Temperatures and Timescales of Crystallization in the Lower Crust of the Oman Ophiolite

JILL A. VANTONGEREN[1]

[1]Department of Earth and Planetary Sciences, Rutgers University; jvantongeren@eps.rutgers.edu

Oceanic crust is formed when mantle-derived magmas are emplaced at the ridge axis, a zone of intense rifting and extension. Magmas begin to cool and crystallize on-axis, forming what is termed the "Mush Zone", a region of partially molten rocks. Over the years several attempts have been made to understand the nature of the Mush Zone, specifically how much partial melt exists and how far off-axis the Mush Zone extends. Geophysical estimates of P-wave velocity perturbations at the East Pacific Rise show a region of low velocity approximately 1.5-2.5 km off-axis, which can be interpreted to be the result of higher temperature [e.g. Dunn et al., 2000] or the existence of partial melt.

I will show stratigraphically-constrained geochemcial data from the lower crust of the Oman ophiolite aimed at quantifying the timing crystallization and the lateral extent of the Mush Zone in the lower crust of a paleo-spreading center. Crystallization temperatures are calculated with the newly developed plagioclase-pyroxene REE thermometer of Sun and Liang [in review]. There does not appear to be any systematic change in the crystallization temperature of lower crustal gabbros with depth in the crust. The solidus temperature and cooling rate of each sample is constrained by the Ca diffusion in olivine geospeedometer [e.g. VanTongeren et al., 2008]. There is no systematic variation in the closure temperature of Ca in olivine, or the cooling rate to the ~800°C isotherm. These results show that gabbros from the lower crust of the Oman ophiolite remain in a partiallly molten state for ~10,000 years on aveage. Assuming a paleo-spreading rate similar to that of the East Pacific Rise, this translates to a "Mush Zone" of partially molten rock up to 1 km off-axis, slightly less than the low velocity zone observed geophysically on the East Pacific Rise.

[1.] Dunn, R. A., et al. *J. Geophys. Res.* **105,** 23537–23–555 (2000).

[2.] Sun, C., Liang, Y.. A REE-in-plagioclase-clinopyroxene thermometer for crustal rocks. (*in review).*

[3] VanTongeren, J. A. et al. *Earth and Planetary Science* **267**, 1, 69-82 (2008).