Surface chemistry and reactivity of bacteriogenic iron oxides from Axial Volcano, Juan de Fuca Ridge, North-east Pacific Ocean

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Iron oxides were collected from the caldera of Axial Volcano, a site of hydrothermal vent activity along the Juan de Fuca Ridge. Mineralogical inspection using X-ray diffraction (XRD) revealed the majority of samples to be 2-line ferrihydrite, with one of the samples corresponding to poorly ordered goethite. Examination using environmental scanning electron microscopy (ESEM) found the constituents of the iron oxides to consist predominantly of bacterial like structures that resembled the iron oxidizing bacteria *Leptothrix ochracea, Gallionella ferruginea* and a novel PV-1 strain. X-ray photoelectron spectroscopy (XPS) detected the presence of Fe, O, C, N, Ca, Si, and P on all the samples with the exception of poorly ordered goethite, where Ca and P were absent, in addition to a weak N peak. Binding energy shifts of the Fe 2p and O 1s peaks were indicative of ferrihydrite and hydroxyl functional groups, while the presence and speciation of the C 1s peak was attributed to the presence of bacteria. Use of acid-base titration data modeling in conjunction with a linear programming regression method (LPM) indicated that the iron oxides are composed of heterogeneous surface functional groups. Differences in iron oxide reactivity values correlated with differences in the bacterial and mineral fabric of the samples. The diverse surface chemistry and high reactivity of these iron oxides may be important in the global cycling of various elements throughout the planet’s oceans due to their presence along widespread Mid-Ocean Ridges.

Hetrogeneity patterns in the earth's mantle from joint seismic tomography

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Joint seismic tomography using information from both P and S waves provides a means of separating the influence of the bulk and shear moduli in the Earth. Different regimes of heterogeneity within the mantle can then be recognised by the relative behaviour of the variations in bulk-sound speed and shear wavespeed. These heterogeneous regimes can then be a useful guide to the nature of geodynamic and geochemical processes.

High resolution results can be achieved for about half of the mantle using reprocessed arrival time data for P and S waves from common sources and receivers, with an iterative tomographic inversion incorporating 3-D ray tracing. This approach is particularly suitable for the delineation of enhanced shear wave speeds as in subducted slabs.

A systematic study of the subduction zone in the western Pacific reveals some surprising variations in the balance of bulk-sound and shear wavespeed, with a switch in the dominant wavetype in the uppermost mantle to shear for older subuction (greater than 90 Ma). A broad change in the nature of the variations in the two wavespeeds can

be recognised between the upper and lower mantle and in particular relatively low bulk-sound speed variation in the mid lower mantle. Superimposed on the larger scale variations are a distinctive and strong shear signature of narrow features in the lower mantle e.g. the inferred Tethyan and Farallon slabs. The features in the high

Resolution images are quite complex in both bulk-sound speed and shear and are highly suggestive of a well stirred lower mantle.

Currently the relative behaviour of bulk-sound and shear wavespeed variations can be better constrained than their absolute amplitudes, but such information still places strong constraints on the nature of geodynamic, and potentially geochemical processes, that cannot be inferred directly from tomographic images for a single wavetype.