

A HAFM study of the effect of carbonate on the growth of the barite (001) surface

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The presence of low concentrations of carbonate anions in aqueous media may have serious implications on the growth and dissolution of minerals. Knowledge of these implications is crucial e.g., in order to evaluate potential problems associated with CO₂ sequestration.

At room temperature, low concentrations of carbonate anions in the growth medium have interesting effects on the growth of barite and Ba_xSr_{1-x}SO₄ solid solutions (Sánchez-Pastor et al., 2006). These effects mainly concern both the growth kinetics by inhibition effects and the modification of the crystal morphology. Using AFM, Sánchez-Pastor et al. (2006) studied these effects on a nano-scale. The study revealed that growth of monolayer steps on both {001} and {210} faces was highly affected by the presence of carbonate at room temperature under given supersaturation conditions. While the steps of the first monolayer always showed an increased growth rate, steps of the second monolayer were spreading with rates inversely proportional to the carbonate concentration in the aqueous solution. Moreover, above a certain carbonate concentration the inhibition was complete and the growth completely stopped. The respective supersaturation and impurity concentration conditions define the so-called dead zone (e.g., Cabrera et al., 1958).

In this work, the main objective is to obtain knowledge of the effect of the presence of CO₃²⁻ on the growth kinetics of barite under elevated temperatures and pressures. Such mildly hydrothermal conditions are of pronounced importance for evaluation of the effect of CO₂ sequestration. The experiments were performed using a hydrothermal atomic force microscope (HAFM; *c.f.*, Jordan et al., 2007). The HAFM showed that: *i*) the growth rate of the first monolayer spreading on the original barite (001) surface increases as the temperature increases (up to 80 °C), *ii*) as in the case of the AFM experiments at room temperature, the growth of the second monolayer is inhibited above a certain carbonate concentration value, and *iii*) the threshold carbonate concentration necessary to completely inhibit the growth of the second monolayer is lower than in the AFM experiments at room temperature.

Thus, the results show that although at a reduced magnitude the effects of carbonate on barite growth kinetics as found at room temperature clearly extends into the range of elevated temperatures and pressures.

References

- Cabrera N Vermilyea DA (1958) Growth and Perfection of Crystals, Chapman & Hall, London, p. 393.
Jordan G, Pokrovsky OS, Guichet X, Schmahl WW (2007) Organic and inorganic ligand effects on magnesite dissolution at 100 °C and pH = 5 to 10. Chem Geol 242: 487-499.
Sánchez-Pastor N, Pina CM, Fernández-Díaz L, Astilleros JM (2006) The effect of CO₃²⁻ on the growth of barite {001} and {210} surfaces: An AFM study. Surf Sci 600: 1369-1381.

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