

Reaction kinetics of Mg-carbonates

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Mineral scale formation is a common and costly phenomenon in many processes handling with aqueous solutions. Carbonate precipitation e.g. is responsible for lost efficiency in heat exchangers and boilers. The retrograde solubility of carbonates is the driving force to produce these scaling minerals. Besides this thermodynamic driving force kinetic factors as cation dehydration are influencing carbonate precipitation. With respect to this, especially magnesium plays a crucial role in the carbonate system. While influencing precipitation rates of calcite and partly being decisive for the final CaCO_3 polymorph formation, the formation of anhydrous Mg-carbonates seems to be inhibited.

To constrain the influence of magnesium in the carbonate system a better understanding of the reaction kinetics of Mg-carbonates is needed. Main Mg-carbonates encountered in natural environments are e.g. dolomite, magnesite and hydromagnesite. In order to investigate their reaction kinetics macroscopic and microscopic techniques can be applied.

An approach to directly assess surface reactivity of minerals is using high resolution microscopy. Following this attempt hydrothermal atomic force microscopy (HAFM) was applied to investigate magnesite reactivity on the (104) surface in the presence of aqueous Ca (fig. 1). This was done by measuring obtuse step propagation speed on the (104) surface of magnesite as a function of aqueous Ca concentration. Preliminary results indicate a bimodal effect of Ca^{2+} on obtuse step advancement rates. For example: at 100 °C, pH 8, and saturation of magnesite of $\Omega = 100$ aqueous Ca concentrations above 0.1 mmol/L lead to decreased obtuse step propagation rates while concentrations in the order of 0.01 mmol/L slightly promote obtuse step advancement.

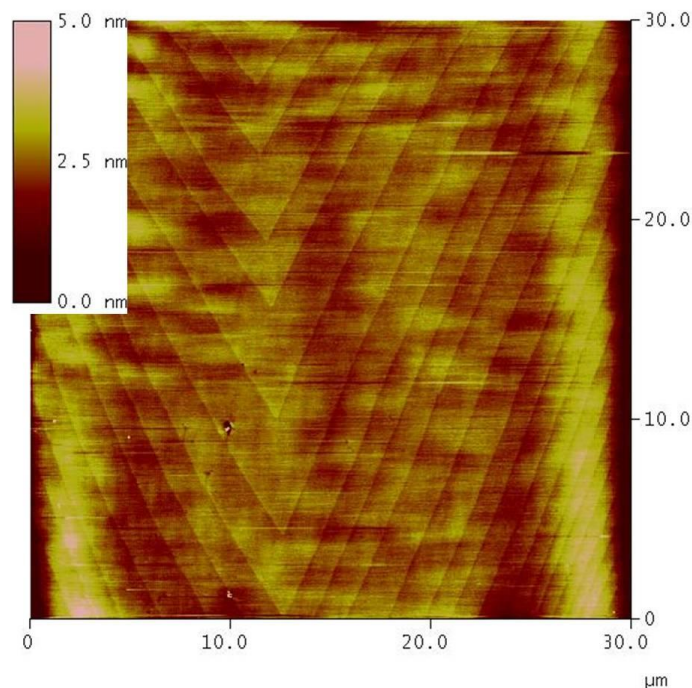


Fig. 1: HAFM-image showing obtuse steps spreading on the magnesite (104) surface.