Electronic Supplementary Material (ESI) for Environmental Science: Processes & Impacts.

Electronic Supplementary Information for

Biological versus Mineralogical Chromium Reduction: Potential for Reoxidation by Manganese Oxide

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Table ESI-1. Concentrations and proportions of Fe, Cr, and Mn used in Cr(VI) reduction and birnessite oxidation experiments.

	Cr(VI) Reduction Experiments				**Birnessite Oxidation Experiments**				
Microcosm Conditions	**(A) Conc. of Cr(VI) (μM)**	**(B) Conc. of Fe mineral (g/L)**	**(C) Max possible conc. of Cr in Fe-Cr solid (μmol/g) (=A/B)**	**(D) Molar ratio of Fe:Cr[d]**	**(E) Conc. of Fe-Cr solid added (g/L)**	**(F) Max. possible conc. of Cr (μM) (=CxE)**	**(G) Conc. birnessite added (g/L)**	**(H) Conc. of Mn (as birnessite[e]) (μM)**	**(I) Minimum possible molar ratio of Mn:Cr (=H/F)**
RCH1/Hematite[a]	50	1.3	38	326	0.5	19	0.016	184	9.6
RCH1/Al-goethite[a]	50	1.3	38	301	0.5	19	0.016	184	9.6
RCH1/NAu-2[a]	50	1.3	38	123	0.5	19	0.016	184	9.6
RCH1 slow/Hematite[a]	50	1.3	38	326	0.5	19	0.016	184	9.6
Dithionite-reduced NAu-2[b]	200	0.8	250	19	0.8	200	0.165	1898	9.5
FeS[c]	200	0.031	6452	2	0.031	200	0.165	1898	9.5

[a]Cr(VI) reduction experiments contained 1.3 g/L of Fe(III) mineral and 50 μM Cr(VI). Birnessite oxidation experiments contained 500 mg/L Fe-Cr solid and 16 mg/L birnessite.

[b]Cr(VI) reduction experiment contained 800 mg/L dithionite reduced NAu-2 and 200 μM Cr(VI). Birnessite oxidation experiments contained 800 mg/L Fe-Cr solid and 165 mg/L birnessite.

[c]Cr(VI) reduction experiments contained 31 mg/L FeS and 200 μM Cr(VI). Birnessite oxidation experiments contained 31 mg/L Fe-Cr precipitate and 165 mg/L birnessite.

[d]The mass fraction of Fe in NAu-2 (37.85% for the <1.5 μM fraction) was taken from Keeling et al. (ref. 52 in the manuscript). Al-goethite was assigned a molecular formula of $Fe_{0.91}Al_{0.09}OOH$.

[e]An approximate formula of MnO_2 for birnessite was assumed.

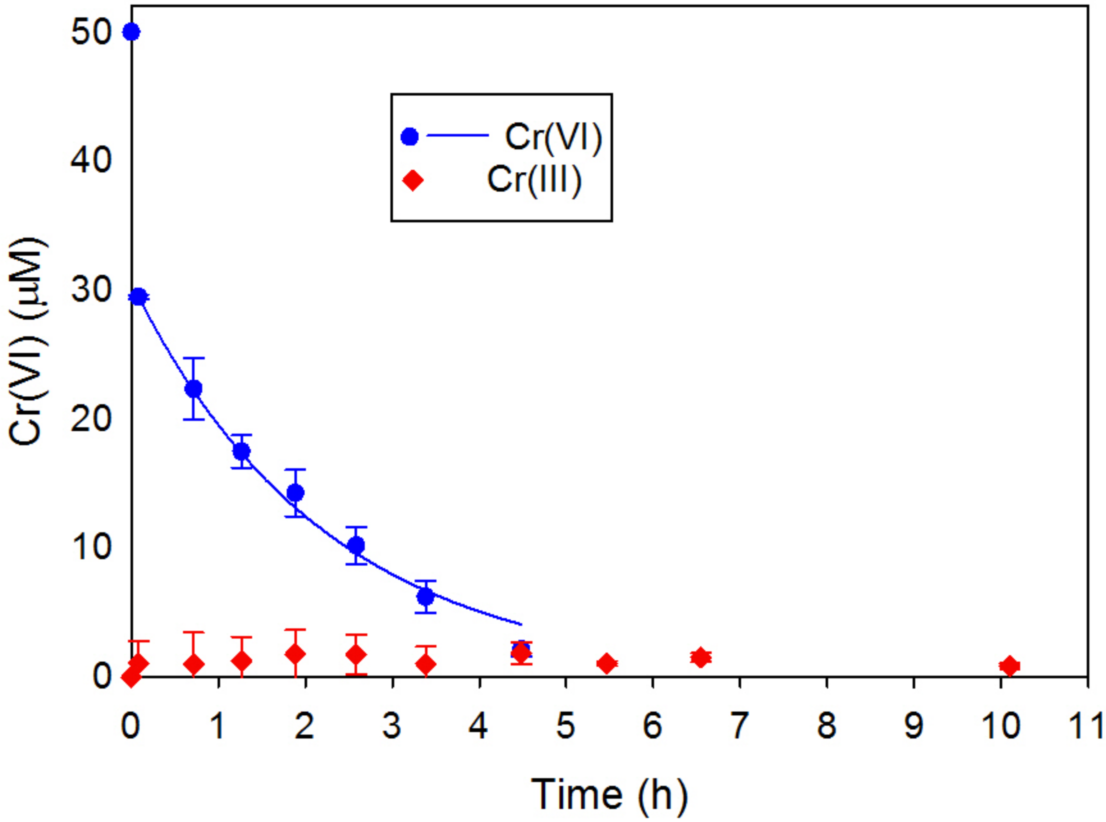

Figure ESI-1. Concentrations of dissolved Cr(VI) and Cr(III) versus time in the RCH1/Al-goethite microcosms. Error bars on symbols are the standard error of mean measurements from duplicate microcosms. The line shows the data fit to a pseudo-first-order rate law.

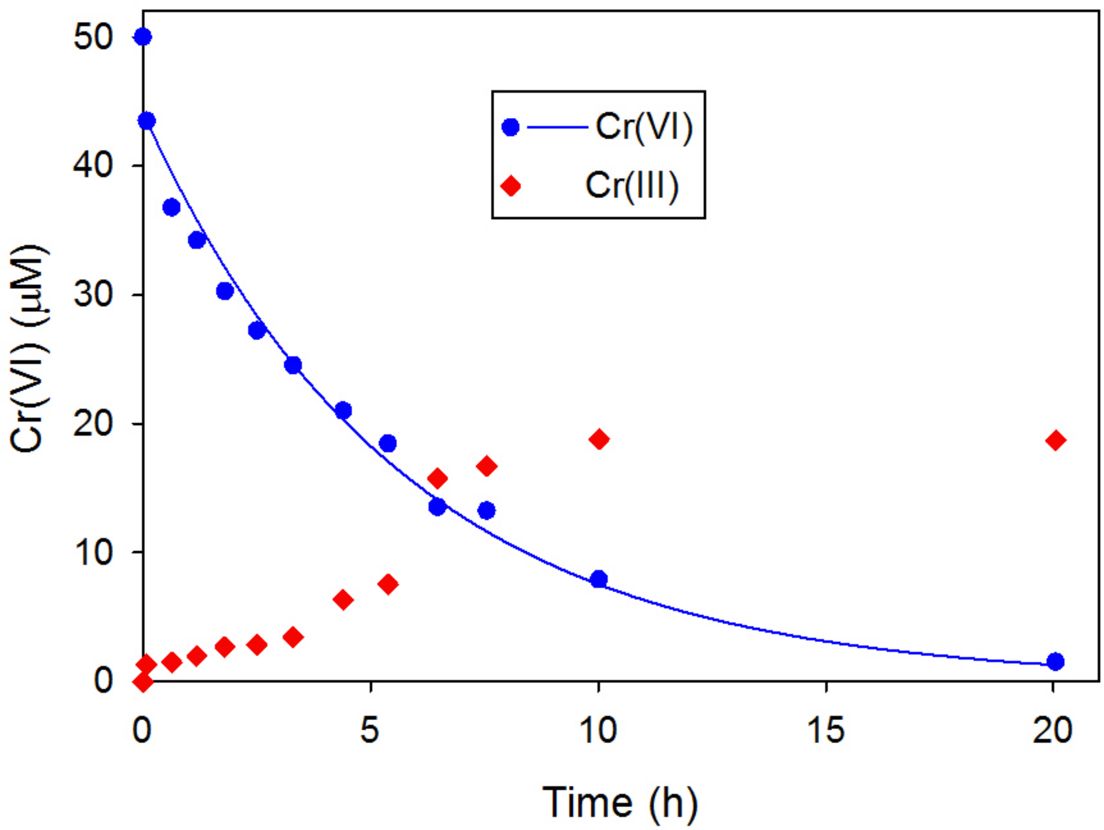

Figure ESI-2. Concentration of dissolved Cr(VI) versus time in the RCH1/NAu-2 microcosm. Results for only one microcosm (no replicates) is shown because there was no Cr(VI) reduction in the second microcosm. Lines show fit of the data to a pseudo first order rate law.

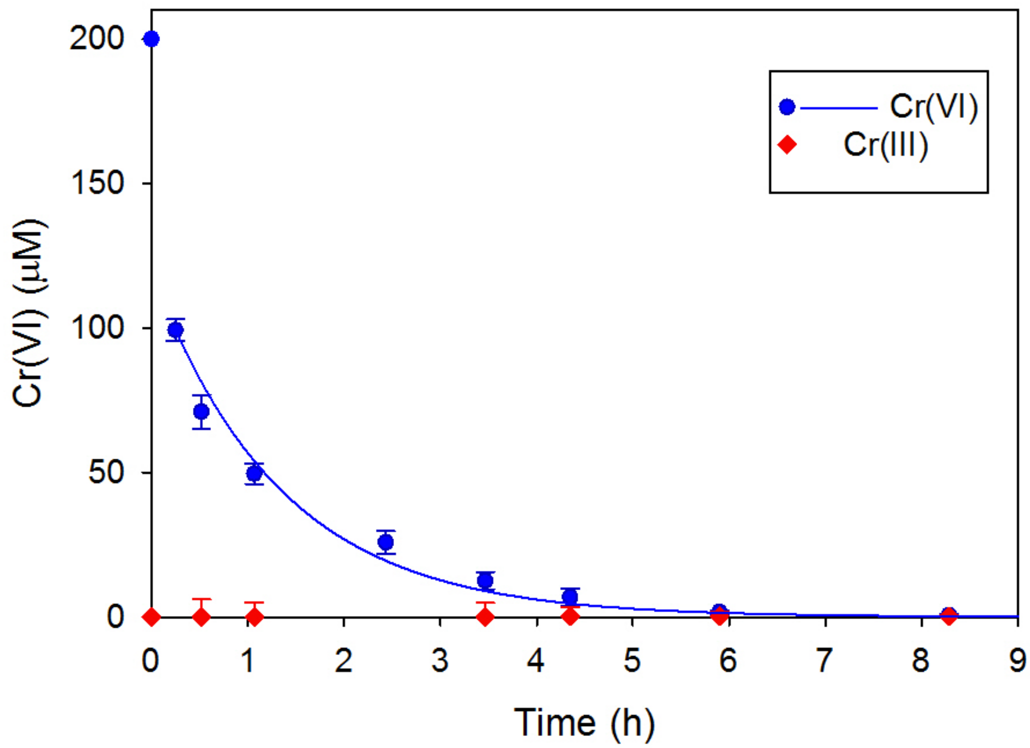

Figure ESI-3. Concentration of dissolved Cr(VI) versus time in the dithionite-reduced NAu-2 microcosm. Error bars on symbols are the standard error of mean measurements from duplicate microcosms. The line shows the data fit to a pseudo-first-order rate law.

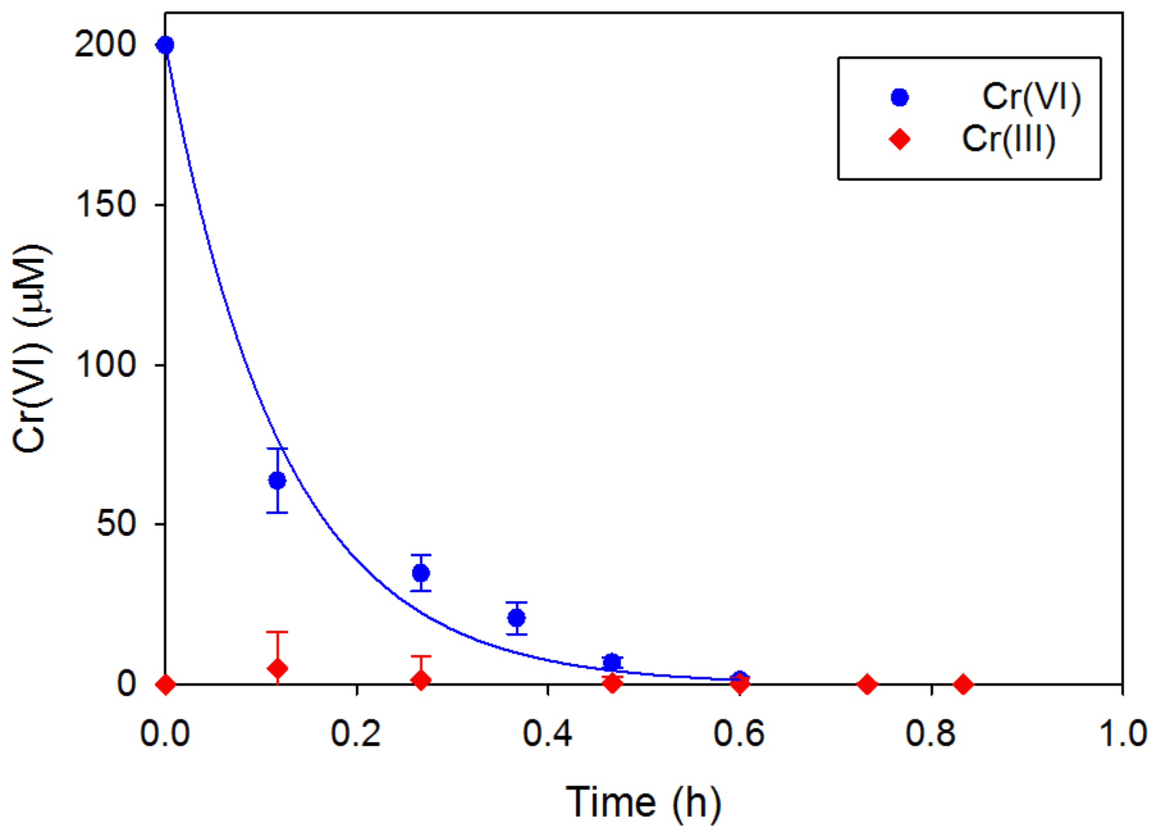

Figure ESI-4. Concentration of dissolved Cr(VI) versus time in the FeS microcosm. Error bars on symbols are the standard error of mean measurements from duplicate microcosms. The line shows the data fit to a pseudo-first-order rate law.

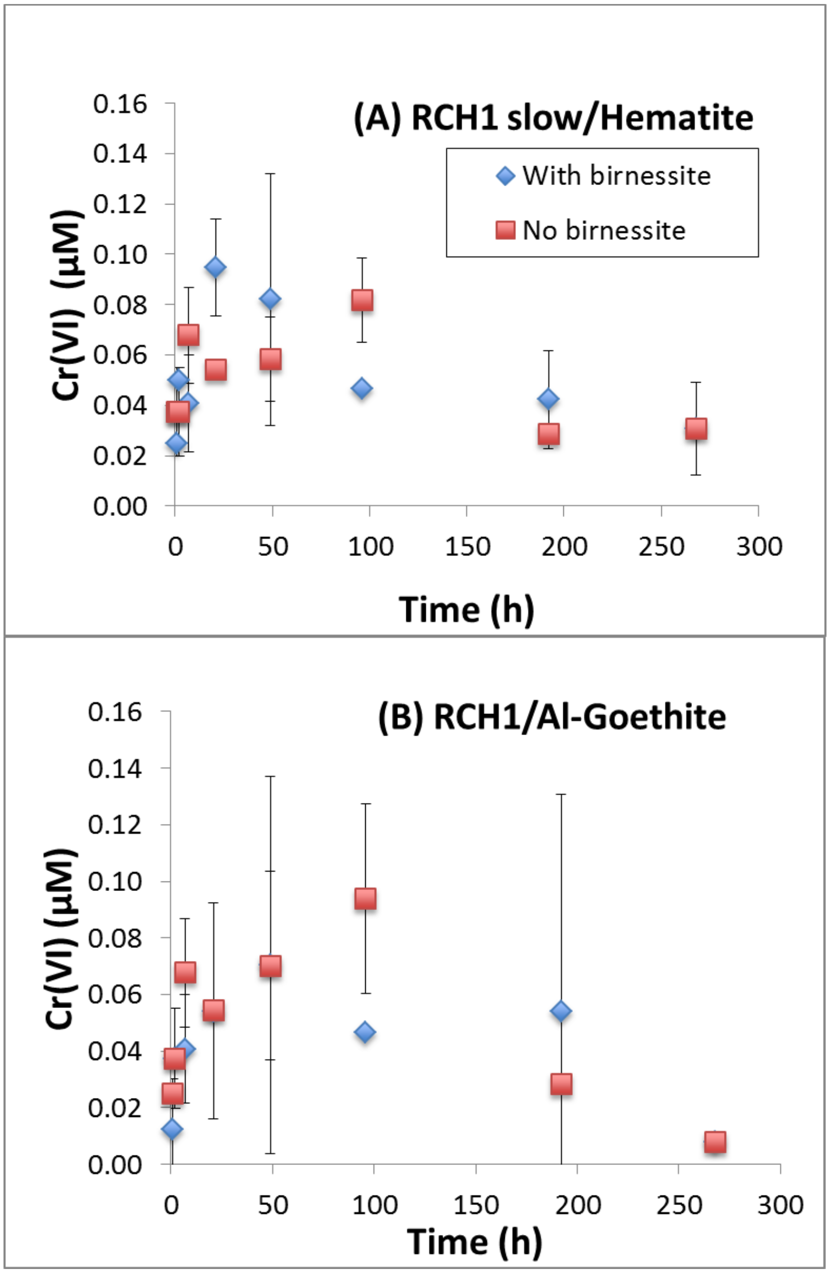

Figure ESI-5. Cr(VI) versus time in precipitates exposed to birnessite.