

Composition, distribution and properties of the Ultra-Depleted Mantle component

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Many chemo-geodynamical considerations are based on trace element and isotopic variations in erupted basalts. This has led to the concept of a heterogeneous convecting mantle that is composed of a variety of "enriched plums" dispersed in a matrix of Depleted MORB mantle (DMM). Incompatible element isotope systems reveal subtleties in plum composition and distribution, assuming that the DMM matrix is of relatively constant composition. Abyssal peridotite studies have shown recently that old, ultra-depleted harzburgites may be an important component in the convective upper mantle [1]. These residues are too depleted to generate basaltic melt and their -possible extreme- isotopic compositions are thus entirely invisible in erupted basalts. In addition, percolation of plum-derived melts can easily overprint the trace element budget of depleted harzburgites, as observed along the Arctic and Mid-Atlantic ridges.

The Ultra-Depleted Mantle (UDM) is a harzburgite melted beyond cpx-out, with an opx mode around 10%, spinel Cr# of 0.65, and bulk Al₂O₃ of 0.2-0.3 wt%. Not only is UDM invisible in MORB, it will reduce the melt productivity and magmatic crustal thickness by reactive plum-derived melt stagnation. The abundance and distribution of such ultradepleted components in the oceanic mantle cannot be inferred from basalt studies. Evidently, there is a range between DMM and UDM that is a function of extent of depletion prior to recent upwelling. We emphasize that even mid-range (Cr# 0.3) harzburgites are nearly cpx-free and also too depleted for significant melt extraction. Future studies will need to establish criteria other than Os isotopes to distinguish between old inherited depletion from local-scale heterogeneity caused by recent focused melt percolation. On the basis of the extent and distribution of local-scale variation in Gakkel Ridge peridotites, we infer that as much as 25% of the convecting upper mantle consists of old UDM that is not rehomogenized by convective stirring.

[1] Liu, *et al.* (2008) *Nature* **452**, 311-316.

First results of geo- and biochemical analyses of terrestrial methane-emitting mud volcanoes in Italy

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The microbially mediated anaerobic oxidation of methane (AOM) supposedly follows the overall chemical equation $\text{CH}_4 + \text{SO}_4^{2-} \rightarrow \text{HCO}_3^- + \text{HS}^- + \text{H}_2\text{O}$ and is now identified as the major sink of the greenhouse gas in marine systems (Reeburgh 1996; Hinrichs and Boetius 2002 and references therein). In the meantime the AOM is also found in terrestrial fluid venting structures like mud volcanoes [1].

The area of "Salse di Nirano" is located near Bologna (Italy) and was formed by the expulsion of water, mud and gas like methane and higher hydrocarbons. These hydrocarbons could be the substrates for microorganisms that perform the AOM. We studied the gas composition, lipid biomarkers and stable isotope ratios to identify the unknown microbial community at this site and to obtain insights into this system. Phylogenetic analyses indicated the presence of bacterial and archaeal lineages that are generally associated with the anaerobic oxidation of methane.

First results of the lipid biomarkers showed that sulfate reducers, methanogens and methanotrophs were present in this habitat. ¹³C-depletion of the specific lipid biomarkers indicate that the AOM takes place at this site.

Furthermore we have studied ancient seep sites in Italy to compare the results with the active mud volcanoes of Salse di Nirano. Therefore we analysed lipid biomarkers, element contents and the stable isotope ratios of ancient seep carbonates.

[1] Alain, Holler, Musat, Elvert, Treude & Krüger (2006) *Environ Microbiol* **8** (4) 574-590. [2] Hinrichs & Boetius (2002) In: *Ocean Margin Systems*, Wefer, Billett & Hebbeln (eds) Berlin, Germany, Springer Verlag, 457-477. [3] Reeburgh (1996) In: Lidstrom & Tabita (eds) *Kluwer Academic Publishers*, Boston 334-342.