Geophysical Research Abstracts, Vol. 7, 10696, 2005
SRef-ID: 1607-7962/gra/EGU05-A-10696

The role of microorganisms in subsurface weathering of hydrothermal sediments: a combined geochemical, mineralogical and microbiological investigation.

R.A. Mills (1), S. Severmann (2), S. Glynn (1), A. Boyce (3), R.D. Pancost (4), M.R. Palmer (1), B. Cragg (5) and R.J. Parkes (5)

(1) School of Ocean and Earth Science, Southampton Oceanography Centre, University of Southampton, Southampton SO14 3ZH, UK, (2) Dept of Geology and Geophysics, University of Wisconsin, Madison, WI 53706, USA, (3) SUERC, Scottish Enterprise Technology Park, Rankine Avenue, East Kilbride, Glasgow, G75 OQF, UK, (4) School of Chemistry, University of Bristol, Bristol, BS8 1TS, UK, (5) School of Earth, Ocean and Planetary Sciences, Cardiff University, Cardiff, CF10 3YE, UK (ram1@soc.soton.ac.uk / Fax: +44 23 8059 3052 / Phone: +44 23 8059 2678).

A detailed geochemical, mineralogical and microbiological study of two adjacent sediment cores from the inactive *Alvin* mounds within the TAG hydrothermal field was conducted to examine, for the first time, the role of microorganisms in subsurface weathering of hydrothermal sulfidic sediments. Results show that there has been substantial post depositional remobilisation of metal species and diagenetic overprinting of the original high-temperature hydrothermal minerals, and aspects have involved microbial processes. Microbial enumeration demonstrates the presence of a population smaller than the average for deep sea sediments, but well-adapted to the metal rich environment. There is a small but significant increase in population size associated with the active redox boundary in an upper metal sulfide layer (50-70 cm) around which active metal remobilisation is concentrated (Cu, Au, Cd, Ag, U, Zn and Zn). Hence, subsurface microorganisms are obtaining energy from metal and/or sulfur metabolism in this near surface zone. Filamentous Fe-oxides observed within the upper sulfide layers may act as nucleation sites for gypsum and silica mineralization. Sulfur isotopic composition of gypsum sulfate is consistent with gypsum precipitation from sulfide oxidation products. Sr/Ca and $^{87}Sr/^{86}Sr$ analyses indicate that the Sr and Ca is derived from mixing between vent fluid and seawater with additional input of Ca

from dissolution of overlying pelagic carbonate material. The filament morphology and association with sulfide oxidation products suggests a biogenic origin for some Fe oxides at the active redox boundary. Lipid biomarker analysis highlights significant differences in the microbial community across the oxide-sulfide boundary.

Deeper in the sediment there is a close association of numbers of culturable Mn and Fe reducing microorganisms with subsurface Fe(II) and Mn(II) porewater profiles suggests active microbial metal reduction at depth in the core (to $\sim$175 cm). Microscale uranium enrichments are associated with pyrite surfaces in zones of Fe(II) reduction. Although microbial populations are present throughout this metalliferous sediment, thermodynamic calculations indicate that the low pH of porewaters and the suboxic/anoxic conditions limits the potential energy available from Fe(II) oxidation, which may restrict microbial chemolithotrophic activity. This suggests that the role of microorganisms in the Fe oxidation and weathering of seafloor massive sulfide deposits may only be dominant in that upper portion of the deposit that is influenced by near neutral pH seawater.