In situ isotopic variation in the Semail Ophiolite lower crust: Reconstructing mantle heterogeneity and crustal accretion

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The compositional heterogeneity of the mantle is well established, as is the concept of MORB as a "window into the mantle". Traditionally MORB has been the primary tool to map geochemical variations and melting processes of the upper mantle. However, the differentiation processes in the lower oceanic crust prior to eruption occur in tandem with magma mixing, which homogenizes the source heterogeneity. It is therefore unlikely that the MORB lavas reflect the full variability of melt compositions delivered to the crust. Furthermore, it remains unclear how discrete, arguably isotopically heterogeneous, batches of mantle melts are homogenised in the oceanic crust. The two competing models for the formation of the lower oceanic crust at fast-spreading ridges – the gabbro glacier and sheeted sill models – have different predictions as to where, and to what extent, melt homogenization occurs.

We present Nd and Sr mineral isotope data of lower crustal gabbroic rocks from the Abyad section in the Semail Ophiolite (Oman). The complete lower crustal section, from the Moho Transition Zone to the base of the sheeted dyke complex, was sampled. Analyses were made *in situ* in order to avoid domains related to post-cumulus reactive porous flow of interstitial melt that are prevalent in oceanic gabbros [1]. Selected crystal cores of clinopyroxene and plagioclase were analyzed for major and trace elements and microdrilled for TIMS analysis.

Our results show that resolvable differences occur in Sr and Nd isotope ratios both between but also within samples. The variation of our dataset exceeds the variability in isotope compositions of the associated lavas in the ophiolite and thus we conclude that growth from isotopically variable melts is recorded in the lower oceanic crustal rocks. This demonstrates that our approach has the potential to elucidate the hidden heterogeneity of the mantle source of oceanic basalts, and shed light on the mechanisms of crustal accretion and melt homogenization.

[1] Lissenberg *et al*. (2013) *EPSL* **361**, 436-447.