Kinetic simulation of olivine alteration with simultaneous nucleation and growth of lizardite and magnesite particles

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Experimental studies have been recently developed in order to better understand the fundamental interactions involved in the serpentinization of olivines, especially in the context of CO_2 geological storage projects. In particular, starting from solutions of high-carbonate alkalinity at 200°C and 16 bar H_2O saturation pressure, Lafay et al. [1] have evidenced the simultaneous precipitation of serpentine and magnesite nanoparticles, on time scales of 60 days.

Here, we present a complementary study, using the numerical code Nanokin already validated in relation with other experimental approaches [2], [3]. It is based on the classical nucleation theory and on a size-dependent (algebraic) growth law, allowing possible growth, resorption and ripening processes. The advantages of the simulation are to document the *in-situ* conditions in the reactive cell (PCO_2, pH, aqueous species activities), and to analyse the parameters responsible for the competition between the various secondary phases.

In particular, relying on the experimental thermo-gravimetric analysis, we highlight the supersaturation state of the aqueous solution with respect to SiO_2, and thus the complex double competition which exists between secondary phases: competition between lizardite and SiO_2 for the silicon released by olivine and competition between magnesite and lizardite for the released magnesium.

Our numerical work thus brings information in the competitive precipitation of complex phases during olivine alteration processes due to high carbonate alkalinity in hydrothermal solutions like those expected in some CO_2 storage systems.

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