



Metal mobilization and transport in magmatic-hydrothermal fluids

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High pressure fluids are major vectors for mass transfer at crustal and mantle depths, where they are involved in processes leading to ore enrichment and mass recycling. The poor understanding of the atomic-scale mechanisms that controls the mobilization and transport of elements at relevant conditions, however, limits the quantitative modelling of these processes. Here we present experiments using X-ray absorption spectroscopy XAS at high pressure to monitor the chemical composition, the molecular structure and thermodynamic quantities for high-pressure fluids. Specifically, we investigate the pressure, temperature and redox controls on the dissolution of ore mineral cassiterite (SnO_2) and the transport of tin in hydrothermal settings.

The XAS measurements were performed over a broad range of P-T conditions (20 – 1000 bar and 30 – 500 °C), fluid compositions and redox state. The investigated fluid compositions represent a natural magmatic fluid and vary in salinity concentrations (2 m - 5 m NaCl) at acidic conditions (0.1 – 1 m HCl). A piece of quartz and a piece of SnO_2 were added as representative silica and Sn sources, and buffer assemblages were used to control oxygen fugacity. The XAS measurements at the Sn K-edge (29.19 keV) were conducted in the FAME autoclave. At the desired P-T condition, the dissolution of cassiterite was monitored by the fluorescence signal of Sn until equilibrium conditions were achieved before the collections of the XAS spectra to determine Sn solubility and the structure of the dominant aqueous complexes. We will discuss the speciation of tin and the controls on the transport and precipitation of cassiterite SnO_2 in high pressure fluids.