High resolution SIMS-based sulfide δ^{34}S: A new tool for characterizing microbial activity in a variety of depositional environments

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The sulfur isotopic compositions of sedimentary sulfates and sulfides are useful for understanding modern microbial ecology and for reconstructing paleoenvironmental conditions associated with the deposition of ancient sediments. In many modern microbially-dominated sedimentary environments, such as microbial mats, or methane seeps, the redox gradients can be steep with the transition from oxic to sulfidic condition over the space of mm to cm. In these environments, it is frequently difficult (either for logistical reasons or sample volume requirements) to sample at a sufficiently high resolution to capture the geochemical and microbiological details associated with these redox transitions. We build upon earlier work [1] to demonstrate the ability to capture aqueous sulfide as silver sulfide, which can then be analyzed using a Cameca NanoSIMS 50L or 7F/Geo for its isotopic composition at a spatial resolution down to $\sim 1 - 50$ um. This allows for the construction of 2D isotopic datasets that document vertical isotope gradients as well as lateral heterogeneity [2]. Here we present the application of this sulfide capture technique to three different modern environments: (1) microbial mats from Guerrero Negro, Baja California Sur, Mexico; (2) the chemocline of meromictic Lake Mahoney, British Columbia, Canada; and (3) methane seep-associated marine sediments offshore Costa Rica. Coherent variations up to 20 permil in δ^{34}S are observed over ranges as small as 1 mm at all depths examined. These data highlight the additional ecological information that can be extracted from high resolution isotopic data, which may improve our understanding of the activity of the microbial ecosystems driving biogeochemical cycling in these systems.

[1] Visscher *et al.* (2000) *Geology* **28**, 912 – 922. [2] Fike *et al.* (2008) *ISME J* **2**, 749–759.

Interaction of carboxylated latex colloids with mineral surfaces studied by AFM force spectroscopy

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Interaction of a carboxylated latex colloid (considered as a model for natural clay colloids) with several mineral surfaces (quartz, muscovite, biotite, K-feldspar, apatite and titanite) is studied with AFM colloid probe technique. The experiments are carried out by varying the pH from 2-10 at constant ionic strength. In addition, the influence of Eu(III), Ca(II) and natural groundwater on the colloid-mineral surface interaction is investigated. With our technique it is possible to measure interaction forces (such as van-der- Waals, adhesion and electrostatic double layer forces) between surfaces. Relatively strong attractive forces are measured at pH values close to and below the expected pH_{pzc} of the mineral surface. Depending on pH and mineral surface, an increase of attractive forces is observed in presence of Eu(III) and Ca(II). Results show that the interaction of colloids with mineral surfaces is mainly determined by electrostatic interactions. However, in presence of Ca(II) at even low concentrations (10^{-4} mol/L), adhesion forces could be evidenced even under conditions (high pH) where charge repulsion between colloid and mineral surface prevails. Figure 1 shows an example measurement carried out on mica at pH 2. Attractive adhesion (negative peak of light grey line) and snap in forces (negative peak of dark grey line) are measured.
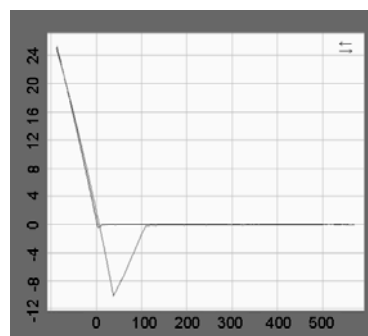

Figure. 1: Force-distance curve measured on mica (I = 0.01 M HCl).