The solubility and reactivity of silica nanoparticles

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The solubility of nanoparticles is a particularly important physicochemical property with major environmental and technological implications. Theoretically, it is predicted that solubility increases as particle size decreases within the nanorange (Gibbs-Thomson effect). However this has been difficult to demonstrate experimentally, due to difficulties in working with such small particles. Specific difficulties include acquiring sets of different size monodisperse nanoparticles, separating dissolved from nano-colloidal phases and maintaining the particles non-aggregated throughout experiments.

Our approach is to synthesise sets of model nanoparticles with optimum properties for solubility and reactivity studies [1]. Here, we present the synthesis of colloidal silica nanoparticles with different sizes (20-200 nm, see figure below) and investigate the effect of size on solubility and reactivity. Colloidal silica is kept in a dialysis bag, within the experimental vessel and dissolved silica is measured in solution aliquots sampled outside the bag. Particle aggregation status is monitored by dynamic light scattering and zeta-potential measurements. Our study shows a clear effect of particle size on solubility.

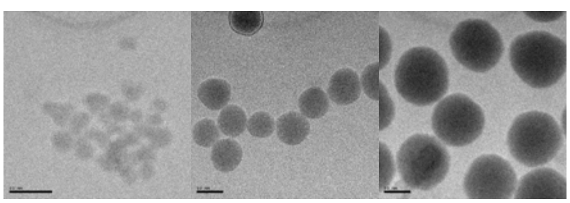

Figure 1: TEM images of three different sizes of silica nanoparticles used in this study (scale bars 50 nm), showing the particles are monodisperse.

[1] Valsami-Jones, *et al*. (2008) *Min. Mag* **72**, 515-519.

Mineralogical controls on microbial communities in glacial environments

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Glacial environments provide ideal conditions for elucidating mineralogical controls on microbial communities via direct microbe-mineral interaction because they exhibit (i) a microbial population which is thought to drive (bio)geochemical mineral weathering processes, (ii) fresh mineral surfaces from subglacial rock abrasion, and (iii) little organic matter relative to terrestrial soil environments. We will disusss the novel application of *in situ* mineral incubation in glacial environments, and their analysis using T-RFLP and clone libraries of 16S rRNA gene sequences, to better understanding minerological controls on microbial communities.

Sterile mineral phases were incubated in the glacial outlet stream channel immediately downstream from the terminus of Robertson Glacier, Alberta, Canada, for 3 week (summer) and 6 month (winter) periods. Incubated mineral phases were then subjected to a range of molecular microbiological techniques which demonstrated a clear mineralogical control on the abundance, diversity, and structure of the mineral-associated bacterial communtiy. Most significantly pyrite, an abundant mineral in the catchment bedrock, which via oxidation provides the dominant anion (SO_4^{2-}) in the outflowing meltwaters, harbored abundant biomass, and a bacterial community most similar to that in the subglacial sediments based on T-RFLP and clone libraries of 16S rRNA gene sequences. These data demonstrate that mineralogy selects for different microbial populations and that specific lithologies likely exert a significant control on the composition of the bacterial communities present in aqueous glacial environments. Moreover, these data suggest that direct microbe-mineral interaction is likely important for solute liberation in subglacial environments.