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Does the reaction between Se and $H_2S_{(g)}$ produce an irriversible precipitate? Find out using Se stable isotopes!

HEATHER KAYLEIGH SHRIMPTON, CAROL PTACEK AND DAVID BLOWES

University of Waterloo

Presenting Author: hshrimpt@uwaterloo.ca

Introduction

Reacting $H_2S_{(g)}$ with Se(IV) will precipitate various Se_nS_{8-n} species or elemental Se and S, depending on the geochemical conditions [1]. The precipitation results in a range of Se stable isotope fractionation factors in solution (8.3 – 10.9‰), possibly depending on the product [2]. The $H_2S_{(g)}$ may be produced abiotically, or biotically by sulfur reducing bacteria (SRB). If the precipitation Se_nS_{8-n} or Se(0) consists of a single fractionation factor over time, it can be modeled to gain insight into Se remediation in the environment.

Methods

Selenite and Na_2S were reacted in multiple batch reactors for increasing lengths of time, up to two weeks. Geochemical conditions were favorable for the precipitation of an Se_nS_{8-n} species. The sealed reaction vessels were kept under anaerobic conditions, and each was sampled sacrificially for cation, anion, speciation, solids, and aqueous isotopes.

Results

Preliminary results suggest that the Se fractionation factor is affected by the length of time the solid is in contact with solution. Examining the solid phase speciation may lead to understanding whether this is due to a change in the precipitated phase over time, or equilibrium fractionation of a single phase.

Discussion

If the fractionation factor changes over time as the product is in contact with solution, models must account for both kinetics and flow conditions. A changing reaction product has implications for the sequestration of Se when planning long term remediation strategies.

[1] Jung *et al.* (2016) *Chemosphere* **163** 351-358. [2] Shrimpton *et al*. (2019) *Goldschmidt, Barcelona.*