Chromium isotope behaviour during microbial reduction activities

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Isotope fractionations during microbial metal reduction provide insight into the mechanisms of metal cycling, and can be used to quantify biogeochemically mediated redox processes in the present environment as well as in the past. In this study, Cr reduction experiments were undertaken with facultative bacteria *Pseudomonas fluorescens* LB 300 and *Shewanella oneidensis* MR-1 to determine the conditions under which Cr is reduced and the corresponding isotope signals that are generated.

Some pioneering studies have already focused on isotope fractionations by microbial reduction activity under anaerobic conditions; the isotopic fractionation factors are in the range of -1.8‰ to -4.1‰, and are quite comparable with ours. The present study has better considered the impacts of the natural variances, and has systematically controlled a broad range of key parameters determining bacterial growth and metabolism, such as species, electron donors, pH, Cr concentration and respiration pathways.

In the experiments with a range of different pH (pH = 4, 6 and 8), the highest reduction rate was found at pH = 8. Cr isotope fractionation from all three aerobic reduction experiments under differing pH conditions conformed to a single Rayleigh distillation model with ε = -3.1‰, indicating pH has little impact on isotope fractionation by bacteria. Experiments using different electron donors, showed citrate promotes a higher Cr reduction rate (15.1 $mg \cdot L^{-1} hour^{-1}$) compared with experiments using glucose (6.6 $mg \cdot L^{-1} \cdot hour^{-1}$), acetate (4.9 $mg \cdot L^{-1} hour^{-1}$) and propionate (4.8 $mg \cdot L^{-1} hour^{-1}$) as electron donors. Isotope fractionation factors were different when applying different nutrients in the experiments; ε = -4.3‰ for the experiment with citrate and -3.1‰ with acetate and glucose.

Future work will investigate bacterial reduction rates and Cr isotope fractionation under varying conditions to better constrain their activity in different environmental settings.

[1] Basu *et al*. (2014) *Geochim. Cosmoch. Acta*. **142(0)**, 349-361 [2] Sikora *et al*. (2008) *Geochim. Cosmoch. Acta*. **72(15)**, 3631-3641