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

Sánchez-Pastor, Nuria1 Jordan, Guntram1 Pina, Carlos M.2 Fernández-Díaz, Lurdes2

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\textsubscript{x}Sr\textsubscript{1-x}SO\textsubscript{4} 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 CO\textsubscript{3}\textsuperscript{2-} 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 CO\textsubscript{2} 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
Abs. No. 224
Meeting: DMG 2008
submitted by: Jordan, Guntram
eemail: jordan@lmu.de
date: 2008-05-30
Req. presentation: Poster
Req. session: S15