



The kinetics of the solvent-mediated transformation of gypsum into calcite

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The transformation of evaporitic calcium sulphates into calcite is a common mineral reaction under Earth surface conditions. It is well known that this process is in the origin of the formation of extensive deposits of diagenetic carbonates (Sanz-Rubio et al., 2001). Stable isotopes analyses indicate that in many sedimentary basins the formation of diagenetic calcite after calcium sulphates resulted from the interaction between meteoric carbonate-rich groundwaters and gypsum/anhydrite deposits (Sanz-Rubio, 2001). As carbonate-rich groundwaters are initially undersaturated with respect to calcium sulphate minerals, such transformation can be driven by the dissolution of these minerals and the simultaneous or subsequent nucleation and growth of calcite crystals. This mechanism can be described as a solvent-mediated phase transformation (Cardew and Davey, 1985). Although the solvent-mediated phase transformation model was originally proposed for isochemical transformations, it can be extended to any process in which a mineral transformation occurs as a result of the dissolution of a phase and the crystallization of a product one, irrespective of any change in the composition of the solids.

In this work we applied the solvent-mediated phase transformation model to the transformation of gypsum into calcite with the aim of drawing general conclusions about the parameters that control its kinetics. Our approach was based on an experimental study of the interaction of gypsum crystals with carbonate-rich aqueous solutions under controlled conditions. We monitored the progress of the transformation by measuring the pH and analysing the composition of the solution after predetermined reaction periods. Speciation and aqueous solution modelling was carried out using PHREEQC

(Pankhurst and Appello, 2000). Moreover, after the experiments, grains of gypsum were collected and the precipitates formed on their surface were confirmed as calcite. According to our results, it is possible to conclude that the system rapidly approaches equilibrium, being the dissolution of gypsum the rate limiting step of the transformation of gypsum into calcite.

References

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