



Dynamic equilibrium during calcite-water interactions

Christine V. Putnis (1,2) and Encarnación Ruiz-Agudo (3)

(1) University of Münster, Institut für Mineralogie, 48149 Münster, Germany (putnisc@uni-muenster.de), (2) Department of Chemistry, Curtin University, 6845 Perth, Australia, (3) Department of Mineralogy and Petrology, University of Granada 18071 Granada, Spain

Direct in situ experiments using atomic force microscopy (AFM) show that when a calcite (01-14) cleavage surface is in contact with a CaCO_3 solution saturated with respect to calcite, the surface dissolves and grows simultaneously and continuously. Furthermore the growth occurs by two distinct mechanisms, both island nucleation and spreading, as well as the formation of nanoparticles, probably amorphous. Initial nanoparticles are first seen in areas of increased dissolution, that is, around etch pit edges. The observations are that at potential equilibrium a calcite surface reacts dynamically. This is further evidence that a mineral surface is a complex landscape with varying reactivities dependent on potential reaction sites such as kinks and edges. When in contact with an aqueous fluid, a calcite surface can dissolve and reprecipitate as a result of varying surface reactivity. These coupled reactions are only possible as a result of the formation of a mineral-fluid boundary layer whose composition differs from the bulk fluid composition. This is a possible mechanism for the re-equilibration of trace elements and isotopes near equilibrium.