Goldschmidt 2024 Abstract
https://doi.org/10.46247/gold2024.23457

Selenium stable isotope ratios during removal by $H_2S_{(g)}$

HEATHER KAYLEIGH SHRIMPTON, CAROL J PTACEK AND DAVID W BLOWES

University of Waterloo

Presenting Author: hshrimpt@uwaterloo.ca

Introduction

One removal mechanism of Se in groundwater is through reduction by sulfur reducing bacteria (SRB), either by direct respiration, or through the production of $H_2S_{(g)}$. When $H_2S_{(g)}$ reacts with Se(IV), it precipitates either Se(0) and S(0), or various Se_nS_{8-n} species. Although the Se stable isotope ratios associated with reduction by SRB have been measured, there are no current studies on stable isotope fractionation during the reaction between Se(IV) and $H_2S_{(g)}$.

Methods

Sacrificial batch experiments were conducted over a span of 3 - 48 hours, using increasing concentrations of Na_2S in 25 mmol L^{-1} Na_2SeO_3 solutions. Filtered samples were collected for Se stable isotopes, cation concentrations, and sulfur speciation. The precipitate was collected for solid phase analysis (PXRD).

Results

A range of fractionation factors could be fit to the data (7.9 – 10.1‰) depending on the S:Se ratio in solution. When S/Se < 1.7, δ^{82}Se values are more variable and the fractionation factor is 10.1 ± 0.6‰. When S/Se > 1.7, δ^{82}Se values are less variable and the fractionation factor is 7.9 ± 0.3‰. The overall fit for the entire S:Se range is 8.6‰.

Discussion

The fractionation factor is related to the S:Se ratio, which affects the precipitate produced [1]. When there is more S in an aqueous system relative to Se, a more consistent precipitate is made, and the degree of fractionation cannot be differentiated from reduction by SRB. At lower relative S concentrations, the precipitate is more affected by factors such as small changes in pH and the overall fractionation can be higher. A change in the fractionation factor with the aqueous S:Se ratio has implications for modelling the fractionation expected in the environment and in remediation systems. Different fractionation factors asociated with Se precipitation at lower S:Se ratios may also impact predictions of Se sequestration in the long term.

[1] Geoffroy *et al.* (2011) *J. Hazard. Mater.* **185** 148-154.