Growth on barite and calcite, from a different perspective

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Our knowledge of surface structures important for crystal growth has been mostly built up from direct observations of cleaved surfaces of different minerals. Here we present a novel approach to study crystal growth by analyzing the development of topography on surfaces with low Miller indices rather than the cleavage surfaces. The advantage of studying such surfaces is that both the type and density of steps and kink sites are characteristic of each (hkl) surface. This allows one to study independently the reactivity and the role of each of these sites during crystal growth under different solution conditions.

In this study, barite ($BaSO_4$) and calcite ($CaCO_3$) crystals were cut and finely polished along specific orientations that expose different densities of specific types of steps and kink sites. The surfaces were then reacted with solutions of different saturation indices, electrolyte concentrations and in the presence of impurity ions. AFM and SEM images of the topography developed during growth, which is specific for each surface orientation and solution composition, can be used to improve our understanding of a) relative growth rates of stable surfaces (note different growing surfaces, Fig.1); b) epitaxial growth and nucleation of different crystal phases (e.g. nucleation and growth of $SrSO_4$ on $BaSO_4$ occurs preferencially at steps (001)/(100) relativelly to (001)/(210) steps, Fig.1b); c) inibition of growth at different step and kink sites by specific ions; d) relation between surface structure, reactivity and development of topography during growth. These studies will enable the development of more robust predictive models that reflect the processes known to occur on the mineral surface.

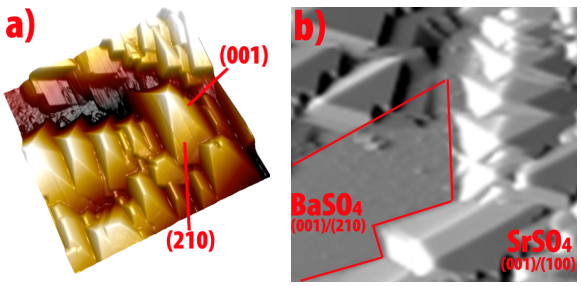

Figure 1: AFM images of growth on a (212) barite, (a) barite (Z=200nm; XY=4μm), (b) SrSO4 (Z=600nm; XY=8μm), note nucleation only from the side with (001)/(100) steps.