

U-series disequilibria of arc lavas revisited: Time-scales of magmatism in convergent margins

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U-series disequilibria have provided a unique powerful tool to constrain the processes and time-scales of magmatism in convergent margins. Preferential transfer of U and Ra relative to Th via addition of slab-derived fluid to the mantle wedge has been proposed to explain the ²³⁸U and ²²⁶Ra excesses observed in arc lavas (e.g., [1]). However, an in-growth melting process is required to produce (²³¹Pa/²³⁵U)>1 in most young arc lavas and ²³⁰Th excess in a significant number of samples. It is thus critical to provide a self-consistent explanation for U-series disequilibria in arc lavas.

Most arc lavas are highly differentiated. Re-visiting global arc lava data shows that U-series disequilibria are correlated with magma differentiation indices (e.g., SiO₂); Sr/Th and Ba/Th generally decreases with increasing SiO₂, showing the effect of magma differentiation at crustal depths. Most importantly, although (²²⁶Ra/²³⁰Th) is correlated with Sr/Th and Ba/Th in lavas from individual arcs, such relationship is not clearly observed in less-differentiated basaltic lavas. Therefore, current observations do not support inheritance of ²²⁶Ra and ²³⁸U excesses from the metasomatised mantle wedge. Instead, in-growth melting may play a more important role than previously believed. Namely, partial melting of the mantle wedge produces ²²⁶Ra and ²³¹Pa excesses, and ²³⁸U-²³⁰Th disequilibrium in arc lavas, depending on fO₂, residual phases, thermal structure, and initial conditions of the wedge [2]. U-series disequilibria are further modified by ageing effect and assimilating old materials, resulting in the positive correlation between (²²⁶Ra/²³⁰Th) and Sr/Th in arc lavas. Such a model reconciles controversial temporal implications from different parent/daughter pairs and implies that rapid magma upwelling (<8,000 years) from the mantle to the Earth's surface is not required.

[1] Turner *et al.* (2003) *Rev. Mineral. Geochem.* **52**, 255-315.

[2] Huang *et al.* (2011) *GCA* **75**, 195-212.

Influence of microbial cells and extracellular polymeric substances on the sorption of As(V) and As(III) on Fe (hydr)oxides

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Adsorption and desorption regulate the partitioning of trace elements between aqueous and solid phases in soils and sediments. Previous studies have indicated that phosphate groups in microbial extracellular polymeric substances (EPS) form inner-sphere surface complexes on Fe(III)-oxide surfaces e.g. with phosphate groups [1], suggesting the potential influence of microbial EPS on As adsorption behavior. In this study, we investigated the adsorption behavior of As(V) and As(III) on goethite, ferrihydrite and hematite under the influence of *Shewanella putrefaciens* cells and EPS, including non P-containing EPS (xanthan, alginic acid) and P-containing EPS isolated from *S. putrefaciens* CN-32. Batch experiments for determining adsorption isotherms and As(V) desorption kinetics were performed at pH 7.0 at room temperature. Additionally, an ATR-FT-IR study was performed to reveal As(V) concurrent desorption with attachment of *S. putrefaciens* cells.

Adsorption of As(III) and As(V) at solution concentrations between 0.001 and 20 μM decreased by 10-45% in the presence of 0.3 g.L⁻¹ EPS from *S. putrefaciens*. Addition of 0.5 g L⁻¹ xanthan and alginic acid decreased As(V) and As(III) adsorption at solution concentrations between 0.6 and 6 μM by 7-66%, which is comparable with EPS from *S. putrefaciens*. Also, inactive *S. putrefaciens* cells, which were treated with paraformaldehyde, induced desorption of As(V) from Fe (hydr)oxide surfaces. ATR-FT-IR spectra evidenced the formation of inner-sphere complexes between bacterial phosphate and carboxylate groups and hematite, which may compete for Fe (hydr)oxide surface sites with As(V). At low cell density (5×10⁷ cells mL⁻¹) inner-sphere coordination of carboxylate groups became less important than at high cell density (5×10⁹ cells mL⁻¹). Our results indicate that the competition between As and bacterial functional groups for Fe (hydr)oxide surface sites is an important factor leading to increased mobility of As.

[1] Omoike & Chorover (2006) *Geochim. Cosmochim. Acta* **70**, 827–838. [2] Huang *et al.* (2011) *Environ. Sci. Technol.* **45**, 2804–2810.