Kinetics and mechanism of dehydration of lawsonite and blueschist

I. DANIEL, J. P. PERRILLAT AND B. REYNARD[1]

[1]Laboratoire de Géologie de Lyon, Université Lyon 1, ENS de Lyon, CNRS, UMR 5276, France (isabelle.daniel@univ-lyon1.fr)

The dehydration of hydrous minerals is the source of aqueous fluids at intermediate-depth in subduction zones. Depending on the pressure and temperature conditions, the fluid released by the dehydration of hydrous minerals may consist in a free fluid phase if dehydration reactions are much faster than the hydration of the surrounding mantle. In the latter situation, the release of a free fluid phase may trigger intermediate-depth seismicity. For instance, the location of the 'upper-plane seismic belt' within the subducting oceanic crust has been observed at conditions that fit the dehydration of lawsonite. The understanding of the consequences of lawsonite and blueschist dehydration requires that their kinetics and mechanism are well characterized.

We have measured the kinetics of dehydration of lawsonite and of a lawsonite-rich blueschist *in situ* at high pressure and high temperature by time resolved synchrotron X-ray diffraction in a closed system, in a Paris-Edinburgh cell. Lawsonite was from single crystals of the Longvale Quarry (Laytonville, Mendocino, CA). The blue schist matrix was artificially enriched in lawsonite, which would have been betlow detection limits otherwise. Measurements were performed between 2 and 5 GPa and dehydration was observed between 600 and 700°C, i.e. at temperatures slightly lower than those currently reported for the stability of lawsonite.

From the analysis of reaction progress data, we determined that the release of aqueous fluid occurs very rapidly, at minimum rates of 10^{-6} to 10^{-4} $m^3_{fluid}.m^3_{rock}.s^{-1}$. This exceeds by orders of magnitude the typical time scale sofar envisioned for such metamorphic reactions. Due to the release of a free fluid phase, the reaction products and zoïsite in particular display a grain size much larger than the initial one. Such a change in grain size during the dehydration of lawsonite also has consequences, which will also be discussed.