

Inhibition of calcite growth by alginate and polyaspartate

O. N. KARASEVA¹, L. Z. LAKSHTANOV^{1,2} AND S. L. S. STIPP²

¹Institute of Experimental Mineralogy RAS, Chernogolovka, Russia (olga@iem.ac.ru)

²Nano-Science Center, Department of Chemistry, University of Copenhagen, Copenhagen, Denmark

We investigated the kinetics of calcite precipitation in the presence of the biopolymers, alginate and polyaspartate, with the constant composition technique. Over the concentration range investigated, the polymers inhibit calcite growth. The extent of inhibition increased with polymer concentration and decreased supersaturation. However, the results suggest two, history dependent processes.

Where calcite is exposed to alginate after growth begins (Case 1), suggesting that alginate sorption inhibits layer growth during step movement by temporarily pinning the advancement of active kink sites. For Case 2, where calcite growth begins while alginate is present, steps are not formed. Rather, AFM images show the formation of surface nuclei. So the mechanisms of inhibition in the two cases are different. At low supersaturation, σ , alginate inhibits calcite growth much strongly when the organic compound is added after growth begins (Case 1) than when it is there in the beginning (Case 2). This difference disappears as supersaturation increases (Fig. 1). In a system with polyaspartate, the opposite behavior is observed: inhibition in Case 1 is much weaker than that in Case 2 (Fig. 1) but as for alginate, this difference diminishes as supersaturation increases.

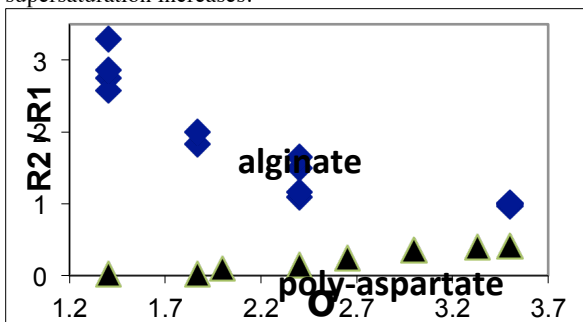


Fig. 1. Ratio of calcite growth rates, i.e. R2 for Case 2 and R1 for Case 1, as a function of relative supersaturation, σ .

This dramatic difference is caused by alginate promoting calcite surface nucleation, decreasing the interface free energy, serving as an effective template for calcite nucleation and growth and easily incorporating into calcite, whereas polyaspartate simply blocks active growth sites, inhibiting surface nucleation.