Conformational studies of binding of biologically produced macromolecules to mineral surfaces

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The conformation of organic molecules during initial molecule-mediated mineralization can control and regulate crystal growth, orientation and size. In this study, we have used fluorescence spectroscopic techniques to reveal the conformation of molecules at the surface of minerals. Photophysics techniques were used to investigate molecular conformation. The binding of biopolymers onto mineral surfaces was quantified using adsorption of dilute aqueous solution to macromolecules as a function of pH in the presence of alumina and silica using Time resolved anisotropy studies (TRAMS), fluorescence and ICP-MS. The alumina and silica particles were used to mimic active sites existing on the surface of kaolin-like particles. It was found that lipopolysaccharides (LPS) for example, had a high adsorption affinity for Al_2O_3 and in contrast adsorbs weakly to SiO_2 surface. Strong adsorption was observed at low pH for both minerals. Macromolecular folding and conformation of LPS, alginate molecules and extra-cellular polysaccharides (EPS) extracted from *P. putida*, at the solid-solution interface was also quantified using TRAMS. The results showed a high pH and ionic strength dependence demonstrating that macromolecule adhesion is favoured and mediated by ions such as H^+ and Ca^{+2} in solution. These findings indicate that proton bridges and van der Waal forces are responsible for interactions at the interface. A model for macromolecule adhesion at the interface including the role of ions in solution and folding was proposed. This model is representative of the behaviour of biological macromolecules at the aqueous-surface interface in natural environments. The processes described here have a direct implication on bacteria mediated mineralisation via concentration of ions from solution.