



Solubility of Aragonite in Aqueous Fluids

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Carbonate dissolution in subduction zone fluids is critical to the carbon budget in subduction zones. Depending on the solubility of carbonate minerals in aqueous fluids, the subducting lithosphere may be either strongly depleted and the mantle metasomatized if the solubility is high, as recently suggested by natural samples or transport carbon deeper into the Earth's mantle if the solubility is low enough. Dissolution of carbonate minerals strongly depends on pressure and temperature as well as on the chemistry of the fluid, leading to a highly variable speciation of aqueous carbon.

Thanks to recent advances in theoretical aqueous geochemistry, combined experimental and theoretical efforts now allow the investigation of speciation and solubility of carbonate minerals in aqueous fluids at PT conditions higher than previously feasible. In this study, we present new in situ X-ray fluorescence measurements of aragonite dissolution up to 5 GPa and 500°C and the subsequent thermodynamic model of aragonite solubility in aqueous fluids thanks to the Deep Earth Water model. The amount of dissolved aragonite in the fluid was calculated from challenging and unprecedented measurements of the Ca fluorescence K-lines at low-energy. Experiments were performed at the ESRF, beamline ID27 using a dedicated design of an externally-heated diamond anvil cell and an incident high-flux and highly focused monochromatic X-Ray beam at 20 keV. The results show a spectacular multimolar solubility of aragonite at HP-HT in water, further enhanced in presence of NaCl and silica in the solution.