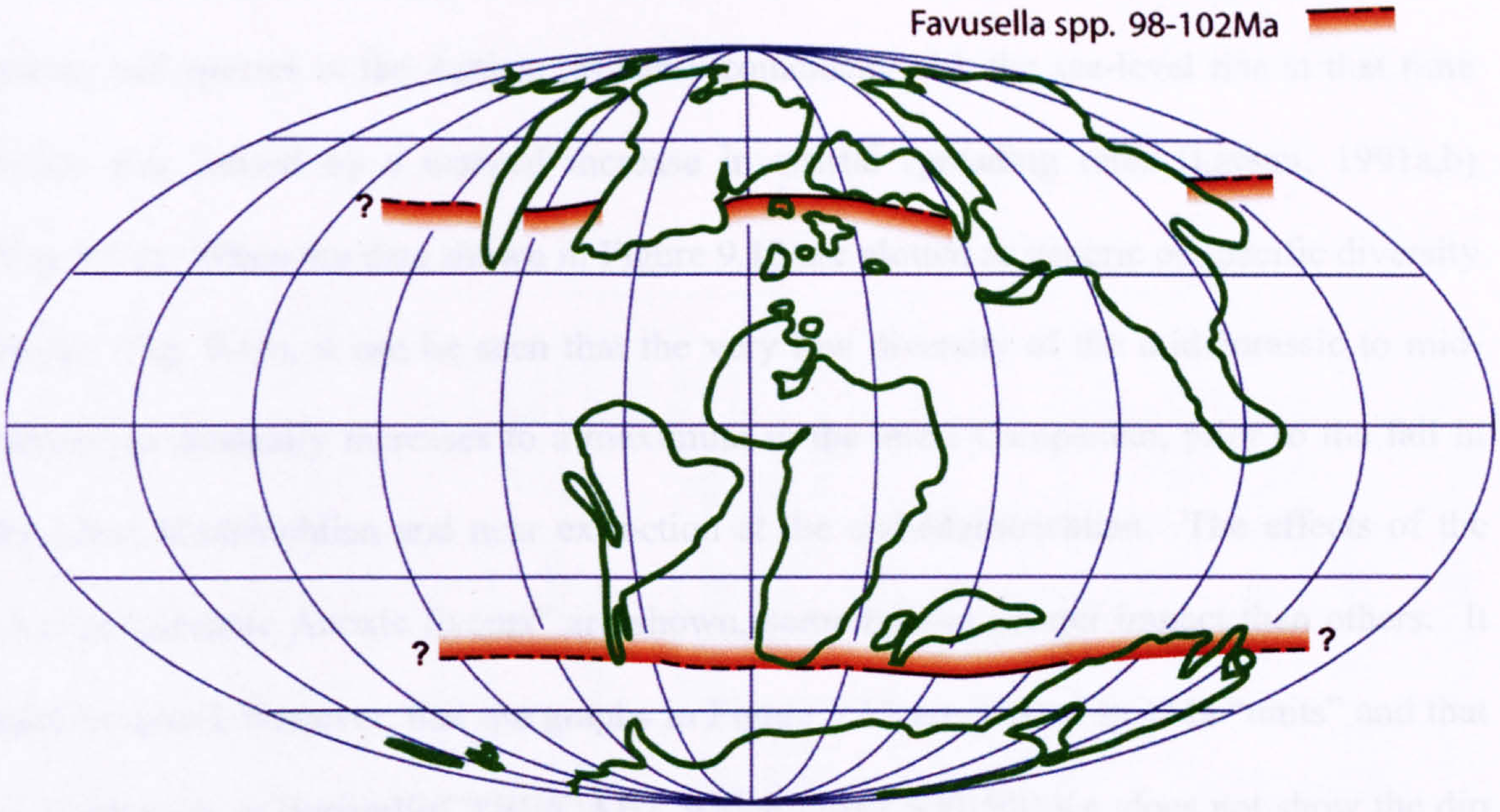


Figure 9.11. Distribution of favusellids in the mid-Cretaceous (map after Smith *et al*., 1994). Favusellids have an almost global distribution to about latitudes 40°N and 40°S (see Hart, 2000). Favusellids are known from the Falkland Plateau and South Atlantic Ocean but not from the Antarctic Peninsula. They are known from the Cauvary Basin (S.E. India) but not the Kerguelen Plateau. Favusellids are also recorded in the Carnarvon Basin in N.W. Australia. In the Northern Hemisphere, favusellids are known from Arizona but not Wyoming in the Western Interior Seaway. In Britain, favusellids are known as far north as The Wash and parts of the Southern North Sea Basin, as well as N. Germany, Poland and the Baltic Sea (Hano Bay).

This mid-Cretaceous change in diversity can be seen in Figure 9.12 with a proliferation of genera and species in the Aptian, probably coincident with the sea-level rise at that time which was caused by a marked increase in crustal spreading rates (Larson, 1991a,b) (Fig. 9.13). When the data shown in Figure 9.12 are plotted as generic or specific diversity graphs (Fig. 9.14), it can be seen that the very low diversity of the mid-Jurassic to mid-Barremian gradually increases to a maximum in the latest Campanian, prior to the fall in the latest Maastrichtian and near extinction at the end-Maastrichtian. The effects of the various "Oceanic Anoxic Events" are shown, some having greater impact than others. It must be noted, however, that the graphs in Figure 9.13 are plotted in 1Ma "units" and that an event such as Bonarelli/CTBE/OAE2, which lasted 300-500 Ka, does not show the dip in diversity recorded by the extinctions before the recovery of the new taxa almost make it look like a non-event.

The fragmentation of Gondwanaland recorded in the Aptian (S. America from Africa, India from Africa, Antarctica from India) clearly provided new migration corridors and a range of new environments to colonize. The drop in diversity in the Albian has been attributed to anoxia (Breheret *et al.*, 1989) or, perhaps, glacial conditions in Antarctica (Price, 1999).

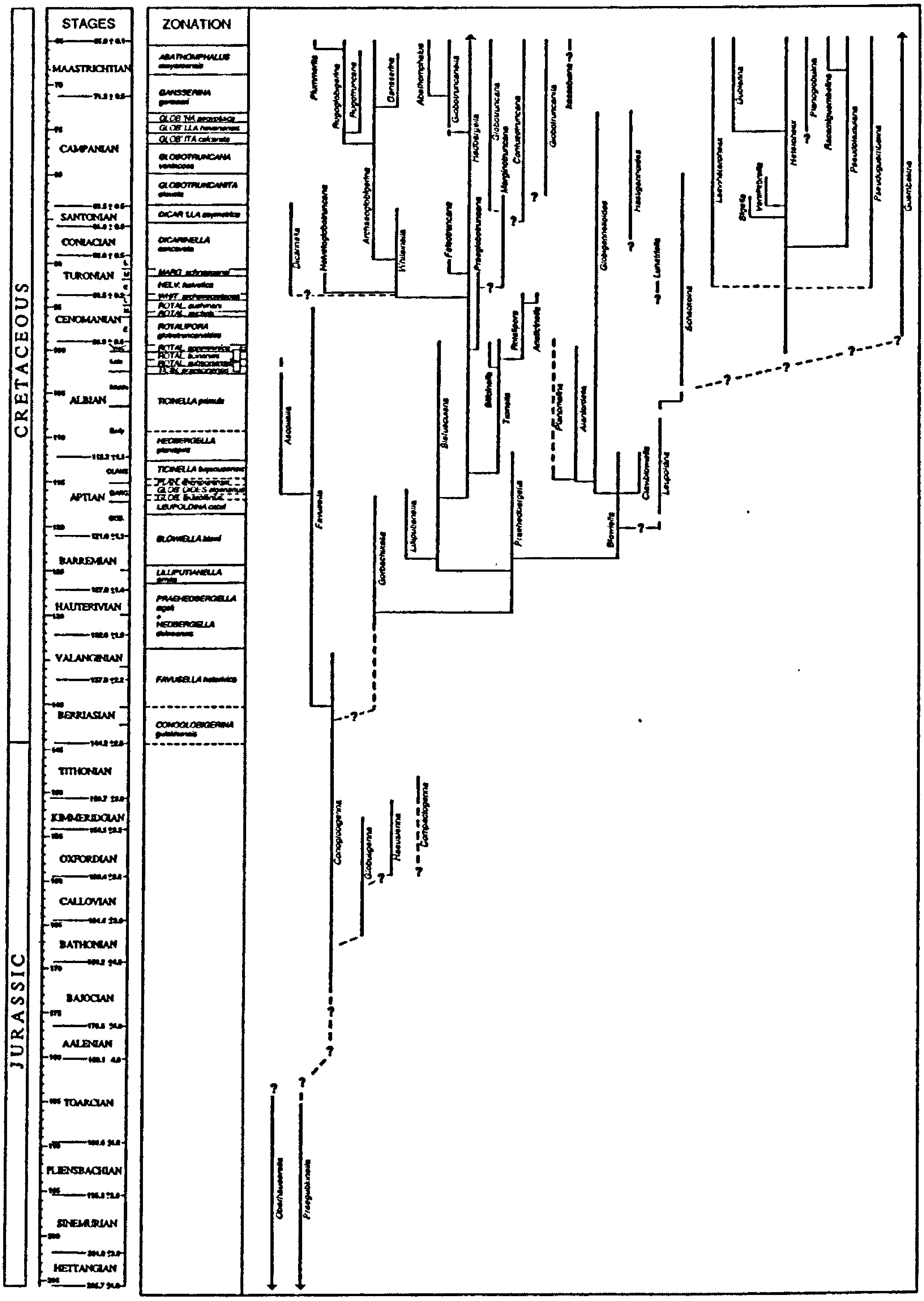


Figure 9.12. Generic evolution of the Jurassic and Cretaceous foraminifera (Hart *et al.*, partly after Hart, 1999).

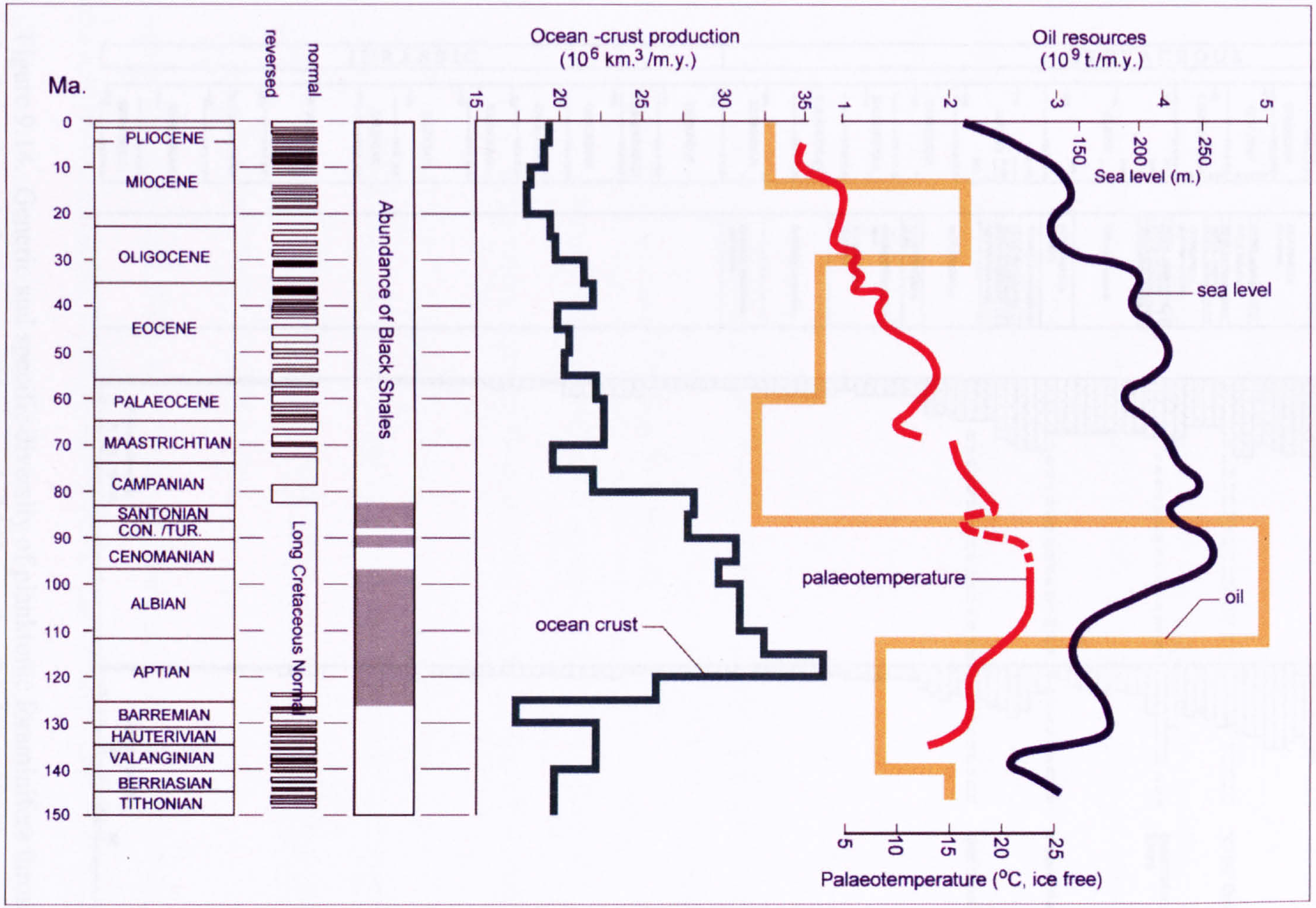


Figure 9.13. Integrated analysis of Mesozoic and Cenozoic magnetostratigraphy (Harland *et al.*, 1990), ocean crust production (Larson, 1991a), sea surface palaeotemperatures (Savin, 1977; Arthur *et al*, 1985), sea-level changes (Haq *et al.*, 1988), black shale deposition (Jenkyns, 1980) and world oil resources (Irving *et al.*, 1974; Tissot, 1979) (Kauffman and Hart, 1996, modified from Larson, 1991a and Larson *et al.*,1993).

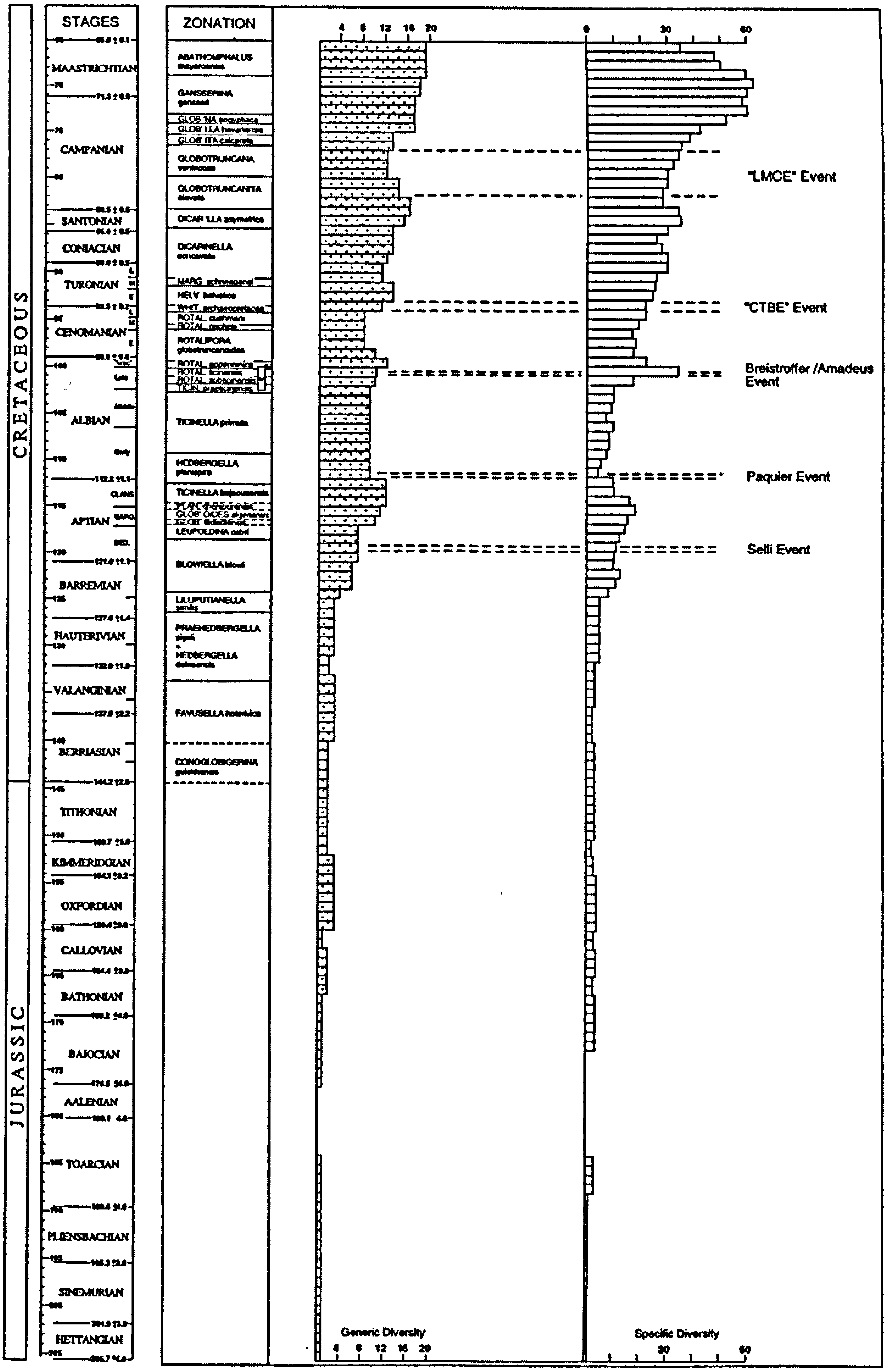


Figure 9.14. Generic and specific diversity of planktonic foraminifera throughout the Jurassic and Cretaceous (Hart *et al.*, 2002, partly after Hart, 1999).

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CHAPTER 10

SUMMARY

10.1 CONCLUSIONS

In 1997 Simmons *et al.* summarised the state of knowledge of the planktonic foraminifera in the Jurassic. Their work was primarily taxonomic and they gathered together a major collection of images of holotypes, paratypes and topotypes to illustrate their views. They re-defined *Conoglobigerina* and *Globuligerina* and created *Haeuslerina* and *Compactogerina*.

Since that book was written (1995/96) there have been a number of major advances:

- important faunas discovered in Southern Poland;
- planktonic foraminifera discovered in the Jurassic strata of the British Isles;
- planktonic foraminifera reported from Mexico, Fuertaventura, Greece and Australia; and
- more detailed work on assemblages of planktonic foraminifera, prepared using the acetic acid reduction method, has been completed on Tethyan limestones that were previously only described in thin section.

It is now known that all of the new species of Oberhauser (1960) and Fuchs (1967, 1970) described from Austria and Northern Italy were almost certainly benthonic in life habit and that the transition from *Oberhauserella* to *Praegubkinella* appears to be the most likely route to the planktonic foraminifera. Changes to this lineage appear to closely follow the Falciferum Zone in the Toarcian and an association with the Toarcian anoxic event is a possibility. There is no certainty that the inflated *Praegubkinella* in the latest Toarcian were planktonic but it is a possibility. If the transition from *Praegubkinella* to *Conoglobigerina* occurred in the latest Toarcian, then it seems plausible that it occurred in the centre of Western Tethys, although only two data points are barely conclusive (Teysachaux, Switzerland and Taurus Mountains, Turkey). If this is true, then the planktonic foraminifera would be one of the few faunal groups where a point of origin can be defined.

What is certain is that within 2 to 3 Ma, in the Bajocian, the planktonic foraminifera had colonised the whole of Western Tethys. This rapid expansion probably indicates a planktonic mode of life and it is clear that, by the Bajocian, a typical, almost "globigerine" morphology had been established. This morphology was quite variable in terms of spire height and the shape/position of the aperture. The latter is quite important as Simmons *et al.* (1997) used the presence of an arch-shaped aperture (*Conoglobigerina*) or a loop-shaped aperture (*Globuligerina*) to identify the two key genera of the Jurassic System. It is certainly the case that some *Globuligerina* possess a markedly loop-shaped aperture with a distinct rim (Simmons *et al.*, 1997, pl. 2.9, figs 7, 10) while other *Globuligerina* have a less pronounced "loop" (Simmons *et al.*, 1997, pl. 2.9, figs 13-15). In her illustrations of *Globigerina bathoniana*, Pazdrowa (1969) illustrated a range of forms, several of which have an arch-shaped aperture, but one of which has a distinctly loop-shaped aperture with a distinct rim. In the same two plates Pazdrowa illustrated a range of spire heights from an almost flat trochospire to forms that have 2.5 whorls of chambers arranged in a very high spire, some quite pointed while others are more bulbous and inflated. Whilst holotypes and paratypes are very important, there are few works in which there has been a systematic treatment of populations.

In the *Globuligerina* microfacies of Southern Poland, the first real foraminiferal packstone with a Jurassic analogue of the modern day "foraminiferal ooze" is seen. This signals, probably for the first time, the development of sea floor accumulations of planktonic foraminiferid tests and the development of a modern, carbonate driven plankton, that was potentially capable of creating and maintaining the Aragonite and Carbonate Compensation Depths, together with their associated lysoclines. The depths of the ACD and CCD are almost impossible to calculate but they appear to have been much shallower than the present day. This event, or series of events, may be one of the most important milestones in the development of the Mesozoic oceans and further locations with this fauna are awaited.

By the Callovian-Oxfordian, the planktonic foraminifera may have had an almost global distribution in the tropics, although data points outside Tethys/Peri-Tethys are rare (Mexico, Middle East, India, etc.). Of concern is the near lack of information between the mid-Oxfordian and the Valanginian and Hauterivian. If this interval marks the transition from aragonite tests to calcite tests, it is doubly important that more assemblages from this interval are studied. Marine successions through this interval are rare and it is clear that more sections should be found, if at all possible (e.g. Fuerteventura, Middle East, Himalaya, etc.).

10.2 FUTURE RESEARCH DIRECTIONS

Further research is required in order to:

- create a standardized taxonomy;

- establish well-defined stratigraphical ranges;
- fill in gaps in the record for the remaining periods of the Jurassic and especially the Jurassic – Cretaceous transition;
- evaluate the taxonomic significance of consecutive and concurrent test construction;
- investigate further the relationship during the Jurassic between test thickness and water depth;
- refine the correlation between sea-level fluctuations and turnovers in other fauna including planktonic foraminifera; and
- further refine the predictions of water column stratification in the Jurassic and the position of the ACD and CCD.

10.3 EPILOGUE

"We have traced the steady development and growth of life from its hazy origin, and early manifestations, down the long corridors of time that lead to the present. It is a wonderful story, a history of millions upon millions of individuals, of millions of different species, through thousands of millions of years. There is nothing more breathtaking in the whole of human experience than the contemplation of this ceaseless cavalcade of living things, hovering between birth and death on the surface of our tiny planet. In an endless procession animals and plants have spread and multiplied and vanished, each for a fleeting moment a part of the continuing process we call life. But this outer view is only one facet of the mystery and wonder and beauty of it all, for within and through and around the bodies of each of these countless individuals there has pulsed the breath of life

– at a score of levels of complexity a bewildering maze of intricate chemical and physical and biological changes have interacted together to produce and maintain this frail thread of life which binds us all. But 'he who stops at the fact misses the glory', and if in the search for the pattern and process of its development we miss the wonder of life and fail to grasp its deep significance for our thinking, then we have missed the glory.

But the man who has caught a glimpse of life in this perspective can only see it as a thing of reverence and wonder. How life evolved we now begin to understand: that it evolved remains a source of wonder: why it evolved is not a question with which science as such is concerned, but it is a question that links the other two, and gives to the scientific quest a purpose and a harmony within the broader and deeper unity of human contemplation. And it is ultimately the question upon our answer to which we build the fabric of our own portion of the history of life." (Rhodes, 1962).

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APPENDIX I

CHRONOLOGY OF THE RECORDING OF "NEW" GENERA AND SPECIES, FOLLOWED BY THE OPINIONS OF SUBSEQUENT AUTHORS

CHRONOLOGY OF THE IDENTIFICATION OF TRIASSIC AND JURASSIC "PLANKTONIC" FORAMINIFERA

Authors	Date	Genus	Species	Location or Source	Age/Range	Referred to by	Date	Compared with
d'Orbigny	1826	*Globigerina*	***bulloides***		Bathonian - Recent	Pazdrowa	1969	*bathoniana*
Terquem & Berthelini	1875	*Globigerina*	***liasina***	E France	Late Pliensbachian	Pazdrowa *"not adequately described and illustrated... preserved only as internal moulds"*	1969	*bathoniana*
						Görög *"not adequately described and illustrated"*	1994	
Terquem	1883	*Globigerina*	***oolithica***	E France		Pazdrowa *"not adequately described and illustrated... preserved only as internal moulds"*	1969	*bathoniana*
Terquem	1883	*Globigerina*	***lobata***			Pazdrowa *"not adequately described and illustrated... preserved only as internal moulds"*	1969	*bathoniana*
Haeusler	1881a 1881b	*Globigerina*	*Helveto-jurassica*	Switzerland: no type locality Switzerland: Aargau-Buren Birmensdorfer Schichten, *Ammonites transversarius*	Oxfordian			*Helveto-jurassica*
	1890	*Globigerina*	*bulloides* var. *Helveto-jurassica*					*bulloides* *bulloides* var. *Helveto-jurassica*
Fariacci & Radoičić (thin-sections)	1964		*helvetojurassica?*	Yugoslavia	Bajocian	Fariacci & Radoičić	1964	*helvetojurassica?*
Radoičić (thin-sections)	1966					Radoičić	1966	
Oesterle	1968	*"Globigerina"*	*helvetojurassica*	Aargau: NW of Zurich, Birmensdorfer Schichten, Eisengraben section				
Oesterle	1969	*"Globigerina"*		Liesberg, Renggeri Tonen		Oesterle	1969	*"Globigerines"* *Trochamina*
Pazdrowa	1969	*Globigerina*				Pazdrowa	1969	*bathoniana*

Authors	Date	Genus	Species	Location or Source	Age/Range	Referred to by	Date	Compared with
Luterbacher (thin-sections)	1972	*Globigerina*		NW Atlantic				
Masters	1977	*Globigerina?*	*?hoterivica*	Birmensdorfer Schichten, Eisengraben section	Dogger-Malm border-Oxfordian	Masters	1977	*jurassica* *hoterivica* *Trochamina*
Stam	1986	*Globuligerina*	*oxfordiana*	Eisengraben Section Birmensdorfer Schichten, *Transverarium Zone* & (Forms assigned by Seibold & Seibold 1960)		Stam	1986	*oxfordiana*
Simmons *et al.*	1997	*Haeuslerina*						
Seibold & Seibold	1959	*Globigerina*	cf. *helveto-jurassica*	S. Germany	Dogger	Seibold & Seibold	1959	*Helveto-jurassica*
	1960	*?Globigerina*	cf. *helveto-jurassica*	S. Germany & Switzerland	Early Oxfordian		1960	*Helveto-jurassica*
Pazdrowa	1969	*Globigerina*				Pazdrowa	1969	*bathoniana*
Schick (thin-section)	**1903**	***"Globigerina"***	***"Globigerina"* sp.**	SW Germany	Earliest Jurassic	Seibold *"original slide seems to be lost"*	1966	
Riegraf	1986			SW Germany 1979-1984 (Schick's locality)		Riegraf *"no planktonic foraminifera; ?T/S of gastropod or juvenile ammonite"*	1986	
						Görög *"not adequately described and illustrated"*	1994	
Subbotina	**1953**	***Globigerina***	***hoterivica***		Mid-Bathonian-Mid-Aptian	Pazdrowa	1969	*jurassica* *bathoniana*
						Masters	1977	
Suleymanov	**1955**	***Gubkinella***						

Authors	Date	Genus	Species	Location or Source	Age/Range	Referred to by	Date	Compared with
Grigelis	1958	*Globigerina*	*oxfordiana* (holotype large form)	Lithuania nr Moscow, Upper Volga Basin Ethiopia, Le Havre Grand Banks-Newfoundland	Early Oxfordian	Bignot & Guyader	1966	
						Premoli Silva	1966	
Hofker	1969	*Trochammina*		(Forms assigned by Bignot & Guyader, Premoli Silva)		Hofker *"benthonic"*	1969	*Trochammina*
Pazdrowa	1969	*Globigerina*				Pazdrowa	1969	*bathoniana*
Bignot & Guyader	1971	*Globuligerina*						
Fuchs	1973		*oxfordiana* (large forms)					
Masters	1977	*Globigerina*		(Forms assigned by Grigelis, Premoli Silva Bignot & Guyader)		Masters	1977	*hoterivica*
Bignot & Janin	1984		oxfordiana (large forms)		Early Bajocian			
Gorbachik	1986	*Globuligerina*						
Stam	1986	*Globuligerina*			Middle Bajocian	Stam	1986	*stellapolaris*
Wernli & Kinder	1986	*Globuligerina*						
Riegraf	1987	*Globuligerina*			Middle Bajocian			
Banner & Desai	1988	*Globuligerina*						
Samson *et al.*	1992	*Globuligerina*						

Authors	Date	Genus	Species	Location or Source	Age/Range	Referred to by	Date	Compared with
Boudagher-Fadel *et al.*	1995	*Globuligerina*						
Simmons *et al.*	1997	*Globuligerina*						
Wernli & Görög	1999	*Globuligerina*		NW Hungary: Bakony Mts-Somhegy	late Early Bajocian-early Late Bajocian			
Wernli & Görög (thin-sections)	2000					Wernli & Görög	2000	*oxfordiana* *medium*
Görög & Wernli	2002	*Globuligerina*		NW Hungary: Bakony Mts-Gyenespuszta	Middle Bathonian-Late Bathonian	Görög & Wernli	2002	*aff. dagestanica*
"numerous authors"			*oxfordiana* (medium forms)					
Wernli & Görög	1999	*Globuligerina*		NW Hungary: Bakony Mts-Somhegy	latest Early Bajocian-early late Bajocian			
Wernli & Görög (thin-sections)	2000					Wernli & Görög	2000	*aff. dagestanica* *aff. bathoniana*
Görög & Wernli	2002	*Globuligerina*		NW Hungary: Bakony Mts-Gyenespuszta	Middle Bathonian-Late Bathonian	Görög & Wernli	2002	*bathoniana*
Gradstein	1983		*oxfordiana* (very small forms)					
Görög & Wernli	2002	*Globuligerina*		NW Hungary: Bakony Mts-Gyenespuszta	Middle Bathonian-Late Bathonian			
Hofman	**1958**	***Globigerina***	*jurassica*	SE Crimea	Bathonian-Early Callovian	Pazdrowa	1969	*bathoniana* *hoterivica*
Fuchs	1973	*Woletzina*		Poland	Late Callovian-Early Oxfordian			
Masters	1977	*Globigerina*	*?hoterivica*		Bathonian-Tithonian	Masters	1977	*avarica* *conica* *bathoniana* *(high-spired forms)* *hoterivica*

Authors	Date	Genus	Species	Location or Source	Age/Range	Referred to by	Date	Compared with
Banner	1982	*Woletzina*						
Simmons *et al.*	1997	*Conoglobigerina*			Bathonian- Early Callovian			
Oberhauser	**1960**	***Globigerina***	***ladinica***	Austria: St. Cassian Settass-Scharte N Richtohofen-Riff	Ladinian			
Fuchs	1967a 1975	*Kallmanita*				Fuchs	1967a 1975	*Globigerina*
						"systematic positions are doubtful"		
						Masters *"benthonic"*	1977	
						Grigelis & Gorbatchik *"benthonic"*	1980	
						Stam *"benthonic"*	1986	
						Loeblich & Tappan *"benthonic"*	1988	
						Simmons *et al.* *"benthonic"*	1997	
Oberhauser	**1960**	***Globigerina***	***mesotriassica***	Austria: St. Cassian Settass-Scharte N Richthofen-Riff	Ladinian			
Fuchs	1967a 1975	*Oberhauserella*				Fuchs	1967a 1975	*Globigerina*
						"systematic positions are doubtful"		
						Masters *"benthonic"*	1977	
						Grigelis & Gorbatchik *"benthonic"*	1980	
						Stam "benthonic"	1986	

Authors	Date	Genus	Species	Location or Source	Age/Range	Referred to by	Date	Compared with
Oberhauser	**1960**	***Globigerina***	***mesotriassica***			Loeblich & Tappan *"benthonic"*	1988	
						Simmons *et al.* *"benthonic"*	1997	
Tamajo (thin-sections)	**1960**	***"Globigerinidi"***		Sicily: Montagna della Busambra	Early Jurassic	Riegraf *"?rotaliid foraminifera"*	1987	
Görög	1994					Görög *"not adequately described and illustrated"*	1994	
Géczy (thin-sections)	**1961**	*"Globigerina-like forms"*		Hungary Bakony Mts -	Early Jurassic	Görög *"not adequately described and illustrated"*	1994	
Morozova & Moskalenko	**1961**	***Conoglobigerina***	***(dagestanica)***		Late Bajocian-Bathonian			
Morozova & Moskalenko	**1961**	***Globigerina*** *(Conoglobigerina)*	***dagestanica***	C Dagestan & Turkmenia	Late Bajocian- Early Bathonian	Masters *"benthonic forms or indeterminable species"*	1977	*avarica* *gaurdakensis*
Grigelis & Gorbatchik	1980	*Conoglobigerina*	*dagestanica*					
Kasimova & Ayileva	1984	*Globigerina*	*araksi*	Azerbaijan	Late Bajocian			
Gorbachik	1986	*Conoglobigerina*	*dagestanica*					
Görög	1994	*Globigerina* *(Conoglobigerina)*				Görög	1994	*geczyi*
Simmons *et al.*	1997	*Conoglobigerina*				Simmons *et al.*	1997	*avarica* *balakhmatova*
Wernli & Görög	1999	*Conoglobigerina*	aff. *dagestanica*	NW Hungary: Bakony Mts-Somhegy	late Early Bajocian- early Late Bajoacian	Wernli & Görög	1999	*dagestanica* *Globuligerina*
Wernli & Görög (thin-sections)	2000	*Conoglobigerina*		NW Hungary: Bakony Mts-Somhegy		Wernli & Görög	2000	*oxfordiana-med* *aff. bathoniana* *bathoniana* *gigantea*
Görög & Wernli	2002	*Conoglobigerina?*		NW Hungary: Bakony Mts - Gyenespuszta	Middle Bathonian- Late Bathonian	Görög & Wernli	2002	*avariformis* *forma sphaerica*

Authors	Date	Genus	Species	Location or Source	Age/Range	Referred to by	Date	Compared with
Morozova & Moskalenko	**1961**	***Globigerina* *(Conoglobigerina)***	***avarica***	C Dagestan	Early Bathonian	Morozova	1961	
Pazdrowa	1969	*Globigerina*				Pazdrowa	1969	*bathoniana*
Brönnimann & Wernli	1971	*"Globigerina"*	*avarica*	S Jura-France	?Late Bajocian-Bathonian			
Masters	1977			(Forms assigned by Morozova & Moskalenko)		Masters *"benthonic forms or indeterminable species"*	1977	*dagestanica* *gaurdakensis* *jurassica*
		Globigerina	*jurassica*	(Forms assigned by Brönnimann & Wernli)				
Stam	1986	*Globuligerina*	*bathoniana*					
Simmons *et al.*	1997	*Conoglobigerina*	*avarica*					
Morozova & Moskalenko	**1961**	***Globigerina* *(Eoglobigerina)***	***balakhmatovae***	Dagestan & Turkmenia	Late Bajocian-Early Bathonian			
Pazdrowa	1969	*Globigerina*				Pazdrowa	1969	*bathoniana*
Brönnimann & Wernli	1971	*"Globigerina"*		S Jura-France				
Masters	1977	*Globigerina*	*hoterivica*	(Forms assigned by Morozova & Moskalenko, Brönnimann & Wernli)				*hoterivica*
Gorbachick	1986	*Globuligerina*	*balakhmatovae*	NW Caucasus	Late Bajocian	Stam	1986	
					Late Bajocian	Riegraf	1987	
						Görög	1994	*geczyi*
Simmons *et al.*	1997	*Conoglobigerina*						

Authors	Date	Genus	Species	Location or Source	Age/Range	Referred to by	Date	Compared with
Morozova & Moskalenko	**1961**	***Globigerina* (*Conoglobigerina*)**	***gaurdakensis***	Dagestan & Turkmenia	Late Bajocian	Balakmatova & Morozova	1961	
Pazdrowa	1969	*Globigerina*				Pazdrowa	1969	*bathoniana*
Masters	1977	*Globigerina*				Masters *"benthonic forms or indeterminable species"*	1977	
Stam	1986	*Globuligerina*	*bathoniana*					
Simmons *et al.*	1997	*Conoglobigerina*			Cenozoic	Simmons *et al*. *"contaminants"*	1997	
Iovčeva & Trifonova	**1961**	***Globigerina***	***conica***	NW Bulgaria: nr Stubel village	Tithonian			
Pazdrowa	19969	*Globigerina*				Pazdrowa	1969	*bathoniana*
Masters	1977	*Globigerina*	*jurassica*	(Forms assigned by Iovčeva & Trifonova)	Bathonian-Tithonian	Masters	1977	*jurassica*
Stam	1986	*Globuligerina*	*bathoniana*					
Banner & Desai	1988	*Globigerina*				Banner & Desai *"?microspheric partner of terquemi"*	1988	*terquemi*
Simmons *et al.*	1997	*Conoglobigerina*						
Iovčeva & Trifonova	**1961**	***Globigerina***	***terquemi***	NW Bulgaria: nr Stubel village	Tithonian			
Pazdrowa	1969	*Globigerina*				Pazdrowa	1969	*bathoniana*
Masters	1977	*Globigerina*	*hoterivica*	(Forms assigned by Iovčeva & Trifonova)	Mid-Bathonian-Mid-Aptian	Masters	1977	*hoterivica*
Stam	1986	*Globuligerina*	*oxfordiana*			Stam	1986	
Banner & Desai	1988	*Globigerina*				Banner & Desai *"?megalospheric partner of conica"*	1988	*conica*
Simmons *et al.*	1997	*Conoglobigerina*						

Authors	Date	Genus	Species	Location or Source	Age/Range	Referred to by	Date	Compared with
Kristan-Tollmann	**1964**	***Globigerina***	**cf. *mesotriassica***	Lower Austria: Plackles-Hohe Wand				*mesotriassica*
Fuchs	1967a	*Oberhauserella*	*quadrilobata*		Rhaetian	Fuchs	1967a	*mesotriassica* *karinthiaca* *Globigerina*
	1973							
	1975					Fuchs *"systematic positions are doubtful"*	1975	
						Masters *"benthonic"*	1977	
						Grigelis & Gorbatchik *"benthonic"*	1980	
						Stam *"benthonic"*	1986	
						Loeblich & Tappan *"benthonic"*	1988	
Quilty	1990	*Oberhauserella*	cf. *quadrilobata*	N Exmouth Plateau		Quilty	1990	*quadrilobata*
Wernli	1995	*Oberhauserella*	*quadrilobata*	Switzerland: Teysachaux Préalpes médianes Fribourgeoises	Early Toarcian	Simmons *et al.* *"benthonic"*	1997	
Kristan-Tollmann	**1964**	***Globigerina***	***rhaetica***	Austria	Rhaetian			
Fuchs	1967a	*Oberhauserella*				Fuchs	1967a	*Globigerina*
	1975					Fuchs *"systematic positions are doubtful"*	1975	
						Masters *"benthonic"*	1977	
						Grigelis & Gorbatchik "benthonic"	1980	

Authors	Date	Genus	Species	Location or Source	Age/Range	Referred to by	Date	Compared with
Kristan-Tollmann	**1964**	***Globigerina***	***rhaetica***	Austria	Rhaetian	Stam *"benthonic"*	1986	
						Loeblich & Tappan *"benthonic"*	1988	
						Simmons *et al.* *"benthonic"*	1997	
Fuchs	**1967**	***Oberhauserella***	***mesotriassica***		Late Ladinian-Rhaetian			*Globigerina*
		Praegubkinella	***kryptumbilicata***		Latest Rhaetian			*Gubkinella* *Oberhauserella*
Fuchs	**1967**	*Praegubkinella*	*kryptumbilicata*	Austria: Xanten (nr Salzburg)	Late Rhaetian			*turgescens* *Gubkinella*
Wernli	1995	*Praegubkinella*	*turgescens*	Switzerland: Teysachaux Préalpes médianes Fribourgeoises	Early Toarcian	Wernli	1995	*kryptumbilicata*
Fuchs	**1967**	***Praegubkinella***	***turgescens***	Austria: Xanten (nr Salzburg)	Late Rhaetian			*kryptumbilicata* *O.alta*
Kristan-Tollmann	1970	*"Praegubkinella"*				Kristan-Tollmann	1970	
Wernli	1995	*Praegubkinella*	aff. *turgescens*	Switzerland: Teysachaux Préalpes médianes Fribourgeoises	Early Toarcian	Wernli	1995	*turgescens*
Fuchs	**1970**	***Oberhauserella***	***crassa***	Lower Austria	Sinemurian	Loeblich & Tappan *"benthonic"*	1988	
						Görög *"not adequately described and illustrated"*	1994	
Fuchs	**1970**	***Oberhauserella***	***planiconvexa***	Lower Austria	Sinemurian	Loeblich & Tappan *"benthonic"*	1988	
						Görög *"not adequately described and illustrated"*	1994	

Authors	Date	Genus	Species	Location or Source	Age/Range	Referred to by	Date	Compared with
Fuchs	1970	***Schlagerina***	***orbis***	Lower Austria	Sinemurian			*Oberhauserella*
						Loeblich & Tappan *"benthonic"*	1987	
						Görög *"not adequately described and illustrated"*	1994	
Bars & Ohm	1968	***Globigerina***	***spuriensis***	Trient Province	Late Dogger	Masters	1977	
						Görög *"aperture not characteristic of planktonic forms"*	1994	
Pazdrowa	1969	***Globigerina***	***bathoniana***	Poland	Bathonian			*dagestanica* *oxfordiana* *avarica* *balakhmatovae* *bulloides* *gaurdakensis* *helvetojurassica* *cf. helvetojurassica* *jurassica* *liassina* *lobata* *oolithica* *conica* *terquemi*
Fuchs	1973	*Conoglobigerina*						
Ascoli	1976	*Gubkinella*						
Gradstein	1976	*"Globigerina"*						
Masters	1977	*Globigerina*	*hoterivica* *jurassica*	(Low-spired variety) (High-spired variety)	Bathonian-Tithonian	Masters	1977	*hoterivica* *jurassica*

Authors	Date	Genus	Species	Location or Source	Age/Range	Referred to by	Date	Compared with
Grigelis & Gorbatchik	1980	*Conoglobigerina*				Grigelis & Gorbatchik	1980	
Bignot & Janin	1984	*Globuligerina*				Bignot & Janin	1984	
Stam	1986	*Globuligerina*	*bathoniana*	Portugal ?Grand Banks	?Late Bajocian/ Late Bathonian- Early Kimmeridgian/ ?Early Valanginian	Stam	1986	*dagestanica*
Riegraf	1987	*Globuligerina*		SW Germany	Late Bajocian Late Bathonian- Early Kimmeridgian/ ?Early Valanginian	Riegraf	1987	
						Görög	1994	*geczyi*
Simmons *et al.*	1997	*Globuligerina*		S Poland N & S Germany N Switzerland Azerbaijan Crimea Portugal N France E Canada	Late Bathonian- Early Kimmeridgian	Simmons *et al.*	1997	
Görög & Wernli	2002	*Globuligerina*		NW Hungary: Bakony Mts-Gyenespuszta	Middle Bathonian- Late Bathonian	Görög & Wernli	2002	*avarica*
Wernli & Görög	1999	*Globuligerina*	aff. *bathoniana*	NW Hungary: Bakony Mts-Somhegy	early Late Bajocian	Wernli & Görög	1999	*bathoniana* *avarica*
Wernli & Görög (thin sections)	2000	*Globuligerina*					2000	*oxfordiana*
Görög & Wernli	2002	*Globuligerina*		NW Hungary: Bakony Mts-Gyenespuszta	Middle Bathonian- Late Bathonian	Görög & Wernli	2002	*bathoniana* *sensu stricto*
Wernli & Görög	1999	*Globuligerina*	*bathoniana* *gigantea*	NW Hungary: Bakony Mts-Somhegy	late Early Bajocian- early Late Bajocian	Wernli & Görög	1999	*bathoniana*

Authors	Date	Genus	Species	Location or Source	Age/Range	Referred to by	Date	Compared with
Wernli & Görög (thin sections)	2000	*Globuligerina*					2000	*aff. bathoniana* *avariformis*
Bignot & Guyader	**1971**	***Globuligerina***	***(oxfordiana)***					
Fuchs	**1973**	***Woletzina***	***jurassica***	Poland				
Grigelis *et al*.	**1977**	***Globuligerina***	***stellapolaris***	N Russia: Timan-Pechora region- Izhma River Pechora River Basin				
Stam	1986		*oxfordiana*			Stam	1986	*oxfordiana*
Görög	1994				Kimmeridgian-Volgian	Görög	1994	*oxfordiana* *geczyi*
Simmons *et al.*	1997	*Compactogerina*			Early Volgian	Simmons *et al*.	1997	
Gorbachik & Poroshina	**1979**	***Globuligerina***	***caucasica*** ?megalospheric partner of *gulekhensis*	S Caucasus Azerbaijan E Crimea	Early Berriasian-Early Valanginian			*gulekhensis*
Banner & Desai	1988	*Conoglobigerina*				Banner & Desai	1988	
Simmons *et al.*	1997	*Conoglobigerina*				Simmons *et al.*	1997	
Gorbachik & Poroshina	**1979**	***Globuligerina***	***gulekhensis*** *"?microspheric partner of caucasica"*	SE Caucasus Azerbaijan E Crimea	Early Berriasian-Early Valanginian			*caucasica*
Banner & Desai	1988	*Conoglobigerina*						

Authors	Date	Genus	Species	Location or Source	Age/Range	Referred to by	Date	Compared with
BouDagher-Fadel *et al.*	1995	*Conoglobigerina*						
Simmons *et al.*	1997	*Conoglobigerina*						
Kuznetsova & Uspenskaya	**1980**	***Globuligerina***	***calloviensis***	Crimea	Early- early Late Callovian	Gorbachik	1986	
Gorbachik	1986	*Globuligerina*						
Simmons *et al.*	1997	*Conoglobigerina*						
Kuznetsova & Gorbachik	**1980**	***Globuligerina***	***meganomica***	N Crimea	late Early- Late Callovian			*dagestanica*
Simmons et al.	1997	*Conoglobigerina*						
Kasimova & Aliyeva	**1984**	***Conoglobigerina***	***avariformis***	Nakhichevan	Late Bajocian			
Simmons *et al.*	1997	*Conoglobigerina*						
Wernli & Görög	1999	*Conoglobigerina*	*avariformis* forma *sphearica*	NW Hungary: Bakony Mts-Somhegy	late Early Bajocian-early Late Bajocian	Wernli & Görög	1999	*avariformis*
Wernli & Görög (thin-sections)	2000	*Conoglobigerina*	*(avariformis sensu lato)*				2000	*bathoniana gigantea*
Görög & Wernli	2002	*Conoglobigerina?*		NW Hungary: Bakony Mts - Gyenespuszta	Middle Bathonian-Late Bathonian	Görög & Wernli	2002	*aff. dagestanica*
				NW Hungary: Bakony Mts-Somhegy	late Early Bajocian	Wernli & Görög	1999	*avariformis* forma alta
Wernli & Görög (thin-sections)	2000	*Conoglobigerina*					2000	*bathoniana gigantea*
Görög & Wernli	2002	*Conoglobigerina?*		NW Hungary: Bakony Mts - Gyenespuszta	Middle Bathonian-Late Bathonian	Görög & Wernli	2002	*Globuligerina*
Kuznetsova & Gorbachik	**1985**	***Globuligerina***	***parva***	Crimea	Early Kimmeridgian			

Authors	Date	Genus	Species	Location or Source	Age/Range	Referred to by	Date	Compared with
Simmons *et al.*	1997	*Haeuslerina*				Simmons *et al*.	1997	*helvetojurassica*
Wernli (thin-sections)	**1988**	***"Protoglobigerinids"***		Turkey: Western Taurus Domuz Dag	Early Jurassic	Görög *"not adequately described and illustrated"*	1994	
Görög Á	**1994**	***Globuligerina***	***geczyi***	Hungary: Gerecse Mts- Nagypisznice Hill, nr Lábatlan	Late Hettangian/ Early Sinemurian			*oxfordiana* *in Bignot & Guyader* *stellapolaris* *balakmatovae* *bathoniana* *dagestanica* *spuriensis*
Simmons *et al.*	1997	*Praemurica* sp.			Danian			*Praemurica sp.*
Wernli	1995	***Praegubkinella***	***fuchsi***	Switzerland: Teysachaux Préalpes médianes Fribourgeoises	Early Toarcian			*racemosa* *turgescens* *balakhmatovae* *Conoglobigerina*
Simmons *et al.*	1997	*Praegubkinella*				Simmons *et al.* *"benthonic"*	1997	*benthonics*
Wernli	1995	***Praegubkinella***	***racemosa***	Switzerland: Teysachaux Préalpes médianes Fribourgeoises	Early Toarcian			*fuchsi* *avarica* *turgescens* *Conoglobigerina*
Simmons *et al.*	1997	*Praegubkinella*				Simmons *et al.* *"free-living"*	1997	*benthonics*
Simmons *et al*.	**1997**	***Haeuslerina***	***(helvetojurassica)***		Oxfordian- Kimmeridgian			
Simmons *et al*.	**1997**	***Compactogerina***	***(stellapolaris)***		Early Volgian			
Wernli & Görög	**1999**	***?Globuligerina***	***hungarica***	NW Hungary: Bakony Mts-Somhegy	Late Bajocian	Wernli & Görög	1999	*all described species*
Wernli & Gorog (thin-sections)	2000	*?Globuligerina*				Wernli & Görög	2000	*oxfordiana*

APPENDIX II

PLATES

Plate 1

1 *Oberhauserella mesotriassica* (Oberhauser, 1960). Holotype.
  a spiral view, scale bar = 75 µm, jwh 0890
  b edge view, scale bar = 75 µm, jwh 0945
  c umbilical view, scale bar = 75 µm, jwh 0926.
Figured by Oberhauser (1960, pl. 5, fig. 18a-c). From a locality in the Settass-Scharte, north of the Richtofen-Riff, near St. Cassian, South Tyrol, northern Italy. Upper Cassian beds, Ladinian. The type slides are in the collections of the Geologische Bundesanstalt, Vienna, no. 1960/4/106.

2 *Oberhauserella mesotriassica* (Oberhauser, 1960). Paratype.
  a spiral view, scale bar = 100 µm, P 059762
  b edge view, scale bar = 100 µm, P 059814
  c umbilical view, scale bar = 100 µm, P 059732
  d oblique-umbilical view, scale bar = 100 µm, P 059735. x300.
Figured by Oberhauser (1960, pl. 5, fig. 19a-c). From a locality in the Settsass-Scharte, north of the Richthofen-Riff, near St. Cassian, South Tyrol, northern Italy. Upper Cassian beds, Ladinian. Geologische Bundesanstalt, Vienna, no. 1960/4/107.

3 *Oberhauserella alta* Fuchs, 1967. ?Paratype.
  a spiral view, scale bar = 86 µm, P 059763
  b edge view, scale bar = 86 µm, P 059815
  c umbilical view, scale bar = 86 µm, P 059733
  d oblique-umbilical view, scale bar = 86 µm, P 059734. x350.
From Plackles, eastern Austria. Plackles marls, Rhaetian. Geologische Bundesanstalt, Vienna, no. 1967/5/25 (4/6).

4 *Oberhauserella crassa* Fuchs, 1970. Holotype.
  a spiral view, scale bar = 120 µm, P 074675
  b edge view, scale bar = 120 µm, P 074682
  c umbilical view, scale bar = 120 µm, P 074667.
Figured by Fuchs (1970, pl. 9, fig. 10). From Hernstein, Lower Austria. Lias α, Lower Jurassic. Geologische Bundesanstalt, Vienna, no. 1970/3/130.

Plate 1

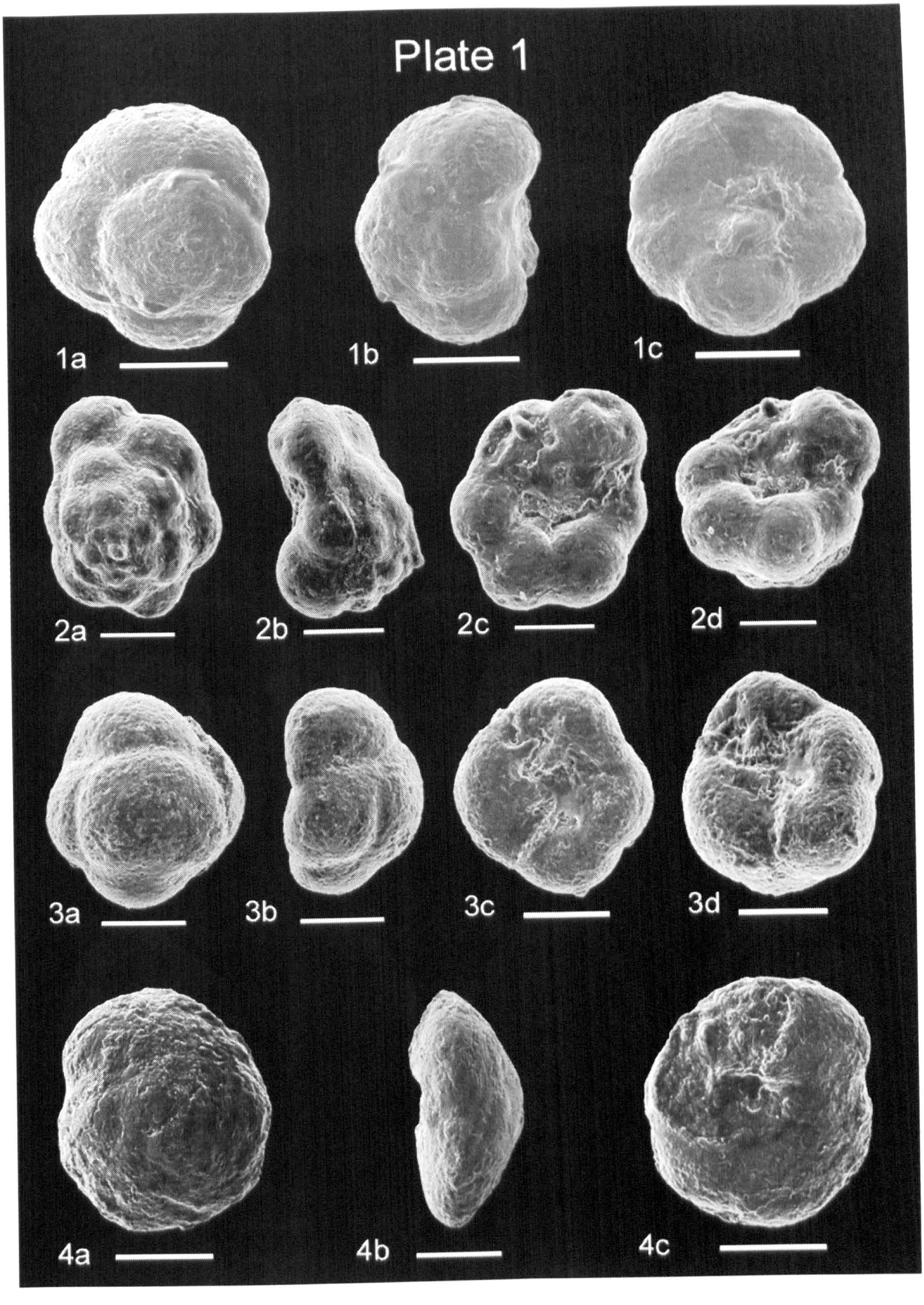


Plate 2

1 *Oberhauserella karinthiaca* Fuchs, 1967. Holotype.
- a spiral view, scale bar = 75 µm, jwh 0927
- b edge view, scale bar = 75 µm, jwh 0946
- c umbilical view, scale bar = 75 µm, jwh 0891

Figured by Fuchs (1967, pl. 3, fig. 3). From Eisenkappel, Kärten, southern Austria. Lower Carnian. Geologische Bundesanstalt, Vienna, no. 1967/5/17.

2 *Oberhauserella norica* Fuchs, 1967. ?Paratype.
- a spiral view, scale bar = 86 µm, P 059765
- b edge view, scale bar = 86 µm, P 059817
- c umbilical view, scale bar = 86 µm, P 059741
- d oblique-umbilical view, scale bar = 86 µm, P 059739. x350.

Figured by Fuchs (1967, pl. 6, fig. 2). From Hinterer Gosausee, central Austria. Rhaetian. Geologische Bundesanstalt, Vienna, no. 1967/5/28.

3 *Oberhauserella quadrilobata* Fuchs, 1967. ?Paratype.
- a spiral view, scale bar = 60 µm, P 059764
- b edge view, scale bar = 60 µm, P 059816
- c umbilical view, scale bar = 60 µm, P 059740
- d oblique-umbilical view, scale bar = 60 µm, P 059738. x500.

Figured by Fuchs (1967, pl. 3, fig. 6). From Rossmoos, central Austria. Upper Norian. Geologische Bundesanstalt, Vienna, no. 1967/5/20.

4 *Kollmannita ladinica* (Oberhauser, 1960). Holotype.
- a spiral view, scale bar = 100 µm, jwh 0925
- b edge view, scale bar = 100 µm, jwh 0944
- c umbilical view, scale bar = 100 µm, jwh 0889

Figured by Oberhauser (1960, pl. 5, figs 14a-c). From a locality in the Settsass-Scharte, north of the Richtofen-Riff, near St. Cassian, South Tyrol, northern Italy. Upper Cassian beds, Ladinian. Geologische Bundesanstalt, Vienna, no. 1960/4/108.

5 *Kollmannita ladinica* (Oberhauser, 1960). Paratype.
- a spiral view, scale bar = 100 µm, P 059761
- b edge view, scale bar = 100 µm, P 059812
- c umbilical view, scale bar = 100 µm, P 059731
- d oblique-umbilical view, scale bar = 100 µm, P 059736
- e detail of ?apertural face, scale bar = 27 µm, P 059813. x300.

Figured by Oberhauser (1960, pl. 5, figs 12a-c). From a locality in the Settsass-Scharte, north of the Richtofen-Riff, near St. Cassian, South Tyrol, northern Italy. Upper Cassian beds, Ladinian. Geologische Bundesanstalt, Vienna, no. 1960/4/109.

Plate 2

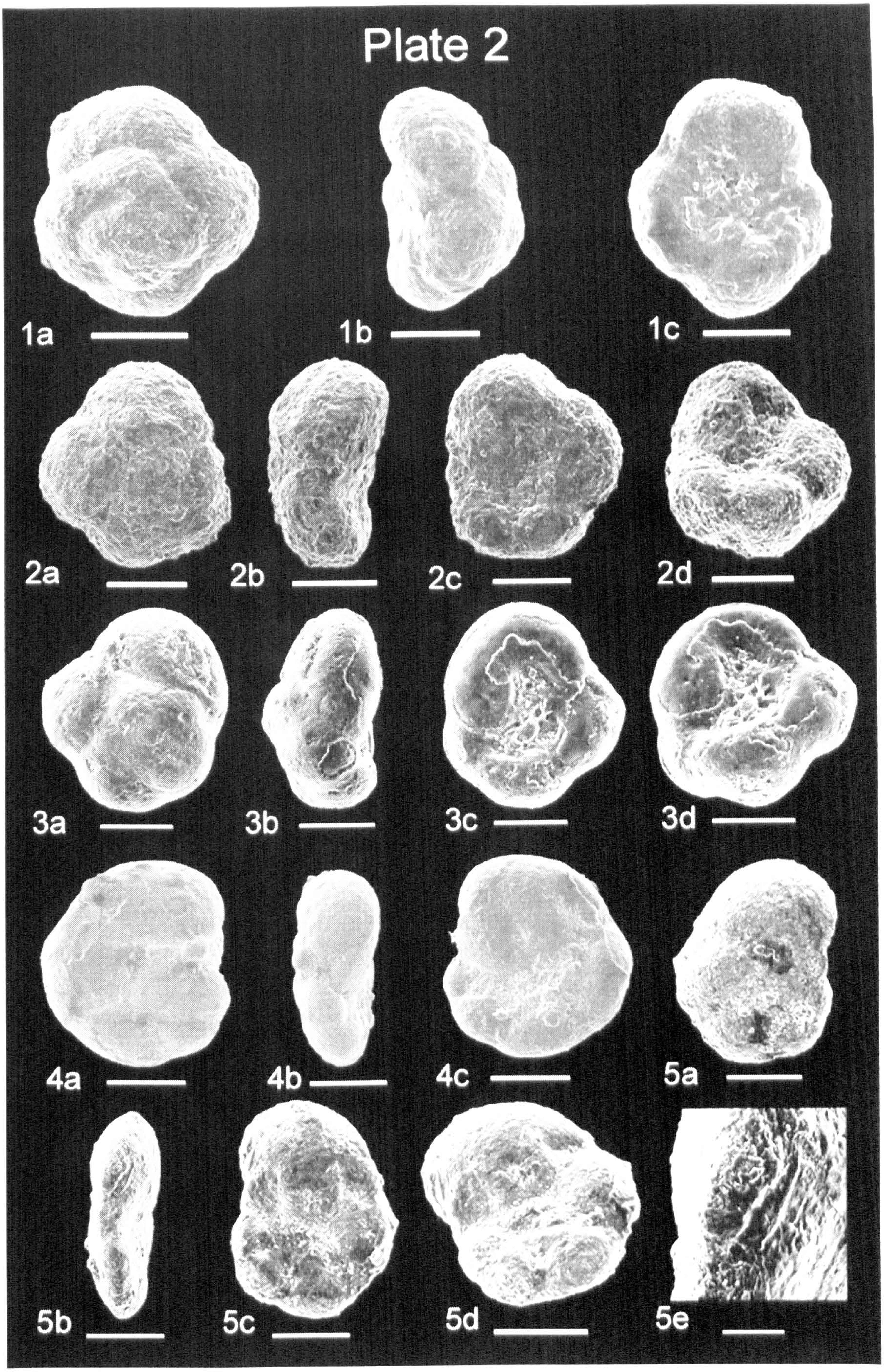


Plate 3

1 *Globuligerina oxfordiana* Grigelis,1958. Topotype.
  a spiral view, scale bar = 60 µm, P 036726
  b umbilical view, scale bar = 60 µm, P 036774.
Oxfordian, Makarievo, Upper Volga Basin, Russia. Specimen from Moscow State University Collections, provided by A. Grigelis.

2 *Globuligerina oxfordiana* (Grigelis, 1958). Le Havre, France.
  a spiral view, scale bar = 60 µm, P 037043
  b edge view, scale bar = 60 µm, P 037099
  c umbilical view, scale bar = 60 µm, P 036938
  d detail of aperture, scale bar = 12 µm, P 036939
  e detail of wall, scale bar = 10 µm, P 036940.
Oxfordian, Le Havre, Seine Maritime, France (donated to the Natural History Museum, London, by Professor G. Bignot).

3 *Globigerina bathoniana* Pazdrowa, 1969. Topotype.
  a spiral view, scale bar = 60 µm, P 036932
  b edge view, scale bar = 60 µm, P 037097
  c umbilical view, scale bar = 60 µm, P 037039.
Middle Bathonian, Ogrodzieniec, Poland.

Plate 3

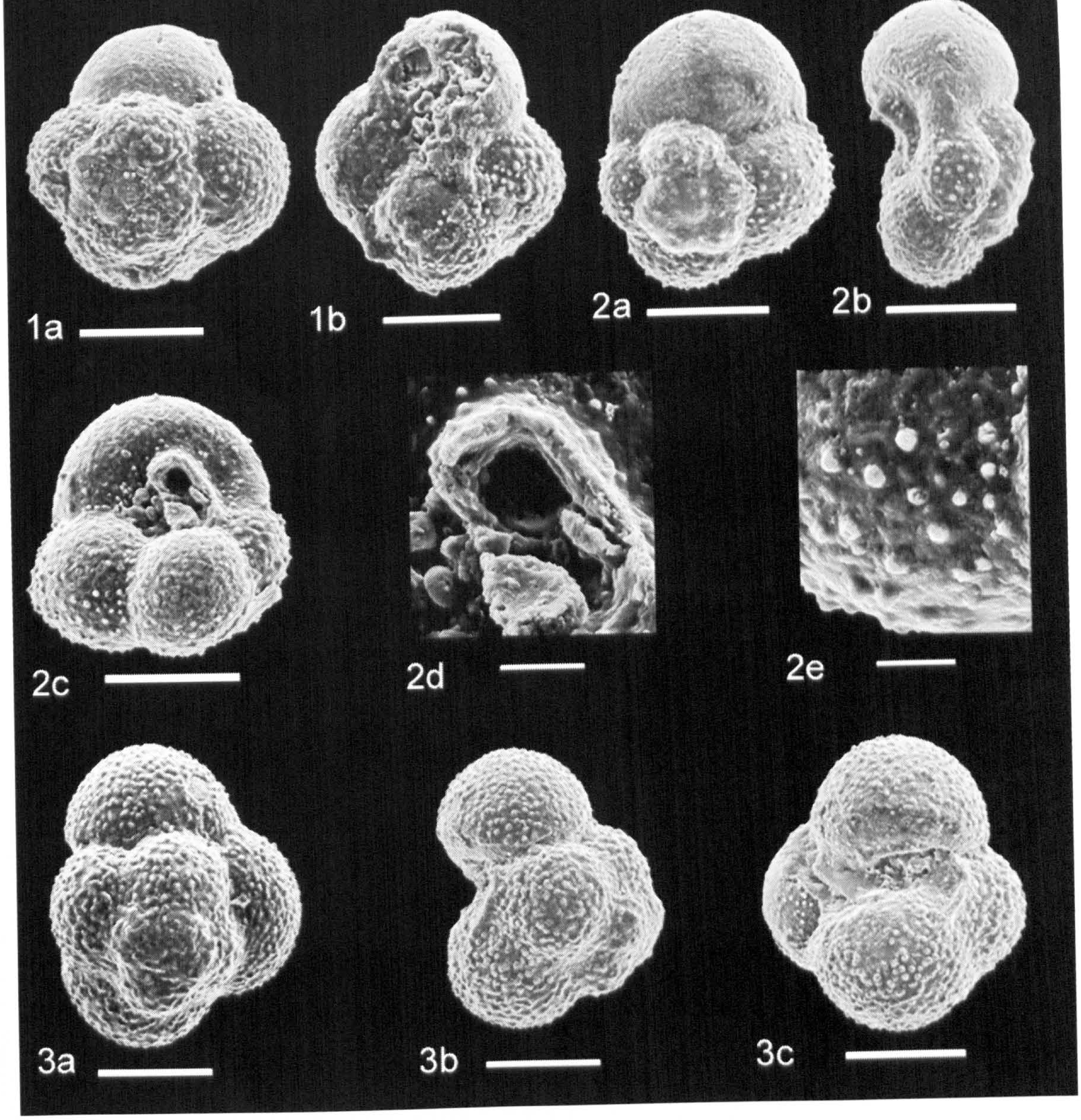


Plate 4

1 *Globuligerina calloviensis* Kuznetsova, 1980. Paratype.
a spiral view, scale bar = 75 µm, P 036918
b edge view, scale bar = 75 µm, P 037091
c umbilical view, scale bar = 75 µm, P 036982.
Early to Middle Callovian, Crimea.

2 *Globuligerina calloviensis* Kuznetsova, 1980. Topotype.
a spiral view, scale bar = 50 µm, P 036629
b edge view, scale bar = 50 µm, P 036765
c umbilical view, scale bar = 50 µm, P 036713.
Early to Middle Callovian, Crimea.

3 *Globuligerina meganomica/calloviensis* Kuznetsova, 1980. Transition, Topotype.
a spiral view, scale bar = 75 µm, P 036625
b umbilical view, scale bar = 75 µm, P 036709.
Late Callovian, Crimea.

4 *Compactogerina stellapolaris* (Grigelis, 1977). Paratype/Topotype?
a spirail view, scale bar = 120 µm, P 036977
b edge view, scale bar = 120 µm, P 037088
c umbilical view, scale bar = 120 µm, P 036912.
Early Volgian, bank of Izhma River, near Zagrivochnaya, Pechora Basin, N. Russia.

5 *Compactogerina stellapolaris* (Grigelis, 1977). Topotype.
a spiral view, scale bar = 120 µm, P 036730
b edge view, scale bar = 120 µm, P 036805
c edge view, scale bar = 120 µm, P 036806
d umbilical view, scale bar = 120 µm, P 036729
e umbilical view, scale bar = 120 µm, P 036777.
Early Volgian, bank of Izhma River, near Zagrivochnaya, Pechora Basin, N. Russia.

Plate 4

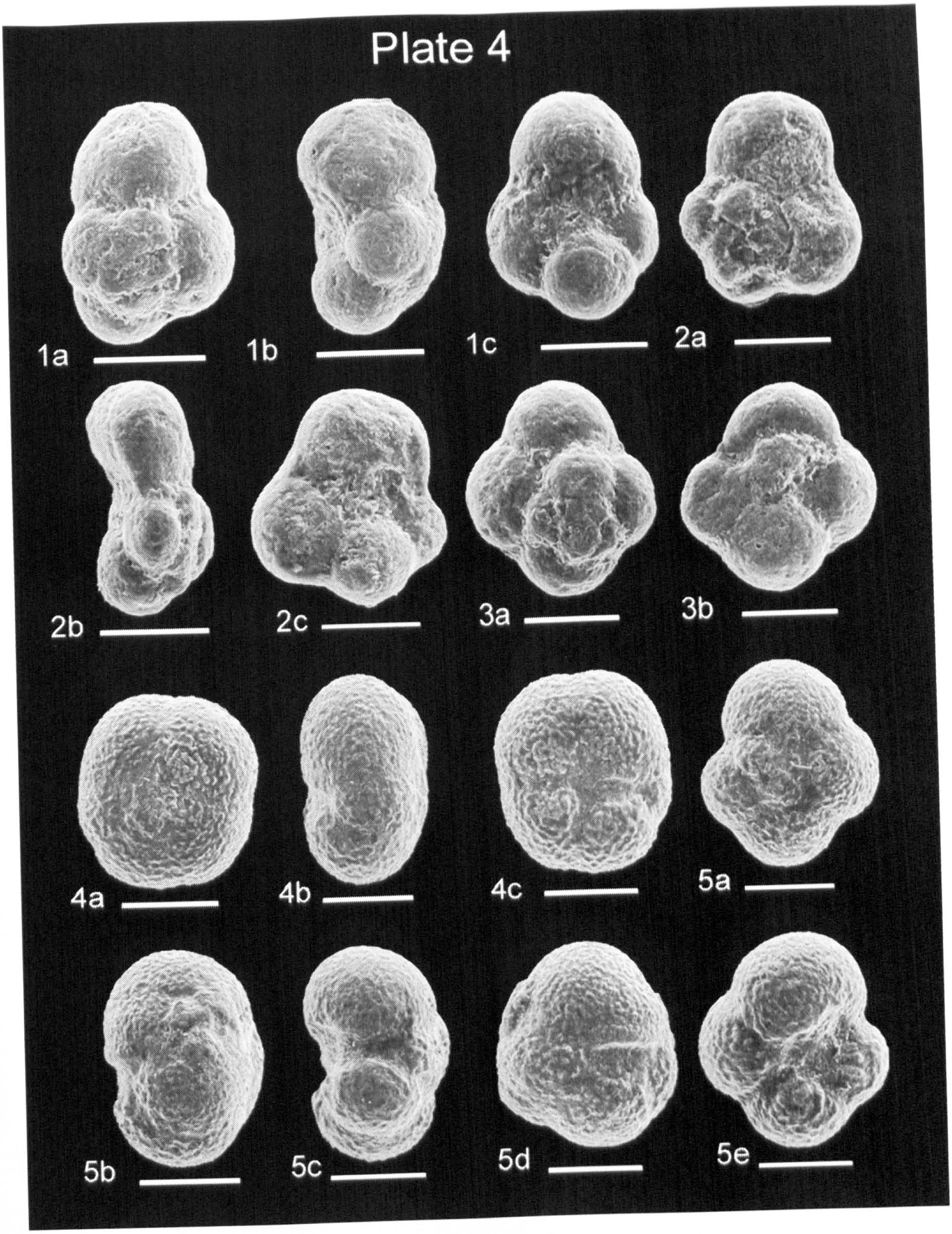


Plate 5

1 *Praegubkinella kryptumbilicata* Fuchs, 1967. Holotype.
- a spiral view, scale bar = 75 µm, jwh 0892
- b edge view, scale bar = 75 µm, jwh 0928
- c umbilical view, scale bar = 75µm, jwh 0947.

Figured by Fuchs (1967, pl. 7, fig. 3). From Xanten, Salzburg, Austria. Upper Rhaetian. Geologische Bundesanstalt, Vienna, no. 1967/5/48.

2 *Praegubkinella turgescens* Fuchs, 1967. Holotype.
- a spiral view, scale bar = 75 µm, jwh 0893
- b edge view, scale bar = 75 µm, jwh 0929
- c umbilical view, scale bar = 75 µm, jwh 0948.

Figured by Fuchs, (1967, pl. 7, fig. 2). From Xanten, Salzburg, Austria. Upper Rhaetian. Geologische Bundesanstalt, Vienna, no. 1967/5/43.

3 *Praegubkinella turgescens* Fuchs, 1967. ?Paratype.
- a spiral view, scale bar = 75 µm, jwh 0930
- b edge view, scale bar = 75 µm, jwh 0949
- c umbilical view, scale bar = 75 µm, jwh 0894.

Figured by Fuchs (1967, pl. 6, fig. 4). From Xanten, Salzburg, Austria. Upper Rhaetian. Geologische Bundesanstalt, Vienna, no. 1967/5/44.

4 *Praegubkinella turgescens* Fuchs, 1967. ?Paratype.
- a spiral view, scale bar = 75 µm, jwh 0931
- b edge view, scale bar = 75 µm, jwh 0950
- c umbilical view, scale bar = 75 µm, jwh 0895.

Figured by Fuchs (1967, pl. 7, fig. 1). From Xanten, Salzburg, Austria. Upper Rhaetian. Geologische Bundesanstalt, Vienna, no. 1967/5/46.

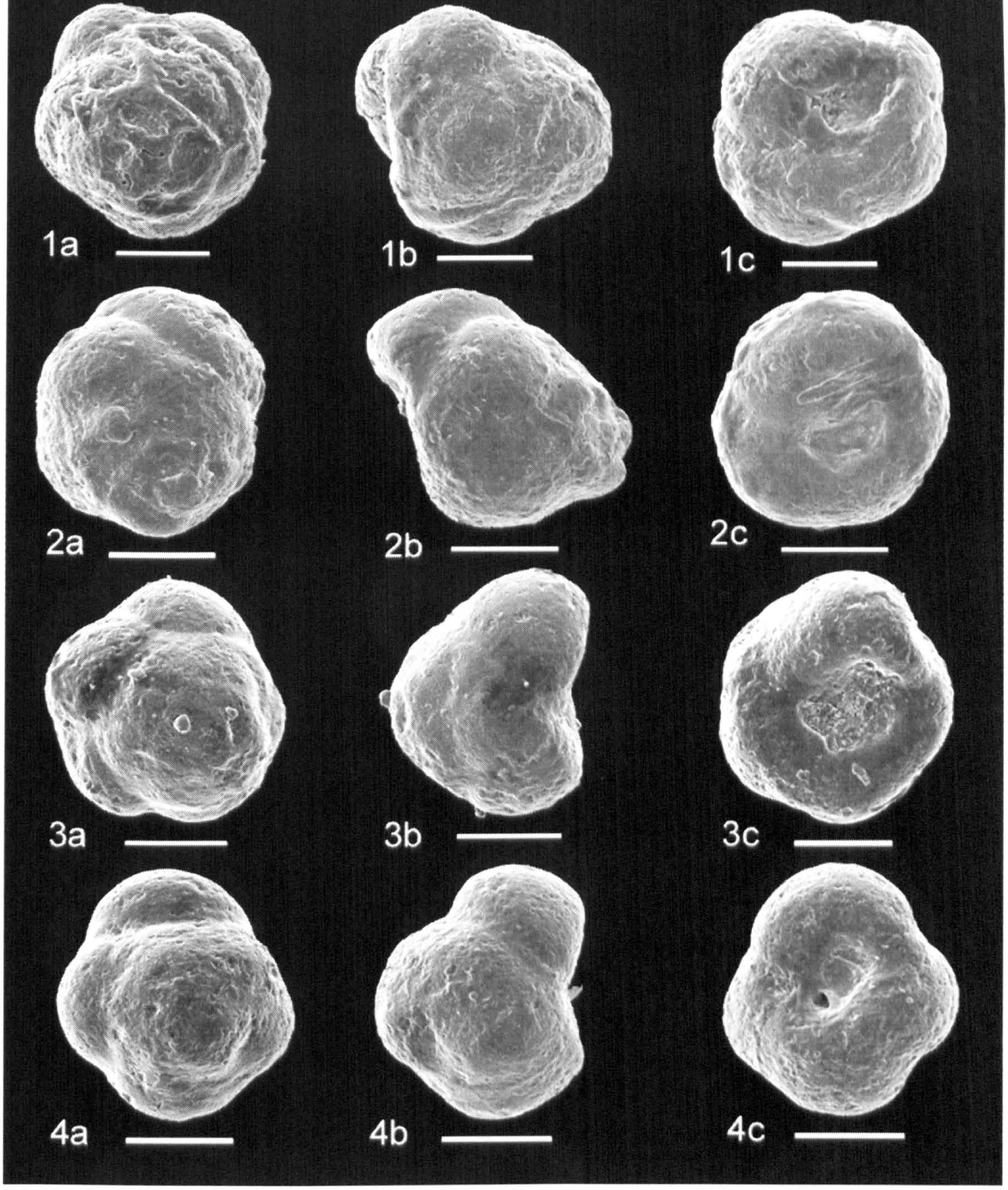


Plate 5

Plate 6

1 *Schlagerina angustiumbilicata* Fuchs,1967. ?Paratype.
- a spiral view, scale bar = 75 µm, jwh 0932
- b edge view, scale bar = 75 µm, jwh 0951
- c umbilical view, scale bar = 75 µm, jwh 0896.

Figured by Fuchs (1967, pl. 3, fig. 10). From Plackles, eastern Austria. Plackles Marls, Rhaetian. Geologische Bundesanstalt, Vienna, no. 1967/5/37.

2 *Schlagerina angustiumbilicata* Fuchs 1967. ?Paratype.
- a spiral view, scale bar = 75 µm, jwh 0897
- b edge view, scale bar = 75 µm, jwh 0952
- c umbilical view, scale bar = 75 µm, jwh 0933.

Figured by Fuchs (1967, pl. 6, fig. 3). From Xanten, Salzburg, Austria. Upper Rhaetian. Geologische Bundesanstalt, Vienna, no. 1967/5/38.

3 *Schlagerina altispira* Fuchs, 1967. Holotype.
- a spiral view, scale bar = 75 µm, jwh 0934
- b edge view, scale bar = 75 µm, jwh 0953
- c umbilical view, scale bar = 75 µm, jwh 0898.

Figured by Fuchs (1967, pl. 4, fig. 1). From Plackles, eastern Austria. Plackles marls, Rhaetian. Geologische Bundesanstalt, Vienna, no. 1967/5/39.

4 *Schlagerina orbis*, Fuchs, 1970. Holotype.
- a spiral view, scale bar = 120 µm, P 074676
- b edge view, scale bar = 120 µm, P 074683
- c umbilical view, scale bar = 120 µm, P 074668.

Figured by Fuchs (1970, pl. 9, fig. 9). From Hernstein, Lower Austria. Lias α, Lower Jurassic. Geologische Bundesanstalt, Vienna, no. 1970/3/132.

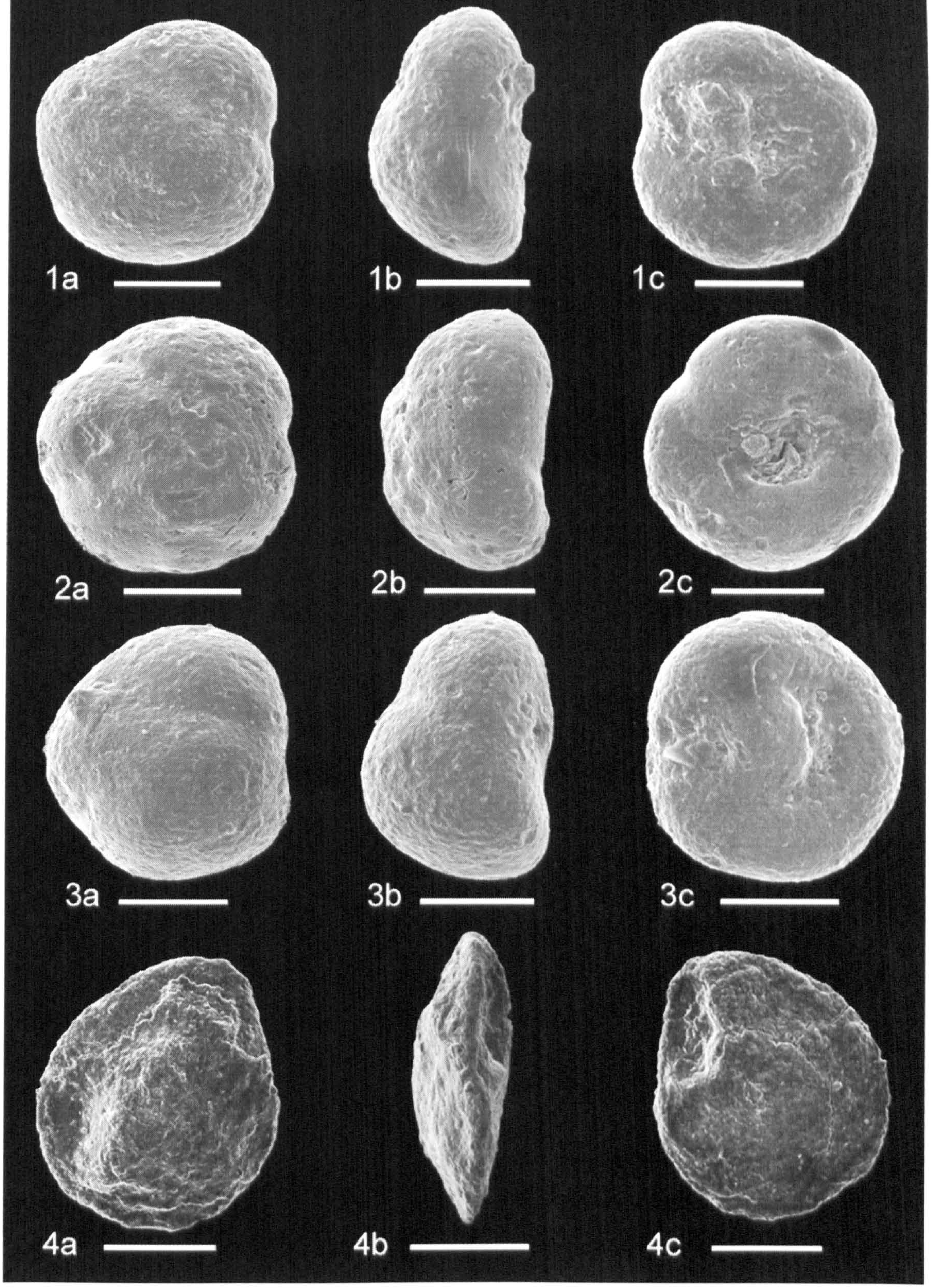


Plate 6

Plate 7

1 *Schlagerina scissumbilicata* Fuchs, 1967. Holotype.
- a spiral view, scale bar = 75 µm, jwh 0935
- b edge view, scale bar = 75 µm, jwh 0954
- c umbilical view, scale bar = 75 µm, jwh 0899.

Figured by Fuchs (1967, pl. 4, fig. 2). From Plackles, eastern Austria. Plackles marls, Rhaetian. Geologische Bundesanstalt, Vienna, no. 1967/5/42.

2 *Schlagerina subcircularis* Fuchs, 1967. Holotype.
- a spiral view, scale bar = 86 µm, jwh 0936
- b edge view, scale bar = 86 µm, jwh 0955
- c umbilical view, scale bar = 86 µm, jwh 0900.

Figured by Fuchs (1967, pl. 4, fig. 4). From Plackles, eastern Austria. Plackles marls, Rhaetian. Geologische Bundesanstalt, Vienna, no. 1967/5/40.

3 *Schmidita hedbergelloides* Fuchs, 1967. Holotype.
- a spiral view, scale bar = 75 µm, jwh 0937
- b edge view, scale bar = 75 µm, jwh 0956
- c umbilical view, scale bar = 75 µm, jwh 0901.

Figured by Fuchs (1967, pl. 4, fig.3). From Plackles, eastern Austria. Plackles marls, Rhaetian. Geologische Bundesanstalt, Vienna, no. 1967/5/14.

4 *Schmidita inflata* Fuchs, 1967. Holotype.
- a spiral view, scale bar = 75 µm, P 059810
- b edge view, scale bar = 75 µm, P 059958
- c umbilical view, scale bar = 75 µm, P 059759
- d oblique-umbilical view, scale bar = 75 µm, P 059766. x400.

Figured by Fuchs (1967, pl. 3, fig 1). From Eisenkappel, Kärnten, southern Austria. Lower Carnian. Geologische Bundesanstalt, Vienna, no. 1967/5/13.

5 *Mariannenina nitida* Fuchs 1973. ?Paratype.
- a spiral view, scale bar = 75 µm, P 059760
- b edge view, scale bar = 75 µm, P 059811
- c umbilical view, scale bar = 75 µm, P 059730
- d ?oblique-umbilical view, scale bar = 75 µm, P 059737. x400.

Figured by Fuchs (1973, pl. 4, fig. 1). From Wiek, near Ogrodzieniec, Poland. Bed 26, lowermost Oxfordian. Geologische Bundesanstalt, Vienna, no. 1973/3/28.

Plate 7

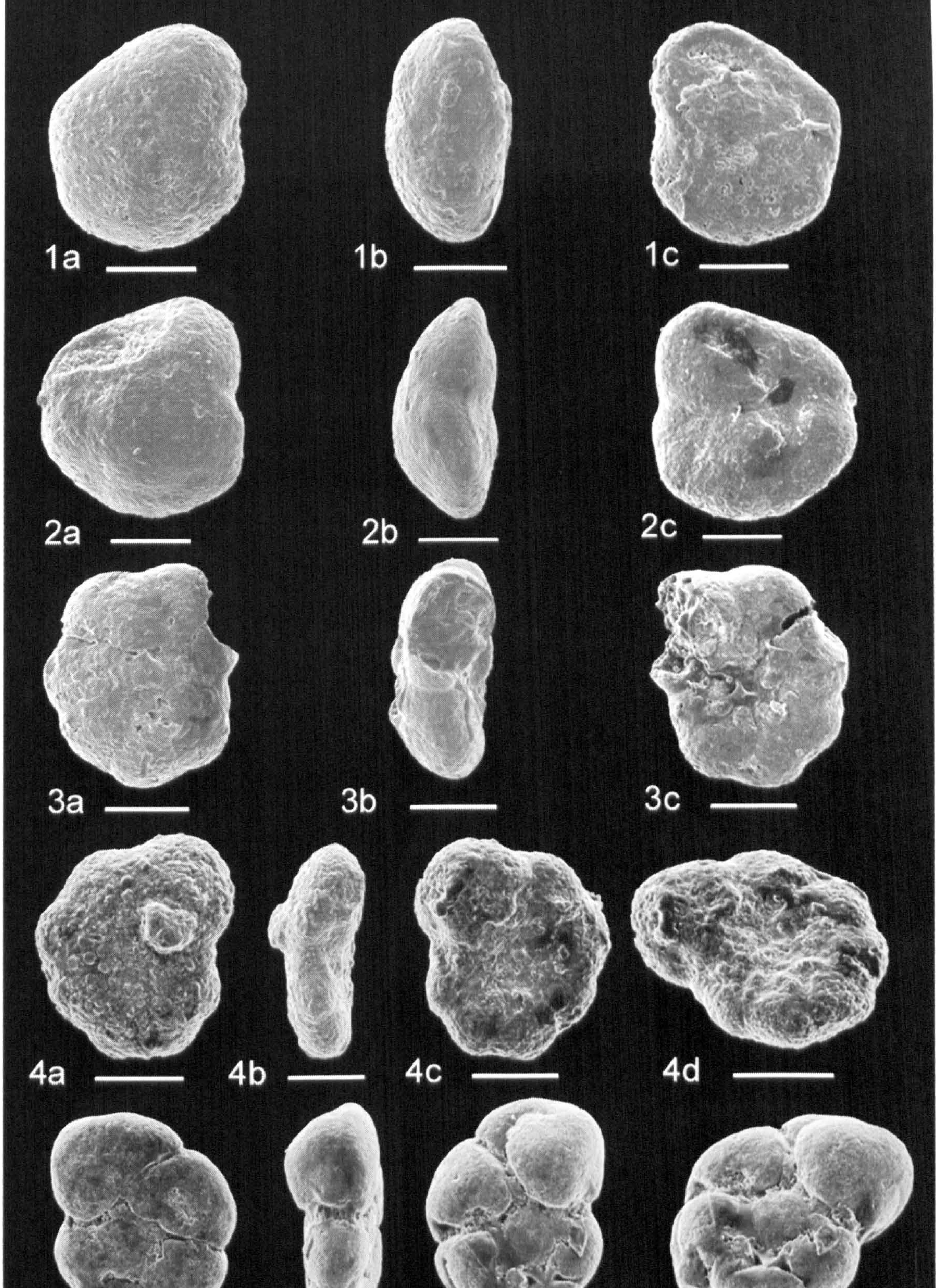


Plate 8

1-9 Glauconitic internal moulds of *Compactogerina* or *Globuligerina* that could be *bathoniana* or *oxfordiana.*
Unless otherwise stated all scale bars = 50 µm;
3, 8 scale bars = 100 µm.

10-15 *Compactogerina* or *Globuligerina* with a variety of spire heights many showing 2-2½ whorls of chambers.
All scale bars = 50 µm.

All specimens from the Callovian/Oxfordian boundary section, Ogrodzieniec, Poland.

Plate 8

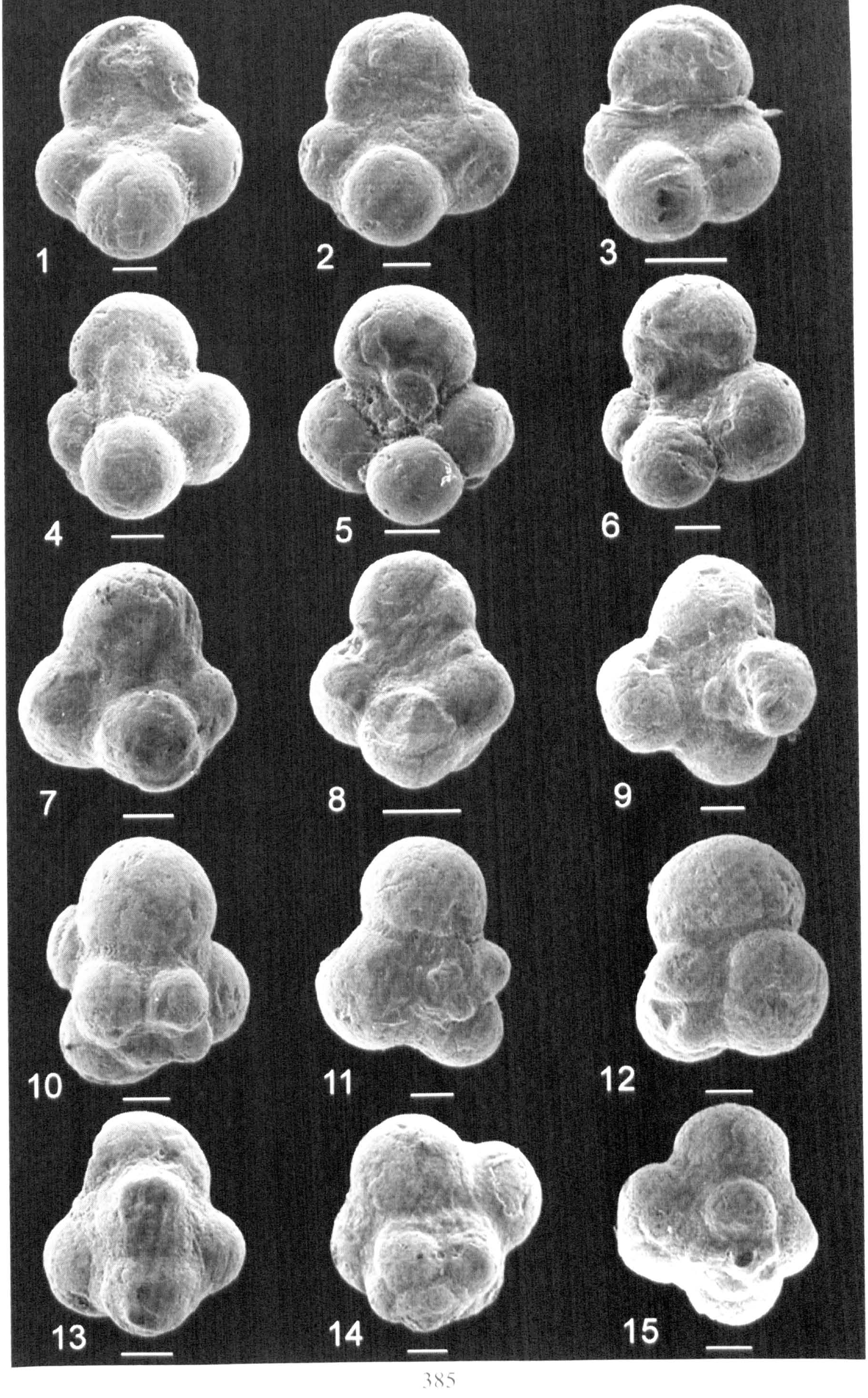


Plate 9

1-8 *Compactogerina* or *Globuligerina* with a variety of spire heights, many showing 2-2½ whorls of chambers.
1, 2, 7, 8 scale bars = 50 µm;
3, 4, 5, 6 scale bars = 100 µm.

9-11 *Haeuslerina helvetojurassica* (Haeusler, 1981).
9, 10 scale bars = 50 µm;
11 scale bar = 100 µm.

All specimens from the Callovian/Oxfordian boundary, Ogrodzieniec, Poland.

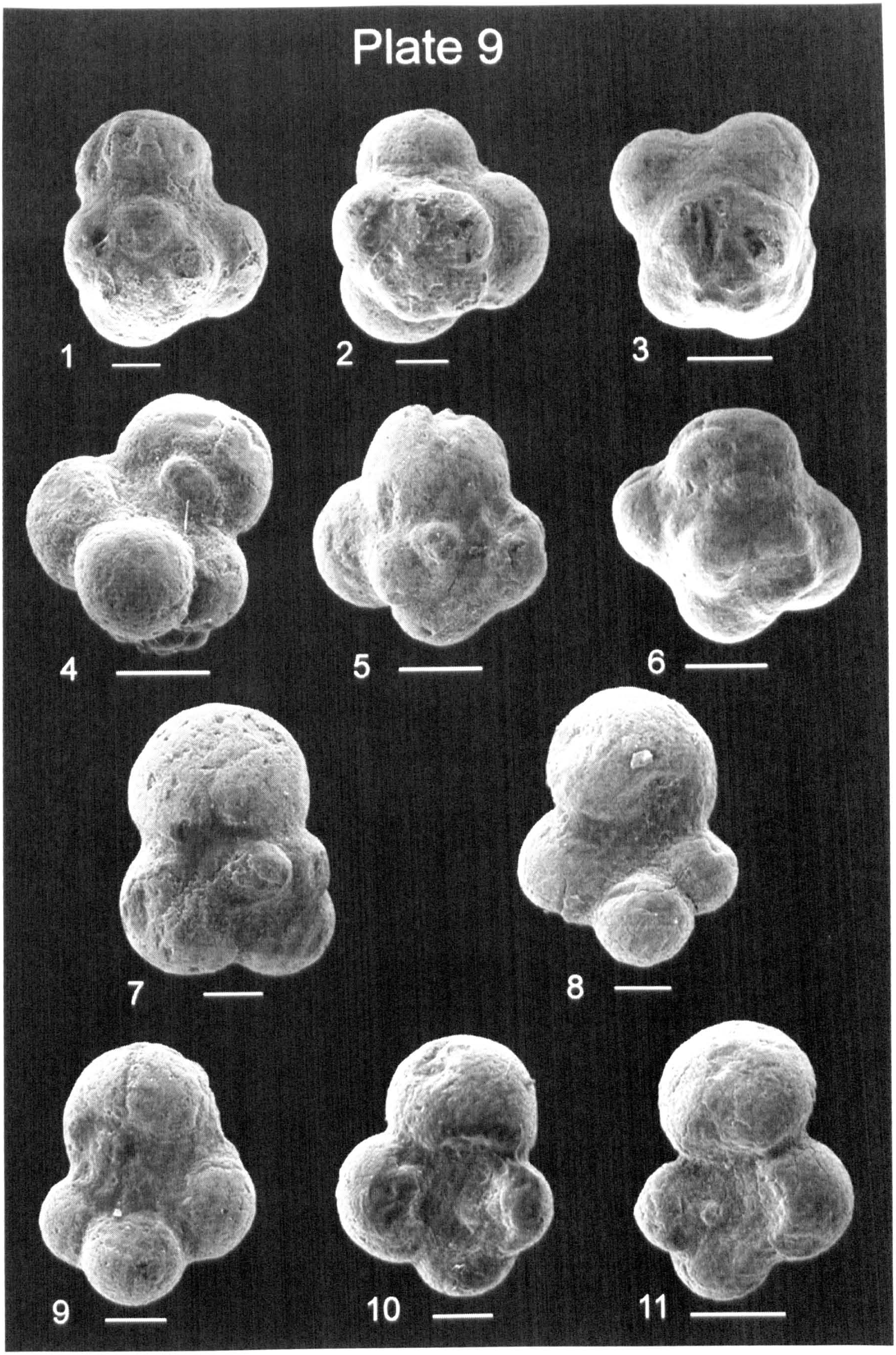


Plate 9

Plate 10

1 *Mariannenina multiloculata* Fuchs, 1973; scale bar = 50 µm.

2 *Mariannenina* cf. *nitida* Fuchs, 1973; scale bar = 100 µm.

3 *Mariannenina* cf. *nitida* Fuchs, 1973; scale bar = 100 µm.

4 *Mariannenina* cf. *nitida* Fuchs, 1973; scale bar = 100 µm.

5 *Mariannenina* cf. *nitida* Fuchs, 1973; scale bar = 100 µm.

6 *Woletzina gaurdakensis* Fuchs 1973; scale bar = 50 µm.

7 *Jurassorotalia curva* Fuchs, 1973; scale bar = 100 µm.

8 Unknown benthic, ?*Lenticulina*; scale bar = 100 µm.

9 Unknown benthic; scale bar = 100 µm.

10 Trochospiral benthic; scale bar = 50 µm.

11 Unknown benthic; scale bar = 100 µm.

12 Unknown; scale bar = 50 µm.

All specimens from the Callovian/Oxfordian boundary, Ozgrodzieniec, Poland.

Plate 10

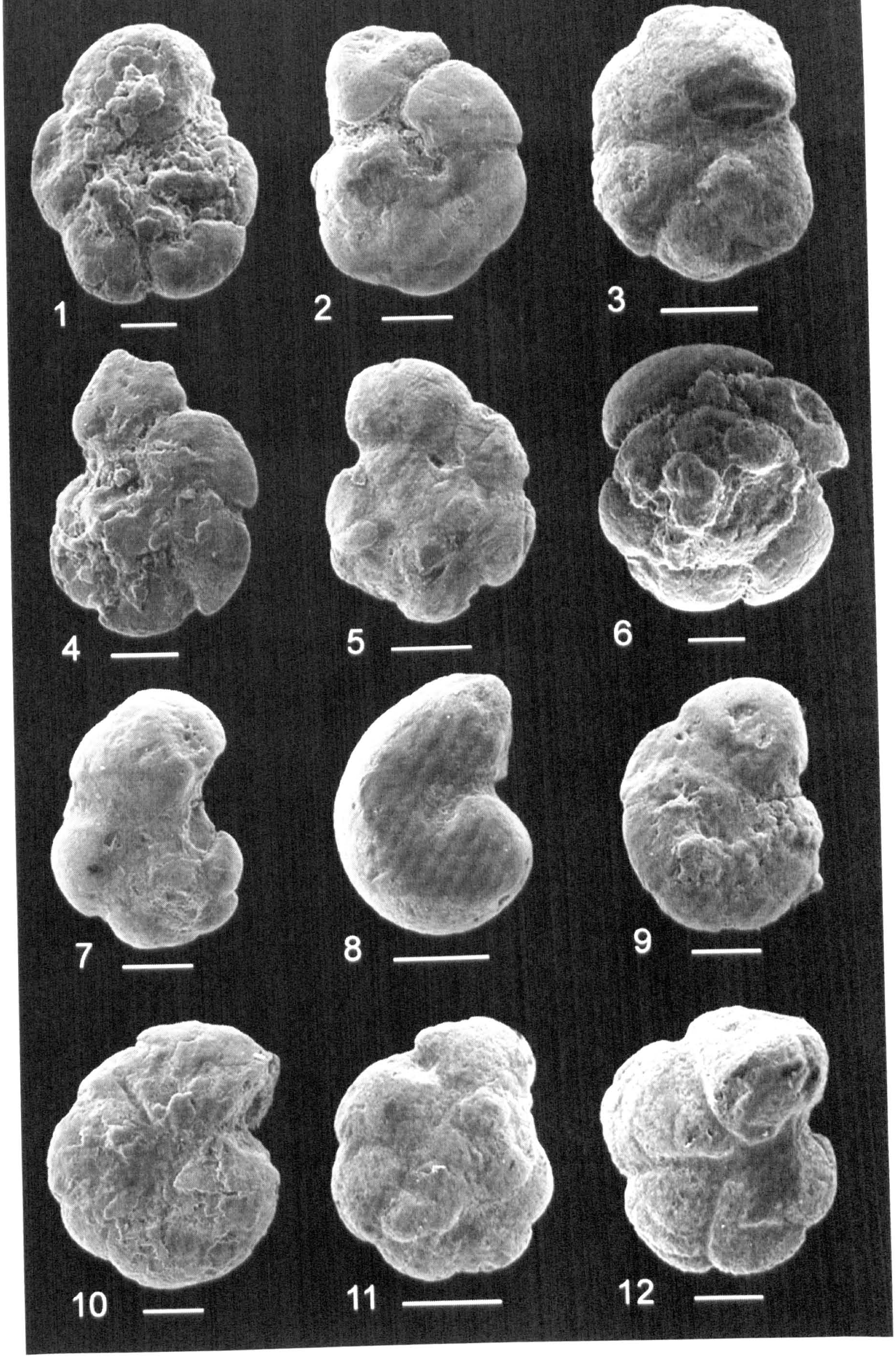


Plate 11

Examples of planktonic foraminifera preserved as pyrite *steinkerns.*

1, 2 *Globuligerina oxfordiana* (Grigelis);

3, 4 *Compactogerina stellapolaris* (Grigelis);

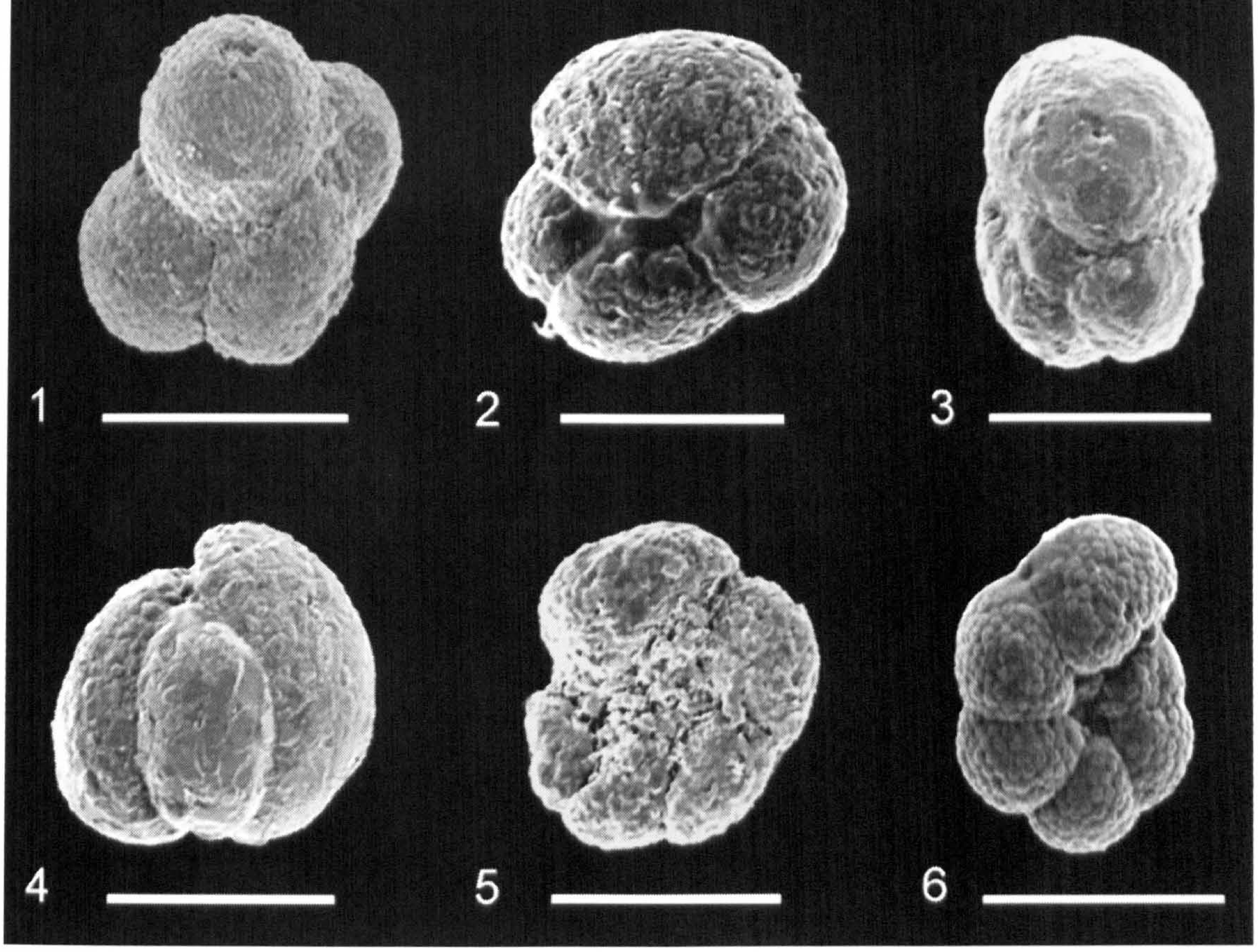
5 unknown form;

6 unknown taxon with distinctive low trochospiral coil, umbilical-extraumbilical aperture and ornamentation; this genus/species is very reminiscent of hedbergellids or praehedbergellids that are previously described from Jurassic strata.

Scale bars = 100 μm.

All specimens from the Mariae Zone, basal Oxfordian, Redcliff, east of Weymouth (Dorset).

Plate 11



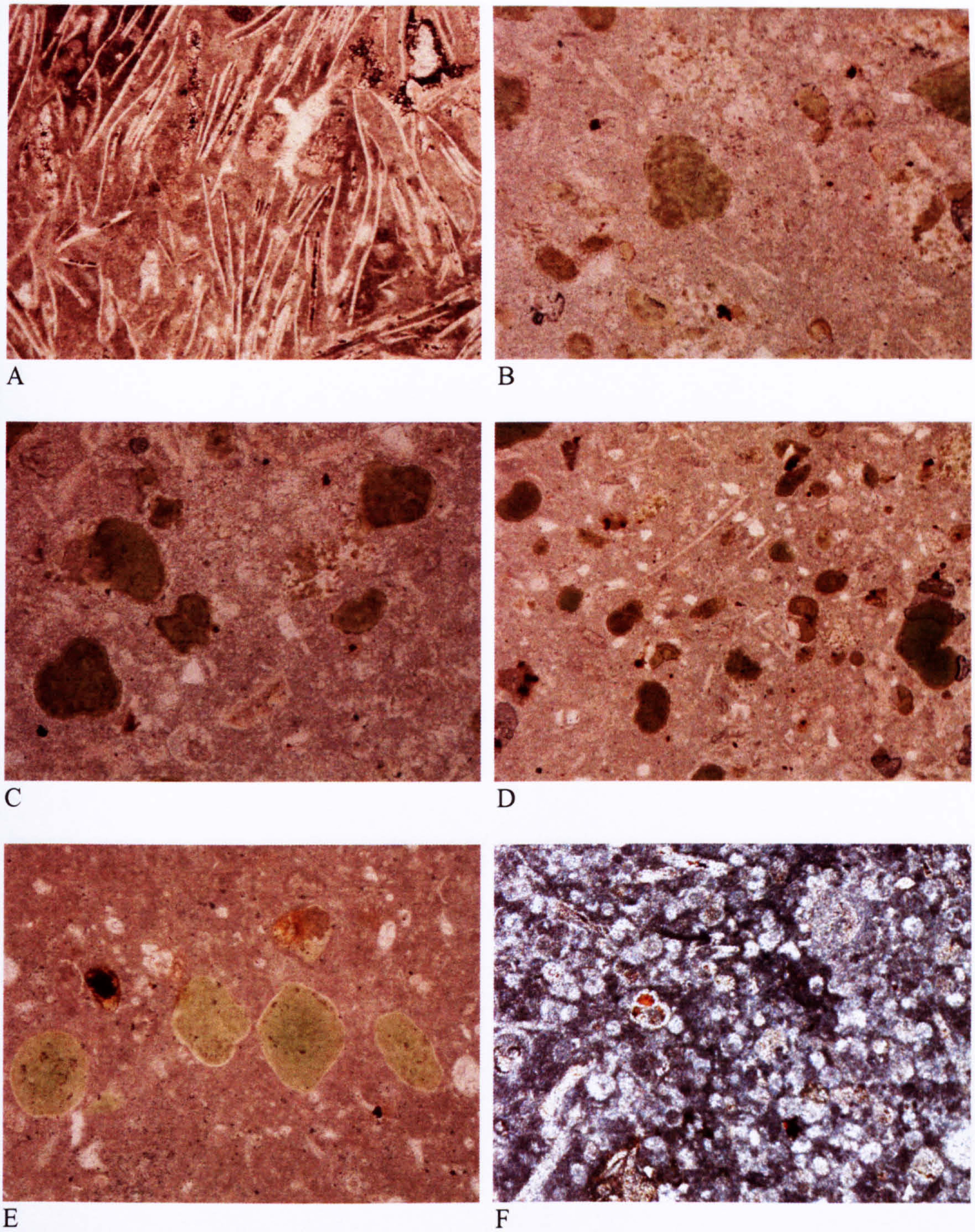


Plate 12. Thin sections from the Ogrodzieniec Quarry. Slide A is dominated by *Bositra*. Slides B-E contain planktonic foraminifera infilled with glauconite. Plates 8-10 show these specimens, now isolated, in the adjacent, less cemented marls. Slide F shows an Fe-stained infilling like those shown in Plate 13. [Field of view for all slides: 3.5 x 2.5 mm.]

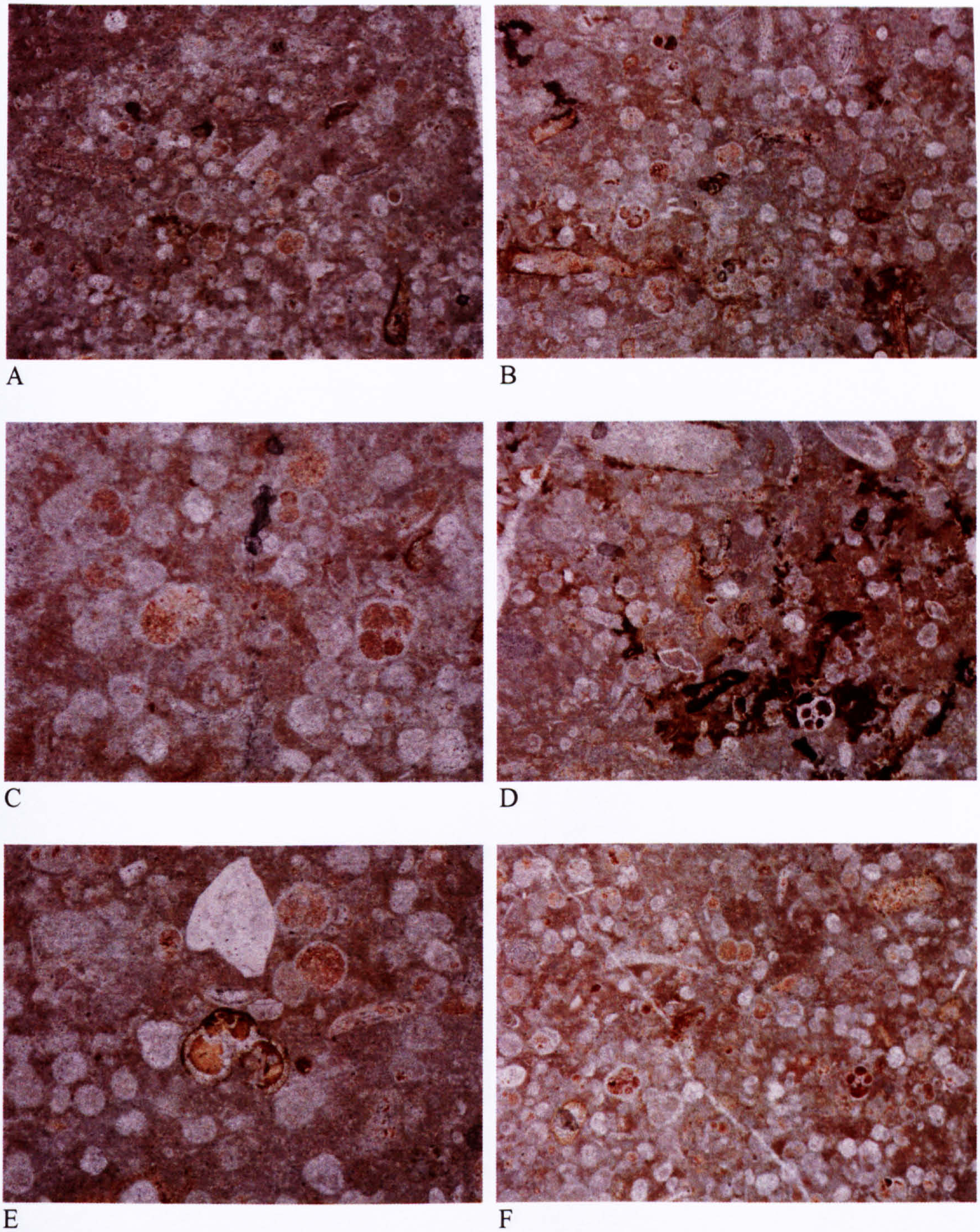


Plate 13. Thin sections from the Ogrodzieniec Quarry. There are a range of planktonic and benthonic foraminifera in the thin sections. Most planktonic foraminifera appear to be infilled with glauconite, now altered to Fe-rich mineral. Some forms (e.g. F) are high spired. [Field of view for all slides: 3.5 x 2.5 mm.]

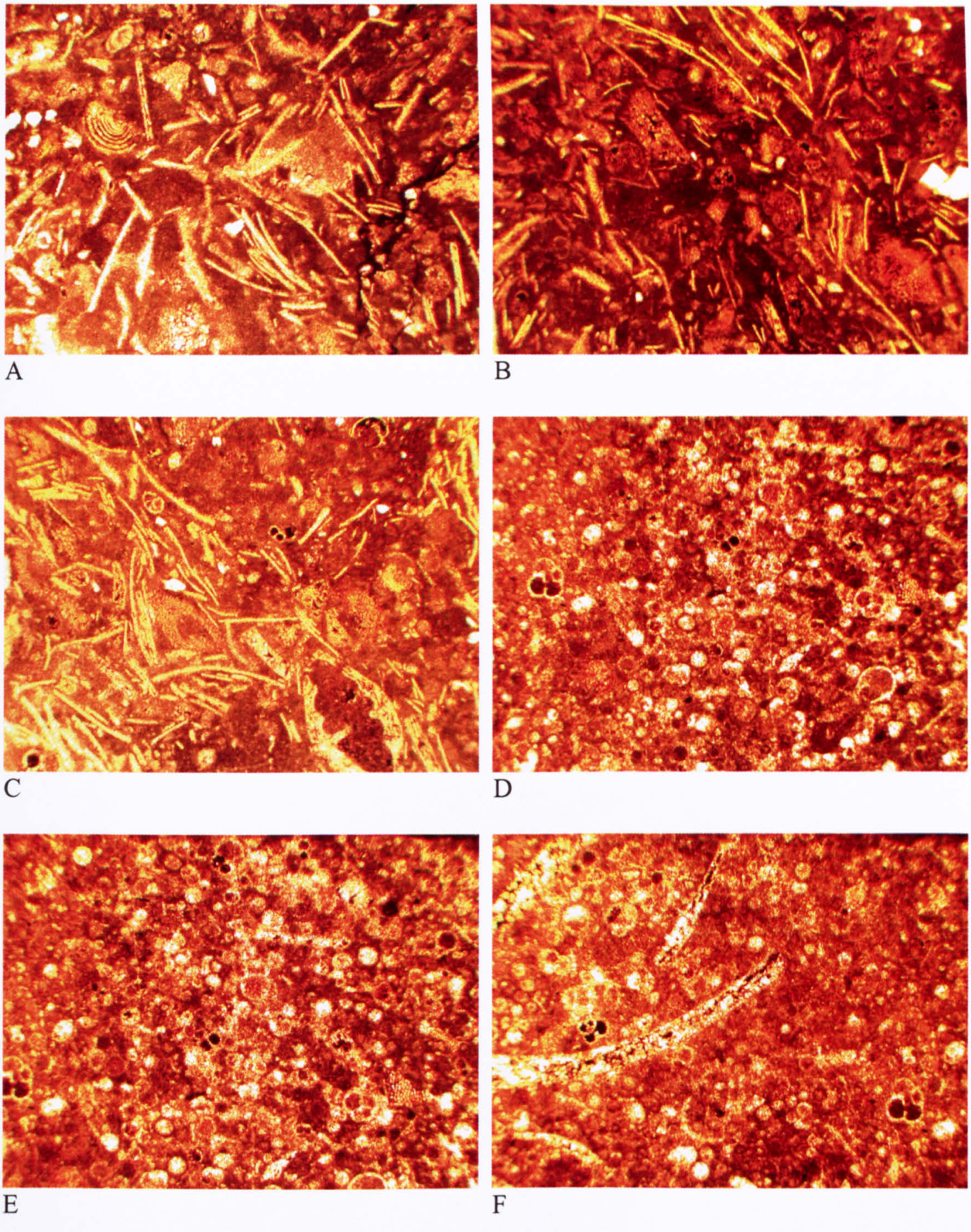


Plate 14. Niedzica Succession: A-D Niedzica Podmajerz - Bed 2 (Lower Bathonian), E-F Czajakowa Skała - Bed 4 (Uppermost Callovian and/or Oxfordian). A variety of species are represented in slides A-D. Slides A and B contain rare planktonic foraminifera with benthonic taxa, *Bositra* and fragmentary macrofossils. Slide C contains only rare planktonic foraminifera, while slide D contains more planktonic taxa but much less macrofossil debris. [Field of view for all slides: 3.5 x 2.5 mm.]

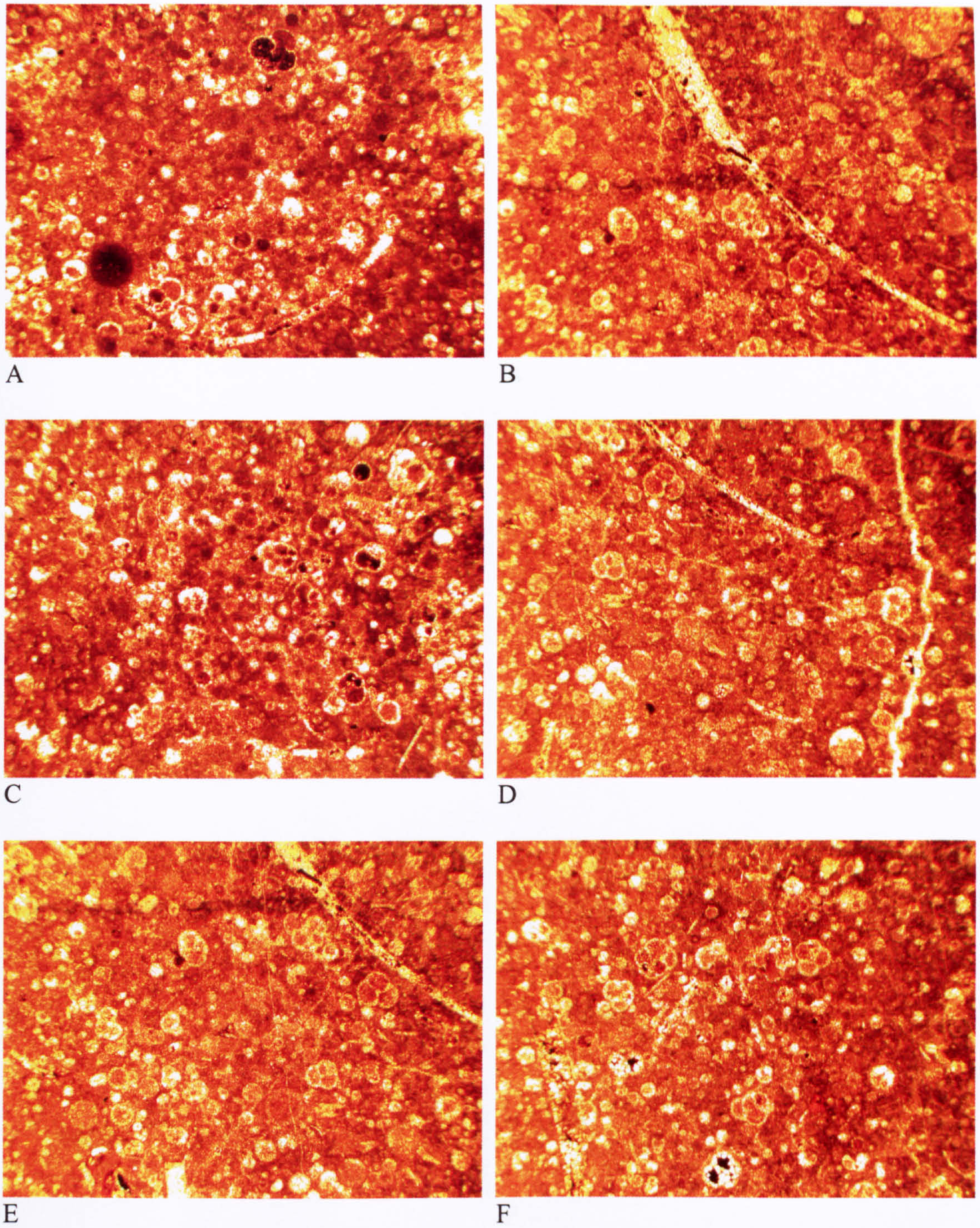


Plate 15. Niedzica Succession: Czajakowa Skała - Bed 4 (Uppermost Callovian and/or Oxfordian). Almost all the thin sections from this succession contain abundant equidimensional planktonic foraminifera. None of the specimens are thick–shelled and most are seen in typical 4-chambered cross-section. [Field of view for all slides: 3.5 x 2.5 mm.]

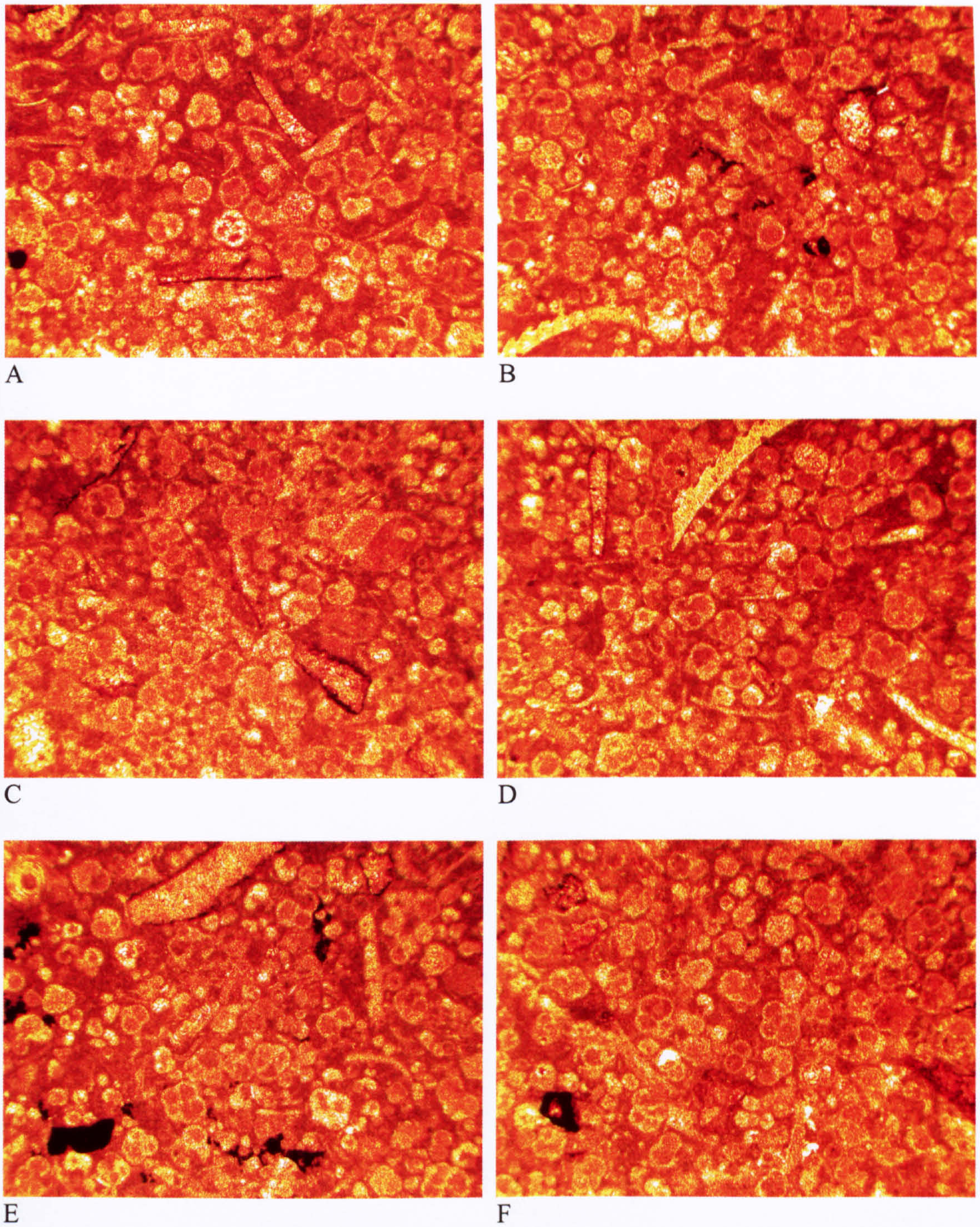


Plate 16. Czorsztyn Succession: Czorsztyn Castle Klippe – Bed 5 (Oxfordian). Almost all the thin sections from this succession contain abundant equi-dimensional planktonic foraminifera. None of the specimens are thick–shelled and most are seen in typical 4-chambered cross-section. In many sections, the rock is a foraminiferal packstone and could almost be described as "foraminiferal ooze". [Field of view for all slides: 3.5 x 2.5 mm.]

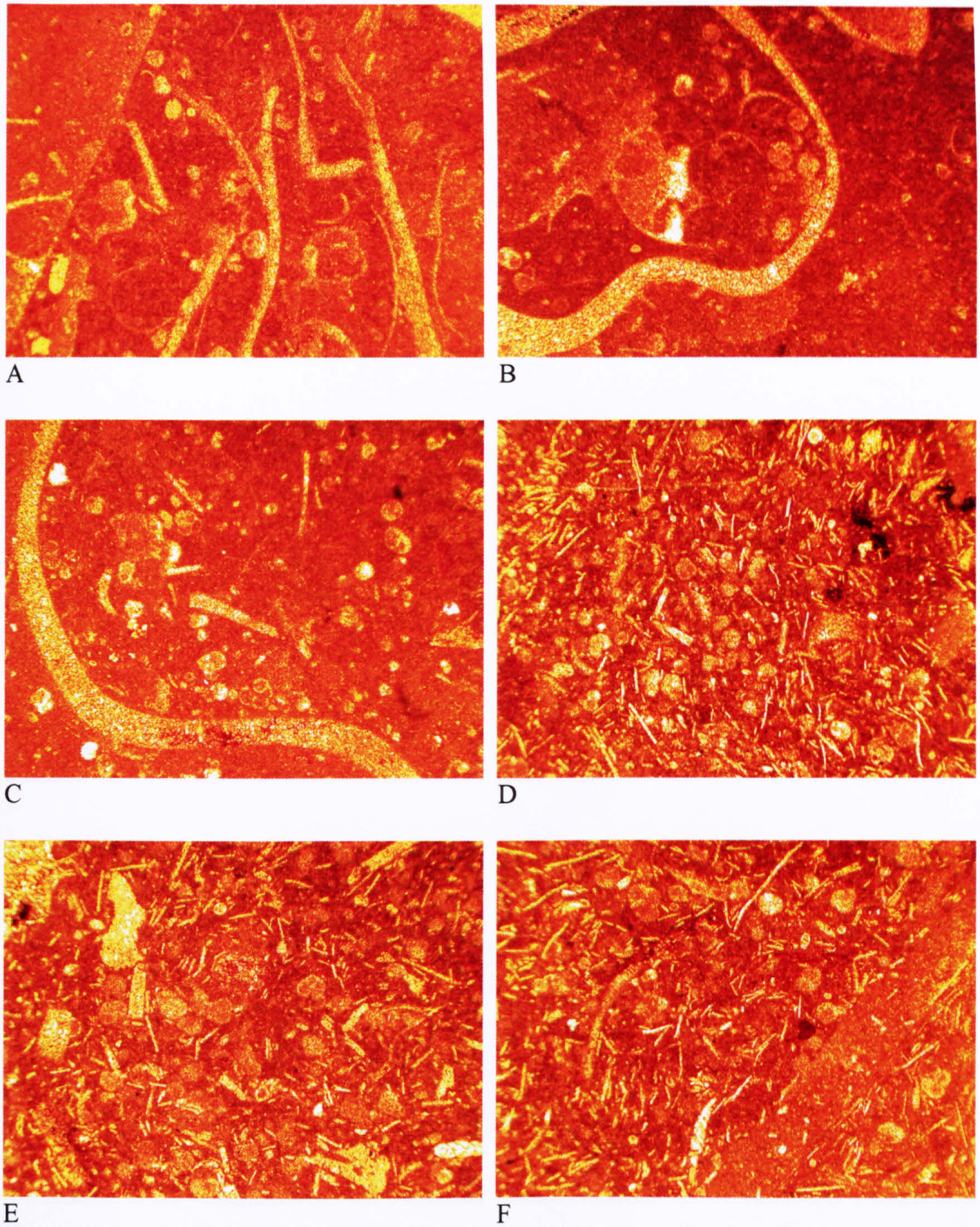


Plate 17. Czorsztyn Succession: A-C Stankowa Skała – Bed 2 (probably Oxfordian), D-F Krupianka Creek - Bed 6 (Kimmeridgian). Sections A-C show fragments of macrofauna, while D-F contain the thin-shelled bivalve *Bositra*. [Field of view for all slides: 3.5 x 2.5 mm.]

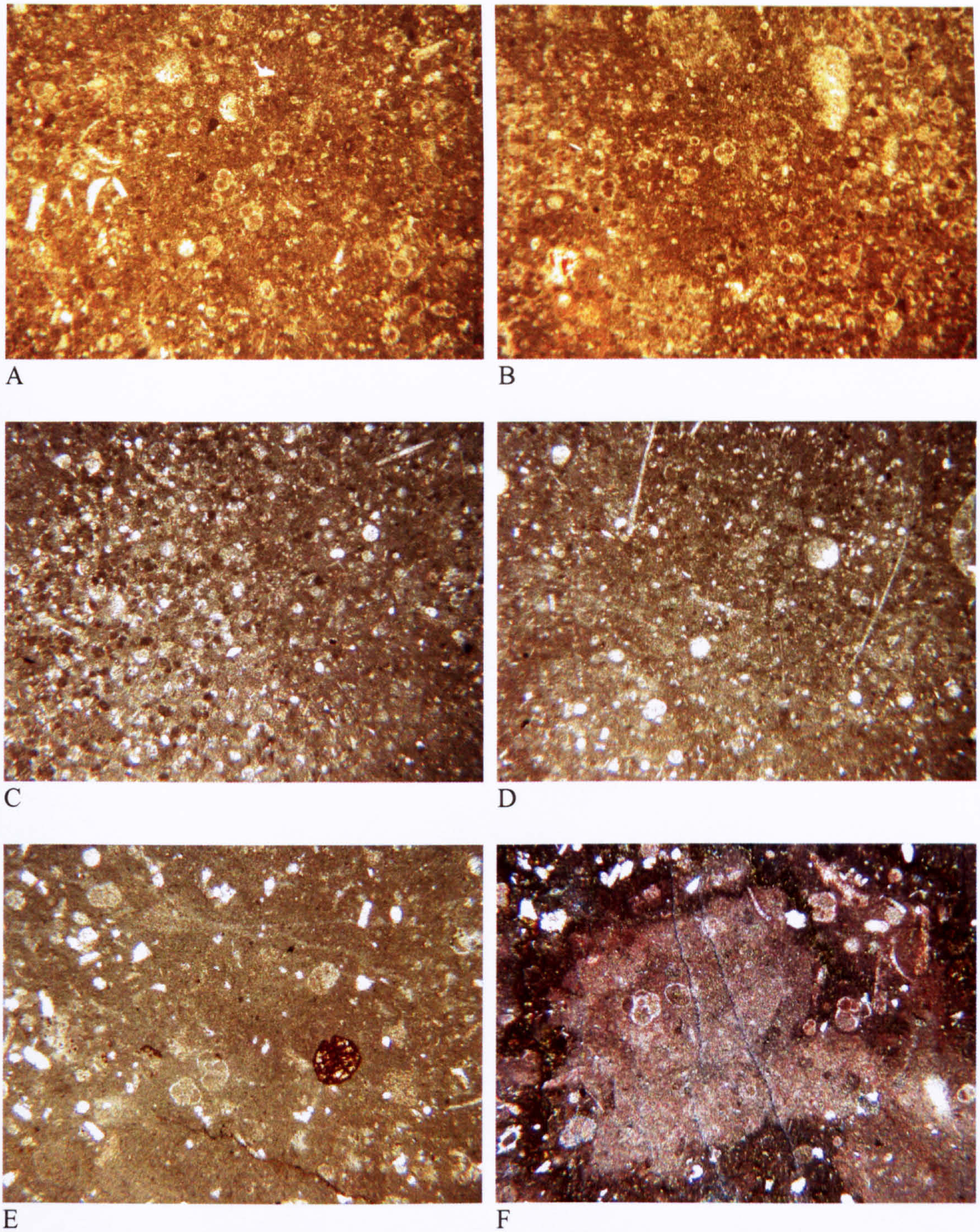


Plate 18. A-B Auenstein, C-F Gantrisch. Planktonic foraminifera are rare and quite small. In some cases, high spired forms are seen (D) but in most sections only the typical 4-chambered cross-section is seen. Thick-shelled forms are not recorded. [Field of view for all slides: 3.5 x 2.5 mm.]

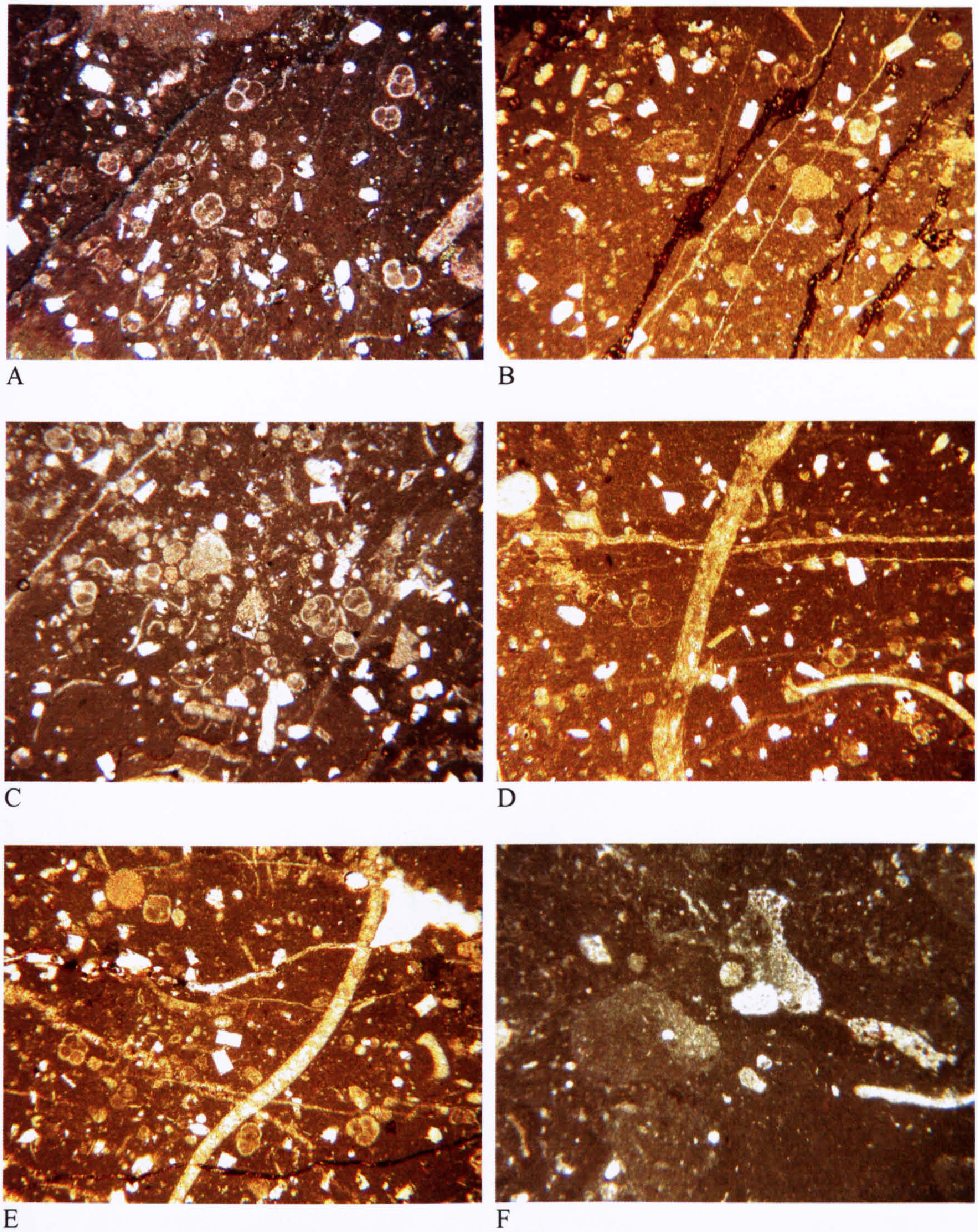


Plate 19. Nissibach. Planktonic foraminifera are rare and quite small. In some cases, high spired forms are seen (D) but in most sections only the typical 4-chambered cross-section is seen. Thick-shelled forms are not recorded. [Field of view for all slides: 3.5 x 2.5 mm.]

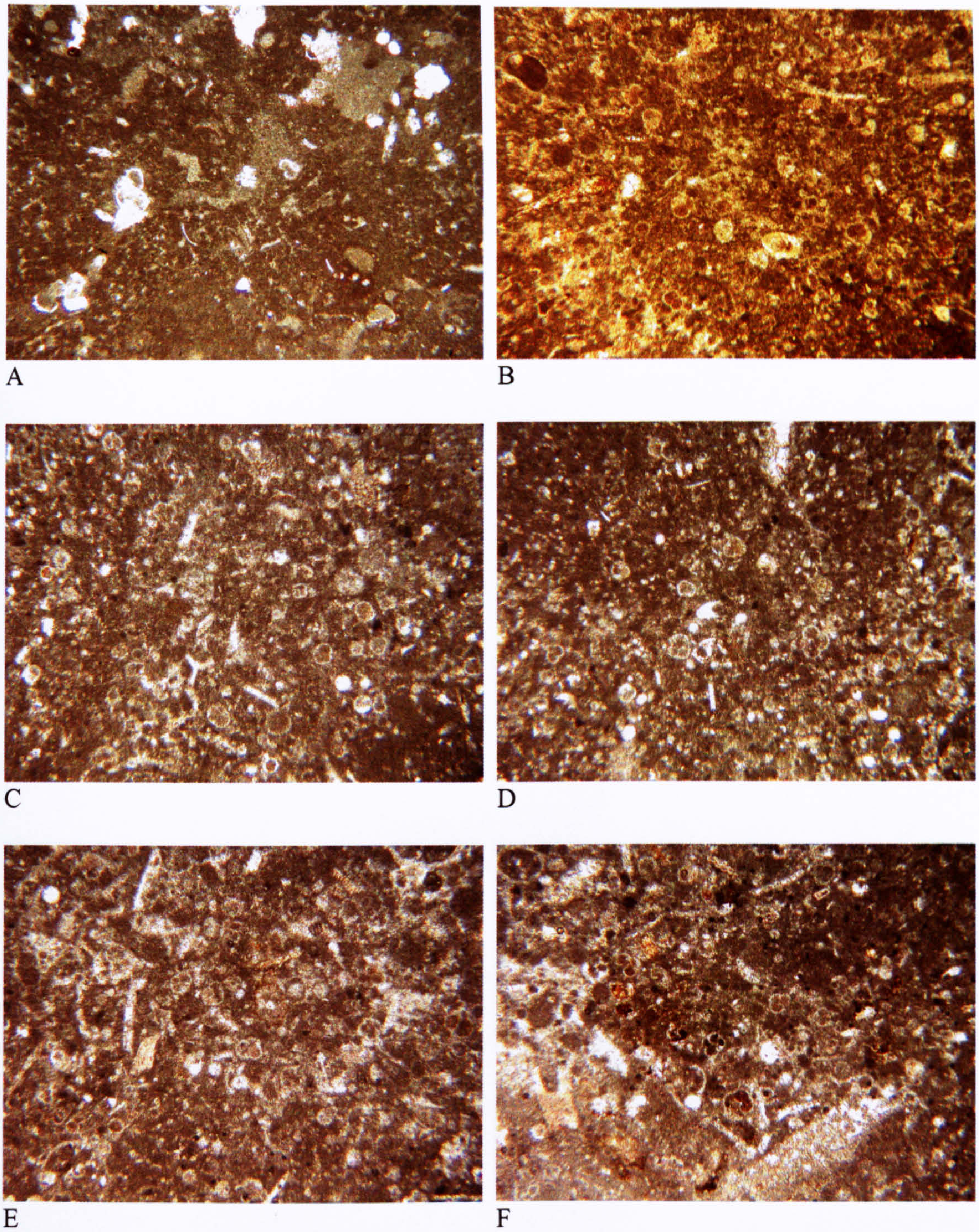


Plate 20. A Nissibach, B-F Madonna della Corona. Planktonic foraminifera are rare and quite small. In some cases they are infilled with Fe-stained carbonate (F). Thick-shelled forms are not recorded. [Field of view for all slides: 3.5 x 2.5 mm.]

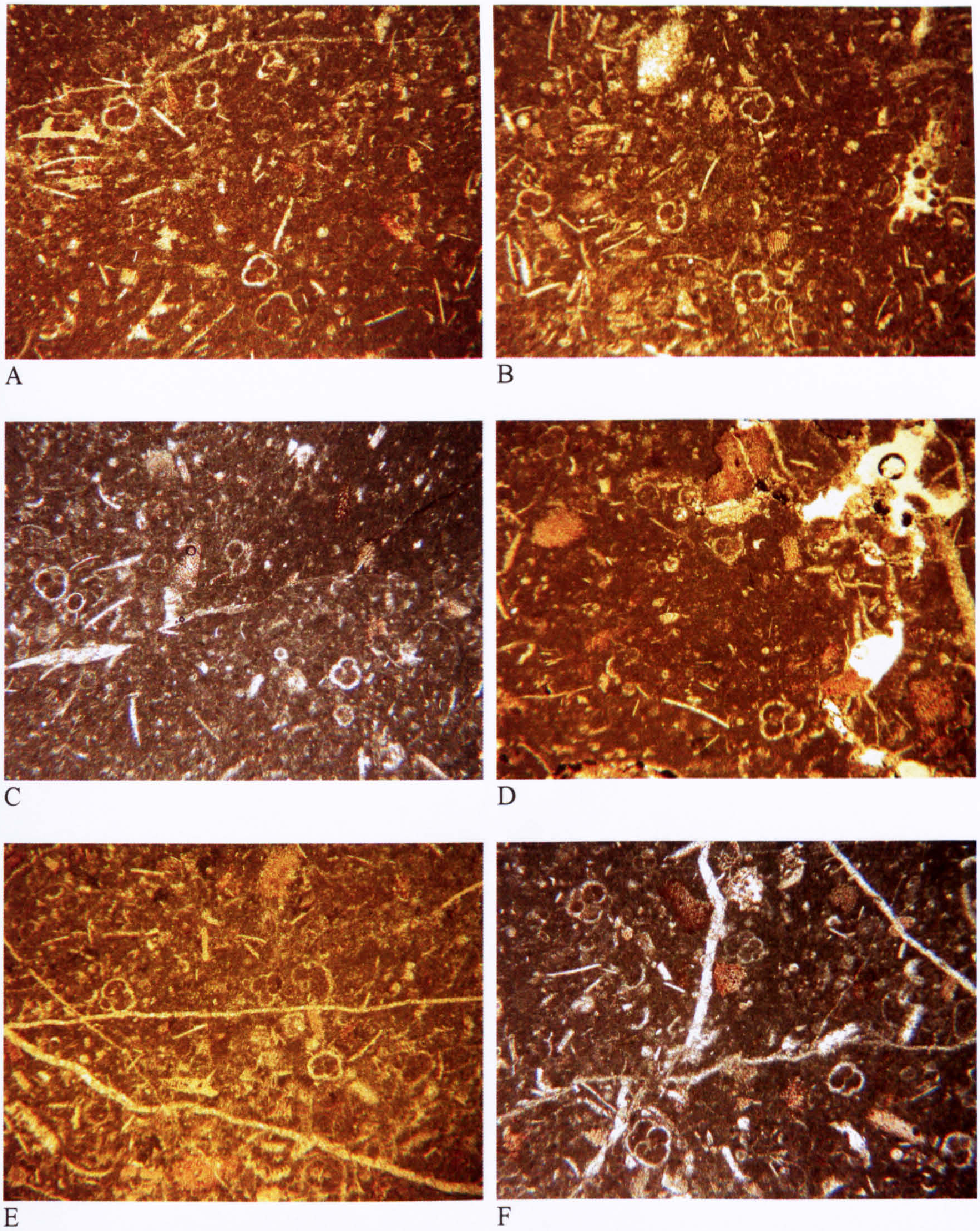


Plate. 21. Thin sections from the Salamis Island showing rare planktonic foraminifera. Both thick- and thin-walled forms are present (C), while all slides have fragments of the bivalve *Bositra*. Some higher spired forms are recorded (F). Many of the thin sections contain calcite veins, which reflect the highly faulted nature of the succession. [Field of view for all slides: 3.5 x 2.5 mm.]

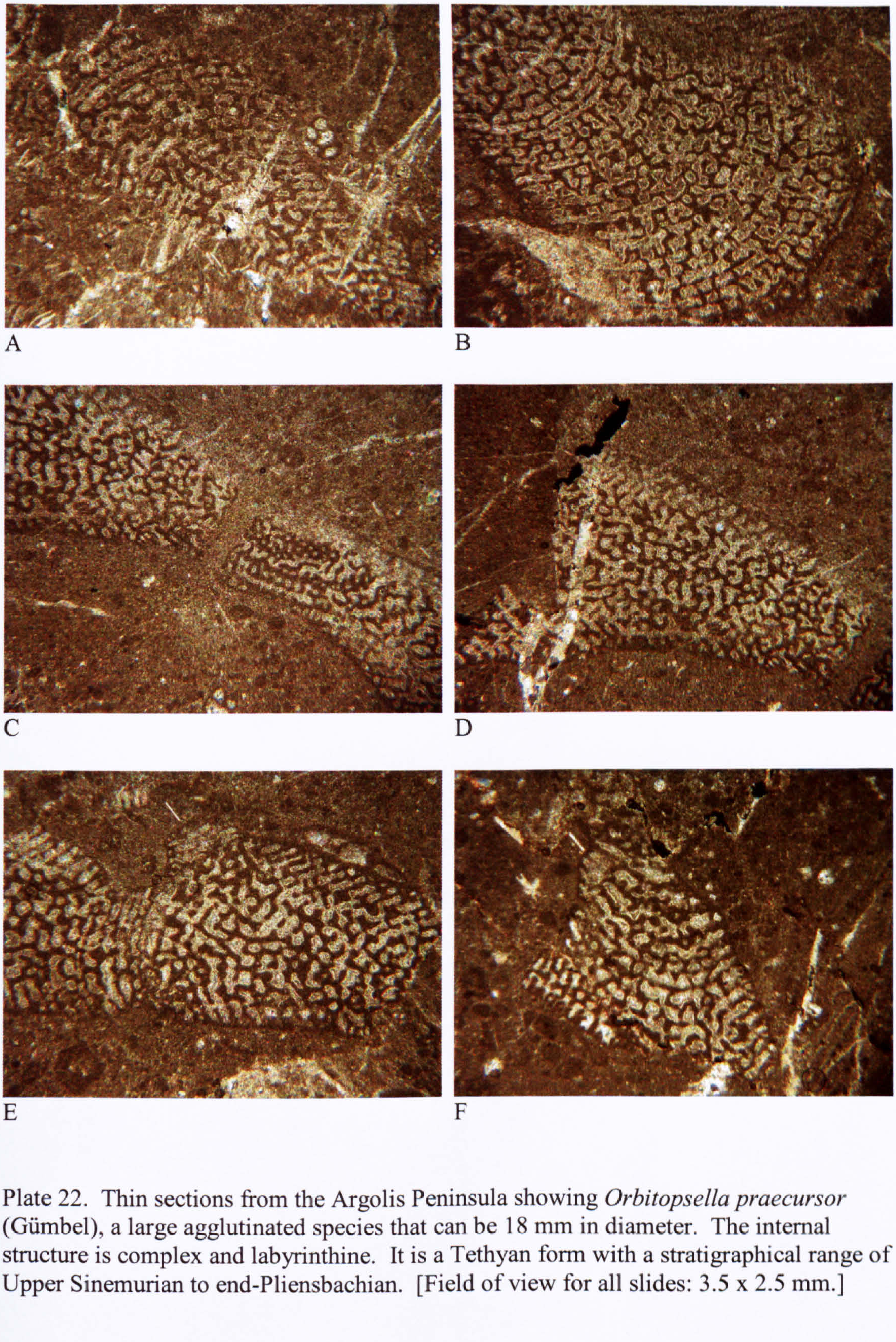


Plate 22. Thin sections from the Argolis Peninsula showing *Orbitopsella praecursor* (Gümbel), a large agglutinated species that can be 18 mm in diameter. The internal structure is complex and labyrinthine. It is a Tethyan form with a stratigraphical range of Upper Sinemurian to end-Pliensbachian. [Field of view for all slides: 3.5 x 2.5 mm.]

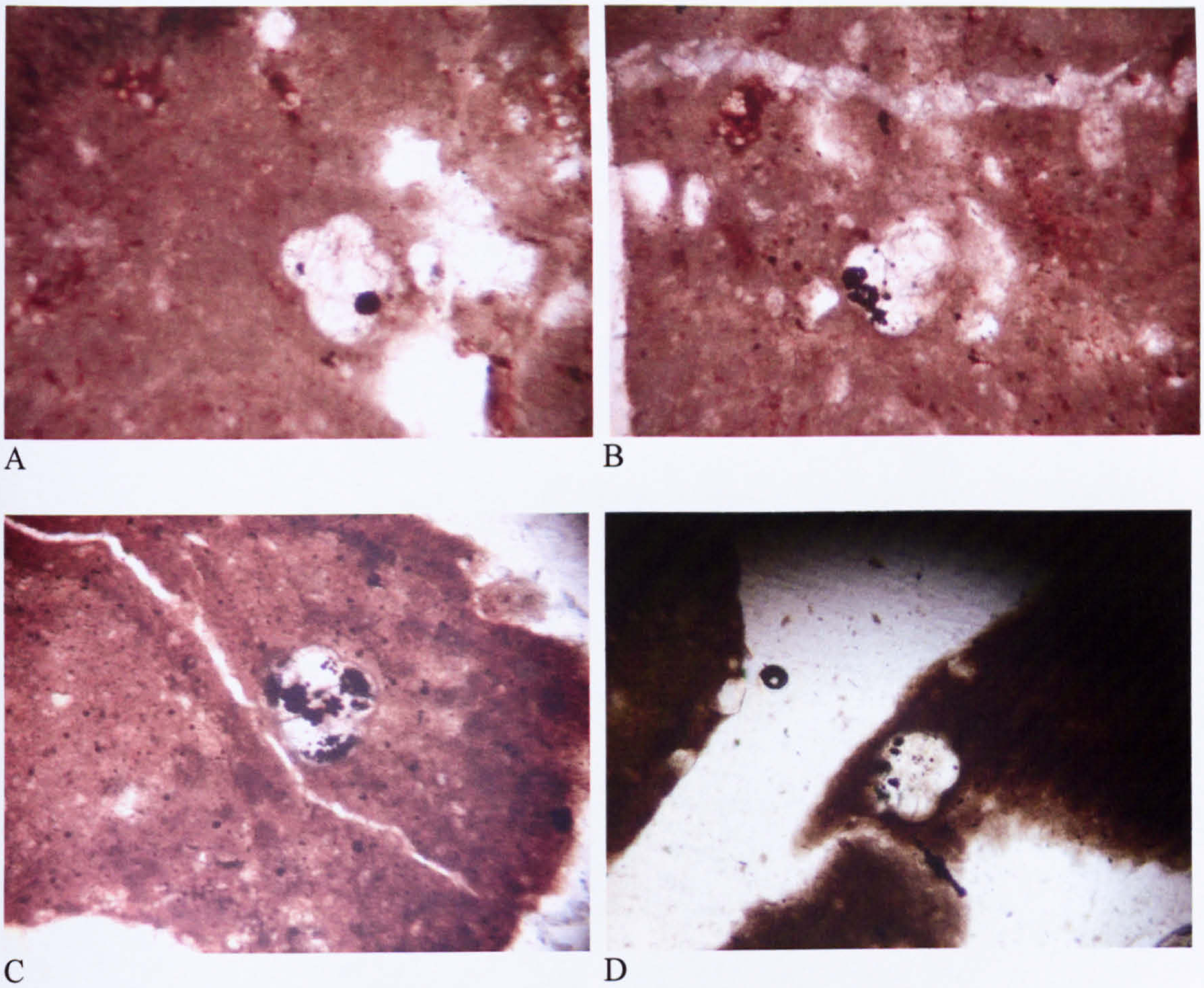


Plate 23. Reported planktonic taxa in thin sections from the Oxfordian of an off-shore borehole in the Sonda de Campeche (Campeche Basin), South-East Mexico. Maximum diameters: A-C = 200 µm; D = 150 µm. (Photographs courtesy of Maria del Carmen Rosales Dominguez, IMP-Bioestratifrafia-Exploracion, 2007).

APPENDIX III

CHAMBER COUNTS AND MEASUREMENT DATA FOR PLANKTONIC FORAMINIFERA IN THIN SECTIONS

SOMHEGY - LAYER BASAL (BAJOCIAN - HUMPHRIESIANUM ZONE)

Thin Section Co-ordinates		No. of Chambers Visible	Max. Diameter (µm)	Wall Thickness (µm)		Species
Vert	Hor			Thick	Thin	
1.5	88.0	3	150.00		12.50	*Globuligerina oxfordiana* (Grigelis)
2.0	89.0	7	200.00		12.50	*Conoglobigerina* aff. *dagestanica* Morozova
2.5	102.0	3	175.00	25.00		*Globuligerina oxfordiana* (Grigelis)
6.0	84.0	4	250.00	25.00		*Globuligerina oxfordiana* (Grigelis)
8.0	111.5	5	325.00	25.00		*Conoglobigerina avariformis* (Kasimova)
9.5	106.5	4	275.00	25.00		*Conoglobigerina avariformis* (Kasimova)
10.0	83.0	3	275.00	25.00		*Conoglobigerina avariformis* (Kasimova)
13.0	94.0	5	300.00		12.50	*Globuligerina bathoniana gigantea* Wemli & Gorog
14.0	95.0	4	200.00		12.50	*Globuligerina oxfordiana* (Grigelis)
14.5	114.0	3	237.50		12.50	*Conoglobigerina* aff. *dagestanica* (Morozova)
15.0	114.0	3	275.00	25.00		*Globuligerina oxfordiana* (Grigelis)
16.0	78.5	3	300.00		12.50	*Globuligerina bathoniana gigantea* (Wemli & Gorog)
18.0	80.0	4	262.50	25.00		*Conoglobigerina avariformis* (Kasimova)
19.0	113.0	4	250.00	25.00		*Globuligerina oxfordiana* (Grigelis)
20.0	100.5	3	275.00	50.00		*Conoglobigerina avariformis* (Kasimova)
20.0	101.0	3	300.00	50.00		*Conoglobigerina avariformis* (Kasimova)
20.0	102.0	3	262.50		18.75	*Globuligerina bathoniana gigantea* (Wemli & Gorog)
21.0	87.5	3	200.00	25.00		*Globuligerina oxfordiana* (Grigelis)
21.0	94.0	3	225.00	37.50		*Globuligerina oxfordiana* (Grigelis)
22.0	112.0	6	275.00	25.00		*Conoglobigerina avariformis* (Kasimova)
22.5	103.0	3	200.00	25.00		*Globuligerina oxfordiana* (Grigelis)
24.5	97.0	3	225.00	25.00		*Globuligerina oxfordiana* (Grigelis)
24.5	97.0	5	275.00	25.00		*Conoglobigerina avariformis* (Kasimova)
25.0	96.5	5	337.50		18.75	*Globuligerina bathoniana gigantea* (Wemli & Gorog)
25.5	84.0	4	225.00	25.00		*Globuligerina oxfordiana* (Grigelis)
26.0	85.0	4	250.00	25.00		*Globuligerina oxfordiana* (Grigelis)
26.0	98.0	3	300.00	50.00		*Conoglobigerina avariformis* (Kasimova)
26.5	84.0	3	200.00	25.00		*Globuligerina oxfordiana* (Grigelis)
29.0	103.5	4	275.00		12.50	*Globuligerina bathoniana gigantea* (Wemli & Gorog)
29.0	110.0	3	150.00		12.50	*Globuligerina oxfordiana* (Grigelis)
29.5	103.5	4	225.00	25.00		*Globuligerina oxfordiana* (Grigelis)
29.5	90.0	3	275.00	37.50		*Conoglobigerina avariformis* (Kasimova)
29.5	89.0	4	250.00	25.00		*Globuligerina oxfordiana* (Grigelis)
30.0	86.0	3	212.50		18.75	*Conoglobigerina* aff. *dagestanica* (Morozova)
31.0	93.0	5	312.50	50.00		*Conoglobigerina avariformis* (Kasimova)
31.0	94.5	4	225.00		18.75	*Conoglobigerina* aff. *dagestanica* (Morozova)
31.0	95.0	4	250.00		18.75	*Conoglobigerina* aff. *dagestanica* (Morozova)
31.0	96.0	7	175.00		6.25	*Globuligerina oxfordiana* (Grigelis)
Total Number of Specimens				**24**	**14**	**38**
Relative Percentages				**63**	**37**	

SOMHEGY - LAYER H1 (BAJOCIAN - HUMPHRIESIANUM ZONE)

Thin Section Co-ordinates		No. of Chambers Visible	Max. Diameter (µm)	Wall Thickness (µm)		Species
Vert	Hor			Thick	Thin	
10.0	100.0	3	175.0		12.50	*Globuligerina oxfordiana* (Grigelis)
10.0	100.0	6	137.5		12.50	*Globuligerina oxfordiana* (Grigelis)
10.5	107.5	4	125.0		12.50	*Globuligerina oxfordiana* (Grigelis)
10.5	107.0	4	150.0		12.50	*Globuligerina oxfordiana* (Grigelis)
10.5	96.5	3	162.5		12.50	*Globuligerina oxfordiana* (Grigelis)
10.5	94.0	3	137.5		12.50	*Globuligerina oxfordiana* (Grigelis)
10.5	92.5	4	225.0		18.75	*Conoglobigerina* aff. *dagestanica* Morozova
11.0	93.0	6	112.5	25.00		*Globuligerina oxfordiana* (Grigelis)
11.0	106.5	4	150.0		12.50	*Globuligerina oxfordiana* (Grigelis)
12.0	76.5	4	137.5		12.50	*Globuligerina oxfordiana* (Grigelis)
12.0	76.5	3	150.0		12.50	*Globuligerina oxfordiana* (Grigelis)
12.0	79.0	4	125.0		12.50	*Globuligerina oxfordiana* (Grigelis)
12.0	79.5	4	225.0		12.50	*Conoglobigerina* aff. *dagestanica* Morozova
12.0	80.0	4	150.0		12.50	*Globuligerina oxfordiana* (Grigelis)
12.0	82.0	3	125.0		18.75	*Globuligerina oxfordiana* (Grigelis)
12.0	84.0	5	137.5		12.50	*Globuligerina oxfordiana* (Grigelis)
12.0	84.0	4	150.0		12.50	*Globuligerina oxfordiana* (Grigelis)
12.0	87.0	3	150.0		12.50	*Globuligerina oxfordiana* (Grigelis)
12.0	88.0	4	150.0		12.50	*Globuligerina oxfordiana* (Grigelis)
12.0	91.0	3	150.0		12.50	*Globuligerina oxfordiana* (Grigelis)
12.0	93.0	4	125.0		12.50	*Globuligerina oxfordiana* (Grigelis)
12.0	97.5	4	175.0	25.00		*Globuligerina oxfordiana* (Grigelis)
12.0	98.0	3	150.0	25.00		*Globuligerina oxfordiana* (Grigelis)
12.0	99.0	4	150.0		12.50	*Globuligerina oxfordiana* (Grigelis)
12.5	95.0	4	125.0		12.50	*Globuligerina oxfordiana* (Grigelis)
12.5	86.0	3	100.0		6.25	*Globuligerina oxfordiana* (Grigelis)
12.5	82.0	3	125.0		18.75	*Globuligerina oxfordiana* (Grigelis)
12.5	81.5	7	125.0		12.50	*Globuligerina oxfordiana* (Grigelis)
12.5	81.5	3	87.5		12.50	*Globuligerina oxfordiana* (Grigelis)
12.5	81.5	3	100.0		6.25	*Globuligerina oxfordiana* (Grigelis)
12.5	80.0	3	125.0		12.50	*Globuligerina oxfordiana* (Grigelis)
13.0	78.0	3	125.0		12.50	*Globuligerina oxfordiana* (Grigelis)
13.0	83.0	4	175.0		6.25	*Globuligerina oxfordiana* (Grigelis)
13.0	86.5	3	150.0		6.25	*Globuligerina oxfordiana* (Grigelis)
13.0	87.0	4	137.5		18.75	*Globuligerina oxfordiana* (Grigelis)
13.0	96.5	4	75.0		6.25	*Globuligerina oxfordiana* (Grigelis)
13.0	99.5	4	125.0		12.50	*Globuligerina oxfordiana* (Grigelis)
13.5	99.5	7	125.0		12.50	*Globuligerina oxfordiana* (Grigelis)
13.5	96.5	4	137.5		12.50	*Globuligerina oxfordiana* (Grigelis)
13.5	96.0	3	150.0	25.00		*Globuligerina oxfordiana* (Grigelis)
13.5	91.0	5	137.5		12.50	*Globuligerina oxfordiana* (Grigelis)
13.5	91.0	3	162.5		18.75	*Globuligerina oxfordiana* (Grigelis)
13.5	90.0	6	100.0		18.75	*Globuligerina oxfordiana* (Grigelis)
13.5	90.0	4	100.0		18.75	*Globuligerina oxfordiana* (Grigelis)
13.5	85.0	3	100.0		12.50	*Globuligerina oxfordiana* (Grigelis)
13.5	81.0	3	162.5		12.50	*Globuligerina oxfordiana* (Grigelis)
13.5	77.5	3	112.5		12.50	*Globuligerina oxfordiana* (Grigelis)
14.0	73.5	4	100.0		12.50	*Globuligerina oxfordiana* (Grigelis)
14.0	75.0	3	125.0		12.50	*Globuligerina oxfordiana* (Grigelis)
14.0	80.5	3	125.0		12.50	*Globuligerina oxfordiana* (Grigelis)
14.0	81.0	3	125.0		12.50	*Globuligerina oxfordiana* (Grigelis)
14.0	81.0	3	75.0		18.75	*Globuligerina oxfordiana* (Grigelis)
14.0	83.0	3	150.0	25.00		*Globuligerina oxfordiana* (Grigelis)
14.0	84.0	3	150.0		12.50	*Globuligerina oxfordiana* (Grigelis)
14.0	85.0	4	125.0		12.50	*Globuligerina oxfordiana* (Grigelis)

SOMHEGY - LAYER H1 (BAJOCIAN - HUMPHRIESIANUM ZONE)

Thin Section Co-ordinates		No. of Chambers Visible	Max. Diameter (µm)	Wall Thickness (µm)		Species
Vert	Hor			Thick	Thin	
14.0	85.0	3	125.0		6.25	*Globuligerina oxfordiana* (Grigelis)
14.0	86.5	4	162.5		6.25	*Globuligerina oxfordiana* (Grigelis)
14.0	86.5	6	162.5		6.25	*Globuligerina oxfordiana* (Grigelis)
14.0	94.0	3	200.0		18.75	*Conoglobigerina* aff. *dagestanica* Morozova
15.0	96.0	4	137.5		18.75	*Globuligerina oxfordiana* (Grigelis)
16.0	75.5	3	125.0		18.75	*Globuligerina oxfordiana* (Grigelis)
16.0	76.0	4	125.0		12.50	*Globuligerina oxfordiana* (Grigelis)
16.0	79.0	4	150.0		12.50	*Globuligerina oxfordiana* (Grigelis)
16.5	79.0	5	150.0		12.50	*Globuligerina oxfordiana* (Grigelis)
16.5	78.0	3	200.0		12.50	*Conoglobigerina* aff. *dagestanica* Morozova
16.5	72.5	3	125.0		12.50	*Globuligerina oxfordiana* (Grigelis)
17.0	70.5	3	150.0		6.25	*Globuligerina oxfordiana* (Grigelis)
17.0	73.0	3	150.0		6.25	*Globuligerina oxfordiana* (Grigelis)
17.0	80.0	3	112.5		6.25	*Globuligerina oxfordiana* (Grigelis)
17.0	90.0	4	175.0		12.50	*Globuligerina oxfordiana* (Grigelis)
17.0	110.5	3	112.5	25.00		*Globuligerina oxfordiana* (Grigelis)
17.0	110.5	3	125.0	25.00		*Globuligerina oxfordiana* (Grigelis)
17.0	111.0	5	125.0		18.75	*Globuligerina oxfordiana* (Grigelis)
17.0	111.5	3	125.0		12.50	*Globuligerina oxfordiana* (Grigelis)
17.0	112.0	3	100.0		12.50	*Globuligerina oxfordiana* (Grigelis)
17.0	112.0	5	150.0		12.50	*Globuligerina oxfordiana* (Grigelis)
17.0	113.5	4	200.0		18.75	*Conoglobigerina* aff. *dagestanica* Morozova
17.5	112.0	3	150.0		18.75	*Globuligerina oxfordiana* (Grigelis)
17.5	75.5	3	137.5		12.50	*Globuligerina oxfordiana* (Grigelis)
17.5	73.5	4	150.0		6.25	*Globuligerina oxfordiana* (Grigelis)
18.0	75.0	3	150.0		18.75	*Globuligerina oxfordiana* (Grigelis)
18.0	75.0	3	200.0		12.50	*Conoglobigerina* aff. *dagestanica* Morozova
18.0	76.0	3	137.5		12.50	*Globuligerina oxfordiana* (Grigelis)
18.0	77.0	3	175.0		6.25	*Globuligerina oxfordiana* (Grigelis)
18.0	77.5	3	125.0		6.25	*Globuligerina oxfordiana* (Grigelis)
18.0	79.5	3	162.5		12.50	*Globuligerina oxfordiana* (Grigelis)
18.0	80.0	4	150.0		18.75	*Globuligerina oxfordiana* (Grigelis)
18.0	110.0	4	150.0		18.75	*Globuligerina oxfordiana* (Grigelis)
18.0	112.0	3	175.0		12.50	*Globuligerina oxfordiana* (Grigelis)
18.0	112.0	4	150.0		12.50	*Globuligerina oxfordiana* (Grigelis)
18.0	112.0	3	150.0		18.75	*Globuligerina oxfordiana* (Grigelis)
18.0	113.5	4	150.0		18.75	*Globuligerina oxfordiana* (Grigelis)
18.5	116.5	4	162.5		18.75	*Globuligerina oxfordiana* (Grigelis)
18.5	112.0	4	150.0		18.75	*Globuligerina oxfordiana* (Grigelis)
18.5	109.5	3	125.0		12.50	*Globuligerina oxfordiana* (Grigelis)
18.5	79.5	4	125.0		12.50	*Globuligerina oxfordiana* (Grigelis)
19.0	65.0	5	112.5		18.75	*Globuligerina oxfordiana* (Grigelis)
19.0	65.5	4	100.0		12.50	*Globuligerina oxfordiana* (Grigelis)
19.0	70.5	3	200.0		6.25	*Conoglobigerina* aff. *dagestanica* Morozova
19.0	71.0	3	100.0		12.50	*Globuligerina oxfordiana* (Grigelis)
19.0	73.0	3	100.0		12.50	*Globuligerina oxfordiana* (Grigelis)
19.0	77.0	3	125.0	25.00		*Globuligerina oxfordiana* (Grigelis)
19.0	107.5	3	150.0		12.50	*Globuligerina oxfordiana* (Grigelis)
19.0	107.5	3	125.0		12.50	*Globuligerina oxfordiana* (Grigelis)
19.0	109.5	6	175.0		18.75	*Globuligerina oxfordiana* (Grigelis)
19.0	112.0	4	200.0		12.50	*Conoglobigerina* aff. *dagestanica* Morozova
19.0	112.5	4	150.0		18.75	*Globuligerina oxfordiana* (Grigelis)
19.5	109.5	4	150.0		12.50	*Globuligerina oxfordiana* (Grigelis)
19.5	109.0	5	150.0		18.75	*Globuligerina oxfordiana* (Grigelis)
19.5	109.0	4	125.0		12.50	*Globuligerina oxfordiana* (Grigelis)

SOMHEGY - LAYER H1 (BAJOCIAN - HUMPHRIESIANUM ZONE)

Thin Section Co-ordinates		No. of Chambers Visible	Max. Diameter (µm)	Wall Thickness (µm)		Species
Vert	Hor			Thick	Thin	
19.5	109.0	4	125.0		12.50	*Globuligerina oxfordiana* (Grigelis)
19.5	108.5	4	125.0		12.50	*Globuligerina oxfordiana* (Grigelis)
19.5	107.0	4	150.0		18.75	*Globuligerina oxfordiana* (Grigelis)
19.5	106.5	3	150.0	25.00		*Globuligerina oxfordiana* (Grigelis)
19.5	77.0	3	150.0		12.50	*Globuligerina oxfordiana* (Grigelis)
19.5	70.0	3	137.5		6.25	*Globuligerina oxfordiana* (Grigelis)
19.5	70.0	3	137.5		12.50	*Globuligerina oxfordiana* (Grigelis)
19.5	69.0	3	150.0		18.75	*Globuligerina oxfordiana* (Grigelis)
19.5	66.5	4	125.0		6.25	*Globuligerina oxfordiana* (Grigelis)
19.5	66.5	3	125.0		12.50	*Globuligerina oxfordiana* (Grigelis)
19.5	66.0	3	125.0		6.25	*Globuligerina oxfordiana* (Grigelis)
19.5	65.5	4	125.0		12.50	*Globuligerina oxfordiana* (Grigelis)
20.0	62.5	4	175.0		12.50	*Globuligerina oxfordiana* (Grigelis)
20.0	64.5	6	100.0		6.25	*Globuligerina oxfordiana* (Grigelis)
20.0	66.0	6	162.5		6.25	*Globuligerina oxfordiana* (Grigelis)
20.0	66.0	4	112.5		12.50	*Globuligerina oxfordiana* (Grigelis)
20.0	66.0	3	125.0		12.50	*Globuligerina oxfordiana* (Grigelis)
20.0	66.5	3	100.0		18.75	*Globuligerina oxfordiana* (Grigelis)
20.0	68.5	3	100.0		12.50	*Globuligerina oxfordiana* (Grigelis)
20.0	69.5	3	150.0		12.50	*Globuligerina oxfordiana* (Grigelis)
20.0	69.5	4	125.0		12.50	*Globuligerina oxfordiana* (Grigelis)
20.0	69.5	3	137.5		12.50	*Globuligerina oxfordiana* (Grigelis)
20.0	70.0	4	162.5		12.50	*Globuligerina oxfordiana* (Grigelis)
20.0	70.0	3	125.0		12.50	*Globuligerina oxfordiana* (Grigelis)
20.0	71.0	3	175.0		12.50	*Globuligerina oxfordiana* (Grigelis)
20.0	72.0	3	125.0		18.75	*Globuligerina oxfordiana* (Grigelis)
20.0	72.0	3	175.0		12.50	*Globuligerina oxfordiana* (Grigelis)
20.0	75.0	4	225.0		12.50	*Conoglobigerina* aff. *dagestanica* Morozova
20.0	76.5	3	150.0		12.50	*Globuligerina oxfordiana* (Grigelis)
20.0	77.0	3	137.5		18.75	*Globuligerina oxfordiana* (Grigelis)
20.0	81.0	4	175.0		12.50	*Globuligerina oxfordiana* (Grigelis)
20.0	81.0	5	175.0		6.25	*Globuligerina oxfordiana* (Grigelis)
20.0	81.0	5	175.0		12.50	*Globuligerina oxfordiana* (Grigelis)
20.0	82.5	3	150.0		18.75	*Globuligerina oxfordiana* (Grigelis)
20.0	82.5	3	150.0		18.75	*Globuligerina oxfordiana* (Grigelis)
20.0	85.5	3	175.0		6.25	*Globuligerina oxfordiana* (Grigelis)
20.0	104.5	3	125.0	25.00		*Globuligerina oxfordiana* (Grigelis)
20.0	104.5	3	125.0	25.00		*Globuligerina oxfordiana* (Grigelis)
20.0	105.5	5	150.0		18.75	*Globuligerina oxfordiana* (Grigelis)
20.0	107.0	4	150.0		12.50	*Globuligerina oxfordiana* (Grigelis)
20.0	108.0	3	125.0		12.50	*Globuligerina oxfordiana* (Grigelis)
20.0	108.5	4	150.0		12.50	*Globuligerina oxfordiana* (Grigelis)
20.0	109.5	3	150.0	25.00		*Globuligerina oxfordiana* (Grigelis)
20.0	109.5	4	175.0		12.50	*Globuligerina oxfordiana* (Grigelis)
20.0	109.5	4	150.0		12.50	*Globuligerina oxfordiana* (Grigelis)
20.0	109.5	4	125.0		18.75	*Globuligerina oxfordiana* (Grigelis)
20.0	111.5	4	175.0		18.75	*Globuligerina oxfordiana* (Grigelis)
20.0	112.0	3	150.0		18.75	*Globuligerina oxfordiana* (Grigelis)
20.0	113.0	3	150.0		12.50	*Globuligerina oxfordiana* (Grigelis)
20.0	117.0	4	200.0		18.75	*Conoglobigerina* aff. *dagestanica* Morozova
20.5	109.0	5	200.0		12.50	*Conoglobigerina* aff. *dagestanica* Morozova
20.5	107.0	3	175.0		12.50	*Globuligerina oxfordiana* (Grigelis)
20.5	103.5	5	175.0		18.75	*Globuligerina oxfordiana* (Grigelis)
20.5	76.5	3	175.0		12.50	*Globuligerina oxfordiana* (Grigelis)
20.5	72.5	4	125.0		12.50	*Globuligerina oxfordiana* (Grigelis)

SOMHEGY - LAYER H1 (BAJOCIAN - HUMPHRIESIANUM ZONE)

Thin Section Co-ordinates		No. of Chambers Visible	Max. Diameter (µm)	Wall Thickness (µm)		Species
Vert	Hor			Thick	Thin	
20.5	71.5	5	150.0		6.25	*Globuligerina oxfordiana* (Grigelis)
20.5	71.0	3	150.0		6.25	*Globuligerina oxfordiana* (Grigelis)
20.5	66.5	4	100.0		18.75	*Globuligerina oxfordiana* (Grigelis)
20.5	65.0	3	125.0		12.50	*Globuligerina oxfordiana* (Grigelis)
20.5	63.0	4	175.0		12.50	*Globuligerina oxfordiana* (Grigelis)
21.0	63.5	3	112.5		12.50	*Globuligerina oxfordiana* (Grigelis)
21.0	64.0	6	125.0		12.50	*Globuligerina oxfordiana* (Grigelis)
21.0	64.5	4	125.0		12.50	*Globuligerina oxfordiana* (Grigelis)
21.0	64.5	4	125.0		12.50	*Globuligerina oxfordiana* (Grigelis)
21.0	64.5	4	150.0		12.50	*Globuligerina oxfordiana* (Grigelis)
21.0	65.0	4	150.0		12.50	*Globuligerina oxfordiana* (Grigelis)
21.0	72.0	4	150.0		12.50	*Globuligerina oxfordiana* (Grigelis)
21.0	103.5	3	100.0		12.50	*Globuligerina oxfordiana* (Grigelis)
21.0	104.5	3	150.0		18.75	*Globuligerina oxfordiana* (Grigelis)
21.0	105.5	4	150.0		18.75	*Globuligerina oxfordiana* (Grigelis)
21.0	107.0	3	125.0		12.50	*Globuligerina oxfordiana* (Grigelis)
21.0	109.5	3	150.0		18.75	*Globuligerina oxfordiana* (Grigelis)
21.0	110.0	3	150.0		12.50	*Globuligerina oxfordiana* (Grigelis)
21.0	113.0	3	150.0		18.75	*Globuligerina oxfordiana* (Grigelis)
21.0	117.5	4	150.0		18.75	*Globuligerina oxfordiana* (Grigelis)
21.0	118.0	3	225.0	25.00		*Globuligerina oxfordiana* (Grigelis)
21.5	118.0	3	175.0		12.50	*Globuligerina oxfordiana* (Grigelis)
21.5	117.5	4	175.0		12.50	*Globuligerina oxfordiana* (Grigelis)
21.5	117.5	3	150.0		18.75	*Globuligerina oxfordiana* (Grigelis)
21.5	115.5	3	125.0		18.75	*Globuligerina oxfordiana* (Grigelis)
21.5	114.0	5	150.0		12.50	*Globuligerina oxfordiana* (Grigelis)
21.5	110.0	4	175.0		12.50	*Globuligerina oxfordiana* (Grigelis)
21.5	109.0	4	162.5	25.00		*Globuligerina oxfordiana* (Grigelis)
21.5	107.0	3	150.0		12.50	*Globuligerina oxfordiana* (Grigelis)
21.5	107.0	4	150.0		12.50	*Globuligerina oxfordiana* (Grigelis)
21.5	106.0	3	125.0		18.75	*Globuligerina oxfordiana* (Grigelis)
21.5	105.5	4	150.0		12.50	*Globuligerina oxfordiana* (Grigelis)
21.5	105.5	4	150.0		18.75	*Globuligerina oxfordiana* (Grigelis)
21.5	105.5	3	187.5		18.75	*Globuligerina oxfordiana* (Grigelis)
21.5	105.0	4	150.0	25.00		*Globuligerina oxfordiana* (Grigelis)
21.5	104.5	3	125.0		18.75	*Globuligerina oxfordiana* (Grigelis)
21.5	104.0	3	100.0		12.50	*Globuligerina oxfordiana* (Grigelis)
21.5	104.0	4	125.0		18.75	*Globuligerina oxfordiana* (Grigelis)
21.5	103.5	3	150.0		18.75	*Globuligerina oxfordiana* (Grigelis)
21.5	103.5	4	125.0		18.75	*Globuligerina oxfordiana* (Grigelis)
21.5	103.0	3	125.0		12.50	*Globuligerina oxfordiana* (Grigelis)
21.5	102.5	4	175.0		12.50	*Globuligerina oxfordiana* (Grigelis)
21.5	101.5	3	125.0		18.75	*Globuligerina oxfordiana* (Grigelis)
21.5	71.0	3	137.5		12.50	*Globuligerina oxfordiana* (Grigelis)
21.5	63.5	3	162.5		12.50	*Globuligerina oxfordiana* (Grigelis)
22.0	62.0	4	200.0		18.75	*Conoglobigerina* aff. *dagestanica* Morozova
22.0	62.0	4	175.0		12.50	*Globuligerina oxfordiana* (Grigelis)
22.0	64.0	3	137.5		18.75	*Globuligerina oxfordiana* (Grigelis)
22.0	68.0	4	150.0		12.50	*Globuligerina oxfordiana* (Grigelis)
22.0	69.0	3	175.0		12.50	*Globuligerina oxfordiana* (Grigelis)
22.0	70.0	3	125.0		12.50	*Globuligerina oxfordiana* (Grigelis)
22.0	74.0	5	162.5		6.25	*Globuligerina oxfordiana* (Grigelis)
22.0	99.5	3	125.0		12.50	*Globuligerina oxfordiana* (Grigelis)
22.0	100.0	4	125.0		12.50	*Globuligerina oxfordiana* (Grigelis)
22.0	100.5	4	162.5		18.75	*Globuligerina oxfordiana* (Grigelis)

SOMHEGY - LAYER H1 (BAJOCIAN - HUMPHRIESIANUM ZONE)

Thin Section Co-ordinates		No. of Chambers Visible	Max. Diameter (µm)	Wall Thickness (µm)		Species
Vert	Hor			Thick	Thin	
22.0	101.5	4	162.5		18.75	*Globuligerina oxfordiana* (Grigelis)
22.0	103.0	4	137.5		12.50	*Globuligerina oxfordiana* (Grigelis)
22.0	104.5	3	125.0		12.50	*Globuligerina oxfordiana* (Grigelis)
22.0	105.0	3	150.0		18.75	*Globuligerina oxfordiana* (Grigelis)
22.0	105.0	4	150.0		12.50	*Globuligerina oxfordiana* (Grigelis)
22.0	105.0	4	150.0		12.50	*Globuligerina oxfordiana* (Grigelis)
22.0	106.0	4	125.0		12.50	*Globuligerina oxfordiana* (Grigelis)
22.0	110.5	3	125.0		18.75	*Globuligerina oxfordiana* (Grigelis)
22.0	112.5	4	150.0		12.50	*Globuligerina oxfordiana* (Grigelis)
22.0	114.5	3	175.0		18.75	*Globuligerina oxfordiana* (Grigelis)
22.0	117.0	4	125.0		18.75	*Globuligerina oxfordiana* (Grigelis)
22.0	117.5	4	225.0	37.50		*Globuligerina oxfordiana* (Grigelis)
22.5	106.0	4	150.0		12.50	*Globuligerina oxfordiana* (Grigelis)
22.5	103.0	3	175.0		12.50	*Globuligerina oxfordiana* (Grigelis)
22.5	102.0	3	150.0		18.75	*Globuligerina oxfordiana* (Grigelis)
22.5	100.0	5	150.0		12.50	*Globuligerina oxfordiana* (Grigelis)
22.5	100.0	6	125.0		6.25	*Globuligerina oxfordiana* (Grigelis)
22.5	99.0	3	150.0		12.50	*Globuligerina oxfordiana* (Grigelis)
22.5	98.5	3	137.5		12.50	*Globuligerina oxfordiana* (Grigelis)
23.0	66.5	3	175.0		12.50	*Globuligerina oxfordiana* (Grigelis)
23.0	67.0	3	125.0		12.50	*Globuligerina oxfordiana* (Grigelis)
23.0	97.0	3	112.5		12.50	*Globuligerina oxfordiana* (Grigelis)
23.0	97.5	3	150.0		18.75	*Globuligerina oxfordiana* (Grigelis)
23.0	97.5	4	175.0		18.75	*Globuligerina oxfordiana* (Grigelis)
23.0	98.5	4	162.5		18.75	*Globuligerina oxfordiana* (Grigelis)
23.0	98.5	4	150.0		18.75	*Globuligerina oxfordiana* (Grigelis)
23.0	99.0	3	150.0		12.50	*Globuligerina oxfordiana* (Grigelis)
23.0	99.0	4	137.5		18.75	*Globuligerina oxfordiana* (Grigelis)
23.0	102.0	3	150.0		12.50	*Globuligerina oxfordiana* (Grigelis)
23.0	103.0	3	125.0		12.50	*Globuligerina oxfordiana* (Grigelis)
23.0	104.0	4	162.5		18.75	*Globuligerina oxfordiana* (Grigelis)
23.0	104.5	3	150.0		18.75	*Globuligerina oxfordiana* (Grigelis)
23.0	107.5	3	125.0		18.75	*Globuligerina oxfordiana* (Grigelis)
23.0	107.5	4	125.0		12.50	*Globuligerina oxfordiana* (Grigelis)
23.0	107.5	3	200.0		18.75	*Conoglobigerina* aff. *dagestanica* Morozova
23.0	108.5	3	137.5		18.75	*Globuligerina oxfordiana* (Grigelis)
23.0	118.5	3	150.0	25.00		*Globuligerina oxfordiana* (Grigelis)
23.5	118.5	3	175.0		18.75	*Globuligerina oxfordiana* (Grigelis)
23.5	108.5	3	150.0		18.75	*Globuligerina oxfordiana* (Grigelis)
23.5	108.5	3	125.0		18.75	*Globuligerina oxfordiana* (Grigelis)
23.5	105.0	4	150.0		12.50	*Globuligerina oxfordiana* (Grigelis)
23.5	104.5	3	137.5		12.50	*Globuligerina oxfordiana* (Grigelis)
23.5	104.0	4	137.5		6.25	*Globuligerina oxfordiana* (Grigelis)
23.5	103.5	3	150.0		18.75	*Globuligerina oxfordiana* (Grigelis)
23.5	103.0	3	150.0		12.50	*Globuligerina oxfordiana* (Grigelis)
23.5	101.5	4	125.0		18.75	*Globuligerina oxfordiana* (Grigelis)
23.5	101.5	3	150.0		18.75	*Globuligerina oxfordiana* (Grigelis)
23.5	99.0	4	175.0		12.50	*Globuligerina oxfordiana* (Grigelis)
23.5	98.5	4	150.0		12.50	*Globuligerina oxfordiana* (Grigelis)
23.5	98.0	4	150.0		12.50	*Globuligerina oxfordiana* (Grigelis)
23.5	97.5	3	150.0		18.75	*Globuligerina oxfordiana* (Grigelis)
23.5	97.0	3	150.0		12.50	*Globuligerina oxfordiana* (Grigelis)
23.5	97.0	4	112.5		12.50	*Globuligerina oxfordiana* (Grigelis)
23.5	96.0	3	125.0		18.75	*Globuligerina oxfordiana* (Grigelis)
23.5	96.0	3	150.0		18.75	*Globuligerina oxfordiana* (Grigelis)

SOMHEGY - LAYER H1 (BAJOCIAN - HUMPHRIESIANUM ZONE)

Thin Section Co-ordinates		No. of Chambers Visible	Max. Diameter (µm)	Wall Thickness (µm)		Species
Vert	Hor			Thick	Thin	
23.5	60.0	4	150.0		12.50	*Globuligerina oxfordiana* (Grigelis)
24.0	93.0	3	112.5		12.50	*Globuligerina oxfordiana* (Grigelis)
24.0	93.0	5	200.0		12.50	*Conoglobigerina* aff. *dagestanica* Morozova
24.0	93.5	3	150.0		12.50	*Globuligerina oxfordiana* (Grigelis)
24.0	94.0	4	150.0		12.50	*Globuligerina oxfordiana* (Grigelis)
24.0	94.5	4	150.0		12.50	*Globuligerina oxfordiana* (Grigelis)
24.0	94.5	3	162.5		12.50	*Globuligerina oxfordiana* (Grigelis)
24.0	95.0	3	150.0		18.75	*Globuligerina oxfordiana* (Grigelis)
24.0	98.0	3	150.0		12.50	*Globuligerina oxfordiana* (Grigelis)
24.0	99.0	3	137.5		12.50	*Globuligerina oxfordiana* (Grigelis)
24.0	99.0	3	112.5		18.75	*Globuligerina oxfordiana* (Grigelis)
24.0	99.0	3	162.5		18.75	*Globuligerina oxfordiana* (Grigelis)
24.0	99.5	4	100.0		18.75	*Globuligerina oxfordiana* (Grigelis)
24.0	106.0	4	175.0		18.75	*Globuligerina oxfordiana* (Grigelis)
24.0	108.0	4	125.0		12.50	*Globuligerina oxfordiana* (Grigelis)
24.0	108.0	4	175.0		12.50	*Globuligerina oxfordiana* (Grigelis)
24.0	109.0	4	175.0		6.25	*Globuligerina oxfordiana* (Grigelis)
24.0	109.0	3	125.0		6.25	*Globuligerina oxfordiana* (Grigelis)
24.0	110.0	3	175.0		18.75	*Globuligerina oxfordiana* (Grigelis)
24.0	111.0	4	175.0		18.75	*Globuligerina oxfordiana* (Grigelis)
24.0	113.5	4	125.0		18.75	*Globuligerina oxfordiana* (Grigelis)
24.0	115.0	3	125.0		18.75	*Globuligerina oxfordiana* (Grigelis)
24.5	110.5	3	200.0		12.50	*Conoglobigerina* aff. *dagestanica* Morozova
24.5	108.0	5	100.0		12.50	*Globuligerina oxfordiana* (Grigelis)
24.5	107.5	5	175.0		12.50	*Globuligerina oxfordiana* (Grigelis)
24.5	107.5	4	162.5		12.50	*Globuligerina oxfordiana* (Grigelis)
24.5	102.5	5	175.0		18.75	*Globuligerina oxfordiana* (Grigelis)
24.5	102.0	3	112.5		12.50	*Globuligerina oxfordiana* (Grigelis)
24.5	102.0	3	125.0		12.50	*Globuligerina oxfordiana* (Grigelis)
24.5	102.0	3	112.5		18.75	*Globuligerina oxfordiana* (Grigelis)
24.5	97.0	5	175.0		12.50	*Globuligerina oxfordiana* (Grigelis)
24.5	97.0	3	125.0		12.50	*Globuligerina oxfordiana* (Grigelis)
24.5	96.0	3	150.0		18.75	*Globuligerina oxfordiana* (Grigelis)
24.5	96.0	3	125.0		12.50	*Globuligerina oxfordiana* (Grigelis)
24.5	95.5	3	150.0		18.75	*Globuligerina oxfordiana* (Grigelis)
24.5	95.5	4	162.5		12.50	*Globuligerina oxfordiana* (Grigelis)
24.5	94.5	3	162.5		12.50	*Globuligerina oxfordiana* (Grigelis)
24.5	94.5	4	150.0		12.50	*Globuligerina oxfordiana* (Grigelis)
24.5	94.5	3	137.5		12.50	*Globuligerina oxfordiana* (Grigelis)
24.5	94.0	3	125.0		12.50	*Globuligerina oxfordiana* (Grigelis)
24.5	93.0	4	175.0		18.75	*Globuligerina oxfordiana* (Grigelis)
24.5	93.0	3	125.0		18.75	*Globuligerina oxfordiana* (Grigelis)
24.5	92.5	3	100.0		12.50	*Globuligerina oxfordiana* (Grigelis)
24.5	92.0	4	125.0		12.50	*Globuligerina oxfordiana* (Grigelis)
24.5	92.0	5	175.0		12.50	*Globuligerina oxfordiana* (Grigelis)
24.5	92.0	4	175.0		12.50	*Globuligerina oxfordiana* (Grigelis)
24.5	92.0	4	137.5		12.50	*Globuligerina oxfordiana* (Grigelis)
24.5	92.0	3	125.0		12.50	*Globuligerina oxfordiana* (Grigelis)
24.5	92.0	3	125.0		12.50	*Globuligerina oxfordiana* (Grigelis)
24.5	91.5	4	100.0		12.50	*Globuligerina oxfordiana* (Grigelis)
24.5	91.5	3	100.0		12.50	*Globuligerina oxfordiana* (Grigelis)
24.5	91.5	3	125.0		12.50	*Globuligerina oxfordiana* (Grigelis)
24.5	91.5	5	175.0		18.75	*Globuligerina oxfordiana* (Grigelis)
24.5	91.5	3	175.0		12.50	*Globuligerina oxfordiana* (Grigelis)
24.5	91.5	4	150.0		12.50	*Globuligerina oxfordiana* (Grigelis)

SOMHEGY - LAYER H1 (BAJOCIAN - HUMPHRIESIANUM ZONE)

Thin Section Co-ordinates		No. of Chambers Visible	Max. Diameter (µm)	Wall Thickness (µm)		Species
Vert	Hor			Thick	Thin	
24.5	91.0	3	112.5		12.50	*Globuligerina oxfordiana* (Grigelis)
24.5	90.0	4	125.0		18.75	*Globuligerina oxfordiana* (Grigelis)
24.5	90.0	5	200.0		18.75	*Conoglobigerina* aff. *dagestanica* Morozova
24.5	89.5	4	125.0		12.50	*Globuligerina oxfordiana* (Grigelis)
24.5	89.5	4	100.0		12.50	*Globuligerina oxfordiana* (Grigelis)
24.5	89.0	4	150.0		12.50	*Globuligerina oxfordiana* (Grigelis)
24.5	62.0	3	150.0	25.00		*Globuligerina oxfordiana* (Grigelis)
24.5	62.0	4	150.0		6.25	*Globuligerina oxfordiana* (Grigelis)
25.0	84.5	3	200.0		6.25	*Conoglobigerina* aff. *dagestanica* Morozova
25.0	86.0	3	125.0		12.50	*Globuligerina oxfordiana* (Grigelis)
25.0	86.0	3	137.5		12.50	*Globuligerina oxfordiana* (Grigelis)
25.0	86.5	3	162.5		18.75	*Globuligerina oxfordiana* (Grigelis)
25.0	87.5	7	200.0		6.25	*Conoglobigerina* aff. *dagestanica* Morozova
25.0	88.0	4	125.0		12.50	*Globuligerina oxfordiana* (Grigelis)
25.0	88.0	4	150.0		12.50	*Globuligerina oxfordiana* (Grigelis)
25.0	88.0	3	175.0		12.50	*Globuligerina oxfordiana* (Grigelis)
25.0	88.5	4	150.0		18.75	*Globuligerina oxfordiana* (Grigelis)
25.0	89.0	4	150.0		18.75	*Globuligerina oxfordiana* (Grigelis)
25.0	89.0	4	112.5		12.50	*Globuligerina oxfordiana* (Grigelis)
25.0	89.5	3	125.0		12.50	*Globuligerina oxfordiana* (Grigelis)
25.0	89.5	4	125.0		12.50	*Globuligerina oxfordiana* (Grigelis)
25.0	89.5	3	150.0		12.50	*Globuligerina oxfordiana* (Grigelis)
25.0	90.5	3	125.0		12.50	*Globuligerina oxfordiana* (Grigelis)
25.0	90.5	3	150.0		12.50	*Globuligerina oxfordiana* (Grigelis)
25.0	90.5	3	150.0		12.50	*Globuligerina oxfordiana* (Grigelis)
25.0	91.5	3	125.0		12.50	*Globuligerina oxfordiana* (Grigelis)
25.0	91.5	4	150.0		12.50	*Globuligerina oxfordiana* (Grigelis)
25.0	93.0	3	125.0		12.50	*Globuligerina oxfordiana* (Grigelis)
25.0	94.0	4	125.0		18.75	*Globuligerina oxfordiana* (Grigelis)
25.0	94.5	3	137.5		12.50	*Globuligerina oxfordiana* (Grigelis)
25.0	94.5	6	150.0		18.75	*Globuligerina oxfordiana* (Grigelis)
25.0	95.5	3	125.0		12.50	*Globuligerina oxfordiana* (Grigelis)
25.0	96.0	4	137.5		18.75	*Globuligerina oxfordiana* (Grigelis)
25.0	98.0	3	125.0		18.75	*Globuligerina oxfordiana* (Grigelis)
25.0	98.0	3	137.5		12.50	*Globuligerina oxfordiana* (Grigelis)
25.0	100.5	3	175.0		12.50	*Globuligerina oxfordiana* (Grigelis)
25.0	101.0	3	137.5		12.50	*Globuligerina oxfordiana* (Grigelis)
25.0	102.5	3	175.0		18.75	*Globuligerina oxfordiana* (Grigelis)
25.0	103.5	4	150.0		18.75	*Globuligerina oxfordiana* (Grigelis)
25.0	104.5	4	137.5		18.75	*Globuligerina oxfordiana* (Grigelis)
25.0	104.5	3	125.0		18.75	*Globuligerina oxfordiana* (Grigelis)
25.0	105.5	3	150.0	25.00		*Globuligerina oxfordiana* (Grigelis)
25.0	106.0	4	125.0	25.00		*Globuligerina oxfordiana* (Grigelis)
25.0	106.0	4	125.0		18.75	*Globuligerina oxfordiana* (Grigelis)
25.0	107.5	4	175.0		12.50	*Globuligerina oxfordiana* (Grigelis)
25.0	107.5	4	112.5		18.75	*Globuligerina oxfordiana* (Grigelis)
25.0	108.5	4	125.0		18.75	*Globuligerina oxfordiana* (Grigelis)
25.0	109.0	3	125.0		12.50	*Globuligerina oxfordiana* (Grigelis)
25.0	109.0	4	150.0		12.50	*Globuligerina oxfordiana* (Grigelis)
25.0	109.0	4	125.0		12.50	*Globuligerina oxfordiana* (Grigelis)
25.0	110.0	4	137.5		12.50	*Globuligerina oxfordiana* (Grigelis)
25.0	114.5	3	125.0	25.00		*Globuligerina oxfordiana* (Grigelis)
25.5	109.0	4	200.0		12.50	*Conoglobigerina* aff. *dagestanica* Morozova
25.5	108.5	4	125.0		12.50	*Globuligerina oxfordiana* (Grigelis)
25.5	108.5	3	137.5		12.50	*Globuligerina oxfordiana* (Grigelis)

SOMHEGY - LAYER H1 (BAJOCIAN - HUMPHRIESIANUM ZONE)

Thin Section Co-ordinates		No. of Chambers Visible	Max. Diameter (µm)	Wall Thickness (µm)		Species
Vert	Hor			Thick	Thin	
25.5	108.5	3	125.0		12.50	*Globuligerina oxfordiana* (Grigelis)
25.5	108.5	4	137.5		12.50	*Globuligerina oxfordiana* (Grigelis)
25.5	108.5	3	150.0		12.50	*Globuligerina oxfordiana* (Grigelis)
25.5	108.0	4	150.0		12.50	*Globuligerina oxfordiana* (Grigelis)
25.5	108.0	3	150.0		12.50	*Globuligerina oxfordiana* (Grigelis)
25.5	108.0	3	125.0		12.50	*Globuligerina oxfordiana* (Grigelis)
25.5	107.0	4	125.0		6.25	*Globuligerina oxfordiana* (Grigelis)
25.5	107.0	4	100.0		12.50	*Globuligerina oxfordiana* (Grigelis)
25.5	107.0	3	125.0		18.75	*Globuligerina oxfordiana* (Grigelis)
25.5	106.0	3	125.0		18.75	*Globuligerina oxfordiana* (Grigelis)
25.5	105.5	3	125.0	25.00		*Globuligerina oxfordiana* (Grigelis)
25.5	104.0	4	137.5		18.75	*Globuligerina oxfordiana* (Grigelis)
25.5	103.5	3	125.0		18.75	*Globuligerina oxfordiana* (Grigelis)
25.5	103.0	4	175.0		18.75	*Globuligerina oxfordiana* (Grigelis)
25.5	102.0	3	187.5		6.25	*Globuligerina oxfordiana* (Grigelis)
25.5	102.0	4	175.0		18.75	*Globuligerina oxfordiana* (Grigelis)
25.5	101.0	4	125.0		18.75	*Globuligerina oxfordiana* (Grigelis)
25.5	101.0	3	137.5		18.75	*Globuligerina oxfordiana* (Grigelis)
25.5	98.0	4	162.5		18.75	*Globuligerina oxfordiana* (Grigelis)
25.5	97.5	4	175.0	25.00		*Globuligerina oxfordiana* (Grigelis)
25.5	96.0	3	200.0		12.50	*Conoglobigerina* aff. *dagestanica* Morozova
25.5	95.0	3	150.0		18.75	*Globuligerina oxfordiana* (Grigelis)
25.5	95.0	3	125.0		12.50	*Globuligerina oxfordiana* (Grigelis)
25.5	95.0	4	125.0		18.75	*Globuligerina oxfordiana* (Grigelis)
25.5	95.0	3	112.5		12.50	*Globuligerina oxfordiana* (Grigelis)
25.5	94.5	6	137.5		12.50	*Globuligerina oxfordiana* (Grigelis)
25.5	94.5	3	100.0		12.50	*Globuligerina oxfordiana* (Grigelis)
25.5	93.0	4	137.5		12.50	*Globuligerina oxfordiana* (Grigelis)
25.5	92.0	3	150.0		18.75	*Globuligerina oxfordiana* (Grigelis)
25.5	91.5	4	125.0		6.25	*Globuligerina oxfordiana* (Grigelis)
25.5	91.0	4	175.0		18.75	*Globuligerina oxfordiana* (Grigelis)
25.5	90.5	3	125.0		12.50	*Globuligerina oxfordiana* (Grigelis)
25.5	90.5	4	175.0		12.50	*Globuligerina oxfordiana* (Grigelis)
25.5	89.5	3	175.0		12.50	*Globuligerina oxfordiana* (Grigelis)
25.5	87.5	3	125.0		12.50	*Globuligerina oxfordiana* (Grigelis)
25.5	87.5	4	100.0		6.25	*Globuligerina oxfordiana* (Grigelis)
26.0	67.5	3	125.0		12.50	*Globuligerina oxfordiana* (Grigelis)
26.0	70.0	3	125.0		12.50	*Globuligerina oxfordiana* (Grigelis)
26.0	85.5	4	112.5		12.50	*Globuligerina oxfordiana* (Grigelis)
26.0	85.5	4	100.0		12.50	*Globuligerina oxfordiana* (Grigelis)
26.0	86.0	4	125.0		12.50	*Globuligerina oxfordiana* (Grigelis)
26.0	87.0	3	150.0		18.75	*Globuligerina oxfordiana* (Grigelis)
26.0	87.5	3	125.0	25.00		*Globuligerina oxfordiana* (Grigelis)
26.0	89.0	6	125.0		18.75	*Globuligerina oxfordiana* (Grigelis)
26.0	89.5	3	125.0	25.00		*Globuligerina oxfordiana* (Grigelis)
26.0	89.5	3	125.0		12.50	*Globuligerina oxfordiana* (Grigelis)
26.0	90.0	3	112.5		12.50	*Globuligerina oxfordiana* (Grigelis)
26.0	90.5	4	162.5		12.50	*Globuligerina oxfordiana* (Grigelis)
26.0	91.0	3	150.0		12.50	*Globuligerina oxfordiana* (Grigelis)
26.0	91.0	3	137.5		12.50	*Globuligerina oxfordiana* (Grigelis)
26.0	91.0	4	125.0		18.75	*Globuligerina oxfordiana* (Grigelis)
26.0	91.0	4	125.0		18.75	*Globuligerina oxfordiana* (Grigelis)
26.0	91.0	4	112.5		12.50	*Globuligerina oxfordiana* (Grigelis)
26.0	92.5	3	150.0		18.75	*Globuligerina oxfordiana* (Grigelis)
26.0	93.0	4	150.0		12.50	*Globuligerina oxfordiana* (Grigelis)

SOMHEGY - LAYER H1 (BAJOCIAN - HUMPHRIESIANUM ZONE)

Thin Section Co-ordinates		No. of Chambers Visible	Max. Diameter (µm)	Wall Thickness (µm)		Species
Vert	Hor			Thick	Thin	
26.0	93.0	4	125.0		12.50	*Globuligerina oxfordiana* (Grigelis)
26.0	94.0	4	100.0		12.50	*Globuligerina oxfordiana* (Grigelis)
26.0	94.0	3	100.0		12.50	*Globuligerina oxfordiana* (Grigelis)
26.0	94.5	3	125.0	25.00		*Globuligerina oxfordiana* (Grigelis)
26.0	94.5	3	150.0		18.75	*Globuligerina oxfordiana* (Grigelis)
26.0	95.0	4	150.0		12.50	*Globuligerina oxfordiana* (Grigelis)
26.0	95.0	3	150.0		6.25	*Globuligerina oxfordiana* (Grigelis)
26.0	95.0	3	150.0		12.50	*Globuligerina oxfordiana* (Grigelis)
26.0	95.5	4	137.5		12.50	*Globuligerina oxfordiana* (Grigelis)
26.0	95.5	4	175.0		6.25	*Globuligerina oxfordiana* (Grigelis)
26.0	95.5	4	125.0		6.25	*Globuligerina oxfordiana* (Grigelis)
26.0	96.5	3	100.0		12.50	*Globuligerina oxfordiana* (Grigelis)
26.0	97.0	4	125.0		18.75	*Globuligerina oxfordiana* (Grigelis)
26.0	97.0	4	175.0		18.75	*Globuligerina oxfordiana* (Grigelis)
26.0	98.5	4	125.0		12.50	*Globuligerina oxfordiana* (Grigelis)
26.0	98.5	3	125.0		18.75	*Globuligerina oxfordiana* (Grigelis)
26.0	99.5	3	175.0		12.50	*Globuligerina oxfordiana* (Grigelis)
26.0	100.0	5	175.0		18.75	*Globuligerina oxfordiana* (Grigelis)
26.0	101.0	5	200.0		12.50	*Conoglobigerina* aff. *dagestanica* Morozova
26.0	102.5	3	137.5		12.50	*Globuligerina oxfordiana* (Grigelis)
26.0	102.5	3	137.5		12.50	*Globuligerina oxfordiana* (Grigelis)
26.0	103.5	3	125.0		18.75	*Globuligerina oxfordiana* (Grigelis)
26.0	104.0	4	150.0		12.50	*Globuligerina oxfordiana* (Grigelis)
26.0	105.0	4	125.0		12.50	*Globuligerina oxfordiana* (Grigelis)
26.5	107.5	3	225.0	25.00		*Globuligerina oxfordiana* (Grigelis)
26.5	107.5	3	175.0		12.50	*Globuligerina oxfordiana* (Grigelis)
26.5	106.5	3	125.0		18.75	*Globuligerina oxfordiana* (Grigelis)
26.5	106.5	3	175.0		12.50	*Globuligerina oxfordiana* (Grigelis)
26.5	105.5	4	125.0		12.50	*Globuligerina oxfordiana* (Grigelis)
26.5	105.5	4	100.0		12.50	*Globuligerina oxfordiana* (Grigelis)
26.5	105.0	4	137.5		12.50	*Globuligerina oxfordiana* (Grigelis)
26.5	104.5	3	125.0		18.75	*Globuligerina oxfordiana* (Grigelis)
26.5	102.0	4	175.0		6.25	*Globuligerina oxfordiana* (Grigelis)
26.5	101.0	5	125.0		12.50	*Globuligerina oxfordiana* (Grigelis)
26.5	100.5	3	100.0		12.50	*Globuligerina oxfordiana* (Grigelis)
26.5	100.5	3	137.5		12.50	*Globuligerina oxfordiana* (Grigelis)
26.5	100.0	3	112.5		12.50	*Globuligerina oxfordiana* (Grigelis)
26.5	100.0	3	100.0		12.50	*Globuligerina oxfordiana* (Grigelis)
26.5	99.5	5	150.0		12.50	*Globuligerina oxfordiana* (Grigelis)
26.5	99.0	3	100.0	25.00		*Globuligerina oxfordiana* (Grigelis)
26.5	99.0	4	125.0		12.50	*Globuligerina oxfordiana* (Grigelis)
26.5	99.0	3	150.0		12.50	*Globuligerina oxfordiana* (Grigelis)
26.5	98.0	3	125.0		18.75	*Globuligerina oxfordiana* (Grigelis)
26.5	97.5	5	162.5		12.50	*Globuligerina oxfordiana* (Grigelis)
26.5	97.0	3	125.0		12.50	*Globuligerina oxfordiana* (Grigelis)
26.5	96.5	3	175.0		18.75	*Globuligerina oxfordiana* (Grigelis)
26.5	95.5	4	125.0		18.75	*Globuligerina oxfordiana* (Grigelis)
26.5	94.0	4	175.0		12.50	*Globuligerina oxfordiana* (Grigelis)
26.5	93.0	4	100.0		12.50	*Globuligerina oxfordiana* (Grigelis)
26.5	93.0	4	125.0		12.50	*Globuligerina oxfordiana* (Grigelis)
26.5	92.5	4	150.0		12.50	*Globuligerina oxfordiana* (Grigelis)
26.5	92.5	3	112.5		18.75	*Globuligerina oxfordiana* (Grigelis)
26.5	92.0	3	125.0		18.75	*Globuligerina oxfordiana* (Grigelis)
26.5	92.0	4	125.0		18.75	*Globuligerina oxfordiana* (Grigelis)
26.5	91.0	3	125.0		12.50	*Globuligerina oxfordiana* (Grigelis)

SOMHEGY - LAYER H1 (BAJOCIAN - HUMPHRIESIANUM ZONE)

Thin Section Co-ordinates		No. of Chambers Visible	Max. Diameter (µm)	Wall Thickness (µm)		Species
Vert	Hor			Thick	Thin	
26.5	91.0	4	150.0		12.50	*Globuligerina oxfordiana* (Grigelis)
26.5	91.0	3	125.0		18.75	*Globuligerina oxfordiana* (Grigelis)
26.5	91.0	3	137.5		18.75	*Globuligerina oxfordiana* (Grigelis)
26.5	90.5	3	125.0		18.75	*Globuligerina oxfordiana* (Grigelis)
26.5	90.5	3	112.5	25.00		*Globuligerina oxfordiana* (Grigelis)
26.5	90.0	4	162.5		18.75	*Globuligerina oxfordiana* (Grigelis)
26.5	90.0	3	162.5		18.75	*Globuligerina oxfordiana* (Grigelis)
26.5	90.0	4	100.0	25.00		*Globuligerina oxfordiana* (Grigelis)
26.5	90.0	3	125.0		12.50	*Globuligerina oxfordiana* (Grigelis)
26.5	89.5	3	125.0		12.50	*Globuligerina oxfordiana* (Grigelis)
26.5	89.0	3	137.5		12.50	*Globuligerina oxfordiana* (Grigelis)
26.5	89.0	3	162.5		6.25	*Globuligerina oxfordiana* (Grigelis)
26.5	88.5	4	150.0		12.50	*Globuligerina oxfordiana* (Grigelis)
26.5	88.0	4	175.0		12.50	*Globuligerina oxfordiana* (Grigelis)
26.5	88.0	4	112.5		12.50	*Globuligerina oxfordiana* (Grigelis)
26.5	87.0	4	125.0		12.50	*Globuligerina oxfordiana* (Grigelis)
26.5	86.5	3	162.5		12.50	*Globuligerina oxfordiana* (Grigelis)
26.5	86.5	4	150.0		18.75	*Globuligerina oxfordiana* (Grigelis)
26.5	85.5	3	112.5		12.50	*Globuligerina oxfordiana* (Grigelis)
26.5	85.0	3	100.0		12.50	*Globuligerina oxfordiana* (Grigelis)
26.5	85.0	3	125.0		12.50	*Globuligerina oxfordiana* (Grigelis)
26.5	84.5	4	162.5		12.50	*Globuligerina oxfordiana* (Grigelis)
26.5	84.5	4	125.0		12.50	*Globuligerina oxfordiana* (Grigelis)
26.5	83.0	3	100.0		12.50	*Globuligerina oxfordiana* (Grigelis)
26.5	63.0	3	200.0		18.75	*Conoglobigerina* aff. *dagestanica* Morozova
27.0	67.0	4	187.5		12.50	*Globuligerina oxfordiana* (Grigelis)
27.0	84.5	3	162.5		12.50	*Globuligerina oxfordiana* (Grigelis)
27.0	84.5	4	137.5		12.50	*Globuligerina oxfordiana* (Grigelis)
27.0	85.0	3	175.0		12.50	*Globuligerina oxfordiana* (Grigelis)
27.0	91.0	4	150.0		18.75	*Globuligerina oxfordiana* (Grigelis)
27.0	92.5	4	125.0		18.75	*Globuligerina oxfordiana* (Grigelis)
27.0	93.5	3	100.0		12.50	*Globuligerina oxfordiana* (Grigelis)
27.0	96.5	3	150.0		12.50	*Globuligerina oxfordiana* (Grigelis)
27.0	97.0	3	125.0	25.00		*Globuligerina oxfordiana* (Grigelis)
27.0	97.0	3	112.5		18.75	*Globuligerina oxfordiana* (Grigelis)
27.0	98.0	3	150.0		18.75	*Globuligerina oxfordiana* (Grigelis)
27.0	100.0	3	100.0		18.75	*Globuligerina oxfordiana* (Grigelis)
27.0	101.0	3	200.0		18.75	*Conoglobigerina* aff. *dagestanica* Morozova
27.0	102.5	3	162.5		12.50	*Globuligerina oxfordiana* (Grigelis)
27.0	103.5	3	200.0		12.50	*Conoglobigerina* aff. *dagestanica* Morozova
27.5	106.5	3	200.0	37.50		*Globuligerina oxfordiana* (Grigelis)
27.5	106.0	4	200.0		18.75	*Conoglobigerina* aff. *dagestanica* Morozova
27.5	105.0	3	125.0		18.75	*Globuligerina oxfordiana* (Grigelis)
27.5	105.0	3	125.0	25.00		*Globuligerina oxfordiana* (Grigelis)
27.5	104.5	4	175.0		12.50	*Globuligerina oxfordiana* (Grigelis)
27.5	104.0	4	125.0		12.50	*Globuligerina oxfordiana* (Grigelis)
27.5	103.5	3	137.5		12.50	*Globuligerina oxfordiana* (Grigelis)
27.5	102.5	3	125.0		18.75	*Globuligerina oxfordiana* (Grigelis)
27.5	101.5	3	150.0		18.75	*Globuligerina oxfordiana* (Grigelis)
27.5	101.5	4	125.0		18.75	*Globuligerina oxfordiana* (Grigelis)
27.5	100.5	4	150.0		18.75	*Globuligerina oxfordiana* (Grigelis)
27.5	99.5	4	137.5		18.75	*Globuligerina oxfordiana* (Grigelis)
27.5	99.5	4	200.0		18.75	*Conoglobigerina* aff. *dagestanica* Morozova
27.5	99.0	3	150.0		12.50	*Globuligerina oxfordiana* (Grigelis)
27.5	98.0	3	137.5		18.75	*Globuligerina oxfordiana* (Grigelis)

SOMHEGY - LAYER H1 (BAJOCIAN - HUMPHRIESIANUM ZONE)

Thin Section Co-ordinates		No. of Chambers Visible	Max. Diameter (µm)	Wall Thickness (µm)		Species
Vert	Hor			Thick	Thin	
27.5	98.0	4	150.0		18.75	*Globuligerina oxfordiana* (Grigelis)
27.5	97.0	3	200.0		18.75	*Conoglobigerina* aff. *dagestanica* Morozova
27.5	97.0	4	112.5		18.75	*Globuligerina oxfordiana* (Grigelis)
27.5	97.0	4	125.0		18.75	*Globuligerina oxfordiana* (Grigelis)
27.5	97.0	4	150.0		18.75	*Globuligerina oxfordiana* (Grigelis)
27.5	97.0	4	125.0		18.75	*Globuligerina oxfordiana* (Grigelis)
27.5	96.5	4	175.0		18.75	*Globuligerina oxfordiana* (Grigelis)
27.5	94.0	3	125.0		18.75	*Globuligerina oxfordiana* (Grigelis)
27.5	94.0	4	137.5		12.50	*Globuligerina oxfordiana* (Grigelis)
27.5	94.0	4	125.0		12.50	*Globuligerina oxfordiana* (Grigelis)
27.5	94.0	3	125.0		18.75	*Globuligerina oxfordiana* (Grigelis)
27.5	94.0	4	137.5		18.75	*Globuligerina oxfordiana* (Grigelis)
27.5	94.0	3	150.0		12.50	*Globuligerina oxfordiana* (Grigelis)
27.5	93.5	5	137.5		6.25	*Globuligerina oxfordiana* (Grigelis)
27.5	93.5	3	125.0		12.50	*Globuligerina oxfordiana* (Grigelis)
27.5	93.5	3	100.0		18.75	*Globuligerina oxfordiana* (Grigelis)
27.5	93.5	3	137.5		6.25	*Globuligerina oxfordiana* (Grigelis)
27.5	93.0	4	175.0		12.50	*Globuligerina oxfordiana* (Grigelis)
27.5	93.0	4	162.5		18.75	*Globuligerina oxfordiana* (Grigelis)
27.5	93.0	4	175.0		18.75	*Globuligerina oxfordiana* (Grigelis)
27.5	93.0	4	125.0		12.50	*Globuligerina oxfordiana* (Grigelis)
27.5	93.0	4	100.0		12.50	*Globuligerina oxfordiana* (Grigelis)
27.5	92.5	3	112.5		12.50	*Globuligerina oxfordiana* (Grigelis)
27.5	92.0	4	150.0		18.75	*Globuligerina oxfordiana* (Grigelis)
27.5	92.0	3	175.0		18.75	*Globuligerina oxfordiana* (Grigelis)
27.5	92.0	4	125.0		12.50	*Globuligerina oxfordiana* (Grigelis)
27.5	91.5	3	175.0		18.75	*Globuligerina oxfordiana* (Grigelis)
27.5	91.0	5	187.5		18.75	*Globuligerina oxfordiana* (Grigelis)
27.5	91.0	3	112.5		18.75	*Globuligerina oxfordiana* (Grigelis)
27.5	91.0	3	150.0		12.50	*Globuligerina oxfordiana* (Grigelis)
27.5	90.5	3	125.0		18.75	*Globuligerina oxfordiana* (Grigelis)
27.5	90.0	4	150.0		18.75	*Globuligerina oxfordiana* (Grigelis)
27.5	90.0	4	100.0		18.75	*Globuligerina oxfordiana* (Grigelis)
27.5	90.0	3	125.0		12.50	*Globuligerina oxfordiana* (Grigelis)
27.5	90.0	3	125.0		12.50	*Globuligerina oxfordiana* (Grigelis)
27.5	90.0	3	175.0		12.50	*Globuligerina oxfordiana* (Grigelis)
27.5	90.0	3	125.0		12.50	*Globuligerina oxfordiana* (Grigelis)
27.5	90.0	4	162.5		12.50	*Globuligerina oxfordiana* (Grigelis)
27.5	89.5	3	137.5		12.50	*Globuligerina oxfordiana* (Grigelis)
27.5	89.0	4	125.0		12.50	*Globuligerina oxfordiana* (Grigelis)
27.5	89.0	3	137.5		12.50	*Globuligerina oxfordiana* (Grigelis)
27.5	87.5	4	150.0		12.50	*Globuligerina oxfordiana* (Grigelis)
27.5	87.0	4	100.0		12.50	*Globuligerina oxfordiana* (Grigelis)
27.5	86.5	3	125.0		12.50	*Globuligerina oxfordiana* (Grigelis)
27.5	86.5	3	112.5		12.50	*Globuligerina oxfordiana* (Grigelis)
27.5	86.0	4	150.0		12.50	*Globuligerina oxfordiana* (Grigelis)
27.5	86.0	5	150.0		12.50	*Globuligerina oxfordiana* (Grigelis)
27.5	86.0	4	150.0		12.50	*Globuligerina oxfordiana* (Grigelis)
27.5	86.0	3	150.0		12.50	*Globuligerina oxfordiana* (Grigelis)
27.5	85.5	4	150.0		12.50	*Globuligerina oxfordiana* (Grigelis)
27.5	85.5	4	262.5		18.75	*Globuligerina bathoniana gigantea* Wernli & Görög
27.5	85.0	4	150.0		12.50	*Globuligerina oxfordiana* (Grigelis)
27.5	84.5	4	150.0		18.75	*Globuligerina oxfordiana* (Grigelis)
27.5	84.5	3	125.0		18.75	*Globuligerina oxfordiana* (Grigelis)
27.5	83.5	3	175.0		18.75	*Globuligerina oxfordiana* (Grigelis)

SOMHEGY - LAYER H1 (BAJOCIAN - HUMPHRIESIANUM ZONE)

Thin Section Co-ordinates		No. of Chambers Visible	Max. Diameter (µm)	Wall Thickness (µm)		Species
Vert	Hor			Thick	Thin	
27.5	83.0	3	150.0		18.75	*Globuligerina oxfordiana* (Grigelis)
27.5	83.0	4	162.5		18.75	*Globuligerina oxfordiana* (Grigelis)
27.5	82.0	4	112.5		12.50	*Globuligerina oxfordiana* (Grigelis)
27.5	82.0	4	137.5		12.50	*Globuligerina oxfordiana* (Grigelis)
27.5	81.5	3	150.0		12.50	*Globuligerina oxfordiana* (Grigelis)
27.5	81.5	4	137.5		18.75	*Globuligerina oxfordiana* (Grigelis)
27.5	69.0	3	175.0		12.50	*Globuligerina oxfordiana* (Grigelis)
28.0	81.0	3	175.0	25.00		*Globuligerina oxfordiana* (Grigelis)
28.0	82.0	3	150.0		12.50	*Globuligerina oxfordiana* (Grigelis)
28.0	83.5	3	187.5		18.75	*Globuligerina oxfordiana* (Grigelis)
28.0	86.5	4	137.5		18.75	*Globuligerina oxfordiana* (Grigelis)
28.0	87.5	4	175.0		12.50	*Globuligerina oxfordiana* (Grigelis)
28.0	90.0	4	125.0		12.50	*Globuligerina oxfordiana* (Grigelis)
28.0	91.0	3	100.0		12.50	*Globuligerina oxfordiana* (Grigelis)
28.0	91.5	3	150.0		12.50	*Globuligerina oxfordiana* (Grigelis)
28.0	91.5	3	150.0		12.50	*Globuligerina oxfordiana* (Grigelis)
28.0	92.0	4	162.5		12.50	*Globuligerina oxfordiana* (Grigelis)
28.0	93.0	4	162.5		18.75	*Globuligerina oxfordiana* (Grigelis)
28.0	93.5	5	162.5		12.50	*Globuligerina oxfordiana* (Grigelis)
28.0	96.5	3	100.0		18.75	*Globuligerina oxfordiana* (Grigelis)
28.0	96.5	4	162.5		12.50	*Globuligerina oxfordiana* (Grigelis)
28.0	100.5	3	150.0		12.50	*Globuligerina oxfordiana* (Grigelis)
28.0	103.5	4	175.0		18.75	*Globuligerina oxfordiana* (Grigelis)
28.0	103.5	4	175.0		18.75	*Globuligerina oxfordiana* (Grigelis)
28.5	103.5	4	162.5		18.75	*Globuligerina oxfordiana* (Grigelis)
28.5	103.5	3	175.0	25.00		*Globuligerina oxfordiana* (Grigelis)
28.5	101.5	3	125.0		12.50	*Globuligerina oxfordiana* (Grigelis)
28.5	101.0	4	200.0		12.50	*Conoglobigerina* aff. *dagestanica* Morozova
28.5	100.0	3	150.0		18.75	*Globuligerina oxfordiana* (Grigelis)
28.5	99.5	5	150.0		18.75	*Globuligerina oxfordiana* (Grigelis)
28.5	99.5	4	175.0		18.75	*Globuligerina oxfordiana* (Grigelis)
28.5	99.5	4	175.0		18.75	*Globuligerina oxfordiana* (Grigelis)
28.5	99.5	6	125.0		18.75	*Globuligerina oxfordiana* (Grigelis)
28.5	98.5	4	125.0		18.75	*Globuligerina oxfordiana* (Grigelis)
28.5	98.5	3	100.0		18.75	*Globuligerina oxfordiana* (Grigelis)
28.5	98.5	4	175.0		12.50	*Globuligerina oxfordiana* (Grigelis)
28.5	98.5	4	125.0		12.50	*Globuligerina oxfordiana* (Grigelis)
28.5	98.5	3	162.5		12.50	*Globuligerina oxfordiana* (Grigelis)
28.5	98.5	3	175.0		18.75	*Globuligerina oxfordiana* (Grigelis)
28.5	98.5	4	175.0	25.00		*Globuligerina oxfordiana* (Grigelis)
28.5	97.5	4	125.0		12.50	*Globuligerina oxfordiana* (Grigelis)
28.5	97.0	3	100.0		6.25	*Globuligerina oxfordiana* (Grigelis)
28.5	96.5	3	150.0		12.50	*Globuligerina oxfordiana* (Grigelis)
28.5	96.5	5	187.5		12.50	*Globuligerina oxfordiana* (Grigelis)
28.5	96.5	4	162.5		12.50	*Globuligerina oxfordiana* (Grigelis)
28.5	95.0	3	100.0		12.50	*Globuligerina oxfordiana* (Grigelis)
28.5	95.0	3	100.0		18.75	*Globuligerina oxfordiana* (Grigelis)
28.5	95.0	3	150.0	25.00		*Globuligerina oxfordiana* (Grigelis)
28.5	94.5	3	150.0	25.00		*Globuligerina oxfordiana* (Grigelis)
28.5	94.0	3	125.0		18.75	*Globuligerina oxfordiana* (Grigelis)
28.5	94.0	5	150.0		12.50	*Globuligerina oxfordiana* (Grigelis)
28.5	93.5	4	137.5		12.50	*Globuligerina oxfordiana* (Grigelis)
28.5	93.5	4	162.5		18.75	*Globuligerina oxfordiana* (Grigelis)
28.5	93.5	5	175.0		12.50	*Globuligerina oxfordiana* (Grigelis)
28.5	91.5	4	175.0		18.75	*Globuligerina oxfordiana* (Grigelis)

SOMHEGY - LAYER H1 (BAJOCIAN - HUMPHRIESIANUM ZONE)

Thin Section Co-ordinates		No. of Chambers Visible	Max. Diameter (µm)	Wall Thickness (µm)		Species
Vert	Hor			Thick	Thin	
28.5	91.5	4	150.0		12.50	*Globuligerina oxfordiana* (Grigelis)
28.5	91.5	4	175.0		18.75	*Globuligerina oxfordiana* (Grigelis)
28.5	91.5	4	175.0		12.50	*Globuligerina oxfordiana* (Grigelis)
28.5	91.0	4	150.0		18.75	*Globuligerina oxfordiana* (Grigelis)
28.5	91.0	3	137.5		18.75	*Globuligerina oxfordiana* (Grigelis)
28.5	90.5	4	150.0		12.50	*Globuligerina oxfordiana* (Grigelis)
28.5	90.0	4	150.0		12.50	*Globuligerina oxfordiana* (Grigelis)
28.5	89.5	3	150.0	25.00		*Globuligerina oxfordiana* (Grigelis)
28.5	89.0	3	162.5	25.00		*Globuligerina oxfordiana* (Grigelis)
28.5	87.5	3	125.0		12.50	*Globuligerina oxfordiana* (Grigelis)
28.5	87.5	3	125.0		12.50	*Globuligerina oxfordiana* (Grigelis)
28.5	87.5	3	125.0		18.75	*Globuligerina oxfordiana* (Grigelis)
28.5	87.5	3	175.0	37.50		*Globuligerina oxfordiana* (Grigelis)
28.5	87.5	4	175.0	25.00		*Globuligerina oxfordiana* (Grigelis)
28.5	87.5	4	162.5		12.50	*Globuligerina oxfordiana* (Grigelis)
28.5	87.0	4	125.0		18.75	*Globuligerina oxfordiana* (Grigelis)
28.5	86.0	4	150.0	25.00		*Globuligerina oxfordiana* (Grigelis)
28.5	86.0	4	125.0		12.50	*Globuligerina oxfordiana* (Grigelis)
28.5	86.0	3	125.0		12.50	*Globuligerina oxfordiana* (Grigelis)
28.5	86.0	3	150.0		18.75	*Globuligerina oxfordiana* (Grigelis)
28.5	85.5	4	225.0		12.50	*Conoglobigerina* aff. *dagestanica* Morozova
28.5	85.0	4	125.0		18.75	*Globuligerina oxfordiana* (Grigelis)
28.5	83.5	3	162.5		18.75	*Globuligerina oxfordiana* (Grigelis)
28.5	83.0	4	125.0		12.50	*Globuligerina oxfordiana* (Grigelis)
28.5	83.0	3	137.5		12.50	*Globuligerina oxfordiana* (Grigelis)
28.5	83.0	3	125.0		18.75	*Globuligerina oxfordiana* (Grigelis)
28.5	82.5	4	112.5		18.75	*Globuligerina oxfordiana* (Grigelis)
28.5	82.5	4	150.0		18.75	*Globuligerina oxfordiana* (Grigelis)
28.5	82.5	4	175.0		18.75	*Globuligerina oxfordiana* (Grigelis)
28.5	82.0	3	125.0		18.75	*Globuligerina oxfordiana* (Grigelis)
28.5	82.0	3	175.0		12.50	*Globuligerina oxfordiana* (Grigelis)
28.5	81.5	4	150.0		12.50	*Globuligerina oxfordiana* (Grigelis)
28.5	81.0	3	150.0		12.50	*Globuligerina oxfordiana* (Grigelis)
28.5	81.0	4	150.0		18.75	*Globuligerina oxfordiana* (Grigelis)
28.5	81.0	4	125.0		12.50	*Globuligerina oxfordiana* (Grigelis)
28.5	80.5	4	200.0		12.50	*Conoglobigerina* aff. *dagestanica* Morozova
28.5	80.5	4	137.5		18.75	*Globuligerina oxfordiana* (Grigelis)
28.5	80.0	3	150.0	25.00		*Globuligerina oxfordiana* (Grigelis)
28.5	80.0	3	125.0	25.00		*Globuligerina oxfordiana* (Grigelis)
28.5	80.0	3	125.0		12.50	*Globuligerina oxfordiana* (Grigelis)
28.5	79.5	4	200.0		12.50	*Conoglobigerina* aff. *dagestanica* Morozova
28.5	81.0	4	125.0		12.50	*Globuligerina oxfordiana* (Grigelis)
28.5	82.5	4	175.0		18.75	*Globuligerina oxfordiana* (Grigelis)
29.0	78.0	4	125.0		12.50	*Globuligerina oxfordiana* (Grigelis)
29.0	78.0	3	125.0	25.00		*Globuligerina oxfordiana* (Grigelis)
29.0	78.0	4	125.0		12.50	*Globuligerina oxfordiana* (Grigelis)
29.0	78.5	3	125.0		18.75	*Globuligerina oxfordiana* (Grigelis)
29.0	79.0	4	112.5		12.50	*Globuligerina oxfordiana* (Grigelis)
29.0	80.5	4	212.5		18.75	*Conoglobigerina* aff. *dagestanica* Morozova
29.0	81.5	4	150.0		18.75	*Globuligerina oxfordiana* (Grigelis)
29.0	81.5	3	150.0		12.50	*Globuligerina oxfordiana* (Grigelis)
29.0	83.5	4	150.0	25.00		*Globuligerina oxfordiana* (Grigelis)
29.0	84.0	4	150.0		18.75	*Globuligerina oxfordiana* (Grigelis)
29.0	86.0	3	212.5		12.50	*Conoglobigerina* aff. *dagestanica* Morozova
29.0	86.0	4	200.0		12.50	*Conoglobigerina* aff. *dagestanica* Morozova

SOMHEGY - LAYER H1 (BAJOCIAN - HUMPHRIESIANUM ZONE)

Thin Section Co-ordinates		No. of Chambers Visible	Max. Diameter (µm)	Wall Thickness (µm)		Species
Vert	Hor			Thick	Thin	
29.0	86.0	3	100.0		18.75	*Globuligerina oxfordiana* (Grigelis)
29.0	87.0	3	150.0		18.75	*Globuligerina oxfordiana* (Grigelis)
29.0	87.5	3	150.0	25.00		*Globuligerina oxfordiana* (Grigelis)
29.0	88.0	3	175.0		18.75	*Globuligerina oxfordiana* (Grigelis)
29.0	88.0	3	175.0		12.50	*Globuligerina oxfordiana* (Grigelis)
29.0	89.5	3	150.0		18.75	*Globuligerina oxfordiana* (Grigelis)
29.0	90.0	4	112.5		18.75	*Globuligerina oxfordiana* (Grigelis)
29.0	90.0	4	137.5		12.50	*Globuligerina oxfordiana* (Grigelis)
29.0	90.5	3	162.5		18.75	*Globuligerina oxfordiana* (Grigelis)
29.0	90.5	5	162.5		12.50	*Globuligerina oxfordiana* (Grigelis)
29.0	91.0	4	175.0		18.75	*Globuligerina oxfordiana* (Grigelis)
29.0	91.0	4	162.5		12.50	*Globuligerina oxfordiana* (Grigelis)
29.0	91.5	4	175.0		12.50	*Globuligerina oxfordiana* (Grigelis)
29.0	93.0	4	187.5		12.50	*Globuligerina oxfordiana* (Grigelis)
29.0	94.0	6	175.0		18.75	*Globuligerina oxfordiana* (Grigelis)
29.0	94.5	3	112.5		18.75	*Globuligerina oxfordiana* (Grigelis)
29.0	94.5	3	125.0		18.75	*Globuligerina oxfordiana* (Grigelis)
29.0	95.0	3	87.5		18.75	*Globuligerina oxfordiana* (Grigelis)
29.0	96.5	4	137.5		18.75	*Globuligerina oxfordiana* (Grigelis)
29.0	97.5	4	137.5		12.50	*Globuligerina oxfordiana* (Grigelis)
29.0	97.5	5	150.0		18.75	*Globuligerina oxfordiana* (Grigelis)
29.0	97.5	5	150.0		12.50	*Globuligerina oxfordiana* (Grigelis)
29.0	98.0	4	150.0		12.50	*Globuligerina oxfordiana* (Grigelis)
29.0	99.5	4	125.0		12.50	*Globuligerina oxfordiana* (Grigelis)
29.0	99.5	4	175.0		12.50	*Globuligerina oxfordiana* (Grigelis)
29.0	100.0	5	175.0		12.50	*Globuligerina oxfordiana* (Grigelis)
29.0	100.0	4	175.0		18.75	*Globuligerina oxfordiana* (Grigelis)
29.0	100.5	3	137.5		12.50	*Globuligerina oxfordiana* (Grigelis)
29.0	101.5	4	175.0	25.00		*Globuligerina oxfordiana* (Grigelis)
29.0	102.5	4	125.0		12.50	*Globuligerina oxfordiana* (Grigelis)
29.0	102.5	4	150.0	25.00		*Globuligerina oxfordiana* (Grigelis)
29.0	103.0	4	150.0		18.75	*Globuligerina oxfordiana* (Grigelis)
29.5	101.5	4	137.5		18.75	*Globuligerina oxfordiana* (Grigelis)
29.5	101.0	4	150.0		12.50	*Globuligerina oxfordiana* (Grigelis)
29.5	101.0	4	112.5		18.75	*Globuligerina oxfordiana* (Grigelis)
29.5	100.5	4	125.0		18.75	*Globuligerina oxfordiana* (Grigelis)
29.5	100.0	4	175.0		12.50	*Globuligerina oxfordiana* (Grigelis)
29.5	99.5	4	125.0		12.50	*Globuligerina oxfordiana* (Grigelis)
29.5	99.5	4	125.0		12.50	*Globuligerina oxfordiana* (Grigelis)
29.5	98.5	4	125.0		12.50	*Globuligerina oxfordiana* (Grigelis)
29.5	98.0	3	125.0		12.50	*Globuligerina oxfordiana* (Grigelis)
29.5	98.0	4	125.0		18.75	*Globuligerina oxfordiana* (Grigelis)
29.5	98.0	4	100.0		18.75	*Globuligerina oxfordiana* (Grigelis)
29.5	98.0	5	150.0		18.75	*Globuligerina oxfordiana* (Grigelis)
29.5	97.5	4	162.5		18.75	*Globuligerina oxfordiana* (Grigelis)
29.5	97.0	5	137.5		12.50	*Globuligerina oxfordiana* (Grigelis)
29.5	96.5	4	137.5		18.75	*Globuligerina oxfordiana* (Grigelis)
29.5	94.5	5	112.5		6.25	*Globuligerina oxfordiana* (Grigelis)
29.5	94.5	4	100.0		12.50	*Globuligerina oxfordiana* (Grigelis)
29.5	93.0	4	200.0		18.75	*Conoglobigerina* aff. *dagestanica* Morozova
29.5	92.5	3	150.0		12.50	*Globuligerina oxfordiana* (Grigelis)
29.5	92.5	4	125.0	25.00		*Globuligerina oxfordiana* (Grigelis)
29.5	91.5	4	175.0		18.75	*Globuligerina oxfordiana* (Grigelis)
29.5	90.5	3	175.0		12.50	*Globuligerina oxfordiana* (Grigelis)
29.5	90.0	4	112.5		12.50	*Globuligerina oxfordiana* (Grigelis)

SOMHEGY - LAYER H1 (BAJOCIAN - HUMPHRIESIANUM ZONE)

Thin Section Co-ordinates		No. of Chambers Visible	Max. Diameter (µm)	Wall Thickness (µm)		Species
Vert	Hor			Thick	Thin	
29.5	90.0	4	100.0		12.50	*Globuligerina oxfordiana* (Grigelis)
29.5	90.0	5	137.5		12.50	*Globuligerina oxfordiana* (Grigelis)
29.5	89.5	4	162.5		6.25	*Globuligerina oxfordiana* (Grigelis)
29.5	89.0	3	112.5		18.75	*Globuligerina oxfordiana* (Grigelis)
29.5	89.0	3	112.5		12.50	*Globuligerina oxfordiana* (Grigelis)
29.5	88.5	3	100.0		18.75	*Globuligerina oxfordiana* (Grigelis)
29.5	88.5	4	175.0		12.50	*Globuligerina oxfordiana* (Grigelis)
29.5	88.5	3	112.5		12.50	*Globuligerina oxfordiana* (Grigelis)
29.5	88.0	4	175.0		12.50	*Globuligerina oxfordiana* (Grigelis)
29.5	87.5	3	125.0		18.75	*Globuligerina oxfordiana* (Grigelis)
29.5	87.0	3	150.0		12.50	*Globuligerina oxfordiana* (Grigelis)
29.5	86.5	3	150.0		18.75	*Globuligerina oxfordiana* (Grigelis)
29.5	86.5	3	150.0		12.50	*Globuligerina oxfordiana* (Grigelis)
29.5	86.5	4	150.0		12.50	*Globuligerina oxfordiana* (Grigelis)
29.5	86.5	4	200.0		12.50	*Conoglobigerina* aff. *dagestanica* Morozova
29.5	86.0	3	200.0		18.75	*Conoglobigerina* aff. *dagestanica* Morozova
29.5	86.0	3	150.0		18.75	*Globuligerina oxfordiana* (Grigelis)
29.5	85.5	4	162.5		18.75	*Globuligerina oxfordiana* (Grigelis)
29.5	85.5	4	100.0		12.50	*Globuligerina oxfordiana* (Grigelis)
29.5	85.0	5	150.0		12.50	*Globuligerina oxfordiana* (Grigelis)
29.5	85.0	3	112.5		12.50	*Globuligerina oxfordiana* (Grigelis)
29.5	83.5	3	100.0		12.50	*Globuligerina oxfordiana* (Grigelis)
29.5	83.5	5	175.0		18.75	*Globuligerina oxfordiana* (Grigelis)
29.5	83.5	3	100.0	25.00		*Globuligerina oxfordiana* (Grigelis)
29.5	83.0	3	125.0	25.00		*Globuligerina oxfordiana* (Grigelis)
29.5	82.5	3	150.0		18.75	*Globuligerina oxfordiana* (Grigelis)
29.5	82.0	3	150.0		12.50	*Globuligerina oxfordiana* (Grigelis)
29.5	81.5	3	150.0		12.50	*Globuligerina oxfordiana* (Grigelis)
29.5	81.0	4	187.5		18.75	*Globuligerina oxfordiana* (Grigelis)
29.5	81.0	4	125.0		12.50	*Globuligerina oxfordiana* (Grigelis)
29.5	80.5	4	175.0		12.50	*Globuligerina oxfordiana* (Grigelis)
29.5	80.5	3	112.5		18.75	*Globuligerina oxfordiana* (Grigelis)
29.5	80.5	4	137.5		12.50	*Globuligerina oxfordiana* (Grigelis)
29.5	80.0	4	187.5		12.50	*Globuligerina oxfordiana* (Grigelis)
29.5	79.5	4	125.0		12.50	*Globuligerina oxfordiana* (Grigelis)
29.5	79.5	4	150.0		12.50	*Globuligerina oxfordiana* (Grigelis)
29.5	78.5	4	150.0		12.50	*Globuligerina oxfordiana* (Grigelis)
29.5	78.5	3	125.0		18.75	*Globuligerina oxfordiana* (Grigelis)
29.5	76.5	3	125.0		12.50	*Globuligerina oxfordiana* (Grigelis)
30.0	77.0	3	125.0		12.50	*Globuligerina oxfordiana* (Grigelis)
30.0	77.0	3	112.5		12.50	*Globuligerina oxfordiana* (Grigelis)
30.0	77.0	3	125.0		12.50	*Globuligerina oxfordiana* (Grigelis)
30.0	78.0	4	175.0		12.50	*Globuligerina oxfordiana* (Grigelis)
30.0	79.0	3	137.5		18.75	*Globuligerina oxfordiana* (Grigelis)
30.0	79.0	3	125.0		18.75	*Globuligerina oxfordiana* (Grigelis)
30.0	79.0	3	125.0	25.00		*Globuligerina oxfordiana* (Grigelis)
30.0	80.0	4	212.5		12.50	*Conoglobigerina* aff. *dagestanica* Morozova
30.0	80.5	3	125.0		18.75	*Globuligerina oxfordiana* (Grigelis)
30.0	81.0	3	125.0		18.75	*Globuligerina oxfordiana* (Grigelis)
30.0	83.0	3	200.0		12.50	*Conoglobigerina* aff. *dagestanica* Morozova
30.0	83.0	3	137.5		12.50	*Globuligerina oxfordiana* (Grigelis)
30.0	83.0	3	200.0		12.50	*Conoglobigerina* aff. *dagestanica* Morozova
30.0	83.5	3	125.0		12.50	*Globuligerina oxfordiana* (Grigelis)
30.0	84.0	3	125.0		18.75	*Globuligerina oxfordiana* (Grigelis)
30.0	85.0	3	125.0		18.75	*Globuligerina oxfordiana* (Grigelis)

SOMHEGY - LAYER H1 (BAJOCIAN - HUMPHRIESIANUM ZONE)

Thin Section Co-ordinates		No. of Chambers Visible	Max. Diameter (µm)	Wall Thickness (µm)		Species
Vert	Hor			Thick	Thin	
30.0	86.0	3	125.0		18.75	*Globuligerina oxfordiana* (Grigelis)
30.0	86.0	3	125.0		12.50	*Globuligerina oxfordiana* (Grigelis)
30.0	87.0	3	125.0		12.50	*Globuligerina oxfordiana* (Grigelis)
30.0	88.0	3	87.5		12.50	*Globuligerina oxfordiana* (Grigelis)
30.0	88.0	3	150.0		12.50	*Globuligerina oxfordiana* (Grigelis)
30.0	88.0	4	150.0		12.50	*Globuligerina oxfordiana* (Grigelis)
30.0	88.0	4	162.5		18.75	*Globuligerina oxfordiana* (Grigelis)
30.0	91.5	4	125.0		12.50	*Globuligerina oxfordiana* (Grigelis)
30.0	92.0	3	112.5		18.75	*Globuligerina oxfordiana* (Grigelis)
30.0	92.0	4	137.5		18.75	*Globuligerina oxfordiana* (Grigelis)
30.0	92.5	3	150.0		12.50	*Globuligerina oxfordiana* (Grigelis)
30.0	92.5	4	125.0		12.50	*Globuligerina oxfordiana* (Grigelis)
30.0	93.0	4	175.0	25.00		*Globuligerina oxfordiana* (Grigelis)
30.0	93.5	4	150.0		12.50	*Globuligerina oxfordiana* (Grigelis)
30.0	96.0	5	225.0		12.50	*Conoglobigerina* aff. *dagestanica* Morozova
30.0	96.5	3	100.0		12.50	*Globuligerina oxfordiana* (Grigelis)
30.0	97.5	3	175.0		18.75	*Globuligerina oxfordiana* (Grigelis)
30.0	99.5	4	100.0		12.50	*Globuligerina oxfordiana* (Grigelis)
30.0	99.5	4	137.5		12.50	*Globuligerina oxfordiana* (Grigelis)
30.0	99.5	5	125.0		6.25	*Globuligerina oxfordiana* (Grigelis)
30.0	100.0	3	175.0		12.50	*Globuligerina oxfordiana* (Grigelis)
30.0	100.5	3	175.0		12.50	*Globuligerina oxfordiana* (Grigelis)
30.0	100.5	3	137.5		12.50	*Globuligerina oxfordiana* (Grigelis)
30.0	106.5	3	187.5	25.00		*Globuligerina oxfordiana* (Grigelis)
30.5	97.0	4	125.0		12.50	*Globuligerina oxfordiana* (Grigelis)
30.5	95.5	3	150.0		12.50	*Globuligerina oxfordiana* (Grigelis)
30.5	95.5	4	150.0		12.50	*Globuligerina oxfordiana* (Grigelis)
30.5	95.5	3	125.0		12.50	*Globuligerina oxfordiana* (Grigelis)
30.5	95.0	3	150.0		18.75	*Globuligerina oxfordiana* (Grigelis)
30.5	95.0	4	175.0		12.50	*Globuligerina oxfordiana* (Grigelis)
30.5	94.5	3	125.0	25.00		*Globuligerina oxfordiana* (Grigelis)
30.5	93.0	5	150.0		12.50	*Globuligerina oxfordiana* (Grigelis)
30.5	92.5	4	125.0		12.50	*Globuligerina oxfordiana* (Grigelis)
30.5	92.5	3	150.0		12.50	*Globuligerina oxfordiana* (Grigelis)
30.5	91.5	4	150.0		12.50	*Globuligerina oxfordiana* (Grigelis)
30.5	88.5	4	150.0		12.50	*Globuligerina oxfordiana* (Grigelis)
30.5	88.5	4	162.5		12.50	*Globuligerina oxfordiana* (Grigelis)
30.5	87.0	3	100.0		12.50	*Globuligerina oxfordiana* (Grigelis)
30.5	87.0	3	150.0		12.50	*Globuligerina oxfordiana* (Grigelis)
30.5	87.0	4	175.0		18.75	*Globuligerina oxfordiana* (Grigelis)
30.5	86.5	5	150.0		18.75	*Globuligerina oxfordiana* (Grigelis)
30.5	86.0	4	112.5		12.50	*Globuligerina oxfordiana* (Grigelis)
30.5	85.0	4	112.5		18.75	*Globuligerina oxfordiana* (Grigelis)
30.5	84.0	4	175.0		12.50	*Globuligerina oxfordiana* (Grigelis)
30.5	84.0	3	125.0		12.50	*Globuligerina oxfordiana* (Grigelis)
30.5	82.5	3	137.5		18.75	*Globuligerina oxfordiana* (Grigelis)
30.5	82.0	3	112.5		18.75	*Globuligerina oxfordiana* (Grigelis)
30.5	81.0	4	175.0		18.75	*Globuligerina oxfordiana* (Grigelis)
30.5	81.0	3	150.0		12.50	*Globuligerina oxfordiana* (Grigelis)
30.5	81.0	4	137.5		18.75	*Globuligerina oxfordiana* (Grigelis)
30.5	79.0	3	100.0		18.75	*Globuligerina oxfordiana* (Grigelis)
30.5	78.5	3	175.0	37.50		*Globuligerina oxfordiana* (Grigelis)
30.5	78.0	4	175.0		12.50	*Globuligerina oxfordiana* (Grigelis)
30.5	77.0	4	150.0		12.50	*Globuligerina oxfordiana* (Grigelis)
30.5	77.0	4	125.0		18.75	*Globuligerina oxfordiana* (Grigelis)

SOMHEGY - LAYER H1 (BAJOCIAN - HUMPHRIESIANUM ZONE)

Thin Section Co-ordinates		No. of Chambers Visible	Max. Diameter (µm)	Wall Thickness (µm)		Species
Vert	Hor			Thick	Thin	
30.5	76.0	4	150.0		12.50	*Globuligerina oxfordiana* (Grigelis)
30.5	75.5	3	125.0		12.50	*Globuligerina oxfordiana* (Grigelis)
30.5	75.0	4	125.0		12.50	*Globuligerina oxfordiana* (Grigelis)
30.5	74.5	3	125.0		12.50	*Globuligerina oxfordiana* (Grigelis)
30.5	74.0	3	100.0		12.50	*Globuligerina oxfordiana* (Grigelis)
31.0	73.5	4	100.0		12.50	*Globuligerina oxfordiana* (Grigelis)
31.0	73.5	4	100.0		12.50	*Globuligerina oxfordiana* (Grigelis)
31.0	74.0	6	200.0		12.50	*Conoglobigerina* aff. *dagestanica* Morozova
31.0	75.0	4	125.0		12.50	*Globuligerina oxfordiana* (Grigelis)
31.0	75.5	3	175.0		12.50	*Globuligerina oxfordiana* (Grigelis)
31.0	75.5	3	162.5		12.50	*Globuligerina oxfordiana* (Grigelis)
31.0	76.0	3	150.0		12.50	*Globuligerina oxfordiana* (Grigelis)
31.0	76.5	3	125.0		12.50	*Globuligerina oxfordiana* (Grigelis)
31.0	76.5	3	175.0		12.50	*Globuligerina oxfordiana* (Grigelis)
31.0	77.0	4	150.0		12.50	*Globuligerina oxfordiana* (Grigelis)
31.0	77.5	3	125.0		12.50	*Globuligerina oxfordiana* (Grigelis)
31.0	78.0	3	112.5		12.50	*Globuligerina oxfordiana* (Grigelis)
31.0	80.0	3	150.0		18.75	*Globuligerina oxfordiana* (Grigelis)
31.0	80.0	3	150.0		18.75	*Globuligerina oxfordiana* (Grigelis)
31.0	80.5	3	137.5		18.75	*Globuligerina oxfordiana* (Grigelis)
31.0	80.5	3	125.0		12.50	*Globuligerina oxfordiana* (Grigelis)
31.0	81.0	4	125.0		12.50	*Globuligerina oxfordiana* (Grigelis)
31.0	81.0	4	162.5		12.50	*Globuligerina oxfordiana* (Grigelis)
31.0	81.5	4	162.5		12.50	*Globuligerina oxfordiana* (Grigelis)
31.0	82.0	4	125.0		12.50	*Globuligerina oxfordiana* (Grigelis)
31.0	83.5	3	125.0		12.50	*Globuligerina oxfordiana* (Grigelis)
31.0	83.5	3	137.5		12.50	*Globuligerina oxfordiana* (Grigelis)
31.0	83.5	3	150.0		12.50	*Globuligerina oxfordiana* (Grigelis)
31.0	84.0	4	125.0		12.50	*Globuligerina oxfordiana* (Grigelis)
31.0	85.0	3	187.5		6.25	*Globuligerina oxfordiana* (Grigelis)
31.0	85.0	3	112.5		12.50	*Globuligerina oxfordiana* (Grigelis)
31.0	86.0	3	150.0		12.50	*Globuligerina oxfordiana* (Grigelis)
31.0	86.5	3	137.5		18.75	*Globuligerina oxfordiana* (Grigelis)
31.0	87.0	4	175.0		12.50	*Globuligerina oxfordiana* (Grigelis)
31.0	87.5	3	150.0		12.50	*Globuligerina oxfordiana* (Grigelis)
31.0	92.5	3	125.0		12.50	*Globuligerina oxfordiana* (Grigelis)
31.0	95.0	3	150.0		12.50	*Globuligerina oxfordiana* (Grigelis)
31.0	96.5	3	125.0		12.50	*Globuligerina oxfordiana* (Grigelis)
31.0	100.5	3	100.0		12.50	*Globuligerina oxfordiana* (Grigelis)
31.5	96.5	3	100.0		12.50	*Globuligerina oxfordiana* (Grigelis)
31.5	96.0	3	150.0		12.50	*Globuligerina oxfordiana* (Grigelis)
31.5	95.5	4	137.5		12.50	*Globuligerina oxfordiana* (Grigelis)
31.5	93.5	4	125.0		18.75	*Globuligerina oxfordiana* (Grigelis)
31.5	93.0	5	175.0		18.75	*Globuligerina oxfordiana* (Grigelis)
31.5	93.0	3	150.0		18.75	*Globuligerina oxfordiana* (Grigelis)
31.5	93.0	3	137.5	25.00		*Globuligerina oxfordiana* (Grigelis)
31.5	92.5	3	200.0		12.50	*Conoglobigerina* aff. *dagestanica* Morozova
31.5	92.5	4	187.5		12.50	*Globuligerina oxfordiana* (Grigelis)
31.5	92.0	5	175.0		12.50	*Globuligerina oxfordiana* (Grigelis)
31.5	92.0	3	125.0		12.50	*Globuligerina oxfordiana* (Grigelis)
31.5	86.5	3	125.0		12.50	*Globuligerina oxfordiana* (Grigelis)
31.5	86.0	3	150.0		12.50	*Globuligerina oxfordiana* (Grigelis)
31.5	86.0	4	162.5		12.50	*Globuligerina oxfordiana* (Grigelis)
31.5	86.0	3	125.0		12.50	*Globuligerina oxfordiana* (Grigelis)
31.5	86.0	4	150.0		12.50	*Globuligerina oxfordiana* (Grigelis)

SOMHEGY - LAYER H1 (BAJOCIAN - HUMPHRIESIANUM ZONE)

Thin Section Co-ordinates		No. of Chambers Visible	Max. Diameter (µm)	Wall Thickness (µm)		Species
Vert	Hor			Thick	Thin	
31.5	86.0	3	125.0		12.50	*Globuligerina oxfordiana* (Grigelis)
31.5	85.5	4	150.0		12.50	*Globuligerina oxfordiana* (Grigelis)
31.5	84.0	4	125.0		12.50	*Globuligerina oxfordiana* (Grigelis)
31.5	84.0	4	150.0		12.50	*Globuligerina oxfordiana* (Grigelis)
31.5	84.0	4	150.0		12.50	*Globuligerina oxfordiana* (Grigelis)
31.5	82.5	5	150.0		12.50	*Globuligerina oxfordiana* (Grigelis)
31.5	82.5	4	125.0		12.50	*Globuligerina oxfordiana* (Grigelis)
31.5	82.0	5	175.0		12.50	*Globuligerina oxfordiana* (Grigelis)
31.5	81.5	5	150.0		12.50	*Globuligerina oxfordiana* (Grigelis)
31.5	80.0	3	150.0		18.75	*Globuligerina oxfordiana* (Grigelis)
31.5	79.5	4	150.0		18.75	*Globuligerina oxfordiana* (Grigelis)
31.5	79.5	3	125.0		18.75	*Globuligerina oxfordiana* (Grigelis)
31.5	79.5	4	100.0		18.75	*Globuligerina oxfordiana* (Grigelis)
31.5	79.0	4	100.0		18.75	*Globuligerina oxfordiana* (Grigelis)
31.5	78.5	4	125.0		18.75	*Globuligerina oxfordiana* (Grigelis)
31.5	78.0	5	175.0	25.00		*Globuligerina oxfordiana* (Grigelis)
31.5	78.0	4	150.0		18.75	*Globuligerina oxfordiana* (Grigelis)
31.5	78.0	3	137.5		18.75	*Globuligerina oxfordiana* (Grigelis)
31.5	78.0	3	200.0	25.00		*Globuligerina oxfordiana* (Grigelis)
31.5	77.5	3	125.0		18.75	*Globuligerina oxfordiana* (Grigelis)
31.5	77.5	3	125.0		18.75	*Globuligerina oxfordiana* (Grigelis)
31.5	77.5	4	175.0		12.50	*Globuligerina oxfordiana* (Grigelis)
31.5	77.5	4	125.0		18.75	*Globuligerina oxfordiana* (Grigelis)
31.5	77.5	4	125.0		18.75	*Globuligerina oxfordiana* (Grigelis)
31.5	77.0	4	225.0	25.00		*Globuligerina oxfordiana* (Grigelis)
31.5	76.5	3	162.5		12.50	*Globuligerina oxfordiana* (Grigelis)
31.5	76.5	3	100.0		18.75	*Globuligerina oxfordiana* (Grigelis)
31.5	76.5	3	100.0		18.75	*Globuligerina oxfordiana* (Grigelis)
31.5	76.5	3	125.0		12.50	*Globuligerina oxfordiana* (Grigelis)
31.5	75.5	3	100.0		18.75	*Globuligerina oxfordiana* (Grigelis)
31.5	75.5	5	150.0		18.75	*Globuligerina oxfordiana* (Grigelis)
31.5	75.0	3	125.0		12.50	*Globuligerina oxfordiana* (Grigelis)
31.5	75.0	4	125.0		12.50	*Globuligerina oxfordiana* (Grigelis)
31.5	74.5	3	175.0		12.50	*Globuligerina oxfordiana* (Grigelis)
31.5	74.5	3	150.0		12.50	*Globuligerina oxfordiana* (Grigelis)
31.5	74.5	3	150.0		12.50	*Globuligerina oxfordiana* (Grigelis)
31.5	74.5	3	100.0		18.75	*Globuligerina oxfordiana* (Grigelis)
31.5	74.0	5	225.0		12.50	*Conoglobigerina* aff. *dagestanica* Morozova
31.5	74.0	4	150.0		6.25	*Globuligerina oxfordiana* (Grigelis)
31.5	73.5	4	125.0		12.50	*Globuligerina oxfordiana* (Grigelis)
31.5	73.5	5	125.0		12.50	*Globuligerina oxfordiana* (Grigelis)
31.5	73.5	5	150.0		12.50	*Globuligerina oxfordiana* (Grigelis)
31.5	72.0	4	162.5		6.25	*Globuligerina oxfordiana* (Grigelis)
32.0	74.0	4	125.0		18.75	*Globuligerina oxfordiana* (Grigelis)
32.0	74.5	4	125.0		18.75	*Globuligerina oxfordiana* (Grigelis)
32.0	75.5	4	125.0		12.50	*Globuligerina oxfordiana* (Grigelis)
32.0	75.5	3	125.0	25.00		*Globuligerina oxfordiana* (Grigelis)
32.0	76.0	4	100.0		12.50	*Globuligerina oxfordiana* (Grigelis)
32.0	77.5	3	150.0		12.50	*Globuligerina oxfordiana* (Grigelis)
32.0	77.5	4	137.5		12.50	*Globuligerina oxfordiana* (Grigelis)
32.0	80.0	4	125.0		12.50	*Globuligerina oxfordiana* (Grigelis)
32.0	81.0	4	125.0		6.25	*Globuligerina oxfordiana* (Grigelis)
32.0	81.5	3	150.0		12.50	*Globuligerina oxfordiana* (Grigelis)
32.0	82.0	4	112.5		12.50	*Globuligerina oxfordiana* (Grigelis)
32.0	83.0	3	125.0		12.50	*Globuligerina oxfordiana* (Grigelis)

SOMHEGY - LAYER H1 (BAJOCIAN - HUMPHRIESIANUM ZONE)

Thin Section Co-ordinates		No. of Chambers Visible	Max. Diameter (μm)	Wall Thickness (μm)		Species
Vert	Hor			Thick	Thin	
32.0	84.0	5	150.0		12.50	*Globuligerina oxfordiana* (Grigelis)
32.0	86.0	4	150.0		12.50	*Globuligerina oxfordiana* (Grigelis)
32.0	86.5	3	150.0		18.75	*Globuligerina oxfordiana* (Grigelis)
32.0	86.5	4	100.0		12.50	*Globuligerina oxfordiana* (Grigelis)
32.0	87.5	3	150.0		18.75	*Globuligerina oxfordiana* (Grigelis)
32.0	87.5	4	150.0		18.75	*Globuligerina oxfordiana* (Grigelis)
32.0	87.5	5	137.5		12.50	*Globuligerina oxfordiana* (Grigelis)
32.0	91.0	3	112.5		12.50	*Globuligerina oxfordiana* (Grigelis)
32.0	91.0	3	100.0		12.50	*Globuligerina oxfordiana* (Grigelis)
32.0	92.0	3	175.0		12.50	*Globuligerina oxfordiana* (Grigelis)
32.0	92.0	3	150.0		12.50	*Globuligerina oxfordiana* (Grigelis)
32.0	92.0	5	175.0		12.50	*Globuligerina oxfordiana* (Grigelis)
32.0	92.5	4	187.5		12.50	*Globuligerina oxfordiana* (Grigelis)
32.0	93.0	3	150.0	25.00		*Globuligerina oxfordiana* (Grigelis)
32.0	94.5	3	125.0		18.75	*Globuligerina oxfordiana* (Grigelis)
32.5	92.0	3	150.0		12.50	*Globuligerina oxfordiana* (Grigelis)
32.5	90.0	3	100.0		12.50	*Globuligerina oxfordiana* (Grigelis)
32.5	88.5	3	125.0		12.50	*Globuligerina oxfordiana* (Grigelis)
32.5	86.5	4	175.0		12.50	*Globuligerina oxfordiana* (Grigelis)
32.5	86.5	3	112.5		12.50	*Globuligerina oxfordiana* (Grigelis)
32.5	86.0	4	187.5		18.75	*Globuligerina oxfordiana* (Grigelis)
32.5	85.5	3	125.0		18.75	*Globuligerina oxfordiana* (Grigelis)
32.5	85.0	4	175.0		18.75	*Globuligerina oxfordiana* (Grigelis)
32.5	84.0	3	150.0		12.50	*Globuligerina oxfordiana* (Grigelis)
32.5	84.0	5	125.0		12.50	*Globuligerina oxfordiana* (Grigelis)
32.5	83.0	3	125.0		12.50	*Globuligerina oxfordiana* (Grigelis)
32.5	83.0	5	125.0		12.50	*Globuligerina oxfordiana* (Grigelis)
32.5	82.5	4	150.0		12.50	*Globuligerina oxfordiana* (Grigelis)
32.5	82.5	4	125.0		18.75	*Globuligerina oxfordiana* (Grigelis)
32.5	81.5	7	150.0		18.75	*Globuligerina oxfordiana* (Grigelis)
32.5	81.0	3	187.5		18.75	*Globuligerina oxfordiana* (Grigelis)
32.5	81.0	3	125.0		18.75	*Globuligerina oxfordiana* (Grigelis)
32.5	80.0	3	125.0		18.75	*Globuligerina oxfordiana* (Grigelis)
32.5	79.5	3	125.0		12.50	*Globuligerina oxfordiana* (Grigelis)
32.5	79.0	4	162.5		18.75	*Globuligerina oxfordiana* (Grigelis)
32.5	78.5	4	137.5		12.50	*Globuligerina oxfordiana* (Grigelis)
32.5	77.5	3	125.0		12.50	*Globuligerina oxfordiana* (Grigelis)
32.5	74.0	4	125.0	25.00		*Globuligerina oxfordiana* (Grigelis)
33.0	78.5	3	150.0		12.50	*Globuligerina oxfordiana* (Grigelis)
33.0	78.5	3	137.5		12.50	*Globuligerina oxfordiana* (Grigelis)
33.0	78.5	4	150.0	25.00		*Globuligerina oxfordiana* (Grigelis)
33.0	79.0	3	150.0		18.75	*Globuligerina oxfordiana* (Grigelis)
33.0	79.0	4	112.5		12.50	*Globuligerina oxfordiana* (Grigelis)
33.0	79.5	3	150.0		12.50	*Globuligerina oxfordiana* (Grigelis)
33.0	80.0	3	125.0		12.50	*Globuligerina oxfordiana* (Grigelis)
33.0	86.0	3	125.0		12.50	*Globuligerina oxfordiana* (Grigelis)
33.0	86.0	3	150.0		12.50	*Globuligerina oxfordiana* (Grigelis)
33.0	86.0	3	175.0		12.50	*Globuligerina oxfordiana* (Grigelis)
33.0	86.0	3	150.0		12.50	*Globuligerina oxfordiana* (Grigelis)
33.0	89.0	3	150.0		12.50	*Globuligerina oxfordiana* (Grigelis)
33.0	90.0	3	137.5		12.50	*Globuligerina oxfordiana* (Grigelis)
33.0	90.0	3	175.0		12.50	*Globuligerina oxfordiana* (Grigelis)
33.5	109.0	3	212.5	37.50		*Globuligerina oxfordiana* (Grigelis)
33.5	90.0	4	137.5		12.50	*Globuligerina oxfordiana* (Grigelis)
33.5	90.0	3	125.0		12.50	*Globuligerina oxfordiana* (Grigelis)

SOMHEGY - LAYER H1 (BAJOCIAN - HUMPHRIESIANUM ZONE)

Thin Section Co-ordinates		No. of Chambers Visible	Max. Diameter (µm)	Wall Thickness (µm)		Species
Vert	Hor			Thick	Thin	
33.5	90.0	4	150.0		12.50	*Globuligerina oxfordiana* (Grigelis)
33.5	89.5	3	150.0		18.75	*Globuligerina oxfordiana* (Grigelis)
33.5	89.5	4	87.5		18.75	*Globuligerina oxfordiana* (Grigelis)
33.5	89.0	4	150.0		12.50	*Globuligerina oxfordiana* (Grigelis)
33.5	89.0	3	100.0		18.75	*Globuligerina oxfordiana* (Grigelis)
33.5	89.0	3	112.5		18.75	*Globuligerina oxfordiana* (Grigelis)
33.5	89.0	3	100.0		18.75	*Globuligerina oxfordiana* (Grigelis)
33.5	89.0	3	112.5		18.75	*Globuligerina oxfordiana* (Grigelis)
33.5	88.0	3	125.0		18.75	*Globuligerina oxfordiana* (Grigelis)
33.5	87.5	3	125.0		12.50	*Globuligerina oxfordiana* (Grigelis)
33.5	87.0	4	137.5	25.00		*Globuligerina oxfordiana* (Grigelis)
33.5	86.0	4	150.0	25.00		*Globuligerina oxfordiana* (Grigelis)
33.5	85.5	3	100.0		12.50	*Globuligerina oxfordiana* (Grigelis)
33.5	85.5	3	150.0		12.50	*Globuligerina oxfordiana* (Grigelis)
33.5	83.0	4	175.0		12.50	*Globuligerina oxfordiana* (Grigelis)
33.5	83.0	3	137.5		12.50	*Globuligerina oxfordiana* (Grigelis)
33.5	82.5	3	150.0		12.50	*Globuligerina oxfordiana* (Grigelis)
34.0	88.5	3	125.0		12.50	*Globuligerina oxfordiana* (Grigelis)
34.0	88.5	4	137.5		12.50	*Globuligerina oxfordiana* (Grigelis)
34.5	88.5	4	175.0		6.25	*Globuligerina oxfordiana* (Grigelis)
34.5	88.0	4	200.0		12.50	*Conoglobigerina* aff. *dagestanica* Morozova
34.5	87.5	3	175.0		12.50	*Globuligerina oxfordiana* (Grigelis)
34.5	87.5	5	200.0		18.75	*Conoglobigerina* aff. *dagestanica* Morozova
34.5	87.5	5	187.5		18.75	*Globuligerina oxfordiana* (Grigelis)
34.5	87.0	3	137.5		18.75	*Globuligerina oxfordiana* (Grigelis)
34.5	87.0	4	175.0		18.75	*Globuligerina oxfordiana* (Grigelis)
34.5	85.5	6	162.5		12.50	*Globuligerina oxfordiana* (Grigelis)
34.5	84.0	5	162.5		6.25	*Globuligerina oxfordiana* (Grigelis)
35.0	87.5	4	125.0		12.50	*Globuligerina oxfordiana* (Grigelis)
35.0	98.0	4	100.0		12.50	*Globuligerina oxfordiana* (Grigelis)
35.0	99.0	4	125.0		18.75	*Globuligerina oxfordiana* (Grigelis)
35.0	100.0	4	200.0		12.50	*Conoglobigerina* aff. *dagestanica* Morozova
35.5	97.5	4	175.0	25.00		*Globuligerina oxfordiana* (Grigelis)
36.0	100.5	4	150.0		12.50	*Globuligerina oxfordiana* (Grigelis)
36.0	100.5	4	150.0		18.75	*Globuligerina oxfordiana* (Grigelis)
36.5	100.0	3	150.0		12.50	*Globuligerina oxfordiana* (Grigelis)
36.5	99.0	4	125.0		18.75	*Globuligerina oxfordiana* (Grigelis)
36.5	99.0	4	137.5		18.75	*Globuligerina oxfordiana* (Grigelis)
37.0	98.5	3	150.0	25.00		*Globuligerina oxfordiana* (Grigelis)
37.0	99.0	3	112.5		12.50	*Globuligerina oxfordiana* (Grigelis)
37.5	102.0	3	112.5		12.50	*Globuligerina oxfordiana* (Grigelis)
37.5	100.0	4	150.0		18.75	*Globuligerina oxfordiana* (Grigelis)
38.0	96.5	3	175.0		12.50	*Globuligerina oxfordiana* (Grigelis)
38.0	96.5	4	137.5		12.50	*Globuligerina oxfordiana* (Grigelis)
38.0	100.0	4	162.5		18.75	*Globuligerina oxfordiana* (Grigelis)
38.0	100.0	3	125.0		12.50	*Globuligerina oxfordiana* (Grigelis)
38.0	100.0	4	125.0		18.75	*Globuligerina oxfordiana* (Grigelis)
38.5	99.0	6	162.5		18.75	*Globuligerina oxfordiana* (Grigelis)
Total Number of Specimens				**71**	**1022**	**1093**
Relative Percentages				**6.5**	**93.5**	

SOMHEGY - LAYER H2 (BAJOCIAN - HUMPHRIESIANUM ZONE)

Thin Section Co-ordinates		No. of Chambers Visible	Max. Diameter (µm)	Wall Thickness (µm)		Species
Vert	Hor			Thick	Thin	
5.0	109.5	3	225.0		18.75	*Conoglobigerina* aff. *dagestanica* Morozova
5.0	110.0	4	150.0		6.25	*Globuligerina oxfordiana* (Grigelis)
5.0	110.0	4	125.0		12.50	*Globuligerina oxfordiana* (Grigelis)
5.0	110.0	4	137.5		12.50	*Globuligerina oxfordiana* (Grigelis)
5.0	111.0	4	175.0		18.75	*Globuligerina oxfordiana* (Grigelis)
5.5	110.5	4	125.0		12.50	*Globuligerina oxfordiana* (Grigelis)
6.0	108.5	3	250.0	31.25		*Globuligerina oxfordiana* (Grigelis)
8.5	84.5	3	225.0	25.00		*Globuligerina oxfordiana* (Grigelis)
8.5	83.5	3	137.5		12.50	*Globuligerina oxfordiana* (Grigelis)
8.5	82.5	7	225.0		18.75	*Conoglobigerina* aff. *dagestanica* Morozova
8.5	82.5	3	150.0	25.00		*Globuligerina oxfordiana* (Grigelis)
9.0	80.0	3	125.0		12.50	*Globuligerina oxfordiana* (Grigelis)
9.0	82.0	3	137.5		18.75	*Globuligerina oxfordiana* (Grigelis)
9.0	83.5	3	112.5		6.25	*Globuligerina oxfordiana* (Grigelis)
9.0	83.5	3	162.5		6.25	*Globuligerina oxfordiana* (Grigelis)
9.0	89.0	4	125.0		18.75	*Globuligerina oxfordiana* (Grigelis)
9.0	89.5	4	175.0		18.75	*Globuligerina oxfordiana* (Grigelis)
9.0	89.5	4	187.5		12.50	*Globuligerina oxfordiana* (Grigelis)
9.0	92.0	4	200.0	50.00		*Globuligerina oxfordiana* (Grigelis)
9.0	92.0	3	175.0		6.25	*Globuligerina oxfordiana* (Grigelis)
9.5	107.5	4	175.0		6.25	*Globuligerina oxfordiana* (Grigelis)
9.5	94.0	3	225.0		18.75	*Conoglobigerina* aff. *dagestanica* Morozova
9.5	92.0	5	225.0	25.00		*Globuligerina oxfordiana* (Grigelis)
9.5	91.0	3	200.0	50.00		*Globuligerina oxfordiana* (Grigelis)
9.5	87.0	5	225.0	37.50		*Globuligerina oxfordiana* (Grigelis)
9.5	87.0	4	137.5		12.50	*Globuligerina oxfordiana* (Grigelis)
9.5	86.5	4	250.0		12.50	*Conoglobigerina* aff. *dagestanica* Morozova
9.5	86.0	3	275.0		18.75	*Globuligerina bathoniana gigantea* Wernli & Görög
9.5	85.0	3	175.0		12.50	*Globuligerina oxfordiana* (Grigelis)
9.5	84.5	4	225.0		18.75	*Conoglobigerina* aff. *dagestanica* Morozova
9.5	84.0	4	100.0		12.50	*Globuligerina oxfordiana* (Grigelis)
10.0	81.0	3	100.0		18.75	*Globuligerina oxfordiana* (Grigelis)
10.0	81.0	3	137.5		12.50	*Globuligerina oxfordiana* (Grigelis)
10.0	82.5	4	137.5		12.50	*Globuligerina oxfordiana* (Grigelis)
10.0	84.0	4	262.5		18.75	*Globuligerina bathoniana gigantea* Wernli & Görög
10.0	88.0	5	225.0	25.00		*Globuligerina oxfordiana* (Grigelis)
10.0	88.5	4	187.5		12.50	*Globuligerina oxfordiana* (Grigelis)
10.0	88.5	4	225.0		12.50	*Conoglobigerina* aff. *dagestanica* Morozova
10.0	93.5	4	162.5		12.50	*Globuligerina oxfordiana* (Grigelis)
10.0	94.0	4	225.0		12.50	*Conoglobigerina* aff. *dagestanica* Morozova
10.5	109.0	3	250.0		18.75	*Conoglobigerina* aff. *dagestanica* Morozova
10.5	100.5	3	225.0		18.75	*Conoglobigerina* aff. *dagestanica* Morozova
10.5	93.0	4	150.0		12.50	*Globuligerina oxfordiana* (Grigelis)
10.5	92.0	3	225.0	25.00		*Globuligerina oxfordiana* (Grigelis)
10.5	91.0	3	162.5		12.50	*Globuligerina oxfordiana* (Grigelis)
10.5	88.0	6	275.0	37.50		*Conoglobigerina avariformis* Kasimova sphaerica
10.5	82.5	4	200.0		6.25	*Conoglobigerina* aff. *dagestanica* Morozova
10.5	82.0	4	137.5		6.25	*Globuligerina oxfordiana* (Grigelis)
10.5	81.5	3	200.0		18.75	*Conoglobigerina* aff. *dagestanica* Morozova
10.5	81.0	3	200.0		18.75	*Conoglobigerina* aff. *dagestanica* Morozova
11.0	77.5	3	225.0		18.75	*Conoglobigerina* aff. *dagestanica* Morozova
11.0	77.5	3	175.0		18.75	*Globuligerina oxfordiana* (Grigelis)
11.0	91.0	3	175.0		18.75	*Globuligerina oxfordiana* (Grigelis)
11.0	92.0	3	200.0		18.75	*Conoglobigerina* aff. *dagestanica* Morozova
11.0	92.5	4	225.0	31.25		*Globuligerina oxfordiana* (Grigelis)

SOMHEGY - LAYER H2 (BAJOCIAN - HUMPHRIESIANUM ZONE)

Thin Section Co-ordinates		No. of Chambers Visible	Max. Diameter (µm)	Wall Thickness (µm)		Species
Vert	Hor			Thick	Thin	
11.5	109.5	3	250.0		12.50	*Conoglobigerina* aff. *dagestanica* Morozova
11.5	109.5	4	250.0		16.75	*Conoglobigerina* aff. *dagestanica* Morozova
11.5	109.0	4	250.0		12.50	*Conoglobigerina* aff. *dagestanica* Morozova
11.5	107.5	3	225.0	25.00		*Globuligerina oxfordiana* (Grigelis)
11.5	84.0	3	175.0		18.75	*Globuligerina oxfordiana* (Grigelis)
12.0	104.5	3	175.0		18.75	*Globuligerina oxfordiana* (Grigelis)
12.0	105.0	4	250.0		18.75	*Conoglobigerina* aff. *dagestanica* Morozova
12.0	106.5	4	275.0		18.75	*Globuligerina bathoniana gigantea* Wernli & Görög
12.5	107.5	4	225.0		18.75	*Conoglobigerina* aff. *dagestanica* Morozova
12.5	106.5	4	100.0		6.25	*Globuligerina oxfordiana* (Grigelis)
12.5	98.0	4	250.0		18.75	*Conoglobigerina* aff. *dagestanica* Morozova
12.5	95.5	3	225.0		12.50	*Conoglobigerina* aff. *dagestanica* Morozova
12.5	95.0	3	175.0		18.75	*Globuligerina oxfordiana* (Grigelis)
12.5	85.0	3	187.5		18.75	*Globuligerina oxfordiana* (Grigelis)
12.5	78.5	4	200.0		18.75	*Conoglobigerina* aff. *dagestanica* Morozova
13.0	96.0	3	175.0		12.50	*Globuligerina oxfordiana* (Grigelis)
13.0	106.5	4	175.0		18.75	*Globuligerina oxfordiana* (Grigelis)
13.0	107.0	3	200.0		12.50	*Conoglobigerina* aff. *dagestanica* Morozova
13.0	107.0	4	212.5		12.50	*Conoglobigerina* aff. *dagestanica* Morozova
13.0	108.5	3	225.0		12.50	*Conoglobigerina* aff. *dagestanica* Morozova
13.5	110.5	4	250.0		18.75	*Conoglobigerina* aff. *dagestanica* Morozova
13.5	107.5	4	225.0		18.75	*Conoglobigerina* aff. *dagestanica* Morozova
13.5	106.0	3	212.5		12.50	*Conoglobigerina* aff. *dagestanica* Morozova
13.5	104.0	4	275.0		18.75	*Globuligerina bathoniana gigantea* Wernli & Görög
13.5	102.5	4	250.0		12.50	*Conoglobigerina* aff. *dagestanica* Morozova
13.5	98.0	5	325.0		12.50	*Globuligerina bathoniana gigantea* Wernli & Görög
13.5	96.5	4	137.5		12.50	*Globuligerina oxfordiana* (Grigelis)
13.5	86.5	4	250.0		18.75	*Conoglobigerina* aff. *dagestanica* Morozova
13.5	83.0	3	250.0		18.75	*Conoglobigerina* aff. *dagestanica* Morozova
13.5	80.0	4	225.0		18.75	*Conoglobigerina* aff. *dagestanica* Morozova
13.5	78.5	5	225.0		12.50	*Conoglobigerina* aff. *dagestanica* Morozova
14.0	73.5	5	200.0		18.75	*Conoglobigerina* aff. *dagestanica* Morozova
14.0	73.5	4	175.0	25.00		*Globuligerina oxfordiana* (Grigelis)
14.0	77.0	4	225.0		18.75	*Conoglobigerina* aff. *dagestanica* Morozova
14.0	78.0	3	200.0		12.50	*Conoglobigerina* aff. *dagestanica* Morozova
14.0	84.0	5	250.0		18.75	*Conoglobigerina* aff. *dagestanica* Morozova
14.0	85.5	4	200.0		18.75	*Conoglobigerina* aff. *dagestanica* Morozova
14.0	89.0	5	125.0		12.50	*Globuligerina oxfordiana* (Grigelis)
14.0	95.5	4	225.0		12.50	*Conoglobigerina* aff. *dagestanica* Morozova
14.0	107.5	5	200.0	25.00		*Globuligerina oxfordiana* (Grigelis)
14.5	104.0	4	125.0		12.50	*Globuligerina oxfordiana* (Grigelis)
14.5	103.5	3	137.5		18.75	*Globuligerina oxfordiana* (Grigelis)
14.5	101.0	3	175.0		12.50	*Globuligerina oxfordiana* (Grigelis)
14.5	100.0	4	125.0		18.75	*Globuligerina oxfordiana* (Grigelis)
14.5	98.0	3	175.0		18.75	*Globuligerina oxfordiana* (Grigelis)
14.5	98.0	5	137.5		12.50	*Globuligerina oxfordiana* (Grigelis)
14.5	95.5	3	112.5		12.50	*Globuligerina oxfordiana* (Grigelis)
14.5	94.0	3	187.5		12.50	*Globuligerina oxfordiana* (Grigelis)
14.5	92.0	3	200.0		18.75	*Conoglobigerina* aff. *dagestanica* Morozova
14.5	88.5	5	150.0		12.50	*Globuligerina oxfordiana* (Grigelis)
14.5	86.0	3	225.0	37.50		*Globuligerina oxfordiana* (Grigelis)
14.5	85.0	3	250.0	25.00		*Globuligerina oxfordiana* (Grigelis)
15.0	74.5	5	237.5		18.75	*Conoglobigerina* aff. *dagestanica* Morozova
15.0	82.5	3	175.0	25.00		*Globuligerina oxfordiana* (Grigelis)
15.0	85.0	4	225.0		18.75	*Conoglobigerina* aff. *dagestanica* Morozova

SOMHEGY - LAYER H2 (BAJOCIAN - HUMPHRIESIANUM ZONE)

Thin Section Co-ordinates		No. of Chambers Visible	Max. Diameter (µm)	Wall Thickness (µm)		Species
Vert	Hor			Thick	Thin	
15.0	88.5	4	200.0	25.00		*Globuligerina oxfordiana* (Grigelis)
15.0	90.5	4	175.0	25.00		*Globuligerina oxfordiana* (Grigelis)
15.0	91.5	3	187.5		18.75	*Globuligerina oxfordiana* (Grigelis)
15.0	92.0	4	175.0		12.50	*Globuligerina oxfordiana* (Grigelis)
15.0	92.0	4	200.0		12.50	*Conoglobigerina* aff. *dagestanica* Morozova
15.0	95.0	4	175.0		18.75	*Globuligerina oxfordiana* (Grigelis)
15.0	95.5	3	175.0		12.50	*Globuligerina oxfordiana* (Grigelis)
15.0	98.5	3	125.0		12.50	*Globuligerina oxfordiana* (Grigelis)
15.0	105.0	4	175.0		12.50	*Globuligerina oxfordiana* (Grigelis)
15.0	107.0	3	150.0		18.75	*Globuligerina oxfordiana* (Grigelis)
15.5	110.5	3	137.5		12.50	*Globuligerina oxfordiana* (Grigelis)
15.5	110.5	3	200.0		12.50	*Conoglobigerina* aff. *dagestanica* Morozova
15.5	108.5	4	150.0	25.00		*Globuligerina oxfordiana* (Grigelis)
15.5	107.0	4	175.0		18.75	*Globuligerina oxfordiana* (Grigelis)
15.5	98.5	4	225.0		18.75	*Conoglobigerina* aff. *dagestanica* Morozova
15.5	95.5	3	175.0		12.50	*Globuligerina oxfordiana* (Grigelis)
15.5	95.0	4	262.5		18.75	*Globuligerina bathoniana gigantea* Wernli & Görög
15.5	95.0	4	225.0	25.00		*Globuligerina oxfordiana* (Grigelis)
15.5	95.0	4	187.5		12.50	*Globuligerina oxfordiana* (Grigelis)
15.5	94.0	4	150.0		18.75	*Globuligerina oxfordiana* (Grigelis)
15.5	94.0	5	225.0		18.75	*Conoglobigerina* aff. *dagestanica* Morozova
15.5	92.5	3	250.0		18.75	*Conoglobigerina* aff. *dagestanica* Morozova
15.5	92.5	4	250.0		12.75	*Conoglobigerina* aff. *dagestanica* Morozova
15.5	92.0	4	200.0		12.50	*Conoglobigerina* aff. *dagestanica* Morozova
15.5	92.0	3	125.0		18.75	*Globuligerina oxfordiana* (Grigelis)
15.5	92.0	3	200.0		18.75	*Conoglobigerina* aff. *dagestanica* Morozova
15.5	91.0	4	200.0	25.00		*Globuligerina oxfordiana* (Grigelis)
15.5	90.5	3	175.0		18.75	*Globuligerina oxfordiana* (Grigelis)
15.5	83.0	3	150.0		18.75	*Globuligerina oxfordiana* (Grigelis)
15.5	81.5	3	200.0	31.25		*Globuligerina oxfordiana* (Grigelis)
15.5	79.5	4	175.0		12.50	*Globuligerina oxfordiana* (Grigelis)
15.5	78.5	3	200.0	25.00		*Globuligerina oxfordiana* (Grigelis)
15.5	78.0	3	162.5		12.50	*Globuligerina oxfordiana* (Grigelis)
15.5	77.5	3	175.0		18.75	*Globuligerina oxfordiana* (Grigelis)
15.5	77.0	4	187.5		18.75	*Globuligerina oxfordiana* (Grigelis)
15.5	76.5	3	200.0		18.75	*Conoglobigerina* aff. *dagestanica* Morozova
15.5	76.0	4	225.0		18.75	*Conoglobigerina* aff. *dagestanica* Morozova
15.5	76.0	4	150.0		12.50	*Globuligerina oxfordiana* (Grigelis)
15.5	76.0	5	225.0		18.75	*Conoglobigerina* aff. *dagestanica* Morozova
16.0	75.0	3	200.0		18.75	*Conoglobigerina* aff. *dagestanica* Morozova
16.0	81.5	3	200.0	25.00		*Globuligerina oxfordiana* (Grigelis)
16.0	86.0	4	125.0		12.50	*Globuligerina oxfordiana* (Grigelis)
16.0	87.0	3	162.5		18.75	*Globuligerina oxfordiana* (Grigelis)
16.0	88.5	4	175.0		12.50	*Globuligerina oxfordiana* (Grigelis)
16.0	95.0	3	200.0		18.75	*Conoglobigerina* aff. *dagestanica* Morozova
16.0	95.5	4	225.0		18.75	*Conoglobigerina* aff. *dagestanica* Morozova
16.0	95.5	4	250.0		18.75	*Conoglobigerina* aff. *dagestanica* Morozova
16.0	100.5	4	200.0		18.75	*Conoglobigerina* aff. *dagestanica* Morozova
16.5	98.5	4	200.0		18.75	*Conoglobigerina* aff. *dagestanica* Morozova
16.5	97.5	4	175.0		12.50	*Globuligerina oxfordiana* (Grigelis)
16.5	97.5	3	150.0		12.50	*Globuligerina oxfordiana* (Grigelis)
16.5	97.5	4	200.0		12.50	*Conoglobigerina* aff. *dagestanica* Morozova
16.5	96.0	3	200.0	25.00		*Globuligerina oxfordiana* (Grigelis)
16.5	95.0	4	225.0		12.50	*Conoglobigerina* aff. *dagestanica* Morozova
16.5	93.5	3	225.0	25.00		*Globuligerina oxfordiana* (Grigelis)

SOMHEGY - LAYER H2 (BAJOCIAN - HUMPHRIESIANUM ZONE)

Thin Section Co-ordinates		No. of Chambers Visible	Max. Diameter (µm)	Wall Thickness (µm)		Species
Vert	Hor			Thick	Thin	
16.5	90.0	3	200.0		18.75	*Conoglobigerina* aff. *dagestanica* Morozova
16.5	88.5	4	175.0		18.75	*Globuligerina oxfordiana* (Grigelis)
16.5	87.5	3	137.5		12.50	*Globuligerina oxfordiana* (Grigelis)
16.5	83.0	3	200.0	25.00		*Globuligerina oxfordiana* (Grigelis)
16.5	79.0	3	150.0		18.75	*Globuligerina oxfordiana* (Grigelis)
16.5	78.0	4	100.0		12.50	*Globuligerina oxfordiana* (Grigelis)
16.5	78.0	3	175.0		12.50	*Globuligerina oxfordiana* (Grigelis)
16.5	73.0	3	125.0		12.50	*Globuligerina oxfordiana* (Grigelis)
16.5	72.5	4	275.0		18.75	*Globuligerina bathoniana gigantea* Wemli & Görög
16.5	72.0	4	400.0	25.00		*Conoglobigerina avariformis* Kasimova alta
17.0	78.5	3	162.5		18.75	*Globuligerina oxfordiana* (Grigelis)
17.0	78.5	3	225.0		18.75	*Conoglobigerina* aff. *dagestanica* Morozova
17.0	79.5	4	175.0		12.50	*Globuligerina oxfordiana* (Grigelis)
17.0	80.0	3	125.0		12.50	*Globuligerina oxfordiana* (Grigelis)
17.0	87.5	4	125.0		12.50	*Globuligerina oxfordiana* (Grigelis)
17.0	87.5	6	150.0		12.50	*Globuligerina oxfordiana* (Grigelis)
17.0	91.5	4	150.0		12.50	*Globuligerina oxfordiana* (Grigelis)
17.0	92.5	3	125.0		18.75	*Globuligerina oxfordiana* (Grigelis)
17.0	96.0	4	162.5		18.75	*Globuligerina oxfordiana* (Grigelis)
17.0	98.0	3	125.0		12.50	*Globuligerina oxfordiana* (Grigelis)
17.5	110.5	4	162.5		12.50	*Globuligerina oxfordiana* (Grigelis)
17.5	109.0	6	175.0		12.50	*Globuligerina oxfordiana* (Grigelis)
17.5	108.5	4	200.0		12.50	*Conoglobigerina* aff. *dagestanica* Morozova
17.5	108.5	5	250.0		18.75	*Conoglobigerina* aff. *dagestanica* Morozova
17.5	107.5	4	175.0		6.25	*Globuligerina oxfordiana* (Grigelis)
17.5	106.0	3	125.0		12.50	*Globuligerina oxfordiana* (Grigelis)
17.5	104.5	5	225.0		12.50	*Conoglobigerina* aff. *dagestanica* Morozova
17.5	104.0	4	200.0		12.50	*Conoglobigerina* aff. *dagestanica* Morozova
17.5	102.5	4	150.0		12.50	*Globuligerina oxfordiana* (Grigelis)
17.5	102.0	4	175.0	25.00		*Globuligerina oxfordiana* (Grigelis)
17.5	101.5	4	125.0		18.75	*Globuligerina oxfordiana* (Grigelis)
17.5	99.0	3	175.0		18.75	*Globuligerina oxfordiana* (Grigelis)
17.5	97.5	3	225.0		18.75	*Conoglobigerina* aff. *dagestanica* Morozova
17.5	97.0	4	150.0		18.75	*Globuligerina oxfordiana* (Grigelis)
17.5	85.5	3	137.5		12.50	*Globuligerina oxfordiana* (Grigelis)
17.5	83.5	3	150.0	25.00		*Globuligerina oxfordiana* (Grigelis)
17.5	83.5	3	200.0	25.00		*Globuligerina oxfordiana* (Grigelis)
17.5	82.5	4	200.0	25.00		*Globuligerina oxfordiana* (Grigelis)
17.5	82.5	3	125.0		18.75	*Globuligerina oxfordiana* (Grigelis)
17.5	81.0	3	175.0		18.75	*Globuligerina oxfordiana* (Grigelis)
17.5	80.5	3	175.0		18.75	*Globuligerina oxfordiana* (Grigelis)
17.5	79.0	4	137.5	25.00		*Globuligerina oxfordiana* (Grigelis)
17.5	78.0	4	225.0		18.75	*Conoglobigerina* aff. *dagestanica* Morozova
17.5	76.0	3	150.0		18.75	*Globuligerina oxfordiana* (Grigelis)
17.5	71.0	3	250.0		18.75	*Conoglobigerina* aff. *dagestanica* Morozova
18.0	79.0	3	150.0		12.50	*Globuligerina oxfordiana* (Grigelis)
18.0	80.5	4	250.0	25.00		*Globuligerina oxfordiana* (Grigelis)
18.0	80.5	4	200.0	25.00		*Globuligerina oxfordiana* (Grigelis)
18.0	101.5	3	225.0		12.50	*Conoglobigerina* aff. *dagestanica* Morozova
18.0	102.0	3	175.0		18.75	*Globuligerina oxfordiana* (Grigelis)
18.0	103.0	4	262.5	25.00		*Conoglobigerina avariformis* Kasimova sphaerica
18.5	108.5	3	162.5		12.50	*Globuligerina oxfordiana* (Grigelis)
18.5	107.0	4	212.5		18.75	*Conoglobigerina* aff. *dagestanica* Morozova
18.5	103.0	3	200.0		18.75	*Conoglobigerina* aff. *dagestanica* Morozova
18.5	103.0	4	212.5		18.75	*Conoglobigerina* aff. *dagestanica* Morozova

SOMHEGY - LAYER H2 (BAJOCIAN - HUMPHRIESIANUM ZONE)

Thin Section Co-ordinates		No. of Chambers Visible	Max. Diameter (µm)	Wall Thickness (µm)		Species
Vert	Hor			Thick	Thin	
18.5	85.5	3	150.0		18.75	*Globuligerina oxfordiana* (Grigelis)
18.5	85.5	3	137.5		18.75	*Globuligerina oxfordiana* (Grigelis)
18.5	85.5	4	162.5		12.50	*Globuligerina oxfordiana* (Grigelis)
18.5	84.0	3	100.0	25.00		*Globuligerina oxfordiana* (Grigelis)
18.5	84.0	4	187.5		18.75	*Globuligerina oxfordiana* (Grigelis)
18.5	78.0	3	225.0		18.75	*Conoglobigerina* aff. *dagestanica* Morozova
18.5	75.0	3	225.0		18.75	*Conoglobigerina* aff. *dagestanica* Morozova
18.5	72.0	4	250.0		18.75	*Conoglobigerina* aff. *dagestanica* Morozova
18.5	71.0	3	125.0		18.75	*Globuligerina oxfordiana* (Grigelis)
19.0	81.0	3	225.0		12.50	*Conoglobigerina* aff. *dagestanica* Morozova
19.0	83.5	7	175.0		18.75	*Globuligerina oxfordiana* (Grigelis)
19.0	95.0	3	200.0		18.75	*Conoglobigerina* aff. *dagestanica* Morozova
19.0	96.0	4	225.0	37.50		*Globuligerina oxfordiana* (Grigelis)
19.0	100.0	3	225.0	37.50		*Globuligerina oxfordiana* (Grigelis)
19.5	110.0	4	212.5	25.00	0.00	*Globuligerina oxfordiana* (Grigelis)
19.5	110.0	3	162.5		18.75	*Globuligerina oxfordiana* (Grigelis)
19.5	109.0	4	175.0		18.75	*Globuligerina oxfordiana* (Grigelis)
19.5	107.5	4	225.0		12.50	*Conoglobigerina* aff. *dagestanica* Morozova
19.5	106.0	4	125.0		18.75	*Globuligerina oxfordiana* (Grigelis)
19.5	102.0	4	125.0		18.75	*Globuligerina oxfordiana* (Grigelis)
19.5	97.0	4	225.0		18.75	*Conoglobigerina* aff. *dagestanica* Morozova
19.5	85.5	3	125.0		18.75	*Globuligerina oxfordiana* (Grigelis)
19.5	81.5	4	225.0		18.75	*Conoglobigerina* aff. *dagestanica* Morozova
19.5	81.0	3	175.0		18.75	*Globuligerina oxfordiana* (Grigelis)
19.5	80.0	4	150.0		12.50	*Globuligerina oxfordiana* (Grigelis)
19.5	75.0	4	225.0		18.75	*Conoglobigerina* aff. *dagestanica* Morozova
20.0	86.0	6	225.0		18.75	*Conoglobigerina* aff. *dagestanica* Morozova
20.0	101.5	6	225.0	25.00		*Globuligerina oxfordiana* (Grigelis)
20.0	107.0	3	175.0		18.75	*Globuligerina oxfordiana* (Grigelis)
20.0	109.0	4	175.0		18.75	*Globuligerina oxfordiana* (Grigelis)
20.0	110.0	4	175.0		12.50	*Globuligerina oxfordiana* (Grigelis)
20.5	103.0	3	200.0		18.75	*Conoglobigerina* aff. *dagestanica* Morozova
20.5	99.0	4	225.0		18.75	*Conoglobigerina* aff. *dagestanica* Morozova
20.5	99.0	3	150.0	37.50		*Globuligerina oxfordiana* (Grigelis)
20.5	96.5	3	200.0	25.00		*Globuligerina oxfordiana* (Grigelis)
20.5	94.0	3	225.0		18.75	*Conoglobigerina* aff. *dagestanica* Morozova
20.5	92.0	3	150.0		18.75	*Globuligerina oxfordiana* (Grigelis)
20.5	92.0	4	225.0	37.50		*Globuligerina oxfordiana* (Grigelis)
20.5	87.5	4	162.5		18.75	*Globuligerina oxfordiana* (Grigelis)
20.5	87.0	4	162.5		12.50	*Globuligerina oxfordiana* (Grigelis)
20.5	84.0	3	225.0	31.25		*Globuligerina oxfordiana* (Grigelis)
20.5	71.0	4	150.0		12.50	*Globuligerina oxfordiana* (Grigelis)
21.0	73.0	5	162.5		12.50	*Globuligerina oxfordiana* (Grigelis)
21.0	77.5	3	150.0		12.50	*Globuligerina oxfordiana* (Grigelis)
21.0	86.5	4	175.0		12.50	*Globuligerina oxfordiana* (Grigelis)
21.0	91.0	3	212.5		18.75	*Conoglobigerina* aff. *dagestanica* Morozova
21.0	91.5	3	150.0	25.00		*Globuligerina oxfordiana* (Grigelis)
21.5	107.0	3	200.0		18.75	*Conoglobigerina* aff. *dagestanica* Morozova
21.5	104.0	4	225.0		18.75	*Conoglobigerina* aff. *dagestanica* Morozova
21.5	96.0	4	175.0		12.50	*Globuligerina oxfordiana* (Grigelis)
21.5	93.5	6	200.0		12.50	*Conoglobigerina* aff. *dagestanica* Morozova
21.5	91.5	4	237.5	31.25		*Globuligerina oxfordiana* (Grigelis)
21.5	80.0	4	150.0		18.75	*Globuligerina oxfordiana* (Grigelis)
21.5	78.0	3	200.0		18.75	*Conoglobigerina* aff. *dagestanica* Morozova
21.5	76.5	3	150.0		18.75	*Globuligerina oxfordiana* (Grigelis)

SOMHEGY - LAYER H2 (BAJOCIAN - HUMPHRIESIANUM ZONE)

Thin Section Co-ordinates		No. of Chambers Visible	Max. Diameter (µm)	Wall Thickness (µm)		Species
Vert	Hor			Thick	Thin	
21.5	76.0	3	150.0		18.75	*Globuligerina oxfordiana* (Grigelis)
21.5	76.0	3	125.0		12.50	*Globuligerina oxfordiana* (Grigelis)
21.5	75.0	3	225.0		18.75	*Conoglobigerina* aff. *dagestanica* Morozova
21.5	74.0	3	150.0		6.25	*Globuligerina oxfordiana* (Grigelis)
21.5	74.0	4	150.0		6.25	*Globuligerina oxfordiana* (Grigelis)
21.5	74.0	4	162.5		6.25	*Globuligerina oxfordiana* (Grigelis)
21.5	73.0	4	150.0		6.25	*Globuligerina oxfordiana* (Grigelis)
21.5	70.5	4	150.0		12.50	*Globuligerina oxfordiana* (Grigelis)
22.0	97.5	3	250.0		12.50	*Conoglobigerina* aff. *dagestanica* Morozova
22.0	105.0	4	225.0		18.75	*Conoglobigerina* aff. *dagestanica* Morozova
22.0	106.0	3	175.0		12.50	*Globuligerina oxfordiana* (Grigelis)
22.5	110.0	3	175.0		18.75	*Globuligerina oxfordiana* (Grigelis)
22.5	110.0	3	150.0		12.50	*Globuligerina oxfordiana* (Grigelis)
22.5	110.0	3	150.0		18.75	*Globuligerina oxfordiana* (Grigelis)
22.5	94.0	4	225.0		18.75	*Conoglobigerina* aff. *dagestanica* Morozova
22.5	92.0	4	225.0	25.00		*Globuligerina oxfordiana* (Grigelis)
22.5	91.0	3	200.0		18.75	*Conoglobigerina* aff. *dagestanica* Morozova
22.5	85.0	3	250.0		12.50	*Conoglobigerina* aff. *dagestanica* Morozova
22.5	80.0	4	200.0		18.75	*Conoglobigerina* aff. *dagestanica* Morozova
22.5	79.5	4	200.0		18.75	*Conoglobigerina* aff. *dagestanica* Morozova
22.5	77.5	4	175.0		6.25	*Globuligerina oxfordiana* (Grigelis)
23.0	71.5	4	300.0		18.75	*Globuligerina bathoniana gigantea* Wernli & Görög
23.0	78.0	3	125.0		12.50	*Globuligerina oxfordiana* (Grigelis)
23.0	78.0	4	125.0		12.50	*Globuligerina oxfordiana* (Grigelis)
23.0	108.0	4	200.0		18.75	*Conoglobigerina* aff. *dagestanica* Morozova
23.5	110.0	5	225.0	25.00		*Globuligerina oxfordiana* (Grigelis)
23.5	109.5	4	187.5		18.75	*Globuligerina oxfordiana* (Grigelis)
23.5	108.0	5	225.0		18.75	*Conoglobigerina* aff. *dagestanica* Morozova
23.5	104.5	3	200.0		18.75	*Conoglobigerina* aff. *dagestanica* Morozova
23.5	84.5	4	175.0		18.75	*Globuligerina oxfordiana* (Grigelis)
23.5	78.5	4	200.0		12.50	*Conoglobigerina* aff. *dagestanica* Morozova
23.5	76.5	3	200.0		18.75	*Conoglobigerina* aff. *dagestanica* Morozova
24.0	81.5	3	150.0		12.50	*Globuligerina oxfordiana* (Grigelis)
24.0	84.5	4	137.5		18.75	*Globuligerina oxfordiana* (Grigelis)
24.0	94.0	3	162.5		6.25	*Globuligerina oxfordiana* (Grigelis)
24.0	96.0	4	187.5		18.75	*Globuligerina oxfordiana* (Grigelis)
24.0	96.0	4	237.5		18.75	*Conoglobigerina* aff. *dagestanica* Morozova
24.0	99.5	4	137.5		18.75	*Globuligerina oxfordiana* (Grigelis)
24.0	102.0	3	175.0		12.50	*Globuligerina oxfordiana* (Grigelis)
24.0	107.0	4	312.5		18.75	*Globuligerina bathoniana gigantea* Wernli & Görög
24.0	109.5	4	200.0		18.75	*Conoglobigerina* aff. *dagestanica* Morozova
24.5	84.5	4	175.0		12.50	*Globuligerina oxfordiana* (Grigelis)
24.5	80.5	6	137.5		12.50	*Globuligerina oxfordiana* (Grigelis)
24.5	78.5	5	200.0		18.75	*Conoglobigerina* aff. *dagestanica* Morozova
24.5	78.5	3	125.0	25.00		*Globuligerina oxfordiana* (Grigelis)
24.5	76.0	4	175.0		12.50	*Globuligerina oxfordiana* (Grigelis)
24.5	74.5	4	175.0		12.50	*Globuligerina oxfordiana* (Grigelis)
25.0	83.5	4	200.0		12.50	*Conoglobigerina* aff. *dagestanica* Morozova
25.0	84.5	5	150.0		12.50	*Globuligerina oxfordiana* (Grigelis)
25.5	109.5	4	125.0		6.25	*Globuligerina oxfordiana* (Grigelis)
25.5	107.5	4	125.0		18.75	*Globuligerina oxfordiana* (Grigelis)
25.5	90.5	3	137.5		18.75	*Globuligerina oxfordiana* (Grigelis)
25.5	89.0	3	150.0		18.75	*Globuligerina oxfordiana* (Grigelis)
25.5	87.0	4	200.0		18.75	*Conoglobigerina* aff. *dagestanica* Morozova
26.0	80.0	4	150.0		18.75	*Globuligerina oxfordiana* (Grigelis)

SOMHEGY - LAYER H2 (BAJOCIAN - HUMPHRIESIANUM ZONE)

Thin Section Co-ordinates		No. of Chambers Visible	Max. Diameter (μm)	Wall Thickness (μm)		Species
Vert	Hor			Thick	Thin	
26.0	86.0	3	175.0		12.50	*Globuligerina oxfordiana* (Grigelis)
26.0	86.0	4	175.0		18.75	*Globuligerina oxfordiana* (Grigelis)
26.0	88.0	3	150.0		6.25	*Globuligerina oxfordiana* (Grigelis)
26.0	91.0	3	137.5		18.75	*Globuligerina oxfordiana* (Grigelis)
26.0	91.0	3	125.0		18.75	*Globuligerina oxfordiana* (Grigelis)
26.0	94.0	4	200.0		18.75	*Conoglobigerina* aff. *dagestanica* Morozova
26.0	96.0	4	162.5		12.50	*Globuligerina oxfordiana* (Grigelis)
26.0	96.5	4	125.0		12.50	*Globuligerina oxfordiana* (Grigelis)
26.0	97.0	4	150.0		12.50	*Globuligerina oxfordiana* (Grigelis)
26.0	97.5	4	137.5		12.50	*Globuligerina oxfordiana* (Grigelis)
26.0	98.0	4	150.0		12.50	*Globuligerina oxfordiana* (Grigelis)
26.0	104.0	3	175.0		12.50	*Globuligerina oxfordiana* (Grigelis)
26.0	105.5	3	150.0		12.50	*Globuligerina oxfordiana* (Grigelis)
26.5	109.0	4	175.0		12.50	*Globuligerina oxfordiana* (Grigelis)
26.5	105.5	4	125.0		12.50	*Globuligerina oxfordiana* (Grigelis)
26.5	99.5	4	150.0		12.50	*Globuligerina oxfordiana* (Grigelis)
26.5	98.5	3	150.0		18.75	*Globuligerina oxfordiana* (Grigelis)
26.5	97.5	4	175.0		12.50	*Globuligerina oxfordiana* (Grigelis)
26.5	96.5	4	150.0		12.50	*Globuligerina oxfordiana* (Grigelis)
26.5	96.0	4	175.0		18.75	*Globuligerina oxfordiana* (Grigelis)
26.5	90.5	3	125.0		18.75	*Globuligerina oxfordiana* (Grigelis)
26.5	90.0	4	150.0		18.75	*Globuligerina oxfordiana* (Grigelis)
26.5	78.0	5	175.0		12.50	*Globuligerina oxfordiana* (Grigelis)
26.5	76.5	3	150.0		18.75	*Globuligerina oxfordiana* (Grigelis)
26.5	75.0	4	150.0		18.75	*Globuligerina oxfordiana* (Grigelis)
26.5	74.5	3	150.0		18.75	*Globuligerina oxfordiana* (Grigelis)
26.5	71.0	3	112.5		18.75	*Globuligerina oxfordiana* (Grigelis)
27.0	76.5	4	150.0		18.75	*Globuligerina oxfordiana* (Grigelis)
27.0	78.0	4	175.0		18.75	*Globuligerina oxfordiana* (Grigelis)
27.0	84.0	4	175.0		18.75	*Globuligerina oxfordiana* (Grigelis)
27.0	99.0	4	150.0		6.25	*Globuligerina oxfordiana* (Grigelis)
27.0	100.5	4	175.0		18.75	*Globuligerina oxfordiana* (Grigelis)
27.0	106.0	4	175.0		12.50	*Globuligerina oxfordiana* (Grigelis)
27.0	109.0	3	150.0		12.50	*Globuligerina oxfordiana* (Grigelis)
27.5	108.5	3	150.0		12.50	*Globuligerina oxfordiana* (Grigelis)
27.5	108.0	4	150.0		12.50	*Globuligerina oxfordiana* (Grigelis)
27.5	104.0	4	175.0		18.75	*Globuligerina oxfordiana* (Grigelis)
27.5	103.0	4	150.0		18.75	*Globuligerina oxfordiana* (Grigelis)
27.5	102.5	4	125.0		18.75	*Globuligerina oxfordiana* (Grigelis)
27.5	89.5	4	287.5		18.75	*Globuligerina bathoniana gigantea* Wernli & Görög
27.5	82.5	4	212.5		18.75	*Conoglobigerina* aff. *dagestanica* Morozova
27.5	78.5	4	175.0		18.75	*Globuligerina oxfordiana* (Grigelis)
27.5	73.5	5	175.0		18.75	*Globuligerina oxfordiana* (Grigelis)
27.5	73.5	4	150.0		18.75	*Globuligerina oxfordiana* (Grigelis)
27.5	73.0	3	125.0		18.75	*Globuligerina oxfordiana* (Grigelis)
27.5	70.0	4	150.0		18.75	*Globuligerina oxfordiana* (Grigelis)
28.0	80.0	3	137.5		12.50	*Globuligerina oxfordiana* (Grigelis)
28.0	103.0	3	162.5		18.75	*Globuligerina oxfordiana* (Grigelis)
28.0	103.0	3	150.0		18.75	*Globuligerina oxfordiana* (Grigelis)
28.5	110.5	4	150.0		18.75	*Globuligerina oxfordiana* (Grigelis)
28.5	110.5	3	175.0	25.00		*Globuligerina oxfordiana* (Grigelis)
28.5	110.0	4	250.0		18.75	*Conoglobigerina* aff. *dagestanica* Morozova
28.5	110.0	3	225.0		18.75	*Conoglobigerina* aff. *dagestanica* Morozova
28.5	109.5	4	125.0		18.75	*Globuligerina oxfordiana* (Grigelis)
28.5	109.5	3	150.0		18.75	*Globuligerina oxfordiana* (Grigelis)

SOMHEGY - LAYER H2 (BAJOCIAN - HUMPHRIESIANUM ZONE)

Thin Section Co-ordinates		No. of Chambers Visible	Max. Diameter (µm)	Wall Thickness (µm)		Species
Vert	Hor			Thick	Thin	
28.5	108.5	4	150.0		18.75	*Globuligerina oxfordiana* (Grigelis)
28.5	102.0	4	175.0		12.50	*Globuligerina oxfordiana* (Grigelis)
28.5	101.5	3	175.0		12.50	*Globuligerina oxfordiana* (Grigelis)
28.5	101.5	4	175.0		12.50	*Globuligerina oxfordiana* (Grigelis)
28.5	98.0	4	175.0		18.75	*Globuligerina oxfordiana* (Grigelis)
28.5	92.0	5	162.5		12.50	*Globuligerina oxfordiana* (Grigelis)
28.5	90.5	4	175.0		12.50	*Globuligerina oxfordiana* (Grigelis)
28.5	88.5	3	175.0		18.75	*Globuligerina oxfordiana* (Grigelis)
28.5	87.5	4	150.0		12.50	*Globuligerina oxfordiana* (Grigelis)
28.5	87.5	3	125.0		12.50	*Globuligerina oxfordiana* (Grigelis)
28.5	86.0	4	162.5		18.75	*Globuligerina oxfordiana* (Grigelis)
28.5	83.5	4	150.0		18.75	*Globuligerina oxfordiana* (Grigelis)
28.5	83.0	4	150.0		12.50	*Globuligerina oxfordiana* (Grigelis)
28.5	82.5	4	175.0		12.50	*Globuligerina oxfordiana* (Grigelis)
28.5	73.0	3	150.0		6.25	*Globuligerina oxfordiana* (Grigelis)
28.5	72.0	4	175.0		12.50	*Globuligerina oxfordiana* (Grigelis)
28.5	71.5	3	150.0		18.75	*Globuligerina oxfordiana* (Grigelis)
28.5	71.0	3	100.0		12.50	*Globuligerina oxfordiana* (Grigelis)
28.5	70.5	3	175.0		18.75	*Globuligerina oxfordiana* (Grigelis)
28.5	70.5	3	125.0		18.75	*Globuligerina oxfordiana* (Grigelis)
28.5	70.0	4	175.0		18.75	*Globuligerina oxfordiana* (Grigelis)
28.5	70.0	4	162.5		18.75	*Globuligerina oxfordiana* (Grigelis)
28.5	70.0	3	100.0		18.75	*Globuligerina oxfordiana* (Grigelis)
29.0	69.5	3	175.0		12.50	*Globuligerina oxfordiana* (Grigelis)
29.0	69.5	3	187.5		12.50	*Globuligerina oxfordiana* (Grigelis)
29.5	108.5	3	100.0		18.75	*Globuligerina oxfordiana* (Grigelis)
29.0	71.0	4	162.5		12.50	*Globuligerina oxfordiana* (Grigelis)
29.0	75.5	4	150.0		12.50	*Globuligerina oxfordiana* (Grigelis)
29.0	78.5	3	150.0		18.75	*Globuligerina oxfordiana* (Grigelis)
29.0	82.5	3	112.5		18.75	*Globuligerina oxfordiana* (Grigelis)
29.0	82.5	3	112.5		12.50	*Globuligerina oxfordiana* (Grigelis)
29.0	87.5	4	137.5		18.75	*Globuligerina oxfordiana* (Grigelis)
29.0	87.5	4	175.0		18.75	*Globuligerina oxfordiana* (Grigelis)
29.0	91.0	4	175.0		12.50	*Globuligerina oxfordiana* (Grigelis)
29.0	92.0	3	150.0		12.50	*Globuligerina oxfordiana* (Grigelis)
29.0	93.0	3	125.0		18.75	*Globuligerina oxfordiana* (Grigelis)
29.0	94.5	3	150.0		12.50	*Globuligerina oxfordiana* (Grigelis)
29.0	107.5	3	175.0		6.25	*Globuligerina oxfordiana* (Grigelis)
29.0	108.5	5	150.0		12.50	*Globuligerina oxfordiana* (Grigelis)
29.5	108.0	4	175.0		6.25	*Globuligerina oxfordiana* (Grigelis)
29.5	108.0	5	187.5		12.50	*Globuligerina oxfordiana* (Grigelis)
29.5	107.5	3	200.0		12.50	*Conoglobigerina* aff. *dagestanica* Morozova
29.5	100.0	4	150.0		18.75	*Globuligerina oxfordiana* (Grigelis)
29.5	97.5	5	175.0		12.50	*Globuligerina oxfordiana* (Grigelis)
29.5	96.5	3	150.0	25.00		*Globuligerina oxfordiana* (Grigelis)
29.5	89.0	3	175.0		12.50	*Globuligerina oxfordiana* (Grigelis)
29.5	88.0	4	200.0		18.75	*Conoglobigerina* aff. *dagestanica* Morozova
29.5	88.0	5	175.0		12.50	*Globuligerina oxfordiana* (Grigelis)
29.5	84.0	3	187.5		18.75	*Globuligerina oxfordiana* (Grigelis)
29.5	78.0	3	150.0		18.75	*Globuligerina oxfordiana* (Grigelis)
29.5	75.0	4	150.0		12.50	*Globuligerina oxfordiana* (Grigelis)
29.5	71.5	5	175.0		12.50	*Globuligerina oxfordiana* (Grigelis)
29.5	70.5	3	125.0		18.75	*Globuligerina oxfordiana* (Grigelis)
30.0	71.5	4	150.0		18.75	*Globuligerina oxfordiana* (Grigelis)
30.0	74.0	3	150.0		12.50	*Globuligerina oxfordiana* (Grigelis)

SOMHEGY - LAYER H2 (BAJOCIAN - HUMPHRIESIANUM ZONE)

Thin Section Co-ordinates		No. of Chambers Visible	Max. Diameter (µm)	Wall Thickness (µm)		Species
Vert	Hor			Thick	Thin	
30.0	75.0	3	150.0		12.50	*Globuligerina oxfordiana* (Grigelis)
30.0	85.0	3	125.0		18.75	*Globuligerina oxfordiana* (Grigelis)
30.0	85.0	3	125.0		12.50	*Globuligerina oxfordiana* (Grigelis)
30.0	91.0	3	100.0		12.50	*Globuligerina oxfordiana* (Grigelis)
30.0	91.5	4	175.0		12.50	*Globuligerina oxfordiana* (Grigelis)
30.0	92.5	3	125.0		18.75	*Globuligerina oxfordiana* (Grigelis)
30.5	109.5	3	125.0		18.75	*Globuligerina oxfordiana* (Grigelis)
30.5	107.0	3	125.0		12.50	*Globuligerina oxfordiana* (Grigelis)
30.5	106.5	4	162.5		18.75	*Globuligerina oxfordiana* (Grigelis)
30.5	103.5	3	175.0		18.75	*Globuligerina oxfordiana* (Grigelis)
30.5	102.0	3	150.0		18.75	*Globuligerina oxfordiana* (Grigelis)
30.5	98.5	3	175.0		12.50	*Globuligerina oxfordiana* (Grigelis)
30.5	98.0	3	162.5		18.75	*Globuligerina oxfordiana* (Grigelis)
30.5	97.5	4	175.0		18.75	*Globuligerina oxfordiana* (Grigelis)
30.5	97.5	3	150.0		18.75	*Globuligerina oxfordiana* (Grigelis)
30.5	95.0	4	175.0		12.50	*Globuligerina oxfordiana* (Grigelis)
30.5	85.5	3	112.5		12.50	*Globuligerina oxfordiana* (Grigelis)
30.5	85.0	5	200.0		18.75	*Conoglobigerina* aff. *dagestanica* Morozova
30.5	82.5	3	125.0		18.75	*Globuligerina oxfordiana* (Grigelis)
30.5	80.5	4	125.0		18.75	*Globuligerina oxfordiana* (Grigelis)
30.5	80.0	3	225.0	25.00		*Globuligerina oxfordiana* (Grigelis)
30.5	80.0	3	150.0		12.50	*Globuligerina oxfordiana* (Grigelis)
30.5	77.5	4	150.0		18.75	*Globuligerina oxfordiana* (Grigelis)
30.5	75.0	4	175.0		18.75	*Globuligerina oxfordiana* (Grigelis)
30.5	74.5	5	237.5		12.50	*Conoglobigerina* aff. *dagestanica* Morozova
30.5	74.5	3	150.0		18.75	*Globuligerina oxfordiana* (Grigelis)
30.5	74.5	3	150.0		12.50	*Globuligerina oxfordiana* (Grigelis)
30.5	74.0	3	137.5		12.50	*Globuligerina oxfordiana* (Grigelis)
30.5	73.5	4	200.0		18.75	*Conoglobigerina* aff. *dagestanica* Morozova
31.0	72.5	3	125.0		12.50	*Globuligerina oxfordiana* (Grigelis)
31.0	74.0	4	175.0		18.75	*Globuligerina oxfordiana* (Grigelis)
31.0	74.5	3	125.0		12.50	*Globuligerina oxfordiana* (Grigelis)
31.0	77.5	4	175.0		12.50	*Globuligerina oxfordiana* (Grigelis)
31.0	78.0	4	200.0		12.50	*Conoglobigerina* aff. *dagestanica* Morozova
31.0	87.0	4	150.0		12.50	*Globuligerina oxfordiana* (Grigelis)
31.0	97.0	4	125.0		18.75	*Globuligerina oxfordiana* (Grigelis)
31.0	107.0	3	125.0		18.75	*Globuligerina oxfordiana* (Grigelis)
31.0	107.0	3	175.0		18.75	*Globuligerina oxfordiana* (Grigelis)
31.0	109.0	3	150.0		18.75	*Globuligerina oxfordiana* (Grigelis)
31.5	95.5	4	200.0		12.50	*Conoglobigerina* aff. *dagestanica* Morozova
31.5	94.0	3	175.0		12.50	*Globuligerina oxfordiana* (Grigelis)
31.5	88.0	4	175.0		12.50	*Globuligerina oxfordiana* (Grigelis)
31.5	88.0	4	175.0		18.75	*Globuligerina oxfordiana* (Grigelis)
31.5	85.5	3	125.0		18.75	*Globuligerina oxfordiana* (Grigelis)
31.5	85.0	3	125.0		12.50	*Globuligerina oxfordiana* (Grigelis)
31.5	82.5	3	175.0		12.50	*Globuligerina oxfordiana* (Grigelis)
32.0	95.0	5	150.0		18.75	*Globuligerina oxfordiana* (Grigelis)
32.5	106.0	4	175.0		18.75	*Globuligerina oxfordiana* (Grigelis)
32.5	89.5	4	125.0		18.75	*Globuligerina oxfordiana* (Grigelis)
32.5	69.5	3	150.0		18.75	*Globuligerina oxfordiana* (Grigelis)
33.0	76.0	4	175.0		18.75	*Globuligerina oxfordiana* (Grigelis)
33.0	76.0	4	150.0		18.75	*Globuligerina oxfordiana* (Grigelis)
33.0	79.0	3	175.0		18.75	*Globuligerina oxfordiana* (Grigelis)
33.0	103.5	3	225.0		18.75	*Conoglobigerina* aff. *dagestanica* Morozova
33.0	104.5	5	137.5		18.75	*Globuligerina oxfordiana* (Grigelis)

SOMHEGY - LAYER H2 (BAJOCIAN - HUMPHRIESIANUM ZONE)

Thin Section Co-ordinates		No. of Chambers Visible	Max. Diameter (µm)	Wall Thickness (µm)		Species
Vert	Hor			Thick	Thin	
33.0	105.5	3	125.0		18.75	*Globuligerina oxfordiana* (Grigelis)
33.0	107.0	3	150.0		18.75	*Globuligerina oxfordiana* (Grigelis)
33.0	107.5	3	175.0		12.50	*Globuligerina oxfordiana* (Grigelis)
33.5	108.0	3	150.0		18.75	*Globuligerina oxfordiana* (Grigelis)
33.5	107.5	4	225.0		18.75	*Conoglobigerina* aff. *dagestanica* Morozova
33.5	101.5	3	175.0		18.75	*Globuligerina oxfordiana* (Grigelis)
33.5	100.5	3	162.5		18.75	*Globuligerina oxfordiana* (Grigelis)
33.5	98.0	4	200.0		12.50	*Conoglobigerina* aff. *dagestanica* Morozova
33.5	87.5	3	125.0		12.50	*Globuligerina oxfordiana* (Grigelis)
33.5	82.5	3	175.0		18.75	*Globuligerina oxfordiana* (Grigelis)
33.5	76.5	3	250.0	25.00		*Globuligerina oxfordiana* (Grigelis)
33.5	76.0	3	200.0		18.75	*Conoglobigerina* aff. *dagestanica* Morozova
33.5	76.0	3	250.0	25.00		*Globuligerina oxfordiana* (Grigelis)
34.0	69.5	3	125.0		18.75	*Globuligerina oxfordiana* (Grigelis)
34.0	72.5	3	125.0		18.75	*Globuligerina oxfordiana* (Grigelis)
34.0	87.5	4	162.5		12.50	*Globuligerina oxfordiana* (Grigelis)
34.5	108.5	4	262.5		18.75	*Globuligerina bathoniana gigantea* Wernli & Görög
34.5	98.5	4	150.0		18.75	*Globuligerina oxfordiana* (Grigelis)
34.5	98.0	3	150.0		18.75	*Globuligerina oxfordiana* (Grigelis)
34.5	85.0	4	150.0		18.75	*Globuligerina oxfordiana* (Grigelis)
34.5	80.0	4	175.0		12.50	*Globuligerina oxfordiana* (Grigelis)
35.0	74.5	3	125.0		12.50	*Globuligerina oxfordiana* (Grigelis)
35.0	76.5	3	150.0		18.75	*Globuligerina oxfordiana* (Grigelis)
35.0	77.5	3	300.0		18.75	*Globuligerina bathoniana gigantea* Wernli & Görög
35.0	93.0	4	162.5		18.75	*Globuligerina oxfordiana* (Grigelis)
35.0	96.0	3	150.0		18.75	*Globuligerina oxfordiana* (Grigelis)
35.0	110.0	3	250.0		18.75	*Conoglobigerina* aff. *dagestanica* Morozova
35.0	110.5	3	125.0		18.75	*Globuligerina oxfordiana* (Grigelis)
35.5	110.0	3	125.0		18.75	*Globuligerina oxfordiana* (Grigelis)
35.5	109.0	4	150.0		18.75	*Globuligerina oxfordiana* (Grigelis)
35.5	109.0	3	125.0		18.75	*Globuligerina oxfordiana* (Grigelis)
35.5	105.0	3	150.0		18.75	*Globuligerina oxfordiana* (Grigelis)
35.5	94.0	3	200.0	25.00		*Globuligerina oxfordiana* (Grigelis)
35.5	93.5	3	150.0		12.50	*Globuligerina oxfordiana* (Grigelis)
35.5	88.5	5	337.5		18.75	*Globuligerina bathoniana gigantea* Wernli & Görög
35.5	82.5	4	350.0		18.75	*Globuligerina bathoniana gigantea* Wernli & Görög
35.5	78.0	3	175.0		12.50	*Globuligerina oxfordiana* (Grigelis)
35.5	76.0	4	100.0		18.75	*Globuligerina oxfordiana* (Grigelis)
35.5	75.0	3	175.0		18.75	*Globuligerina oxfordiana* (Grigelis)
35.5	75.0	3	125.0		18.75	*Globuligerina oxfordiana* (Grigelis)
35.5	73.5	4	200.0		18.75	*Conoglobigerina* aff. *dagestanica* Morozova
35.5	72.5	3	150.0		18.75	*Globuligerina oxfordiana* (Grigelis)
35.5	72.0	3	137.5		12.50	*Globuligerina oxfordiana* (Grigelis)
35.5	72.0	3	125.0		18.75	*Globuligerina oxfordiana* (Grigelis)
35.5	71.5	3	112.5		12.50	*Globuligerina oxfordiana* (Grigelis)
36.0	72.0	4	150.0		18.75	*Globuligerina oxfordiana* (Grigelis)
36.0	74.0	3	187.5		12.50	*Globuligerina oxfordiana* (Grigelis)
36.0	75.0	3	125.0		18.75	*Globuligerina oxfordiana* (Grigelis)
36.0	75.0	3	187.5		18.75	*Globuligerina oxfordiana* (Grigelis)
36.0	76.5	3	100.0		18.75	*Globuligerina oxfordiana* (Grigelis)
36.0	77.0	3	162.5		18.75	*Globuligerina oxfordiana* (Grigelis)
36.0	77.0	3	175.0		12.50	*Globuligerina oxfordiana* (Grigelis)
36.0	78.5	3	150.0		18.75	*Globuligerina oxfordiana* (Grigelis)
36.0	78.5	3	125.0		18.75	*Globuligerina oxfordiana* (Grigelis)
36.0	89.0	4	150.0		18.75	*Globuligerina oxfordiana* (Grigelis)

SOMHEGY - LAYER H2 (BAJOCIAN - HUMPHRIESIANUM ZONE)

Thin Section Co-ordinates		No. of Chambers Visible	Max. Diameter (µm)	Wall Thickness (µm)		Species
Vert	Hor			Thick	Thin	
36.0	96.5	4	137.5		12.50	*Globuligerina oxfordiana* (Grigelis)
36.0	100.5	5	125.0		6.25	*Globuligerina oxfordiana* (Grigelis)
36.0	106.5	3	137.5		12.50	*Globuligerina oxfordiana* (Grigelis)
36.0	109.5	3	125.0		12.50	*Globuligerina oxfordiana* (Grigelis)
36.5	106.0	3	125.0		12.50	*Globuligerina oxfordiana* (Grigelis)
36.5	104.0	4	175.0		18.75	*Globuligerina oxfordiana* (Grigelis)
36.5	104.0	3	137.5		12.50	*Globuligerina oxfordiana* (Grigelis)
36.5	104.0	3	200.0	25.00		*Globuligerina oxfordiana* (Grigelis)
36.5	103.0	3	137.5		12.50	*Globuligerina oxfordiana* (Grigelis)
36.5	101.5	3	162.5		12.50	*Globuligerina oxfordiana* (Grigelis)
36.5	97.0	4	125.0		12.50	*Globuligerina oxfordiana* (Grigelis)
36.5	97.0	4	150.0	31.25		*Globuligerina oxfordiana* (Grigelis)
36.5	96.0	4	125.0		12.50	*Globuligerina oxfordiana* (Grigelis)
36.5	95.0	4	150.0		12.50	*Globuligerina oxfordiana* (Grigelis)
36.5	94.0	3	162.5		6.25	*Globuligerina oxfordiana* (Grigelis)
36.5	85.0	4	162.5		12.50	*Globuligerina oxfordiana* (Grigelis)
36.5	83.0	4	162.5		12.50	*Globuligerina oxfordiana* (Grigelis)
36.5	81.5	3	150.0		12.50	*Globuligerina oxfordiana* (Grigelis)
36.5	80.0	3	150.0		18.75	*Globuligerina oxfordiana* (Grigelis)
36.5	79.5	4	175.0		18.75	*Globuligerina oxfordiana* (Grigelis)
36.5	78.0	3	125.0		12.50	*Globuligerina oxfordiana* (Grigelis)
36.5	78.0	4	175.0		18.75	*Globuligerina oxfordiana* (Grigelis)
36.5	76.5	3	187.5		18.75	*Globuligerina oxfordiana* (Grigelis)
36.5	76.5	3	112.5		12.50	*Globuligerina oxfordiana* (Grigelis)
36.5	74.5	3	87.5		6.25	*Globuligerina oxfordiana* (Grigelis)
36.5	74.5	4	175.0		12.50	*Globuligerina oxfordiana* (Grigelis)
36.5	73.0	3	200.0	25.00		*Globuligerina oxfordiana* (Grigelis)
37.0	70.5	4	325.0		18.75	*Globuligerina bathoniana gigantea* Wernli & Görög
37.0	74.5	4	175.0		12.50	*Globuligerina oxfordiana* (Grigelis)
37.0	75.0	5	200.0		18.75	*Conoglobigerina* aff. *dagestanica* Morozova
37.0	80.5	3	162.5		18.75	*Globuligerina oxfordiana* (Grigelis)
37.0	80.5	4	150.0		12.50	*Globuligerina oxfordiana* (Grigelis)
37.0	82.5	3	125.0		18.75	*Globuligerina oxfordiana* (Grigelis)
37.0	102.5	4	125.0		6.25	*Globuligerina oxfordiana* (Grigelis)
37.0	103.0	3	175.0		18.75	*Globuligerina oxfordiana* (Grigelis)
37.0	106.5	3	125.0		18.75	*Globuligerina oxfordiana* (Grigelis)
37.0	107.0	4	125.0		18.75	*Globuligerina oxfordiana* (Grigelis)
37.0	108.0	4	150.0		18.75	*Globuligerina oxfordiana* (Grigelis)
37.0	108.5	3	150.0		18.75	*Globuligerina oxfordiana* (Grigelis)
37.5	108.5	3	150.0	25.00		*Globuligerina oxfordiana* (Grigelis)
37.5	103.5	3	100.0		12.50	*Globuligerina oxfordiana* (Grigelis)
37.5	103.5	3	125.0		18.75	*Globuligerina oxfordiana* (Grigelis)
37.5	98.0	4	200.0		18.75	*Conoglobigerina* aff. *dagestanica* Morozova
37.5	98.0	4	187.5		18.75	*Globuligerina oxfordiana* (Grigelis)
37.5	97.5	3	175.0		18.75	*Globuligerina oxfordiana* (Grigelis)
37.5	95.5	3	175.0		12.50	*Globuligerina oxfordiana* (Grigelis)
37.5	95.5	4	175.0		18.75	*Globuligerina oxfordiana* (Grigelis)
37.5	95.0	5	200.0		18.75	*Conoglobigerina* aff. *dagestanica* Morozova
37.5	95.0	6	200.0		18.75	*Conoglobigerina* aff. *dagestanica* Morozova
37.5	95.0	3	125.0		18.75	*Globuligerina oxfordiana* (Grigelis)
37.5	92.0	4	187.5		18.75	*Globuligerina oxfordiana* (Grigelis)
37.5	90.5	3	125.0		18.75	*Globuligerina oxfordiana* (Grigelis)
37.5	88.0	3	162.5		12.50	*Globuligerina oxfordiana* (Grigelis)
37.5	81.0	3	187.5		12.50	*Globuligerina oxfordiana* (Grigelis)
37.5	75.0	3	125.0		18.75	*Globuligerina oxfordiana* (Grigelis)

SOMHEGY - LAYER H2 (BAJOCIAN - HUMPHRIESIANUM ZONE)

Thin Section Co-ordinates		No. of Chambers Visible	Max. Diameter (µm)	Wall Thickness (µm)		Species
Vert	Hor			Thick	Thin	
37.5	75.0	3	175.0		12.50	*Globuligerina oxfordiana* (Grigelis)
38.0	76.0	4	200.0		18.75	*Conoglobigerina* aff. *dagestanica* Morozova
38.0	95.0	3	150.0		18.75	*Globuligerina oxfordiana* (Grigelis)
38.0	97.0	3	200.0		18.75	*Conoglobigerina* aff. *dagestanica* Morozova
38.0	98.0	4	200.0		18.75	*Conoglobigerina* aff. *dagestanica* Morozova
38.0	101.0	3	125.0		12.50	*Globuligerina oxfordiana* (Grigelis)
38.0	105.0	3	175.0		12.50	*Globuligerina oxfordiana* (Grigelis)
38.0	105.5	4	162.5		12.50	*Globuligerina oxfordiana* (Grigelis)
38.5	110.5	3	125.0		18.75	*Globuligerina oxfordiana* (Grigelis)
38.5	107.5	3	112.5		12.50	*Globuligerina oxfordiana* (Grigelis)
38.5	103.5	3	150.0		12.50	*Globuligerina oxfordiana* (Grigelis)
38.5	103.5	3	175.0		18.75	*Globuligerina oxfordiana* (Grigelis)
38.5	97.5	3	175.0		18.75	*Globuligerina oxfordiana* (Grigelis)
38.5	96.0	4	125.0		18.75	*Globuligerina oxfordiana* (Grigelis)
38.5	92.0	4	150.0		12.50	*Globuligerina oxfordiana* (Grigelis)
38.5	78.0	4	150.0		12.50	*Globuligerina oxfordiana* (Grigelis)
38.5	77.5	3	200.0		12.50	*Conoglobigerina* aff. *dagestanica* Morozova
39.0	74.0	3	125.0	25.00		*Globuligerina oxfordiana* (Grigelis)
39.0	75.0	3	137.5		18.75	*Globuligerina oxfordiana* (Grigelis)
39.0	75.0	3	125.0	25.00		*Globuligerina oxfordiana* (Grigelis)
39.0	81.0	3	225.0		18.75	*Conoglobigerina* aff. *dagestanica* Morozova
39.0	82.0	3	350.0	37.50		*Conoglobigerina avariformis* Kasimova alta
39.0	85.5	4	150.0		18.75	*Globuligerina oxfordiana* (Grigelis)
39.0	85.5	4	150.0		18.75	*Globuligerina oxfordiana* (Grigelis)
39.0	86.0	3	125.0		18.75	*Globuligerina oxfordiana* (Grigelis)
39.0	86.0	3	175.0		18.75	*Globuligerina oxfordiana* (Grigelis)
39.0	87.0	4	162.5		18.75	*Globuligerina oxfordiana* (Grigelis)
39.0	98.0	4	150.0		18.75	*Globuligerina oxfordiana* (Grigelis)
39.0	98.5	3	150.0		18.75	*Globuligerina oxfordiana* (Grigelis)
39.5	102.0	3	150.0		18.75	*Globuligerina oxfordiana* (Grigelis)
39.5	99.5	5	200.0		18.75	*Conoglobigerina* aff. *dagestanica* Morozova
39.5	88.0	4	175.0		18.75	*Globuligerina oxfordiana* (Grigelis)
39.5	86.0	3	162.5		18.75	*Globuligerina oxfordiana* (Grigelis)
39.5	79.5	3	125.0		12.50	*Globuligerina oxfordiana* (Grigelis)
39.5	79.0	3	150.0		12.50	*Globuligerina oxfordiana* (Grigelis)
39.5	78.0	4	150.0		12.50	*Globuligerina oxfordiana* (Grigelis)
39.5	73.0	3	125.0		12.50	*Globuligerina oxfordiana* (Grigelis)
39.5	71.5	4	200.0		12.50	*Conoglobigerina* aff. *dagestanica* Morozova
39.5	71.0	4	125.0		12.50	*Globuligerina oxfordiana* (Grigelis)
39.5	68.5	3	100.0		12.50	*Globuligerina oxfordiana* (Grigelis)
39.5	68.0	3	200.0		12.50	*Conoglobigerina* aff. *dagestanica* Morozova
40.0	68.5	3	137.5		12.50	*Globuligerina oxfordiana* (Grigelis)
40.0	70.5	3	125.0		18.75	*Globuligerina oxfordiana* (Grigelis)
40.0	71.0	4	150.0		18.75	*Globuligerina oxfordiana* (Grigelis)
40.0	72.5	3	150.0		18.75	*Globuligerina oxfordiana* (Grigelis)
40.0	73.5	3	100.0		18.75	*Globuligerina oxfordiana* (Grigelis)
40.0	74.5	3	175.0		18.75	*Globuligerina oxfordiana* (Grigelis)
40.0	84.5	4	212.5		18.75	*Conoglobigerina* aff. *dagestanica* Morozova
40.5	107.0	4	125.0		18.75	*Globuligerina oxfordiana* (Grigelis)
40.5	91.5	3	125.0		18.75	*Globuligerina oxfordiana* (Grigelis)
40.5	88.5	3	150.0		18.75	*Globuligerina oxfordiana* (Grigelis)
40.5	82.5	4	162.5		18.75	*Globuligerina oxfordiana* (Grigelis)
40.5	81.5	4	137.5		18.75	*Globuligerina oxfordiana* (Grigelis)
40.5	80.5	3	137.5		18.75	*Globuligerina oxfordiana* (Grigelis)
40.5	76.0	4	150.0		18.75	*Globuligerina oxfordiana* (Grigelis)

SOMHEGY - LAYER H2 (BAJOCIAN - HUMPHRIESIANUM ZONE)

Thin Section Co-ordinates		No. of Chambers Visible	Max. Diameter (µm)	Wall Thickness (µm)		Species
Vert	Hor			Thick	Thin	
40.5	75.0	3	125.0		12.50	*Globuligerina oxfordiana* (Grigelis)
40.5	75.0	4	175.0		18.75	*Globuligerina oxfordiana* (Grigelis)
40.5	68.0	3	137.5		12.50	*Globuligerina oxfordiana* (Grigelis)
41.0	75.0	4	175.0		12.50	*Globuligerina oxfordiana* (Grigelis)
41.0	76.0	4	137.5		12.50	*Globuligerina oxfordiana* (Grigelis)
41.0	76.5	3	137.5		18.75	*Globuligerina oxfordiana* (Grigelis)
41.0	81.0	4	150.0		18.75	*Globuligerina oxfordiana* (Grigelis)
41.0	100.5	4	200.0		18.75	*Conoglobigerina* aff. *dagestanica* Morozova
41.5	105.5	3	150.0		18.75	*Globuligerina oxfordiana* (Grigelis)
41.5	102.0	3	125.0		18.75	*Globuligerina oxfordiana* (Grigelis)
41.5	100.5	4	150.0		18.75	*Globuligerina oxfordiana* (Grigelis)
41.5	88.0	3	175.0		18.75	*Globuligerina oxfordiana* (Grigelis)
41.5	87.5	3	175.0		18.75	*Globuligerina oxfordiana* (Grigelis)
41.5	84.0	3	175.0		12.50	*Globuligerina oxfordiana* (Grigelis)
41.5	82.0	4	200.0		12.50	*Conoglobigerina* aff. *dagestanica* Morozova
41.5	81.5	3	125.0		18.75	*Globuligerina oxfordiana* (Grigelis)
41.5	73.0	3	150.0		12.50	*Globuligerina oxfordiana* (Grigelis)
42.0	84.5	4	150.0		12.50	*Globuligerina oxfordiana* (Grigelis)
42.0	88.0	4	200.0		18.75	*Conoglobigerina* aff. *dagestanica* Morozova
42.0	88.5	3	175.0		12.50	*Globuligerina oxfordiana* (Grigelis)
42.0	90.5	3	150.0		18.75	*Globuligerina oxfordiana* (Grigelis)
42.0	91.5	4	187.5		12.50	*Globuligerina oxfordiana* (Grigelis)
42.0	95.5	4	175.0		18.75	*Globuligerina oxfordiana* (Grigelis)
42.0	96.0	4	187.5		18.75	*Globuligerina oxfordiana* (Grigelis)
42.0	96.0	4	200.0		12.50	*Conoglobigerina* aff. *dagestanica* Morozova
42.0	105.5	3	150.0		12.50	*Globuligerina oxfordiana* (Grigelis)
42.0	110.0	4	175.0		18.75	*Globuligerina oxfordiana* (Grigelis)
42.0	110.0	3	137.5		18.75	*Globuligerina oxfordiana* (Grigelis)
42.5	103.0	3	125.0		18.75	*Globuligerina oxfordiana* (Grigelis)
42.5	100.5	3	125.0		18.75	*Globuligerina oxfordiana* (Grigelis)
42.5	99.5	3	150.0		12.50	*Globuligerina oxfordiana* (Grigelis)
42.5	98.5	3	175.0		18.75	*Globuligerina oxfordiana* (Grigelis)
42.5	97.5	4	175.0		12.50	*Globuligerina oxfordiana* (Grigelis)
42.5	97.0	3	125.0		18.75	*Globuligerina oxfordiana* (Grigelis)
42.5	97.0	3	150.0		18.75	*Globuligerina oxfordiana* (Grigelis)
42.5	96.5	3	125.0		18.75	*Globuligerina oxfordiana* (Grigelis)
42.5	96.0	3	175.0		18.75	*Globuligerina oxfordiana* (Grigelis)
42.5	96.0	3	100.0		12.50	*Globuligerina oxfordiana* (Grigelis)
42.5	93.0	3	175.0		18.75	*Globuligerina oxfordiana* (Grigelis)
42.5	88.5	3	162.5		18.75	*Globuligerina oxfordiana* (Grigelis)
42.5	87.0	3	150.0		18.75	*Globuligerina oxfordiana* (Grigelis)
42.5	83.0	3	162.5		18.75	*Globuligerina oxfordiana* (Grigelis)
42.5	83.0	3	150.0		12.50	*Globuligerina oxfordiana* (Grigelis)
42.5	83.0	3	112.5		18.75	*Globuligerina oxfordiana* (Grigelis)
42.5	75.5	4	175.0		18.75	*Globuligerina oxfordiana* (Grigelis)
42.5	68.0	3	125.0		12.50	*Globuligerina oxfordiana* (Grigelis)
43.0	68.5	4	125.0		18.75	*Globuligerina oxfordiana* (Grigelis)
43.0	74.5	4	162.5		18.75	*Globuligerina oxfordiana* (Grigelis)
43.0	74.5	4	150.0		18.75	*Globuligerina oxfordiana* (Grigelis)
43.0	81.5	4	175.0		18.75	*Globuligerina oxfordiana* (Grigelis)
43.0	82.0	4	175.0		18.75	*Globuligerina oxfordiana* (Grigelis)
43.0	83.0	5	175.0		18.75	*Globuligerina oxfordiana* (Grigelis)
43.0	83.5	4	187.5		18.75	*Globuligerina oxfordiana* (Grigelis)
43.0	83.5	4	175.0		18.75	*Globuligerina oxfordiana* (Grigelis)
43.0	86.5	3	162.5		18.75	*Globuligerina oxfordiana* (Grigelis)

SOMHEGY - LAYER H2 (BAJOCIAN - HUMPHRIESIANUM ZONE)

Thin Section Co-ordinates		No. of Chambers Visible	Max. Diameter (µm)	Wall Thickness (µm)		Species
Vert	Hor			Thick	Thin	
43.0	86.5	3	137.5		18.75	*Globuligerina oxfordiana* (Grigelis)
43.0	86.5	3	150.0		18.75	*Globuligerina oxfordiana* (Grigelis)
43.0	87.0	3	137.5		18.75	*Globuligerina oxfordiana* (Grigelis)
43.0	87.0	3	125.0		12.50	*Globuligerina oxfordiana* (Grigelis)
43.0	89.0	4	200.0		12.50	*Conoglobigerina* aff. *dagestanica* Morozova
43.0	89.0	3	162.5		12.50	*Globuligerina oxfordiana* (Grigelis)
43.0	89.5	3	125.0		18.75	*Globuligerina oxfordiana* (Grigelis)
43.0	89.5	3	175.0		18.75	*Globuligerina oxfordiana* (Grigelis)
43.0	89.5	3	137.5		18.75	*Globuligerina oxfordiana* (Grigelis)
43.0	90.5	3	150.0		12.50	*Globuligerina oxfordiana* (Grigelis)
43.0	92.0	4	150.0		12.50	*Globuligerina oxfordiana* (Grigelis)
43.0	97.5	3	200.0		18.75	*Conoglobigerina* aff. *dagestanica* Morozova
43.0	98.0	3	200.0		18.75	*Conoglobigerina* aff. *dagestanica* Morozova
43.0	100.0	4	150.0		12.50	*Globuligerina oxfordiana* (Grigelis)
43.0	100.0	4	150.0	25.00		*Globuligerina oxfordiana* (Grigelis)
43.0	100.0	4	175.0		18.75	*Globuligerina oxfordiana* (Grigelis)
43.0	100.5	4	150.0		18.75	*Globuligerina oxfordiana* (Grigelis)
43.0	103.5	3	125.0		12.50	*Globuligerina oxfordiana* (Grigelis)
43.0	103.5	4	125.0		12.50	*Globuligerina oxfordiana* (Grigelis)
43.0	104.0	4	162.5		18.75	*Globuligerina oxfordiana* (Grigelis)
43.0	106.5	3	125.0		18.75	*Globuligerina oxfordiana* (Grigelis)
43.0	108.5	4	175.0		12.50	*Globuligerina oxfordiana* (Grigelis)
43.5	105.5	4	175.0		18.75	*Globuligerina oxfordiana* (Grigelis)
43.5	104.5	3	187.5		18.75	*Globuligerina oxfordiana* (Grigelis)
43.5	104.0	4	150.0		18.75	*Globuligerina oxfordiana* (Grigelis)
43.5	103.5	3	100.0		12.50	*Globuligerina oxfordiana* (Grigelis)
43.5	102.5	3	162.5		18.75	*Globuligerina oxfordiana* (Grigelis)
43.5	102.0	4	125.0		12.50	*Globuligerina oxfordiana* (Grigelis)
43.5	101.5	4	125.0		18.75	*Globuligerina oxfordiana* (Grigelis)
43.5	101.0	3	175.0		18.75	*Globuligerina oxfordiana* (Grigelis)
43.5	100.5	4	150.0		18.75	*Globuligerina oxfordiana* (Grigelis)
43.5	91.0	3	150.0		18.75	*Globuligerina oxfordiana* (Grigelis)
43.5	89.5	3	112.5		12.50	*Globuligerina oxfordiana* (Grigelis)
43.5	89.0	3	187.5		12.50	*Globuligerina oxfordiana* (Grigelis)
43.5	88.0	4	150.0		12.50	*Globuligerina oxfordiana* (Grigelis)
43.5	88.0	3	137.5		18.75	*Globuligerina oxfordiana* (Grigelis)
43.5	87.0	3	150.0		12.50	*Globuligerina oxfordiana* (Grigelis)
43.5	83.0	4	162.5		12.50	*Globuligerina oxfordiana* (Grigelis)
43.5	80.5	3	175.0		12.50	*Globuligerina oxfordiana* (Grigelis)
43.5	74.0	3	112.5		18.75	*Globuligerina oxfordiana* (Grigelis)
44.0	74.0	4	200.0		18.75	*Conoglobigerina* aff. *dagestanica* Morozova
44.0	79.0	3	125.0		18.75	*Globuligerina oxfordiana* (Grigelis)
44.0	84.0	3	125.0		18.75	*Globuligerina oxfordiana* (Grigelis)
44.0	92.0	3	175.0		18.75	*Globuligerina oxfordiana* (Grigelis)
44.0	97.0	3	137.5		18.75	*Globuligerina oxfordiana* (Grigelis)
44.0	97.5	3	162.5	25.00		*Globuligerina oxfordiana* (Grigelis)
44.0	98.5	4	125.0		12.50	*Globuligerina oxfordiana* (Grigelis)
44.0	99.0	5	175.0		12.50	*Globuligerina oxfordiana* (Grigelis)
44.0	100.0	4	200.0		18.75	*Conoglobigerina* aff. *dagestanica* Morozova
44.0	106.5	4	150.0		12.50	*Globuligerina oxfordiana* (Grigelis)
44.0	107.0	4	162.5		12.50	*Globuligerina oxfordiana* (Grigelis)
44.0	107.5	4	150.0	25.00		*Globuligerina oxfordiana* (Grigelis)
44.0	107.5	3	162.5		18.75	*Globuligerina oxfordiana* (Grigelis)
44.0	107.5	3	175.0		12.50	*Globuligerina oxfordiana* (Grigelis)
44.0	108.0	4	150.0		18.75	*Globuligerina oxfordiana* (Grigelis)

SOMHEGY - LAYER H2 (BAJOCIAN - HUMPHRIESIANUM ZONE)

Thin Section Co-ordinates		No. of Chambers Visible	Max. Diameter (µm)	Wall Thickness (µm)		Species
Vert	Hor			Thick	Thin	
44.0	108.0	3	200.0		18.75	*Conoglobigerina* aff. *dagestanica* Morozova
44.0	108.0	3	62.5		6.25	*Globuligerina oxfordiana* (Grigelis)
44.0	108.0	3	150.0		18.75	*Globuligerina oxfordiana* (Grigelis)
44.0	108.5	4	175.0		12.50	*Globuligerina oxfordiana* (Grigelis)
44.5	109.0	4	150.0		18.75	*Globuligerina oxfordiana* (Grigelis)
44.5	108.5	4	150.0		18.75	*Globuligerina oxfordiana* (Grigelis)
44.5	108.0	6	175.0		12.50	*Globuligerina oxfordiana* (Grigelis)
44.5	107.5	4	125.0		18.75	*Globuligerina oxfordiana* (Grigelis)
44.5	107.5	3	150.0		12.50	*Globuligerina oxfordiana* (Grigelis)
44.5	105.0	4	200.0		12.50	*Conoglobigerina* aff. *dagestanica* Morozova
44.5	104.5	4	162.5		12.50	*Globuligerina oxfordiana* (Grigelis)
44.5	97.5	3	162.5		18.75	*Globuligerina oxfordiana* (Grigelis)
44.5	92.0	4	200.0		18.75	*Conoglobigerina* aff. *dagestanica* Morozova
44.5	90.0	3	112.5		12.50	*Globuligerina oxfordiana* (Grigelis)
44.5	89.5	4	175.0		18.75	*Globuligerina oxfordiana* (Grigelis)
44.5	89.5	3	137.5		18.75	*Globuligerina oxfordiana* (Grigelis)
44.5	86.5	3	137.5		18.75	*Globuligerina oxfordiana* (Grigelis)
44.5	86.0	4	137.5		18.75	*Globuligerina oxfordiana* (Grigelis)
44.5	84.0	4	212.5		12.50	*Conoglobigerina* aff. *dagestanica* Morozova
44.5	81.0	3	125.0		12.50	*Globuligerina oxfordiana* (Grigelis)
44.5	79.0	4	175.0		18.75	*Globuligerina oxfordiana* (Grigelis)
45.0	96.0	3	137.5		18.75	*Globuligerina oxfordiana* (Grigelis)
45.0	97.0	4	125.0		12.50	*Globuligerina oxfordiana* (Grigelis)
45.0	101.0	3	200.0		18.75	*Conoglobigerina* aff. *dagestanica* Morozova
45.0	102.5	4	162.5		18.75	*Globuligerina oxfordiana* (Grigelis)
45.0	104.0	3	150.0		12.50	*Globuligerina oxfordiana* (Grigelis)
45.0	108.5	4	162.5		18.75	*Globuligerina oxfordiana* (Grigelis)
Total Number of Specimens				**67**	**730**	**797**
Relative Percentages				**8**	**92**	

SOMHEGY - LAYER H4 (BAJOCIAN - HUMPHRIESIANUM ZONE)

Thin Section Co-ordinates		No. of Chambers Visible	Max. Diameter (µm)	Wall Thickness (µm)		Species
Vert	Hor			Thick	Thin	
7.5	76.0	3	200.00	25.00		*Globuligerina oxfordiana* (Grigelis)
9.5	78.0	3	287.50	37.50		*Conoglobigerina avariformis* Kasimova sphaerica
10.5	90.0	4	125.00	25.00		*Globuligerina oxfordiana* (Grigelis)
10.5	90.0	4	225.00	25.00		*Globuligerina oxfordiana* (Grigelis)
11.0	88.5	4	275.00	25.00		*Conoglobigerina avariformis* Kasimova sphaerica
11.0	90.0	4	175.00		18.75	*Globuligerina oxfordiana* (Grigelis)
11.0	90.5	4	275.00	37.50		*Conoglobigerina avariformis* Kasimova alta
11.5	93.0	4	275.00	25.00		*Conoglobigerina avariformis* Kasimova sphaerica
11.5	81.0	8	200.00	25.00		*Globuligerina oxfordiana* (Grigelis)
12.0	85.0	5	212.50	25.00		*Globuligerina oxfordiana* (Grigelis)
12.0	85.0	3	200.00	25.00		*Globuligerina oxfordiana* (Grigelis)
12.0	93.5	4	250.00	37.50		*Conoglobigerina avariformis* Kasimova sphaerica
12.0	95.5	3	350.00	37.50		*Conoglobigerina avariformis* Kasimova sphaerica
12.5	86.5	4	175.00	25.00		*Globuligerina oxfordiana* (Grigelis)
12.5	86.0	5	175.00		12.50	*Globuligerina oxfordiana* (Grigelis)
12.5	86.0	3	250.00	25.00		*Globuligerina oxfordiana* (Grigelis)
12.5	85.5	3	175.00	25.00		*Globuligerina oxfordiana* (Grigelis)
12.5	85.0	3	150.00	25.00		*Globuligerina oxfordiana* (Grigelis)
12.5	84.5	5	225.00	25.00		*Globuligerina oxfordiana* (Grigelis)
13.0	85.5	4	175.00	37.50		*Globuligerina oxfordiana* (Grigelis)
13.0	86.0	4	175.00	25.00		*Globuligerina oxfordiana* (Grigelis)
13.0	86.0	4	125.00	25.00		*Globuligerina oxfordiana* (Grigelis)
13.0	87.0	3	175.00		18.75	*Globuligerina oxfordiana* (Grigelis)
13.5	90.0	3	175.00	25.00		*Globuligerina oxfordiana* (Grigelis)
13.5	89.0	3	175.00	25.00		*Globuligerina oxfordiana* (Grigelis)
13.5	86.0	3	250.00		12.50	*Conoglobigerina* aff. *dagestanica* Morozova
13.5	85.5	3	187.50		12.50	*Globuligerina oxfordiana* (Grigelis)
14.0	86.5	4	162.50	25.00		*Globuligerina oxfordiana* (Grigelis)
14.0	87.0	3	225.00	25.00		*Globuligerina oxfordiana* (Grigelis)
14.0	89.5	3	287.50	37.50		*Conoglobigerina avariformis* Kasimova alta
14.5	91.5	5	175.00	25.00		*Globuligerina oxfordiana* (Grigelis)
14.5	91.5	4	175.00	25.00		*Globuligerina oxfordiana* (Grigelis)
14.5	91.5	4	175.00		12.50	*Globuligerina oxfordiana* (Grigelis)
15.0	87.0	4	225.00		18.75	*Conoglobigerina* aff. *dagestanica* Morozova
15.5	94.5	4	150.00		12.50	*Globuligerina oxfordiana* (Grigelis)
15.5	91.5	4	175.00	25.00		*Globuligerina oxfordiana* (Grigelis)
16.0	83.0	4	225.00	25.00		*Globuligerina oxfordiana* (Grigelis)
16.0	90.5	3	275.00	25.00		*Conoglobigerina avariformis* Kasimova alta
16.0	91.5	4	237.50	25.00		*Globuligerina oxfordiana* (Grigelis)
16.0	91.5	3	137.50		12.50	*Globuligerina oxfordiana* (Grigelis)
16.0	94.0	3	175.00		12.50	*Globuligerina oxfordiana* (Grigelis)
16.0	95.0	3	250.00		18.75	*Conoglobigerina* aff. *dagestanica* Morozova
16.0	95.0	4	200.00	25.00		*Globuligerina oxfordiana* (Grigelis)
16.0	95.0	4	200.00	25.00		*Globuligerina oxfordiana* (Grigelis)
16.0	95.5	4	225.00		12.50	*Conoglobigerina* aff. *dagestanica* Morozova
16.0	95.5	4	212.50	25.00		*Globuligerina oxfordiana* (Grigelis)
16.0	98.5	6	200.00		18.75	*Conoglobigerina* aff. *dagestanica* Morozova
16.0	99.0	3	150.00	25.00		*Globuligerina oxfordiana* (Grigelis)
16.5	98.5	6	200.00		18.75	*Conoglobigerina* aff. *dagestanica* Morozova
16.5	97.0	4	200.00	25.00		*Globuligerina oxfordiana* (Grigelis)
16.5	91.5	5	312.50		12.50	*Globuligerina bathoniana gigantea* Wernli & Görög
17.0	88.5	4	162.50	25.00		*Globuligerina oxfordiana* (Grigelis)
17.0	94.5	4	250.00		18.75	*Conoglobigerina* aff. *dagestanica* Morozova
17.0	99.0	3	250.00	25.00		*Globuligerina oxfordiana* (Grigelis)
17.0	99.5	4	175.00		18.75	*Globuligerina oxfordiana* (Grigelis)

SOMHEGY - LAYER H4 (BAJOCIAN - HUMPHRIESIANUM ZONE)

Thin Section Co-ordinates		No. of Chambers Visible	Max. Diameter (µm)	Wall Thickness (µm)		Species
Vert	Hor			Thick	Thin	
17.5	103.0	4	150.00		18.75	*Globuligerina oxfordiana* (Grigelis)
17.5	88.0	3	175.00		18.75	*Globuligerina oxfordiana* (Grigelis)
17.5	88.0	5	225.00	25.00		*Globuligerina oxfordiana* (Grigelis)
17.5	87.5	6	175.00		18.75	*Globuligerina oxfordiana* (Grigelis)
17.5	86.5	3	162.50		12.50	*Globuligerina oxfordiana* (Grigelis)
17.5	86.0	4	225.00		12.50	*Conoglobigerina* aff. *dagestanica* Morozova
18.0	89.5	5	200.00		18.75	*Conoglobigerina* aff. *dagestanica* Morozova
18.0	90.0	6	200.00		12.50	*Conoglobigerina* aff. *dagestanica* Morozova
18.0	99.0	6	225.00		12.50	*Conoglobigerina* aff. *dagestanica* Morozova
18.0	100.0	3	162.50		12.50	*Globuligerina oxfordiana* (Grigelis)
18.0	100.5	3	162.50	25.00		*Globuligerina oxfordiana* (Grigelis)
18.0	102.5	3	225.00	25.00		*Globuligerina oxfordiana* (Grigelis)
18.0	104.0	4	175.00		18.75	*Globuligerina oxfordiana* (Grigelis)
19.0	75.5	3	125.00		18.75	*Globuligerina oxfordiana* (Grigelis)
19.0	76.0	6	175.00	25.00		*Globuligerina oxfordiana* (Grigelis)
19.0	101.5	3	200.00	25.00		*Globuligerina oxfordiana* (Grigelis)
19.0	103.0	6	225.00	25.00		*Globuligerina oxfordiana* (Grigelis)
19.0	107.5	5	225.00	37.50		*Globuligerina oxfordiana* (Grigelis)
19.0	108.0	5	250.00	25.00		*Globuligerina oxfordiana* (Grigelis)
19.5	108.0	3	200.00	25.00		*Globuligerina oxfordiana* (Grigelis)
19.5	107.5	4	150.00		12.50	*Globuligerina oxfordiana* (Grigelis)
19.5	101.0	4	187.50	37.50		*Globuligerina oxfordiana* (Grigelis)
19.5	100.5	5	187.50		12.50	*Conoglobigerina* aff. *dagestanica* Morozova
19.5	99.0	5	225.00		18.75	*Conoglobigerina* aff. *dagestanica* Morozova
19.5	91.0	4	237.50		12.50	*Globuligerina oxfordiana* (Grigelis)
19.5	80.5	4	112.50		6.25	*Globuligerina oxfordiana* (Grigelis)
19.5	77.0	4	175.00		18.75	*Globuligerina oxfordiana* (Grigelis)
19.5	74.0	3	250.00	25.00		*Globuligerina oxfordiana* (Grigelis)
20.5	105.5	3	250.00	25.00		*Conoglobigerina avariformis* Kasimova sphaerica
20.0	63.0	3	275.00		18.75	*Globuligerina bathoniana gigantea* Wernli & Görög
20.0	77.5	3	150.00		12.50	*Globuligerina oxfordiana* (Grigelis)
20.0	87.5	3	187.50		12.50	*Globuligerina oxfordiana* (Grigelis)
20.0	96.0	3	250.00	25.00		*Globuligerina oxfordiana* (Grigelis)
20.0	109.0	3	225.00	25.00		*Globuligerina oxfordiana* (Grigelis)
20.5	110.5	5	275.00	25.00		*Conoglobigerina avariformis* Kasimova alta
20.5	105.5	3	250.00	25.00		*Globuligerina oxfordiana* (Grigelis)
20.5	93.0	3	162.50	25.00		*Globuligerina oxfordiana* (Grigelis)
20.5	92.5	5	175.00		12.50	*Globuligerina oxfordiana* (Grigelis)
20.5	85.5	4	175.00	25.00		*Globuligerina oxfordiana* (Grigelis)
21.0	92.5	6	225.00	25.00		*Globuligerina oxfordiana* (Grigelis)
21.0	93.5	3	200.00	37.50		*Globuligerina oxfordiana* (Grigelis)
21.0	98.5	4	225.00		12.50	*Conoglobigerina* aff. *dagestanica* Morozova
21.5	94.5	3	200.00	25.00		*Globuligerina oxfordiana* (Grigelis)
22.0	91.0	3	175.00		18.75	*Globuligerina oxfordiana* (Grigelis)
22.0	91.5	4	200.00		12.50	*Conoglobigerina* aff. *dagestanica* Morozova
22.0	92.5	4	200.00	25.00		*Globuligerina oxfordiana* (Grigelis)
22.0	93.0	3	175.00	25.00		*Globuligerina oxfordiana* (Grigelis)
22.0	94.0	6	225.00	25.00		*Globuligerina oxfordiana* (Grigelis)
22.0	95.0	4	162.50		18.75	*Globuligerina oxfordiana* (Grigelis)
22.0	104.0	3	175.00	25.00		*Globuligerina oxfordiana* (Grigelis)
22.0	105.5	4	175.00	25.00		*Globuligerina oxfordiana* (Grigelis)
22.5	96.0	3	225.00	25.00		*Globuligerina oxfordiana* (Grigelis)
22.5	92.5	4	200.00	25.00		*Globuligerina oxfordiana* (Grigelis)
22.5	90.5	3	175.00		18.75	*Globuligerina oxfordiana* (Grigelis)
22.5	89.0	4	175.00		12.50	*Globuligerina oxfordiana* (Grigelis)

SOMHEGY - LAYER H4 (BAJOCIAN - HUMPHRIESIANUM ZONE)

Thin Section Co-ordinates		No. of Chambers Visible	Max. Diameter (μm)	Wall Thickness (μm)		Species
Vert	Hor			Thick	Thin	
22.5	88.5	4	175.00	25.00		*Globuligerina oxfordiana* (Grigelis)
23.0	92.5	4	225.00		18.75	*Conoglobigerina* aff. *dagestanica* Morozova
23.0	109.0	3	225.00	37.50		*Globuligerina oxfordiana* (Grigelis)
23.5	109.5	5	225.00		18.75	*Conoglobigerina* aff. *dagestanica* Morozova
23.5	105.0	4	200.00		18.75	*Conoglobigerina* aff. *dagestanica* Morozova
23.5	92.0	3	162.50		12.50	*Globuligerina oxfordiana* (Grigelis)
24.0	90.0	3	162.50		12.50	*Globuligerina oxfordiana* (Grigelis)
24.0	92.5	4	225.00	25.00		*Globuligerina oxfordiana* (Grigelis)
24.0	104.0	4	175.00	25.00		*Globuligerina oxfordiana* (Grigelis)
24.0	104.5	3	200.00	25.00		*Globuligerina oxfordiana* (Grigelis)
24.0	105.0	3	200.00	25.00		*Globuligerina oxfordiana* (Grigelis)
24.0	105.5	3	125.00		18.75	*Globuligerina oxfordiana* (Grigelis)
24.5	94.5	5	250.00	25.00		*Globuligerina oxfordiana* (Grigelis)
25.0	93.5	4	200.00		12.50	*Conoglobigerina* aff. *dagestanica* Morozova
25.0	93.5	4	150.00	25.00		*Globuligerina oxfordiana* (Grigelis)
25.0	108.5	4	250.00		12.50	*Conoglobigerina* aff. *dagestanica* Morozova
25.5	108.0	3	200.00	25.00		*Globuligerina oxfordiana* (Grigelis)
25.5	107.5	4	225.00	25.00		*Globuligerina oxfordiana* (Grigelis)
25.5	106.5	4	200.00		18.75	*Conoglobigerina* aff. *dagestanica* Morozova
25.5	99.5	4	212.50		12.50	*Conoglobigerina* aff. *dagestanica* Morozova
25.5	97.5	3	200.00	25.00		*Globuligerina oxfordiana* (Grigelis)
25.5	95.0	3	200.00	25.00		*Globuligerina oxfordiana* (Grigelis)
25.5	95.0	5	200.00	25.00		*Globuligerina oxfordiana* (Grigelis)
26.0	97.0	3	187.50		12.50	*Globuligerina oxfordiana* (Grigelis)
26.5	107.5	3	250.00	25.00		*Globuligerina oxfordiana* (Grigelis)
26.5	100.0	4	175.00	25.00		*Globuligerina oxfordiana* (Grigelis)
26.5	100.0	4	200.00	25.00		*Globuligerina oxfordiana* (Grigelis)
26.5	97.5	3	175.00		12.50	*Globuligerina oxfordiana* (Grigelis)
26.5	97.5	4	225.00	25.00		*Globuligerina oxfordiana* (Grigelis)
26.5	97.5	3	175.00		18.75	*Globuligerina oxfordiana* (Grigelis)
27.0	100.0	4	200.00		18.75	*Conoglobigerina* aff. *dagestanica* Morozova
27.0	100.5	4	250.00		12.50	*Conoglobigerina* aff. *dagestanica* Morozova
27.0	102.0	4	200.00		12.50	*Conoglobigerina* aff. *dagestanica* Morozova
27.0	104.5	4	175.00		18.75	*Globuligerina oxfordiana* (Grigelis)
27.5	105.5	4	200.00	25.00		*Globuligerina oxfordiana* (Grigelis)
27.5	101.5	3	225.00	37.50		*Globuligerina oxfordiana* (Grigelis)
27.5	101.0	4	225.00	25.00		*Globuligerina oxfordiana* (Grigelis)
27.5	100.0	4	175.00		18.75	*Globuligerina oxfordiana* (Grigelis)
28.0	101.5	3	137.50		18.75	*Globuligerina oxfordiana* (Grigelis)
28.5	102.0	3	150.00	25.00		*Globuligerina oxfordiana* (Grigelis)
28.5	88.5	3	287.50	37.50		*Conoglobigerina avariformis* Kasimova alta
32.5	82.0	3	125.00		18.75	*Globuligerina oxfordiana* (Grigelis)
33.0	87.5	4	212.50		12.50	*Conoglobigerina* aff. *dagestanica* Morozova
33.5	87.5	3	200.00		18.75	*Conoglobigerina* aff. *dagestanica* Morozova
33.5	87.0	4	112.50		12.50	*Globuligerina oxfordiana* (Grigelis)
33.5	77.5	3	125.00		18.75	*Globuligerina oxfordiana* (Grigelis)
34.0	97.0	4	175.00		12.50	*Globuligerina oxfordiana* (Grigelis)
34.5	99.0	4	125.00		12.50	*Globuligerina oxfordiana* (Grigelis)
34.5	98.5	3	150.00		12.50	*Globuligerina oxfordiana* (Grigelis)
34.5	97.0	3	150.00		12.50	*Globuligerina oxfordiana* (Grigelis)
34.5	96.5	3	175.00		18.75	*Globuligerina oxfordiana* (Grigelis)
35.0	99.5	4	125.00		18.75	*Globuligerina oxfordiana* (Grigelis)
35.0	99.5	4	125.00		18.75	*Globuligerina oxfordiana* (Grigelis)
35.0	101.0	3	175.00		12.50	*Globuligerina oxfordiana* (Grigelis)
37.5	81.0	4	200.00	25.00		*Globuligerina oxfordiana* (Grigelis)

SOMHEGY - LAYER H4 (BAJOCIAN - HUMPHRIESIANUM ZONE)

Thin Section Co-ordinates		No. of Chambers Visible	Max. Diameter (µm)	Wall Thickness (µm)		Species
Vert	Hor			Thick	Thin	
38.0	87.0	4	162.50		12.50	*Globuligerina oxfordiana* (Grigelis)
38.0	91.0	3	137.50		18.75	*Globuligerina oxfordiana* (Grigelis)
38.0	91.5	3	200.00		12.50	*Conoglobigerina* aff. *dagestanica* Morozova
38.0	92.0	4	175.00	25.00		*Globuligerina oxfordiana* (Grigelis)
38.0	92.0	4	225.00	25.00		*Globuligerina oxfordiana* (Grigelis)
38.5	93.0	3	250.00		18.75	*Conoglobigerina* aff. *dagestanica* Morozova
38.5	92.5	4	187.50		12.50	*Globuligerina oxfordiana* (Grigelis)
38.5	92.0	3	150.00		12.50	*Globuligerina oxfordiana* (Grigelis)
38.5	92.0	4	200.00	37.50		*Globuligerina oxfordiana* (Grigelis)
38.5	91.0	4	200.00	25.00		*Globuligerina oxfordiana* (Grigelis)
38.5	88.5	3	200.00	25.00		*Globuligerina oxfordiana* (Grigelis)
39.0	92.5	3	162.50		12.50	*Globuligerina oxfordiana* (Grigelis)
39.0	93.0	4	225.00		12.50	*Conoglobigerina* aff. *dagestanica* Morozova
39.0	98.0	4	137.50		18.75	*Globuligerina oxfordiana* (Grigelis)
39.5	98.0	3	200.00		18.75	*Conoglobigerina* aff. *dagestanica* Morozova
39.5	97.5	3	200.00		12.50	*Conoglobigerina* aff. *dagestanica* Morozova
39.5	95.5	3	125.00		18.75	*Globuligerina oxfordiana* (Grigelis)
Total Number of Specimens				**94**	**88**	**182**
Relative Percentages				**52**	**48**	

SOMHEGY - LAYER N1 (BAJOCIAN - NIORTENSE ZONE)

Thin Section Co-ordinates		No. of Chambers Visible	Max. Diameter (µm)	Wall Thickness (µm)		Species
Vert	Hor			Thick	Thin	
9.5	86.0	3	162.50		6.25	*Globuligerina oxfordiana* (Grigelis)
9.5	77.5	3	162.50		6.25	*Globuligerina oxfordiana* (Grigelis)
10.0	98.5	3	75.00		6.25	*Globuligerina oxfordiana* (Grigelis)
10.0	99.0	3	100.00		6.25	*Globuligerina oxfordiana* (Grigelis)
12.5	109.5	3	75.00		18.75	*Globuligerina oxfordiana* (Grigelis)
12.5	96.0	3	100.00		12.50	*Globuligerina oxfordiana* (Grigelis)
13.0	80.5	3	125.00		12.50	*Globuligerina oxfordiana* (Grigelis)
13.5	110.0	3	250.00	25.00		*Globuligerina oxfordiana* (Grigelis)
13.5	101.5	5	125.00		6.25	*Globuligerina oxfordiana* (Grigelis)
13.5	99.0	3	150.00		6.25	*Globuligerina oxfordiana* (Grigelis)
13.5	90.0	3	75.00		6.25	*Globuligerina oxfordiana* (Grigelis)
13.5	87.5	3	100.00		12.50	*Globuligerina oxfordiana* (Grigelis)
13.5	85.5	3	112.50		12.50	*Globuligerina oxfordiana* (Grigelis)
14.0	79.0	3	100.00	25.00		*Globuligerina oxfordiana* (Grigelis)
14.0	100.5	3	125.00		6.25	*Globuligerina oxfordiana* (Grigelis)
14.0	103.5	4	212.50		12.50	*Globuligerina* aff. *bathoniana* (Pazdrowa)
14.5	98.5	3	125.00		6.25	*Globuligerina oxfordiana* (Grigelis)
14.5	74.5	3	100.00		12.50	*Globuligerina oxfordiana* (Grigelis)
14.5	74.5	4	137.50		12.50	*Globuligerina oxfordiana* (Grigelis)
16.0	89.0	3	100.00		18.75	*Globuligerina oxfordiana* (Grigelis)
16.0	90.0	3	100.00		12.50	*Globuligerina oxfordiana* (Grigelis)
16.5	107.5	3	225.00		12.50	*Globuligerina* aff. *bathoniana* (Pazdrowa)
16.5	71.5	3	150.00		12.50	*Globuligerina oxfordiana* (Grigelis)
16.5	71.0	7	100.00		18.75	*Globuligerina oxfordiana* (Grigelis)
17.0	82.5	3	137.50		12.50	*Globuligerina oxfordiana* (Grigelis)
17.0	89.5	3	125.00		12.50	*Globuligerina oxfordiana* (Grigelis)
17.5	77.5	7	75.00		12.50	*Globuligerina oxfordiana* (Grigelis)
18.0	101.0	3	125.00		6.25	*Globuligerina oxfordiana* (Grigelis)
18.0	101.0	4	125.00		12.50	*Globuligerina oxfordiana* (Grigelis)
18.5	82.0	3	125.00		18.75	*Globuligerina oxfordiana* (Grigelis)
19.5	72.5	5	225.00	37.50		*Globuligerina oxfordiana* (Grigelis)
21.0	108.5	5	125.00		18.75	*Globuligerina oxfordiana* (Grigelis)
22.0	99.0	6	225.00	25.00		*Globuligerina oxfordiana* (Grigelis)
22.0	110.0	5	137.50	25.00		*Globuligerina oxfordiana* (Grigelis)
22.0	111.0	3	125.00		12.50	*Globuligerina oxfordiana* (Grigelis)
22.5	77.0	7	250.00		12.50	*Globuligerina* aff. *bathoniana* (Pazdrowa)
24.0	76.0	4	225.00	25.00		*Globuligerina oxfordiana* (Grigelis)
24.0	76.0	3	250.00	25.00		*Globuligerina oxfordiana* (Grigelis)
24.0	91.5	4	137.50	25.00		*Globuligerina oxfordiana* (Grigelis)
24.0	101.0	3	125.00	25.00		*Globuligerina oxfordiana* (Grigelis)
24.5	98.0	4	125.00		6.25	*Globuligerina oxfordiana* (Grigelis)
24.5	98.0	3	100.00		6.25	*Globuligerina oxfordiana* (Grigelis)
25.5	75.5	4	225.00	25.00		*Globuligerina oxfordiana* (Grigelis)
26.0	82.0	3	287.50	25.00		*Conoglobigerina avariformis* Kasimova sphaerica
27.0	78.0	3	100.00		12.50	*Globuligerina oxfordiana* (Grigelis)
27.0	82.0	4	125.00		12.50	*Globuligerina oxfordiana* (Grigelis)
27.5	80.5	3	175.00		18.75	*Globuligerina oxfordiana* (Grigelis)
28.0	73.0	3	125.00		6.25	*Globuligerina oxfordiana* (Grigelis)
28.0	107.5	3	237.50	25.00		*Globuligerina oxfordiana* (Grigelis)
28.0	109.0	6	225.00	25.00		*Globuligerina oxfordiana* (Grigelis)
28.5	85.5	3	187.50	25.00		*Globuligerina oxfordiana* (Grigelis)
31.0	81.0	4	225.00		18.75	*Globuligerina* aff. *bathoniana* (Pazdrowa)
31.0	87.5	6	350.00		6.25	*Globuligerina bathoniana gigantea* Wernli & Görög
31.5	112.5	3	225.00	37.50		*Globuligerina oxfordiana* (Grigelis)
32.0	77.0	4	275.00	25.00		*Conoglobigerina avariformis* Kasimova sphaerica

SOMHEGY - LAYER N1 (BAJOCIAN - NIORTENSE ZONE)

Thin Section Co-ordinates		No. of Chambers Visible	Max. Diameter (µm)	Wall Thickness (µm)		Species
Vert	Hor			Thick	Thin	
32.0	79.0	4	100.00		12.50	*Globuligerina oxfordiana* (Grigelis)
34.0	81.5	4	250.00	25.00		*Globuligerina oxfordiana* (Grigelis)
35.5	82.5	4	275.00	25.00		*Conoglobigerina avariformis* Kasimova sphaerica
36.0	92.5	4	275.00		18.75	*Globuligerina bathoniana gigantea* Wernli & Görög
36.5	94.0	3	362.50	25.00		*Conoglobigerina avariformis* Kasimova sphaerica
37.5	77.0	3	200.00	25.00		*Globuligerina oxfordiana* (Grigelis)
38.0	76.5	4	225.00	25.00		*Globuligerina oxfordiana* (Grigelis)
38.0	103.0	4	300.00	25.00		*Conoglobigerina avariformis* Kasimova sphaerica
40.0	93.5	3	200.00		18.75	*Globuligerina* aff. *bathoniana* (Pazdrowa)
40.0	99.5	4	287.50	25.00		*Conoglobigerina avariformis* Kasimova sphaerica
42.0	87.0	3	175.00		12.50	*Globuligerina oxfordiana* (Grigelis)
42.0	93.5	3	100.00		12.50	*Globuligerina oxfordiana* (Grigelis)
Total Number of Specimens				23	44	67
Relative Percentages				34	66	

SOMHEGY - LAYER N2 (BAJOCIAN - NIORTENSE ZONE)

Thin Section Co-ordinates		No. of Chambers Visible	Max. Diameter (µm)	Wall Thickness (µm)		Species
Vert	Hor			Thick	Thin	
6.0	97.0	3	175.00		12.50	*Globuligerina oxfordiana* (Grigelis)
6.0	99.0	3	287.50	37.50		*Conoglobigerina avariformis* Kasimova sphaerica
6.5	97.0	3	150.00		12.50	*Globuligerina oxfordiana* (Grigelis)
6.5	96.5	3	175.00		12.50	*Globuligerina oxfordiana* (Grigelis)
7.0	97.0	4	150.00	25.00		*Globuligerina oxfordiana* (Grigelis)
7.5	88.0	3	225.00		12.50	*Conoglobigerina* aff. *dagestanica* Morozova
8.0	89.0	3	125.00		6.25	*Globuligerina oxfordiana* (Grigelis)
8.0	89.0	3	100.00		6.25	*Globuligerina oxfordiana* (Grigelis)
8.0	95.5	3	175.00		12.50	*Globuligerina oxfordiana* (Grigelis)
8.0	96.5	3	150.00		12.50	*Globuligerina oxfordiana* (Grigelis)
8.5	100.0	4	112.50		6.25	*Globuligerina oxfordiana* (Grigelis)
8.5	98.0	4	137.50		6.25	*Globuligerina oxfordiana* (Grigelis)
8.5	92.0	5	150.00		12.50	*Globuligerina oxfordiana* (Grigelis)
8.5	91.5	3	125.00		12.50	*Globuligerina oxfordiana* (Grigelis)
8.5	91.5	4	125.00		12.50	*Globuligerina oxfordiana* (Grigelis)
8.5	89.0	4	212.50		18.75	*Conoglobigerina* aff. *dagestanica* Morozova
9.5	111.5	3	125.00		6.25	*Globuligerina oxfordiana* (Grigelis)
10.0	111.5	3	175.00		6.25	*Globuligerina oxfordiana* (Grigelis)
10.5	96.0	4	200.00		6.25	*Conoglobigerina* aff. *dagestanica* Morozova
11.0	87.5	3	175.00		6.25	*Globuligerina oxfordiana* (Grigelis)
11.5	88.0	3	150.00		12.50	*Globuligerina oxfordiana* (Grigelis)
11.5	88.0	3	125.00		6.25	*Globuligerina oxfordiana* (Grigelis)
12.0	83.0	4	250.00	37.50		*Globuligerina oxfordiana* (Grigelis)
12.0	105.0	6	250.00	50.00		*Globuligerina oxfordiana* (Grigelis)
12.5	114.5	4	125.00		12.50	*Globuligerina oxfordiana* (Grigelis)
12.5	112.0	3	200.00		12.50	*Conoglobigerina* aff. *dagestanica* Morozova
12.5	111.0	3	125.00		12.50	*Globuligerina oxfordiana* (Grigelis)
12.5	102.5	3	125.00		12.50	*Globuligerina oxfordiana* (Grigelis)
13.0	91.0	3	162.50	25.00		*Globuligerina oxfordiana* (Grigelis)
13.5	115.0	4	225.00	37.50		*Globuligerina oxfordiana* (Grigelis)
13.5	115.0	4	225.00	37.50		*Globuligerina oxfordiana* (Grigelis)
13.5	115.0	3	162.50	25.00		*Globuligerina oxfordiana* (Grigelis)
13.5	84.0	4	125.00		6.25	*Globuligerina oxfordiana* (Grigelis)
13.5	83.0	4	100.00		6.25	*Globuligerina oxfordiana* (Grigelis)
14.0	79.0	3	200.00	37.50		*Globuligerina oxfordiana* (Grigelis)
14.0	89.0	3	125.00	25.00		*Globuligerina oxfordiana* (Grigelis)
14.5	112.5	8	200.00		12.50	*Conoglobigerina* aff. *dagestanica* Morozova
14.5	112.5	8	225.00	37.50		*Globuligerina oxfordiana* (Grigelis)
14.5	90.0	3	125.00	25.00		*Globuligerina oxfordiana* (Grigelis)
15.0	92.0	3	175.00	25.00		*Globuligerina oxfordiana* (Grigelis)
15.0	95.0	3	175.00		12.50	*Globuligerina oxfordiana* (Grigelis)
15.0	110.0	3	100.00	25.00		*Globuligerina oxfordiana* (Grigelis)
16.0	91.5	4	150.00		12.50	*Globuligerina oxfordiana* (Grigelis)
16.0	93.0	4	137.50	25.00		*Globuligerina oxfordiana* (Grigelis)
16.0	94.5	3	287.50	25.00		*Conoglobigerina avariformis* Kasimova sphaerica
16.0	111.0	4	125.00		12.50	*Globuligerina oxfordiana* (Grigelis)
16.5	114.0	3	100.00		12.50	*Globuligerina oxfordiana* (Grigelis)
16.5	102.5	3	150.00		6.25	*Globuligerina oxfordiana* (Grigelis)
16.5	80.0	5	200.00		6.25	*Conoglobigerina* aff. *dagestanica* Morozova
17.0	114.0	3	150.00		12.50	*Globuligerina oxfordiana* (Grigelis)
17.5	109.5	4	150.00	25.00		*Globuligerina oxfordiana* (Grigelis)
17.5	108.0	3	125.00		12.50	*Globuligerina oxfordiana* (Grigelis)
18.0	91.0	5	137.50		12.50	*Globuligerina oxfordiana* (Grigelis)
18.0	91.0	4	175.00		6.25	*Globuligerina oxfordiana* (Grigelis)
18.0	101.0	4	137.50		6.25	*Globuligerina oxfordiana* (Grigelis)

SOMHEGY - LAYER N2 (BAJOCIAN - NIORTENSE ZONE)

Thin Section Co-ordinates		No. of Chambers Visible	Max. Diameter (µm)	Wall Thickness (µm)		Species
Vert	Hor			Thick	Thin	
18.0	103.5	5	137.50		12.50	*Globuligerina oxfordiana* (Grigelis)
18.5	101.0	5	175.00		6.25	*Globuligerina oxfordiana* (Grigelis)
18.5	84.0	5	125.00		6.25	*Globuligerina oxfordiana* (Grigelis)
18.5	73.0	4	200.00	25.00		*Globuligerina oxfordiana* (Grigelis)
19.0	79.5	4	200.00		12.50	*Conoglobigerina* aff. *dagestanica* Morozova
19.0	80.0	4	137.50	25.00		*Globuligerina oxfordiana* (Grigelis)
19.0	82.5	5	125.00		6.25	*Globuligerina oxfordiana* (Grigelis)
19.5	82.5	3	125.00		12.50	*Globuligerina oxfordiana* (Grigelis)
20.0	83.5	3	212.50	25.00		*Globuligerina oxfordiana* (Grigelis)
20.0	84.5	5	187.50		6.25	*Globuligerina oxfordiana* (Grigelis)
20.0	86.0	5	225.00		6.25	*Conoglobigerina* aff. *dagestanica* Morozova
20.5	90.0	3	175.00		6.25	*Globuligerina oxfordiana* (Grigelis)
21.0	72.0	3	225.00	50.00		*Globuligerina oxfordiana* (Grigelis)
21.0	77.0	3	175.00		12.50	*Globuligerina oxfordiana* (Grigelis)
21.0	100.5	3	300.00	25.00		*Conoglobigerina avariformis* Kasimova sphaerica
21.5	113.5	3	125.00		12.50	*Globuligerina oxfordiana* (Grigelis)
21.5	97.5	3	275.00	25.00		*Conoglobigerina avariformis* Kasimova sphaerica
21.5	97.5	3	125.00		6.25	*Globuligerina oxfordiana* (Grigelis)
21.5	81.5	3	75.00		6.25	*Globuligerina oxfordiana* (Grigelis)
21.5	71.0	3	175.00		12.50	*Globuligerina oxfordiana* (Grigelis)
22.0	105.0	6	150.00		6.25	*Globuligerina oxfordiana* (Grigelis)
22.0	105.5	3	137.50		6.25	*Globuligerina oxfordiana* (Grigelis)
22.0	106.5	3	125.00		6.25	*Globuligerina oxfordiana* (Grigelis)
22.0	107.0	4	200.00		6.25	*Conoglobigerina* aff. *dagestanica* Morozova
22.5	107.0	3	125.00		12.50	*Globuligerina oxfordiana* (Grigelis)
22.5	106.0	6	250.00		12.50	*Globuligerina* aff. *bathoniana* (Pazdrowa)
22.5	105.0	5	175.00		12.50	*Globuligerina oxfordiana* (Grigelis)
22.5	79.5	3	100.00		12.50	*Globuligerina oxfordiana* (Grigelis)
22.5	72.5	5	275.00	25.00		*Conoglobigerina avariformis* Kasimova sphaerica
23.0	75.0	3	125.00		12.50	*Globuligerina oxfordiana* (Grigelis)
23.0	79.5	4	125.00		12.50	*Globuligerina oxfordiana* (Grigelis)
23.0	82.5	3	137.50		6.25	*Globuligerina oxfordiana* (Grigelis)
23.0	97.0	3	125.00		12.50	*Globuligerina oxfordiana* (Grigelis)
23.0	98.0	4	125.00		12.50	*Globuligerina oxfordiana* (Grigelis)
23.0	104.5	5	162.50		6.25	*Globuligerina oxfordiana* (Grigelis)
23.0	105.0	5	137.50		12.50	*Globuligerina oxfordiana* (Grigelis)
23.0	105.0	8	150.00		12.50	*Globuligerina oxfordiana* (Grigelis)
23.5	106.5	6	150.00	25.00		*Globuligerina oxfordiana* (Grigelis)
23.5	106.5	6	162.50		12.50	*Globuligerina oxfordiana* (Grigelis)
23.5	106.5	4	175.00		12.50	*Globuligerina oxfordiana* (Grigelis)
23.5	106.5	6	150.00		12.50	*Globuligerina oxfordiana* (Grigelis)
23.5	106.0	3	125.00		12.50	*Globuligerina oxfordiana* (Grigelis)
23.5	106.0	3	125.00		12.50	*Globuligerina oxfordiana* (Grigelis)
23.5	106.0	3	137.50		6.25	*Globuligerina oxfordiana* (Grigelis)
23.5	106.0	3	125.00		6.25	*Globuligerina oxfordiana* (Grigelis)
23.5	99.0	4	125.00		12.50	*Globuligerina oxfordiana* (Grigelis)
23.5	98.0	3	162.50		12.50	*Globuligerina oxfordiana* (Grigelis)
23.5	87.0	4	137.50		12.50	*Globuligerina oxfordiana* (Grigelis)
23.5	73.5	5	212.50		6.25	*Conoglobigerina* aff. *dagestanica* Morozova
24.0	72.5	3	125.00		6.25	*Globuligerina oxfordiana* (Grigelis)
24.0	74.0	4	150.00		6.25	*Globuligerina oxfordiana* (Grigelis)
24.0	86.5	4	150.00		12.50	*Globuligerina oxfordiana* (Grigelis)
24.0	98.0	3	150.00		6.25	*Globuligerina oxfordiana* (Grigelis)
24.0	99.0	3	125.00		12.50	*Globuligerina oxfordiana* (Grigelis)
24.0	103.0	4	75.00		6.25	*Globuligerina oxfordiana* (Grigelis)

SOMHEGY - LAYER N2 (BAJOCIAN - NIORTENSE ZONE)

Thin Section Co-ordinates		No. of Chambers Visible	Max. Diameter (µm)	Wall Thickness (µm)		Species
Vert	Hor			Thick	Thin	
24.0	103.0	4	100.00		6.25	*Globuligerina oxfordiana* (Grigelis)
24.0	106.0	3	150.00		6.25	*Globuligerina oxfordiana* (Grigelis)
24.5	72.5	4	175.00		6.25	*Globuligerina oxfordiana* (Grigelis)
24.5	72.0	3	200.00		6.25	*Conoglobigerina* aff. *dagestanica* Morozova
25.5	109.0	3	200.00		12.50	*Conoglobigerina* aff. *dagestanica* Morozova
25.5	109.0	3	200.00		12.50	*Conoglobigerina* aff. *dagestanica* Morozova
25.5	105.5	3	100.00		12.50	*Globuligerina oxfordiana* (Grigelis)
25.5	89.0	3	150.00		12.50	*Globuligerina oxfordiana* (Grigelis)
25.5	87.0	3	287.50		6.25	*Globuligerina bathoniana gigantea* Wernli & Görög
26.0	72.0	4	150.00		6.25	*Globuligerina oxfordiana* (Grigelis)
26.0	73.0	4	125.00		12.50	*Globuligerina oxfordiana* (Grigelis)
26.0	75.0	4	100.00		6.25	*Globuligerina oxfordiana* (Grigelis)
26.0	109.0	3	125.00		6.25	*Globuligerina oxfordiana* (Grigelis)
27.0	111.0	4	150.00		12.50	*Globuligerina oxfordiana* (Grigelis)
27.5	108.0	4	150.00		12.50	*Globuligerina oxfordiana* (Grigelis)
28.0	75.5	3	200.00		6.25	*Conoglobigerina* aff. *dagestanica* Morozova
28.0	76.0	3	162.50		12.50	*Globuligerina oxfordiana* (Grigelis)
28.0	82.0	4	100.00		12.50	*Globuligerina oxfordiana* (Grigelis)
28.0	82.0	3	100.00		12.50	*Globuligerina oxfordiana* (Grigelis)
28.0	86.0	4	125.00		6.25	*Globuligerina oxfordiana* (Grigelis)
28.0	89.0	6	200.00	25.00		*Globuligerina oxfordiana* (Grigelis)
28.0	97.5	3	125.00		12.50	*Globuligerina oxfordiana* (Grigelis)
28.0	107.0	4	125.00		12.50	*Globuligerina oxfordiana* (Grigelis)
28.0	109.0	4	150.00		12.50	*Globuligerina oxfordiana* (Grigelis)
28.5	93.5	4	150.00		12.50	*Globuligerina oxfordiana* (Grigelis)
29.0	73.5	3	75.00		12.50	*Globuligerina oxfordiana* (Grigelis)
29.0	82.5	6	150.00		6.25	*Globuligerina oxfordiana* (Grigelis)
29.5	95.0	4	150.00	25.00		*Globuligerina oxfordiana* (Grigelis)
29.5	86.0	5	125.00		6.25	*Globuligerina oxfordiana* (Grigelis)
29.5	81.0	4	150.00		6.25	*Globuligerina oxfordiana* (Grigelis)
29.5	81.0	5	150.00		6.25	*Globuligerina oxfordiana* (Grigelis)
29.5	74.0	4	100.00	37.50		*Globuligerina oxfordiana* (Grigelis)
30.0	86.0	3	175.00		12.50	*Globuligerina oxfordiana* (Grigelis)
30.0	86.0	3	187.50		12.50	*Globuligerina oxfordiana* (Grigelis)
30.0	88.0	6	125.00	25.00		*Globuligerina oxfordiana* (Grigelis)
30.0	90.0	4	100.00	25.00		*Globuligerina oxfordiana* (Grigelis)
30.0	90.5	4	100.00	25.00		*Globuligerina oxfordiana* (Grigelis)
30.0	91.0	4	162.50		6.25	*Globuligerina oxfordiana* (Grigelis)
30.0	102.5	5	125.00		12.50	*Globuligerina oxfordiana* (Grigelis)
30.0	106.5	3	200.00		12.50	*Conoglobigerina* aff. *dagestanica* Morozova
30.0	107.0	3	125.00	25.00		*Globuligerina oxfordiana* (Grigelis)
30.0	107.0	3	75.00		12.50	*Globuligerina oxfordiana* (Grigelis)
30.0	108.5	3	225.00	37.50		*Globuligerina oxfordiana* (Grigelis)
30.5	108.5	4	137.50	25.00		*Globuligerina oxfordiana* (Grigelis)
30.5	88.0	4	150.00		6.25	*Globuligerina oxfordiana* (Grigelis)
30.5	87.0	5	400.00		12.50	*Globuligerina bathoniana gigantea* Wernli & Görög
31.0	71.5	3	125.00		12.50	*Globuligerina oxfordiana* (Grigelis)
31.0	73.0	4	200.00		12.50	*Conoglobigerina* aff. *dagestanica* Morozova
31.0	79.0	3	75.00		6.25	*Globuligerina oxfordiana* (Grigelis)
31.0	79.5	4	125.00		12.50	*Globuligerina oxfordiana* (Grigelis)
31.0	86.0	3	125.00	25.00		*Globuligerina oxfordiana* (Grigelis)
31.0	86.5	3	125.00		12.50	*Globuligerina oxfordiana* (Grigelis)
31.0	87.0	4	175.00	25.00		*Globuligerina oxfordiana* (Grigelis)
31.0	87.0	3	100.00		6.25	*Globuligerina oxfordiana* (Grigelis)
31.0	87.5	4	137.50		12.50	*Globuligerina oxfordiana* (Grigelis)

SOMHEGY - LAYER N2 (BAJOCIAN - NIORTENSE ZONE)

Thin Section Co-ordinates		No. of Chambers Visible	Max. Diameter (µm)	Wall Thickness (µm)		Species
Vert	Hor			Thick	Thin	
31.0	102.5	5	100.00		12.50	*Globuligerina oxfordiana* (Grigelis)
31.5	102.0	6	175.00		12.50	*Globuligerina oxfordiana* (Grigelis)
31.5	93.5	5	175.00	37.50		*Globuligerina oxfordiana* (Grigelis)
31.5	70.0	3	200.00		12.50	*Conoglobigerina* aff. *dagestanica* Morozova
32.0	72.0	5	125.00		6.25	*Globuligerina oxfordiana* (Grigelis)
32.0	77.0	3	150.00	25.00		*Globuligerina oxfordiana* (Grigelis)
32.0	94.0	7	250.00		6.25	*Globuligerina* aff. *bathoniana* (Pazdrowa)
32.5	103.0	3	125.00		12.50	*Globuligerina oxfordiana* (Grigelis)
32.5	87.0	4	125.00		6.25	*Globuligerina oxfordiana* (Grigelis)
32.5	76.0	3	125.00		12.50	*Globuligerina oxfordiana* (Grigelis)
32.5	74.5	4	212.50	25.00		*Globuligerina oxfordiana* (Grigelis)
32.5	70.0	4	100.00		6.25	*Globuligerina oxfordiana* (Grigelis)
33.0	83.5	4	100.00	25.00		*Globuligerina oxfordiana* (Grigelis)
33.0	84.0	6	125.00		12.50	*Globuligerina oxfordiana* (Grigelis)
33.0	86.5	4	175.00		6.25	*Globuligerina oxfordiana* (Grigelis)
33.0	87.0	5	125.00		6.25	*Globuligerina oxfordiana* (Grigelis)
33.0	91.0	6	175.00		12.50	*Globuligerina oxfordiana* (Grigelis)
33.0	91.5	3	75.00		6.25	*Globuligerina oxfordiana* (Grigelis)
33.0	92.5	3	150.00		6.25	*Globuligerina oxfordiana* (Grigelis)
33.0	96.0	3	150.00		6.25	*Globuligerina oxfordiana* (Grigelis)
33.0	99.5	3	100.00		12.50	*Globuligerina oxfordiana* (Grigelis)
33.5	102.5	4	150.00	25.00		*Globuligerina oxfordiana* (Grigelis)
33.5	99.5	3	112.50		6.25	*Globuligerina oxfordiana* (Grigelis)
33.5	83.5	6	150.00		12.50	*Globuligerina oxfordiana* (Grigelis)
33.5	83.5	6	125.00		12.50	*Globuligerina oxfordiana* (Grigelis)
34.0	72.0	4	200.00	37.50		*Globuligerina oxfordiana* (Grigelis)
34.0	73.5	4	112.50		12.50	*Globuligerina oxfordiana* (Grigelis)
34.0	76.0	5	125.00		12.50	*Globuligerina oxfordiana* (Grigelis)
34.0	81.0	4	125.00		12.50	*Globuligerina oxfordiana* (Grigelis)
34.5	94.0	3	200.00		12.50	*Conoglobigerina* aff. *dagestanica* Morozova
34.5	79.0	5	150.00		12.50	*Globuligerina oxfordiana* (Grigelis)
35.0	71.0	5	175.00	25.00		*Globuligerina oxfordiana* (Grigelis)
35.0	80.0	3	150.00		12.50	*Globuligerina oxfordiana* (Grigelis)
35.0	80.0	4	125.00		12.50	*Globuligerina oxfordiana* (Grigelis)
35.0	86.5	6	125.00		12.50	*Globuligerina oxfordiana* (Grigelis)
35.5	90.0	3	150.00		6.25	*Globuligerina oxfordiana* (Grigelis)
35.5	77.0	3	150.00		12.50	*Globuligerina oxfordiana* (Grigelis)
35.5	76.0	3	125.00		12.50	*Globuligerina oxfordiana* (Grigelis)
35.5	75.5	4	200.00		12.50	*Conoglobigerina* aff. *dagestanica* Morozova
35.5	72.0	5	137.50	37.50		*Globuligerina oxfordiana* (Grigelis)
37.0	69.0	4	150.00		12.50	*Globuligerina oxfordiana* (Grigelis)
37.0	72.5	4	175.00		12.50	*Globuligerina oxfordiana* (Grigelis)
37.0	72.5	3	112.50		6.25	*Globuligerina oxfordiana* (Grigelis)
37.0	73.0	3	137.50		12.50	*Globuligerina oxfordiana* (Grigelis)
37.0	76.0	5	137.50	37.50		*Globuligerina oxfordiana* (Grigelis)
37.0	80.0	3	137.50		12.50	*Globuligerina oxfordiana* (Grigelis)
37.0	81.5	3	100.00		6.25	*Globuligerina oxfordiana* (Grigelis)
37.0	85.0	6	150.00		12.50	*Globuligerina oxfordiana* (Grigelis)
37.5	90.0	3	100.00		12.50	*Globuligerina oxfordiana* (Grigelis)
37.5	89.0	3	112.50	25.00		*Globuligerina oxfordiana* (Grigelis)
38.0	72.0	6	112.50		6.25	*Globuligerina oxfordiana* (Grigelis)
38.0	72.0	3	150.00		6.25	*Globuligerina oxfordiana* (Grigelis)
38.0	72.0	4	112.50		6.25	*Globuligerina oxfordiana* (Grigelis)
38.0	76.0	3	150.00		12.50	*Globuligerina oxfordiana* (Grigelis)
38.0	87.5	3	150.00	25.00		*Globuligerina oxfordiana* (Grigelis)

SOMHEGY - LAYER N2 (BAJOCIAN - NIORTENSE ZONE)

Thin Section Co-ordinates		No. of Chambers Visible	Max. Diameter (µm)	Wall Thickness (µm)		Species
Vert	Hor			Thick	Thin	
38.5	79.0	4	100.00		6.25	*Globuligerina oxfordiana* (Grigelis)
38.5	77.0	3	125.00		12.50	*Globuligerina oxfordiana* (Grigelis)
38.5	71.0	4	225.00		12.50	*Conoglobigerina* aff. *dagestanica* Morozova
38.5	71.0	3	175.00		12.50	*Globuligerina oxfordiana* (Grigelis)
38.5	70.0	3	125.00		12.50	*Globuligerina oxfordiana* (Grigelis)
39.0	70.0	3	125.00	1.00		*Globuligerina oxfordiana* (Grigelis)
39.0	70.5	4	112.50		12.50	*Globuligerina oxfordiana* (Grigelis)
39.0	76.0	4	187.50		18.75	*Globuligerina oxfordiana* (Grigelis)
39.0	77.0	3	237.50		18.75	*Globuligerina* aff. *bathoniana* (Pazdrowa)
39.0	77.0	4	112.50		6.25	*Globuligerina oxfordiana* (Grigelis)
39.0	78.0	3	125.00		12.50	*Globuligerina oxfordiana* (Grigelis)
39.0	78.5	3	200.00		6.25	*Conoglobigerina* aff. *dagestanica* Morozova
40.0	80.0	5	100.00		18.75	*Globuligerina oxfordiana* (Grigelis)
40.0	84.5	3	125.00		18.75	*Globuligerina oxfordiana* (Grigelis)
40.0	84.5	3	112.50		12.50	*Globuligerina oxfordiana* (Grigelis)
40.5	84.5	4	150.00		12.50	*Globuligerina oxfordiana* (Grigelis)
41.5	86.5	7	137.50		18.75	*Globuligerina oxfordiana* (Grigelis)
42.0	73.0	3	112.50		6.25	*Globuligerina oxfordiana* (Grigelis)
42.0	73.5	4	237.50		12.50	*Globuligerina* aff. *bathoniana* (Pazdrowa)
42.5	85.0	3	100.00		6.25	*Globuligerina oxfordiana* (Grigelis)
42.5	74.0	4	137.50		12.50	*Globuligerina oxfordiana* (Grigelis)
42.5	74.0	4	150.00		12.50	*Globuligerina oxfordiana* (Grigelis)
42.5	73.5	4	125.00		12.50	*Globuligerina oxfordiana* (Grigelis)
42.5	73.5	4	150.00		12.50	*Globuligerina oxfordiana* (Grigelis)
42.5	73.0	3	112.50		6.25	*Globuligerina oxfordiana* (Grigelis)
43.0	75.0	3	162.50		18.75	*Globuligerina oxfordiana* (Grigelis)
43.0	75.0	3	175.00		12.50	*Globuligerina oxfordiana* (Grigelis)
43.0	75.0	4	150.00		12.50	*Globuligerina oxfordiana* (Grigelis)
43.0	81.5	4	150.00		6.25	*Globuligerina oxfordiana* (Grigelis)
43.0	81.5	4	175.00		12.50	*Globuligerina oxfordiana* (Grigelis)
43.5	86.0	5	100.00		12.50	*Globuligerina oxfordiana* (Grigelis)
43.5	86.0	6	125.00		6.25	*Globuligerina oxfordiana* (Grigelis)
43.5	81.0	3	150.00		6.25	*Globuligerina oxfordiana* (Grigelis)
44.0	75.0	4	150.00		12.50	*Globuligerina oxfordiana* (Grigelis)
44.0	81.0	3	150.00		6.25	*Globuligerina oxfordiana* (Grigelis)
44.0	84.0	4	175.00	25.00		*Globuligerina oxfordiana* (Grigelis)
44.0	84.0	3	100.00		12.50	*Globuligerina oxfordiana* (Grigelis)
44.5	84.0	3	175.00	25.00		*Globuligerina oxfordiana* (Grigelis)
44.5	77.5	8	162.50		18.75	*Globuligerina oxfordiana* (Grigelis)
44.5	71.5	4	175.00		12.50	*Globuligerina oxfordiana* (Grigelis)
45.0	77.5	3	125.00		12.50	*Globuligerina oxfordiana* (Grigelis)
45.0	77.5	7	150.00	25.00		*Globuligerina oxfordiana* (Grigelis)
45.5	80.0	3	87.50		6.25	*Globuligerina oxfordiana* (Grigelis)
45.5	77.5	4	175.00		12.50	*Globuligerina oxfordiana* (Grigelis)
Total Number of Specimens				**51**	**213**	**264**
Relative Percentages				**19**	**81**	

SOMHEGY - LAYER P (BAJOCIAN - PARKINSONI ZONE)

Thin Section Co-ordinates		No. of Chambers Visible	Max. Diameter (µm)	Wall Thickness (µm)		Species
Vert	Hor			Thick	Thin	
7.0	96.5	3	212.50		18.75	*Conoglobigerina* aff. *dagestanica* Morozova
7.0	97.5	3	100.00		12.50	*Globuligerina oxfordiana* (Grigelis)
7.5	101.0	4	225.00		18.75	*Conoglobigerina* aff. *dagestanica* Morozova
8.0	98.5	3	212.50		12.50	*Conoglobigerina* aff. *dagestanica* Morozova
8.0	99.0	3	250.00		12.50	*Globuligerina* aff. *bathoniana* (Pazdrowa)
8.0	101.5	3	250.00	25.00		*Globuligerina oxfordiana* (Grigelis)
8.0	102.5	3	187.50		18.75	*Globuligerina oxfordiana* (Grigelis)
9.0	90.0	3	200.00		18.75	*Conoglobigerina* aff. *dagestanica* Morozova
9.0	94.5	3	250.00	25.00		*Globuligerina oxfordiana* (Grigelis)
9.0	95.0	4	275.00	37.50		*Conoglobigerina avariformis* Kasimova sphaerica
9.0	100.5	3	250.00	50.00		*Globuligerina oxfordiana* (Grigelis)
9.5	100.5	4	262.50	25.00		*Conoglobigerina avariformis* Kasimova sphaerica
10.0	88.5	4	312.50		18.75	*Globuligerina bathoniana gigantea* Wernli & Görög
10.0	89.5	3	225.00		18.75	*Conoglobigerina* aff. *dagestanica* Morozova
10.0	91.5	4	300.00	43.75		*Conoglobigerina avariformis* Kasimova sphaerica
10.0	95.0	4	300.00	43.75		*Conoglobigerina avariformis* Kasimova sphaerica
10.5	96.0	3	275.00		18.75	*Globuligerina bathoniana gigantea* Wernli & Görög
10.5	90.0	4	237.50		18.75	*Globuligerina* aff. *bathoniana* (Pazdrowa)
10.5	88.5	3	175.00	25.00		*Globuligerina oxfordiana* (Grigelis)
10.5	83.0	4	287.50	25.00		*Conoglobigerina avariformis* Kasimova sphaerica
11.0	86.0	3	225.00	31.25		*Globuligerina oxfordiana* (Grigelis)
11.0	93.5	5	325.00	25.00		*Conoglobigerina avariformis* Kasimova sphaerica
11.0	97.0	3	275.00	50.00		*Conoglobigerina avariformis* Kasimova sphaerica
11.0	97.5	3	250.00	50.00		*Globuligerina oxfordiana* (Grigelis)
11.5	106.0	3	275.00		18.75	*Globuligerina bathoniana gigantea* Wernli & Görög
11.5	102.5	3	162.50		12.50	*Globuligerina oxfordiana* (Grigelis)
11.5	97.5	4	350.00	25.00		*Conoglobigerina avariformis* Kasimova sphaerica
11.5	94.0	4	287.50	37.50		*Conoglobigerina avariformis* Kasimova sphaerica
11.5	93.0	3	275.00	37.50		*Conoglobigerina avariformis* Kasimova sphaerica
11.5	91.5	4	287.50	37.50		*Conoglobigerina avariformis* Kasimova sphaerica
11.5	90.0	6	375.00		18.75	*Globuligerina bathoniana gigantea* Wernli & Görög
11.5	88.5	5	350.00	31.25		*Conoglobigerina avariformis* Kasimova sphaerica
12.0	92.5	4	287.50	43.75		*Conoglobigerina avariformis* Kasimova sphaerica
12.0	94.5	6	325.00	31.25		*Conoglobigerina avariformis* Kasimova sphaerica
12.0	98.5	4	312.50	31.25		*Conoglobigerina avariformis* Kasimova sphaerica
12.0	99.5	3	275.00	25.00		*Conoglobigerina avariformis* Kasimova sphaerica
12.0	101.0	4	275.00		18.75	*Globuligerina bathoniana gigantea* Wernli & Görög
12.5	106.5	4	200.00		18.75	*Globuligerina* aff. *bathoniana* (Pazdrowa)
12.5	97.0	3	325.00	37.50		*Conoglobigerina avariformis* Kasimova sphaerica
12.5	94.5	6	250.00	31.25		*Conoglobigerina avariformis* Kasimova sphaerica
12.5	89.0	5	200.00		12.50	*Conoglobigerina* aff. *dagestanica* Morozova
13.0	74.0	3	200.00	31.25		*Globuligerina oxfordiana* (Grigelis)
13.0	79.0	3	287.50	37.50		*Conoglobigerina avariformis* Kasimova sphaerica
13.0	84.5	4	275.00	37.50		*Conoglobigerina avariformis* Kasimova sphaerica
13.0	85.0	5	375.00		18.75	*Globuligerina bathoniana gigantea* Wernli & Görög
13.0	86.0	4	250.00		18.75	*Globuligerina* aff. *bathoniana* (Pazdrowa)
13.0	89.0	4	362.50		18.75	*Globuligerina bathoniana gigantea* Wernli & Görög
13.0	93.5	5	325.00	37.50		*Conoglobigerina avariformis* Kasimova sphaerica
13.0	98.5	4	250.00		12.50	*Globuligerina* aff. *bathoniana* (Pazdrowa)
13.5	103.5	5	275.00		18.75	*Globuligerina bathoniana gigantea* Wernli & Görög
13.5	102.0	4	300.00	50.00		*Conoglobigerina avariformis* Kasimova sphaerica
13.5	101.0	4	262.50		18.75	*Globuligerina bathoniana gigantea* Wernli & Görög
13.5	99.5	4	250.00	37.50		*Globuligerina oxfordiana* (Grigelis)
13.5	99.5	3	225.00	37.50		*Globuligerina oxfordiana* (Grigelis)(14)
13.5	90.5	3	300.00	25.00		*Conoglobigerina avariformis* Kasimova sphaerica

SOMHEGY - LAYER P (BAJOCIAN - PARKINSONI ZONE)

Thin Section Co-ordinates		No. of Chambers Visible	Max. Diameter (µm)	Wall Thickness (µm)		Species
Vert	Hor			Thick	Thin	
13.5	89.5	6	312.50	50.00		*Conoglobigerina avariformis* Kasimova sphaerica
13.5	88.5	3	325.00	25.00		*Conoglobigerina avariformis* Kasimova sphaerica
13.5	83.0	4	175.00	37.50		*Globuligerina oxfordiana* (Grigelis)
13.5	80.5	3	200.00	25.00		*Globuligerina oxfordiana* (Grigelis)
13.5	77.5	4	212.50	25.00		*Globuligerina oxfordiana* (Grigelis)
13.5	74.5	3	250.00		18.75	*Globuligerina* aff. *bathoniana* (Pazdrowa)
13.5	74.0	4	237.50	37.50		*Globuligerina oxfordiana* (Grigelis)
13.5	74.0	3	212.50		18.75	*Globuligerina* aff. *bathoniana* (Pazdrowa)
14.0	76.0	3	200.00		18.75	*Globuligerina* aff. *bathoniana* (Pazdrowa)
14.0	79.0	4	325.00		18.75	*Globuligerina bathoniana gigantea* Wernli & Görög
14.0	81.0	4	250.00	25.00		*Globuligerina oxfordiana* (Grigelis)
14.0	82.5	4	250.00	37.50		*Globuligerina oxfordiana* (Grigelis)
14.0	85.0	4	275.00	25.00		*Conoglobigerina avariformis* Kasimova sphaerica
14.0	90.5	5	275.00	37.50		*Conoglobigerina avariformis* Kasimova sphaerica
14.0	91.5	4	275.00	31.25		*Conoglobigerina avariformis* Kasimova sphaerica
14.0	92.0	4	275.00	25.00		*Conoglobigerina avariformis* Kasimova sphaerica
14.0	93.5	3	200.00		18.75	*Globuligerina* aff. *bathoniana* (Pazdrowa)
14.0	95.0	3	275.00	31.25		*Conoglobigerina avariformis* Kasimova sphaerica
14.0	98.5	4	200.00		18.75	*Globuligerina* aff. *bathoniana* (Pazdrowa)
14.0	102.0	4	300.00	37.50		*Conoglobigerina avariformis* Kasimova sphaerica
14.5	111.0	4	275.00	37.50		*Conoglobigerina avariformis* Kasimova sphaerica
14.5	99.5	4	300.00	25.00		*Conoglobigerina avariformis* Kasimova sphaerica
14.5	98.5	5	300.00		18.75	*Globuligerina bathoniana gigantea* Wernli & Görög
14.5	93.5	4	287.50	31.25		*Conoglobigerina avariformis* Kasimova sphaerica
14.5	93.5	4	300.00	31.25		*Conoglobigerina avariformis* Kasimova sphaerica
14.5	90.5	4	287.50	25.00		*Conoglobigerina avariformis* Kasimova sphaerica
14.5	84.0	4	287.50	37.50		*Conoglobigerina avariformis* Kasimova sphaerica
14.5	81.0	3	225.00		18.75	*Globuligerina* aff. *bathoniana* (Pazdrowa)
14.5	75.0	4	325.00	31.25		*Conoglobigerina avariformis* Kasimova sphaerica
14.5	74.5	3	262.50	31.25		*Conoglobigerina avariformis* Kasimova sphaerica
14.5	72.0	3	225.00		18.75	*Globuligerina* aff. *bathoniana* (Pazdrowa)
14.5	72.0	4	375.00		18.75	*Globuligerina bathoniana gigantea* Wernli & Görög
14.5	70.5	3	300.00	37.50		*Conoglobigerina avariformis* Kasimova sphaerica
15.0	66.5	4	325.00	43.75		*Conoglobigerina avariformis* Kasimova sphaerica
15.0	67.0	5	200.00		18.75	*Globuligerina* aff. *bathoniana* (Pazdrowa)
15.0	67.5	3	237.50	31.25		*Globuligerina oxfordiana* (Grigelis)
15.0	70.5	4	275.00	37.50		*Conoglobigerina avariformis* Kasimova sphaerica
15.0	71.0	4	275.00	31.25		*Conoglobigerina avariformis* Kasimova sphaerica
15.0	72.5	4	275.00	37.50		*Conoglobigerina avariformis* Kasimova sphaerica
15.0	75.0	4	250.00	50.00		*Globuligerina oxfordiana* (Grigelis)
15.0	76.0	4	300.00	37.50		*Conoglobigerina avariformis* Kasimova sphaerica
15.0	80.0	3	275.00		18.75	*Globuligerina bathoniana gigantea* Wernli & Görög
15.0	80.5	4	262.50	31.25		*Conoglobigerina avariformis* Kasimova sphaerica
15.0	82.0	4	275.00	31.25		*Conoglobigerina avariformis* Kasimova sphaerica
15.0	82.0	4	225.00	25.00		*Globuligerina oxfordiana* (Grigelis)
15.0	85.5	3	275.00	25.00		*Conoglobigerina avariformis* Kasimova sphaerica
15.0	85.5	3	250.00		18.75	*Globuligerina* aff. *bathoniana* (Pazdrowa)
15.0	86.0	4	300.00	37.50		*Conoglobigerina avariformis* Kasimova sphaerica
15.0	87.5	4	287.50	37.50		*Conoglobigerina avariformis* Kasimova sphaerica
15.0	88.5	3	225.00	37.50		*Globuligerina oxfordiana* (Grigelis)
15.0	90.0	3	250.00	37.50		*Globuligerina oxfordiana* (Grigelis)
15.0	90.5	5	312.50	37.50		*Conoglobigerina avariformis* Kasimova sphaerica
15.0	94.5	4	275.00	31.25		*Conoglobigerina avariformis* Kasimova sphaerica
15.0	110.0	3	225.00	25.00		*Globuligerina oxfordiana* (Grigelis)
15.5	101.5	4	250.00		18.75	*Globuligerina* aff. *bathoniana* (Pazdrowa)

SOMHEGY - LAYER P (BAJOCIAN - PARKINSONI ZONE)

Thin Section Co-ordinates		No. of Chambers Visible	Max. Diameter (µm)	Wall Thickness (µm)		Species
Vert	Hor			Thick	Thin	
15.5	94.0	6	325.00	25.00		*Conoglobigerina avariformis* Kasimova sphaerica
15.5	93.5	3	187.50		12.50	*Globuligerina oxfordiana* (Grigelis)
15.5	91.0	3	300.00	25.00		*Conoglobigerina avariformis* Kasimova sphaerica
15.5	87.5	4	225.00	25.00		*Globuligerina oxfordiana* (Grigelis)
15.5	85.0	4	262.50	31.25		*Conoglobigerina avariformis* Kasimova sphaerica
15.5	85.0	3	225.00	37.50		*Globuligerina oxfordiana* (Grigelis)
15.5	82.0	4	275.00	31.25		*Conoglobigerina avariformis* Kasimova sphaerica
15.5	81.5	4	337.50	31.25		*Conoglobigerina avariformis* Kasimova sphaerica
15.5	76.5	3	300.00	37.50		*Conoglobigerina avariformis* Kasimova sphaerica
15.5	71.0	3	250.00	37.50		*Globuligerina oxfordiana* (Grigelis)
15.5	70.0	4	275.00	37.50		*Conoglobigerina avariformis* Kasimova sphaerica
16.0	65.5	4	300.00	37.50		*Conoglobigerina avariformis* Kasimova sphaerica
16.0	65.5	4	287.50	37.50		*Conoglobigerina avariformis* Kasimova sphaerica
16.0	66.0	4	250.00	37.50		*Globuligerina oxfordiana* (Grigelis)
16.0	67.5	3	200.00		18.75	*Conoglobigerina* aff. *dagestanica* Morozova
16.0	68.5	3	237.50		18.75	*Globuligerina* aff. *bathoniana* (Pazdrowa)
16.0	75.0	5	250.00		18.75	*Globuligerina* aff. *bathoniana* (Pazdrowa)
16.0	75.5	4	250.00	31.25		*Globuligerina oxfordiana* (Grigelis)
16.0	76.0	4	325.00	37.50		*Conoglobigerina avariformis* Kasimova sphaerica
16.0	77.0	3	250.00	37.50		*Globuligerina oxfordiana* (Grigelis)
16.0	81.0	4	325.00	37.50		*Conoglobigerina avariformis* Kasimova sphaerica
16.0	81.5	3	250.00	37.50		*Globuligerina oxfordiana* (Grigelis)
16.0	83.0	3	175.00		12.50	*Globuligerina oxfordiana* (Grigelis)
16.0	89.0	4	287.50	37.50		*Conoglobigerina avariformis* Kasimova sphaerica
16.0	96.5	4	325.00	25.00		*Conoglobigerina avariformis* Kasimova sphaerica
16.0	103.5	4	325.00	31.25		*Conoglobigerina avariformis* Kasimova sphaerica
16.0	105.0	4	250.00		18.75	*Globuligerina* aff. *bathoniana* (Pazdrowa)
16.0	105.0	3	250.00	25.00		*Globuligerina oxfordiana* (Grigelis)
16.0	107.5	5	275.00	37.50		*Conoglobigerina avariformis* Kasimova sphaerica
16.0	112.0	3	325.00	31.25		*Conoglobigerina avariformis* Kasimova sphaerica
16.5	112.5	3	275.00	37.50		*Conoglobigerina avariformis* Kasimova sphaerica
16.5	110.5	3	212.50	37.50		*Globuligerina oxfordiana* (Grigelis)
16.5	110.5	3	200.00	25.00		*Globuligerina oxfordiana* (Grigelis)
16.5	108.5	4	225.00		12.50	*Conoglobigerina* aff. *dagestanica* Morozova
16.5	108.0	5	262.50	25.00		*Conoglobigerina avariformis* Kasimova sphaerica
16.5	106.5	3	225.00	37.50		*Globuligerina oxfordiana* (Grigelis)
16.5	103.0	3	275.00	37.50		*Conoglobigerina avariformis* Kasimova sphaerica
16.5	103.0	4	250.00		12.50	*Globuligerina* aff. *bathoniana* (Pazdrowa)
16.5	102.0	5	275.00	31.25		*Conoglobigerina avariformis* Kasimova sphaerica
16.5	101.5	4	237.50	31.25		*Globuligerina oxfordiana* (Grigelis)
16.5	100.0	3	287.50		12.50	*Globuligerina bathoniana gigantea* Wernli & Görög
16.5	85.5	4	237.50	25.00		*Globuligerina oxfordiana* (Grigelis)
16.5	85.5	3	275.00	31.25		*Conoglobigerina avariformis* Kasimova sphaerica
16.5	85.0	3	275.00		18.75	*Globuligerina bathoniana gigantea* Wernli & Görög
16.5	75.5	5	250.00		18.75	*Globuligerina* aff. *bathoniana* (Pazdrowa)
16.5	73.5	3	250.00	31.25		*Globuligerina oxfordiana* (Grigelis)
17.0	68.0	3	250.00	31.25		*Globuligerina oxfordiana* (Grigelis)
17.0	78.5	3	225.00	37.50		*Globuligerina oxfordiana* (Grigelis)
17.0	79.5	4	312.50	37.50		*Conoglobigerina avariformis* Kasimova sphaerica
17.0	83.0	3	275.00	25.00		*Conoglobigerina avariformis* Kasimova sphaerica
17.0	90.0	4	300.00		18.75	*Globuligerina bathoniana gigantea* Wernli & Görög
17.0	94.0	3	225.00	25.00		*Globuligerina oxfordiana* (Grigelis)
17.0	100.5	3	237.50	37.50		*Globuligerina oxfordiana* (Grigelis)
17.0	101.5	3	275.00	31.25		*Conoglobigerina avariformis* Kasimova sphaerica
17.0	110.5	4	275.00	31.25		*Conoglobigerina avariformis* Kasimova sphaerica

SOMHEGY - LAYER P (BAJOCIAN - PARKINSONI ZONE)

Thin Section Co-ordinates		No. of Chambers Visible	Max. Diameter (µm)	Wall Thickness (µm)		Species
Vert	Hor			Thick	Thin	
17.0	112.0	5	250.00	25.00		*Globuligerina oxfordiana* (Grigelis)
17.5	112.0	4	175.00		18.75	*Globuligerina oxfordiana* (Grigelis)
17.5	112.0	4	250.00	25.00		*Globuligerina oxfordiana* (Grigelis)
17.5	111.5	3	237.50	31.25		*Globuligerina oxfordiana* (Grigelis)
17.5	111.0	5	325.00		12.50	*Globuligerina bathoniana gigantea* Wernli & Görög
17.5	109.5	3	262.50		18.75	*Globuligerina bathoniana gigantea* Wernli & Görög
17.5	109.0	4	312.50	25.00		*Conoglobigerina avariformis* Kasimova sphaerica
17.5	106.0	4	337.50	31.25		*Conoglobigerina avariformis* Kasimova sphaerica
17.5	105.5	4	275.00	31.25		*Conoglobigerina avariformis* Kasimova sphaerica
17.5	104.5	3	237.50	25.00		*Globuligerina oxfordiana* (Grigelis)
17.5	103.0	4	250.00	31.25		*Globuligerina oxfordiana* (Grigelis)
17.5	97.5	5	275.00	37.50		*Conoglobigerina avariformis* Kasimova sphaerica
17.5	95.0	4	325.00		18.75	*Globuligerina bathoniana gigantea* Wernli & Görög
17.5	93.0	4	300.00		18.75	*Globuligerina bathoniana gigantea* Wernli & Görög
17.5	86.0	3	275.00	31.25		*Conoglobigerina avariformis* Kasimova sphaerica
17.5	86.0	4	200.00	25.00		*Globuligerina oxfordiana* (Grigelis)
17.5	85.5	4	225.00	37.50		*Globuligerina oxfordiana* (Grigelis)
17.5	84.5	5	262.50	37.50		*Conoglobigerina avariformis* Kasimova sphaerica
17.5	80.5	5	262.50	31.25		*Conoglobigerina avariformis* Kasimova sphaerica
17.5	80.0	4	300.00	25.00		*Conoglobigerina avariformis* Kasimova sphaerica
17.5	79.5	4	237.50	25.00		*Globuligerina oxfordiana* (Grigelis)
17.5	79.0	3	262.50	37.50		*Conoglobigerina avariformis* Kasimova sphaerica
17.5	71.5	4	300.00	37.50		*Conoglobigerina avariformis* Kasimova sphaerica
17.5	71.0	4	250.00	37.50		*Globuligerina oxfordiana* (Grigelis)
17.5	68.5	3	250.00	37.50		*Globuligerina oxfordiana* (Grigelis)
18.0	66.0	3	200.00	25.00		*Globuligerina oxfordiana* (Grigelis)
18.0	70.0	5	262.50	31.25		*Conoglobigerina avariformis* Kasimova sphaerica
18.0	76.5	4	300.00	37.50		*Conoglobigerina avariformis* Kasimova sphaerica
18.0	78.5	4	325.00		12.50	*Globuligerina bathoniana gigantea* Wernli & Görög
18.0	78.5	4	275.00	31.25		*Conoglobigerina avariformis* Kasimova sphaerica
18.0	80.5	6	275.00	25.00		*Conoglobigerina avariformis* Kasimova sphaerica
18.0	84.0	4	287.50	37.50		*Conoglobigerina avariformis* Kasimova sphaerica
18.0	84.5	5	287.50	37.50		*Conoglobigerina avariformis* Kasimova sphaerica
18.0	97.0	4	200.00		18.75	*Conoglobigerina* aff. *dagestanica* Morozova
18.0	98.0	3	125.00		12.50	*Globuligerina oxfordiana* (Grigelis)
18.0	98.5	4	225.00	31.25		*Globuligerina oxfordiana* (Grigelis)
18.0	100.5	3	237.50	31.25		*Globuligerina oxfordiana* (Grigelis)
18.0	102.5	5	362.50		18.75	*Globuligerina bathoniana gigantea* Wernli & Görög
18.0	107.0	4	225.00	25.00		*Globuligerina oxfordiana* (Grigelis)
18.0	112.5	3	250.00	37.50		*Globuligerina oxfordiana* (Grigelis)
18.0	112.5	3	175.00	37.50		*Globuligerina oxfordiana* (Grigelis)
18.5	111.0	3	212.50		18.75	*Conoglobigerina* aff. *dagestanica* Morozova
18.5	110.0	6	262.50		18.75	*Globuligerina bathoniana gigantea* Wernli & Görög
18.5	109.0	4	325.00		18.75	*Globuligerina bathoniana gigantea* Wernli & Görög
18.5	107.5	3	225.00	25.00		*Globuligerina oxfordiana* (Grigelis)
18.5	105.5	4	300.00	43.75		*Conoglobigerina avariformis* Kasimova sphaerica
18.5	100.0	3	237.50	31.25		*Globuligerina oxfordiana* (Grigelis)
18.5	100.0	3	250.00	37.50		*Globuligerina oxfordiana* (Grigelis)
18.5	98.0	3	200.00	25.00		*Globuligerina oxfordiana* (Grigelis)
18.5	96.5	3	250.00	37.50		*Globuligerina oxfordiana* (Grigelis)
18.5	95.0	3	300.00	25.00		*Conoglobigerina avariformis* Kasimova sphaerica
18.5	92.0	4	325.00	25.00		*Conoglobigerina avariformis* Kasimova sphaerica
18.5	92.0	4	275.00	37.50		*Conoglobigerina avariformis* Kasimova sphaerica
18.5	87.5	3	250.00	37.50		*Globuligerina oxfordiana* (Grigelis)
18.5	85.5	5	325.00	25.00		*Conoglobigerina avariformis* Kasimova sphaerica

SOMHEGY - LAYER P (BAJOCIAN - PARKINSONI ZONE)

Thin Section Co-ordinates		No. of Chambers Visible	Max. Diameter (μm)	Wall Thickness (μm)		Species
Vert	Hor			Thick	Thin	
18.5	81.5	4	275.00	37.50		*Conoglobigerina avariformis* Kasimova sphaerica
18.5	81.0	6	300.00	25.00		*Conoglobigerina avariformis* Kasimova sphaerica
18.5	75.5	3	250.00	37.50		*Globuligerina oxfordiana* (Grigelis)
18.5	69.0	4	300.00	25.00		*Conoglobigerina avariformis* Kasimova sphaerica
18.5	68.5	3	225.00		12.50	*Conoglobigerina* aff. *dagestanica* Morozova
19.0	65.5	3	225.00	31.25		*Globuligerina oxfordiana* (Grigelis)
19.0	71.5	5	275.00	25.00		*Conoglobigerina avariformis* Kasimova sphaerica
19.0	72.0	4	150.00		12.50	*Globuligerina oxfordiana* (Grigelis)
19.0	77.5	4	275.00	37.50		*Conoglobigerina avariformis* Kasimova sphaerica
19.0	79.0	4	225.00		18.75	*Conoglobigerina* aff. *dagestanica* Morozova
19.0	82.5	5	250.00		18.75	*Globuligerina* aff. *bathoniana* (Pazdrowa)
19.0	83.0	3	262.50		18.75	*Globuligerina bathoniana gigantea* Wernli & Görög
19.0	88.0	4	325.00	25.00		*Conoglobigerina avariformis* Kasimova sphaerica
19.0	92.0	4	325.00	25.00		*Conoglobigerina avariformis* Kasimova sphaerica
19.0	92.5	5	237.50		18.75	*Globuligerina* aff. *bathoniana* (Pazdrowa)
19.0	93.0	5	312.50	25.00		*Conoglobigerina avariformis* Kasimova sphaerica
19.0	100.0	4	275.00	37.50		*Conoglobigerina avariformis* Kasimova sphaerica
19.0	109.0	4	325.00		18.75	*Globuligerina bathoniana gigantea* Wernli & Görög
19.0	111.5	5	250.00		18.75	*Globuligerina* aff. *bathoniana* (Pazdrowa)
19.5	111.0	3	262.50		18.75	*Globuligerina bathoniana gigantea* Wernli & Görög
19.5	93.0	3	175.00	25.00		*Globuligerina oxfordiana* (Grigelis)
19.5	93.0	4	275.00		18.75	*Globuligerina bathoniana gigantea* Wernli & Görög
19.5	93.0	5	312.50	25.00		*Conoglobigerina avariformis* Kasimova sphaerica
19.5	91.5	4	250.00		18.75	*Globuligerina* aff. *bathoniana* (Pazdrowa)
19.5	90.5	3	212.50	25.00		*Globuligerina oxfordiana* (Grigelis)
19.5	90.0	3	200.00	31.25		*Globuligerina oxfordiana* (Grigelis)
19.5	84.5	5	262.50	37.50		*Conoglobigerina avariformis* Kasimova sphaerica
19.5	82.5	3	250.00	37.50		*Globuligerina oxfordiana* (Grigelis)
19.5	82.0	4	262.50	31.25		*Conoglobigerina avariformis* Kasimova sphaerica
19.5	81.5	4	287.50		12.50	*Globuligerina bathoniana gigantea* Wernli & Görög
19.5	79.5	3	187.50		18.75	*Globuligerina oxfordiana* (Grigelis)
19.5	76.5	4	325.00	31.25		*Conoglobigerina avariformis* Kasimova sphaerica
19.5	76.0	3	325.00	31.25		*Conoglobigerina avariformis* Kasimova sphaerica
19.5	75.0	4	250.00	37.50		*Globuligerina oxfordiana* (Grigelis)
19.5	70.5	6	375.00		12.50	*Globuligerina bathoniana gigantea* Wernli & Görög
20.0	67.0	3	262.50	37.50		*Conoglobigerina avariformis* Kasimova sphaerica
20.0	73.5	3	262.50	37.50		*Conoglobigerina avariformis* Kasimova sphaerica
20.0	78.5	3	250.00	37.50		*Globuligerina oxfordiana* (Grigelis)
20.0	88.5	3	225.00	25.00		*Globuligerina oxfordiana* (Grigelis)
20.0	90.0	3	300.00	31.25		*Conoglobigerina avariformis* Kasimova sphaerica
20.0	92.0	3	212.50	50.00		*Globuligerina oxfordiana* (Grigelis)
20.0	92.0	4	300.00	37.50		*Conoglobigerina avariformis* Kasimova sphaerica
20.0	92.5	4	312.50	37.50		*Conoglobigerina avariformis* Kasimova sphaerica
20.0	96.0	4	262.50	31.25		*Conoglobigerina avariformis* Kasimova sphaerica
20.0	109.0	5	325.00	31.25		*Conoglobigerina avariformis* Kasimova sphaerica
20.0	113.5	4	250.00	37.50		*Globuligerina oxfordiana* (Grigelis)
20.5	103.5	4	250.00	37.50		*Globuligerina oxfordiana* (Grigelis)
20.5	103.5	3	262.50	25.00		*Conoglobigerina avariformis* Kasimova sphaerica
20.5	103.5	4	225.00		18.75	*Conoglobigerina* aff. *dagestanica* Morozova
20.5	102.5	4	237.50	31.25		*Globuligerina oxfordiana* (Grigelis)
20.5	100.0	4	250.00	31.25		*Globuligerina oxfordiana* (Grigelis)
20.5	98.0	4	262.50	37.50		*Conoglobigerina avariformis* Kasimova sphaerica
20.5	97.0	4	200.00		18.75	*Conoglobigerina* aff. *dagestanica* Morozova
20.5	96.5	5	337.50	37.50		*Conoglobigerina avariformis* Kasimova sphaerica
20.5	96.5	4	325.00	37.50		*Conoglobigerina avariformis* Kasimova sphaerica

SOMHEGY - LAYER P (BAJOCIAN - PARKINSONI ZONE)

Thin Section Co-ordinates		No. of Chambers Visible	Max. Diameter (µm)	Wall Thickness (µm)		Species
Vert	Hor			Thick	Thin	
20.5	95.0	3	275.00		18.75	*Globuligerina bathoniana gigantea* Wernli & Görög
20.5	94.5	5	300.00		18.75	*Globuligerina bathoniana gigantea* Wernli & Görög
20.5	94.0	3	300.00		18.75	*Globuligerina bathoniana gigantea* Wernli & Görög
20.5	90.0	3	300.00	37.50		*Conoglobigerina avariformis* Kasimova sphaerica
20.5	89.0	5	325.00	25.00		*Conoglobigerina avariformis* Kasimova sphaerica
20.5	88.5	3	300.00	25.00		*Conoglobigerina avariformis* Kasimova sphaerica
20.5	82.5	4	287.50	31.25		*Conoglobigerina avariformis* Kasimova sphaerica
20.5	81.0	5	312.50	37.50		*Conoglobigerina avariformis* Kasimova sphaerica
20.5	80.5	4	225.00	31.25		*Globuligerina oxfordiana* (Grigelis)
20.5	80.5	3	262.50	25.00		*Conoglobigerina avariformis* Kasimova sphaerica
20.5	73.5	5	337.50	31.25		*Conoglobigerina avariformis* Kasimova sphaerica
20.5	73.0	3	275.00	25.00		*Conoglobigerina avariformis* Kasimova sphaerica
20.5	70.5	3	150.00		18.75	*Globuligerina oxfordiana* (Grigelis)
20.5	70.0	4	300.00	25.00		*Conoglobigerina avariformis* Kasimova sphaerica
20.5	69.0	4	300.00		18.75	*Globuligerina bathoniana gigantea* Wernli & Görög
20.5	68.0	3	237.50	37.50		*Globuligerina oxfordiana* (Grigelis)
20.5	66.0	4	300.00		18.75	*Globuligerina bathoniana gigantea* Wernli & Görög
21.0	65.5	4	300.00	25.00		*Conoglobigerina avariformis* Kasimova sphaerica
21.0	67.5	3	350.00	25.00		*Conoglobigerina avariformis* Kasimova sphaerica
21.0	68.0	3	262.50	25.00		*Conoglobigerina avariformis* Kasimova sphaerica
21.0	72.5	4	337.50	25.00		*Conoglobigerina avariformis* Kasimova sphaerica
21.0	78.5	3	262.50	31.25		*Conoglobigerina avariformis* Kasimova sphaerica
21.0	81.0	3	250.00	37.50		*Globuligerina oxfordiana* (Grigelis)
21.0	85.5	6	337.50	25.00		*Conoglobigerina avariformis* Kasimova sphaerica
21.0	99.0	5	275.00	25.00		*Conoglobigerina avariformis* Kasimova sphaerica
21.0	99.5	4	250.00		18.75	*Globuligerina* aff. *bathoniana* (Pazdrowa)
21.0	102.0	3	275.00	37.50		*Conoglobigerina avariformis* Kasimova sphaerica
21.0	104.5	4	250.00	25.00		*Globuligerina oxfordiana* (Grigelis)
21.0	107.5	3	250.00	25.00		*Globuligerina oxfordiana* (Grigelis)
21.0	109.0	3	187.50		18.75	*Globuligerina oxfordiana* (Grigelis)
21.0	109.5	3	250.00	43.75		*Globuligerina oxfordiana* (Grigelis)
21.5	114.0	4	300.00	25.00		*Conoglobigerina avariformis* Kasimova sphaerica
21.5	113.5	3	250.00		18.75	*Globuligerina* aff. *bathoniana* (Pazdrowa)
21.5	113.5	3	287.50	37.50		*Conoglobigerina avariformis* Kasimova sphaerica
21.5	112.5	4	325.00	37.50		*Conoglobigerina avariformis* Kasimova sphaerica
21.5	107.5	7	325.00		18.75	*Globuligerina bathoniana gigantea* Wernli & Görög
21.5	105.0	4	325.00	37.50		*Conoglobigerina avariformis* Kasimova sphaerica
21.5	104.5	4	300.00	25.00		*Conoglobigerina avariformis* Kasimova sphaerica
21.5	104.5	4	275.00	37.50		*Conoglobigerina avariformis* Kasimova sphaerica
21.5	104.0	3	325.00	37.50		*Conoglobigerina avariformis* Kasimova sphaerica
21.5	97.0	4	325.00	25.00		*Conoglobigerina avariformis* Kasimova sphaerica
21.5	95.5	3	275.00	37.50		*Conoglobigerina avariformis* Kasimova sphaerica
21.5	93.5	4	325.00	37.50		*Conoglobigerina avariformis* Kasimova sphaerica
21.5	92.5	4	287.50	43.75		*Conoglobigerina avariformis* Kasimova sphaerica
21.5	91.0	4	275.00	37.50		*Conoglobigerina avariformis* Kasimova sphaerica
21.5	81.0	4	325.00	31.25		*Conoglobigerina avariformis* Kasimova sphaerica
21.5	80.0	4	300.00		12.50	*Globuligerina bathoniana gigantea* Wernli & Görög
21.5	78.0	4	187.50	25.00		*Globuligerina oxfordiana* (Grigelis)
21.5	77.5	4	300.00	31.25		*Conoglobigerina avariformis* Kasimova sphaerica
21.5	77.0	4	250.00	25.00		*Globuligerina oxfordiana* (Grigelis)
21.5	76.5	5	250.00	37.50		*Globuligerina oxfordiana* (Grigelis)
21.5	76.0	4	325.00	25.00		*Conoglobigerina avariformis* Kasimova sphaerica
21.5	76.0	4	250.00		12.50	*Globuligerina* aff. *bathoniana* (Pazdrowa)
21.5	75.0	3	225.00	37.50		*Globuligerina oxfordiana* (Grigelis)
21.5	72.0	4	237.50	25.00		*Globuligerina oxfordiana* (Grigelis)

SOMHEGY - LAYER P (BAJOCIAN - PARKINSONI ZONE)

Thin Section Co-ordinates		No. of Chambers Visible	Max. Diameter (µm)	Wall Thickness (µm)		Species
Vert	Hor			Thick	Thin	
21.5	70.5	3	275.00	25.00		*Conoglobigerina avariformis* Kasimova sphaerica
21.5	69.0	6	300.00	31.25		*Conoglobigerina avariformis* Kasimova sphaerica
21.5	68.0	4	237.50	25.00		*Globuligerina oxfordiana* (Grigelis)
21.5	67.0	4	300.00	37.50		*Conoglobigerina avariformis* Kasimova sphaerica
21.5	66.5	4	300.00	37.50		*Conoglobigerina avariformis* Kasimova sphaerica
22.0	65.5	5	300.00	25.00		*Conoglobigerina avariformis* Kasimova sphaerica
22.0	73.5	5	300.00	31.25		*Conoglobigerina avariformis* Kasimova sphaerica
22.0	75.0	3	262.50	37.50		*Conoglobigerina avariformis* Kasimova sphaerica
22.0	83.5	4	325.00		12.50	*Globuligerina bathoniana gigantea* Wernli & Görög
22.0	92.0	3	287.50	25.00		*Conoglobigerina avariformis* Kasimova sphaerica
22.0	94.5	4	275.00		18.75	*Globuligerina bathoniana gigantea* Wernli & Görög
22.0	101.0	6	350.00	37.50		*Conoglobigerina avariformis* Kasimova sphaerica
22.0	101.5	3	262.50	37.50		*Conoglobigerina avariformis* Kasimova sphaerica
22.0	108.0	3	275.00	31.25		*Conoglobigerina avariformis* Kasimova sphaerica
22.0	108.0	3	275.00		18.75	*Globuligerina bathoniana gigantea* Wernli & Görög
22.0	111.0	6	300.00		18.75	*Globuligerina bathoniana gigantea* Wernli & Görög
22.0	111.5	4	325.00	31.25		*Conoglobigerina avariformis* Kasimova sphaerica
22.0	113.0	4	237.50		18.75	*Globuligerina* aff. *bathoniana* (Pazdrowa)
22.0	114.0	4	275.00	25.00		*Conoglobigerina avariformis* Kasimova sphaerica
22.5	112.5	7	262.50	25.00		*Conoglobigerina avariformis* Kasimova sphaerica
22.5	111.5	3	300.00	37.50		*Conoglobigerina avariformis* Kasimova sphaerica
22.5	105.5	4	275.00	25.00		*Conoglobigerina avariformis* Kasimova sphaerica
22.5	105.5	4	250.00	25.00		*Globuligerina oxfordiana* (Grigelis)
22.5	105.5	7	275.00	25.00		*Conoglobigerina avariformis* Kasimova sphaerica
22.5	101.5	4	275.00	37.50		*Conoglobigerina avariformis* Kasimova sphaerica
22.5	101.0	7	287.50	25.00		*Conoglobigerina avariformis* Kasimova sphaerica
22.5	97.5	4	237.50	37.50		*Globuligerina oxfordiana* (Grigelis)
22.5	94.5	4	275.00		18.75	*Globuligerina bathoniana gigantea* Wernli & Görög
22.5	92.0	4	287.50		18.75	*Globuligerina bathoniana gigantea* Wernli & Görög
22.5	87.5	4	325.00	37.50		*Conoglobigerina avariformis* Kasimova sphaerica
22.5	86.5	5	350.00	25.00		*Conoglobigerina avariformis* Kasimova sphaerica
22.5	85.5	3	200.00		18.75	*Conoglobigerina* aff. *dagestanica* Morozova
22.5	80.5	4	250.00	31.25		*Globuligerina oxfordiana* (Grigelis)
22.5	80.5	4	225.00		18.75	*Conoglobigerina* aff. *dagestanica* Morozova
22.5	80.0	3	200.00	25.00		*Globuligerina oxfordiana* (Grigelis)
22.5	80.0	5	337.50	31.25		*Conoglobigerina avariformis* Kasimova sphaerica
22.5	78.5	4	312.50	31.25		*Conoglobigerina avariformis* Kasimova sphaerica
22.5	78.0	4	262.50		18.75	*Globuligerina bathoniana gigantea* Wernli & Görög
22.5	77.5	4	275.00	37.50		*Conoglobigerina avariformis* Kasimova sphaerica
22.5	76.5	3	200.00		18.75	*Conoglobigerina* aff. *dagestanica* Morozova
22.5	76.5	3	225.00		12.50	*Conoglobigerina* aff. *dagestanica* Morozova
22.5	76.5	4	225.00	31.25		*Globuligerina oxfordiana* (Grigelis)
22.5	76.5	4	300.00	31.25		*Conoglobigerina avariformis* Kasimova sphaerica
22.5	74.0	4	275.00	37.50		*Conoglobigerina avariformis* Kasimova sphaerica
22.5	71.5	5	300.00	37.50		*Conoglobigerina avariformis* Kasimova sphaerica
22.5	71.0	5	250.00	31.25		*Globuligerina oxfordiana* (Grigelis)
22.5	70.0	4	275.00	31.25		*Conoglobigerina avariformis* Kasimova sphaerica
22.5	70.0	4	275.00	25.00		*Conoglobigerina avariformis* Kasimova sphaerica
23.0	70.0	4	312.50		18.75	*Globuligerina bathoniana gigantea* Wernli & Görög
23.0	77.0	5	275.00	25.00		*Conoglobigerina avariformis* Kasimova sphaerica
23.0	96.0	3	250.00	31.25		*Globuligerina oxfordiana* (Grigelis)
23.0	103.0	4	287.50	25.00		*Conoglobigerina avariformis* Kasimova sphaerica
23.0	104.5	4	275.00	25.00		*Conoglobigerina avariformis* Kasimova sphaerica
23.0	106.5	3	250.00		12.50	*Globuligerina* aff. *bathoniana* (Pazdrowa)
23.0	110.5	3	250.00	37.50		*Globuligerina oxfordiana* (Grigelis)

SOMHEGY - LAYER P (BAJOCIAN - PARKINSONI ZONE)

Thin Section Co-ordinates		No. of Chambers Visible	Max. Diameter (µm)	Wall Thickness (µm)		Species
Vert	Hor			Thick	Thin	
23.0	112.0	4	300.00	37.50		*Conoglobigerina avariformis* Kasimova sphaerica
23.0	112.0	4	275.00	25.00		*Conoglobigerina avariformis* Kasimova sphaerica
23.0	112.5	3	200.00		18.75	*Conoglobigerina* aff. *dagestanica* Morozova
23.0	112.5	3	200.00		18.75	*Conoglobigerina* aff. *dagestanica* Morozova
23.5	113.5	3	287.50	31.25		*Conoglobigerina avariformis* Kasimova sphaerica
23.5	111.5	4	350.00	37.50		*Conoglobigerina avariformis* Kasimova sphaerica
23.5	111.0	6	325.00	31.25		*Conoglobigerina avariformis* Kasimova sphaerica
23.5	109.0	5	300.00	25.00		*Conoglobigerina avariformis* Kasimova sphaerica
23.5	107.5	5	300.00	31.25		*Conoglobigerina avariformis* Kasimova sphaerica
23.5	107.5	3	225.00	25.00		*Globuligerina oxfordiana* (Grigelis)
23.5	106.5	4	300.00	31.25		*Conoglobigerina avariformis* Kasimova sphaerica
23.5	106.0	4	225.00		18.75	*Conoglobigerina* aff. *dagestanica* Morozova
23.5	102.5	3	262.50	31.25		*Conoglobigerina avariformis* Kasimova sphaerica
23.5	101.5	6	337.50		18.75	*Globuligerina bathoniana gigantea* Wernli & Görög
23.5	100.0	3	200.00	31.25		*Globuligerina oxfordiana* (Grigelis)
23.5	99.5	4	300.00	25.00		*Conoglobigerina avariformis* Kasimova sphaerica
23.5	88.5	4	275.00	37.50		*Conoglobigerina avariformis* Kasimova sphaerica
23.5	88.0	3	225.00		12.50	*Conoglobigerina* aff. *dagestanica* Morozova
23.5	88.0	4	300.00	25.00		*Conoglobigerina avariformis* Kasimova sphaerica
23.5	83.0	4	250.00		18.75	*Globuligerina* aff. *bathoniana* (Pazdrowa)
23.5	82.0	4	312.50		18.75	*Globuligerina bathoniana gigantea* Wernli & Görög
23.5	81.0	5	300.00	25.00		*Conoglobigerina avariformis* Kasimova sphaerica
23.5	80.0	4	262.50	25.00		*Conoglobigerina avariformis* Kasimova sphaerica
23.5	80.0	5	175.00		18.75	*Globuligerina oxfordiana* (Grigelis)
23.5	79.5	4	250.00	25.00		*Globuligerina oxfordiana* (Grigelis)
23.5	78.0	4	325.00	31.25		*Conoglobigerina avariformis* Kasimova sphaerica
23.5	77.5	3	262.50	25.00		*Conoglobigerina avariformis* Kasimova sphaerica
23.5	77.5	4	250.00		18.75	*Globuligerina* aff. *bathoniana* (Pazdrowa)
23.5	74.0	4	275.00		18.75	*Globuligerina bathoniana gigantea* Wernli & Görög
23.5	67.5	4	250.00		12.50	*Globuligerina* aff. *bathoniana* (Pazdrowa)
23.5	66.0	6	325.00	25.00		*Conoglobigerina avariformis* Kasimova sphaerica
24.0	69.0	3	200.00	25.00		*Globuligerina oxfordiana* (Grigelis)
24.0	70.0	4	200.00	25.00		*Globuligerina oxfordiana* (Grigelis)
24.0	71.5	4	300.00		18.75	*Globuligerina bathoniana gigantea* Wernli & Görög
24.0	72.0	4	250.00	25.00		*Globuligerina oxfordiana* (Grigelis)
24.0	72.5	3	275.00	37.50		*Conoglobigerina avariformis* Kasimova sphaerica
24.0	72.5	4	250.00	37.50		*Globuligerina oxfordiana* (Grigelis)
24.0	73.0	3	225.00		18.75	*Conoglobigerina* aff. *dagestanica* Morozova
24.0	73.5	3	225.00	37.50		*Globuligerina oxfordiana* (Grigelis)
24.0	76.5	3	275.00	37.50		*Conoglobigerina avariformis* Kasimova sphaerica
24.0	77.0	3	275.00	37.50		*Conoglobigerina avariformis* Kasimova sphaerica
24.0	77.5	4	262.50		18.75	*Globuligerina bathoniana gigantea* Wernli & Görög
24.0	78.5	4	250.00	31.25		*Globuligerina oxfordiana* (Grigelis)
24.0	80.0	5	325.00	25.00		*Conoglobigerina avariformis* Kasimova sphaerica
24.0	80.0	4	275.00	31.25		*Conoglobigerina avariformis* Kasimova sphaerica
24.0	83.0	4	250.00	25.00		*Globuligerina oxfordiana* (Grigelis)
24.0	88.5	5	275.00	37.50		*Conoglobigerina avariformis* Kasimova sphaerica
24.0	89.0	4	262.50	25.00		*Conoglobigerina avariformis* Kasimova sphaerica
24.0	89.0	3	200.00	37.50		*Globuligerina oxfordiana* (Grigelis)
24.0	90.0	3	225.00		18.75	*Conoglobigerina* aff. *dagestanica* Morozova
24.0	95.0	4	325.00	25.00		*Conoglobigerina avariformis* Kasimova sphaerica
24.0	105.5	3	300.00	25.00		*Conoglobigerina avariformis* Kasimova sphaerica
24.0	107.5	4	225.00	25.00		*Globuligerina oxfordiana* (Grigelis)
24.0	111.0	3	275.00	25.00		*Conoglobigerina avariformis* Kasimova sphaerica
24.5	114.0	3	237.50	25.00		*Globuligerina oxfordiana* (Grigelis)

SOMHEGY - LAYER P (BAJOCIAN - PARKINSONI ZONE)

Thin Section Co-ordinates		No. of Chambers Visible	Max. Diameter (µm)	Wall Thickness (µm)		Species
Vert	Hor			Thick	Thin	
24.5	106.5	3	275.00	25.00		*Conoglobigerina avariformis* Kasimova sphaerica
24.5	106.5	3	300.00	31.25		*Conoglobigerina avariformis* Kasimova sphaerica
24.5	105.0	3	225.00		12.50	*Conoglobigerina* aff. *dagestanica* Morozova
24.5	103.5	3	250.00	25.00		*Globuligerina oxfordiana* (Grigelis)
24.5	103.5	6	262.50	37.50		*Conoglobigerina avariformis* Kasimova sphaerica
.24.5	103.5	3	250.00	25.00		*Globuligerina oxfordiana* (Grigelis)
24.5	103.5	4	200.00	25.00		*Globuligerina oxfordiana* (Grigelis)
24.5	103.5	3	250.00	25.00		*Globuligerina oxfordiana* (Grigelis)
24.5	100.0	4	300.00	37.50		*Conoglobigerina avariformis* Kasimova sphaerica
24.5	81.0	4	275.00	37.50		*Conoglobigerina avariformis* Kasimova sphaerica
24.5	77.5	4	275.00	37.50		*Conoglobigerina avariformis* Kasimova sphaerica
24.5	72.5	3	275.00	37.50		*Conoglobigerina avariformis* Kasimova sphaerica
24.5	72.5	4	237.50		12.50	*Globuligerina* aff. *bathoniana* (Pazdrowa)
24.5	71.5	3	275.00	1.50		*Conoglobigerina avariformis* Kasimova sphaerica
24.5	69.5	4	225.00		18.75	*Conoglobigerina* aff. *dagestanica* Morozova
24.5	68.5	4	225.00	25.00		*Globuligerina oxfordiana* (Grigelis)
24.5	67.5	5	200.00		18.75	*Conoglobigerina* aff. *dagestanica* Morozova
25.0	66.0	6	287.50	43.75		*Conoglobigerina avariformis* Kasimova sphaerica
25.0	70.0	4	275.00	43.75		*Conoglobigerina avariformis* Kasimova sphaerica
25.0	70.5	4	300.00	37.50		*Conoglobigerina avariformis* Kasimova sphaerica
25.0	75.0	5	312.50	37.50		*Conoglobigerina avariformis* Kasimova sphaerica
25.0	76.5	5	262.50	37.50		*Conoglobigerina avariformis* Kasimova sphaerica
25.0	94.5	4	200.00	25.00		*Globuligerina oxfordiana* (Grigelis)
25.0	94.5	4	225.00	25.00		*Globuligerina oxfordiana* (Grigelis)
25.0	95.5	3	200.00	25.00		*Globuligerina oxfordiana* (Grigelis)
25.0	97.5	6	300.00	25.00		*Conoglobigerina avariformis* Kasimova sphaerica
25.0	103.5	4	250.00	25.00		*Conoglobigerina avariformis* (Kasimova)(117)
25.0	103.5	5	262.50	25.00		*Conoglobigerina avariformis* Kasimova sphaerica
25.5	105.0	4	262.50	37.50		*Conoglobigerina avariformis* Kasimova sphaerica
25.5	102.5	3	275.00	25.00		*Conoglobigerina avariformis* Kasimova sphaerica
25.5	101.5	3	275.00	37.50		*Conoglobigerina avariformis* Kasimova sphaerica
25.5	101.0	4	250.00	25.00		*Globuligerina oxfordiana* (Grigelis)
25.5	97.0	3	237.50		18.75	*Globuligerina* aff. *bathoniana* (Pazdrowa)
25.5	92.0	5	250.00	25.00		*Globuligerina oxfordiana* (Grigelis)
25.5	91.5	3	300.00	25.00		*Conoglobigerina avariformis* Kasimova sphaerica
25.5	89.0	5	237.50		12.50	*Globuligerina* aff. *bathoniana* (Pazdrowa)
25.5	89.0	4	300.00	31.25		*Conoglobigerina avariformis* Kasimova sphaerica
25.5	89.0	4	300.00		18.75	*Globuligerina bathoniana gigantea* Wernli & Görög
25.5	76.0	4	250.00		12.50	*Globuligerina* aff. *bathoniana* (Pazdrowa)
25.5	70.5	4	200.00		18.75	*Conoglobigerina* aff. *dagestanica* Morozova
25.5	70.5	4	225.00	31.25		*Globuligerina oxfordiana* (Grigelis)
26.0	67.5	4	275.00	37.50		*Conoglobigerina avariformis* Kasimova sphaerica
26.0	67.5	5	237.50	31.25		*Globuligerina oxfordiana* (Grigelis)
26.0	67.5	4	287.50	37.50		*Conoglobigerina avariformis* Kasimova sphaerica
26.0	68.0	5	325.00		18.75	*Globuligerina bathoniana gigantea* Wernli & Görög
26.0	91.5	4	275.00	37.50		*Conoglobigerina avariformis* Kasimova sphaerica
26.0	92.0	5	275.00		18.75	*Globuligerina bathoniana gigantea* Wernli & Görög
26.0	96.5	5	350.00	25.00		*Conoglobigerina avariformis* Kasimova sphaerica
26.0	98.0	4	250.00	37.50		*Globuligerina oxfordiana* (Grigelis)
26.0	102.5	4	300.00	37.50		*Conoglobigerina avariformis* Kasimova sphaerica
26.0	103.5	4	275.00		18.75	*Globuligerina bathoniana gigantea* Wernli & Görög
26.0	104.0	3	287.50	37.50		*Conoglobigerina avariformis* Kasimova sphaerica
26.0	111.0	4	275.00	37.50		*Conoglobigerina avariformis* Kasimova sphaerica
26.5	106.5	4	300.00	37.50		*Conoglobigerina avariformis* Kasimova sphaerica
26.5	106.5	3	225.00	25.00		*Globuligerina oxfordiana* (Grigelis)

SOMHEGY - LAYER P (BAJOCIAN - PARKINSONI ZONE)

Thin Section Co-ordinates		No. of Chambers Visible	Max. Diameter (µm)	Wall Thickness (µm)		Species
Vert	Hor			Thick	Thin	
26.5	101.0	5	275.00	25.00		*Conoglobigerina avariformis* Kasimova sphaerica
26.5	100.0	3	225.00		12.50	*Conoglobigerina* aff. *dagestanica* Morozova
26.5	98.5	4	250.00	25.00		*Globuligerina oxfordiana* (Grigelis)
26.5	98.0	4	275.00	31.25		*Conoglobigerina avariformis* Kasimova sphaerica
26.5	97.0	4	250.00		12.50	*Globuligerina* aff. *bathoniana* (Pazdrowa)
26.5	95.0	4	300.00	31.25		*Conoglobigerina avariformis* Kasimova sphaerica
26.5	94.5	4	275.00	31.25		*Conoglobigerina avariformis* Kasimova sphaerica
26.5	93.5	4	275.00	25.00		*Conoglobigerina avariformis* Kasimova sphaerica
26.5	92.0	4	300.00	37.50		*Conoglobigerina avariformis* Kasimova sphaerica
26.5	92.0	5	325.00	37.50		*Conoglobigerina avariformis* Kasimova sphaerica
26.5	91.5	3	275.00	25.00		*Conoglobigerina avariformis* Kasimova sphaerica
26.5	88.0	4	225.00	37.50		*Globuligerina oxfordiana* (Grigelis)
26.5	84.0	4	225.00		18.75	*Conoglobigerina* aff. *dagestanica* Morozova
26.5	77.5	4	337.50	37.50		*Conoglobigerina avariformis* Kasimova sphaerica
26.5	76.5	4	300.00	25.00		*Conoglobigerina avariformis* Kasimova sphaerica
26.5	71.5	4	275.00	37.50		*Conoglobigerina avariformis* Kasimova sphaerica
26.5	67.5	4	325.00	31.25		*Conoglobigerina avariformis* Kasimova sphaerica
26.5	66.5	4	300.00	31.25		*Conoglobigerina avariformis* Kasimova sphaerica
26.5	65.0	5	325.00		18.75	*Globuligerina bathoniana gigantea* Wernli & Görög
27.0	63.5	6	325.00	37.50		*Conoglobigerina avariformis* Kasimova sphaerica
27.0	65.0	3	225.00	25.00		*Globuligerina oxfordiana* (Grigelis)
27.0	66.5	3	237.50	37.50		*Globuligerina oxfordiana* (Grigelis)
27.0	67.0	4	300.00	37.50		*Conoglobigerina avariformis* Kasimova sphaerica
27.0	69.5	4	275.00	25.00		*Conoglobigerina avariformis* Kasimova sphaerica
27.0	73.0	3	250.00	37.50		*Globuligerina oxfordiana* (Grigelis)
27.0	73.5	4	225.00		12.50	*Conoglobigerina* aff. *dagestanica* Morozova
27.0	73.5	3	225.00	25.00		*Globuligerina oxfordiana* (Grigelis)
27.0	76.0	4	300.00	25.00		*Conoglobigerina avariformis* Kasimova sphaerica
27.0	83.5	4	275.00	37.50		*Conoglobigerina avariformis* Kasimova sphaerica
27.0	83.5	3	250.00	31.25		*Conoglobigerina avariformis* Kasimova sphaerica
27.0	84.5	4	350.00		18.75	*Globuligerina bathoniana gigantea* Wernli & Görög
27.0	93.5	4	350.00	25.00		*Conoglobigerina avariformis* Kasimova sphaerica
27.0	96.0	3	300.00	43.75		*Conoglobigerina avariformis* Kasimova sphaerica
27.0	104.5	4	275.00	31.25		*Conoglobigerina avariformis* Kasimova sphaerica
27.0	106.5	4	300.00	31.25		*Conoglobigerina avariformis* Kasimova sphaerica
27.0	107.0	4	300.00	25.00		*Conoglobigerina avariformis* Kasimova sphaerica
27.0	107.5	5	200.00	31.25		*Conoglobigerina avariformis* Kasimova sphaerica
27.0	108.5	3	275.00	31.25		*Conoglobigerina avariformis* Kasimova sphaerica
27.5	114.0	4	300.00		18.75	*Globuligerina bathoniana gigantea* Wernli & Görög
27.5	111.0	3	300.00	37.50		*Conoglobigerina avariformis* Kasimova sphaerica
27.5	110.0	4	275.00	37.50		*Conoglobigerina avariformis* Kasimova sphaerica
27.5	109.0	4	275.00	25.00		*Conoglobigerina avariformis* Kasimova sphaerica
27.5	108.5	4	287.50	31.25		*Conoglobigerina avariformis* Kasimova sphaerica
27.5	107.5	4	250.00	37.50		*Conoglobigerina avariformis* (Kasimova)(IIII)
27.5	107.5	4	350.00		12.50	*Globuligerina bathoniana gigantea* Wernli & Görög
27.5	107.5	4	312.50	31.25		*Conoglobigerina avariformis* Kasimova sphaerica
27.5	107.0	4	250.00	31.25		*Globuligerina oxfordiana* (Grigelis)
27.5	107.0	5	200.00	31.25		*Globuligerina oxfordiana* (Grigelis)
27.5	106.0	4	200.00		18.75	*Conoglobigerina* aff. *dagestanica* Morozova
27.5	99.0	3	237.50	31.25		*Globuligerina oxfordiana* (Grigelis)
27.5	99.0	5	275.00	25.00		*Conoglobigerina avariformis* Kasimova sphaerica
27.5	97.5	3	275.00	31.25		*Conoglobigerina avariformis* Kasimova sphaerica
27.5	78.0	3	275.00		18.75	*Globuligerina bathoniana gigantea* Wernli & Görög
27.5	76.0	5	275.00	37.50		*Conoglobigerina avariformis* Kasimova sphaerica
27.5	71.5	4	262.50	37.50		*Conoglobigerina avariformis* Kasimova sphaerica

SOMHEGY - LAYER P (BAJOCIAN - PARKINSONI ZONE)

Thin Section Co-ordinates		No. of Chambers Visible	Max. Diameter (µm)	Wall Thickness (µm)		Species
Vert	Hor			Thick	Thin	
27.5	71.5	4	275.00	37.50		*Conoglobigerina avariformis* Kasimova sphaerica
27.5	71.0	4	250.00	25.00		*Globuligerina oxfordiana* (Grigelis)
27.5	71.0	4	275.00	25.00		*Conoglobigerina avariformis* Kasimova sphaerica
27.5	70.5	4	250.00		18.75	*Globuligerina* aff. *bathoniana* (Pazdrowa)
27.5	66.0	4	337.50	31.25		*Conoglobigerina avariformis* Kasimova sphaerica
27.5	65.5	4	237.50	31.25		*Globuligerina oxfordiana* (Grigelis)
27.5	64.5	4	300.00	31.25		*Conoglobigerina avariformis* Kasimova sphaerica
27.5	64.5	4	300.00	37.50		*Conoglobigerina avariformis* Kasimova sphaerica
27.5	64.0	3	212.50	37.50		*Globuligerina oxfordiana* (Grigelis)
28.0	67.0	5	275.00	31.25		*Conoglobigerina avariformis* Kasimova sphaerica
28.0	67.5	6	275.00		12.50	*Globuligerina bathoniana gigantea* Wernli & Görög
28.0	68.0	5	287.50	25.00		*Conoglobigerina avariformis* Kasimova sphaerica
28.0	68.5	4	275.00	37.50		*Conoglobigerina avariformis* Kasimova sphaerica
28.0	69.5	4	275.00	25.00		*Conoglobigerina avariformis* Kasimova sphaerica
28.0	75.0	3	200.00	25.00		*Globuligerina oxfordiana* (Grigelis)
28.0	76.0	5	262.50	37.50		*Conoglobigerina avariformis* Kasimova sphaerica
28.0	76.5	5	287.50		18.75	*Globuligerina bathoniana gigantea* Wernli & Görög
28.0	104.5	4	300.00	37.50		*Conoglobigerina avariformis* Kasimova sphaerica
28.0	109.5	4	225.00		12.50	*Conoglobigerina* aff. *dagestanica* Morozova
28.0	110.5	3	200.00		18.75	*Conoglobigerina* aff. *dagestanica* Morozova
28.0	112.0	3	300.00	31.25		*Conoglobigerina avariformis* Kasimova sphaerica
28.0	114.0	3	250.00	25.00		*Globuligerina oxfordiana* (Grigelis)
28.5	114.0	4	200.00		18.75	*Conoglobigerina* aff. *dagestanica* Morozova
28.5	113.5	4	337.50	31.25		*Conoglobigerina avariformis* Kasimova sphaerica
28.5	113.5	5	212.50		18.75	*Conoglobigerina* aff. *dagestanica* Morozova
28.5	110.5	4	275.00	25.00		*Conoglobigerina avariformis* Kasimova sphaerica
28.5	110.0	4	287.50	37.50		*Conoglobigerina avariformis* Kasimova sphaerica
28.5	109.5	4	300.00	25.00		*Conoglobigerina avariformis* Kasimova sphaerica
28.5	109.0	5	250.00	37.50		*Globuligerina oxfordiana* (Grigelis)
28.5	107.5	4	262.50	25.00		*Conoglobigerina avariformis* Kasimova sphaerica
28.5	106.0	3	225.00	25.00		*Globuligerina oxfordiana* (Grigelis)
28.5	102.5	4	300.00	37.50		*Conoglobigerina avariformis* Kasimova sphaerica
28.5	102.5	4	287.50	31.25		*Conoglobigerina avariformis* Kasimova sphaerica
28.5	99.0	4	300.00	25.00		*Conoglobigerina avariformis* Kasimova sphaerica
28.5	99.0	4	275.00	37.50		*Conoglobigerina avariformis* Kasimova sphaerica
28.5	98.5	3	250.00	31.25		*Globuligerina oxfordiana* (Grigelis)
28.5	95.0	3	300.00	25.00		*Conoglobigerina avariformis* Kasimova sphaerica
28.5	92.0	5	300.00	37.50		*Conoglobigerina avariformis* Kasimova sphaerica
28.5	87.5	4	312.50	37.50		*Conoglobigerina avariformis* Kasimova sphaerica
28.5	75.5	4	275.00	37.50		*Conoglobigerina avariformis* Kasimova sphaerica
28.5	72.0	3	312.50	37.50		*Conoglobigerina avariformis* Kasimova sphaerica
28.5	68.5	5	312.50	37.50		*Conoglobigerina avariformis* Kasimova sphaerica
28.5	68.5	6	325.00	31.25		*Conoglobigerina avariformis* Kasimova sphaerica
28.5	65.5	4	350.00	25.00		*Conoglobigerina avariformis* Kasimova sphaerica
28.5	64.5	5	300.00	31.25		*Conoglobigerina avariformis* Kasimova sphaerica
28.5	64.5	3	250.00	37.50		*Globuligerina oxfordiana* (Grigelis)
28.5	63.5	4	250.00	37.50		*Globuligerina oxfordiana* (Grigelis)
29.0	66.0	3	237.50	37.50		*Globuligerina oxfordiana* (Grigelis)
29.0	78.0	3	312.50	31.25		*Conoglobigerina avariformis* Kasimova sphaerica
29.0	78.0	3	300.00	25.00		*Conoglobigerina avariformis* Kasimova sphaerica
29.0	84.0	3	262.50		12.50	*Globuligerina bathoniana gigantea* Wernli & Görög
29.0	92.0	3	275.00	25.00		*Conoglobigerina avariformis* Kasimova sphaerica
29.0	103.0	3	250.00	25.00		*Globuligerina oxfordiana* (Grigelis)
29.0	107.5	3	250.00	37.50		*Globuligerina oxfordiana* (Grigelis)
29.5	112.5	6	325.00	31.25		*Conoglobigerina avariformis* Kasimova sphaerica

SOMHEGY - LAYER P (BAJOCIAN - PARKINSONI ZONE)

Thin Section Co-ordinates		No. of Chambers Visible	Max. Diameter (µm)	Wall Thickness (µm)		Species
Vert	Hor			Thick	Thin	
29.5	110.5	3	262.50		18.75	*Globuligerina bathoniana gigantea* Wernli & Görög
29.5	110.0	4	275.00	25.00		*Conoglobigerina avariformis* Kasimova sphaerica
29.5	107.5	4	350.00	31.25		*Conoglobigerina avariformis* Kasimova sphaerica
29.5	96.0	5	300.00	37.50		*Conoglobigerina avariformis* Kasimova sphaerica
29.5	84.0	3	275.00		12.50	*Globuligerina bathoniana gigantea* Wernli & Görög
29.5	77.0	4	300.00	37.50		*Conoglobigerina avariformis* Kasimova sphaerica
29.5	76.5	4	287.50	31.25		*Conoglobigerina avariformis* Kasimova sphaerica
29.5	74.0	5	287.50	50.00		*Conoglobigerina avariformis* Kasimova sphaerica
29.5	69.5	5	300.00	31.25		*Conoglobigerina avariformis* Kasimova sphaerica
29.5	66.5	3	175.00		18.75	*Globuligerina oxfordiana* (Grigelis)
30.0	66.0	3	200.00		12.50	*Conoglobigerina* aff. *dagestanica* Morozova
30.0	66.0	4	200.00		18.75	*Conoglobigerina* aff. *dagestanica* Morozova
30.0	67.0	4	150.00		6.25	*Globuligerina oxfordiana* (Grigelis)
30.0	73.0	3	225.00	31.25		*Globuligerina oxfordiana* (Grigelis)
30.0	96.0	4	262.50	25.00		*Conoglobigerina avariformis* Kasimova sphaerica
30.0	108.0	4	337.50	37.50		*Conoglobigerina avariformis* Kasimova sphaerica
30.0	108.5	4	325.00	25.00		*Conoglobigerina avariformis* Kasimova sphaerica
30.0	109.5	4	300.00	31.25		*Conoglobigerina avariformis* Kasimova sphaerica
30.0	112.5	3	337.50		18.75	*Globuligerina bathoniana gigantea* Wernli & Görög
30.0	113.0	3	275.00		18.75	*Globuligerina bathoniana gigantea* Wernli & Görög
30.5	112.0	5	275.00	31.25		*Conoglobigerina avariformis* Kasimova sphaerica
30.5	110.0	5	275.00	31.25		*Conoglobigerina avariformis* Kasimova sphaerica
30.5	109.0	4	300.00	25.00		*Conoglobigerina avariformis* Kasimova sphaerica
30.5	108.0	5	325.00	37.50		*Conoglobigerina avariformis* Kasimova sphaerica
30.5	102.0	4	325.00	25.00		*Conoglobigerina avariformis* Kasimova sphaerica
30.5	93.0	4	250.00	31.25		*Globuligerina oxfordiana* (Grigelis)
30.5	90.0	4	300.00	31.25		*Conoglobigerina avariformis* Kasimova sphaerica
30.5	87.0	5	300.00		18.75	*Globuligerina bathoniana gigantea* Wernli & Görög
30.5	85.5	3	275.00	31.25		*Conoglobigerina avariformis* Kasimova sphaerica
30.5	74.5	3	300.00	31.25		*Conoglobigerina avariformis* Kasimova sphaerica
30.5	74.0	5	300.00	25.00		*Conoglobigerina avariformis* Kasimova sphaerica
30.5	68.0	4	275.00	31.25		*Conoglobigerina avariformis* Kasimova sphaerica
30.5	67.0	5	325.00	25.00		*Conoglobigerina avariformis* Kasimova sphaerica
31.0	64.0	5	300.00		18.75	*Globuligerina bathoniana gigantea* Wernli & Görög
31.0	102.5	4	300.00		18.75	*Globuligerina bathoniana gigantea* Wernli & Görög
31.5	106.0	3	275.00	25.00		*Conoglobigerina avariformis* Kasimova sphaerica
31.5	93.5	5	275.00		18.75	*Globuligerina bathoniana gigantea* Wernli & Görög
31.5	71.5	4	325.00	37.50		*Conoglobigerina avariformis* Kasimova sphaerica
31.5	70.5	4	275.00	37.50		*Conoglobigerina avariformis* Kasimova sphaerica
32.0	82.5	3	287.50	31.25		*Conoglobigerina avariformis* Kasimova sphaerica
32.0	88.5	3	225.00		12.50	*Conoglobigerina* aff. *dagestanica* Morozova
32.0	96.5	5	325.00	25.00		*Conoglobigerina avariformis* Kasimova sphaerica
32.0	101.5	5	300.00		18.75	*Globuligerina bathoniana gigantea* Wernli & Görög
32.0	103.0	4	225.00	37.50		*Globuligerina oxfordiana* (Grigelis)
32.0	110.5	4	325.00		12.50	*Globuligerina bathoniana gigantea* Wernli & Görög
32.5	113.5	4	225.00		0.50	*Conoglobigerina* aff. *dagestanica* Morozova
32.5	113.0	3	250.00	25.00		*Globuligerina oxfordiana* (Grigelis)
32.5	113.0	4	275.00	31.25		*Conoglobigerina avariformis* Kasimova sphaerica
32.5	110.5	4	262.50	25.00		*Conoglobigerina avariformis* Kasimova sphaerica
32.5	94.5	3	275.00	31.25		*Conoglobigerina avariformis* Kasimova sphaerica
32.5	94.0	4	262.50	31.25		*Conoglobigerina avariformis* Kasimova sphaerica
32.5	82.5	3	287.50	31.25		*Conoglobigerina avariformis* Kasimova sphaerica
32.5	70.5	4	287.50	31.25		*Conoglobigerina avariformis* Kasimova sphaerica
33.0	75.0	4	287.50	25.00		*Conoglobigerina avariformis* Kasimova sphaerica
33.0	78.5	6	300.00	31.25		*Conoglobigerina avariformis* Kasimova sphaerica

SOMHEGY - LAYER P (BAJOCIAN - PARKINSONI ZONE)

Thin Section Co-ordinates		No. of Chambers Visible	Max. Diameter (µm)	Wall Thickness (µm)		Species
Vert	Hor			Thick	Thin	
33.5	94.0	4	237.50	37.50		*Globuligerina oxfordiana* (Grigelis)
33.5	92.0	4	225.00	37.50		*Globuligerina oxfordiana* (Grigelis)
33.5	91.0	5	275.00		12.50	*Globuligerina bathoniana gigantea* Wernli & Görög
33.5	87.5	3	275.00	37.50		*Conoglobigerina avariformis* Kasimova sphaerica
33.5	87.0	4	225.00		18.75	*Conoglobigerina* aff. *dagestanica* Morozova
33.5	82.0	4	300.00	25.00		*Conoglobigerina avariformis* Kasimova sphaerica
33.5	79.0	4	275.00	31.25		*Conoglobigerina avariformis* Kasimova sphaerica
33.5	78.5	5	250.00	31.25		*Globuligerina oxfordiana* (Grigelis)
33.5	78.5	4	200.00	31.25		*Globuligerina oxfordiana* (Grigelis)
34.0	74.0	5	300.00	25.00		*Conoglobigerina avariformis* Kasimova sphaerica
34.0	77.5	5	287.50	37.50		*Conoglobigerina avariformis* Kasimova sphaerica
34.0	81.0	3	325.00	25.00		*Conoglobigerina avariformis* Kasimova sphaerica
34.0	82.5	4	325.00		18.75	*Globuligerina bathoniana gigantea* Wernli & Görög
34.0	86.0	5	275.00	37.50		*Conoglobigerina avariformis* Kasimova sphaerica
34.0	88.0	4	262.50	25.00		*Conoglobigerina avariformis* Kasimova sphaerica
34.0	88.5	3	275.00		18.75	*Globuligerina bathoniana gigantea* Wernli & Görög
34.0	88.5	4	300.00		18.75	*Globuligerina bathoniana gigantea* Wernli & Görög
34.0	97.0	4	325.00	25.00		*Conoglobigerina avariformis* Kasimova sphaerica
34.0	109.5	5	275.00	25.00		*Conoglobigerina avariformis* Kasimova sphaerica
34.0	109.5	3	275.00	37.50		*Conoglobigerina avariformis* Kasimova sphaerica
34.5	109.5	5	250.00	31.25		*Globuligerina oxfordiana* (Grigelis)
34.5	105.0	4	250.00	25.00		*Globuligerina oxfordiana* (Grigelis)
34.5	104.0	5	275.00	50.00		*Conoglobigerina avariformis* Kasimova sphaerica
34.5	96.0	3	300.00	50.00		*Conoglobigerina avariformis* Kasimova sphaerica
34.5	93.5	4	225.00		18.75	*Conoglobigerina* aff. *dagestanica* Morozova
34.5	93.5	4	250.00	25.00		*Globuligerina oxfordiana* (Grigelis)
34.5	90.5	4	237.50	25.00		*Globuligerina oxfordiana* (Grigelis)
34.5	89.0	4	237.50	25.00		*Globuligerina oxfordiana* (Grigelis)
34.5	88.5	4	175.00	25.00		*Globuligerina oxfordiana* (Grigelis)
34.5	88.0	6	275.00	25.00		*Conoglobigerina avariformis* Kasimova sphaerica
34.5	86.5	4	225.00	37.50		*Globuligerina oxfordiana* (Grigelis)
34.5	86.0	4	225.00	37.50		*Globuligerina oxfordiana* (Grigelis)
34.5	83.5	3	225.00	25.00		*Globuligerina oxfordiana* (Grigelis)
34.5	76.5	3	225.00		18.75	*Conoglobigerina* aff. *dagestanica* Morozova
34.5	75.0	4	300.00		18.75	*Globuligerina bathoniana gigantea* Wernli & Görög
34.5	74.0	3	200.00		12.50	*Conoglobigerina* aff. *dagestanica* Morozova
34.5	70.0	5	300.00	25.00		*Conoglobigerina avariformis* Kasimova sphaerica
34.5	70.0	5	325.00	25.00		*Conoglobigerina avariformis* Kasimova sphaerica
35.0	69.0	4	262.50		18.75	*Globuligerina bathoniana gigantea* Wernli & Görög
35.0	82.0	6	325.00	31.25		*Conoglobigerina avariformis* Kasimova sphaerica
35.0	86.0	3	162.50	25.00		*Globuligerina oxfordiana* (Grigelis)
35.0	91.0	3	275.00	37.50		*Conoglobigerina avariformis* Kasimova sphaerica
35.0	94.5	5	262.50	25.00		*Conoglobigerina avariformis* Kasimova sphaerica
35.0	95.0	3	275.00	25.00		*Conoglobigerina avariformis* Kasimova sphaerica
35.0	99.5	4	275.00	31.25		*Conoglobigerina avariformis* Kasimova sphaerica
35.5	112.5	5	300.00	31.25		*Conoglobigerina avariformis* Kasimova sphaerica
35.5	112.0	3	275.00	25.00		*Conoglobigerina avariformis* Kasimova sphaerica
35.5	111.5	3	237.50	25.00		*Globuligerina oxfordiana* (Grigelis)
35.5	111.0	5	275.00	37.50		*Conoglobigerina avariformis* Kasimova sphaerica
35.5	110.0	4	225.00	31.25		*Globuligerina oxfordiana* (Grigelis)
35.5	109.5	4	262.50		12.50	*Globuligerina bathoniana gigantea* Wernli & Görög
35.5	109.0	5	337.50	31.25		*Conoglobigerina avariformis* Kasimova sphaerica
35.5	108.5	4	212.50	31.25		*Globuligerina oxfordiana* (Grigelis)
35.5	108.5	4	250.00	31.25		*Globuligerina oxfordiana* (Grigelis)
35.5	108.0	4	337.50	31.25		*Conoglobigerina avariformis* Kasimova sphaerica

SOMHEGY - LAYER P (BAJOCIAN - PARKINSONI ZONE)

Thin Section Co-ordinates		No. of Chambers Visible	Max. Diameter (µm)	Wall Thickness (µm)		Species
Vert	Hor			Thick	Thin	
35.5	105.0	4	162.50		18.75	*Globuligerina oxfordiana* (Grigelis)
35.5	104.5	4	300.00	25.00		*Conoglobigerina avariformis* Kasimova sphaerica
35.5	102.0	4	250.00	31.25		*Globuligerina oxfordiana* (Grigelis)
35.5	101.0	5	250.00	31.25		*Globuligerina oxfordiana* (Grigelis)
35.5	101.0	5	200.00		18.75	*Conoglobigerina* aff. *dagestanica* Morozova
35.5	100.0	4	300.00		18.75	*Globuligerina bathoniana gigantea* Wernli & Görög
35.5	98.5	4	250.00	1.25		*Globuligerina oxfordiana* (Grigelis)
35.5	98.5	4	212.50		12.50	*Conoglobigerina* aff. *dagestanica* Morozova
35.5	98.0	5	275.00	31.25		*Conoglobigerina avariformis* Kasimova sphaerica
35.5	96.5	4	250.00	31.25		*Globuligerina oxfordiana* (Grigelis)
35.5	96.5	5	275.00		12.50	*Globuligerina bathoniana gigantea* Wernli & Görög
35.5	95.5	4	187.50		12.50	*Globuligerina oxfordiana* (Grigelis)
35.5	95.0	7	275.00	31.25		*Conoglobigerina avariformis* Kasimova sphaerica
35.5	90.5	4	250.00		18.75	*Globuligerina* aff. *bathoniana* (Pazdrowa)
35.5	70.0	3	225.00		18.75	*Conoglobigerina* aff. *dagestanica* Morozova
35.5	69.5	3	225.00	25.00		*Globuligerina oxfordiana* (Grigelis)
35.5	68.5	4	212.50		18.75	*Conoglobigerina* aff. *dagestanica* Morozova
36.0	68.0	4	275.00	37.50		*Conoglobigerina avariformis* Kasimova sphaerica
36.0	74.0	4	262.50	37.50		*Conoglobigerina avariformis* Kasimova sphaerica
36.0	76.0	4	250.00		12.50	*Globuligerina* aff. *bathoniana* (Pazdrowa)
36.0	95.0	5	300.00	25.00		*Conoglobigerina avariformis* Kasimova sphaerica
36.0	95.5	3	200.00		12.50	*Conoglobigerina* aff. *dagestanica* Morozova
36.0	97.0	5	225.00		12.50	*Conoglobigerina* aff. *dagestanica* Morozova
36.0	99.5	3	212.50		12.50	*Conoglobigerina* aff. *dagestanica* Morozova
36.0	100.0	4	300.00		12.50	*Globuligerina bathoniana gigantea* Wernli & Görög
36.0	107.0	3	275.00		18.75	*Globuligerina bathoniana gigantea* Wernli & Görög
36.0	110.5	6	300.00		12.50	*Globuligerina bathoniana gigantea* Wernli & Görög
36.0	92.0	3	212.50		18.75	*Conoglobigerina* aff. *dagestanica* Morozova
36.0	93.5	3	275.00	37.50		*Conoglobigerina avariformis* Kasimova sphaerica
36.5	111.5	3	275.00		12.50	*Globuligerina bathoniana gigantea* Wernli & Görög
36.5	111.5	4	312.50	25.00		*Conoglobigerina avariformis* Kasimova sphaerica
36.5	108.5	5	237.50	37.50		*Globuligerina oxfordiana* (Grigelis)
36.5	107.5	4	300.00	37.50		*Conoglobigerina avariformis* Kasimova sphaerica
36.5	107.5	6	375.00	37.50		*Conoglobigerina avariformis* Kasimova sphaerica
36.5	96.0	4	250.00	37.50		*Globuligerina oxfordiana* (Grigelis)
36.5	95.5	3	200.00	25.00		*Globuligerina oxfordiana* (Grigelis)
36.5	95.0	3	300.00		18.75	*Globuligerina bathoniana gigantea* Wernli & Görög
36.5	95.0	3	300.00		18.75	*Globuligerina bathoniana gigantea* Wernli & Görög
36.5	94.5	5	300.00	37.50		*Conoglobigerina avariformis* Kasimova sphaerica
36.5	94.5	5	300.00	31.25		*Conoglobigerina avariformis* Kasimova sphaerica
36.5	94.0	3	250.00	31.25		*Globuligerina oxfordiana* (Grigelis)
36.5	80.5	3	300.00	43.75		*Conoglobigerina avariformis* Kasimova sphaerica
36.5	80.0	4	162.50		18.75	*Globuligerina oxfordiana* (Grigelis)
36.5	74.5	3	212.50		12.50	*Conoglobigerina* aff. *dagestanica* Morozova
36.5	71.5	4	312.50	25.00		*Conoglobigerina avariformis* Kasimova sphaerica
37.0	68.5	4	262.50	25.00		*Conoglobigerina avariformis* Kasimova sphaerica
37.0	69.5	4	325.00		18.75	*Globuligerina bathoniana gigantea* Wernli & Görög
37.0	70.0	3	287.50		18.75	*Globuligerina bathoniana gigantea* Wernli & Görög
37.0	72.0	3	275.00	37.50		*Conoglobigerina avariformis* Kasimova sphaerica
37.0	85.0	4	275.00	37.50		*Conoglobigerina avariformis* Kasimova sphaerica
37.0	91.0	4	312.50	43.75		*Conoglobigerina avariformis* Kasimova sphaerica
37.0	95.0	4	275.00		12.50	*Globuligerina bathoniana gigantea* Wernli & Görög
37.0	98.0	3	200.00		18.75	*Conoglobigerina* aff. *dagestanica* Morozova
37.0	99.0	5	200.00		18.75	*Conoglobigerina* aff. *dagestanica* Morozova
37.0	108.0	3	225.00		12.50	*Conoglobigerina* aff. *dagestanica* Morozova

SOMHEGY - LAYER P (BAJOCIAN - PARKINSONI ZONE)

Thin Section Co-ordinates		No. of Chambers Visible	Max. Diameter (µm)	Wall Thickness (µm)		Species
Vert	Hor			Thick	Thin	
37.0	109.5	4	350.00	25.00		*Conoglobigerina avariformis* Kasimova sphaerica
37.5	109.0	3	225.00	25.00		*Globuligerina oxfordiana* (Grigelis)
37.5	107.5	3	275.00	25.00		*Conoglobigerina avariformis* Kasimova sphaerica
37.5	106.0	3	275.00	25.00		*Conoglobigerina avariformis* Kasimova sphaerica
37.5	100.0	4	250.00	31.25		*Globuligerina oxfordiana* (Grigelis)
37.5	84.5	4	300.00	25.00		*Conoglobigerina avariformis* Kasimova sphaerica
37.5	70.0	4	300.00		18.75	*Globuligerina bathoniana gigantea* Wernli & Görög
37.5	70.0	4	312.50	37.50		*Conoglobigerina avariformis* Kasimova sphaerica
37.5	69.5	3	225.00		12.50	*Conoglobigerina* aff. *dagestanica* Morozova
37.5	68.5	4	275.00	25.00		*Conoglobigerina avariformis* Kasimova sphaerica
37.5	67.5	4	225.00	37.50		*Globuligerina oxfordiana* (Grigelis)
38.0	67.5	4	275.00	37.50		*Conoglobigerina avariformis* Kasimova sphaerica
38.0	67.5	4	225.00	25.00		*Globuligerina oxfordiana* (Grigelis)
38.5	91.0	3	300.00	37.50		*Conoglobigerina avariformis* Kasimova sphaerica
38.5	91.0	4	262.50	37.50		*Conoglobigerina avariformis* Kasimova sphaerica
38.5	90.5	4	287.50	25.00		*Conoglobigerina avariformis* Kasimova sphaerica
38.5	81.0	4	325.00	37.50		*Conoglobigerina avariformis* Kasimova sphaerica
38.5	81.0	3	187.50	25.00		*Globuligerina oxfordiana* (Grigelis)
38.5	70.5	4	275.00		18.75	*Globuligerina bathoniana gigantea* Wernli & Görög
38.5	68.0	4	300.00	25.00		*Conoglobigerina avariformis* Kasimova sphaerica
39.0	72.5	3	212.50	37.50		*Globuligerina oxfordiana* (Grigelis)
39.0	73.5	3	250.00	25.00		*Globuligerina oxfordiana* (Grigelis)
39.0	91.0	3	300.00	25.00		*Conoglobigerina avariformis* Kasimova sphaerica
39.5	104.0	4	225.00	31.25		*Globuligerina oxfordiana* (Grigelis)
39.5	80.0	3	250.00	25.00		*Globuligerina oxfordiana* (Grigelis)
39.5	78.0	3	275.00	31.25		*Conoglobigerina avariformis* Kasimova sphaerica
40.0	72.5	3	262.50	37.50		*Conoglobigerina avariformis* Kasimova sphaerica
40.0	81.0	4	325.00	50.00		*Conoglobigerina avariformis* Kasimova sphaerica
40.0	84.0	3	300.00	37.50		*Conoglobigerina avariformis* Kasimova sphaerica
40.0	85.0	3	262.50	25.00		*Conoglobigerina avariformis* Kasimova sphaerica
40.0	99.0	5	312.50	37.50		*Conoglobigerina avariformis* Kasimova sphaerica
40.5	70.0	4	212.50		18.75	*Conoglobigerina* aff. *dagestanica* Morozova
40.5	69.0	6	375.00		18.75	*Globuligerina bathoniana gigantea* Wernli & Görög
41.0	65.0	4	325.00		18.75	*Globuligerina bathoniana gigantea* Wernli & Görög
41.0	86.0	3	250.00	25.00		*Globuligerina oxfordiana* (Grigelis)
41.0	96.5	4	225.00		18.75	*Conoglobigerina* aff. *dagestanica* Morozova
41.0	111.0	7	300.00	25.00		*Conoglobigerina avariformis* Kasimova sphaerica
41.5	112.5	4	312.50		18.75	*Globuligerina bathoniana gigantea* Wernli & Görög
41.5	111.5	5	275.00	25.00		*Conoglobigerina avariformis* Kasimova sphaerica
41.5	110.0	4	300.00			*Conoglobigerina avariformis* Kasimova sphaerica
41.5	105.0	5	300.00			*Conoglobigerina avariformis* Kasimova sphaerica
41.5	101.0	4	325.00		18.75	*Globuligerina bathoniana gigantea* Wernli & Görög
41.5	97.0	4	275.00		18.75	*Globuligerina bathoniana gigantea* Wernli & Görög
41.5	93.0	4	287.50		18.75	*Globuligerina bathoniana gigantea* Wernli & Görög
41.5	87.5	4	287.50			*Globuligerina bathoniana gigantea* Wernli & Görög
41.5	74.5	4	275.00			*Globuligerina bathoniana gigantea* Wernli & Görög
41.5	74.0	4	300.00	37.50		*Conoglobigerina avariformis* Kasimova sphaerica
41.5	65.0	4	225.00		18.75	*Conoglobigerina* aff. *dagestanica* Morozova
42.0	72.0	3	250.00	37.50		*Globuligerina oxfordiana* (Grigelis)
42.0	111.0	4	300.00	37.50		*Conoglobigerina avariformis* Kasimova sphaerica
42.5	113.0	4	287.50	37.50		*Conoglobigerina avariformis* Kasimova sphaerica
42.5	109.5	4	275.00	37.50		*Conoglobigerina avariformis* Kasimova sphaerica
42.5	100.0	4	175.00		12.50	*Globuligerina oxfordiana* (Grigelis)
42.5	97.0	3	300.00	25.00		*Conoglobigerina avariformis* Kasimova sphaerica
42.5	71.0	3	225.00	25.00		*Globuligerina oxfordiana* (Grigelis)

SOMHEGY - LAYER P (BAJOCIAN - PARKINSONI ZONE)

Thin Section Co-ordinates		No. of Chambers Visible	Max. Diameter (μm)	Wall Thickness (μm)		Species
Vert	Hor			Thick	Thin	
43.0	89.5	3	237.50		18.75	*Globuligerina* aff. *bathoniana* (Pazdrowa)
43.5	112.5	5	275.00			*Conoglobigerina avariformis* Kasimova sphaerica
43.5	107.5	3	275.00	25.00		*Conoglobigerina avariformis* Kasimova sphaerica
43.5	99.5	4	250.00	31.25		*Globuligerina oxfordiana* (Grigelis)
43.5	97.0	3	275.00			*Globuligerina bathoniana gigantea* Wernli & Görög
43.5	97.0	3	300.00	31.25		*Conoglobigerina avariformis* Kasimova sphaerica
43.5	95.0	4	250.00	31.25		*Globuligerina oxfordiana* (Grigelis)
43.5	95.0	3	250.00	31.25		*Globuligerina oxfordiana* (Grigelis)
43.5	94.0	3	250.00	31.25		*Globuligerina oxfordiana* (Grigelis)
43.5	85.0	3	250.00			*Globuligerina oxfordiana* (Grigelis)
43.5	85.0	4	287.50	37.50		*Conoglobigerina avariformis* Kasimova sphaerica
43.5	82.0	4	300.00	37.50		*Conoglobigerina avariformis* Kasimova sphaerica
43.5	82.0	4	237.50	25.00		*Globuligerina oxfordiana* (Grigelis)
43.5	78.5	4	325.00			*Globuligerina bathoniana gigantea* Wernli & Görög
44.0	67.0	4	375.00	37.50		*Conoglobigerina avariformis* Kasimova sphaerica
44.0	68.0	3	225.00		6.25	*Conoglobigerina* aff. *dagestanica* Morozova
44.0	69.5	5	325.00	37.50		*Conoglobigerina avariformis* Kasimova sphaerica
44.0	72.0	4	275.00	31.25		*Conoglobigerina avariformis* Kasimova sphaerica
44.0	75.5	3	200.00		12.50	*Conoglobigerina* aff. *dagestanica* Morozova
44.0	84.5	4	275.00	25.00		*Conoglobigerina avariformis* Kasimova sphaerica
44.0	85.0	4	275.00		18.75	*Globuligerina bathoniana gigantea* Wernli & Görög
44.0	95.0	3	312.50	31.25		*Conoglobigerina avariformis* Kasimova sphaerica
44.0	103.0	3	250.00		18.75	*Globuligerina* aff. *bathoniana* (Pazdrowa)
44.0	102.0	3	250.00	43.75		*Globuligerina oxfordiana* (Grigelis)
44.5	108.0	3	275.00	37.50		*Conoglobigerina avariformis* Kasimova sphaerica
44.5	108.0	3	250.00		18.75	*Globuligerina* aff. *bathoniana* (Pazdrowa)
44.5	103.5	3	200.00	37.50		*Globuligerina oxfordiana* (Grigelis)
44.5	103.5	4	325.00	25.00		*Conoglobigerina avariformis* Kasimova sphaerica
44.5	102.5	4	250.00	25.00		*Globuligerina oxfordiana* (Grigelis)
44.5	102.5	4	300.00	37.50		*Conoglobigerina avariformis* Kasimova sphaerica
44.5	98.5	4	250.00	31.25		*Globuligerina oxfordiana* (Grigelis)
44.5	98.0	6	300.00		18.75	*Globuligerina bathoniana gigantea* Wernli & Görög
44.5	97.0	5	287.50		18.75	*Globuligerina bathoniana gigantea* Wernli & Görög
44.5	85.5	4	337.50		18.75	*Globuligerina bathoniana gigantea* Wernli & Görög
44.5	75.0	4	275.00	25.00		*Conoglobigerina avariformis* Kasimova sphaerica
44.5	74.5	3	200.00		18.75	*Conoglobigerina* aff. *dagestanica* Morozova
44.5	69.0	4	350.00	37.50		*Conoglobigerina avariformis* Kasimova sphaerica
45.0	97.5	3	275.00	37.50		*Conoglobigerina avariformis* Kasimova sphaerica
45.0	102.0	3	225.00		18.75	*Conoglobigerina* aff. *dagestanica* Morozova
45.0	103.5	3	300.00	25.00		*Conoglobigerina avariformis* Kasimova sphaerica
45.0	107.0	3	300.00	31.25		*Conoglobigerina avariformis* Kasimova sphaerica
45.0	107.5	5	225.00		12.50	*Conoglobigerina* aff. *dagestanica* Morozova
Total Number of Specimens				635	232	867
Relative Percentages				73	27	

NIEDZICA SUCCESSION: NIEDZICA PODMAJERZ - NP-B/2 (LOWER BATHONIAN)

Thin Section Co-ordinates		No. of Chambers Visible	Maximum Diameter (µm)	Wall Thickness (µm)		Species
Vert	Hor			Thick	Thin	
4.5	77.5	4	262.5		18.75	*Globuligerina bathoniana gigantea* Wernli & Görög
5.0	74.5	4	187.5		12.50	*Globuligerina oxfordiana* (Grigelis)
5.0	74.5	3	150.0		12.50	*Globuligerina oxfordiana* (Grigelis)
5.5	81.0	3	175.0	25.00		*Globuligerina oxfordiana* (Grigelis)
5.5	81.0	3	162.5		12.50	*Globuligerina oxfordiana* (Grigelis)
5.5	80.5	3	150.0		12.50	*Globuligerina oxfordiana* (Grigelis)
5.5	72.0	3	150.0		18.75	*Globuligerina oxfordiana* (Grigelis)
6.0	72.0	3	200.0	25.00		*Globuligerina oxfordiana* (Grigelis)
6.0	72.0	3	225.0	50.00		*Globuligerina oxfordiana* (Grigelis)
6.0	77.0	3	237.5	37.50		*Globuligerina oxfordiana* (Grigelis)
6.5	80.5	4	212.5		12.50	*Globuligerina* aff. *bathoniana* (Pazdrowa)
6.5	78.0	4	175.0		18.75	*Globuligerina oxfordiana* (Grigelis)
7.5	91.0	3	175.0		18.75	*Globuligerina oxfordiana* (Grigelis)
7.5	81.0	4	187.5	25.00		*Globuligerina oxfordiana* (Grigelis)
8.0	78.0	4	225.0	31.25		*Globuligerina oxfordiana* (Grigelis)
8.0	79.0	4	175.0	31.25		*Globuligerina oxfordiana* (Grigelis)
8.0	79.0	4	175.0		18.75	*Globuligerina oxfordiana* (Grigelis)
8.0	80.0	3	137.5	25.00		*Globuligerina oxfordiana* (Grigelis)
8.0	81.0	3	162.5		18.75	*Globuligerina oxfordiana* (Grigelis)
8.0	81.5	3	137.5	31.25		*Globuligerina oxfordiana* (Grigelis)
8.0	87.0	3	150.0	0.00	18.75	*Globuligerina oxfordiana* (Grigelis)
8.5	94.0	4	137.5	0.00	12.50	*Globuligerina oxfordiana* (Grigelis)
9.0	91.5	3	187.5	37.50		*Globuligerina oxfordiana* (Grigelis)
9.5	93.5	4	200.0		12.50	*Conoglobigerina* aff. *dagestanica* Morozova
9.5	92.0	4	162.5	25.00		*Globuligerina oxfordiana* (Grigelis)
9.5	91.5	4	262.5	31.25		*Globuligerina oxfordiana* (Grigelis)
9.5	86.0	3	225.0		18.75	*Conoglobigerina* aff. *dagestanica* Morozova
10.0	92.5	3	175.0	25.00		*Globuligerina oxfordiana* (Grigelis)
10.5	91.0	3	162.5		18.75	*Globuligerina oxfordiana* (Grigelis)
10.5	81.0	4	275.0	0.00	18.75	*Globuligerina bathoniana gigantea* Wernli & Görög
10.5	76.0	4	225.0	0.00	18.75	*Conoglobigerina* aff. *dagestanica* Morozova
11.0	95.5	4	162.5	25.00	0.00	*Globuligerina oxfordiana* (Grigelis)
11.5	95.0	3	187.5		18.75	*Globuligerina oxfordiana* (Grigelis)
11.5	94.5	4	250.0		12.50	*Globuligerina* aff. *bathoniana* (Pazdrowa)
11.5	80.0	4	125.0		18.75	*Globuligerina oxfordiana* (Grigelis)
12.0	83.5	4	150.0	25.00		*Globuligerina oxfordiana* (Grigelis)
12.0	90.0	3	200.0	25.00		*Globuligerina oxfordiana* (Grigelis)
12.0	95.0	3	200.0	25.00		*Globuligerina oxfordiana* (Grigelis)
12.5	104.5	3	200.0		18.75	*Conoglobigerina* aff. *dagestanica* Morozova
12.5	96.0	4	187.5		12.50	*Globuligerina oxfordiana* (Grigelis)
12.5	95.5	3	175.0	25.00		*Globuligerina oxfordiana* (Grigelis)
12.5	87.0	3	212.5		18.75	*Conoglobigerina* aff. *dagestanica* Morozova
13.0	82.5	3	175.0		12.50	*Globuligerina oxfordiana* (Grigelis)
13.0	83.0	4	200.0	25.00		*Globuligerina oxfordiana* (Grigelis)
13.5	83.5	4	175.0	31.25		*Globuligerina oxfordiana* (Grigelis)
14.5	108.5	4	250.0	25.00		*Globuligerina oxfordiana* (Grigelis)
14.5	80.0	4	162.5		18.75	*Globuligerina oxfordiana* (Grigelis)
15.0	85.0	3	162.5	25.00		*Globuligerina oxfordiana* (Grigelis)
15.0	86.0	4	175.0		18.75	*Globuligerina oxfordiana* (Grigelis)
15.0	97.0	4	237.5		12.50	*Globuligerina* aff. *bathoniana* (Pazdrowa)
15.0	104.0	3	200.0		12.50	*Conoglobigerina* aff. *dagestanica* Morozova
15.5	108.0	4	225.0		12.50	*Globuligerina* aff. *bathoniana* (Pazdrowa)
15.5	99.5	3	250.0		12.50	*Globuligerina* aff. *bathoniana* (Pazdrowa)
15.5	99.5	3	200.0		12.50	*Conoglobigerina* aff. *dagestanica* Morozova
16.5	108.0	3	200.0		18.75	*Globuligerina* aff. *bathoniana* (Pazdrowa)

NIEDZICA SUCCESSION: NIEDZICA PODMAJERZ - NP-B/2 (LOWER BATHONIAN)

Thin Section Co-ordinates		No. of Chambers Visible	Maximum Diameter (µm)	Wall Thickness (µm)		Species
Vert	Hor			Thick	Thin	
15.5	85.5	4	175.0	25.00		*Globuligerina oxfordiana* (Grigelis)
15.5	85.0	4	262.5		18.75	*Globuligerina bathoniana gigantea* Wernli & Görög
16.0	86.0	4	137.5		18.75	*Globuligerina oxfordiana* (Grigelis)
16.0	101.0	4	225.0		18.75	*Globuligerina* aff. *bathoniana* (Pazdrowa)
16.5	108.0	3	200.0		18.75	*Globuligerina* aff. *bathoniana* (Pazdrowa)
16.5	102.5	5	200.0	25.00		*Globuligerina oxfordiana* (Grigelis)
16.5	85.0	3	187.5	25.00		*Globuligerina oxfordiana* (Grigelis)
16.5	84.0	3	150.0		18.75	*Globuligerina oxfordiana* (Grigelis)
16.5	76.0	3	237.5		18.75	*Globuligerina* aff. *bathoniana* (Pazdrowa)
17.0	77.0	4	187.5	25.00		*Globuligerina oxfordiana* (Grigelis)
17.0	78.5	3	200.0	37.50		*Globuligerina oxfordiana* (Grigelis)
17.0	79.5	4	162.5		18.75	*Globuligerina oxfordiana* (Grigelis)
17.0	80.0	3	175.0	25.00		*Globuligerina oxfordiana* (Grigelis)
17.0	84.5	3	212.5	31.25		*Globuligerina oxfordiana* (Grigelis)
17.0	89.5	4	200.0	25.00		*Globuligerina oxfordiana* (Grigelis)
17.0	94.5	3	212.5	31.25		*Globuligerina oxfordiana* (Grigelis)
17.0	96.5	5	187.5		12.50	*Globuligerina oxfordiana* (Grigelis)
17.5	99.0	5	175.0		12.50	*Globuligerina oxfordiana* (Grigelis)
17.5	98.0	3	150.0	25.00		*Globuligerina oxfordiana* (Grigelis)
17.5	96.5	3	162.5		18.75	*Globuligerina oxfordiana* (Grigelis)
17.5	84.0	4	212.5	31.25		*Globuligerina oxfordiana* (Grigelis)
17.5	83.0	4	212.5	31.25		*Globuligerina oxfordiana* (Grigelis)
17.5	82.5	4	175.0	25.00		*Globuligerina oxfordiana* (Grigelis)
18.0	83.0	4	175,0	25.00		*Globuligerina oxfordiana* (Grigelis)
18.0	83.0	4	212.5	25.00		*Globuligerina oxfordiana* (Grigelis)
18.0	83.5	3	150.0	25.00		*Globuligerina oxfordiana* (Grigelis)
18.0	86.0	3	162.5	25.00		*Globuligerina oxfordiana* (Grigelis)
18.0	86.0	3	175.0	25.00		*Globuligerina oxfordiana* (Grigelis)
18.0	104.5	3	250.0		12.50	*Globuligerina* aff. *bathoniana* (Pazdrowa)
18.5	101.0	4	212.5		12.50	*Globuligerina* aff. *bathoniana* (Pazdrowa)
19.0	72.5	4	237.5	37.50		*Globuligerina oxfordiana* (Grigelis)
19.0	84.0	4	275.0		18.75	*Globuligerina bathoniana gigantea* Wernli & Görög
19.0	85.0	3	212.5		18.75	*Conoglobigerina* aff. *dagestanica* Morozova
19.0	104.0	4	225.0		12.50	*Conoglobigerina* aff. *dagestanica* Morozova
19.0	104.0	3	162.5		18.75	*Globuligerina oxfordiana* (Grigelis)
19.5	105.5	3	125.0	25.00		*Globuligerina oxfordiana* (Grigelis)
19.5	105.0	4	150.0		12.50	*Globuligerina oxfordiana* (Grigelis)
19.5	103.5	4	125.0		12.50	*Globuligerina oxfordiana* (Grigelis)
19.5	102.0	4	200.0	25.00		*Globuligerina oxfordiana* (Grigelis)
19.5	85.0	3	175.0		18.75	*Globuligerina oxfordiana* (Grigelis)
19.5	76.0	4	212.5	25.00		*Globuligerina oxfordiana* (Grigelis)
19.5	68.0	3	225.0	25.00		*Globuligerina oxfordiana* (Grigelis)
20.0	105.0	4	112.5		12.50	*Globuligerina oxfordiana* (Grigelis)
20.5	85.0	6	150.0		12.50	*Globuligerina oxfordiana* (Grigelis)
20.5	80.0	3	237.5		18.75	*Globuligerina* aff. *bathoniana* (Pazdrowa)
Total Number of Specimens				45	55	100
Relative Percentages				45	55	

NIEDZICA SUCCESSION: CZAJAKOWA SKALA - Cs4-0,4 (UPPERMOST CALLOVIAN/OXFORDIAN)

Thin Section Co-ordinates		No. of Chambers Visible	Maximum Diameter (µm)	Wall Thickness (µm)		Species
Vert	Hor			Thick	Thin	
5.5	100.5	3	187.5		18.75	*Globuligerina oxfordiana* (Grigelis)
6.0	99.0	3	162.5		18.75	*Globuligerina oxfordiana* (Grigelis)
6.0	100.0	3	200.0	37.50		*Globuligerina oxfordiana* (Grigelis)
6.0	100.5	6	225.0	31.25		*Globuligerina oxfordiana* (Grigelis)
6.0	101.5	4	150.0	25.00		*Globuligerina oxfordiana* (Grigelis)
6.0	104.5	3	175.0	31.25		*Globuligerina oxfordiana* (Grigelis)
6.5	102.5	3	212.5		18.75	*Conoglobigerina* aff. *dagestanica* Morozova
6.5	98.0	3	187.5	31.25		*Globuligerina oxfordiana* (Grigelis)
6.5	96.0	3	200.0	31.25		*Globuligerina oxfordiana* (Grigelis)
7.0	97.5	3	287.5	37.50		*Globuligerina oxfordiana* (Grigelis)
7.0	105.5	4	162.5	25.00		*Globuligerina oxfordiana* (Grigelis)
7.5	108.0	3	250.0	37.50		*Globuligerina oxfordiana* (Grigelis)
7.5	107.5	3	187.5	37.50		*Globuligerina oxfordiana* (Grigelis)
7.5	107.0	5	225.0	31.25		*Globuligerina oxfordiana* (Grigelis)
7.5	105.0	4	250.0	25.00		*Globuligerina oxfordiana* (Grigelis)
7.5	97.5	5	225.0		18.75	*Globuligerina* aff. *bathoniana* (Pazdrowa)
7.5	96.5	4	187.5	31.25		*Globuligerina oxfordiana* (Grigelis)
8.0	97.0	4	237.5		18.75	*Globuligerina* aff. *bathoniana* (Pazdrowa)
8.0	105.5	4	250.0	31.25		*Globuligerina oxfordiana* (Grigelis)
8.0	108.5	3	250.0		18.75	*Globuligerina* aff. *bathoniana* (Pazdrowa)
8.5	109.5	3	250.0	31.25		*Globuligerina oxfordiana* (Grigelis)
8.5	106.0	4	250.0	25.00		*Globuligerina oxfordiana* (Grigelis)
8.5	101.5	3	150.0		18.75	*Globuligerina oxfordiana* (Grigelis)
9.0	91.5	3	150.0		18.75	*Globuligerina oxfordiana* (Grigelis)
9.0	92.5	3	175.0		18.75	*Globuligerina oxfordiana* (Grigelis)
9.0	102.0	3	275.0	25.00		*Globuligerina oxfordiana* (Grigelis)
9.0	102.5	4	275.0	25.00		*Globuligerina oxfordiana* (Grigelis)
9.0	104.0	3	250.0	37.50		*Globuligerina oxfordiana* (Grigelis)
9.0	105.5	3	225.0	31.25		*Globuligerina oxfordiana* (Grigelis)
9.0	109.5	3	300.0	37.50		*Globuligerina oxfordiana* (Grigelis)
9.0	110.0	3	250.0	37.50		*Globuligerina oxfordiana* (Grigelis)
9.5	107.0	4	225.0		18.75	*Globuligerina* aff. *bathoniana* (Pazdrowa)
9.5	106.0	4	137.5	25.00		*Globuligerina oxfordiana* (Grigelis)
9.5	105.5	3	125.0		12.50	*Globuligerina oxfordiana* (Grigelis)
9.5	105.5	3	162.5		12.50	*Globuligerina oxfordiana* (Grigelis)
9.5	105.5	4	150.0		12.50	*Globuligerina oxfordiana* (Grigelis)
9.5	104.0	3	262.5	31.25		*Globuligerina oxfordiana* (Grigelis)
9.5	102.0	4	287.5		18.75	*Globuligerina bathoniana gigantea* Wernli & Görög
9.5	101.5	4	275.0		18.75	*Globuligerina bathoniana gigantea* Wernli & Görög
9.5	95.5	4	225.0	37.50		*Globuligerina oxfordiana* (Grigelis)
10.0	91.0	4	312.5	31.25		*Globuligerina oxfordiana* (Grigelis)
10.5	110.5	4	287.5		18.75	*Globuligerina bathoniana gigantea* Wernli & Görög
10.5	110.0	3	187.5	25.00		*Globuligerina oxfordiana* (Grigelis)
10.5	107.0	4	150.0		18.75	*Globuligerina oxfordiana* (Grigelis)
10.5	103.0	3	237.5	25.00		*Globuligerina oxfordiana* (Grigelis)
10.5	103.0	3	200.0	31.25		*Globuligerina oxfordiana* (Grigelis)
10.5	101.5	5	300.0	37.50		*Globuligerina oxfordiana* (Grigelis)
10.5	100.5	4	125.0	25.00		*Globuligerina oxfordiana* (Grigelis)
10.5	99.0	3	275.0	37.50		*Globuligerina oxfordiana* (Grigelis)
10.5	95.0	3	187.5	31.25		*Globuligerina oxfordiana* (Grigelis)
10.5	91.5	3	200.0	25.00		*Globuligerina oxfordiana* (Grigelis)
11.0	95.0	4	200.0	37.50		*Globuligerina oxfordiana* (Grigelis)
11.0	96.0	4	175.0	31.25		*Globuligerina oxfordiana* (Grigelis)
11.0	96.0	4	312.5		18.75	*Globuligerina bathoniana gigantea* Wernli & Görög
11.0	97.5	3	187.5	25.00		*Globuligerina oxfordiana* (Grigelis)

NIEDZICA SUCCESSION: CZAJAKOWA SKALA - Cs4-0,4 (UPPERMOST CALLOVIAN/OXFORDIAN)

Thin Section Co-ordinates		No. of Chambers Visible	Maximum Diameter (µm)	Wall Thickness (µm)		Species
Vert	Hor			Thick	Thin	
11.0	100.0	4	287.5	25.00		*Globuligerina oxfordiana* (Grigelis)
11.0	100.5	4	162.5	37.50		*Globuligerina oxfordiana* (Grigelis)
11.0	101.5	4	225.0	25.00		*Globuligerina oxfordiana* (Grigelis)
11.0	109.5	5	325.0		18.75	*Globuligerina bathoniana gigantea* Wernli & Görög
11.5	111.5	3	250.0	31.25		*Globuligerina oxfordiana* (Grigelis)
11.5	110.5	4	225.0	25.00		*Globuligerina oxfordiana* (Grigelis)
11.5	108.0	3	125.0		12.50	*Globuligerina oxfordiana* (Grigelis)
11.5	107.0	3	187.5	37.50		*Globuligerina oxfordiana* (Grigelis)
11.5	102.5	3	225.0	31.25		*Globuligerina oxfordiana* (Grigelis)
11.5	94.5	4	250.0	37.50		*Globuligerina oxfordiana* (Grigelis)
11.5	94.5	3	150.0	37.50		*Globuligerina oxfordiana* (Grigelis)
11.5	89.5	3	150.0		12.50	*Globuligerina oxfordiana* (Grigelis)
12.0	97.5	3	112.5	31.25		*Globuligerina oxfordiana* (Grigelis)
12.0	98.0	3	200.0	25.00		*Globuligerina oxfordiana* (Grigelis)
12.0	99.0	3	225.0	37.50		*Globuligerina oxfordiana* (Grigelis)
12.0	110.0	3	200.0	37.50		*Globuligerina oxfordiana* (Grigelis)
12.5	108.0	4	200.0		18.75	*Globuligerina* aff. *bathoniana* (Pazdrowa)
12.5	101.5	3	175.0	31.25		*Globuligerina oxfordiana* (Grigelis)
12.5	94.5	4	250.0	25.00		*Globuligerina oxfordiana* (Grigelis)
12.5	94.0	4	212.5	37.50		*Globuligerina oxfordiana* (Grigelis)
13.0	105.0	3	287.5	25.00		*Globuligerina oxfordiana* (Grigelis)
13.0	113.5	3	225.0	50.00		*Globuligerina oxfordiana* (Grigelis)
13.5	101.0	3	137.5		6.25	*Globuligerina oxfordiana* (Grigelis)
13.5	97.5	4	137.5		12.50	*Globuligerina oxfordiana* (Grigelis)
13.5	96.5	4	200.0	25.00		*Globuligerina oxfordiana* (Grigelis)
13.5	95.0	3	225.0	50.00		*Globuligerina oxfordiana* (Grigelis)
13.5	94.5	3	175.0	31.25		*Globuligerina oxfordiana* (Grigelis)
14.0	92.0	4	250.0	31.25		*Globuligerina oxfordiana* (Grigelis)
14.0	92.5	3	187.5		18.75	*Globuligerina oxfordiana* (Grigelis)
14.0	93.0	3	187.5		18.75	*Globuligerina oxfordiana* (Grigelis)
14.0	93.5	4	312.5	25.00		*Globuligerina oxfordiana* (Grigelis)
14.0	97.5	3	187.5		18.75	*Globuligerina oxfordiana* (Grigelis)
14.0	103.0	4	162.5		18.75	*Globuligerina oxfordiana* (Grigelis)
14.0	104.0	4	287.5	25.00		*Globuligerina oxfordiana* (Grigelis)
14.0	105.0	3	150.0		18.75	*Globuligerina oxfordiana* (Grigelis)
14.5	111.0	3	225.0		18.75	*Globuligerina oxfordiana* (Grigelis)
14.5	109.0	3	125.0		18.75	*Globuligerina oxfordiana* (Grigelis)
14.5	108.5	5	175.0		18.75	*Globuligerina oxfordiana* (Grigelis)
14.5	107.5	4	200.0	37.50		*Globuligerina oxfordiana* (Grigelis)
14.5	101.5	3	250.0	31.25		*Globuligerina oxfordiana* (Grigelis)
14.5	97.5	4	150.0		12.50	*Globuligerina oxfordiana* (Grigelis)
14.5	97.5	4	225.0	31.25		*Globuligerina oxfordiana* (Grigelis)
14.5	97.0	4	162.5		12.50	*Globuligerina oxfordiana* (Grigelis)
14.5	96.5	3	175.0	25.00		*Globuligerina oxfordiana* (Grigelis)
14.5	95.5	3	187.5		12.50	*Globuligerina oxfordiana* (Grigelis)
14.5	95.0	5	262.5	31.25		*Globuligerina oxfordiana* (Grigelis)
15.0	89.5	3	150.0	50.00		*Globuligerina oxfordiana* (Grigelis)
15.0	90.5	4	287.5		18.75	*Globuligerina bathoniana gigantea* Wernli & Görög
15.0	92.5	3	187.5		6.25	*Globuligerina oxfordiana* (Grigelis)
15.0	93.5	3	275.0		18.75	*Globuligerina bathoniana gigantea* Wernli & Görög
15.0	102.0	3	212.5	37.50		*Globuligerina oxfordiana* (Grigelis)
15.0	106.5	3	212.5	25.00		*Globuligerina oxfordiana* (Grigelis)
15.0	107.0	3	237.5	37.50		*Globuligerina oxfordiana* (Grigelis)
15.0	109.0	3	250.0	37.50		*Globuligerina oxfordiana* (Grigelis)
15.0	110.5	4	237.5		18.75	*Globuligerina* aff. *bathoniana* (Pazdrowa)

NIEDZICA SUCCESSION: CZAJAKOWA SKALA - Cs4-0,4 (UPPERMOST CALLOVIAN/OXFORDIAN)

Thin Section Co-ordinates		No. of Chambers Visible	Maximum Diameter (μm)	Wall Thickness (μm)		Species
Vert	Hor			Thick	Thin	
15.5	115.0	3	212.5	37.50		*Globuligerina oxfordiana* (Grigelis)
15.5	114.0	3	237.5	31.25		*Globuligerina oxfordiana* (Grigelis)
15.5	109.0	3	237.5	37.50		*Globuligerina oxfordiana* (Grigelis)
15.5	101.0	3	175.0		18.75	*Globuligerina oxfordiana* (Grigelis)
15.5	96.0	4	287.5		18.75	*Globuligerina bathoniana gigantea* Wernli & Görög
15.5	90.5	4	262.5	31.25		*Globuligerina oxfordiana* (Grigelis)
15.5	90.0	3	262.5	50.00		*Globuligerina oxfordiana* (Grigelis)
16.0	98.0	3	200.0	25.00		*Globuligerina oxfordiana* (Grigelis)
16.0	106.0	4	237.5		12.50	*Globuligerina* aff. *bathoniana* (Pazdrowa)
16.5	109.5	3	187.5	25.00		*Globuligerina oxfordiana* (Grigelis)
16.5	108.5	4	150.0		18.75	*Globuligerina oxfordiana* (Grigelis)
16.5	106.5	3	150.0		18.75	*Globuligerina oxfordiana* (Grigelis)
16.5	103.5	4	225.0	31.25		*Globuligerina oxfordiana* (Grigelis)
16.5	98.0	4	275.0	25.00		*Globuligerina oxfordiana* (Grigelis)
16.5	96.5	4	262.5	25.00		*Globuligerina oxfordiana* (Grigelis)
16.5	95.5	5	287.5	25.00		*Globuligerina oxfordiana* (Grigelis)
16.5	90.0	4	212.5		18.75	*Globuligerina* aff. *bathoniana* (Pazdrowa)
17.0	89.0	3	237.5	37.50		*Globuligerina oxfordiana* (Grigelis)
17.0	94.0	3	162.5		12.50	*Globuligerina oxfordiana* (Grigelis)
17.0	95.0	4	150.0		12.50	*Globuligerina oxfordiana* (Grigelis)
17.0	96.5	4	212.5		18.75	*Globuligerina* aff. *bathoniana* (Pazdrowa)
17.0	110.5	4	162.5		18.75	*Globuligerina oxfordiana* (Grigelis)
17.0	109.5	3	175.0	31.25		*Globuligerina oxfordiana* (Grigelis)
17.5	110.0	3	250.0	37.50		*Globuligerina oxfordiana* (Grigelis)
17.5	109.0	4	225.0		18.75	*Globuligerina* aff. *bathoniana* (Pazdrowa)
17.5	106.5	4	262.5	37.50		*Globuligerina oxfordiana* (Grigelis)
17.5	104.0	3	237.5	31.25		*Globuligerina oxfordiana* (Grigelis)
17.5	100.5	4	187.5	31.25		*Globuligerina oxfordiana* (Grigelis)
17.5	96.0	4	225.0		18.75	*Conoglobigerina* aff. *dagestanica* Morozova
17.5	94.0	4	175.0	31.25		*Globuligerina oxfordiana* (Grigelis)
17.5	90.5	3	250.0	50.00		*Globuligerina oxfordiana* (Grigelis)
18.0	93.0	4	250.0	37.50		*Globuligerina oxfordiana* (Grigelis)
18.0	94.0	4	250.0	37.50		*Globuligerina oxfordiana* (Grigelis)
18.0	95.0	3	162.5	25.00		*Globuligerina oxfordiana* (Grigelis)
18.0	96.5	3	187.5		18.75	*Globuligerina oxfordiana* (Grigelis)
18.0	100.0	3	162.5		18.75	*Globuligerina oxfordiana* (Grigelis)
18.0	106.5	3	200.0	37.50		*Globuligerina oxfordiana* (Grigelis)
18.0	107.5	3	262.5		18.75	*Globuligerina bathoniana gigantea* Wernli & Görög
18.5	117.0	4	212.5	31.25		*Globuligerina oxfordiana* (Grigelis)
18.5	112.0	3	212.5	37.50		*Globuligerina oxfordiana* (Grigelis)
18.5	112.0	3	200.0	25.00		*Globuligerina oxfordiana* (Grigelis)
18.5	108.5	3	150.0		18.75	*Globuligerina oxfordiana* (Grigelis)
18.5	107.0	4	225.0	37.50		*Globuligerina oxfordiana* (Grigelis)
19.0	106.0	3	212.5	25.00		*Globuligerina oxfordiana* (Grigelis)
19.0	110.0	4	250.0	31.25		*Globuligerina oxfordiana* (Grigelis)
19.0	116.0	4	325.0	37.50		*Globuligerina oxfordiana* (Grigelis)
19.5	113.0	4	300.0	37.50		*Globuligerina oxfordiana* (Grigelis)
19.5	110.0	4	237.5	31.25		*Globuligerina oxfordiana* (Grigelis)
19.5	98.0	3	275.0	25.00		*Globuligerina oxfordiana* (Grigelis)
20.0	95.5	3	237.5	31.25		*Globuligerina oxfordiana* (Grigelis)
20.0	96.0	3	162.5		18.75	*Globuligerina oxfordiana* (Grigelis)
20.0	97.0	4	225.0	25.00		*Globuligerina oxfordiana* (Grigelis)
20.0	99.0	4	162.5		12.50	*Globuligerina oxfordiana* (Grigelis)
20.0	110.0	4	212.5	25.00		*Globuligerina oxfordiana* (Grigelis)
20.5	106.5	4	212.5		18.75	*Conoglobigerina* aff. *dagestanica* Morozova

NIEDZICA SUCCESSION: CZAJAKOWA SKALA - Cs4-0,4 (UPPERMOST CALLOVIAN/OXFORDIAN)

Thin Section Co-ordinates		No. of Chambers Visible	Maximum Diameter (µm)	Wall Thickness (µm)		Species
Vert	Hor			Thick	Thin	
20.5	105.5	3	250.0	25.00		*Globuligerina oxfordiana* (Grigelis)
20.5	105.0	3	175.0	25.00		*Globuligerina oxfordiana* (Grigelis)
20.5	98.0	3	200.0		18.75	*Globuligerina* aff. *bathoniana* (Pazdrowa)
20.5	97.0	3	275.0		18.75	*Globuligerina bathoniana gigantea* Wernli & Görög
21.0	95.5	3	250.0		18.75	*Conoglobigerina* aff. *dagestanica* Morozova
21.5	109.0	3	212.5		18.75	*Conoglobigerina* aff. *dagestanica* Morozova
21.5	104.5	6	225.0	25.00		*Globuligerina oxfordiana* (Grigelis)
21.5	103.5	4	200.0	31.25		*Globuligerina oxfordiana* (Grigelis)
21.5	103.5	4	300.0	25.00		*Globuligerina oxfordiana* (Grigelis)
21.5	103.5	4	212.5	31.25		*Globuligerina oxfordiana* (Grigelis)
21.5	103.0	3	262.5	25.00		*Globuligerina oxfordiana* (Grigelis)
22.0	103.0	3	237.5		18.75	*Globuligerina* aff. *bathoniana* (Pazdrowa)
22.0	105.5	4	175.0		18.75	*Globuligerina oxfordiana* (Grigelis)
22.5	111.0	3	175.0	37.50		*Globuligerina oxfordiana* (Grigelis)
22.5	107.0	4	125.0	25.00		*Globuligerina oxfordiana* (Grigelis)
22.5	107.0	4	137.5	25.00		*Globuligerina oxfordiana* (Grigelis)
23.0	102.0	4	200.0	25.00		*Globuligerina oxfordiana* (Grigelis)
23.0	103.5	3	200.0		18.75	*Conoglobigerina* aff. *dagestanica* Morozova
23.0	104.0	4	287.5		18.75	*Globuligerina bathoniana gigantea* Wernli & Görög
23.0	106.0	4	225.0	25.00		*Globuligerina oxfordiana* (Grigelis)
23.0	109.5	3	225.0	25.00		*Globuligerina oxfordiana* (Grigelis)
23.5	113.5	4	337.5		18.75	*Globuligerina bathoniana gigantea* Wernli & Görög
23.5	110.5	5	275.0		18.75	*Globuligerina bathoniana gigantea* Wernli & Görög
23.5	106.5	3	125.0		18.75	*Globuligerina oxfordiana* (Grigelis)
Total Number of Specimens				**120**	**69**	**189**
Relative Percentages				**63**	**37**	

CZORSZTYN SUCCESSION: CZORSZTYN CASTLE KLIPPE - CzZ 5b (OXFORDIAN)

Thin Section Co-ordinates		No. of Chambers Visible	Maximum Diameter (µm)	Wall Thickness (µm)		Species
Vert	Hor			Thick	Thin	
3.0	90.0	3	225.0	31.25		*Globuligerina oxfordiana* (Grigelis)
4.5	109.0	4	237.5		12.50	*Globuligerina* aff. *bathoniana* (Pazdrowa)
5.0	107.0	3	225.0		12.50	*Globuligerina* aff. *bathoniana* (Pazdrowa)
5.5	109.5	3	275.0		18.75	*Globuligerina bathoniana gigantea* Wernli & Görög
6.0	109.0	4	287.5	25.00		*Globuligerina oxfordiana* (Grigelis)
6.5	108.5	4	225.0	25.00		*Globuligerina oxfordiana* (Grigelis)
7.0	87.5	3	225.0		12.50	*Globuligerina* aff. *bathoniana* (Pazdrowa)
7.0	106.5	3	225.0		18.75	*Globuligerina* aff. *bathoniana* (Pazdrowa)
7.0	112.0	5	237.5		18.75	*Globuligerina* aff. *bathoniana* (Pazdrowa)
7.0	113.0	3	225.0		18.75	*Globuligerina* aff. *bathoniana* (Pazdrowa)
7.5	115.0	3	187.5		12.50	*Globuligerina oxfordiana* (Grigelis)
7.5	114.5	5	250.0		12.50	*Globuligerina* aff. *bathoniana* (Pazdrowa)
7.5	110.5	4	212.5	25.00		*Globuligerina* aff. *bathoniana* (Pazdrowa)
7.5	109.5	4	225.0	25.00		*Globuligerina oxfordiana* (Grigelis)
7.5	107.5	4	250.0		12.50	*Globuligerina oxfordiana* (Grigelis)
7.5	88.0	4	200.0	31.25		*Globuligerina oxfordiana* (Grigelis)
8.0	107.0	4	250.0	25.00		*Globuligerina oxfordiana* (Grigelis)
8.0	110.0	5	212.5		6.25	*Globuligerina* aff. *bathoniana* (Pazdrowa)
8.5	110.5	3	225.0		12.50	*Globuligerina* aff. *bathoniana* (Pazdrowa)
8.5	110.0	3	212.5	31.25		*Globuligerina oxfordiana* (Grigelis)
9.0	110.0	3	275.0		18.75	*Globuligerina bathoniana gigantea* Wernli & Görög
9.0	114.0	4	250.0		18.75	*Globuligerina* aff. *bathoniana* (Pazdrowa)
9.0	114.5	4	250.0		18.75	*Globuligerina* aff. *bathoniana* (Pazdrowa)
9.5	112.0	4	262.5		18.75	*Globuligerina bathoniana gigantea* Wernli & Görög
10.0	90.0	3	250.0		12.50	*Globuligerina* aff. *bathoniana* (Pazdrowa)
10.0	92.0	4	175.0		6.25	*Globuligerina oxfordiana* (Grigelis)
10.0	94.0	4	212.5		12.50	*Globuligerina* aff. *bathoniana* (Pazdrowa)
10.0	101.5	4	212.5		12.50	*Globuligerina* aff. *bathoniana* (Pazdrowa)
10.0	111.0	4	250.0		12.50	*Globuligerina* aff. *bathoniana* (Pazdrowa)
10.5	108.0	4	200.0		18.75	*Globuligerina* aff. *bathoniana* (Pazdrowa)
10.5	103.0	3	200.0		12.50	*Globuligerina* aff. *bathoniana* (Pazdrowa)
10.5	102.0	4	237.5		18.75	*Globuligerina* aff. *bathoniana* (Pazdrowa)
10.5	90.0	4	275.0	37.50		*Globuligerina oxfordiana* (Grigelis)
10.5	87.0	4	250.0		12.50	*Globuligerina* aff. *bathoniana* (Pazdrowa)
11.0	88.5	4	237.5		18.75	*Globuligerina* aff. *bathoniana* (Pazdrowa)
11.0	90.0	3	287.5		12.50	*Globuligerina bathoniana gigantea* Wernli & Görög
11.5	100.0	3	200.0	25.00		*Globuligerina oxfordiana* (Grigelis)
11.5	87.5	3	225.0		12.50	*Globuligerina* aff. *bathoniana* (Pazdrowa)
12.0	86.0	3	275.0		12.50	*Globuligerina bathoniana gigantea* Wernli & Gorog
12.0	86.0	3	237.5		12.50	*Globuligerina* aff. *bathoniana* (Pazdrowa)
12.0	87.0	4	212.5		12.50	*Globuligerina* aff. *bathoniana* (Pazdrowa)
12.0	87.0	4	212.5		12.50	*Globuligerina* aff. *bathoniana* (Pazdrowa)
12.0	88.5	3	237.5	37.50		*Globuligerina oxfordiana* (Grigelis)
12.0	94.0	3	225.0	31.25		*Globuligerina oxfordiana* (Grigelis)
12.0	96.0	3	237.5	37.50		*Globuligerina oxfordiana* (Grigelis)
12.0	104.5	4	287.5		18.75	*Globuligerina bathoniana gigantea* Wernli & Görög
12.0	107.7	3	225.0		18.75	*Globuligerina* aff. *bathoniana* (Pazdrowa)
12.0	109.0	3	250.0	25.00		*Globuligerina oxfordiana* (Grigelis)
12.5	109.5	3	275.0		12.50	*Globuligerina bathoniana gigantea* Wernli & Görög
12.5	113.5	3	225.0		18.75	*Globuligerina* aff. *bathoniana* (Pazdrowa)
12.5	110.0	3	262.5		12.50	*Globuligerina bathoniana gigantea* Wernli & Görög
12.5	107.5	4	237.5		18.75	*Globuligerina* aff. *bathoniana* (Pazdrowa)
12.5	101.0	3	250.0	37.50		*Globuligerina oxfordiana* (Grigelis)
12.5	101.0	3	225.0	25.00		*Globuligerina oxfordiana* (Grigelis)
12.5	100.0	4	237.5		18.75	*Globuligerina* aff. *bathoniana* (Pazdrowa)

CZORSZTYN SUCCESSION: CZORSZTYN CASTLE KLIPPE - CzZ 5b (OXFORDIAN)

Thin Section Co-ordinates		No. of Chambers Visible	Maximum Diameter (µm)	Wall Thickness (µm)		Species
Vert	Hor			Thick	Thin	
12.5	99.0	4	250.0		12.50	*Globuligerina* aff. *bathoniana* (Pazdrowa)
12.5	95.0	3	275.0		18.75	*Globuligerina bathoniana gigantea* Wernli & Görög
12.5	94.0	3	225.0	25.00		*Globuligerina oxfordiana* (Grigelis)
12.5	92.5	4	237.5		12.50	*Globuligerina* aff. *bathoniana* (Pazdrowa)
12.5	89.0	4	225.0		12.50	*Globuligerina* aff. *bathoniana* (Pazdrowa)
13.0	85.5	4	262.5		18.75	*Globuligerina bathoniana gigantea* Wernli & Görög
13.0	86.5	4	225.0		18.75	*Globuligerina* aff. *bathoniana* (Pazdrowa)
13.0	87.5	4	250.0		12.50	*Globuligerina* aff. *bathoniana* (Pazdrowa)
13.0	93.0	4	300.0	37.50		*Globuligerina oxfordiana* (Grigelis)
13.0	93.5	3	225.0		18.75	*Globuligerina* aff. *bathoniana* (Pazdrowa)
13.0	94.5	4	262.5		18.75	*Globuligerina bathoniana gigantea* Wernli & Görög
13.0	95.0	4	237.5	25.00		*Globuligerina oxfordiana* (Grigelis)
13.0	96.0	3	200.0	31.25		*Globuligerina oxfordiana* (Grigelis)
13.0	97.5	3	225.0	25.00		*Globuligerina oxfordiana* (Grigelis)
13.0	103.5	4	262.5		18.75	*Globuligerina bathoniana gigantea* Wernli & Görög
13.0	107.0	3	187.5		12.50	*Globuligerina oxfordiana* (Grigelis)
13.0	108.0	4	262.5	25.00		*Globuligerina oxfordiana* (Grigelis)
13.0	110.0	3	225.0	37.50		*Globuligerina oxfordiana* (Grigelis)
13.0	110.5	4	287.5		12.50	*Globuligerina bathoniana gigantea* Wernli & Görög
13.0	113.0	3	300.0	25.00		*Globuligerina oxfordiana* (Grigelis)
13.5	114.5	3	275.0	25.00		*Globuligerina oxfordiana* (Grigelis)
13.5	114.5	3	300.0	25.00		*Globuligerina oxfordiana* (Grigelis)
13.5	113.5	3	287.5	25.00		*Globuligerina oxfordiana* (Grigelis)
13.5	113.5	3	300.0	25.00		*Globuligerina oxfordiana* (Grigelis)
13.5	108.0	4	262.5		18.75	*Globuligerina bathoniana gigantea* Wernli & Görög
13.5	106.5	3	150.0		18.75	*Globuligerina oxfordiana* (Grigelis)
13.5	101.0	4	250.0		18.75	*Globuligerina* aff. *bathoniana* (Pazdrowa)
13.5	100.0	4	262.5	37.50	0.00	*Globuligerina oxfordiana* (Grigelis)
13.5	93.5	4	250.0	25.00	0.00	*Globuligerina oxfordiana* (Grigelis)
13.5	93.5	4	262.5		18.75	*Globuligerina bathoniana gigantea* Wernli & Görög
13.5	93.0	3	250.0		18.75	*Globuligerina* aff. *bathoniana* (Pazdrowa)
13.5	92.5	5	300.0		18.75	*Globuligerina bathoniana gigantea* Wernli & Görög
13.5	92.0	3	262.5		18.75	*Globuligerina* aff. *bathoniana* (Pazdrowa)
13.5	92.0	3	275.0	25.00		*Globuligerina oxfordiana* (Grigelis)
13.5	90.0	4	250.0		12.50	*Globuligerina* aff. *bathoniana* (Pazdrowa)
13.5	89.5	4	200.0		12.50	*Globuligerina* aff. *bathoniana* (Pazdrowa)
13.5	88.0	3	250.0	37.50		*Globuligerina oxfordiana* (Grigelis)
13.5	88.0	3	225.0	25.00		*Globuligerina oxfordiana* (Grigelis)
13.5	96.5	4	237.5	25.00		*Globuligerina oxfordiana* (Grigelis)
13.5	85.0	3	212.5		18.75	*Globuligerina* aff. *bathoniana* (Pazdrowa)
14.0	85.0	4	200.0	25.00		*Globuligerina oxfordiana* (Grigelis)
14.0	87.5	3	175.0		18.75	*Globuligerina oxfordiana* (Grigelis)
14.0	89.0	4	275.0	25.00		*Globuligerina oxfordiana* (Grigelis)
14.0	89.5	3	225.0		18.75	*Globuligerina* aff. *bathoniana* (Pazdrowa)
14.0	90.0	3	250.0	25.00		*Globuligerina oxfordiana* (Grigelis)
14.0	90.5	3	150.0		18.75	*Globuligerina oxfordiana* (Grigelis)
14.0	92.0	4	237.5		18.75	*Globuligerina* aff. *bathoniana* (Pazdrowa)
14.0	92.5	4	200.0		18.75	*Globuligerina* aff. *bathoniana* (Pazdrowa)
14.0	95.0	4	150.0		18.75	*Globuligerina* aff. *bathoniana* (Pazdrowa)
14.0	98.5	4	237.5	25.00		*Globuligerina oxfordiana* (Grigelis)
14.0	99.0	4	237.5		18.75	*Globuligerina* aff. *bathoniana* (Pazdrowa)
14.0	99.5	3	275.0	25.00		*Globuligerina oxfordiana* (Grigelis)
14.0	104.0	4	250.0	25.00		*Globuligerina oxfordiana* (Grigelis)
14.0	105.0	4	250.0		12.50	*Globuligerina* aff. *bathoniana* (Pazdrowa)
14.0	107.0	3	237.5		12.50	*Globuligerina* aff. *bathoniana* (Pazdrowa)

CZORSZTYN SUCCESSION: CZORSZTYN CASTLE KLIPPE - CzZ 5b (OXFORDIAN)

Thin Section Co-ordinates		No. of Chambers Visible	Maximum Diameter (µm)	Wall Thickness (µm)		Species
Vert	Hor			Thick	Thin	
14.0	108.5	5	262.5		12.50	*Globuligerina* aff. *bathoniana* (Pazdrowa)
14.0	112.0	3	287.5		12.50	*Globuligerina* aff. *bathoniana* (Pazdrowa)
14.0	112.0	3	275.0		18.75	*Globuligerina* aff. *bathoniana* (Pazdrowa)
14.5	111.0	4	250.0		18.75	*Globuligerina* aff. *bathoniana* (Pazdrowa)
14.5	104.0	4	275.0		12.50	*Globuligerina bathoniana gigantea* Wernli & Görög
14.5	102.0	4	262.5	37.50		*Globuligerina oxfordiana* (Grigelis)
14.5	102.0	3	250.0		18.75	*Globuligerina* aff. *bathoniana* (Pazdrowa)
14.5	92.0	4	275.0	25.00		*Globuligerina oxfordiana* (Grigelis)
14.5	90.0	4	275.0		18.75	*Globuligerina bathoniana gigantea* Wernli & Görög
14.5	86.0	4	225.0		12.50	*Globuligerina* aff. *bathoniana* (Pazdrowa)
15.0	85.5	4	250.0		18.75	*Globuligerina* aff. *bathoniana* (Pazdrowa)
15.0	87.0	4	262.5		18.75	*Globuligerina bathoniana gigantea* Wernli & Görög
15.0	87.5	3	212.5		12.50	*Globuligerina* aff. *bathoniana* (Pazdrowa)
15.0	88.5	4	225.0		18.75	*Globuligerina* aff. *bathoniana* (Pazdrowa)
15.0	89.0	4	275.0		18.75	*Globuligerina bathoniana gigantea* Wernli & Görög
15.0	90.5	5	300.0		18.75	*Globuligerina bathoniana gigantea* Wernli & Görög
15.0	91.0	4	275.0		12.50	*Globuligerina bathoniana gigantea* Wernli & Görög
15.0	91.0	3	262.5		18.75	*Globuligerina bathoniana gigantea* Wernli & Görög
15.0	92.5	4	212.5		12.50	*Globuligerina* aff. *bathoniana* (Pazdrowa)
15.0	96.5	4	275.0	25.00		*Globuligerina oxfordiana* (Grigelis)
15.0	100.5	3	212.5		18.75	*Globuligerina* aff. *bathoniana* (Pazdrowa)
15.0	106.0	4	262.5		18.75	*Globuligerina* aff. *bathoniana* (Pazdrowa)
15.5	104.0	3	200.0	25.00		*Globuligerina oxfordiana* (Grigelis)
15.5	102.0	3	225.0		18.75	*Globuligerina* aff. *bathoniana* (Pazdrowa)
15.5	97.5	4	300.0	25.00		*Globuligerina oxfordiana* (Grigelis)
15.5	96.0	3	250.0		18.75	*Globuligerina* aff. *bathoniana* (Pazdrowa)
15.5	94.0	3	225.0		12.50	*Globuligerina* aff. *bathoniana* (Pazdrowa)
15.5	93.0	4	175.0		12.50	*Globuligerina oxfordiana* (Grigelis)
15.5	93.0	4	237.5		18.75	*Globuligerina* aff. *bathoniana* (Pazdrowa)
15.5	91.0	4	325.0		18.75	*Globuligerina bathoniana gigantea* Wernli & Görög
15.5	91.0	3	287.5		18.75	*Globuligerina bathoniana gigantea* Wernli & Görög
15.5	87.5	3	225.0		18.75	*Globuligerina* aff. *bathoniana* (Pazdrowa)
15.5	86.5	4	250.0	31.25		*Globuligerina oxfordiana* (Grigelis)
16.0	85.0	3	225.0		12.50	*Globuligerina* aff. *bathoniana* (Pazdrowa)
16.0	85.5	4	262.5		12.50	*Globuligerina bathoniana gigantea* Wernli & Görög
16.0	87.5	5	275.0	25.00		*Globuligerina oxfordiana* (Grigelis)
16.0	87.5	4	300.0	25.00		*Globuligerina oxfordiana* (Grigelis)
16.0	88.5	4	287.5	25.00		*Globuligerina oxfordiana* (Grigelis)
16.0	88.5	4	250.0		18.75	*Globuligerina* aff. *bathoniana* (Pazdrowa)
16.0	92.5	4	225.0		18.75	*Globuligerina* aff. *bathoniana* (Pazdrowa)
16.0	94.0	3	225.0		18.75	*Globuligerina* aff. *bathoniana* (Pazdrowa)
16.0	95.5	3	200.0	25.00		*Globuligerina oxfordiana* (Grigelis)
16.0	96.0	3	250.0	25.00		*Globuligerina oxfordiana* (Grigelis)
16.0	96.5	3	187.5		18.75	*Globuligerina* aff. *bathoniana* (Pazdrowa)
16.0	97.0	3	212.5		18.75	*Globuligerina* aff. *bathoniana* (Pazdrowa)
16.0	97.5	4	262.5	37.50		*Globuligerina oxfordiana* (Grigelis)
16.0	99.5	3	225.0	25.00		*Globuligerina oxfordiana* (Grigelis)
16.0	100.0	3	300.0	25.00		*Globuligerina oxfordiana* (Grigelis)
16.0	100.5	3	225.0		18.75	*Globuligerina* aff. *bathoniana* (Pazdrowa)
16.0	104.0	4	225.0	25.00		*Globuligerina oxfordiana* (Grigelis)
16.0	104.0	3	262.5	31.25		*Globuligerina oxfordiana* (Grigelis)
16.0	104.5	4	287.5		18.75	*Globuligerina bathoniana gigantea* Wernli & Görög
16.0	105.5	3	237.5	37.50		*Globuligerina oxfordiana* (Grigelis)
16.0	106.5	4	200.0		18.75	*Globuligerina* aff. *bathoniana* (Pazdrowa)
16.0	109.5	4	275.0	25.00		*Globuligerina oxfordiana* (Grigelis)

CZORSZTYN SUCCESSION: CZORSZTYN CASTLE KLIPPE - CzZ 5b (OXFORDIAN)

Thin Section Co-ordinates		No. of Chambers Visible	Maximum Diameter (µm)	Wall Thickness (µm)		Species
Vert	Hor			Thick	Thin	
16.0	109.5	3	237.5	25.00		*Globuligerina oxfordiana* (Grigelis)
16.0	112.5	4	250.0		18.75	*Globuligerina* aff. *bathoniana* (Pazdrowa)
16.0	113.0	4	275.0		18.75	*Globuligerina bathoniana gigantea* Wernli & Görög
16.0	114.0	3	225.0		18.75	*Globuligerina* aff. *bathoniana* (Pazdrowa)
16.5	109.5	4	250.0		18.75	*Globuligerina* aff. *bathoniana* (Pazdrowa)
16.5	105.5	4	287.5		18.75	*Globuligerina bathoniana gigantea* Wernli & Görög
16.5	105.0	3	175.0		18.75	*Globuligerina oxfordiana* (Grigelis)
16.5	104.0	3	275.0	25.00		*Globuligerina oxfordiana* (Grigelis)
16.5	104.0	4	212.5	37.50		*Globuligerina oxfordiana* (Grigelis)
16.5	103.0	3	300.0		18.75	*Globuligerina* aff. *bathoniana* (Pazdrowa)
16.5	102.0	3	237.5	25.00		*Globuligerina oxfordiana* (Grigelis)
16.5	100.0	3	250.0		18.75	*Globuligerina* aff. *bathoniana* (Pazdrowa)
16.5	100.0	3	200.0		18.75	*Globuligerina* aff. *bathoniana* (Pazdrowa)
16.5	99.5	3	262.5		12.50	*Globuligerina bathoniana gigantea* Wernli & Görög
16.5	99.0	3	237.5		12.50	*Globuligerina* aff. *bathoniana* (Pazdrowa)
16.5	97.5	4	212.5	50.00		*Globuligerina oxfordiana* (Grigelis)
16.5	96.0	4	262.5	37.50		*Globuligerina oxfordiana* (Grigelis)
16.5	96.0	4	225.0	37.50		*Globuligerina oxfordiana* (Grigelis)
16.5	94.0	4	250.0	31.25		*Globuligerina oxfordiana* (Grigelis)
16.5	92.5	3	225.0		18.75	*Globuligerina* aff. *bathoniana* (Pazdrowa)
16.5	92.0	3	237.5		18.75	*Globuligerina* aff. *bathoniana* (Pazdrowa)
16.5	90.5	3	212.5	31.25		*Globuligerina oxfordiana* (Grigelis)
16.5	90.0	4	212.5	31.25		*Globuligerina oxfordiana* (Grigelis)
16.5	88.5	4	237.5	25.00		*Globuligerina oxfordiana* (Grigelis)
17.0	85.0	4	237.5		18.75	*Globuligerina* aff. *bathoniana* (Pazdrowa)
17.0	85.5	3	225.0	25.00		*Globuligerina oxfordiana* (Grigelis)
17.0	87.5	3	275.0		18.75	*Globuligerina bathoniana gigantea* Wernli & Görög
17.0	88.0	3	250.0		18.75	*Globuligerina* aff. *bathoniana* (Pazdrowa)
17.0	89.0	3	212.5		18.75	*Globuligerina* aff. *bathoniana* (Pazdrowa)
17.0	90.0	4	212.5		18.75	*Globuligerina* aff. *bathoniana* (Pazdrowa)
17.0	91.0	4	300.0	37.50		*Globuligerina oxfordiana* (Grigelis)
17.0	92.0	4	250.0	25.00		*Globuligerina oxfordiana* (Grigelis)
17.0	92.5	3	150.0		12.50	*Globuligerina oxfordiana* (Grigelis)
17.0	94.0	4	187.5	31.25		*Globuligerina oxfordiana* (Grigelis)
17.0	96.0	4	225.0	25.00		*Globuligerina oxfordiana* (Grigelis)
17.0	98.0	3	200.0	25.00		*Globuligerina oxfordiana* (Grigelis)
17.0	98.0	3	162.5	25.00		*Globuligerina oxfordiana* (Grigelis)
17.0	101.0	4	200.0	25.00		*Globuligerina oxfordiana* (Grigelis)
17.0	109.5	4	300.0	37.50		*Globuligerina oxfordiana* (Grigelis)
17.0	114.0	3	275.0	37.50		*Globuligerina oxfordiana* (Grigelis)
17.5	113.5	3	150.0		18.75	*Globuligerina oxfordiana* (Grigelis)
17.5	113.0	4	175.0	25.00		*Globuligerina oxfordiana* (Grigelis)
17.5	112.5	4	237.5		12.50	*Globuligerina* aff. *bathoniana* (Pazdrowa)
17.5	109.5	4	237.5		18.75	*Globuligerina* aff. *bathoniana* (Pazdrowa)
17.5	108.5	4	312.5	25.00		*Globuligerina oxfordiana* (Grigelis)
17.5	108.0	4	325.0	25.00		*Globuligerina oxfordiana* (Grigelis)
17.5	107.5	4	187.5	25.00		*Globuligerina oxfordiana* (Grigelis)
17.5	107.0	4	325.0	25.00		*Globuligerina oxfordiana* (Grigelis)
17.5	106.0	4	275.0		18.75	*Globuligerina bathoniana gigantea* Wernli & Görög
17.5	104.0	4	312.5	25.00		*Globuligerina oxfordiana* (Grigelis)
17.5	103.5	3	262.5		18.75	*Globuligerina bathoniana gigantea* Wernli & Görög
17.5	102.5	3	250.0	31.25		*Globuligerina oxfordiana* (Grigelis)
17.5	99.5	3	337.5	25.00		*Globuligerina oxfordiana* (Grigelis)
17.5	98.5	3	250.0	25.00		*Globuligerina oxfordiana* (Grigelis)
17.5	95.5	4	250.0	25.00		*Globuligerina oxfordiana* (Grigelis)

CZORSZTYN SUCCESSION: CZORSZTYN CASTLE KLIPPE - CzZ 5b (OXFORDIAN)

Thin Section Co-ordinates		No. of Chambers Visible	Maximum Diameter (µm)	Wall Thickness (µm)		Species
Vert	Hor			Thick	Thin	
17.5	94.5	4	275.0	31.25		*Globuligerina oxfordiana* (Grigelis)
17.5	94.0	3	250.0		18.75	*Globuligerina* aff. *bathoniana* (Pazdrowa)
17.5	94.0	3	225.0		18.75	*Globuligerina* aff. *bathoniana* (Pazdrowa)
17.5	93.0	4	237.5	50.00		*Globuligerina oxfordiana* (Grigelis)
17.5	91.0	4	250.0	37.50		*Globuligerina oxfordiana* (Grigelis)
17.5	89.0	4	287.5	31.25		*Globuligerina oxfordiana* (Grigelis)
17.5	88.0	3	262.5	37.50		*Globuligerina oxfordiana* (Grigelis)
17.5	86.0	3	325.0		18.75	*Globuligerina bathoniana gigantea* Wernli & Görög
17.5	86.0	3	237.5		12.50	*Globuligerina* aff. *bathoniana* (Pazdrowa)
17.5	85.0	4	212.5	25.00		*Globuligerina oxfordiana* (Grigelis)
18.0	80.0	3	237.5	25.00		*Globuligerina oxfordiana* (Grigelis)
18.0	84.0	4	275.0	37.50		*Globuligerina oxfordiana* (Grigelis)
18.0	91.0	4	250.0	25.00		*Globuligerina oxfordiana* (Grigelis)
18.0	94.0	3	175.0		18.75	*Globuligerina oxfordiana* (Grigelis)
18.0	97.0	3	275.0	31.25		*Globuligerina oxfordiana* (Grigelis)
18.0	109.0	3	225.0		18.75	*Globuligerina* aff. *bathoniana* (Pazdrowa)
18.0	109.0	3	225.0		18.75	*Globuligerina* aff. *bathoniana* (Pazdrowa)
18.5	110.0	4	250.0	37.50		*Globuligerina oxfordiana* (Grigelis)
18.5	108.0	3	175.0	50.00		*Globuligerina oxfordiana* (Grigelis)
18.5	106.5	3	275.0	25.00		*Globuligerina oxfordiana* (Grigelis)
18.5	106.0	4	325.0	25.00		*Globuligerina oxfordiana* (Grigelis)
18.5	99.5	4	300.0	25.00		*Globuligerina oxfordiana* (Grigelis)
18.5	96.5	3	237.5	37.50		*Globuligerina oxfordiana* (Grigelis)
18.5	96.5	3	250.0		12.50	*Globuligerina* aff. *bathoniana* (Pazdrowa)
18.5	96.0	4	275.0		12.50	*Globuligerina bathoniana gigantea* Wernli & Görög
18.5	95.5	3	250.0		18.75	*Globuligerina* aff. *bathoniana* (Pazdrowa)
18.5	92.0	3	237.5	31.25		*Globuligerina oxfordiana* (Grigelis)
18.5	91.0	3	200.0	25.00		*Globuligerina oxfordiana* (Grigelis)
19.0	84.0	4	275.0		18.75	*Globuligerina bathoniana gigantea* Wernli & Görög
19.0	91.0	4	250.0		18.75	*Globuligerina* aff. *bathoniana* (Pazdrowa)
19.0	91.5	4	250.0	25.00		*Globuligerina oxfordiana* (Grigelis)
19.0	93.0	4	287.5		18.75	*Globuligerina bathoniana gigantea* Wernli & Görög
19.0	97.5	3	300.0	43.75		*Globuligerina oxfordiana* (Grigelis)
19.0	100.0	5	337.5	25.00		*Globuligerina oxfordiana* (Grigelis)
19.0	100.5	4	187.5	37.50		*Globuligerina oxfordiana* (Grigelis)
19.0	101.0	3	262.5	25.00		*Globuligerina oxfordiana* (Grigelis)
19.0	105.0	4	262.5	37.50		*Globuligerina oxfordiana* (Grigelis)
19.0	109.0	4	275.0		18.75	*Globuligerina bathoniana gigantea* Wernli & Görög
19.0	110.0	4	225.0	31.25		*Globuligerina oxfordiana* (Grigelis)
19.0	111.5	3	275.0	25.00		*Globuligerina oxfordiana* (Grigelis)
19.5	110.5	4	237.5		18.75	*Globuligerina* aff. *bathoniana* (Pazdrowa)
19.5	108.5	3	262.5		18.75	*Globuligerina bathoniana gigantea* Wernli & Görög
19.5	108.0	3	250.0	37.50		*Globuligerina oxfordiana* (Grigelis)
19.5	106.0	3	237.5	31.25		*Globuligerina oxfordiana* (Grigelis)
19.5	105.5	4	262.5	31.25		*Globuligerina oxfordiana* (Grigelis)
19.5	103.0	4	300.0	31.25		*Globuligerina oxfordiana* (Grigelis)
19.5	98.5	3	212.5		18.75	*Globuligerina* aff. *bathoniana* (Pazdrowa)
19.5	97.5	4	262.5		18.75	*Globuligerina bathoniana gigantea* Wernli & Görög
19.5	94.0	4	200.0	25.00		*Globuligerina oxfordiana* (Grigelis)
19.5	93.0	4	275.0	25.00		*Globuligerina oxfordiana* (Grigelis)
19.5	91.5	3	212.5	25.00		*Globuligerina oxfordiana* (Grigelis)
19.5	91.0	4	225.0	37.50		*Globuligerina oxfordiana* (Grigelis)
19.5	90.5	4	287.5		18.75	*Globuligerina bathoniana gigantea* Wernli & Görög
19.5	89.0	4	212.5	37.50		*Globuligerina oxfordiana* (Grigelis)
19.5	88.5	3	262.5		18.75	*Globuligerina bathoniana gigantea* Wernli & Görög

CZORSZTYN SUCCESSION: CZORSZTYN CASTLE KLIPPE - CzZ 5b (OXFORDIAN)

Thin Section Co-ordinates		No. of Chambers Visible	Maximum Diameter (µm)	Wall Thickness (µm)		Species
Vert	Hor			Thick	Thin	
19.5	87.0	3	225.0	37.50		*Globuligerina oxfordiana* (Grigelis)
19.5	86.5	3	287.5	25.00		*Globuligerina oxfordiana* (Grigelis)
19.5	86.0	4	237.5		18.75	*Globuligerina* aff. *bathoniana* (Pazdrowa)
20.0	89.0	3	225.0		12.50	*Globuligerina* aff. *bathoniana* (Pazdrowa)
20.0	90.0	4	225.0	25.00		*Globuligerina oxfordiana* (Grigelis)
20.0	90.5	3	225.0	31.25		*Globuligerina oxfordiana* (Grigelis)
20.0	92.0	3	212.5	31.25		*Globuligerina oxfordiana* (Grigelis)
20.0	92.5	4	237.5		18.75	*Globuligerina* aff. *bathoniana* (Pazdrowa)
20.0	93.5	4	250.0		18.75	*Globuligerina* aff. *bathoniana* (Pazdrowa)
20.0	96.0	3	237.5		18.75	*Globuligerina* aff. *bathoniana* (Pazdrowa)
20.0	96.0	4	187.5		12.50	*Globuligerina* aff. *bathoniana* (Pazdrowa)
20.0	96.5	3	212.5	25.00		*Globuligerina oxfordiana* (Grigelis)
20.0	97.5	4	250.0	37.50		*Globuligerina oxfordiana* (Grigelis)
20.0	98.5	3	250.0	25.00		*Globuligerina oxfordiana* (Grigelis)
20.0	101.5	3	250.0		18.75	*Globuligerina* aff. *bathoniana* (Pazdrowa)
20.0	105.5	3	237.5		18.75	*Globuligerina* aff. *bathoniana* (Pazdrowa)
20.0	106.0	3	262.5		18.75	*Globuligerina bathoniana gigantea* Wernli & Görög
20.0	106.0	4	250.0	25.00		*Globuligerina oxfordiana* (Grigelis)
20.0	106.5	3	250.0	31.25		*Globuligerina oxfordiana* (Grigelis)
20.0	110.5	4	250.0	25.00		*Globuligerina oxfordiana* (Grigelis)
20.5	110.0	4	275.0	50.00		*Globuligerina oxfordiana* (Grigelis)
20.5	109.0	3	187.5		18.75	*Globuligerina oxfordiana* (Grigelis)
20.5	106.5	4	250.0	37.50		*Globuligerina* aff. *bathoniana* (Pazdrowa)
20.5	10.0	4	187.5		18.75	*Globuligerina oxfordiana* (Grigelis)
20.5	104.5	3	187.5	37.50		*Globuligerina oxfordiana* (Grigelis)
20.5	103.5	4	237.5	25.00		*Globuligerina oxfordiana* (Grigelis)
20.5	101.5	4	237.5		18.75	*Globuligerina* aff. *bathoniana* (Pazdrowa)
20.5	100.5	4	287.5		12.50	*Globuligerina bathoniana gigantea* Wernli & Görög
20.5	100.0	4	262.5	37.50		*Globuligerina oxfordiana* (Grigelis)
20.5	99.5	3	250.0	25.00		*Globuligerina oxfordiana* (Grigelis)
20.5	99.5	3	212.5	31.25		*Globuligerina oxfordiana* (Grigelis)
20.5	99.0	3	262.5	25.00		*Globuligerina oxfordiana* (Grigelis)
20.5	98.5	3	262.5	37.50		*Globuligerina oxfordiana* (Grigelis)
20.5	98.0	3	250.0		18.75	*Globuligerina* aff. *bathoniana* (Pazdrowa)
20.5	97.0	4	237.5	37.50		*Globuligerina oxfordiana* (Grigelis)
20.5	96.0	4	237.5	37.50		*Globuligerina oxfordiana* (Grigelis)
20.5	95.5	4	212.5	31.25		*Globuligerina oxfordiana* (Grigelis)
20.5	95.0	3	212.5		18.75	*Globuligerina* aff. *bathoniana* (Pazdrowa)
20.5	94.5	3	187.5	31.25		*Globuligerina oxfordiana* (Grigelis)
20.5	92.0	4	212.5	25.00		*Globuligerina oxfordiana* (Grigelis)
20.5	91.0	4	250.0		18.75	*Globuligerina* aff. *bathoniana* (Pazdrowa)
20.5	90.0	3	287.5	43.75		*Globuligerina oxfordiana* (Grigelis)
20.5	85.5	4	175.0	31.25		*Globuligerina oxfordiana* (Grigelis)
20.5	85.0	3	200.0	37.50		*Globuligerina oxfordiana* (Grigelis)
21.0	86.0	3	200.0	25.00		*Globuligerina oxfordiana* (Grigelis)
21.0	88.0	4	262.5	25.00		*Globuligerina oxfordiana* (Grigelis)
21.0	88.0	4	225.0		18.75	*Globuligerina* aff. *bathoniana* (Pazdrowa)
21.0	88.0	4	300.0		18.75	*Globuligerina* aff. *bathoniana* (Pazdrowa)
21.0	94.0	4	200.0	31.25		*Globuligerina oxfordiana* (Grigelis)
21.0	95.0	4	237.5	37.50		*Globuligerina oxfordiana* (Grigelis)
21.0	96.0	3	250.0	37.50		*Globuligerina oxfordiana* (Grigelis)
21.0	98.0	4	225.0	25.00		*Globuligerina oxfordiana* (Grigelis)
21.0	98.5	3	212.5		18.75	*Globuligerina* aff. *bathoniana* (Pazdrowa)
21.0	100.5	3	212.5		18.75	*Globuligerina* aff. *bathoniana* (Pazdrowa)
21.0	101.5	3	212.5	37.50		*Globuligerina oxfordiana* (Grigelis)

CZORSZTYN SUCCESSION: CZORSZTYN CASTLE KLIPPE - CzZ 5b (OXFORDIAN)

Thin Section Co-ordinates		No. of Chambers Visible	Maximum Diameter (µm)	Wall Thickness (µm)		Species
Vert	Hor			Thick	Thin	
21.0	102.5	4	225.0		18.75	*Globuligerina* aff. *bathoniana* (Pazdrowa)
21.0	103.5	3	275.0		18.75	*Globuligerina bathoniana gigantea* Wernli & Görög
21.0	105.5	3	250.0		18.75	*Globuligerina* aff. *bathoniana* (Pazdrowa)
21.0	106.5	4	312.5		18.75	*Globuligerina bathoniana gigantea* Wernli & Görög
21.0	107.5	3	287.5		18.75	*Globuligerina bathoniana gigantea* Wernli & Görög
21.0	108.0	3	225.0	37.50		*Globuligerina oxfordiana* (Grigelis)
21.0	109.5	4	262.5	25.00		*Globuligerina oxfordiana* (Grigelis)
21.0	110.0	4	262.5	37.50	0.00	*Globuligerina oxfordiana* (Grigelis)
21.5	109.0	4	262.5		18.75	*Globuligerina bathoniana gigantea* Wernli & Görög
21.5	106.5	4	250.0	25.00		*Globuligerina oxfordiana* (Grigelis)
21.5	105.0	3	225.0	37.50		*Globuligerina oxfordiana* (Grigelis)
21.5	104.0	3	275.0	37.50		*Globuligerina oxfordiana* (Grigelis)
21.5	102.5	3	250.0	25.00		*Globuligerina oxfordiana* (Grigelis)
21.5	101.5	3	237.5	37.50		*Globuligerina oxfordiana* (Grigelis)
21.5	99.0	4	200.0	31.25		*Globuligerina oxfordiana* (Grigelis)
21.5	97.0	3	225.0	31.25		*Globuligerina oxfordiana* (Grigelis)
21.5	94.5	3	250.0	31.25		*Globuligerina oxfordiana* (Grigelis)
21.5	94.5	4	325.0	31.25		*Globuligerina oxfordiana* (Grigelis)
21.5	92.0	3	237.5	31.25		*Globuligerina oxfordiana* (Grigelis)
21.5	92.0	3	237.5		18.75	*Globuligerina* aff. *bathoniana* (Pazdrowa)
21.5	90.5	3	312.5		18.75	*Globuligerina bathoniana gigantea* Wernli & Görög
21.5	90.0	4	275.0	25.00		*Globuligerina oxfordiana* (Grigelis)
21.5	90.0	4	237.5	25.00		*Globuligerina oxfordiana* (Grigelis)
21.5	90.0	4	300.0	31.25		*Globuligerina oxfordiana* (Grigelis)
21.5	89.5	4	225.0		18.75	*Globuligerina* aff. *bathoniana* (Pazdrowa)
21.5	89.0	4	250.0	31.25		*Globuligerina oxfordiana* (Grigelis)
21.5	88.0	3	225.0		18.75	*Globuligerina* aff. *bathoniana* (Pazdrowa)
21.5	88.0	4	275.0		18.75	*Globuligerina bathoniana gigantea* Wernli & Görög
21.5	88.0	3	175.0		18.75	*Globuligerina* aff. *bathoniana* (Pazdrowa)
21.5	82.0	3	250.0		18.75	*Globuligerina* aff. *bathoniana* (Pazdrowa)
22.0	85.0	3	212.5	25.00		*Globuligerina oxfordiana* (Grigelis)
22.0	86.5	4	250.0	31.25		*Globuligerina oxfordiana* (Grigelis)
22.0	89.0	4	237.5	25.00		*Globuligerina oxfordiana* (Grigelis)
22.0	89.5	4	225.0		18.75	*Globuligerina* aff. *bathoniana* (Pazdrowa)
22.0	90.0	3	237.5		18.75	*Globuligerina* aff. *bathoniana* (Pazdrowa)
22.0	90.0	3	275.0	37.50		*Globuligerina oxfordiana* (Grigelis)
22.0	90.0	3	275.0	25.00		*Globuligerina oxfordiana* (Grigelis)
22.0	92.0	4	250.0		18.75	*Globuligerina* aff. *bathoniana* (Pazdrowa)
22.0	93.5	4	262.5	37.50		*Globuligerina oxfordiana* (Grigelis)
22.0	96.0	3	287.5	37.50		*Globuligerina oxfordiana* (Grigelis)
22.0	96.0	3	237.5		18.75	*Globuligerina* aff. *bathoniana* (Pazdrowa)
22.0	97.0	3	250.0		18.75	*Globuligerina* aff. *bathoniana* (Pazdrowa)
22.0	98.5	4	250.0		18.75	*Globuligerina* aff. *bathoniana* (Pazdrowa)
22.0	99.5	4	237.5	25.00		*Globuligerina oxfordiana* (Grigelis)
22.0	99.5	3	275.0		18.75	*Globuligerina bathoniana gigantea* Wernli & Görög
22.0	100.0	4	300.0	50.00		*Globuligerina oxfordiana* (Grigelis)
22.0	100.0	4	312.5	25.00		*Globuligerina oxfordiana* (Grigelis)
22.0	100.5	3	237.5	25.00		*Globuligerina oxfordiana* (Grigelis)
22.0	101.0	3	175.0		18.75	*Globuligerina* aff. *bathoniana* (Pazdrowa)
22.0	101.5	4	275.0		18.75	*Globuligerina bathoniana gigantea* Wernli & Görög
22.0	103.0	3	225.0	31.25		*Globuligerina oxfordiana* (Grigelis)
22.0	104.5	3	287.5	25.00		*Globuligerina oxfordiana* (Grigelis)
22.0	106.0	4	300.0	25.00		*Globuligerina oxfordiana* (Grigelis)
22.0	106.5	4	225.0	31.25		*Globuligerina oxfordiana* (Grigelis)
22.0	107.0	3	237.5		18.75	*Globuligerina* aff. *bathoniana* (Pazdrowa)

CZORSZTYN SUCCESSION: CZORSZTYN CASTLE KLIPPE - CzZ 5b (OXFORDIAN)

Thin Section Co-ordinates		No. of Chambers Visible	Maximum Diameter (µm)	Wall Thickness (µm)		Species
Vert	Hor			Thick	Thin	
22.0	108.0	4	337.5		18.75	*Globuligerina bathoniana gigantea* Wernli & Görög
22.5	109.0	4	237.5	43.75		*Globuligerina oxfordiana* (Grigelis)
22.5	107.5	3	250.0		18.75	*Globuligerina* aff. *bathoniana* (Pazdrowa)
22.5	107.5	4	250.0	25.00		*Globuligerina oxfordiana* (Grigelis)
22.5	107.0	3	225.0		18.75	*Globuligerina* aff. *bathoniana* (Pazdrowa)
22.5	107.0	3	212.5	31.25	0.00	*Globuligerina oxfordiana* (Grigelis)
22.5	106.0	4	250.0	37.50	0.00	*Globuligerina oxfordiana* (Grigelis)
22.5	105.5	4	175.0		12.50	*Globuligerina* aff. *bathoniana* (Pazdrowa)
22.5	105.0	3	212.5		18.75	*Globuligerina* aff. *bathoniana* (Pazdrowa)
22.5	104.5	3	262.5	25.00		*Globuligerina oxfordiana* (Grigelis)
22.5	104.0	4	225.0	25.00		*Globuligerina oxfordiana* (Grigelis)
22.5	103.0	4	250.0		18.75	*Globuligerina* aff. *bathoniana* (Pazdrowa)
22.5	103.0	4	275.0	25.00		*Globuligerina oxfordiana* (Grigelis)
22.5	102.0	4	262.5		18.75	*Globuligerina bathoniana gigantea* Wernli & Görög
22.5	101.0	3	250.0	37.50		*Globuligerina oxfordiana* (Grigelis)
22.5	101.0	3	150.0		18.75	*Globuligerina oxfordiana* (Grigelis)
22.5	101.0	4	300.0	37.50		*Globuligerina oxfordiana* (Grigelis)
22.5	95.0	3	200.0		18.75	*Globuligerina* aff. *bathoniana* (Pazdrowa)
22.5	94.0	3	275.0	50.00		Globuligerina oxfordiana (Grigelis)(118)
22.5	94.0	4	250.0		18.75	*Globuligerina* aff. *bathoniana* (Pazdrowa)
22.5	94.0	3	275.0	31.25		*Globuligerina oxfordiana* (Grigelis)
22.5	93.0	4	225.0	25.00		*Globuligerina oxfordiana* (Grigelis)
22.5	93.0	3	287.5	25.00		*Globuligerina oxfordiana* (Grigelis)
22.5	92.5	3	225.0	25.00		*Globuligerina oxfordiana* (Grigelis)
22.5	92.5	4	300.0	25.00		*Globuligerina oxfordiana* (Grigelis)
22.5	92.5	4	275.0	25.00		*Globuligerina oxfordiana* (Grigelis)
22.5	92.5	3	250.0	25.00		*Globuligerina oxfordiana* (Grigelis)
22.5	92.0	3	250.0		18.75	*Globuligerina* aff. *bathoniana* (Pazdrowa)
22.5	89.0	4	250.0		18.75	*Globuligerina* aff. *bathoniana* (Pazdrowa)
22.5	86.0	3	250.0		12.50	*Globuligerina* aff. *bathoniana* (Pazdrowa)
23.0	83.5	3	275.0		18.75	*Globuligerina* aff. *bathoniana* (Pazdrowa)
23.0	86.0	4	325.0		18.75	*Globuligerina bathoniana gigantea* Wernli & Görög
23.0	87.0	3	225.0		18.75	*Globuligerina* aff. *bathoniana* (Pazdrowa)
23.0	87.0	3	225.0		18.75	*Globuligerina* aff. *bathoniana* (Pazdrowa)
23.0	92.0	4	225.0		18.75	*Globuligerina* aff. *bathoniana* (Pazdrowa)
23.0	93.5	3	250.0		18.75	*Globuligerina* aff. *bathoniana* (Pazdrowa)
23.0	95.5	3	237.5	31.25		*Globuligerina oxfordiana* (Grigelis)
23.0	97.0	4	275.0		18.75	*Globuligerina bathoniana gigantea* Wernli & Görög
23.0	98.0	4	212.5	25.00		*Globuligerina oxfordiana* (Grigelis)
23.0	98.0	5	250.0		18.75	*Globuligerina oxfordiana* (Grigelis)
23.0	99.5	4	275.0	25.00		*Globuligerina oxfordiana* (Grigelis)
23.0	104.5	3	212.5	31.25		*Globuligerina oxfordiana* (Grigelis)
23.0	108.0	4	200.0		18.75	*Globuligerina* aff. *bathoniana* (Pazdrowa)
23.0	108.5	4	200.0		18.75	*Globuligerina* aff. *bathoniana* (Pazdrowa)
23.5	108.5	3	262.5		18.75	*Globuligerina bathoniana gigantea* Wernli & Görög
23.5	108.0	3	250.0	25.00		*Globuligerina oxfordiana* (Grigelis)
23.5	107.0	4	287.5		18.75	*Globuligerina bathoniana gigantea* Wernli & Görög
23.5	104.5	3	237.5	25.00		*Globuligerina oxfordiana* (Grigelis)
23.5	102.0	4	287.5		18.75	*Globuligerina bathoniana gigantea* Wernli & Görög
23.5	102.0	4	237.5		18.75	*Globuligerina* aff. *bathoniana* (Pazdrowa)
23.5	98.5	3	237.5	31.25		*Globuligerina oxfordiana* (Grigelis)
23.5	97.5	3	225.0	25.00		*Globuligerina oxfordiana* (Grigelis)
23.5	96.0	4	300.0	25.00		*Globuligerina oxfordiana* (Grigelis)
23.5	95.5	3	262.5		18.75	*Globuligerina bathoniana gigantea* Wernli & Görög
23.5	95.5	5	225.0		12.50	*Globuligerina* aff. *bathoniana* (Pazdrowa)

CZORSZTYN SUCCESSION: CZORSZTYN CASTLE KLIPPE - CzZ 5b (OXFORDIAN)

Thin Section Co-ordinates		No. of Chambers Visible	Maximum Diameter (µm)	Wall Thickness (µm)		Species
Vert	Hor			Thick	Thin	
23.5	95.0	4	275.0	25.00		*Globuligerina oxfordiana* (Grigelis)
23.5	95.0	4	262.5	37.50		*Globuligerina oxfordiana* (Grigelis)
23.5	94.5	3	275.0	31.25		*Globuligerina oxfordiana* (Grigelis)
23.5	94.0	4	237.5	37.50		*Globuligerina oxfordiana* (Grigelis)
23.5	93.5	3	162.5		6.25	*Globuligerina oxfordiana* (Grigelis)
23.5	91.5	4	187.5		18.75	*Globuligerina oxfordiana* (Grigelis)
23.5	91.0	3	212.5	25.00		*Globuligerina oxfordiana* (Grigelis)
23.5	90.5	3	262.5	31.25		*Globuligerina oxfordiana* (Grigelis)
23.5	90.5	3	200.0	31.25		*Globuligerina oxfordiana* (Grigelis)
23.5	89.5	3	212.5		18.75	*Globuligerina* aff. *bathoniana* (Pazdrowa)
23.5	87.0	4	187.5	31.25		*Globuligerina oxfordiana* (Grigelis)
Total Number of Specimens				**225**	**226**	**451**
Relative Percentages				**50**	**50**	

CZORSZTYN SUCCESSION: STANKOWA SKALA - BED 2 (PROBALY OXFORDIAN)

Thin Section Co-ordinates		No. of Chambers Visible	Maximum Diameter (µm)	Wall Thickness (µm)		Species
Vert	Hor			Thick	Thin	
3.0	79.0	3	175.0	37.50		*Globuligerina oxfordiana* (Grigelis)
4.0	84.0	3	137.5		18.75	*Globuligerina oxfordiana* (Grigelis)
4.0	93.5	4	200.0		12.50	*Globuligerina* aff. *bathoniana* (Pazdrowa)
4.5	102.0	3	150.0		12.50	*Globuligerina oxfordiana* (Grigelis)
4.5	97.5	4	175.0	25.00		*Globuligerina oxfordiana* (Grigelis)
4.5	92.0	4	150.0		18.75	*Globuligerina oxfordiana* (Grigelis)
4.5	87.0	3	175.0	25.00		*Globuligerina oxfordiana* (Grigelis)
5.0	99.0	3	150.0		12.50	*Globuligerina oxfordiana* (Grigelis)
5.0	100.5	6	200.0		18.75	*Globuligerina* aff. *bathoniana* (Pazdrowa)
5.5	94.0	4	162.5		18.75	*Globuligerina oxfordiana* (Grigelis)
5.5	93.5	4	175.0	25.00		*Globuligerina oxfordiana* (Grigelis)
5.5	93.0	4	150.0		18.75	*Globuligerina oxfordiana* (Grigelis)
5.5	93.0	4	162.5		12.50	*Globuligerina oxfordiana* (Grigelis)
5.5	93.0	3	162.5	25.00		*Globuligerina oxfordiana* (Grigelis)
5.5	92.5	3	175.0		18.75	*Globuligerina oxfordiana* (Grigelis)
6.0	94.0	3	200.0	25.00		*Globuligerina oxfordiana* (Grigelis)
6.5	106.0	4	225.0		18.75	*Globuligerina* aff. *bathoniana* (Pazdrowa)
6.5	106.0	4	162.5		18.75	*Globuligerina oxfordiana* (Grigelis)
6.5	101.0	4	225.0	31.25		*Globuligerina oxfordiana* (Grigelis)
6.5	101.0	3	200.0		18.75	*Globuligerina* aff. *bathoniana* (Pazdrowa)
6.5	94.5	3	200.0	25.00		*Globuligerina oxfordiana* (Grigelis)
7.5	101.0	4	200.0		18.75	*Globuligerina* aff. *bathoniana* (Pazdrowa)
7.5	100.0	4	137.5		12.50	*Globuligerina oxfordiana* (Grigelis)
7.5	82.0	3	187.5		18.75	*Globuligerina oxfordiana* (Grigelis)
8.0	97.0	4	200.0		18.75	*Globuligerina* aff. *bathoniana* (Pazdrowa)
8.5	97.0	4	162.5		18.75	*Globuligerina oxfordiana* (Grigelis)
8.5	95.0	3	225.0	37.50		*Globuligerina oxfordiana* (Grigelis)
9.0	103.5	3	200.0	50.00		*Globuligerina oxfordiana* (Grigelis)
9.5	96.0	3	175.0	25.00		*Globuligerina oxfordiana* (Grigelis)
10.0	84.0	4	175.0	25.00		*Globuligerina oxfordiana* (Grigelis)
10.5	90.0	4	262.5	25.00		*Globuligerina oxfordiana* (Grigelis)
11.0	90.5	4	175.0	25.00		*Globuligerina oxfordiana* (Grigelis)
11.0	97.0	4	150.0	25.00		*Globuligerina oxfordiana* (Grigelis)
11.0	100.0	4	162.5		12.50	*Globuligerina oxfordiana* (Grigelis)
11.5	102.5	3	150.0		12.50	*Globuligerina oxfordiana* (Grigelis)
11.5	101.0	3	175.0		12.50	*Globuligerina oxfordiana* (Grigelis)
11.5	99.0	3	175.0		18.75	*Globuligerina oxfordiana* (Grigelis)
11.5	91.5	4	175.0	25.00		*Globuligerina oxfordiana* (Grigelis)
11.5	84.0	4	150.0		18.75	*Globuligerina oxfordiana* (Grigelis)
11.5	104.0	4	212.5		12.50	*Globuligerina oxfordiana* (Grigelis)
12.0	90.0	4	150.0		12.50	*Globuligerina oxfordiana* (Grigelis)
12.0	95.5	4	137.5	25.00		*Globuligerina oxfordiana* (Grigelis)
12.0	95.5	3	150.0	25.00		*Globuligerina oxfordiana* (Grigelis)
12.0	97.5	4	162.5	25.00		*Globuligerina oxfordiana* (Grigelis)
12.5	103.0	3	212.5		18.75	*Globuligerina* aff. *bathoniana* (Pazdrowa)
12.5	102.0	3	212.5		12.50	*Globuligerina* aff. *bathoniana* (Pazdrowa)
12.5	98.0	3	187.5		12.50	*Globuligerina oxfordiana* (Grigelis)
12.5	98.0	4	175.0		18.75	*Globuligerina oxfordiana* (Grigelis)
13.0	82.5	4	137.5		12.50	*Globuligerina oxfordiana* (Grigelis)
13.0	106.0	3	187.5		18.75	*Globuligerina oxfordiana* (Grigelis)
13.5	106.5	4	125.0		12.50	*Globuligerina oxfordiana* (Grigelis)
13.5	102.5	4	187.5		12.50	*Globuligerina oxfordiana* (Grigelis)
13.5	101.0	4	187.5		12.50	*Globuligerina oxfordiana* (Grigelis)
13.5	97.5	3	137.5		12.50	*Globuligerina oxfordiana* (Grigelis)
13.5	97.5	3	150.0		12.50	*Globuligerina oxfordiana* (Grigelis)

CZORSZTYN SUCCESSION: STANKOWA SKALA - BED 2 (PROBALY OXFORDIAN)

Thin Section Co-ordinates		No. of Chambers Visible	Maximum Diameter (µm)	Wall Thickness (µm)		Species
Vert	Hor			Thick	Thin	
13.5	88.5	3	162.5	25.00		*Globuligerina oxfordiana* (Grigelis)
13.5	82.5	3	137.5		12.50	*Globuligerina oxfordiana* (Grigelis)
14.0	96.5	4	200.0		18.75	*Globuligerina* aff. *bathoniana* (Pazdrowa)
14.0	100.0	4	137.5		12.50	*Globuligerina oxfordiana* (Grigelis)
14.0	103.5	4	212.5		12.50	*Globuligerina* aff. *bathoniana* (Pazdrowa)
14.5	98.5	4	150.0		18.75	*Globuligerina oxfordiana* (Grigelis)
14.5	98.5	4	175.0		18.75	*Globuligerina oxfordiana* (Grigelis)
14.5	98.0	4	137.5	25.00		*Globuligerina oxfordiana* (Grigelis)
14.5	86.0	3	200.0		12.50	*Globuligerina* aff. *bathoniana* (Pazdrowa)
15.0	102.0	3	162.5	25.00		*Globuligerina oxfordiana* (Grigelis)
15.5	105.5	4	187.5		18.75	*Globuligerina oxfordiana* (Grigelis)
15.5	97.5	4	175.0	25.00		*Globuligerina oxfordiana* (Grigelis)
15.5	97.5	3	175.0		18.75	*Globuligerina oxfordiana* (Grigelis)
15.5	94.0	4	125.0		12.50	*Globuligerina oxfordiana* (Grigelis)
15.5	90.0	4	200.0	25.00		*Globuligerina oxfordiana* (Grigelis)
16.0	89.0	3	150.0	25.00		*Globuligerina oxfordiana* (Grigelis)
16.0	95.5	3	300.0	25.00		*Globuligerina oxfordiana* (Grigelis)
16.0	97.0	5	175.0	25.00		*Globuligerina oxfordiana* (Grigelis)
16.0	98.0	3	162.5		18.75	*Globuligerina oxfordiana* (Grigelis)
16.5	101.0	4	175.0	50.00		*Globuligerina oxfordiana* (Grigelis)
16.5	101.0	4	187.5	25.00		*Globuligerina oxfordiana* (Grigelis)
16.5	98.0	3	162.5		12.50	*Globuligerina oxfordiana* (Grigelis)
16.5	98.0	4	162.5	31.25		*Globuligerina oxfordiana* (Grigelis)
16.5	94.0	4	162.5		18.75	*Globuligerina oxfordiana* (Grigelis)
16.5	93.5	3	150.0		18.75	*Globuligerina oxfordiana* (Grigelis)
16.5	90.5	3	162.5		18.75	*Globuligerina oxfordiana* (Grigelis)
16.5	87.5	4	187.5		12.50	*Globuligerina oxfordiana* (Grigelis)
17.5	100.0	3	162.5	37.50		*Globuligerina oxfordiana* (Grigelis)
17.5	93.0	3	175.0		18.75	*Globuligerina oxfordiana* (Grigelis)
17.5	86.0	3	150.0	25.00		*Globuligerina oxfordiana* (Grigelis)
18.0	94.5	4	162.5		18.75	*Globuligerina oxfordiana* (Grigelis)
18.0	104.5	3	175.0		12.50	*Globuligerina oxfordiana* (Grigelis)
18.5	98.0	3	162.5		12.50	*Globuligerina oxfordiana* (Grigelis)
19.0	99.5	3	162.5		12.50	*Globuligerina oxfordiana* (Grigelis)
19.0	100.0	4	125.0		6.25	*Globuligerina oxfordiana* (Grigelis)
19.5	90.0	3	150.0		18.75	*Globuligerina oxfordiana* (Grigelis)
20.5	91.0	3	137.5	25.00		*Globuligerina oxfordiana* (Grigelis)
21.0	94.0	3	187.5		12.50	*Globuligerina oxfordiana* (Grigelis)
21.0	97.0	3	150.0		12.50	*Globuligerina oxfordiana* (Grigelis)
21.0	102.5	5	150.0		18.75	*Globuligerina oxfordiana* (Grigelis)
21.0	102.5	3	225.0		18.75	*Globuligerina* aff. *bathoniana* (Pazdrowa)
22.0	97.5	3	150.0	37.50	#REF!	*Globuligerina oxfordiana* (Grigelis)
22.5	99.5	3	137.5		18.75	*Globuligerina oxfordiana* (Grigelis)
23.0	98.0	3	137.5	25.00		*Globuligerina oxfordiana* (Grigelis)
23.0	100.5	4	175.0	25.00		*Globuligerina oxfordiana* (Grigelis)
23.5	100.0	3	150.0		12.50	*Globuligerina oxfordiana* (Grigelis)
23.5	100.0	3	162.5	37.50		*Globuligerina oxfordiana* (Grigelis)
Total Number of Specimens				37	65	102
Relative Percentages				36	64	

CZORSZTYN SUCCESSION: KRUPIANKA CREEK - Krp 6 (KIMMERIDGIAN)

Thin Section Co-ordinates		No. of Chambers Visible	Maximum Diameter (µm)	Wall Thickness (µm)		Species
Vert	Hor			Thick	Thin	
7.0	108.0	3	225.0	25.00		*Globuligerina oxfordiana* (Grigelis)
8.0	101.5	4	162.5		18.75	*Globuligerina oxfordiana* (Grigelis)
8.0	110.0	3	162.5	25.00		*Globuligerina oxfordiana* (Grigelis)
8.5	107.5	3	137.5	25.00		*Globuligerina oxfordiana* (Grigelis)
9.0	100.5	4	175.0		12.50	*Globuligerina oxfordiana* (Grigelis)
9.0	108.5	4	162.5		18.75	*Globuligerina oxfordiana* (Grigelis)
9.0	116.0	3	200.0	25.00		*Globuligerina oxfordiana* (Grigelis)
9.5	102.5	3	175.0	25.00		*Globuligerina oxfordiana* (Grigelis)
10.0	109.5	3	175.0		18.75	*Globuligerina oxfordiana* (Grigelis)
10.0	109.5	6	187.5	25.00		*Globuligerina oxfordiana* (Grigelis)
10.0	119.0	4	200.0	31.25		*Globuligerina oxfordiana* (Grigelis)
10.5	118.5	4	187.5	31.25		*Globuligerina oxfordiana* (Grigelis)
10.5	113.0	4	175.0		12.50	*Globuligerina oxfordiana* (Grigelis)
10.5	109.5	3	162.5		18.75	*Globuligerina oxfordiana* (Grigelis)
10.5	104.5	4	162.5		12.50	*Globuligerina oxfordiana* (Grigelis)
10.5	104.0	4	175.0		12.50	*Globuligerina oxfordiana* (Grigelis)
11.0	81.5	3	150.0		12.50	*Globuligerina oxfordiana* (Grigelis)
11.0	82.0	3	200.0		18.75	*Globuligerina* aff. *bathoniana* (Pazdrowa)
11.0	117.5	3	137.5		12.50	*Globuligerina oxfordiana* (Grigelis)
11.0	118.5	3	150.0		12.50	*Globuligerina oxfordiana* (Grigelis)
11.5	117.0	3	137.5		12.50	*Globuligerina oxfordiana* (Grigelis)
11.5	105.5	3	200.0		12.50	*Globuligerina* aff. *bathoniana* (Pazdrowa)
11.5	82.0	8	212.5		18.75	*Globuligerina* aff. *bathoniana* (Pazdrowa)
12.0	76.0	4	162.5		18.75	*Globuligerina oxfordiana* (Grigelis)
12.0	89.0	5	137.5		12.50	*Globuligerina oxfordiana* (Grigelis)
12.0	103.0	4	125.0		18.75	*Globuligerina oxfordiana* (Grigelis)
12.0	103.0	3	162.5	25.00		*Globuligerina oxfordiana* (Grigelis)
12.0	106.0	3	200.0		12.50	*Globuligerina oxfordiana* (Grigelis)
12.5	118.5	5	262.5		12.50	*Globuligerina bathoniana gigantea* Wernli & Görög
12.5	85.5	3	125.0		18.75	*Globuligerina oxfordiana* (Grigelis)
12.5	81.0	3	150.0		12.50	*Globuligerina oxfordiana* (Grigelis)
12.5	78.0	3	175.0		12.50	*Globuligerina oxfordiana* (Grigelis)
12.5	77.5	3	200.0		12.50	*Globuligerina* aff. *bathoniana* (Pazdrowa)
12.5	76.5	4	100.0		6.25	*Globuligerina oxfordiana* (Grigelis)
13.0	77.0	3	200.0		12.50	*Globuligerina* aff. *bathoniana* (Pazdrowa)
13.0	112.5	5	150.0		12.50	*Globuligerina oxfordiana* (Grigelis)
13.0	113.0	3	150.0		12.50	*Globuligerina oxfordiana* (Grigelis)
13.0	113.0	3	162.5		18.75	*Globuligerina oxfordiana* (Grigelis)
13.0	117.0	3	162.5	25.00		*Globuligerina oxfordiana* (Grigelis)
13.5	108.0	4	187.5		18.75	*Globuligerina oxfordiana* (Grigelis)
13.5	96.0	4	162.5		12.50	*Globuligerina oxfordiana* (Grigelis)
13.5	77.0	3	137.5		12.50	*Globuligerina oxfordiana* (Grigelis)
13.5	75.5	4	212.5		12.50	*Globuligerina* aff. *bathoniana* (Pazdrowa)
14.0	118.0	4	187.5		18.75	*Globuligerina oxfordiana* (Grigelis)
15.0	111.0	4	162.5		18.75	*Globuligerina oxfordiana* (Grigelis)
15.0	115.0	3	187.5	25.00		*Globuligerina oxfordiana* (Grigelis)
15.5	110.5	3	212.5		12.50	*Globuligerina* aff. *bathoniana* (Pazdrowa)
15.5	109.0	4	225.0		12.50	*Globuligerina* aff. *bathoniana* (Pazdrowa)
15.5	105.0	4	187.5		6.25	*Globuligerina oxfordiana* (Grigelis)
16.0	110.5	4	187.5	25.00		*Globuligerina oxfordiana* (Grigelis)
17.5	117.0	3	212.5		12.50	*Globuligerina* aff. *bathoniana* (Pazdrowa)
17.5	111.5	3	162.5		12.50	*Globuligerina oxfordiana* (Grigelis)
18.0	112.0	3	175.0		18.75	*Globuligerina oxfordiana* (Grigelis)
18.5	103.0	3	175.0		12.50	*Globuligerina oxfordiana* (Grigelis)
19.0	107.5	3	150.0		12.50	*Globuligerina oxfordiana* (Grigelis)

CZORSZTYN SUCCESSION: KRUPIANKA CREEK - Krp 6 (KIMMERIDGIAN)

Thin Section Co-ordinates		No. of Chambers Visible	Maximum Diameter (µm)	Wall Thickness (µm)		Species
Vert	Hor			Thick	Thin	
20.0	103.0	4	200.0		12.50	*Globuligerina* aff. *bathoniana* (Pazdrowa)
20.0	106.0	3	150.0	31.25	0.00	*Globuligerina oxfordiana* (Grigelis)
Total Number of Specimens				**13**	**44**	**57**
Relative Percentages				**23**	**77**	

AUENSTEIN - SAMPLE Au26 (OXFORDIAN - TRANSVERSARIUM ZONE)

Thin Section Co-ordinates		No. of Chambers Visible	Max. Diameter (µm)	Wall Thickness (µm)		Species
Vert	Hor			Thick	Thin	
2) 8.0	112.0	5	255.00		15.00	*Globuligerina oxfordiana* (Grigelis)
8.5	99.0	4	95.00		15.00	*Globuligerina oxfordiana* (Grigelis)
12.5	98.0	4	110.00		15.00	*Globuligerina oxfordiana* (Grigelis)
13.0	88.0	3	170.00	25.00		*Globuligerina oxfordiana* (Grigelis)
R) 7.0	100.0	3	90.00		12.50	*Globuligerina oxfordiana* (Grigelis)
9.0	111.0	3	135.00	25.00		*Globuligerina oxfordiana* (Grigelis)
9.0	111.0	3	155.00		20.00	*Globuligerina oxfordiana* (Grigelis)
9.0	112.5	4	160.00		15.00	*Globuligerina oxfordiana* (Grigelis)
11.0	102.5	7	130.00		15.00	*Globuligerina oxfordiana* (Grigelis)
12.0	102.0	3	110.00		15.00	*Globuligerina oxfordiana* (Grigelis)
13.0	93.5	4	125.00		12.50	*Globuligerina oxfordiana* (Grigelis)
18.0	105.5	4	100.00		18.75	*Globuligerina oxfordiana* (Grigelis)
20.5	116.0	3	150.00		18.75	*Globuligerina oxfordiana* (Grigelis)
22.5	111.0	5	125.00		18.75	*Globuligerina oxfordiana* (Grigelis)
22.5	111.0	4	125.00		18.75	*Globuligerina oxfordiana* (Grigelis)
22.5	102.0	4	140.00		20.00	*Globuligerina oxfordiana* (Grigelis)
22.5	102.0	3	120.00		20.00	*Globuligerina oxfordiana* (Grigelis)
Total Number of Specimens				**2**	**15**	**17**
Relative Percentages				**12**	**88**	

GANTRISCH - SAMPLE Ga8 (OXFORDIAN - TRANSVERSARIUM ZONE)

Thin Section Co-ordinates		No. of Chambers Visible	Max. Diameter (µm)	Wall Thickness (µm)		Species
Vert	Hor			Thick	Thin	
1) 3.5	101.5	4	90.00		10.00	*Globuligerina oxfordiana* (Grigelis)
3.5	108.5	3	85.00		7.50	*Globuligerina oxfordiana* (Grigelis)
5.0	109.5	4	135.00		7.50	*Globuligerina oxfordiana* (Grigelis)
14.5	95.0	5	122.50		7.50	*Globuligerina oxfordiana* (Grigelis)
15.0	92.5	3	125.00		15.00	*Globuligerina oxfordiana* (Grigelis)
17.0	104.0	5	105.00		5.00	*Globuligerina oxfordiana* (Grigelis)
17.5	101.0	3	110.00		12.50	*Globuligerina oxfordiana* (Grigelis)
18.0	99.0	3	90.00		5.00	*Globuligerina oxfordiana* (Grigelis)
19.0	104.5	4	120.00		5.00	*Globuligerina oxfordiana* (Grigelis)
19.5	111.0	4	130.00		10.00	*Globuligerina oxfordiana* (Grigelis)
20.5	105.0	4	110.00		7.50	*Globuligerina oxfordiana* (Grigelis)
2) 4.0	100.0	4	105.00		5.00	*Globuligerina oxfordiana* (Grigelis)
10.0	109.5	4	100.00		7.50	*Globuligerina oxfordiana* (Grigelis)
22.0	102.5	4	85.00		12.50	*Globuligerina oxfordiana* (Grigelis)
24.0	104.5	4	110.00		12.50	*Globuligerina oxfordiana* (Grigelis)
R) 4.5	89.5	4	115.00		15.00	*Globuligerina oxfordiana* (Grigelis)
4.5	107.5	4	125.00		7.50	*Globuligerina oxfordiana* (Grigelis)
10.0	122.5	3	175.00		7.50	*Globuligerina oxfordiana* (Grigelis)
Total Number of Specimens				**0**	**18**	**18**
Relative Percentages				**0**	**100**	

NISSIBACH - SAMPLE Ni10 (OXFORDIAN - TRANSVERSARIUM ZONE)

Thin Section Co-ordinates		No. of Chambers Visible	Maximum Diameter (µm)	Wall Thickness (µm)		Species
Vert	Hor			Thick	Thin	
1) 3.0	101.0	4	330.00		20.00	*Globuligerina oxfordiana* (Grigelis)
3.0	101.5	3	270.00		20.00	*Globuligerina oxfordiana* (Grigelis)
3.0	102.0	4	235.00		20.00	*Globuligerina oxfordiana* (Grigelis)
3.0	102.0	7	200.00		20.00	*Globuligerina oxfordiana* (Grigelis)
3.0	102.5	3	200.00		7.50	*Globuligerina oxfordiana* (Grigelis)
3.0	103.0	4	275.00		20.00	*Globuligerina oxfordiana* (Grigelis)
3.0	104.0	3	190.00		12.50	*Globuligerina oxfordiana* (Grigelis)
3.5	98.0	6	255.00		20.00	*Globuligerina oxfordiana* (Grigelis)
4.0	104.0	4	110.00		7.50	*Globuligerina oxfordiana* (Grigelis)
4.0	101.0	2	150.00		10.00	*Globuligerina oxfordiana* (Grigelis)
5.5	89.0	3	225.00		15.00	*Globuligerina oxfordiana* (Grigelis)
6.0	102.0	5	225.00		15.00	*Globuligerina oxfordiana* (Grigelis)
6.0	101.0	4	150.00		15.00	*Globuligerina oxfordiana* (Grigelis)
6.0	100.0	2	175.00		15.00	*Globuligerina oxfordiana* (Grigelis)
6.0	97.0	5	320.00		15.00	*Globuligerina oxfordiana* (Grigelis)
6.0	91.0	3	175.00		7.50	*Globuligerina oxfordiana* (Grigelis)
6.0	91.0	6	175.00		15.00	*Globuligerina oxfordiana* (Grigelis)
6.0	90.0	5	245.00	25.00		*Globuligerina oxfordiana* (Grigelis)
6.0	89.0	4	195.00		15.00	*Globuligerina oxfordiana* (Grigelis)
6.0	86.0	4	255.00		20.00	*Globuligerina oxfordiana* (Grigelis)
7.0	95.0	3	190.00		15.00	*Globuligerina oxfordiana* (Grigelis)
7.0	95.5	4	120.00		15.00	*Globuligerina oxfordiana* (Grigelis)
7.0	95.5	4	180.00		15.00	*Globuligerina oxfordiana* (Grigelis)
8.0	96.0	3	205.00		20.00	*Globuligerina oxfordiana* (Grigelis)
8.0	91.0	4	80.00		5.00	*Globuligerina oxfordiana* (Grigelis)
8.0	90.5	6	95.00		5.00	*Globuligerina oxfordiana* (Grigelis)
8.0	89.5	5	220.00		15.00	*Globuligerina oxfordiana* (Grigelis)
8.5	83.0	5	215.00		15.00	*Globuligerina oxfordiana* (Grigelis)
9.0	90.0	4	245.00	25.00		*Globuligerina oxfordiana* (Grigelis)
9.0	111.0	3	170.00		7.50	*Globuligerina oxfordiana* (Grigelis)
10.0	92.5	4	125.00		5.00	*Globuligerina oxfordiana* (Grigelis)
10.0	89.0	7	245.00		20.00	*Globuligerina oxfordiana* (Grigelis)
10.0	88.0	4	235.00	25.00		*Globuligerina oxfordiana* (Grigelis)
10.0	87.5	4	270.00	25.00		*Globuligerina oxfordiana* (Grigelis)
11.0	87.0	4	230.00		7.50	*Globuligerina* aff. *bathoniana* (Pazdrowa)
11.0	87.0	4	190.00		7.50	*Globuligerina oxfordiana* (Grigelis)
11.0	96.5	4	105.00		7.50	*Globuligerina oxfordiana* (Grigelis)
12.0	106.5	2	230.00		12.50	*Globuligerina oxfordiana* (Grigelis)
12.0	83.0	4	225.00		15.00	*Globuligerina oxfordiana* (Grigelis)
12.5	107.0	4	240.00		12.50	*Globuligerina oxfordiana* (Grigelis)
13.0	106.0	4	230.00		15.00	*Globuligerina oxfordiana* (Grigelis)
13.0	106.0	4	300.00		10.00	*Globuligerina oxfordiana* (Grigelis)
14.0	105.5	5	235.00		7.50	*Globuligerina* aff. *bathoniana* (Pazdrowa)
14.0	105.0	5	180.00		7.50	*Globuligerina oxfordiana* (Grigelis)
14.0	100.0	3	195.00	30.00		*Globuligerina oxfordiana* (Grigelis)
14.0	96.0	3	140.00		20.00	*Globuligerina oxfordiana* (Grigelis)
14.0	95.0	3	210.00		15.00	*Globuligerina oxfordiana* (Grigelis)
14.5	83.5	3	250.00	25.00		*Globuligerina oxfordiana* (Grigelis)
15.0	98.5	3	140.00		7.50	*Globuligerina oxfordiana* (Grigelis)
15.0	101.5	3	245.00		15.00	*Globuligerina oxfordiana* (Grigelis)
15.0	103.0	4	230.00		15.00	*Globuligerina oxfordiana* (Grigelis)
15.0	106.0	5	225.00		15.00	*Globuligerina oxfordiana* (Grigelis)
15.0	106.5	5	240.00		20.00	*Globuligerina oxfordiana* (Grigelis)
16.0	100.5	4	165.00		10.00	*Globuligerina oxfordiana* (Grigelis)
16.0	99.5	3	120.00		7.50	*Globuligerina oxfordiana* (Grigelis)

NISSIBACH - SAMPLE Ni10 (OXFORDIAN - TRANSVERSARIUM ZONE)

Thin Section Co-ordinates		No. of Chambers Visible	Maximum Diameter (µm)	Wall Thickness (µm)		Species
Vert	Hor			Thick	Thin	
16.0	86.0	4	175.00		7.50	*Globuligerina oxfordiana* (Grigelis)
17.0	84.5	3	170.00		15.00	*Globuligerina oxfordiana* (Grigelis)
17.0	97.5	5	200.00		10.00	*Globuligerina oxfordiana* (Grigelis)
17.0	108.0	4	250.00		15.00	*Globuligerina oxfordiana* (Grigelis)
17.5	107.0	4	220.00		15.00	*Globuligerina oxfordiana* (Grigelis)
18.0	99.5	4	160.00		15.00	*Globuligerina oxfordiana* (Grigelis)
19.0	93.5	6	220.00		20.00	*Globuligerina oxfordiana* (Grigelis)
19.0	103.5	4	150.00		7.50	*Globuligerina oxfordiana* (Grigelis)
19.0	106.0	3	270.00		20.00	*Globuligerina oxfordiana* (Grigelis)
20.0	89.5	4	180.00		20.00	*Globuligerina oxfordiana* (Grigelis)
20.0	83.5	4	170.00		15.00	*Globuligerina oxfordiana* (Grigelis)
21.0	98.0	4	145.00		12.50	*Globuligerina oxfordiana* (Grigelis)
23.5	85.0	3	165.00		12.50	*Globuligerina oxfordiana* (Grigelis)
23.5	97.0	4	190.00		12.50	*Globuligerina oxfordiana* (Grigelis)
24.0	97.0	4	250.00		20.00	*Globuligerina oxfordiana* (Grigelis)
24.0	96.5	3	170.00		12.50	*Globuligerina oxfordiana* (Grigelis)
24.0	94.5	4	185.00		12.50	*Globuligerina oxfordiana* (Grigelis)
24.5	91.0	4	220.00	25.00		*Globuligerina oxfordiana* (Grigelis)
2) 4.0	102.5	5	245.00	30.00		*Globuligerina oxfordiana* (Grigelis)
4.0	88.0	3	275.00	30.00		*Globuligerina oxfordiana* (Grigelis)
4.0	78.0	3	180.00	30.00		*Globuligerina oxfordiana* (Grigelis)
6.0	87.0	4	270.00		15.00	*Globuligerina oxfordiana* (Grigelis)
6.0	86.0	4	210.00		7.50	*Globuligerina* aff. *bathoniana* (Pazdrowa)
7.0	99.0	4	180.00	30.00		*Globuligerina oxfordiana* (Grigelis)
8.0	111.5	4	270.00	25.00		*Globuligerina oxfordiana* (Grigelis)
8.0	99.0	4	130.00		15.00	*Globuligerina oxfordiana* (Grigelis)
10.0	108.0	3	185.00	25.00		*Globuligerina oxfordiana* (Grigelis)
10.0	93.0	3	145.00		7.50	*Globuligerina oxfordiana* (Grigelis)
10.0	87.5	7	240.00	25.00		*Globuligerina oxfordiana* (Grigelis)
11.0	92.5	4	185.00		15.00	*Globuligerina oxfordiana* (Grigelis)
13.0	107.0	3	240.00		15.00	*Globuligerina oxfordiana* (Grigelis)
14.5	88.0	3	175.00		10.00	*Globuligerina oxfordiana* (Grigelis)
15.0	109.0	3	160.00		10.00	*Globuligerina oxfordiana* (Grigelis)
15.0	109.0	4	245.00		15.00	*Globuligerina oxfordiana* (Grigelis)
16.0	105.0	4	250.00		15.00	*Globuligerina oxfordiana* (Grigelis)
16.0	103.5	3	155.00		15.00	*Globuligerina oxfordiana* (Grigelis)
16.0	103.5	3	150.00		7.50	*Globuligerina oxfordiana* (Grigelis)
16.0	102.0	4	225.00	25.00		*Globuligerina oxfordiana* (Grigelis)
17.0	96.0	5	300.00	25.00		*Globuligerina oxfordiana* (Grigelis)
17.0	103.5	4	260.00	25.00		*Globuligerina oxfordiana* (Grigelis)
17.0	105.5	4	215.00	22.50		*Globuligerina oxfordiana* (Grigelis)
17.0	107.0	4	200.00		5.00	*Globuligerina* aff. *bathoniana* (Pazdrowa)
18.0	106.5	4	300.00	25.00		*Globuligerina oxfordiana* (Grigelis)
18.0	105.5	4	260.00	25.00		*Globuligerina oxfordiana* (Grigelis)
19.0	103.0	4	310.00		20.00	*Globuligerina oxfordiana* (Grigelis)
19.0	107.0	6	265.00		15.00	*Globuligerina oxfordiana* (Grigelis)
19.5	87.5	4	140.00		7.50	*Globuligerina oxfordiana* (Grigelis)
20.5	106.5	3	165.00		7.50	*Globuligerina oxfordiana* (Grigelis)
20.5	104.5	4	225.00	25.00		*Globuligerina oxfordiana* (Grigelis)
20.5	102.0	4	295.00		12.50	*Globuligerina oxfordiana* (Grigelis)
20.5	99.0	4	120.00		12.50	*Globuligerina oxfordiana* (Grigelis)
22.0	103.5	4	210.00		7.50	*Globuligerina* aff. *bathoniana* (Pazdrowa)
22.0	97.5	3	145.00		12.50	*Globuligerina oxfordiana* (Grigelis)
22.0	96.5	3	95.00		7.50	*Globuligerina oxfordiana* (Grigelis)
23.0	92.5	5	265.00		20.00	*Globuligerina oxfordiana* (Grigelis)

NISSIBACH - SAMPLE Ni10 (OXFORDIAN - TRANSVERSARIUM ZONE)

Thin Section Co-ordinates		No. of Chambers Visible	Maximum Diameter (µm)	Wall Thickness (µm)		Species
Vert	Hor			Thick	Thin	
23.0	94.0	5	240.00	25.00		*Globuligerina oxfordiana* (Grigelis)
23.0	94.5	6	175.00		17.50	*Globuligerina oxfordiana* (Grigelis)
23.0	97.0	4	270.00		15.00	*Globuligerina oxfordiana* (Grigelis)
23.0	100.0	3	155.00		12.50	*Globuligerina oxfordiana* (Grigelis)
R) 5.5	117.0	4	240.00		15.00	*Globuligerina oxfordiana* (Grigelis)
6.0	110.0	3	125.00		12.50	*Globuligerina oxfordiana* (Grigelis)
6.0	106.0	3	175.00		15.00	*Globuligerina oxfordiana* (Grigelis)
6.0	97.0	4	170.00		12.50	*Globuligerina oxfordiana* (Grigelis)
6.0	94.0	3	135.00		12.50	*Globuligerina oxfordiana* (Grigelis)
6.5	96.0	3	165.00		12.50	*Globuligerina oxfordiana* (Grigelis)
7.0	89.5	5	155.00		15.00	*Globuligerina oxfordiana* (Grigelis)
7.0	90.0	4	195.00	22.50		*Globuligerina oxfordiana* (Grigelis)
7.0	92.0	4	265.00		17.50	*Globuligerina oxfordiana* (Grigelis)
8.0	90.5	3	145.00		7.50	*Globuligerina oxfordiana* (Grigelis)
8.5	116.5	3	185.00		10.00	*Globuligerina oxfordiana* (Grigelis)
8.5	98.0	3	285.00		15.00	*Globuligerina oxfordiana* (Grigelis)
9.0	96.0	6	295.00		20.00	*Globuligerina oxfordiana* (Grigelis)
9.0	114.0	6	245.00		12.50	*Globuligerina oxfordiana* (Grigelis)
9.0	118.0	4	295.00		12.50	*Globuligerina oxfordiana* (Grigelis)
9.5	89.0	4	215.00	25.00		*Globuligerina oxfordiana* (Grigelis)
9.5	92.0	3	170.00		10.00	*Globuligerina oxfordiana* (Grigelis)
9.5	98.0	5	305.00	25.00		*Globuligerina oxfordiana* (Grigelis)
10.0	114.5	5	235.00		12.50	*Globuligerina oxfordiana* (Grigelis)
10.0	114.5	5	310.00		12.50	*Globuligerina oxfordiana* (Grigelis)
10.0	102.0	3	140.00		7.50	*Globuligerina oxfordiana* (Grigelis)
10.0	96.0	4	125.00		7.50	*Globuligerina oxfordiana* (Grigelis)
10.0	95.0	4	245.00		20.00	*Globuligerina oxfordiana* (Grigelis)
10.0	92.5	4	215.00		15.00	*Globuligerina oxfordiana* (Grigelis)
10.0	92.5	4	135.00		7.50	*Globuligerina oxfordiana* (Grigelis)
10.0	92.0	4	150.00		20.00	*Globuligerina oxfordiana* (Grigelis)
10.5	101.5	4	160.00		15.00	*Globuligerina oxfordiana* (Grigelis)
10.5	101.5	3	145.00		5.00	*Globuligerina oxfordiana* (Grigelis)
10.5	95.5	4	275.00	22.50		*Globuligerina oxfordiana* (Grigelis)
11.0	93.5	3	180.00		10.00	*Globuligerina oxfordiana* (Grigelis)
11.0	115.5	4	190.00		15.00	*Globuligerina oxfordiana* (Grigelis)
11.5	101.5	5	190.00		15.00	*Globuligerina oxfordiana* (Grigelis)
11.5	101.5	6	220.00		10.00	*Globuligerina oxfordiana* (Grigelis)
12.0	117.5	3	300.00		15.00	*Globuligerina oxfordiana* (Grigelis)
12.0	107.0	3	175.00		7.50	*Globuligerina oxfordiana* (Grigelis)
12.0	104.0	3	185.00		15.00	*Globuligerina oxfordiana* (Grigelis)
12.0	102.0	4	155.00		15.00	*Globuligerina oxfordiana* (Grigelis)
12.0	101.5	4	145.00		17.50	*Globuligerina oxfordiana* (Grigelis)
12.0	101.0	5	275.00	25.00		*Globuligerina oxfordiana* (Grigelis)
12.0	100.5	4	305.00	25.00		*Globuligerina oxfordiana* (Grigelis)
12.0	95.5	6	115.00		12.50	*Globuligerina oxfordiana* (Grigelis)
12.0	95.0	3	135.00		10.00	*Globuligerina oxfordiana* (Grigelis)
12.0	95.0	4	200.00	27.50		*Globuligerina oxfordiana* (Grigelis)
12.5	100.5	4	120.00		5.00	*Globuligerina oxfordiana* (Grigelis)
13.0	95.0	3	225.00		17.50	*Globuligerina oxfordiana* (Grigelis)
13.0	95.5	4	130.00		15.00	*Globuligerina oxfordiana* (Grigelis)
13.0	96.0	3	155.00		12.50	*Globuligerina oxfordiana* (Grigelis)
13.0	100.0	4	250.00	27.50		*Globuligerina oxfordiana* (Grigelis)
13.0	100.0	4	220.00	27.50		*Globuligerina oxfordiana* (Grigelis)
13.5	90.0	4	175.00		7.50	*Globuligerina oxfordiana* (Grigelis)
13.5	101.0	3	275.00	30.00		*Globuligerina oxfordiana* (Grigelis)

NISSIBACH - SAMPLE Ni10 (OXFORDIAN - TRANSVERSARIUM ZONE)

Thin Section Co-ordinates		No. of Chambers Visible	Maximum Diameter (µm)	Wall Thickness (µm)		Species
Vert	Hor			Thick	Thin	
14.0	110.5	4	210.00		7.50	*Globuligerina* aff. *bathoniana* (Pazdrowa)
14.0	105.0	3	170.00		7.50	*Globuligerina oxfordiana* (Grigelis)
14.0	105.0	3	235.00		7.50	*Globuligerina oxfordiana* (Grigelis)
14.0	102.0	4	175.00		7.50	*Globuligerina oxfordiana* (Grigelis)
14.0	96.5	4	200.00	25.00		*Globuligerina oxfordiana* (Grigelis)
14.0	96.0	4	245.00		20.00	*Globuligerina oxfordiana* (Grigelis)
14.0	96.0	3	210.00		7.50	*Globuligerina oxfordiana* (Grigelis)
14.0	95.0	3	235.00	25.00		*Globuligerina oxfordiana* (Grigelis)
14.0	95.0	4	110.00		7.50	*Globuligerina oxfordiana* (Grigelis)
15.0	89.5	4	112.50		12.50	*Globuligerina oxfordiana* (Grigelis)
15.0	89.5	3	170.00		7.50	*Globuligerina oxfordiana* (Grigelis)
15.0	93.5	3	240.00		15.00	*Globuligerina oxfordiana* (Grigelis)
15.5	98.5	8	215.00		7.50	*Globuligerina* aff. *bathoniana* (Pazdrowa)
15.5	98.5	4	235.00	22.50		*Globuligerina oxfordiana* (Grigelis)
16.0	97.5	3	165.00		15.00	*Globuligerina oxfordiana* (Grigelis)
16.5	96.5	3	135.00		15.00	*Globuligerina oxfordiana* (Grigelis)
16.5	95.0	4	215.00		15.00	*Globuligerina oxfordiana* (Grigelis)
16.5	93.0	3	162.50		7.50	*Globuligerina oxfordiana* (Grigelis)
16.5	90.5	4	162.50		12.50	*Globuligerina oxfordiana* (Grigelis)
17.0	97.5	4	105.00		10.00	*Globuligerina oxfordiana* (Grigelis)
17.5	104.5	4	235.00		15.00	*Globuligerina oxfordiana* (Grigelis)
18.0	102.0	4	270.00		15.00	*Globuligerina oxfordiana* (Grigelis)
18.0	92.5	4	180.00		7.50	*Globuligerina oxfordiana* (Grigelis)
18.0	91.5	4	305.00		12.50	*Globuligerina oxfordiana* (Grigelis)
18.0	91.0	3	215.00		15.00	*Globuligerina oxfordiana* (Grigelis)
20.5	99.5	3	140.00		7.50	*Globuligerina oxfordiana* (Grigelis)
20.5	95.0	4	110.00		12.50	*Globuligerina oxfordiana* (Grigelis)
21.0	91.0	6	255.00		15.00	*Globuligerina oxfordiana* (Grigelis)
21.0	91.0	3	135.00		15.00	*Globuligerina oxfordiana* (Grigelis)
21.0	94.0	4	260.00		15.00	*Globuligerina oxfordiana* (Grigelis)
21.0	97.5	4	125.00		17.50	*Globuligerina oxfordiana* (Grigelis)
21.0	98.0	3	205.00		15.00	*Globuligerina oxfordiana* (Grigelis)
21.0	99.0	3	175.00		17.50	*Globuligerina oxfordiana* (Grigelis)
21.0	99.5	4	180.00		15.00	*Globuligerina oxfordiana* (Grigelis)
21.5	96.0	3	110.00		7.50	*Globuligerina oxfordiana* (Grigelis)
21.5	100.0	4	165.00		20.00	*Globuligerina oxfordiana* (Grigelis)
21.5	104.5	6	115.00		15.00	*Globuligerina oxfordiana* (Grigelis)
22.0	103.5	3	180.00		12.50	*Globuligerina oxfordiana* (Grigelis)
22.0	98.0	3	180.00		12.50	*Globuligerina oxfordiana* (Grigelis)
22.0	96.0	4	190.00		7.50	*Globuligerina oxfordiana* (Grigelis)
22.0	95.5	4	205.00	25.00		*Globuligerina oxfordiana* (Grigelis)
22.0	88.5	3	155.00		12.50	*Globuligerina oxfordiana* (Grigelis)
22.5	96.0	6	145.00		12.50	*Globuligerina oxfordiana* (Grigelis)
22.5	90.0	4	180.00	22.50		*Globuligerina oxfordiana* (Grigelis)
22.5	88.0	4	185.00	22.50		*Globuligerina oxfordiana* (Grigelis)
23.0	93.0	3	170.00		15.00	*Globuligerina oxfordiana* (Grigelis)
23.5	106.0	6	225.00		15.00	*Globuligerina oxfordiana* (Grigelis)
24.0	96.0	4	270.00	25.00		*Globuligerina oxfordiana* (Grigelis)
24.5	89.5	4	240.00		20.00	*Globuligerina oxfordiana* (Grigelis)
25.0	89.0	3	275.00		20.00	*Globuligerina oxfordiana* (Grigelis)
25.0	90.0	4	205.00		12.50	*Globuligerina oxfordiana* (Grigelis)
Total Number of Specimens				39	177	216
Relative Percentages				18	82	

MADONNA DELLA CORONA - SAMPLE Mc3 (TRANSVERSARIUM OR BIFURCATUS ZONE)

Thin Section Co-ordinates		No. of Chambers Visible	Max. Diameter (µm)	Wall Thickness (µm)		Species
Vert	Hor			Thick	Thin	
1) 5.0	101.5	5	185.00		15.00	*Globuligerina oxfordiana* (Grigelis)
5.0	101.5	3	170.00		10.00	*Globuligerina oxfordiana* (Grigelis)
5.0	103.0	4	170.00		12.50	*Globuligerina oxfordiana* (Grigelis)
5.0	104.0	3	200.00		7.50	*Globuligerina* aff. *bathoniana* (Pazdrowa)
5.0	106.0	4	215.00		15.00	*Globuligerina oxfordiana* (Grigelis)
5.0	106.5	4	180.00		15.00	*Globuligerina oxfordiana* (Grigelis)
5.5	103.5	5	185.00		12.50	*Globuligerina oxfordiana* (Grigelis)
5.5	106.5	6	330.00		12.50	*Globuligerina oxfordiana* (Grigelis)
5.5	108.0	4	345.00		15.00	*Globuligerina oxfordiana* (Grigelis)
7.0	101.0	3	185.00		20.00	*Globuligerina oxfordiana* (Grigelis)
7.0	103.0	3	150.00		17.50	*Globuligerina oxfordiana* (Grigelis)
7.0	106.0	3	195.00		15.00	*Globuligerina oxfordiana* (Grigelis)
7.0	108.0	4	180.00		15.00	*Globuligerina oxfordiana* (Grigelis)
7.0	112.5	5	195.00		15.00	*Globuligerina oxfordiana* (Grigelis)
7.5	102.0	3	185.00		17.50	*Globuligerina oxfordiana* (Grigelis)
7.5	107.5	4	180.00		12.50	*Globuligerina oxfordiana* (Grigelis)
7.5	110.0	4	175.00		12.50	*Globuligerina oxfordiana* (Grigelis)
8.0	110.0	3	140.00		15.00	*Globuligerina oxfordiana* (Grigelis)
8.0	103.5	4	145.00		10.00	*Globuligerina oxfordiana* (Grigelis)
8.0	103.0	4	185.00		20.00	*Globuligerina oxfordiana* (Grigelis)
8.5	111.5	3	140.00		15.00	*Globuligerina oxfordiana* (Grigelis)
8.5	111.5	6	195.00		15.00	*Globuligerina oxfordiana* (Grigelis)
8.5	109.0	3	175.00		12.50	*Globuligerina oxfordiana* (Grigelis)
8.5	105.5	4	175.00		12.50	*Globuligerina oxfordiana* (Grigelis)
8.5	104.0	4	162.50		20.00	*Globuligerina oxfordiana* (Grigelis)
8.5	101.5	3	210.00		15.00	*Globuligerina oxfordiana* (Grigelis)
8.5	101.0	3	180.00		12.50	*Globuligerina oxfordiana* (Grigelis)
8.5	101.0	4	172.50		12.50	*Globuligerina oxfordiana* (Grigelis)
8.5	97.0	5	185.00		12.50	*Globuligerina oxfordiana* (Grigelis)
9.0	97.0	3	170.00		12.50	*Globuligerina oxfordiana* (Grigelis)
9.0	101.0	4	180.00		15.00	*Globuligerina oxfordiana* (Grigelis)
9.0	105.5	4	175.00		12.50	*Globuligerina oxfordiana* (Grigelis)
9.0	107.0	4	155.00		12.50	*Globuligerina oxfordiana* (Grigelis)
10.0	105.5	4	165.00		7.50	*Globuligerina oxfordiana* (Grigelis)
11.0	102.5	4	210.00	22.50		*Globuligerina oxfordiana* (Grigelis)
11.0	105.5	4	190.00		20.00	*Globuligerina oxfordiana* (Grigelis)
12.0	116.5	4	175.00		15.00	*Globuligerina oxfordiana* (Grigelis)
12.0	108.5	4	160.00		15.00	*Globuligerina oxfordiana* (Grigelis)
12.0	106.0	4	185.00	25.00		*Globuligerina oxfordiana* (Grigelis)
12.0	106.0	4	165.00		12.50	*Globuligerina oxfordiana* (Grigelis)
12.0	97.0	3	200.00	25.00		*Globuligerina oxfordiana* (Grigelis)
12.5	109.0	4	155.00		17.50	*Globuligerina oxfordiana* (Grigelis)
12.5	105.0	3	155.00	20.00		*Globuligerina oxfordiana* (Grigelis)
12.5	96.0	3	175.00		15.00	*Globuligerina oxfordiana* (Grigelis)
13.0	98.5	4	200.00	25.00		*Globuligerina oxfordiana* (Grigelis)
13.0	99.0	4	200.00	22.50		*Globuligerina oxfordiana* (Grigelis)
13.0	115.0	4	175.00		15.00	*Globuligerina oxfordiana* (Grigelis)
13.5	115.5	3	175.00		7.50	*Globuligerina oxfordiana* (Grigelis)
14.0	118.0	3	145.00	25.00		*Globuligerina oxfordiana* (Grigelis)
14.0	118.0	3	160.00		15.00	*Globuligerina oxfordiana* (Grigelis)
14.0	116.0	3	205.00		15.00	*Globuligerina oxfordiana* (Grigelis)
14.0	115.5	3	175.00		15.00	*Globuligerina oxfordiana* (Grigelis)
14.0	109.0	4	145.00		12.50	*Globuligerina oxfordiana* (Grigelis)
14.0	95.0	3	195.00		12.50	*Globuligerina oxfordiana* (Grigelis)
15.5	99.5	4	175.00		12.50	*Globuligerina oxfordiana* (Grigelis)

MADONNA DELLA CORONA - SAMPLE Mc3 (TRANSVERSARIUM OR BIFURCATUS ZONE)

Thin Section Co-ordinates		No. of Chambers Visible	Max. Diameter (µm)	Wall Thickness (µm)		Species
Vert	Hor			Thick	Thin	
16.0	99.5	3	175.00		15.00	*Globuligerina oxfordiana* (Grigelis)
16.0	96.5	4	180.00		15.00	*Globuligerina oxfordiana* (Grigelis)
16.0	95.0	4	185.00		12.50	*Globuligerina oxfordiana* (Grigelis)
16.0	94.0	4	160.00		15.00	*Globuligerina oxfordiana* (Grigelis)
17.0	92.0	3	245.00	22.50		*Globuligerina oxfordiana* (Grigelis)
17.0	101.5	4	175.00		12.50	*Globuligerina oxfordiana* (Grigelis)
17.0	106.0	4	190.00		15.00	*Globuligerina oxfordiana* (Grigelis)
17.0	116.0	3	190.00		12.50	*Globuligerina oxfordiana* (Grigelis)
17.0	117.0	3	215.00		12.50	*Globuligerina oxfordiana* (Grigelis)
17.5	92.0	4	255.00	22.50		*Globuligerina oxfordiana* (Grigelis)
17.5	100.0	4	170.00		15.00	*Globuligerina oxfordiana* (Grigelis)
17.5	102.0	3	155.00		17.50	*Globuligerina oxfordiana* (Grigelis)
17.5	105.0	4	180.00		10.00	*Globuligerina oxfordiana* (Grigelis)
17.5	107.5	3	170.00		12.50	*Globuligerina oxfordiana* (Grigelis)
17.5	111.5	4	235.00	22.50		*Globuligerina oxfordiana* (Grigelis)
17.5	115.0	4	205.00		7.50	*Globuligerina* aff. *bathoniana* (Pazdrowa)
18.0	115.0	3	225.00		10.00	*Globuligerina oxfordiana* (Grigelis)
18.0	113.0	4	215.00		20.00	*Globuligerina oxfordiana* (Grigelis)
18.0	109.0	4	240.00		12.50	*Globuligerina oxfordiana* (Grigelis)
18.5	112.0	4	200.00	22.50		*Globuligerina oxfordiana* (Grigelis)
18.5	94.0	3	230.00		15.00	*Globuligerina oxfordiana* (Grigelis)
19.0	103.0	3	120.00		10.00	*Globuligerina oxfordiana* (Grigelis)
19.0	104.0	4	165.00	22.50		*Globuligerina oxfordiana* (Grigelis)
19.0	109.0	4	195.00		15.00	*Globuligerina oxfordiana* (Grigelis)
19.5	103.5	3	182.50		17.50	*Globuligerina oxfordiana* (Grigelis)
19.5	104.0	3	200.00	25.00		*Globuligerina oxfordiana* (Grigelis)
20.0	108.0	4	162.50		12.50	*Globuligerina oxfordiana* (Grigelis)
20.0	105.0	4	210.00		15.00	*Globuligerina oxfordiana* (Grigelis)
20.0	95.0	3	160.00		12.50	*Globuligerina oxfordiana* (Grigelis)
20.5	111.0	4	182.50		12.50	*Globuligerina oxfordiana* (Grigelis)
20.5	108.0	4	212.50		12.50	*Globuligerina oxfordiana* (Grigelis)
22.0	110.0	4	210.00		10.00	*Globuligerina oxfordiana* (Grigelis)
22.0	110.0	4	175.00		10.00	*Globuligerina oxfordiana* (Grigelis)
22.0	107.0	3	195.00		12.50	*Globuligerina oxfordiana* (Grigelis)
23.0	100.5	3	195.00		10.00	*Globuligerina oxfordiana* (Grigelis)
2) 5.5	89.0	3	125.00		7.50	*Globuligerina oxfordiana* (Grigelis)
5.5	89.5	3	150.00		15.00	*Globuligerina oxfordiana* (Grigelis)
7.0	86.5	4	175.00		12.50	*Globuligerina oxfordiana* (Grigelis)
7.0	86.5	4	160.00		15.00	*Globuligerina oxfordiana* (Grigelis)
7.5	85.5	5	185.00		12.50	*Globuligerina oxfordiana* (Grigelis)
7.5	85.5	4	120.00		7.50	*Globuligerina oxfordiana* (Grigelis)
7.5	88.0	4	195.00		12.50	*Globuligerina oxfordiana* (Grigelis)
7.5	88.0	4	180.00		12.50	*Globuligerina oxfordiana* (Grigelis)
7.5	88.0	3	125.00		7.50	*Globuligerina oxfordiana* (Grigelis)
7.5	89.5	3	160.00		12.50	*Globuligerina oxfordiana* (Grigelis)
7.5	92.0	4	140.00		15.00	*Globuligerina oxfordiana* (Grigelis)
7.5	95.0	3	200.00		10.00	*Globuligerina oxfordiana* (Grigelis)
8.0	92.0	3	150.00		15.00	*Globuligerina oxfordiana* (Grigelis)
8.0	92.0	4	210.00		12.50	*Globuligerina oxfordiana* (Grigelis)
8.0	90.5	3	150.00		12.50	*Globuligerina oxfordiana* (Grigelis)
8.5	84.5	4	170.00		12.50	*Globuligerina oxfordiana* (Grigelis)
9.0	86.0	3	160.00		15.00	*Globuligerina oxfordiana* (Grigelis)
9.0	88.5	3	135.00		10.00	*Globuligerina oxfordiana* (Grigelis)
9.0	89.5	4	150.00		7.50	*Globuligerina oxfordiana* (Grigelis)
9.0	90.5	4	170.00		15.00	*Globuligerina oxfordiana* (Grigelis)

MADONNA DELLA CORONA - SAMPLE Mc3 (TRANSVERSARIUM OR BIFURCATUS ZONE)

Thin Section Co-ordinates		No. of Chambers Visible	Max. Diameter (µm)	Wall Thickness (µm)		Species
Vert	Hor			Thick	Thin	
9.0	91.0	4	160.00		15.00	*Globuligerina oxfordiana* (Grigelis)
9.0	92.0	4	162.50		10.00	*Globuligerina oxfordiana* (Grigelis)
9.5	90.5	3	175.00		15.00	*Globuligerina oxfordiana* (Grigelis)
9.5	91.0	4	200.00		12.50	*Globuligerina oxfordiana* (Grigelis)
10.0	94.0	3	165.00		12.50	*Globuligerina oxfordiana* (Grigelis)
10.0	92.0	4	165.00		12.50	*Globuligerina oxfordiana* (Grigelis)
10.5	90.5	4	152.50		12.50	*Globuligerina oxfordiana* (Grigelis)
11.0	90.5	4	165.00		15.00	*Globuligerina oxfordiana* (Grigelis)
11.0	90.5	3	165.00		10.00	*Globuligerina oxfordiana* (Grigelis)
11.0	92.0	3	160.00		15.00	*Globuligerina oxfordiana* (Grigelis)
11.0	97.0	4	215.00		7.50	*Globuligerina* aff. *bathoniana* (Pazdrowa)
11.5	84.0	3	185.00		12.50	*Globuligerina oxfordiana* (Grigelis)
11.5	89.5	4	180.00		12.50	*Globuligerina oxfordiana* (Grigelis)
11.5	91.5	3	230.00	22.50		*Globuligerina oxfordiana* (Grigelis)
11.5	93.0	3	165.00		15.00	*Globuligerina oxfordiana* (Grigelis)
11.5	93.0	3	175.00		15.00	*Globuligerina oxfordiana* (Grigelis)
11.5	93.5	4	210.00		15.00	*Globuligerina oxfordiana* (Grigelis)
12.0	100.5	3	200.00		15.00	*Globuligerina oxfordiana* (Grigelis)
12.0	96.0	3	180.00		15.00	*Globuligerina oxfordiana* (Grigelis)
12.0	95.5	4	205.00		15.00	*Globuligerina oxfordiana* (Grigelis)
12.0	93.0	4	185.00		15.00	*Globuligerina oxfordiana* (Grigelis)
12.0	92.0	4	195.00		20.00	*Globuligerina oxfordiana* (Grigelis)
12.0	88.5	4	125.00		15.00	*Globuligerina oxfordiana* (Grigelis)
12.0	88.0	4	155.00		12.50	*Globuligerina oxfordiana* (Grigelis)
12.0	88.0	3	165.00		15.00	*Globuligerina oxfordiana* (Grigelis)
12.5	89.0	4	185.00		15.00	*Globuligerina oxfordiana* (Grigelis)
12.5	86.5	4	165.00		15.00	*Globuligerina oxfordiana* (Grigelis)
12.5	86.0	4	125.00		5.00	*Globuligerina oxfordiana* (Grigelis)
13.0	84.5	4	240.00		15.00	*Globuligerina oxfordiana* (Grigelis)
13.0	85.5	5	170.00		15.00	*Globuligerina oxfordiana* (Grigelis)
13.0	86.5	3	160.00		15.00	*Globuligerina oxfordiana* (Grigelis)
13.0	91.5	4	160.00		15.00	*Globuligerina oxfordiana* (Grigelis)
13.0	92.0	4	150.00		10.00	*Globuligerina oxfordiana* (Grigelis)
13.0	94.0	3	225.00		15.00	*Globuligerina oxfordiana* (Grigelis)
13.0	94.0	3	200.00		15.00	*Globuligerina oxfordiana* (Grigelis)
13.0	95.0	5	180.00		15.00	*Globuligerina oxfordiana* (Grigelis)
13.0	97.0	3	230.00	22.50		*Globuligerina oxfordiana* (Grigelis)
13.5	88.5	3	212.50		15.00	*Globuligerina oxfordiana* (Grigelis)
13.5	88.5	3	115.00		7.50	*Globuligerina oxfordiana* (Grigelis)
13.5	88.5	4	132.50		12.50	*Globuligerina oxfordiana* (Grigelis)
13.5	94.0	5	190.00		17.50	*Globuligerina oxfordiana* (Grigelis)
13.5	94.5	4	200.00		20.00	*Globuligerina oxfordiana* (Grigelis)
14.0	100.0	4	160.00		7.50	*Globuligerina oxfordiana* (Grigelis)
14.0	99.0	4	180.00		20.00	*Globuligerina oxfordiana* (Grigelis)
14.0	96.0	4	190.00		20.00	*Globuligerina oxfordiana* (Grigelis)
14.0	95.0	3	200.00		20.00	*Globuligerina oxfordiana* (Grigelis)
14.0	93.0	4	155.00		7.50	*Globuligerina oxfordiana* (Grigelis)
14.0	91.0	3	140.00		7.50	*Globuligerina oxfordiana* (Grigelis)
14.0	88.5	3	155.00		10.00	*Globuligerina oxfordiana* (Grigelis)
14.0	86.0	4	120.00		5.00	*Globuligerina oxfordiana* (Grigelis)
14.5	95.0	3	150.00		7.50	*Globuligerina oxfordiana* (Grigelis)
14.5	93.0	3	190.00		7.50	*Globuligerina oxfordiana* (Grigelis)
14.5	89.5	3	145.00		7.50	*Globuligerina oxfordiana* (Grigelis)
15.0	82.5	3	132.50	22.50		*Globuligerina oxfordiana* (Grigelis)
15.0	83.0	3	165.00		10.00	*Globuligerina oxfordiana* (Grigelis)

MADONNA DELLA CORONA - SAMPLE Mc3 (TRANSVERSARIUM OR BIFURCATUS ZONE)

Thin Section Co-ordinates		No. of Chambers Visible	Max. Diameter (µm)	Wall Thickness (µm)		Species
Vert	Hor			Thick	Thin	
15.0	87.5	4	185.00		12.50	*Globuligerina oxfordiana* (Grigelis)
15.0	94.5	3	142.50		12.50	*Globuligerina oxfordiana* (Grigelis)
15.0	96.0	3	142.50		7.50	*Globuligerina oxfordiana* (Grigelis)
15.0	96.0	3	170.00		12.50	*Globuligerina oxfordiana* (Grigelis)
15.0	100.0	3	230.00		15.00	*Globuligerina oxfordiana* (Grigelis)
15.0	100.0	3	145.00		15.00	*Globuligerina oxfordiana* (Grigelis)
15.5	83.0	5	182.50		12.50	*Globuligerina oxfordiana* (Grigelis)
15.5	83.5	3	190.00		12.50	*Globuligerina oxfordiana* (Grigelis)
15.5	87.5	4	160.00		17.50	*Globuligerina oxfordiana* (Grigelis)
16.0	100.0	3	130.00		15.00	*Globuligerina oxfordiana* (Grigelis)
16.0	98.5	4	140.00		7.50	*Globuligerina oxfordiana* (Grigelis)
16.0	95.5	4	180.00		15.00	*Globuligerina oxfordiana* (Grigelis)
16.0	89.0	4	150.00		17.50	*Globuligerina oxfordiana* (Grigelis)
16.0	87.5	3	180.00		17.50	*Globuligerina oxfordiana* (Grigelis)
16.0	86.0	4	150.00		12.50	*Globuligerina oxfordiana* (Grigelis)
16.0	85.0	4	145.00		7.50	*Globuligerina oxfordiana* (Grigelis)
17.0	85.0	3	130.00		12.50	*Globuligerina oxfordiana* (Grigelis)
17.0	85.0	4	170.00		12.50	*Globuligerina oxfordiana* (Grigelis)
17.0	85.5	4	135.00		12.50	*Globuligerina oxfordiana* (Grigelis)
17.0	86.0	3	180.00		12.50	*Globuligerina oxfordiana* (Grigelis)
17.0	86.0	3	230.00		12.50	*Globuligerina oxfordiana* (Grigelis)
17.0	87.0	3	175.00		12.50	*Globuligerina oxfordiana* (Grigelis)
17.0	88.5	5	185.00		15.00	*Globuligerina oxfordiana* (Grigelis)
17.0	90.0	3	142.50		12.50	*Globuligerina oxfordiana* (Grigelis)
17.0	97.5	3	155.00		12.50	*Globuligerina oxfordiana* (Grigelis)
17.0	98.0	3	170.00		12.50	*Globuligerina oxfordiana* (Grigelis)
17.5	85.0	3	132.50	25.00		*Globuligerina oxfordiana* (Grigelis)
17.5	86.0	4	215.00		7.50	*Globuligerina* aff. *bathoniana* (Pazdrowa)
17.5	86.5	3	205.00		15.00	*Globuligerina oxfordiana* (Grigelis)
17.5	87.0	3	195.00		12.50	*Globuligerina oxfordiana* (Grigelis)
18.0	100.0	3	215.00		10.00	*Globuligerina oxfordiana* (Grigelis)
18.0	95.5	4	140.00		12.50	*Globuligerina oxfordiana* (Grigelis)
18.0	93.0	4	180.00		12.50	*Globuligerina oxfordiana* (Grigelis)
18.0	90.0	3	170.00		15.00	*Globuligerina oxfordiana* (Grigelis)
18.0	86.0	3	165.00		10.00	*Globuligerina oxfordiana* (Grigelis)
18.0	86.0	4	180.00		12.50	*Globuligerina oxfordiana* (Grigelis)
18.5	99.5	3	182.50		12.50	*Globuligerina oxfordiana* (Grigelis)
18.5	94.0	4	250.00		7.50	*Globuligerina* aff. *bathoniana* (Pazdrowa)
18.5	90.5	3	145.00		15.00	*Globuligerina oxfordiana* (Grigelis)
18.5	86.0	4	165.00		12.50	*Globuligerina oxfordiana* (Grigelis)
19.0	86.0	3	135.00		15.00	*Globuligerina oxfordiana* (Grigelis)
19.0	89.0	3	245.00		17.50	*Globuligerina oxfordiana* (Grigelis)
19.0	91.0	3	155.00		15.00	*Globuligerina oxfordiana* (Grigelis)
19.0	91.5	4	145.00		7.50	*Globuligerina oxfordiana* (Grigelis)
19.5	87.0	4	190.00		17.50	*Globuligerina oxfordiana* (Grigelis)
19.5	87.0	4	165.00		12.50	*Globuligerina oxfordiana* (Grigelis)
19.5	88.0	3	125.00		12.50	*Globuligerina oxfordiana* (Grigelis)
19.5	91.5	4	240.00		20.00	*Globuligerina oxfordiana* (Grigelis)
20.0	92.0	4	190.00		12.50	*Globuligerina oxfordiana* (Grigelis)
20.0	91.0	4	185.00		12.50	*Globuligerina oxfordiana* (Grigelis)
20.0	88.5	4	145.00		12.50	*Globuligerina oxfordiana* (Grigelis)
20.0	88.0	4	175.00		15.00	*Globuligerina oxfordiana* (Grigelis)
20.0	88.0	3	215.00		12.50	*Globuligerina oxfordiana* (Grigelis)
20.5	91.0	3	182.50		20.00	*Globuligerina oxfordiana* (Grigelis)
20.5	91.0	3	185.00		15.00	*Globuligerina oxfordiana* (Grigelis)

MADONNA DELLA CORONA - SAMPLE Mc3 (TRANSVERSARIUM OR BIFURCATUS ZONE)

Thin Section Co-ordinates		No. of Chambers Visible	Max. Diameter (µm)	Wall Thickness (µm)		Species
Vert	Hor			Thick	Thin	
20.5	87.5	4	200.00		15.00	*Globuligerina oxfordiana* (Grigelis)
21.0	91.0	4	155.00		7.50	*Globuligerina oxfordiana* (Grigelis)
21.0	92.5	3	210.00		15.00	*Globuligerina oxfordiana* (Grigelis)
22.0	95.0	3	220.00		15.00	*Globuligerina oxfordiana* (Grigelis)
22.0	95.0	3	145.00		7.50	*Globuligerina oxfordiana* (Grigelis)
22.0	94.0	4	200.00		15.00	*Globuligerina oxfordiana* (Grigelis)
22.0	93.0	3	190.00		15.00	*Globuligerina oxfordiana* (Grigelis)
23.0	91.0	3	160.00		15.00	*Globuligerina oxfordiana* (Grigelis)
23.0	92.5	3	150.00		7.50	*Globuligerina oxfordiana* (Grigelis)
23.0	92.5	3	180.00		15.00	*Globuligerina oxfordiana* (Grigelis)
23.0	97.0	4	140.00		12.00	*Globuligerina oxfordiana* (Grigelis)
23.5	92.0	3	140.00		5.00	*Globuligerina oxfordiana* (Grigelis)
23.5	92.5	4	180.00		10.00	*Globuligerina oxfordiana* (Grigelis)
23.5	93.0	3	230.00		12.50	*Globuligerina oxfordiana* (Grigelis)
23.5	95.0	3	190.00		15.00	*Globuligerina oxfordiana* (Grigelis)
24.0	97.0	4	130.00		12.50	*Globuligerina oxfordiana* (Grigelis)
24.0	97.0	4	150.00		7.50	*Globuligerina oxfordiana* (Grigelis)
24.0	95.0	3	150.00		10.00	*Globuligerina oxfordiana* (Grigelis)
24.0	94.0	4	180.00		5.00	*Globuligerina oxfordiana* (Grigelis)
24.0	91.0	4	160.00		10.00	*Globuligerina oxfordiana* (Grigelis)
24.0	90.0	3	180.00		7.50	*Globuligerina oxfordiana* (Grigelis)
R) 3.0	105.0	6	200.00		10.00	*Globuligerina oxfordiana* (Grigelis)
4.0	112.0	4	175.00		10.00	*Globuligerina oxfordiana* (Grigelis)
4.0	107.0	5	140.00		5.00	*Globuligerina oxfordiana* (Grigelis)
5.0	103.0	6	242.50		15.00	*Globuligerina oxfordiana* (Grigelis)
5.0	103.5	3	180.00		10.00	*Globuligerina oxfordiana* (Grigelis)
5.0	104.0	4	140.00		7.50	*Globuligerina oxfordiana* (Grigelis)
5.0	108.0	4	180.00		20.00	*Globuligerina oxfordiana* (Grigelis)
5.0	113.0	4	200.00		7.50	*Globuligerina* aff. *bathoniana* (Pazdrowa)
5.0	113.5	4	210.00		10.00	*Globuligerina oxfordiana* (Grigelis)
5.5	103.0	4	190.00		15.00	*Globuligerina oxfordiana* (Grigelis)
5.5	109.0	4	190.00		15.00	*Globuligerina oxfordiana* (Grigelis)
5.5	113.0	3	205.00		15.00	*Globuligerina oxfordiana* (Grigelis)
6.0	121.0	3	190.00		15.00	*Globuligerina oxfordiana* (Grigelis)
6.0	112.0	5	190.00		15.00	*Globuligerina oxfordiana* (Grigelis)
6.0	111.5	3	180.00		15.00	*Globuligerina oxfordiana* (Grigelis)
6.0	109.5	3	155.00		12.50	*Globuligerina oxfordiana* (Grigelis)
6.0	109.5	4	140.00		7.50	*Globuligerina oxfordiana* (Grigelis)
6.0	107.0	4	195.00		15.00	*Globuligerina oxfordiana* (Grigelis)
7.0	102.5	4	160.00		15.00	*Globuligerina oxfordiana* (Grigelis)
7.0	104.5	3	180.00		12.50	*Globuligerina oxfordiana* (Grigelis)
7.0	108.0	3	145.00		12.50	*Globuligerina oxfordiana* (Grigelis)
7.0	109.0	4	240.00		7.50	*Globuligerina* aff. *bathoniana* (Pazdrowa)
8.0	119.0	3	190.00		10.00	*Globuligerina oxfordiana* (Grigelis)
8.0	107.5	3	205.00		12.50	*Globuligerina oxfordiana* (Grigelis)
9.0	99.0	3	180.00	25.00		*Globuligerina oxfordiana* (Grigelis)
9.0	103.0	4	162.50		7.50	*Globuligerina oxfordiana* (Grigelis)
9.0	103.5	4	210.00		10.00	*Globuligerina oxfordiana* (Grigelis)
9.0	104.0	3	150.00		12.50	*Globuligerina oxfordiana* (Grigelis)
9.0	108.0	3	210.00		17.50	*Globuligerina oxfordiana* (Grigelis)
9.0	108.5	3	180.00		15.00	*Globuligerina oxfordiana* (Grigelis)
9.5	108.5	3	170.00		12.50	*Globuligerina oxfordiana* (Grigelis)
11.0	96.0	4	150.00		7.50	*Globuligerina oxfordiana* (Grigelis)
11.0	96.5	3	160.00		7.50	*Globuligerina oxfordiana* (Grigelis)
11.0	98.0	4	180.00		12.50	*Globuligerina oxfordiana* (Grigelis)

MADONNA DELLA CORONA - SAMPLE Mc3 (TRANSVERSARIUM OR BIFURCATUS ZONE)

Thin Section Co-ordinates		No. of Chambers Visible	Max. Diameter (µm)	Wall Thickness (µm)		Species
Vert	Hor			Thick	Thin	
11.0	103.0	6	180.00		15.00	*Globuligerina oxfordiana* (Grigelis)
11.0	105.0	3	155.00		20.00	*Globuligerina oxfordiana* (Grigelis)
11.0	107.0	3	140.00		12.50	*Globuligerina oxfordiana* (Grigelis)
11.0	110.5	3	170.00		12.50	*Globuligerina oxfordiana* (Grigelis)
11.0	118.0	6	190.00		17.50	*Globuligerina oxfordiana* (Grigelis)
11.0	119.0	4	180.00		12.50	*Globuligerina oxfordiana* (Grigelis)
11.0	120.0	3	135.00		10.00	*Globuligerina oxfordiana* (Grigelis)
12.0	114.5	4	200.00		15.00	*Globuligerina oxfordiana* (Grigelis)
13.0	112.0	3	170.00		12.50	*Globuligerina oxfordiana* (Grigelis)
13.0	116.5	3	170.00		12.50	*Globuligerina oxfordiana* (Grigelis)
13.5	119.0	3	185.00		15.00	*Globuligerina oxfordiana* (Grigelis)
17.0	106.0	4	180.00		7.50	*Globuligerina oxfordiana* (Grigelis)
17.5	116.5	4	170.00		15.00	*Globuligerina oxfordiana* (Grigelis)
19.5	109.0	4	170.00		5.00	*Globuligerina oxfordiana* (Grigelis)
20.0	104.5	4	200.00		10.00	*Globuligerina oxfordiana* (Grigelis)
20.0	104.0	3	205.00		7.50	*Globuligerina* aff. *bathoniana* (Pazdrowa)
20.0	104.0	4	205.00		12.50	*Globuligerina oxfordiana* (Grigelis)
20.0	102.0	3	160.00		10.00	*Globuligerina oxfordiana* (Grigelis)
20.5	104.5	3	190.00		15.00	*Globuligerina oxfordiana* (Grigelis)
22.0	104.0	4	200.00		15.00	*Globuligerina oxfordiana* (Grigelis)
22.5	111.5	3	175.00		10.00	*Globuligerina oxfordiana* (Grigelis)
Total Number of Specimens				**17**	**279**	**296**
Relative Percentages				**6**	**94**	

MONTE KUMETA - 1 (BAJOCIAN)

Thin Section Co-ordinates		No. of Chambers Visible	Maximum Diameter (μm)	Wall Thickness (μm)		Species
Vert	Hor			Thick	Thin	
3.0	99.0	4	175.00		12.50	*Globuligerina oxfordiana* (Grigelis)
3.0	106.0	4	200.00		12.50	*Conoglobigerina* aff. *dagestanica* (Morozova)
3.0	107.0	3	100.00		12.50	*Globuligerina oxfordiana* (Grigelis)
3.0	107.5	4	125.00		12.50	*Globuligerina oxfordiana* (Grigelis)
3.5	107.0	3	162.50		12.50	*Globuligerina oxfordiana* (Grigelis)
3.5	102.5	4	225.00		12.50	*Conoglobigerina* aff. *dagestanica* (Morozova)
3.5	100.0	4	150.00		12.50	*Globuligerina oxfordiana* (Grigelis)
3.5	97.5	4	137.50		12.50	*Globuligerina oxfordiana* (Grigelis)
5.0	94.5	3	200.00		12.50	*Globuligerina oxfordiana* (Grigelis)
5.0	95.0	4	200.00		12.50	*Conoglobigerina* aff. *dagestanica* (Morozova)
5.0	100.0	3	162.50		12.50	*Globuligerina oxfordiana* (Grigelis)
5.0	106.0	4	175.00	25.00		*Globuligerina oxfordiana* (Grigelis)
5.0	106.0	5	175.00		18.75	*Globuligerina oxfordiana* (Grigelis)
5.5	111.5	5	175.00		12.50	*Globuligerina oxfordiana* (Grigelis)
5.5	106.0	4	175.00		18.75	*Globuligerina oxfordiana* (Grigelis)
5.5	105.5	3	150.00		12.50	*Globuligerina oxfordiana* (Grigelis)
5.5	100.5	3	112.50		12.50	*Globuligerina oxfordiana* (Grigelis)
5.5	100.0	3	150.00		12.50	*Globuligerina oxfordiana* (Grigelis)
5.5	94.0	4	150.00		12.50	*Globuligerina oxfordiana* (Grigelis)
6.0	92.0	4	162.50		12.50	*Globuligerina oxfordiana* (Grigelis)
6.0	95.0	3	200.00		12.50	*Conoglobigerina* aff. *dagestanica* (Morozova)
6.5	96.0	3	150.00	37.50		*Globuligerina oxfordiana* (Grigelis)
6.5	94.0	4	175.00		12.50	*Globuligerina oxfordiana* (Grigelis)
6.5	88.0	4	125.00		12.50	*Globuligerina oxfordiana* (Grigelis)
7.0	76.5	3	150.00		12.50	*Globuligerina oxfordiana* (Grigelis)
7.0	111.0	3	125.00		18.75	*Globuligerina oxfordiana* (Grigelis)
8.0	105.5	3	150.00		12.50	*Globuligerina oxfordiana* (Grigelis)
8.5	108.5	3	125.00		12.50	*Globuligerina oxfordiana* (Grigelis)
9.0	66.5	4	162.50		12.50	*Globuligerina oxfordiana* (Grigelis)
9.0	67.0	4	150.00		6.25	*Globuligerina oxfordiana* (Grigelis)
9.0	67.5	4	175.00		6.25	*Globuligerina oxfordiana* (Grigelis)
9.0	69.5	4	137.50		12.50	*Globuligerina oxfordiana* (Grigelis)
9.0	72.0	4	125.00		6.25	*Globuligerina oxfordiana* (Grigelis)
9.0	74.0	4	187.50		12.50	*Globuligerina oxfordiana* (Grigelis)
9.0	90.5	4	125.00		6.25	*Globuligerina oxfordiana* (Grigelis)
9.0	94.5	6	150.00		6.25	*Globuligerina oxfordiana* (Grigelis)
9.0	95.5	3	175.00		12.50	*Globuligerina oxfordiana* (Grigelis)
9.0	97.0	3	150.00		12.50	*Globuligerina oxfordiana* (Grigelis)
9.0	108.5	3	125.00		18.75	*Globuligerina oxfordiana* (Grigelis)
9.0	110.5	4	225.00		12.50	*Conoglobigerina* aff. *dagestanica* (Morozova)
9.5	109.5	4	125.00		12.50	*Globuligerina oxfordiana* (Grigelis)
10.0	71.0	5	200.00		18.75	*Conoglobigerina* aff. *dagestanica* (Morozova)
10.0	73.5	4	187.50		12.50	*Globuligerina oxfordiana* (Grigelis)
10.0	94.5	4	137.50		12.50	*Globuligerina oxfordiana* (Grigelis)
10.0	99.5	4	200.00		12.50	*Conoglobigerina* aff. *dagestanica* (Morozova)
10.0	110.5	4	150.00	31.25		*Globuligerina oxfordiana* (Grigelis)
10.5	110.5	4	175.00	37.50		*Globuligerina oxfordiana* (Grigelis)
11.0	69.5	3	187.50		12.50	*Globuligerina oxfordiana* (Grigelis)
11.0	74.5	3	150.00		6.25	*Globuligerina oxfordiana* (Grigelis)
11.0	87.5	4	200.00		18.75	*Conoglobigerina* aff. *dagestanica* (Morozova)
11.0	105.0	4	200.00		18.75	*Conoglobigerina* aff. *dagestanica* (Morozova)
11.0	107.0	4	200.00		6.25	*Conoglobigerina* aff. *dagestanica* (Morozova)
11.0	111.0	4	200.00	37.50		*Globuligerina oxfordiana* (Grigelis)
11.5	104.0	3	200.00		18.75	*Conoglobigerina* aff. *dagestanica* (Morozova)
11.5	102.5	4	150.00		6.25	*Globuligerina oxfordiana* (Grigelis)

MONTE KUMETA - 1 (BAJOCIAN)

Thin Section Co-ordinates		No. of Chambers Visible	Maximum Diameter (µm)	Wall Thickness (µm)		Species
Vert	Hor			Thick	Thin	
11.5	99.0	3	175.00	25.00		*Globuligerina oxfordiana* (Grigelis)
11.5	95.0	4	125.00		18.75	*Globuligerina oxfordiana* (Grigelis)
11.5	87.5	4	200.00		18.75	*Conoglobigerina* aff. *dagestanica* (Morozova)
11.5	80.5	4	150.00		12.50	*Globuligerina oxfordiana* (Grigelis)
11.5	80.0	3	150.00		6.25	*Globuligerina oxfordiana* (Grigelis)
12.0	87.0	3	175.00		18.75	*Globuligerina oxfordiana* (Grigelis)
12.0	87.0	5	237.50		12.50	*Conoglobigerina* aff. *dagestanica* (Morozova)
12.5	96.5	3	262.50	25.00		*Globuligerina oxfordiana* (Grigelis)
12.5	82.5	3	125.00		18.75	*Globuligerina oxfordiana* (Grigelis)
12.5	80.5	4	125.00		6.25	*Globuligerina oxfordiana* (Grigelis)
12.5	66.0	4	125.00		6.25	*Globuligerina oxfordiana* (Grigelis)
13.0	86.5	4	175.00		12.50	*Globuligerina oxfordiana* (Grigelis)
13.0	97.0	4	250.00	25.00		*Globuligerina oxfordiana* (Grigelis)
13.5	101.0	4	175.00		18.75	*Globuligerina oxfordiana* (Grigelis)
13.5	82.0	5	162.50		6.25	*Globuligerina oxfordiana* (Grigelis)
14.0	72.5	4	137.50		6.25	*Globuligerina oxfordiana* (Grigelis)
14.5	73.5	4	175.00		12.50	*Globuligerina oxfordiana* (Grigelis)
15.0	100.0	4	212.50	25.00		*Globuligerina oxfordiana* (Grigelis)
15.5	105.0	4	150.00	25.00		*Globuligerina oxfordiana* (Grigelis)
16.0	109.0	3	125.00		12.50	*Globuligerina oxfordiana* (Grigelis)
17.0	79.5	4	225.00		12.50	*Conoglobigerina* aff. *dagestanica* (Morozova)
17.5	106.5	3	175.00		12.50	*Globuligerina oxfordiana* (Grigelis)
17.5	105.0	3	112.50		6.25	*Globuligerina oxfordiana* (Grigelis)
19.5	107.5	3	150.00		18.75	*Globuligerina oxfordiana* (Grigelis)
19.5	104.5	4	150.00		12.50	*Globuligerina oxfordiana* (Grigelis)
19.5	89.0	4	175.00		12.50	*Globuligerina oxfordiana* (Grigelis)
19.5	88.0	3	200.00		6.25	*Conoglobigerina* aff. *dagestanica* (Morozova)
20.0	90.0	4	200.00		12.50	*Conoglobigerina* aff. *dagestanica* (Morozova)
20.5	88.0	3	200.00		12.50	*Conoglobigerina* aff. *dagestanica* (Morozova)
22.5	95.5	3	200.00		12.50	*Conoglobigerina* aff. *dagestanica* (Morozova)
22.5	91.0	3	200.00		12.50	*Conoglobigerina* aff. *dagestanica* (Morozova)
22.5	89.5	4	187.50		18.75	*Globuligerina oxfordiana* (Grigelis)
23.0	101.0	4	162.50		6.25	*Globuligerina oxfordiana* (Grigelis)
23.5	98.5	3	225.00		18.75	*Conoglobigerina* aff. *dagestanica* (Morozova)
23.5	94.0	3	150.00		6.25	*Globuligerina oxfordiana* (Grigelis)
23.5	94.0	4	175.00		6.25	*Globuligerina oxfordiana* (Grigelis)
24.0	101.0	4	212.50	37.50		*Globuligerina oxfordiana* (Grigelis)
Total Number of Specimens				**11**	**81**	**92**
Relative Percentages				**12**	**88**	

MONTE KUMETA - 2 (BAJOCIAN)

Thin Section Co-ordinates		No. of Chambers Visible	Maximum Diameter (µm)	Wall Thickness (µm)		Species
Vert	Hor			Thick	Thin	
4.0	69.0	3	175.0		18.75	*Globuligerina oxfordiana* (Grigelis)
4.0	98.5	4	125.0		12.50	*Globuligerina oxfordiana* (Grigelis)
4.0	99.5	4	150.0		18.75	*Globuligerina oxfordiana* (Grigelis)
4.0	111.5	4	137.5		18.75	*Globuligerina oxfordiana* (Grigelis)
4.5	109.0	3	125.0		12.50	*Globuligerina oxfordiana* (Grigelis)
4.5	108.0	3	200.0		18.75	*Conoglobigerina* aff. *dagestanica* (Morozova)
4.5	107.5	4	175.0		12.50	*Globuligerina oxfordiana* (Grigelis)
4.5	107.5	3	175.0		12.50	*Globuligerina oxfordiana* (Grigelis)
5.5	71.5	3	200.0		12.50	*Conoglobigerina* aff. *dagestanica* (Morozova)
5.5	70.0	4	150.0		12.50	*Globuligerina oxfordiana* (Grigelis)
5.5	69.0	3	225.0	25.00		*Globuligerina oxfordiana* (Grigelis)
6.0	76.5	4	200.0		12.50	*Conoglobigerina* aff. *dagestanica* (Morozova)
6.0	89.0	3	150.0		18.75	*Globuligerina oxfordiana* (Grigelis)
8.0	94.5	4	137.5	25.00		*Globuligerina oxfordiana* (Grigelis)
9.5	89.5	3	200.0	37.50		*Globuligerina oxfordiana* (Grigelis)
10.0	90.5	3	275.0	37.50		*Globuligerina oxfordiana* (Grigelis)
10.5	68.0	4	175.0		12.50	*Globuligerina oxfordiana* (Grigelis)
10.5	67.0	3	150.0		12.50	*Globuligerina oxfordiana* (Grigelis)
10.5	66.5	4	137.5		12.50	*Globuligerina oxfordiana* (Grigelis)
10.5	66.0	3	112.5		6.25	*Globuligerina oxfordiana* (Grigelis)
11.0	113.5	3	200.0		6.25	*Conoglobigerina* aff. *dagestanica* (Morozova)
11.5	101.0	4	137.5		6.25	*Globuligerina oxfordiana* (Grigelis)
11.5	77.0	3	200.0		6.25	*Conoglobigerina* aff. *dagestanica* (Morozova)
11.5	76.0	3	200.0		12.50	*Conoglobigerina* aff. *dagestanica* (Morozova)
12.0	78.0	3	150.0		12.50	*Globuligerina oxfordiana* (Grigelis)
12.0	101.0	4	200.0		12.50	*Conoglobigerina* aff. *dagestanica* (Morozova)
12.5	112.5	4	125.0		12.50	*Globuligerina oxfordiana* (Grigelis)
12.5	74.0	3	187.5		12.50	*Globuligerina oxfordiana* (Grigelis)
12.5	65.0	3	125.0		12.50	*Globuligerina oxfordiana* (Grigelis)
13.0	65.0	4	175.0		12.50	*Globuligerina oxfordiana* (Grigelis)
13.0	66.0	4	187.5		12.50	*Globuligerina oxfordiana* (Grigelis)
13.0	88.5	3	175.0		12.50	*Globuligerina oxfordiana* (Grigelis)
13.0	89.0	3	125.0		18.75	*Globuligerina oxfordiana* (Grigelis)
13.5	65.5	3	150.0		12.50	*Globuligerina oxfordiana* (Grigelis)
14.0	67.0	3	237.5		12.50	*Conoglobigerina* aff. *dagestanica* (Morozova)
14.0	75.0	3	137.5		12.50	*Globuligerina oxfordiana* (Grigelis)
14.0	108.0	3	175.0		6.25	*Globuligerina oxfordiana* (Grigelis)
14.0	108.5	3	237.5		6.25	*Conoglobigerina* aff. *dagestanica* (Morozova)
14.0	112.5	4	125.0		18.75	*Globuligerina oxfordiana* (Grigelis)
14.5	113.0	4	175.0		18.75	*Globuligerina oxfordiana* (Grigelis)
14.5	109.0	4	150.0		18.75	*Globuligerina oxfordiana* (Grigelis)
15.0	90.5	4	175.0		18.75	*Globuligerina oxfordiana* (Grigelis)
15.5	70.5	3	150.0		18.75	*Globuligerina oxfordiana* (Grigelis)
15.5	66.0	3	225.0		18.75	*Conoglobigerina* aff. *dagestanica* (Morozova)
16.5	101.5	3	200.0		12.50	*Conoglobigerina* aff. *dagestanica* (Morozova)
16.5	88.5	3	250.0	37.50		*Globuligerina oxfordiana* (Grigelis)
16.5	77.0	4	175.0		12.50	*Globuligerina oxfordiana* (Grigelis)
18.0	100.0	4	162.5		6.25	*Globuligerina oxfordiana* (Grigelis)
18.5	67.0	4	237.5	31.25		*Globuligerina oxfordiana* (Grigelis)
18.5	66.5	4	175.0		18.75	*Globuligerina oxfordiana* (Grigelis)
20.5	66.0	4	162.5		6.25	*Globuligerina oxfordiana* (Grigelis)
20.5	66.0	4	150.0		6.25	*Globuligerina oxfordiana* (Grigelis)
21.0	69.0	3	175.0		12.50	*Globuligerina oxfordiana* (Grigelis)
21.0	72.0	4	175.0		12.50	*Globuligerina oxfordiana* (Grigelis)
Total Number of Specimens				**6**	**48**	**54**
Relative Percentages				**11**	**89**	

MONTE KUMETA - 3 (BAJOCIAN)

Thin Section Co-ordinates		No. of Chambers Visible	Maximum Diameter (µm)	Wall Thickness (µm)		Species
Vert	Hor			Thick	Thin	
2.0	64.0	4	200.0		18.75	*Conoglobigerina* aff. *dagestanica* (Morozova)
2.0	75.0	3	125.0		18.75	*Globuligerina oxfordiana* (Grigelis)
2.0	88.5	4	175.0		18.75	*Globuligerina oxfordiana* (Grigelis)
2.0	92.0	5	150.0		12.50	*Globuligerina oxfordiana* (Grigelis)
2.0	92.5	4	225.0	25.00		*Globuligerina oxfordiana* (Grigelis)
2.0	92.5	3	175.0		18.75	*Globuligerina oxfordiana* (Grigelis)
4.5	100.0	3	137.5		6.25	*Globuligerina oxfordiana* (Grigelis)
5.0	64.5	3	137.5		6.25	*Globuligerina oxfordiana* (Grigelis)
5.0	89.5	4	187.5	25.00		*Globuligerina oxfordiana* (Grigelis)
5.0	97.5	4	187.5		18.75	*Globuligerina oxfordiana* (Grigelis)
5.0	106.0	3	200.0	25.00		*Globuligerina oxfordiana* (Grigelis)
6.0	62.0	4	225.0		18.75	*Conoglobigerina* aff. *dagestanica* (Morozova)
6.0	65.0	4	175.0		18.75	*Globuligerina oxfordiana* (Grigelis)
6.0	70.5	3	150.0		12.50	*Globuligerina oxfordiana* (Grigelis)
6.5	87.0	4	150.0		12.50	*Globuligerina oxfordiana* (Grigelis)
7.0	70.0	3	175.0		12.50	*Globuligerina oxfordiana* (Grigelis)
7.0	93.0	3	150.0		18.75	*Globuligerina oxfordiana* (Grigelis)
7.0	83.5	3	150.0		18.75	*Globuligerina oxfordiana* (Grigelis)
7.5	104.0	4	150.0		12.50	*Globuligerina oxfordiana* (Grigelis)
7.5	110.5	3	125.0		12.50	*Globuligerina oxfordiana* (Grigelis)
7.5	104.0	4	150.0		12.50	*Globuligerina oxfordiana* (Grigelis)
8.0	69.0	3	125.0		12.50	*Globuligerina oxfordiana* (Grigelis)
8.0	94.5	3	150.0		18.75	*Globuligerina oxfordiana* (Grigelis)
8.0	95.0	4	175.0		12.50	*Globuligerina oxfordiana* (Grigelis)
8.0	105.0	3	187.5	25.00		*Globuligerina oxfordiana* (Grigelis)
8.5	104.0	3	150.0		6.25	*Globuligerina oxfordiana* (Grigelis)
8.5	103.0	3	200.0		18.75	*Conoglobigerina* aff. *dagestanica* (Morozova)
8.5	80.5	4	175.0		18.75	*Globuligerina oxfordiana* (Grigelis)
8.5	64.5	4	200.0		12.50	*Conoglobigerina* aff. *dagestanica* (Morozova)
8.5	63.5	4	175.0		18.75	*Globuligerina oxfordiana* (Grigelis)
9.0	66.5	4	162.5		6.25	*Globuligerina oxfordiana* (Grigelis)
9.0	84.0	3	150.0		12.50	*Globuligerina oxfordiana* (Grigelis)
9.0	91.5	3	250.0		18.75	*Conoglobigerina* aff. *dagestanica* (Morozova)
9.0	102.0	4	200.0		12.50	*Conoglobigerina* aff. *dagestanica* (Morozova)
9.0	107.0	4	162.5		12.50	*Globuligerina oxfordiana* (Grigelis)
9.5	118.5	4	175.0		12.50	*Globuligerina oxfordiana* (Grigelis)
10.0	74.0	4	200.0		12.50	*Conoglobigerina* aff. *dagestanica* (Morozova)
10.0	92.5	4	225.0		18.75	*Conoglobigerina* aff. *dagestanica* (Morozova)
10.0	109.0	4	212.5		12.50	*Conoglobigerina* aff. *dagestanica* (Morozova)
10.0	120.0	4	225.0	25.00		*Globuligerina oxfordiana* (Grigelis)
10.5	90.5	4	187.5		12.50	*Globuligerina oxfordiana* (Grigelis)
10.5	71.5	3	200.0		18.75	*Conoglobigerina* aff. *dagestanica* (Morozova)
10.5	70.0	3	125.0		18.75	*Globuligerina oxfordiana* (Grigelis)
11.5	81.5	3	125.0		12.50	*Globuligerina oxfordiana* (Grigelis)
12.5	71.0	4	150.0		12.50	*Globuligerina oxfordiana* (Grigelis)
13.0	64.0	4	125.0		12.50	*Globuligerina oxfordiana* (Grigelis)
13.0	67.5	4	175.0		18.75	*Globuligerina oxfordiana* (Grigelis)
13.0	68.5	4	150.0		12.50	*Globuligerina oxfordiana* (Grigelis)
13.0	74.0	4	250.0		18.75	*Conoglobigerina* aff. *dagestanica* (Morozova)
13.0	83.5	3	137.5		12.50	*Globuligerina oxfordiana* (Grigelis)
13.0	94.0	3	187.5		18.75	*Globuligerina oxfordiana* (Grigelis)
13.0	96.0	3	150.0		12.50	*Globuligerina oxfordiana* (Grigelis)
13.0	99.5	3	150.0		18.75	*Globuligerina oxfordiana* (Grigelis)
13.5	110.5	3	175.0		12.50	*Globuligerina oxfordiana* (Grigelis)
13.5	109.0	4	162.5		12.50	*Globuligerina oxfordiana* (Grigelis)

MONTE KUMETA - 3 (BAJOCIAN)

Thin Section Co-ordinates		No. of Chambers Visible	Maximum Diameter (µm)	Wall Thickness (µm)		Species
Vert	Hor			Thick	Thin	
13.5	103.0	4	125.0		12.50	*Globuligerina oxfordiana* (Grigelis)
13.5	101.5	4	125.0		6.25	*Globuligerina oxfordiana* (Grigelis)
14.0	70.5	4	187.5		12.50	*Globuligerina oxfordiana* (Grigelis)
14.0	114.0	4	150.0		18.75	*Globuligerina oxfordiana* (Grigelis)
14.0	114.5	3	200.0	31.25		*Globuligerina oxfordiana* (Grigelis)
14.5	90.5	4	187.5		18.75	*Globuligerina oxfordiana* (Grigelis)
14.5	71.5	4	100.0		12.50	*Globuligerina oxfordiana* (Grigelis)
14.5	71.0	4	212.5		18.75	*Conoglobigerina* aff. *dagestanica* (Morozova)
15.5	89.0	4	175.0		12.50	*Globuligerina oxfordiana* (Grigelis)
16.0	97.0	3	150.0		18.75	*Globuligerina oxfordiana* (Grigelis)
16.5	66.0	3	175.0		12.50	*Globuligerina oxfordiana* (Grigelis)
17.0	89.0	3	175.0	25.00		*Globuligerina oxfordiana* (Grigelis)
17.5	101.0	3	125.0		12.50	*Globuligerina oxfordiana* (Grigelis)
17.5	100.0	3	187.5		12.50	*Globuligerina oxfordiana* (Grigelis)
17.5	84.5	3	112.5		12.50	*Globuligerina oxfordiana* (Grigelis)
18.0	106.0	4	125.0		12.50	*Globuligerina oxfordiana* (Grigelis)
18.0	106.0	3	125.0		12.50	*Globuligerina oxfordiana* (Grigelis)
18.5	76.0	3	112.5		12.50	*Globuligerina oxfordiana* (Grigelis)
19.0	61.0	4	187.5		18.75	*Globuligerina oxfordiana* (Grigelis)
19.0	89.5	3	187.5		18.75	*Globuligerina oxfordiana* (Grigelis)
19.5	61.5	3	150.0		18.75	*Globuligerina oxfordiana* (Grigelis)
20.0	73.0	4	225.0		12.50	*Conoglobigerina* aff. *dagestanica* (Morozova)
20.0	77.5	4	162.5		6.25	*Globuligerina oxfordiana* (Grigelis)
20.0	89.0	4	200.0		12.50	*Conoglobigerina* aff. *dagestanica* (Morozova)
20.0	107.5	4	175.0		18.75	*Globuligerina oxfordiana* (Grigelis)
20.0	107.5	4	200.0		12.50	*Conoglobigerina* aff. *dagestanica* (Morozova)
20.5	108.0	4	150.0		12.50	*Globuligerina oxfordiana* (Grigelis)
21.0	108.0	3	175.0		12.50	*Globuligerina oxfordiana* (Grigelis)
21.5	112.0	4	175.0		18.75	*Globuligerina oxfordiana* (Grigelis)
21.5	108.5	3	175.0		12.50	*Globuligerina oxfordiana* (Grigelis)
21.5	107.0	3	162.5		12.50	*Globuligerina oxfordiana* (Grigelis)
22.0	109.0	4	212.5		12.50	*Conoglobigerina* aff. *dagestanica* (Morozova)
22.0	112.5	4	187.5		12.50	*Globuligerina oxfordiana* (Grigelis)
22.5	92.5	3	162.5		12.50	*Globuligerina oxfordiana* (Grigelis)
22.5	92.0	3	200.0		18.75	*Conoglobigerina* aff. *dagestanica* (Morozova)
23.0	109.0	4	175.0		18.75	*Globuligerina oxfordiana* (Grigelis)
Total Number of Specimens				7	84	91
Relative Percentages				8	92	