The activity of an ancient biogenic polysaccharide: A strong growth inhibitor and morphology moderator for calcite

K.K. SAND[1†]*, C.S. PEDERSEN[1], S. SJÖBERG[2], J.W. NIELSEN[1], E. MAKOVICKY[3] AND S.L.S. STIPP[1]

[1]Nano-Science Center, University of Copenhagen, Denmark (*kks@nano.ku.dk)
[2]Department of Chemistry, Umeå University, Sweden.
[3]Department of Geography and Geology, University of Copenhagen, Denmark
[†]Lawrence Berkeley National Laboratories, Berkeley, USA

In biomineralization, it is well known that organisms use organic molecules to design minerals for specific functions, but can an organic molecule survive deposition, burial and millions of years of geological processes and still influence fluid-mineral behavior? We explored growth and dissolution of calcite during exposure to an acidic polysaccharide (PS) that was extracted from a 65 million year old chalk sample.

We observed bulk calcite and freshly cleaved {10.4} surfaces during exposure to the extracted PS in a pure system and with seawater cations present. In bulk experiments, the ancient PS inhibits calcite growth, even at very low concentrations, namely µg/L, by adsorbing at terrace edges. Atomic force microscopy images demonstrate high affinity for step edges, where its presence results in increased step density and a dramatic change in morphology from ordered rhombohedral step advance to dendritic clusters (figure). The adsorption behaviour of the PS was independent of solution cation composition

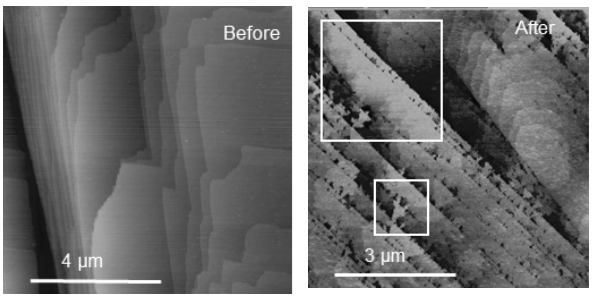

Figure: A {10.4} cleavage surface of calcite before and after exposure to a solution containing polysaccharide.