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Cr isotope fractionation in metal-mineral-microbe interactions

Qiong Zhang (1), Don Porcelli (1), Ian Thompson (2), Ken Amor (1), and Stephen Galer (3)

(1) Department of Earth Sciences, University of Oxford, United Kingdom, (2) Department of Engineering Science, University of Oxford, United Kingdon, (3) Max Planck Institute for Chemistry, Climate Geochemistry Department, 55128 Mainz, Germany

Microbes interact with metals and minerals in the environments, altering their physical and chemical state whilst in turn the metals and minerals affect microbial growth, activity and survival. The interactions between Cr, Fe minerals and bacteria were investigated in this study. Cr(VI) reduction experiments by two iron-reducing bacteria, *Pseudomonas fluorescens* LB 300 and *Shewanella oneidensis* MR 1, in the presence of two iron oxide minerals, goethite and hematite, were conducted. Both minerals were found to inhibit the Cr(VI) reduction rate by *Pseudomonas fluorescens* LB 300 but accelerated *Shewanella oneidensis* MR 1. The Cr isotopic fractionation factor generated by both bacteria was mostly independent of the presence of the minerals, except for hematite with *Pseudomonas fluorescens* LB 300, where the ε was much higher. Aqueous Fe(III) in the solution did not have any detectable impact on either bacterial Cr reduction rates or the isotopic fractionation factors, indicating that the reduction of Cr(VI) occurred prior to that of Fe(III). The presence of aqueous Fe(II) induced a very fast abiotic reduction of Cr, but had little impact on the bacterial Cr reduction rates or its isotope fractionations. The evidence suggests that the different impact that Fe minerals had on the bacteria were related to the way they attached to the minerals and the difference in the reduction mechanism. SEM images confirmed that the attachment of *Pseudomonas fluorescens* LB 300 on the mineral surfaces were much more tightly packed than that of *Shewanella oneidensis* MR 1, so reducing mineral-metal interactions.