

Evidence for melt accumulation in the subridge melting region: A mantle residua perspective

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Melt extraction from the mantle has been shown to be driven by channelization favoured by melting of source heterogeneities possibly leading to melt accumulation both on- and off-axis¹. Here we present a REE study of clinopyroxene in residual abyssal peridotites showing that melt extraction rarely follows fractional melting trends at the typical dredge haul scale (<1 km). Instead local melting trends reveal REE pattern evolution usually driven by infiltration of relatively enriched melts frequently accompanied by melt accumulation. Estimated compositions of the infiltrating melts suggest they derive by mildly enriched heterogeneities and/or grt-field melting of a DMM-like source². Observed data can be modelled by open system melting in which instantaneous melts represent the mix of influxing and locally generated melts and where the melt exceeding the critical mass porosity escapes. The out coming scenario shows a possible intermittent behaviour where melting switches from near-fractional to near-batch. In open system melting this behaviour is imaged by fluctuations of the critical porosity/degree of melting value, where the critical mass porosity is a proxy of the accumulated melt fraction.

Lower thermal settings and spreading rates could favour the retention of the compositional trends associated to fluctuations in the melting regime. Accordingly, we found that the statistical distribution of REE trends accounts for a more effective melt accumulation and enriched melt infiltration along the South West Indian Ridge with respect to the Mid Atlantic Ridge.

[1]Katz & Weatherley, 2012. *EPSL* Vol. **335-336**, Pp. 226-237. [2] Seyler *Et Al.*, 2011. *G3* Vol. **12** (9), Doi:10.1029/2011gc003585.

Lifestyles of the slow and lonely – A story told by sulfate isotopes

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Sulfur is a bio-essential component of any living organism and is at the same time heavily used by microbes for energy yielding (dissimilatory) processes. Dissimilatory sulfate reduction (DSR) coupled to the oxidation of organic matter plays a pivotal role in the re-mineralization of organic matter in marine sediments, which is owed mostly to the high concentration of sulfate in the overlying seawater relative to other energetically more favorable electron acceptors such as oxygen or nitrate. When sulfate is depleted methane becomes the end product of organic matter degradation. At the interface between downward diffusing sulfate and upward diffusing methane (sulfate-methane transition) sulfate is consumed by sulfate reduction coupled to the anaerobic oxidation of methane (SR-AOM). In the classic view, DSR is thus confined to the main sulfate zone, a redox zone where the more favorable electron acceptors are absent.

Thanks to new findings, such as i) the discovery of sulfate generation in methanic sediments well below the main sulfate zone, the so-called “cryptic sulfur cycle” (Holmkvist *et al.* 2011 [1]), ii) the discovery that SR-AOM utilizes biochemical pathways different from DSR (Milucka *et al.* 2012 [2]) and iii) the discovery of sulfur oxidation by cable bacteria (Pfeffer *et al.* 2012 [3]) our view on sedimentary sulfur cycling has recently been dramatically changed and broadened.

Stable sulfur and oxygen isotope tracing of these newly discovered processes in the environment and in the rock record could provide us with compelling insights into these so far unrecognized biochemical sulfur transformations. However, there is a complication/caveat: we do not yet know what isotope signature we should look for.

I hypothesize that the sulfur and oxygen isotope effects of oxidative and reductive sulfur cycling mediated by microbes in the deep biosphere – organisms that live a slow and lonely life – may provide clues to what isotope signatures to expect.

[1] Holmkvist *et al.* (2011) *Geochim. Cosmochim. Acta* **75**, 3581-3599. [2] Milucka *et al.* (2012) *Nature* **491**, 541–546. [3] Pfeffer *et al.* (2012) *Nature* **491**, 218–221.