

How mobile is selenium in claystone? Insights given by radiochemistry and X-ray absorption spectroscopy

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Introduction

The transport in the Callovo-Oxfordian clay formation of Se under its more oxidised forms, *i.e.* Se(IV) and Se(VI), was studied by means of batch and diffusion experiments [1], carried out at lab in N₂/CO₂ glovebox for mimicking as much as possible the physico-chemical conditions prevailing in-situ. A radiochemical approach using HTO, ³⁶Cl and ⁷⁵Se, as tracers, was supplemented by a non-radioactive one, for which the solid was investigated by X-Ray Absorption Spectroscopic (XAS) methods.

Results and Discussion

Results showed that Se(VI) diffused almost like ³⁶Cl, with little affinity towards clayey rocks ($R_d < 0.02 \text{ mL g}^{-1}$). Conversely, the batch and diffusion-experiments revealed that Se(IV) exhibited a much stronger affinity towards the Callovo-Oxfordian claystone, in inverse correlation to initial Se concentration. Values of R_d were estimated, ranging from 10 to about 200 mL g^{-1} for $[\text{Se(IV)}]_{\text{ini}}$ decreasing from 10^{-3} to $10^{-6} \text{ mol L}^{-1}$. This behaviour could not be reproduced only with a simple model, especially for the pristine samples (diffusion experiments), since Se showed a secondary maximum $\sim 2 \text{ mm}$ under the surface, both in the radioactive and stable diffusion cells (Figure 1). The determination of the selenium oxidation state by XAS revealed that the total Se profile was clearly the sum of the contribution of (i) Se(IV), exhibiting a relative regular diffusion profile and of (ii) the more reduced selenium species (Se(red) \sim Se(0), Se(-I) and/or Se(-II)), especially located at about 2 mm from the interface (Figure 1).

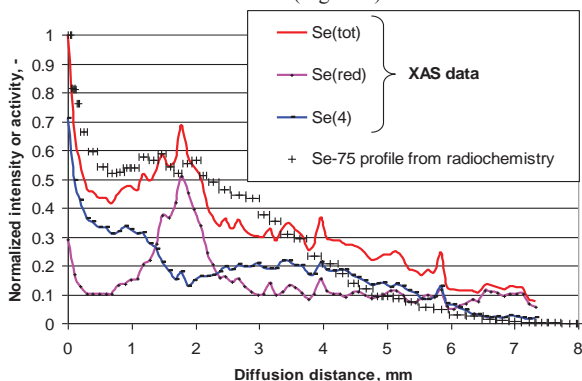


Figure 1: Distribution of the Selenium species along the rock profile obtained by XAS and comparison with radiochemistry data

The origin of the selenium distribution linked to some reduction processes was discussed regarding the mineralogy and the physico-chemical conditions prevailing in the pores.

[1] Savoye *et al.* (2010) *Environ. Sci. Technol.* **44**, 3698-3704.

Retention of melt in granulite terrains

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Introduction

Previous work [1] showed that metagreywacke protoliths in the Ashuanipi Subprovince in northern Quebec produced approximately 600000 km^3 of granitic melt during granulite facies anatexis. Virtually all that melt was extracted from where it formed, leaving behind an Opx + Bt + Pl \pm Qz residuum. What became of that melt?

Results

Fieldwork shows that very little of the anatectic melt collected into leucosomes, but a significant proportion remained in the granulite terrain as secondary diatexite migmatite. Melt accumulated in regional-scale dilatant sites. Field, geochemical and microstructural studies indicate that the secondary diatexite plays an important role in the evolution of granitic magma. Their microstructure and whole rock geochemistry indicates that a small proportion have the composition appropriate for the initial, anatectic melt. Most have compositions (supported by field relations) indicative of significant contamination by their melt-depleted wall rocks; contamination by the peritectic phase (Opx) alone is not sufficient. The microstructure (form and composition) of the feldspar-crystal framework in the diatexite reveals a wide range of responses to deformation during solidification. In places, meter-sized patches of leucocratic monzogranite occur in the diatexite and indicate local fractional crystallisation. However, most of the secondary diatexite represents an accumulation of plagioclase from which the fractionated melt has been removed. Kilometre-sized bodies of leucocratic monzogranite in the terrain represent part of the volume of fractionated melt that separated from the secondary plagioclase-rich cumulate diatexite, the balance moved to higher crustal levels.

Conclusions

Granulite terrains are much less depleted in melt than analysis of the residual rocks alone indicates. Large amounts of anatectic melt may be retained and melt from different source rocks can accumulate in the same sites. These sites represent a key reservoir in the deep crust where the composition of granite magma is established. Fractional crystallisation and general contamination exert a greater control on composition than source rock composition, or entrainment of peritectic phases.

[1] Guernina & Sawyer (2003) *Journal of Metamorphic Geology* **21**, 181-201-pp.