High-pressure microbiology in the synchrotron light

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The Earth's subsurface is characterized by hostile conditions for life in terms of temperature, pressure and nutrient availability. Although our current view of the biosphere extension is restricted to shallow geological depths, deep life may enconter pressures of hundreds MPa. As an important microbial energetic process, dissimilatory metal reduction needed to be investigated as a function of pressure.

We measured the effects of pressure on the reduction of Se(IV) and Fe(III) to Se(0) and Fe(II), respectively by the bacterial model Shewanella oneidensis MR-1. This strain is a mesophilic and piezosensitive counterpart of psychrophilic and piezophilic Shewanella representatives that have been frequently isolated from deep-sea environments. Kinetics and yields of Se(IV) and Fe(III) reduction were monitored *in situ* by X-ray Absorption Spectroscopy (XAS) in an autoclave optimized for *in situ* XAS measurements [1]. Most measurements were performed at the BM30B beamline of the European Synchrotron Radiation Facility (ESRF, Grenoble, France). Early measurements on the reduction of Se(IV) were also performed in diamond anvil cell at the ID22 beamline of the ESRF.

Metal reduction occurs in cultures of MR-1 at pressures in excess of 100 MPa. This shows that the metabolic activity of a microbe, despite being piezosensitive, extends far beyond its pressure limits for growth here at 50 MPa. Consequently, considering only the ability to grow in the conditions of the deep subsurface as a proof of metabolic activity may lead to an underestimation of the impact of the biosphere in deep environments. Although the exact experimental conditions do not mimic complex subsurface environments, we show here that the metabolic activity of a surface microbe potentially brought to the deep subsurface can affect significantly biogeochemical cycles as those of selenium, but more importantly those of iron and carbon.

[1] Picard *et al*. (2011) *Geobiology*, **9**, 196-204.

Subduction factory unroofed: Modern submarine magmatism in the North Fiji Basin, Southwest Pacifc

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An extensional setting at the southern termination of the North Fiji Backarc Basin (southwest Pacific), which occurs in response to westward roll-back of the Vanuatu trench and eastward roll-back of the Tonga trench, allows subduction-related magmas to reach the surface (seafloor) with only a minimal extent of both fractionation and crustal contamination, thus providing a unique insight into magma generation processes with the subduction factory.

Volcanic rocks collected within this are during the SS10/2004, SS08/2006 and SS03/2009 voyages of the R/V "Southern Surveyor" reveal a large spectrum of subduction-related magma compositions from backarc basin basalts to boninites, calc-alkaline basalts and high-Mg adakites. All magma series have very primitive, high MgO endmembers, which contain abundant high-magnesian olivine phenocrysts (Fo 92-94) formed during the earliest stages of melt evolution.

The data reveal that melts produced due to adiabatic decompression of the mantle wedge play an important role in magma genesis. Within the studied area, a number of such melts can be identified which differ in both the extent of the contribution of the subduction-derived components, and the extent of depletion of the mantle source. Also abundant are melts produced by melting of the basaltic component of the subducted oceanic crust, which extensively re-equilibrate with the surrounding mantle during their accent to the surface. These melts are also characterised by a range of compositions, range from low-Si, high-Mg to high-Si, high-Mg adakites.

There is clear petrographic and geochemical evidence for extensive mixing between high-Mg adakitic and backarc basin magmas in this area, which results in formation of primitive magmas with typical calc-alkaline and boninitic affinities. Our results suggest that in less extensional settings, where unfractionated magmas rarely reach the surface, the role of this mixing in the genesis of typical calc-alkaline magmas may be more difficult to identify, however it may play an important role in subduction-related magma genesis in general.