Adsorption of ribonucleotides onto aluminum and iron oxides

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Mineral surfaces are known to adsorb organic molecules such as nucleic acids [1] [2]. They might have concentrated the building blocks of biomolecules in the context of the origin of life, facilitating their polymerization. They also protect them from degradation [3] [4] contributing to an extracellular genetic pool used by microorganisms in soils for horizontal gene transfers [5]. Previous work has highlighted the predominant role of the edges of mineral particles in the adsorption of nucleotides [6], implying *oxide-like* adsorption sites. Here we further investigate the interactions of ribonucleotides with alumina and hematite, as a function of pH, ionic strength and ligand-to-solid ratio. Batch adsorption experiments and surface complexation calculations using the Extended Triple Layer Model allow us to predict the speciation of the surface species, the stoichiometry and thermodynamic equilibrium constants for the adsorption of nucleotides. Both oxides lead to high values of adsorption of nucleotides (> 2 μmol/m^2). However, at high pH, hematite nanoparticles show a significantly higher adsorption compared to alumina. On alumina surfaces we propose the formation of a monodentate inner-sphere complex at low pH, and a bidentate outer-sphere complex at higher pH, both involving the negatively charged phosphate group [7]. This pH-dependency might have implications for the availability of nucleotides both in the context of the origin of life for polymerization and in modern soils for lateral gene transfer.

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