Focused melt flow in the shallow mantle: Evidence for transient instabilities in the partially molten mantle beneath an ocean ridge?

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The Kane Megamullion is an oceanic core complex in the western rift mountains of the Mid-Atlantic Ridge at 23°30'N bordered by the Kane F.Z. exposing 2.2-3.3 Ma crust extending up to ~50 km wide along isochrons. This corresponds to nearly the entire length of a second order magmatic ridge segment – generally believed to be the fundamental unit of accretion at a slow spread mid-ocean ridge. Crust of corresponding age and position on the opposing African tectonic plate exposes the intact volcanic carapace that originally overlay much of the core complex. Mapping along an isochron across the center of complex showed that the central region, corresponding to the segment midpoint exposes largely granular plagioclase-free harzburgite, and virtually no dunite indicating little focused flow of melt through the mantle there [1]. In addition, while sampling the detachment fault surface itself recovered abundant pillow lavas and dike debris, remnants of the overlying hanging wall volcanic complex, little gabbro was found. This indicates that the volcanic complex was fed from magmatic centers to the north or south, and that locally the crust accreted at the midpoint of the segment consisted of dikes and volcanics intruded over the shallow mantle. To the south, however, dunite and wherlitic dunite (<5% Cpx), associated with granular harzburgite tectonites, are abundant. In the same area primitive troctolites, olivine gabbro and oxide gabbro intercalated with sheeted dikes are abundant, consistent with the delivery of primary MORB liquids at this point [2]. Further north, a second magmatic complex is exposed along the wall of the transform, while seismic reflection suggest yet another magmatic complex is situated directly east of the segment midpoint beneath the detachment fault surface. Thus, there is strong evidence for focused melt flow from the mantle at different points in time, suggesting that it is controlled by transient instabilities in the partially molten mantle beneath the ridge.

[1] Dick *et al.* G3, in press. [2] Lisenberg & Dick, in prep. [3] Canales *et al.,* in prep.

Mg isotopic composition of ferromanganese nodules from the Antarctic Circumpolar Current: A record of secular Mg isotope variation in seawater?

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Magnesium has a residence time of *ca.* 14 Ma in the oceans and is a major conservative constituent of seawater. A temporal record of the stable Mg isotopic of seawater during the Cenozoic would provide valuable constraints into the sources and sinks of Mg to the ocean. Such a record would also constrain the Mg/Ca Cenozoic evolution of seawater, which is critical to the use of this geochemical proxy in foraminifera when attempting to quantify changes in ocean temperatures.

Ferromanganese crusts and nodules preserve records of ocean chemistry over tens of millions of years, yet no stable Mg isotope data have been reported for the Fe-Mn oxyhydroxide phase of these authigenic sediments, which contains ca. 1 wt.% MgO. This reflects the difficulty in separating Mg from the chemically similar elements (Mn and Ni) that are present at high levels in ferromanganese materials by normal, nitric-acid-based, cation exchange methods.

We present the first analyses of stable Mg isotope variations in ferromanganese nodules, which were recovered from depths of ca. 4 km off the east coast of New Zealand and are bathed in the Antarctic Circumpolar Current. The nodules were dated by ^{10}Be methods and are up to 15 Myr in age. Mg isotope ratios were measured by MC-ICPMS after chemical purification of Mg from all other elements including Mn and Ni. Preliminary data suggest that secular variations in δ^{25}Mg over the past 8 Ma were minor with Mg stable isotopes being significantly lighter than modern seawater (ca. -0.7 to -0.8‰ with respect to DSM-3), but became significantly heavier (-0.2‰) between 8 and 10 Ma. Work is in progress to extend the record and its temporal resolution, along with an experimental study to investigate the sense and magnitude of Mg isotope fractionation associated with precipitation of Fe and Mg oxyhydroxides.