Paleoproterozoic positive carbon isotope excursion and organic carbon burial

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Paleoproterozoic sedimentary carbonates indicate that oceans were affected by a dramatic positive carbon isotope excursion between 2.2 and 2.1 Ga (Karhu and Holland, 1996). In the geochemical carbon cycle, a positive shift in marine $\delta^{13}C$ values requires an increase in the burial fraction of organic carbon relative to carbonate carbon. Higher rates of organic carbon burial, in turn, lead to higher rates of release of oxidizing power in the surficial environment. However, geological evidence for excessive organic carbon sedimentation seems to be missing from sedimentary successions deposited between 2.2 and 2.1 Ga (Melezhik and Fallick, 1996). Mantle subduction is a possible, alternative sink for organic carbon, causing a permanent change in the oxidation state of the Earth's surface.

Following the Paleoproterozoic carbon isotope excursion the Fennoscandian Shield experienced a period of subduction and multiple island arc collisions in the Svecofennian orogeny. A post-collisional magmatic event at about 1.8 Ga comprises lamprophyres and peraluminous granites interpreted to have been derived from rapidly enriched lithospheric mantle (Eklund et al., 1998). The rock suite includes a carbonatite intrusion at Halpanen in southern Finland, characterized by unusually low $\delta^{13}C$ values of calcite, with an average at –12.3 ‰. The data are supported by results from lamprophyre calcite and contrast strongly with the signatures generally observed in mantle derived carbonatites. As the isotope composition of carbon in carbonatites can be expected to provide a good estimate of the average $\delta^{13}C$ value in their mantle source, the results suggest an uncommonly high degree of ^{13}C-depletion in the subcontinental mantle after the Svecofennian orogeny. This may be related to excessive subduction of organic light carbon into the mantle and derivation of metasomatizing fluids from the descending slab. The evidence for anomalous mantle compositions is limited to the Fennoscandian Shield, and clearly more data is needed to confirm the pattern and to evaluate the connection of the event to the Paleoproterozoic carbon isotope excursion.

References

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Substrate preference of bacteria

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Biodegradation is important for the breakdown of toxic organic components. Better understanding of the controls on bacterial activity can aid the improvement of remediation strategies for soil and groundwater. Many bacteria prefer attachment to a substrate, to remain in a favourable environment or to insure a steady source of adsorbed nutrients. Before strains are developed for remediation in specific geological settings, mineral surface preference should be determined. A strain developed for oil-spill clean-up on sandy beaches, for example, would be useless if the bacterium only adsorbs to clay.

Our study takes a simple approach by using contact mode AFM to examine a selection of mineral surfaces that were exposed to solutions containing bacteria. Cleaved samples of calcite, gypsum, muscovite and biotite and a clean glass cover slip (as a model for quartz) were exposed to droplets of bacteria-containing solution. Water from a local pond produced bacterial assemblages that varied with mineral substrate. Many of the species found on one mineral surface were absent on the others. Experiments with a monoculture of *Pseudomonas putida* also showed substrate preference.

Figure 1: AFM picture of muscovite exposed to pond water. Pili attach one species to the substrate, but not the other. The bacteria are about 1 μm long.