



Lithium control on experimental serpentinization processes: implications for natural systems

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Fluid mobile elements such as As, B, Li or Sb are of prime importance to trace fluid-rock interactions in the oceanic lithosphere from its hydrothermal alteration at the ocean ridge up to its dehydration in deep subduction. Although the cycle of fluid mobile elements is increasingly studied, their partitioning between fluid and mineral are still poorly known and their role on mechanism and kinetic of serpentinization reaction have been neglected. In the present experimental study supported by two kinds of experiments, we focussed on Li study and highlighted that this element plays a substantial role on serpentinization reaction kinetic/mechanism and on serpentine textural properties. Indeed, in presence of $200 \mu\text{g g}^{-1}$ of dissolved Li alteration rate is 2-4 times faster with respect to olivine alteration reactions in undoped system (1) at same experimental conditions (alkaline solution, $T = 200^\circ\text{C}$, $P_{\text{sat}} \sim 16$ bar, olivine grains $< 150 \mu\text{m}$). Moreover, serpentinization reaction mechanism is modified in presence of Li and characterized by a decoupling between olivine dissolution and serpentine precipitation. The control of olivine grain size on Li distribution between serpentinization products and fluid suggests for Li sequestration by an adsorption mechanism. Additionally, with respect to pure chrysotile synthesis (2) we indicated that Li strongly affects chrysotile sizes and morphology especially by favoring wider particles precipitation and stabilizing lizardite (3). Experimental distribution coefficients obtained in both systems are compatible with measurements made on abyssal serpentinites and hydrothermal fluids. These remarkable results increase our ability for understanding the fate of Li during fluid/olivine interaction and its retroactive effect on serpentinization reactions. At mid ocean ridge this may explain Li heterogeneous distributions and links between chemical and mineralogical observations. Moreover in subduction environments, where fluids released from the slab are particularly enriched in Li (up to $100 \mu\text{g g}^{-1}$), this last component may substantially favor serpentinite channel formation and propagation.

(1) Lafay et al. (2012). *J. Cryst. Growth*, 347, 62-72. (2) Lafay et al. (2013) *Chemistry – A European Journal* 19, 5417–5424. (3) Lafay et al. (2014) *Microporous et Mesoporous Materials* 183; 81–90.