

Supplementary data A

Table A1 Concentrations of P and Fe, ionic strength and the saturation index with respect to chromite in sulfuric acid solutions used in the dissolution experiments

Solution	P [mmolL ⁻¹]	Fe [molL ⁻¹]	Volume and pH	Ionic strength	Ω chromite Initial ¹
A	2.9	0	25mL, pH 2.5	0.03	-45
TK	2.3	0.12	25mL, ~pH 2.3	0.26	-33
A + bacteria	2.8	0.0048	24mL+ 1mL bacteria TK, ~pH 2.3	0.04	-42
TK + bacteria	2.3	0.12	24mL + 1mL bacteria TK, ~pH 2.3	0.26	-30

¹ calculated with 1×10^{-7} mmolL⁻¹ Cr(OH)₂⁺, Ω is defined as Ω = log (Ion activity product – log (equilibrium constant K)

Table A2 Weighted binding energy of the Cr2p peak and normalized proportions of Al, Mg, Cr, Si and Fe on the surface of untreated and treated chromitite surfaces

	Al [%]	Mg [%]	Cr [%]	Si [%]	Fe [%]	weighted binding energy [eV]
Untreated						
Chromite-rich	36.7	9.4	32.0	12.0	9.9	577.0
Chromite-rich	37.4	7.4	32.2	12.3	10.7	576.9
Silicate-rich	30.2	15.3	25.5	19.7	9.3	576.9
Silicate-rich	31.3	15.4	26.1	19.1	8.2	577.0
Average	33.9	11.9	29.0	15.8	9.5	577.0
Standard deviation	3.7	4.1	3.6	4.2	1.1	0.0
Bacteria + TK solution						
Chromite-rich	31.9	7.8	27.5	18.8	14.0	577.5
Silicate-rich	36.4	7.0	25.2	19.0	12.4	577.3
Average	34.1	7.4	26.3	18.9	13.2	577.4
Standard deviation	3.2	0.6	1.7	0.2	1.2	0.1
TK solution						
Chromite-rich	35.2	6.4	27.4	18.4	12.6	577.4
Silicate-rich	29.9	7.5	25.2	22.9	14.6	577.3
Average	32.5	7.0	26.3	20.6	13.6	577.4
Standard deviation	3.8	0.7	1.6	3.2	1.5	0.0
Solution A						
Chromite-rich	34.9	7.8	28.5	21.2	7.6	577.3
Silicate-rich	30.1	8.6	28.7	23.9	8.7	577.4
Average	32.5	8.2	28.6	22.6	8.1	577.3
Standard deviation	3.4	0.6	0.2	1.9	0.8	0.1
bacteria + solution A						

Chromite-rich	34.0	5.1	24.7	21.3	14.8	577.2
Silicate-rich	30.6	5.2	26.4	23.3	14.6	577.3
Average	32.3	5.2	25.5	22.3	14.7	577.3
Standard deviation	2.4	0.1	1.2	1.4	0.1	0.1
deionized water						
Chromite-rich	36.5	9.6	22.2	21.3	10.5	577.1
Silicate-rich	32.9	9.6	23.4	24.5	9.7	577.2
average	34.7	9.6	22.8	22.9	10.1	577.1
Standard deviation	2.5	0.0	0.8	2.3	0.6	0.1
solution A+ 0.1 molL⁻¹ MnO₂						
Chromite-rich	32.9	10.1	28.7	18.2	10.2	577.4
Silicate-rich	33.5	11.5	23.8	23.3	7.9	577.5
average	33.2	10.8	26.2	20.8	9.0	577.4
Standard deviation	0.4	1.0	3.5	3.6	1.6	0.1
0.1 molL⁻¹ MnO₂						
Chromite-rich	34.1	9.7	22.7	24.7	8.8	577.6
Silicate-rich	30.2	11.1	17.5	30.8	10.4	577.4
Average	32.1	10.4	20.1	27.7	9.6	577.5
Standard deviation	2.8	1.0	3.7	4.4	1.1	0.1
0.1 molL⁻¹ MnO₂ + 0.05 molL⁻¹ CaCO₃						
Chromite-rich	33.6	11.1	26.6	18.7	10.0	577.2
Silicate-rich	36.3	7.7	18.6	28.6	8.7	577.1
Average	35.0	9.4	22.6	23.7	9.3	577.1
Standard deviation	1.9	2.4	5.7	7.0	0.9	0.0
0.05 molL⁻¹ CaCO₃						
Chromite-rich	36.1	9.3	25.7	21.8	7.2	577.3
Silicate-rich	37.5	8.3	22.7	22.5	9.0	577.3

Average	36.8	8.8	24.2	22.1	8.1	577.3
Standard deviation	36.7	9.4	32.0	12.0	9.9	577.0

Table A3 Bulk dissolution experiments of chromitite powder samples and the concentrations of the major elements in solution after the experiment

100 mg chromite powder in 25 mL solution for 1 month;	Al mgL ⁻¹	Cr mgL ⁻¹	Fe mgL ⁻¹	Si mgL ⁻¹	Mg mgL ⁻¹	pH initial	pH end
Bacteria + TK solution ¹	9.4	3.8	5670	12	67.1	2.3	2.38
TK solution ¹	9.8	4	6430	13	70.7	2.3	2.36
Solution A	19.2	6.75	6.42	30.5	118	2.5	2.65
Bacteria Solution A	10.1	3.5	61.4	15.5	86.6	2.3	2.4
H ₂ O	0.049	0.112	0.056	1.67	6.41	Neutral	6.7
TK solution 0.1 mol L ⁻¹ MnO ₂	10.9	1.3	1900	15	64.6	2.3	2.37
Solution A 0.1 molL ⁻¹ MnO ₂	0.066	0.087	0.138	12.6	89.4	2.5	4.28
0.1 molL ⁻¹ MnO ₂	0.01	0.014	0.018	1.89	16.3	6.2	6.7
0.1 molL-1 MnO ₂ 0.05 molL ⁻¹ CaCO ₃	0.01	0.056	0.015	1.01	9.51	8.0	7.65
0.05 molL ⁻¹ CaCO ₃	0.054	0.163	0.01	2.06	6.8	9.2	7.81

¹ contains Fe-sulfate solution

Table A4. Composition of an untreated chromitite sample determined with XRF

element	at [%]
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Al	4.77
Ba	0.01
Ca	0.07
Cr	21.32
Fe	9.93
K	0.02
H ₂ O	0.04
Mg	5.19
Mn	0.09
Na	0.03
Si	1.14
Ti	0.15
V	0.06

A5 X-ray powder diffraction pattern of the examined chromite

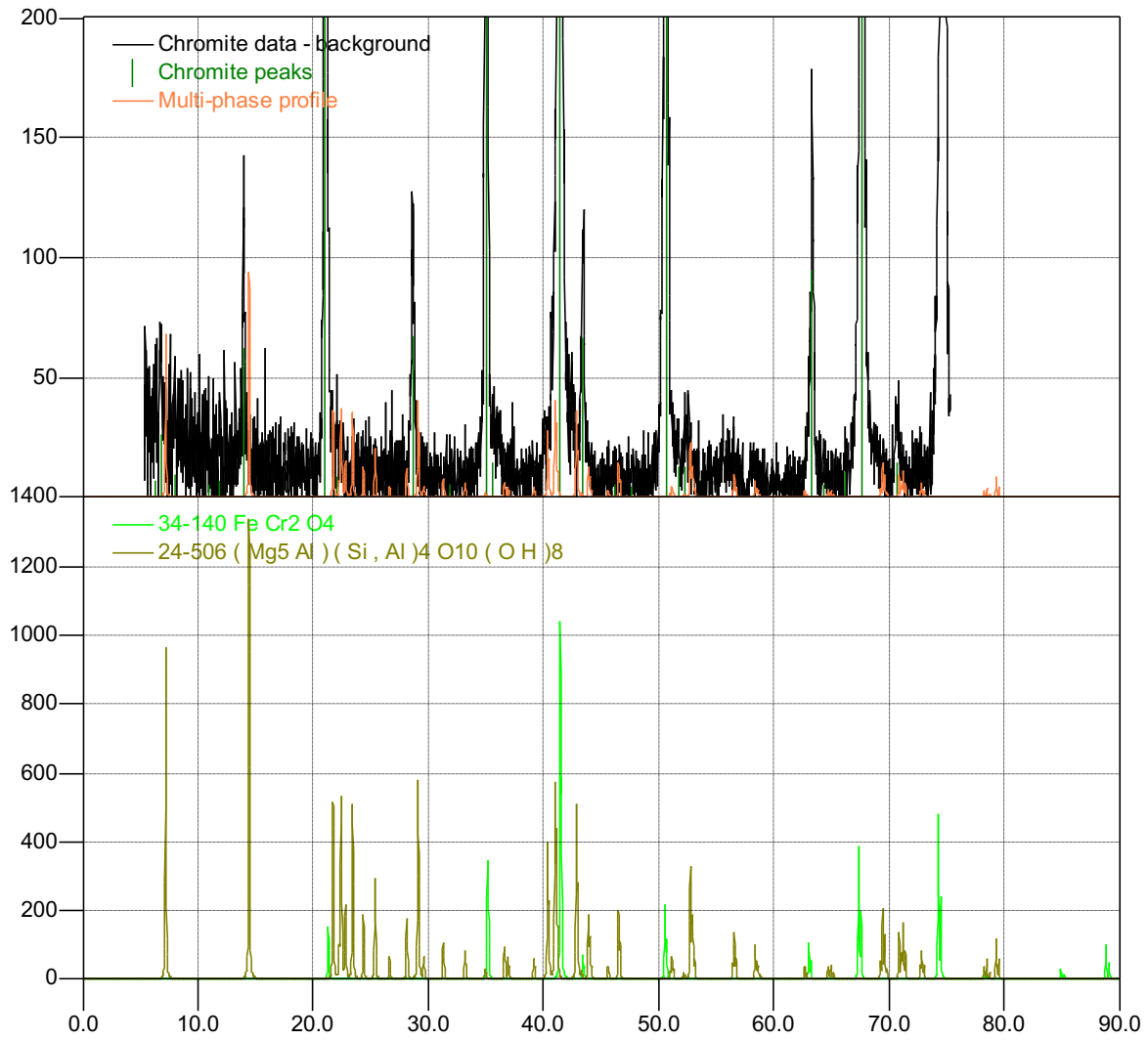


Table A6- Microbial community composition following dissolution experiment (sample of bacteria + 24mL TK media).

Data is ranked based on abundances, OUT stands for operational taxonomy unit

OUT	Kingdom	Phylum	Class	Order	Family	Genus	% abundance
1	Bacteria	Proteobacteria	Alphaproteobacteria	Rhodospirillales	Acetobacteraceae	Acidiphilium	94.92
23	Archaea	Euryarchaeota	Methanomicobia	Methanocellales			0.12
31	Bacteria	Proteobacteria	Gammaproteobacteria	Enterobacteriales	Enterobacteriaceae		0.39
64	Bacteria	Proteobacteria	Alphaproteobacteria	Rhodospirillales	Acetobacteraceae	Acidiphilium	5.01
70	Bacteria	Actinobacteria	Actinobacteria	Actinomycetales	Micrococcaceae		0.39
144	Bacteria	Firmicutes	Bacilli	Bacillales	Alicyclobacillaceae		0.39
152	Bacteria	Actinobacteria	Actinobacteria	Actinomycetales	ACK-M1		0.12
187	Bacteria	Actinobacteria	Actinobacteria	Actinomycetales	ACK-M1		0.39
278	Bacteria	Proteobacteria	Betaproteobacteria				0.39
295	Bacteria	Bacteroidetes	Cytophagia	Cytophagales	Cytophagaceae		0.79
442	Bacteria	Proteobacteria	Betaproteobacteria	Burkholderiales	Oxalobacteraceae	Polynucleobacter	0.39
727	Bacteria	Bacteroidetes	Flavobacteriia	Flavobacteriales	Cryomorphaceae	Fluviicola	0.39
791	Bacteria	Bacteroidetes	[Saprospirae]	[Saprospirales]	Chitinophagaceae		0.39