Microbial δ^{34}S fractionation in a shallow submarine hydrothermal vent system, Vulcano, Italy

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Because of large temperature and pH gradients and the broad diversity of organic and inorganic energy sources [1, 2] the shallow submarine hydrothermal system of Vulcano, Italy can be considered a good early Earth analogue. The aim of this study is to determine the activity of sulfate reducing prokaryotes (SRP) in this modern environment, expressed in sulfate reduction rate (SRR) and sulfur isotope fractionation, in order to apply better constraints on presence and activity of SRP in Archean environments.

We performed flow-through reactor experiments with sediment collected close to shallow submarine vents in Baia de Levante, Vulcano Island. The advantage of flow-through reactors is that the intact undisturbed sediment was used and experimental conditions could easily be changed. Samples were taken both on the beach and immediately offshore, close to and away from gas emanations and at *in situ* temperatures in the sediment of 30-90°C. The sediments were incubated at 30, 60 and 85°C and the input solution was in some cases amended with a variety of electron donors including lactate, formate, acetate and ethanol.

Preliminary results indicate that high SRR were achieved within the same sediment sample for the whole temperature range when amending with lactate. The active mesophilic (30°C) and thermophilic populations (60°C) showed simular rates (100 to 150 nmol $cm^{-3}h^{-1}$) whereas the active hyperthermophilic population (85°C) showed the highest rates (up to 200 nmol $cm^{-3}h^{-1}$). The magnitude of isotope fractionation will be compared against SRR for this site. In addition, we will study changes in SRP population in the sediment during the time course of the experiment. Results will be compared with other mesophilic estuarine localities [3] and will aid the interpretation of microbial δ^{34}S variations in the rock record.

[1] Rogers K.L. & Amend J.P. (2006) *GCA* **70** 6180-6200. [2] Amend J.P. *et al.* (2003) *Geobiology* **1** 37-58. [3] Canfield D.E. (2001) *GCA* **65 (7)** 1117-1124.

A window into exotic Arctic mantle

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The Gakkel Ridge is the slowest spreading of the major ocean ridges, and thus provides a window into the Earth's mantle as spreading rate approaches its lower limits. In the central part of the Gakkel, magmatism essentially disappears, leading to a "sparsely magmatic zone" reflecting the lowest degrees of suboceanic mantle melting. Unusual basalt compositions recovered here likely reflect the low melting temperature "veins" of the upper mantle in this region. These lavas have very high Ti_8 (>2.5 wt%) and Fe_8 (>11.7 wt%) and much lower Si_8 (<48.1 wt%) than other Gakkel lavas. REE patterns are highly fractionated with elevated (Dy/Yb) ratios, indicative of partial melting in the presence of garnet. Major element similarities between these basalts and experimental melts of garnet pyroxenite [1], together with the trace element characteristics, shows that these melts, likely the first fractions produced, are the products of vein melting in the sub-ridge environment.

Very low Si_8 and Ti_8 and much lower La/Sm and K/Ti ratios, relative to the bulk of the Gakkel Ridge lavas, characterize a second subset of basalts. These "ultra-depleted" samples occur at segment ends (within the EVZ and SMZ) and as isolated off-axis eruptions, where the last gasps of melting may erupt unmixed. Despite having samples that apparently represent the first and last gasps of melting beneath the Gakkel, very low La/Sm, enriched isotopes, and high Dy/Yb, are difficult to reconcile with such melts being a major component of other Gakkel Ridge basalts or the constellation of MORB compositions in general.

[1] Kogiso, T. & M.M. Hirschmann (2006) *EPSL*, **249**(3-4) 188-189.