

Microbial Community Responses to Vanadium Distributions in Mining Geological Environments and Bioremediation Assessment

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Introduction

This supporting information includes sampling locations, physicochemical properties of original samples in Panzhihua region, China, alpha-diversity estimator, rarefaction curves of bacterial communities in all original samples and cultivated samples, microbial community compositions in multiple matrices at phylum level of original samples, NMDS plots of bacterial communities in different cultivated systems, and comparison of vanadium contents with existing studies. All original samples were collected in April, 2016 and analyzed after collection. Methods for physicochemical properties analysis are described in the main paper. Microbial communities were analyzed by high-throughput sequencing, which is also described in the main paper.

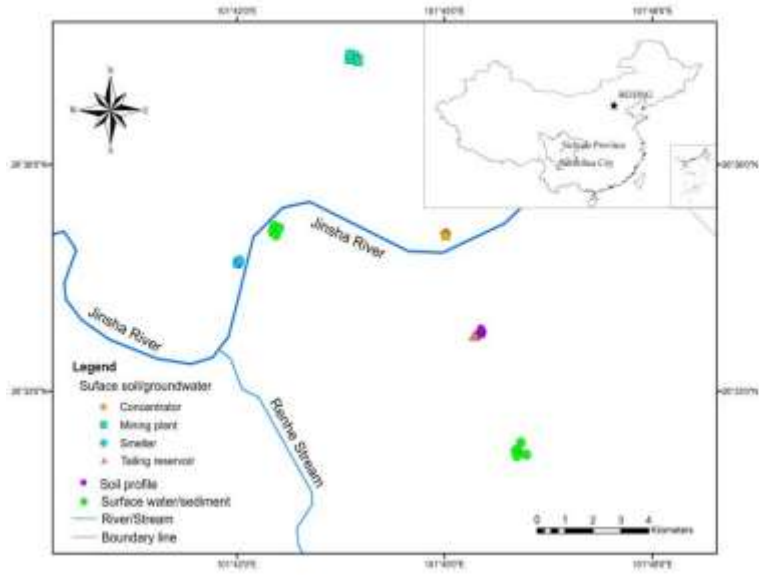


Fig. S1. Sampling locations of different processing stages of vanadium-bearing titanomagnetite in Panzhihua region, China.

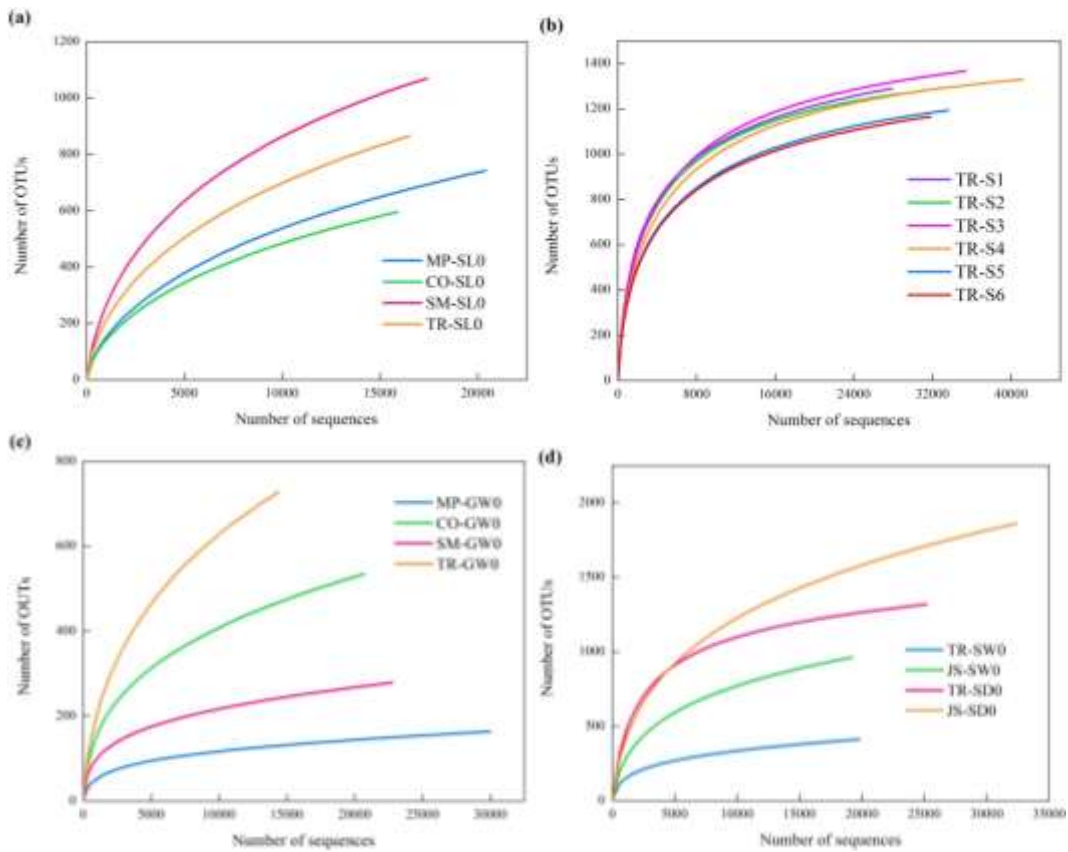


Fig. S2. Rarefaction curves based on sequencing of bacterial communities in different matrices. (a) surface soils; (b) vertical soil profile; (c) groundwater; and (d) surface water and sediments. The OTUs were defined by 97% similarity.

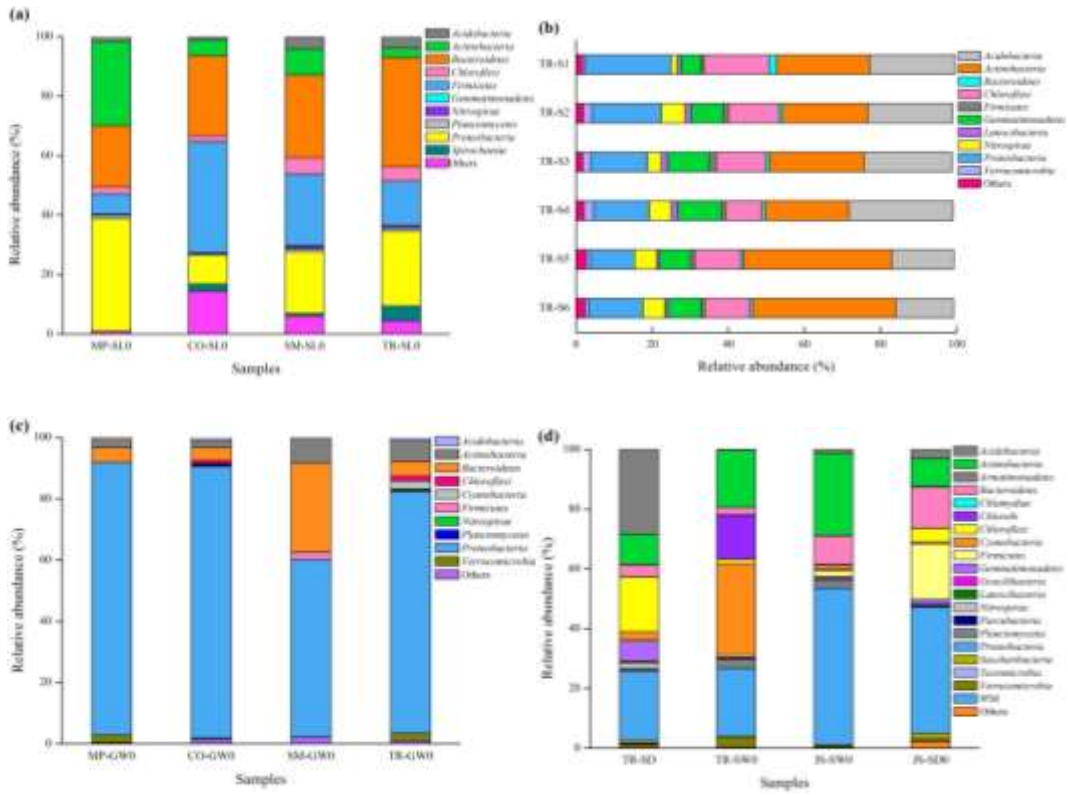


Fig. S3. Microbial community compositions revealed by high-throughput sequencing in multiple matrices at phylum level. (a) surface soils; (b) vertical soil profile; (c) groundwater; and (d) surface water and sediments.

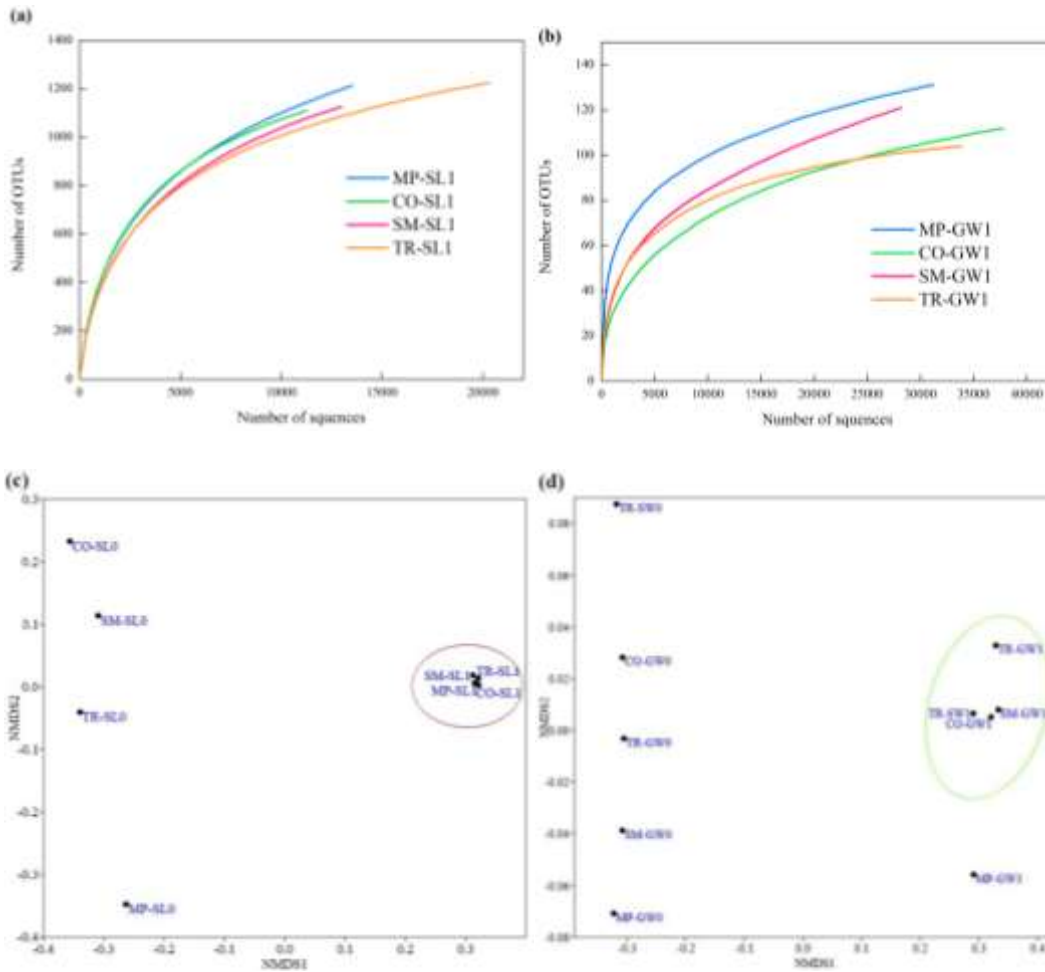


Fig. S4. Rarefaction curves and NMDS plots based on sequencing of bacterial communities in different cultivated systems. Rarefaction curves in (a) soil-inoculated system and (b) water-inoculated system. NMDS plots of (a) soil-inoculated system and (b) water-inoculated system.

Sample	pH	OM/(g kg ⁻¹)	TN/(g kg ⁻¹)	Available P/(mg kg ⁻¹)	Available S/(mg kg ⁻¹)	Cr/(×10 ² mg kg ⁻¹)	Ti/(g kg ⁻¹)	Fe/(g kg ⁻¹)	Al/(g kg ⁻¹)	Cu/(mg kg ⁻¹)	Zn/(×10 ² mg kg ⁻¹)
MP-SL0	7.31 ± 0.06	15.7 ± 0.18	0.41 ± 0.04	18.9 ± 0.28	73.1 ± 1.25	0.53 ± 0.02	4.50 ± 0.19	55.1 ± 1.58	63.3 ± 1.54	5.58 ± 1.81	0.91 ± 0.04
CO-SL0	8.30 ± 0.05	11.5 ± 0.59	0.01 ± 0.01	12.3 ± 0.15	10.1 ± 0.18	0.55 ± 0.05	3.95 ± 1.18	45.6 ± 1.65	40.2 ± 0.15	49.9 ± 1.18	1.88 ± 0.05
SM-SL0	7.34 ± 0.06	20.4 ± 1.09	0.86 ± 0.09	38.1 ± 1.24	7.49 ± 0.98	2.60 ± 0.11	7.61 ± 1.56	81.4 ± 3.27	70.9 ± 1.34	39.4 ± 0.95	1.25 ± 0.02
TR-SL0	8.25 ± 0.02	26.5 ± 0.41	0.53 ± 0.11	20.3 ± 0.21	22.4 ± 0.95	0.75 ± 0.06	2.22 ± 0.27	37.9 ± 1.15	52.5 ± 0.58	9.45 ± 2.13	1.42 ± 0.12
TR-S1	6.97 ± 0.03	15.9 ± 0.15	0.46 ± 0.05	21.5 ± 1.51	35.3 ± 0.48	0.64 ± 0.04	2.64 ± 0.95	30.7 ± 1.46	33.9 ± 0.87	17.1 ± 1.84	0.69 ± 0.08
TR-S2	7.33 ± 0.03	13.6 ± 0.19	0.48 ± 0.15	21.4 ± 0.54	32.2 ± 0.18	0.77 ± 0.02	2.83 ± 0.58	27.2 ± 3.98	29.9 ± 1.16	14.6 ± 1.65	0.68 ± 0.04
TR-S3	7.39 ± 0.04	13.1 ± 0.34	0.49 ± 0.08	20.6 ± 0.98	36.3 ± 0.18	0.69 ± 0.05	2.65 ± 0.87	27.9 ± 2.15	29.5 ± 1.71	14.3 ± 2.22	0.65 ± 0.05
TR-S4	7.47 ± 0.07	13.1 ± 0.56	0.44 ± 0.03	18.2 ± 0.16	29.6 ± 1.15	0.54 ± 0.04	2.68 ± 0.59	27.3 ± 2.33	28.3 ± 1.17	14.2 ± 3.19	0.65 ± 0.07
TR-S5	7.52 ± 0.02	13.5 ± 0.38	0.37 ± 0.12	19.7 ± 0.89	35.5 ± 1.21	0.38 ± 0.02	2.58 ± 0.84	26.4 ± 1.48	26.8 ± 1.32	13.5 ± 3.64	0.63 ± 0.05
TR-S6	7.55 ± 0.01	13.0 ± 0.56	0.44 ± 0.07	19.9 ± 0.64	31.6 ± 1.25	0.29 ± 0.03	2.49 ± 0.49	27.3 ± 1.44	26.5 ± 1.85	14.8 ± 2.51	0.64 ± 0.05
TR-SD0	7.89 ± 0.05	23.9 ± 0.88	0.21 ± 0.09	28.3 ± 0.15	34.3 ± 1.15	0.56 ± 0.02	2.86 ± 0.59	32.5 ± 1.17	30.9 ± 1.77	26.5 ± 4.15	0.96 ± 0.11
JS-SD0	8.13 ± 0.03	25.6 ± 0.75	0.38 ± 0.06	29.2 ± 0.18	35.2 ± 1.15	1.10 ± 0.07	9.23 ± 0.38	42.1 ± 1.68	19.6 ± 0.81	13.4 ± 3.57	0.77 ± 0.14

Table S1. Physicochemical properties of original soils and sediments sampled in Panzhuhua region, China.

Locality	Description	V concentration (mg L ⁻¹)	Reference
Colorado, USA	Near a tailings pile footprint	0.770	Ortiz-Bernad et al. (2004)
Northeastern San Joaquin Valley, USA	Existing infrastructure and a robust agricultural industry	0.003-0.070	Wright et al. (2014)
Buenos Aires, Argentina	The groundwater of the southeastern pampean region	0.050-2.470	Fiorentino et al. (2007)
Western France	Wetland groundwaters in a small tributary of Petit Hermitage Creek with intensive agricultural practices	0.001-0.012	Pourret et al. (2012)
Panzhuhua, China	Jinsha River near a tailing pile	0.076-0.285	Wang et al. (2009)
Panzhuhua, China	Four mining and smelting processes	0.013-0.614	This study

Table S2. Vanadium concentrations in aqueous matrices (reported previously as well as in the present study).

Sample	pH	TOC/(mg L ⁻¹)	ORP/(×10 ² mV)	Cr/(mg L ⁻¹)	Cd/(mg L ⁻¹)	Ca/(mg L ⁻¹)	Cl ⁻ /(×10 ² mg L ⁻¹)	NO ₃ ⁻ /(mg L ⁻¹)	SO ₄ ²⁻ /(×10 ² mg L ⁻¹)
MP-GW0	7.31 ± 0.12	0.94 ± 0.05	2.49 ± 0.31	0.01 ± 0.00	0.09 ± 0.01	0.36 ± 0.08	0.06 ± 0.01	8.54 ± 0.11	0.95 ± 0.05
CO-GW0	8.07 ± 0.27	0.05 ± 0.01	2.30 ± 0.12	0.01 ± 0.01	0.09 ± 0.02	0.56 ± 0.15	0.07 ± 0.01	15.5 ± 0.06	1.17 ± 0.06
SM-GW0	7.59 ± 0.24	-	2.33 ± 0.19	0.19 ± 0.02	0.09 ± 0.01	0.78 ± 0.21	0.72 ± 0.08	74.1 ± 0.37	1.35 ± 0.08
TR-GW0	7.61 ± 0.18	-	2.45 ± 0.18	0.35 ± 0.03	0.09 ± 0.03	5.34 ± 0.11	1.44 ± 0.05	9.50 ± 0.91	0.77 ± 0.07
TR-SW0	7.58 ± 0.19	1.95 ± 0.04	2.62 ± 0.14	0.01 ± 0.00	0.01 ± 0.00	5.28 ± 0.29	4.59 ± 0.18	8.86 ± 0.12	1.98 ± 0.03
JS-SW0	8.08 ± 0.22	0.05 ± 0.01	2.43 ± 0.11	0.02 ± 0.01	0.02 ± 0.01	0.28 ± 0.08	0.11 ± 0.02	9.36 ± 0.08	0.83 ± 0.04

Table S3. Physicochemical properties of original groundwater and surface water samples in Panzhihua region, China.

Sample	OUT number	Ace	Chao1	Shannon	Simpson	Coverage
MP-SL0	745	1362	1145	3.46	0.10	0.99
CO-SL0	597	1169	936	3.60	0.07	0.98
SM-SL0	783	1503	1464	4.74	0.03	0.98
TR-SL0	867	1660	1445	4.22	0.05	0.98
TR-S1	1289	1441	1444	6.13	0.00	0.99
TR-S2	1279	1376	1392	6.03	0.00	0.99
TR-S3	1366	1476	1506	6.06	0.00	0.99
TR-S4	1330	1415	1418	5.90	0.01	1.00
TR-S5	1193	1325	1330	5.77	0.01	0.99
TR-S6	1164	1307	1323	5.72	0.01	0.99
MP-GW0	164	310	259	1.53	0.53	1.00
CO-GW0	535	965	792	3.71	0.09	0.99
SM-GW0	279	440	394	3.56	0.06	1.00
TR-GW0	728	1294	1103	4.29	0.04	0.98
TR-SW0	416	642	599	3.91	0.06	0.99
JS-SW0	964	1321	1373	4.81	0.036	0.98
TR-SD0	1318	1467	1513	6.14	0.01	0.99
JS-SD0	1871	2573	2568	5.84	0.01	0.98

Table S4. Alpha-diversity estimator of bacterial communities in all original samples.

Sample	OUT number	Ace	Chao1	Shannon	Simpson	Coverage
MP-SL1	1218	1605	1610	5.97	0.01	0.97
CO-SL1	1110	1349	1355	5.90	0.01	0.97
SM-SL1	1028	1452	1435	5.70	0.01	0.97
TR-SL1	1225	1496	1534	5.81	0.01	0.98
MP-GW1	131	165	164	1.91	0.40	1.00
CO-GW1	112	140	153	1.39	0.43	1.00
SM-GW1	121	250	194	2.00	0.21	1.00
TR-GW1	104	113	112	1.98	0.22	1.00
TR-SW1	177	272	228	2.31	0.24	1.00

Table S5. Alpha-diversity estimator of bacterial communities in the cultivated samples.