Mn as a potential energy source for subseafloor chemoautotrophs

M. Ivarsson[1] and N.G. Holm[1]

[1] Stockholm University, Dept. of geology and geochemistry; magnus.ivarsson@geo.su.se

Ocean floor basalts have been recognized to harbor and support a deep biosphere consisting of chemoautotrophic microorganisms. Such microbes use chemically stored energy from minerals that they are attached to or from elements solved in the hydrothermal fluids as an energy source. The most common element that microbes use in such environments is Fe^{2+} which they oxidize to Fe^{3+}, but other elements like S or organic compounds like methane can also be used. One element that has been suggested to be involved in the metabolic process of such bacteria is Mn. Iron and manganese are geochemically and biogeochemically closely associated with each other and are known to interact with each other in various reactions. Iron-oxidizing bacteria, for example, have been shown to be able to oxidize manganese as well. However, Mn-oxidation has not yet been proved to exist in autotrophy, only in heterotrophy. When Mn-oxidizing microbes have been found in basalts from ocean-floor environments they have been interpreted to be heterotrophs that can grow on low concentrations of simple to complex organics, bot not Mn(II) as a sole energy source [1]. Fe-oxidizing bacteria have been suggested to be the initial colonizers of basalts, and their autotrophic growth could lead to primary carbon-fixation and accumulation of organic substrates that would stimulate the activity of heterotrophic Mn-oxidizing bacteria.

Our research of fossilized microbes, conducted on basalt samples from three different seamounts belonging to the Emperor Seamounts, shows that colonies of solely Mn-oxidizing bacteria exist separated from Fe-oxidizing bacteria. Analysis with laser ablation ICP-MS show that whole colonies of fossilized microbes are enriched in Mn and contain very low amounts of iron. The laser ablation analyses also confirm the occurrence of microfossil colonies that are enriched in iron and not manganese, but these different colonies are widely separated and not connected in any way. Fluid inclusion studies further confirm that no organic carbon has occurred in the fluids, which the microbes could have used as an energy source. These results indicate that Mn is an important energy source for subseafloor chemoautotrophs and that Mn probably can serve as main energy source for microorganisms in such environments.

References

[1] Templeton A., Haucke L., Bailey B., Staudigel H. and Tebo B (2005) *abstract AGU 2005 fall meeting*.