An atomic force microscopy study of polyacrylate adsorption at calcite-water interfaces

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Calcite (CaCO3) is a major constituent of sedimentary rocks and the use of calcite particles widespread in numerous industrial applications (i.e., plastic, paper, paints, or concrete). In these applications, calcite particles are often handled as slurries. In order to control the stability of these suspensions, sodium polyacrylate (NaPA) is widely used [1]. However, the stabilization mechanism and the adsorption characteristics on this substrate are poorly understood.

To improve our understanding of the adsorption behavior of NaPA at calcite-water interfaces, a systematic study by atomic force microscopy (AFM) was carried out. Various conformational transitions of the adsorbed polyelectrolyte could be established. In particular, at high polymer concentration (> 1 mg/L), NaPA adsorbs as multi-molecular aggregates (Fig. 1A). These aggregates transform into molecular networks upon washing with water (Fig. 1B). This transition suggests that adsorption forces are weak or that a precipitation is taking place. At low NaPA concentrations, worm-like NaPA chains could be visualized. In this case, no effect of washing is observed indicating strong adsorption forces. The findings are in agreement with the well established phase diagrams of NaPA [2].

![Figure 1. AFM height images taken in air of NaPA adsorbed on calcite surface before (A) and after (B) washing and flux drying. NaPA concentration, 30 mg/L; supporting electrolyte, 0.1 mM CaCl2 and 10 mM NaCl at pH 9.](image)