

Solubility of minerals in HP-HT aqueous fluids: an *in situ* synchrotron X-ray fluorescence study

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CO₂-rich saline aqueous fluids are liberated into the mantle when the altered oceanic crust is subducted, leading to the important geochemical phenomena of mantle wedge metasomatism and arc magmatism. To better understand these processes, knowledge of mineral-fluid equilibria and mineral solubility in HP-HT crustal fluids is thus required.

We report here *in situ* measurements on the solubility of strontianite (SrCO₃) and GeO₂-rutile at P (up to 6.6 GPa) and T (up to 400°C) relevant for cold subducted slabs. The composition of the fluid surrounding the crystal, loaded in an externally heated diamond-anvil cell, was analysed *in situ* by monitoring the X-ray fluorescence of Sr²⁺ and Ge⁴⁺ cations, respectively, until chemical equilibrium was reached. Experiments were carried out at the ESRF (ID22 beamline) using a high-resolution monochromatic beam (2×5 μm² and 18 keV), and a collection geometry at 30° from the transmitted beam.

This results in quantitative analysis of the solution down to the 20 ppm level. In the case of strontianite, kinetic data of the dissolution reaction showed instantaneous equilibration times at 400 °C. Measured dissolution rates are essentially compatible with a first-order reaction mechanism and allow to retrieve the activation energy (E_A) for the dissolution of SrCO₃ at HP-HT conditions. Taking into account activity coefficients, measured Sr²⁺ concentrations are used to determine the solubility constant (K_s) of SrCO₃ at HP-HT conditions, allowing further thermodynamic modelling of carbonate dissolution.

In the case of GeO₂-rutile, we observed a gradient of the Ge concentration in the fluid. Hence, on the top of solubility measurements, it also allows to calculate the diffusion coefficients of Ge in high P-T aqueous fluids. This experiment thus shows the suitability of the SXRF technique for the *in situ* study of elemental diffusion in aqueous systems under high P-T conditions. Such data are essential for the modeling of diffusive transport of elements and its influence on the growth and dissolution of minerals.