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In situ observations of amorphous calcium carbonate (ACC) transformation into crystalline $CaCO_3$

SARAH BONILLA-CORREA, ENCARNACIÓN RUIZ-AGUDO AND MARIA P. ASTA

University of Granada

Presenting Author: sarahbonillacorrea@gmail.com

The study of $CaCO_3$ formation shows increasing evidence that it occurs according to non-classical growth and nucleation processes, in which amorphous calcium carbonate (ACC) plays a fundamental role acting as a precursor phase of the final crystalline phase [1-2-3] This is the case not only for $CaCO_3$ in biominerals, but also in an important number of natural systems e.g., speleothems, travertines, tufas, etc. [1-4]. This suggests that the formation of ACC seems to be more common in nature than generally assumed. Further knowledge is nevertheless needed regarding ACC crystallization under low-temperature conditions (0-25°C) in solutions varying degrees of supersaturations to simulate not only marine environments, but also the low-temperature environment of lakes, rivers, or caves.

Here we analyze the process of ACC to calcite transformation using *in situ* atomic force microscopy (AFM) and different solutions of varying saturation states with respect to calcite and with Raman microscope to observe and identify which intermediate phases that are generated in the crystallization process. Also, recrystallization experiments were performed using environmental scanning electron microscopy (ESEM) cycles by varying the relative humidity of the chamber between 70-100%. Observations by these techniques show how the spherical ACC nanoparticles initially develop straight facets at the edges and with time acquire characteristics of the structure of calcite.

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