A seismological perspective on mantle lengthscales

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Although many seismological images are oriented towards the defination of larger scale features in the mantle, the distribution of sources and receivers allows reasonably high resolution for about half the mantle. In such images the best resolution is of high velocity anomalies, mostly likely associated with past subduction; yet some anomalies appear in regions without subduction in the last 150 Myr. This suggests that some fragments of subducted material display significant resistance to thermal assimilation into the surrounding mantle. A typical dimension of these high wavespeed features is of the order of 500 km, which is interestingly a typical dimension of a coherent segment of slabs entering a subduction zone. For smaller bodies surface processes are likely to be more important than volumetric and this may require some reassessment of the types of diffusion parameters employed in thermochemical convection calculations.

The role of extracellular polysaccharides in the adsorption of metals onto biofilms

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Bacterial adsorption can affect the behavior of metals in the environment. There have been a considerable number of studies that examine adsorption of metals onto bacterial cells. However, but bacteria in most natural settings exist within biofilms, which are an attached growth state of bacteria where structured communities of cells are linked together in a matrix that includes secreted extracellular polysaccharides (EPS), proteins, and DNA. Experimental evidence indicates that EPS can bind significant concentrations of metal cations and protons, but the importance of EPS adsorption of metals and protons relative to cell wall adsorption is unknown.

In this study, we conducted potentiometric titrations to determine the proton binding capacities of three types of biomass samples: 1) bacterial cells with EPS material removed through an enzyme treatment; 2) untreated bacterial cells with EPS material intact; and 3) EPS material alone that was separated and isolated from the bacterial cells that secreted them. Gram-negative *Pseudomonas putida* biomass was used in all experiments; EPS removal was accomplished by washing the biomass in a solution that contained the enzyme glucoamylase, which cuts α-glucosidic bonds. EPS separation and isolation from the cells was done using ultracentrifugation at low temperature. Potentiometric titrations were conducted with each sample suspended in a 0.1 M $NaClO_4$ electrolyte to buffer ionic strength. The titration data were interpreted with a discrete site non-electrostatic surface complexation model so that the modeling results could be compared to those for a range of bacterial cells already studied.

The potentiometric titration data from the three different types of samples are identical to one another within experimental uncertainties. The data can be modeled successfully using 4 discrete sites, and the calculated site concentrations and acidity constants for each type of sample are within error of each other, and within error of the universal model of proton reactivity for bacteria proposed by Borrok *et al.* (2005). These results imply that either the EPS molecules are inert to proton binding, or that they exhibit virtually identical proton binding properties to those of the cell wall. These results could greatly simplify modeling of metal adsorption in biofilm-bearing geologic systems.