

Surface speciation of aspartate and glutamate on titanium dioxide

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Interactions that occur at the interface between molecules and mineral surfaces in the presence of water are integral to many chemical and physical processes, including the behaviour of pollutants in the environment, the effects of metal implants in the human body, and perhaps the origin of life. In the emergence of life, mineral surfaces may have played a role in the selection of amino acids, leading to the formation of proteins that are essential building blocks of life. To investigate this hypothesis, we are studying two amino acids, aspartic (Asp) and glutamic (Glu) acid, and their adsorption to the rutile form of titanium dioxide. The objective is to get a fundamental understanding of the speciation and coordination chemistry of these amino acids at the rutile surface.

Little is known about the adsorption of amino acids to mineral surfaces. However, previously published ATR-IR spectroscopic results [1] showed that Asp and Glu adsorb on amorphous titanium dioxide in a similar manner depending on pH and surface coverage. According to this study, both Asp and Glu bind predominantly in a bridging-bidentate fashion involving both carboxylate groups. However, a second species in which the ligand chelates titanium through the distal carboxylate group may be present at low pH and high coverage. Glu also forms a third mixed chelating-monodentate surface complex. To investigate whether these complexes are also formed on the rutile surface, we plan to do ATR-FTIR spectroscopic measurements on the rutile-Asp and rutile-Glu systems, respectively.

We have commenced a systematic investigation of Asp and Glu interactions with the rutile surface using potentiometric titrations, adsorption experiments and ATR-FTIR spectroscopy. The spectroscopic evidence integrated with quantitative adsorption data and potentiometric titration data are used to describe the adsorption with surface complexation models.

[1] Roddick-Lanzilotta A.D. & McQuillan A.J. (2000) *J. Colloid & Interface Sci.* **227**, 48-54.

Geochemical monitoring of the hydrothermal systems of Dominica, Lesser Antilles

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The island of Dominica is situated in the Lesser Antilles volcanic island arc. Geothermal monitoring of hydrothermal systems on the island was initiated in 2001 to geochemically characterize the systems and to establish baseline levels of activity from which changes can be detected.

The geothermal fluids of Dominica were found to be typical of those observed in arc-type settings, with the geothermal waters being classified as predominantly acid-sulphate type. The gases have strong hydrothermal signatures and are dominated by carbon dioxide, having hydrogen sulphide as the main sulphurous gas.

Additionally, the saturation indices of mineral assemblages in the hydrothermal systems were used as geothermometers to estimate subsurface temperatures. Reservoir temperatures of Dominica geothermal systems have been estimated to range between 100 - 150°C, using water chemistry data. In comparison equilibria temperatures of the hydrothermal systems of Dominica derived from the evaluation of molar ratios of CH₄/CO₂ and CO/CO₂ revealed higher temperatures (175 - 300°C) for the gases. This suggests that the source of the gases lie deeper than the hydrothermal reservoirs themselves, and that they preserve more of their higher temperature signatures due to slower reaction kinetics and decreased solubility in water.