

Interaction of Se(IV)/Se(VI) species with granitic rock: Understanding of retention processes

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Introduction

The fission product ⁷⁹Se belongs between radionuclides considered in safety assessment of radioactive waste geological repository, namely due to relative long half life (3.56·10⁵ yrs), anionic form in solution and biogenic character.

Modelling

According to modelling (the Geochemist's Workbench) Se can be present at -II, 0, +IV and +VI oxidation states under granitic water conditions. Se (0) stability field would increase with increasing concentration of Se.

Experimental

Se(IV) and Se(VI) as anionic species are not usually supposed to be strongly bound on mineral surfaces [1]. Series of batch sorption experiments with crushed granitic rock revealed different sorption properties of selenite Se(IV) and selenate Se(VI), with favourable attraction of Se(IV). The higher oxidation state of selenium and large grain size significantly decreased K_D-values.

Discussion

In order to identify potential retention mechanisms, LA-ICP-MS and PIXE measurement were performed on surface of granitic samples after contact with Se(IV) or Se(VI) solution. Surface maps revealed trend of Se increased concentration in presence of Fe.

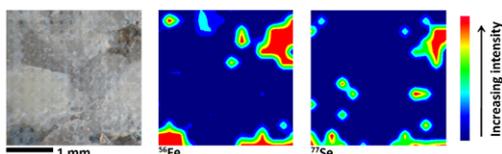


Figure 1: LA-ICP-MS surface map of granite sample after contact with 2.10⁻⁵ M Se(IV) solution.

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Seawater-derived REY and HFSE systematics in Archean BIFs

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The HFSE and REE-Y patterns of Banded Iron Formations (BIFs) can be used to place constraints on the trace element composition of Archean seawater [e.g. 1]. Here we report the first high-precision HFSE (Nb, Ta, Zr, Hf) and REE (Lu, Sm, Nd) concentration data for separated chert and magnetite mesobands of ca. 3.7 Ga old BIFs from Isua (SW Greenland) and ca. 2.7 Ga old BIFs from the Temagami Formation (Superior Province, Canada), all obtained by isotope dilution. Other trace element measurements were performed using Quadrupole ICP-MS.

PAAS-normalized REY signatures of both Archean BIFs are comparable to modern and other Archean seawater patterns (e.g. [2]) and show seawater-like positive La, Y, Gd anomalies. Positive Eu anomalies suggest an enhanced hydrothermal input in Archean oceans, and the constant lack of negative Ce anomalies indicates anoxic seawater conditions [3].

Superchondritic ratios of Nb/Ta and Zr/Hf in magnetite bands of the Isua BIFs (40.2 - 59.2; 44.9 - 53.7) point toward lower Nb/Ta and Zr/Hf ratios of Isua cherts (19.2 - 32.5; 31.3 - 46.1). Temagami BIFs display the same characteristic with superchondritic Zr/Hf ratios in magnetite samples (38.1 - 47.1) contrary to subchondritic Zr/Hf ratios in cherts (18.9 - 28.5). By contrast magnetite and chert layers of Temagami BIFs exhibit uniform Nb/Ta ratios (14.1 - 27.0). Compared to compositions of modern aqueous [e.g. 4] and hydrothermal reservoirs, HFSE ratios of the Archean BIFs lie between those fields. Therefore different depositional environments for Isua and Temagami BIFs are favoured and also a different behaviour of both geochemical twins (Nb-Ta and Zr-Hf) in different water depths and water masses of Archean seawater is suggested.

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