Surface Charge of Anatase at High Ionic Strength

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Charge development on mineral surfaces is an important control on the fate of minor and trace elements in a wide range of environments. Environments having high salt concentrations (i.e., high ionic strength, I) are common to many of these important environments. In this study, we determined the zeta potential (ζ) of anatase in potassium chloride solutions with concentrations up to 3M (25°C). The zeta potential is the potential at the hydrodynamic shear plane. In this study, we made use of the electro-acoustic effect. This effect is based on the development of a measureable potential/current when the electrical double layer outside the shearplane is separated from a charged particle through rapid oscillation induced by a sound wave. The instrument used in this study, Dispersion Technology DT-300, measures the colloid vibration current (CVI). The advantage of this type of measurement is that the particles are not subjected to a high electric field (common to typical zeta potential measurements), which leads to electrode reactions and a shift of solution pH.

Measurements were collected by subtracting the ion vibration current (IVI) due to the presence of potassium and chloride ions from the CVI. The correction is necessary for measurements in solutions with I > 0.25 M. This subtraction was done at each of the measurement conditions by centrifuging the slurrly, measuring the IVI of the supernatant, reconstituting the slurry, and then measuring CVI of the slurry. Subtraction of IVI at each condition is critical because IVI changes with pH and accounts for most of raw signal.

The results show that the anatase isoelectric point shifts from a pH ~6.5 to a value of ~4.5 at 1M KCl. At ionic strength in excess of 1 M KCl, the surface appears to be slightly negatively charged accross the pH range accessible by this technique (pH 2.5-10). The loss of an isoelectric point suggests that KCl is no longer an indifferent electrolyte at 1 M KCl and higher.

The zeta potential measurements are consistent with standard Electrical Double Layer models in that at high ionic strength most of the surface charge is compensated within the shear plane. However, this theory does not explain the loss of the isoelectric point with ionic strength. Further work on other minerals is planned.