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Chronology for mountainous river terraces: OSL/IRSL and rock dating techniques applied to carbonate-rich terraces in the Atlas Mountains

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Chronology for mountainous river terraces

OSL/IRSL and rock dating applied to strath terraces in the Atlas Mountains

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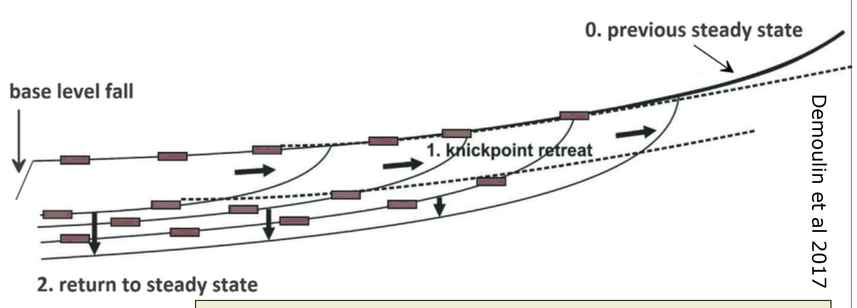
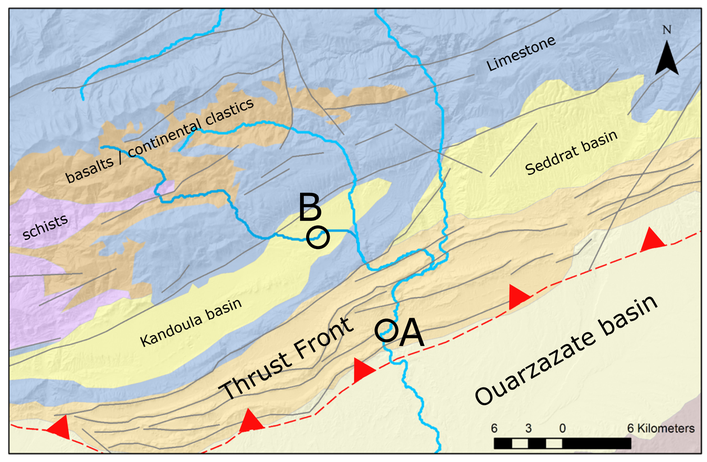
1) Motivation and Aims: Unlocking a tectonic and climatic archive

River strath terraces form as a river switches between aggrading sediments and incision. Unlocking this archive of tectonic and climatic history requires strong age control

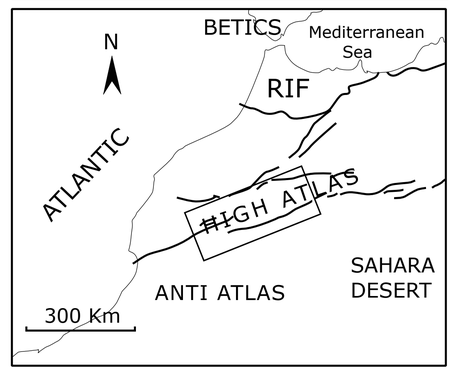


Conglomerates pose challenges to dose rate determination and sampling techniques. Experimental pebble and bedrock OSL provide potential insight into terrace formation

2) The Mgoun study catchment



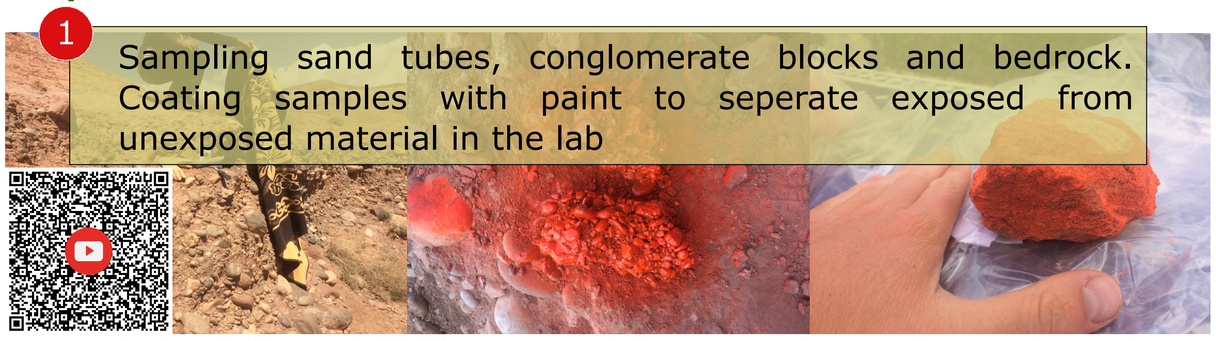
On the southern High Atlas, river like the Mgoun cross an active thrust front (Boulton et al 2014). A dryland climate next to the Sahara controls river dynamics



Source rocks are predominantly carbonates, with low concentrations of quartz and feldspar in terrace sediments. Coarse conglomerates are typical for fluvial sediments in high relief landscapes

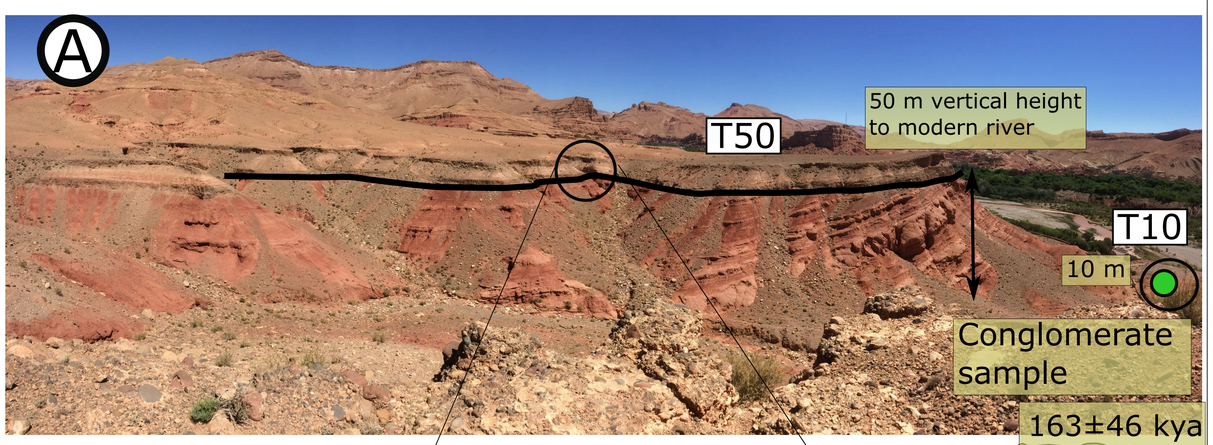
3) Methods

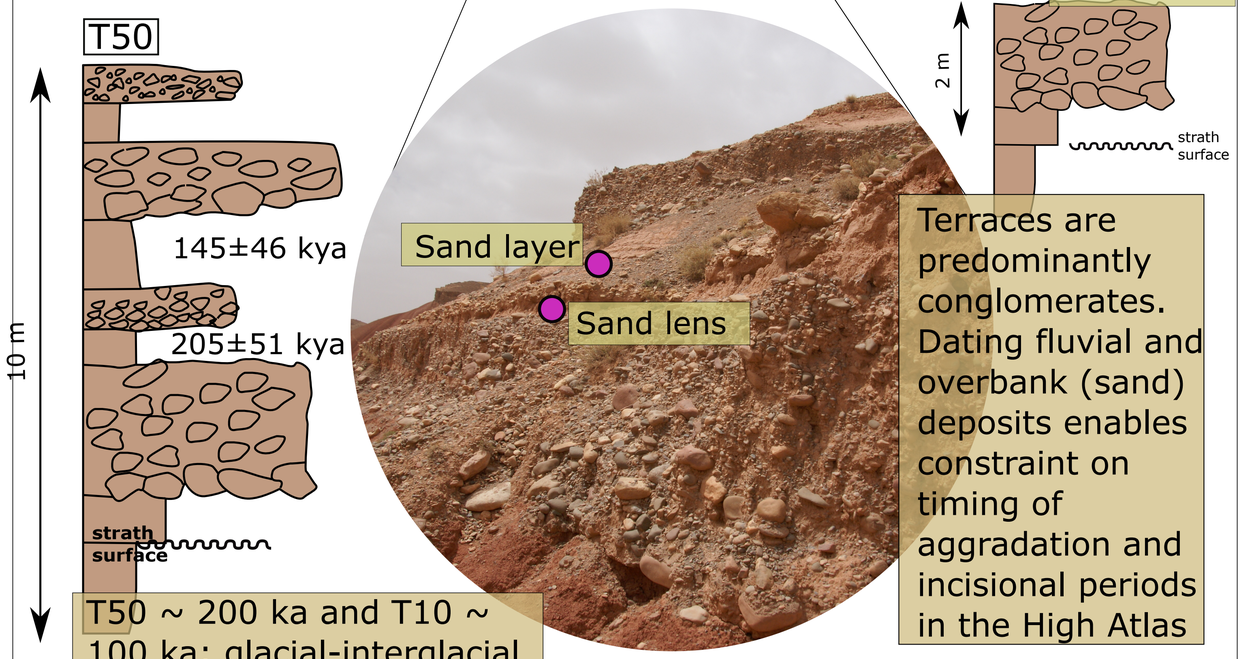
1 Sampling sand tubes, conglomerate blocks and bedrock. Coating samples with paint to seperate exposed from unexposed material in the lab



2 Lab: OSL and IRSL on sand from sand samples and sand from conglomerate samples. OSL/IRSL tests on chips from pebbles/ bedrock sliced cores (profiling)

4) Terraces and Material:

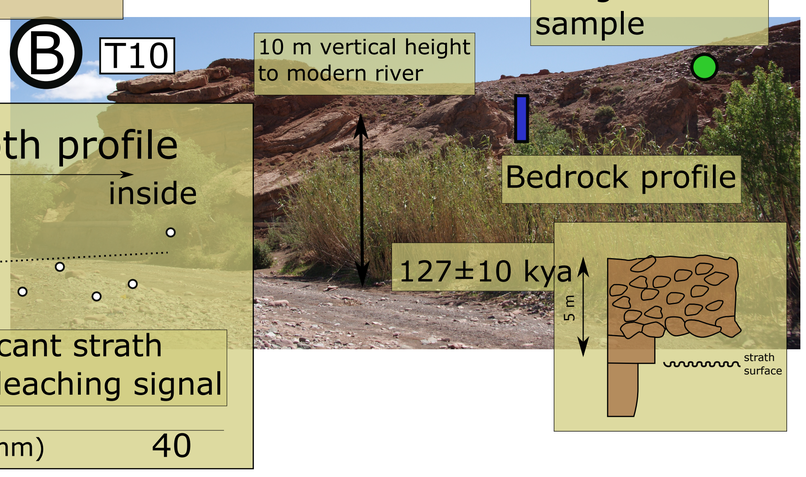


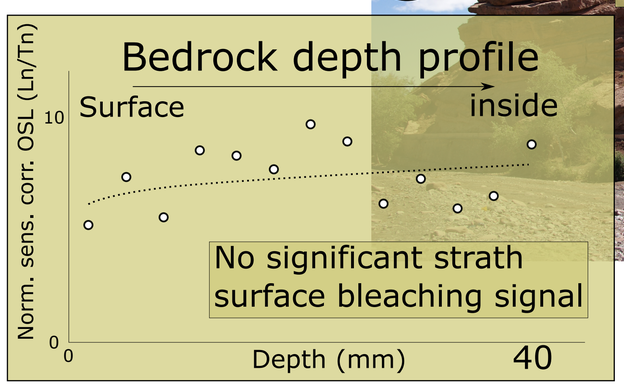


Terraces are predominantly conglomerates. Dating fluvial and overbank (sand) deposits enables constraint on timing of aggradation and incisional periods in the High Atlas

T50 ~ 200 ka and T10 ~ 100 ka: glacial-interglacial timescale

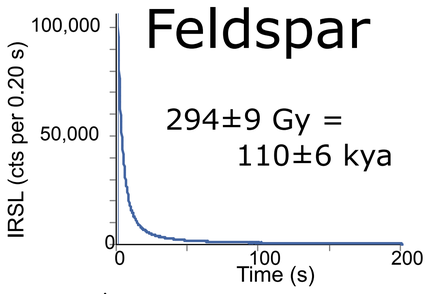
Bedrock OSL

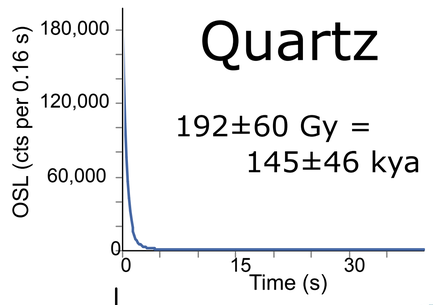


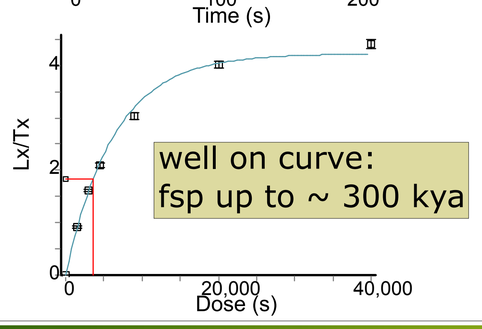


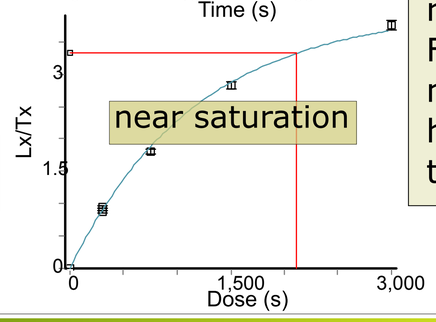
No significant strath surface bleaching signal

5) Quartz and feldspar signals: saturation limit?



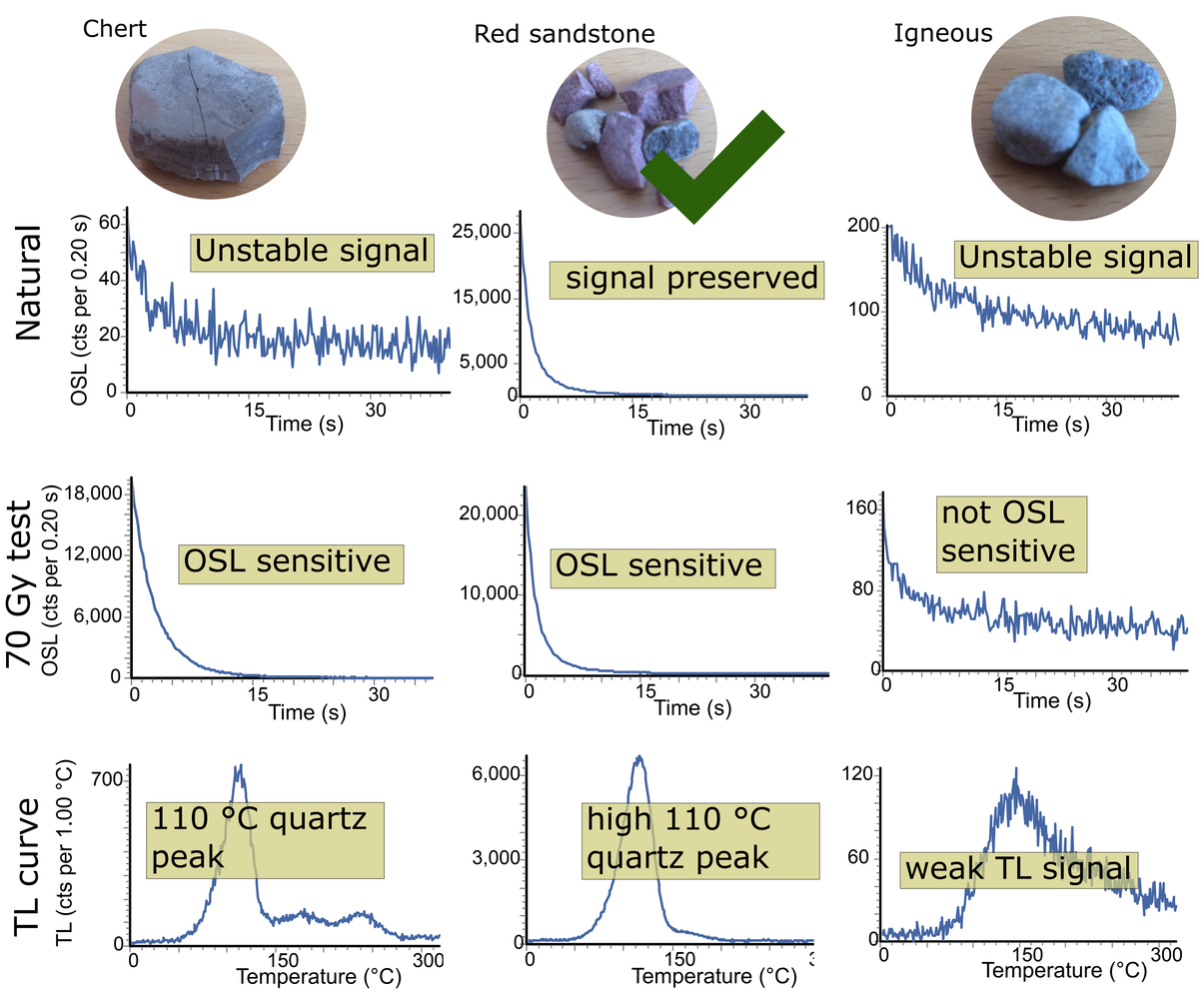






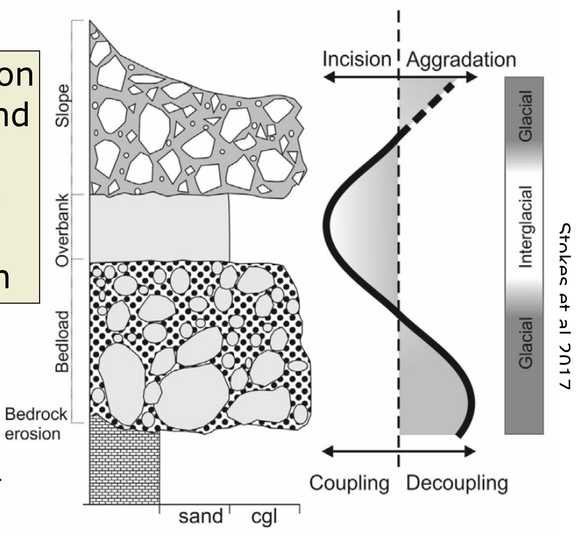
Dose rates for sand and conglomerates are 0.7±0.1 and 1.24 ±0.09 Gy/kyr respectively. Feldspar is needed for the higher terraces.

6) Pebble OSL: which lithology?



7) How/when do terraces form?

Nearby sparse OSL dates suggest incision and aggradation occur on interglacial and glacial timescales. Our dates agree and have the potential to constrain at which stage in a cycle these processes occur and to resolve tectonic waves of incision



6) Conclusions

- 10 - 50 m level terraces span 100-200 ka and supply insight into glaciall-interglacial cycles of incision and aggradation
- Red sandstone pebbles can be used for pebble OSL
- Bedrock profiles indicate limited bleaching or subsequent removal of the strath surface

References:

Demoulin, A., Mather, A.E. and Whittaker, A.C., 2017, Fluvial Archives, a valuable record of vertical crustal deformation: Quaternary Science Reviews V. 166, p. 10-37

Stokes, M., 2017, Controls on dryland mountain landscape development along the NW Saharan desert margin: Insights from Quaternary river terrace sequences (Dades River, south-central High Atlas, Morocco): Quaternary Science Reviews V. 166, p. 363-379