Determination of zircon/melt REE partition coefficient from 7 μm spot analysis using NanoSIMS

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Zircon is a common accessory mineral in crustal felsic rocks and the best container of inclusions due to its stability in the most geologic environments. For this reteintive feature, zircon has been used for estimation of parental magma composition such as REE. Several micron-scale spot analysis, however, is necessary to obtain the accurate compositions because zircon contains a lot of tiny mineral and melt inclusions. NanoSIMS is able to analyze both host zircon and melt inclusion with several-μm spot, and we can obtain more accurate partition coefficient for the estimation of parental magma composition. Here we report our new result of REE abundances in a melt inclusion and its host zircon obtained by NanoSIMS.

Analyzed sample is a zircon which was separated from the Torihama dacite in Japan and its REE composition was measured by SHRIMP [1]. We carried out REE analyses of a melt inclusion in the zircon using Cameca NanoSIMS 50 at Ocean Research Institute, University of Tokyo. Spot size was 7 μm with 500 pA of O^- primary beam. REE abundance was measured by using five collectors and jumping the magnetic field six steps and using a medium energy-filtering. A -60 V energy offset was applied to the secondary beam in order to minimize molecular interference.

Melt inclusion represents LREE-enrichment chondrite-normalized patterns and relatively flat middle to heavy REE. Its host zircon indicates normal REE pattern of igneous zircon such as low-LREE, high-HREE, positive Ce anomaly and negative Eu anomaly.

Partition coefficients ($^{zircon/melt}D$) calculated from REE abundances of the melt inclusion and its host zircon are listed as following: La (0.00046), Ce (0.37), Pr (0.025), Nd (0.155), Sm (2.19), Gd (17.5), Dy (50.2), Ho (103), Er (129), Tm (161), Yb (321) and Lu (296). As compared to previously estimated $^{zircon/melt}D$-values using other method including ion microprobe [2], our new $^{zircon/melt}D$ determined by melt inclusion analysis is relatively high $^{zircon/melt}D$-values in LREE and is similar to that reported by Sano *et al.* [1]. NanoSIMS is promising tool for microanalysis of earth science.

[1] Sano, *et al.* (2002) *Chem. Geol.* **184**, 217-230. [2] Hanchar and van Westrenen (2007) *Elements*, **3** 37-42.

Reductive Sorption of Se(IV,VI) onto Pyrite: A μ-XRF/XAS Study

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^{79}Se is a long-lived, safety-relevant radionuclide in radioactive waste from nuclear power plants. The anionic nature and high solubility of oxidized Se species released from the waste prevents efficient sorption on most mineral surfaces, leading to high calculated doses in performance assessment for disposal sites. Pyrite (FeS_2) is one of the few phases in the radionuclide pathway having potential of scavenging oxidized Se species through reductive sorption on its surface [1]. In the present study, the interaction of Se(IV,VI) species with pyrite under strictly anoxic conditions was investigated using micro X-ray spectroscopy (μ-XAS).

Polished chips of natural pyrite (Navajun, Spain) were reacted with 10^{-2} M $Na_2Se(IV)O_3$ or $Na_2Se(VI)O_4$ solutions at 80°C during two months. Micro X-ray Fluorescence (μ-XRF) maps and μ-XAS spectra were collected in suitable sample holders flushed with inert gas at the Swiss Light Source (X05 beamline), using a beam focused to roughly 1 × 1 μm.

A highly heterogeneous distribution of Se on the pyrite surface was observed on the μ-XRF maps. Several highly-concentrated Se spots of a few μm size were detected, surrounded by areas with low and uniform Se-level distribution. Micro X-ray Absorption Near-Edge Spectra (μ-XANES) in both regions indicate that Se(IV) and Se(VI) were partially reduced to Se(0) (Figure 1).

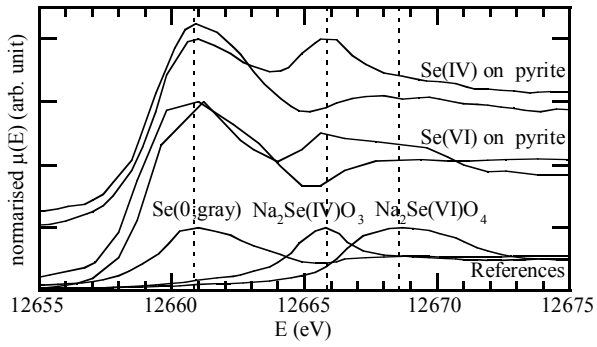

Figure 1: Typical μ-XANES of Se K-edge at low-Se and high-Se level spots on the pyrite and of reference compounds

[1] Breynaert *et al.* (2008) *Env. Sci. Technol.* **42**, 3595–3601.