Mechanics of bacterial sulfate reduction deduced from sulfur and oxygen isotopes in pore fluid sulfate

GILAD ANTLER[1]*, ALEXANDRA V. TURCHYN[2], VICTORIA RENNIE[2], BARAK HERUT[3] AND ORIT SIVAN[1]

[1]Department of Geological and Environmental Sciences, Ben Gurion University, Beer Sheva 84105, Israel.
[2]Department of Earth Sciences, University of Cambridge, Cambridge CB2 3EQ, UK.
[3]Israel Oceanographic and Limnological Research, National Institute of Oceanography, Haifa 31080, Israel.

Bacterial sulfate reduction (BSR) is responsible for the majority of organic matter oxidation in marine sediments and therefore is a key player in the global carbon cycle. The biochemical pathway of sulfate reduction occurs in several reversible steps; each of these steps has an associated isotope fractionation. The ratio between the forward and backward fluxes at each step, the relationship of the individual fluxes to the overall rate of BSR and the resultant expressed sulfur and oxygen isotope fractionation during BSR in natural environments remains enigmatic. The aim of this study is to further our understanding of BSR through analysis and subsequent modelling of sulfur and oxygen isotopes in pore fluid sulfate from ODP-acquired deep sea sediments, the shallow Eastern Mediterranean, and the Yarqon estuary (Israel). Our data demonstrates a correlation between the net rate of BSR and the slope of the relative evolution of oxygen and sulfur isotopes ($\delta^{18}O_{(SO4)}$ vs. $\delta^{34}S_{(SO4)}$) in the residual sulfate pool. We combine these results with literature data to show that this correlation scales over many orders of magnitude (for rate of BSR). Our model, combined with previously published pure culture data [1], suggests that the critical parameter for the relative evolution of oxygen and sulfur isotopes during BSR in natural environments is the rate of intracellular sulfite oxidation. We find that the lower the net rate of BSR, the steeper the slope ($\delta^{18}O_{(SO4)}$ vs. $\delta^{34}S_{(SO4)}$) and the more intense sulfite oxidation.

[1] Mangalo *et al.* (2008) *Geochim.Cosmochim.Acta* **72**, 1513-1520.

Geochemical constrains on Lower Ordovician magmatism at the Central Iberian Zone (Central Portugal)

I.M.H.R. ANTUNES[1]*, A.M.R. NEIVA[2]* AND M.M.V.G. SILVA[2]*

[1]Polytechnic Institute of Castelo Branco, 6001-919 Castelo Branco, Portugal (imantunes@ipcb.pt) * Geoscience Centre, University of Coimbra
[2]Department of Earth Sciences, Univ. Coimbra, 3000-272 Coimbra, Portugal (neiva@dct.uc.pt; mmvsilva@dct.uc.pt)

The Central Iberian Zone (CIZ) of the Iberian Massif contains important magmatic bodies, most of them of Variscan age, emplaced during and after the ductile deformation Variscan phases. Ordovician magmatism has been considered rare in the CIZ, however recent geochronological data indicate a Lower Ordovician emplacement age for granitic rocks.

The Oledo pluton has an Early Ordovician emplacement age of 479 - 480 Ma, obtained by ID-TIMS U-Pb ages, on zircon and monazite crystals. This pluton is exposed over an area of about 260 km^2 and intruded the Cambrian schist-metagreywacke complex, which consists of alternating metapelites and metagraywackes with metaconglomerate and marble intercalations. It contains four distinct and contemporaneous granodioritic to granitic phases (GrA-GrD) derived from different magmatic sources.

The pluton shows local deformation and magmatic flow structures probably related to the Caledonian and Variscan deformation events. Granodiorite GrA is the most deformed granitic rock with shear zones and deformation at the border. Granodiorites GrA and GrC contain fine-grained biotite tonalite (TME) and granodiorite microgranular enclaves (GME), which are darker and richer in mafic minerals than the host granodiorites. The geological, mineralogical, geochemical and isotopic (Nd, Sr and O) data indicate that TME and GME and host GrA are of I- type and were related by fractional crystallization process. Least-square analysis of major elements and modelling of trace elements support that GME and host GrA are derived from the TME magma by fractional crystallization of plagioclase, grunerite, biotite and ilmenite from the TME magma. Granodiorite GrB is of hybrid origin. Most variation diagrams for whole-rocks and biotites from GME and host granodiorite GrC show linear trends. Major and trace elements modelling suggest that they result from mixing of relatively primitive granodiorite magma with a magma derived from crustal melting. TME corresponds to globules of a more mafic relatively primitive magma. Granite GrD is of S-type and represents another pulse of magma.