Isotopic Composition and Age of Abyssal Peridotites from the Gakkel Ridge

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Introduction

The Gakkel Ridge is one of the slowest spreading ridge segments in the global ridge system and with some of the thinnest oceanic crust. In some locations there is little or no evidence for volcanic activity and oceanic mantle is directly exposed on the ocean floor. This provides an excellent opportunity to investigate the heterogeneity of the oceanic mantle in situ.

Experimental

Clinopyroxene separates from thirty peridotites were analyzed for trace element and Nd, Hf and Os isotopic composition. LA-ICP-MS analysis for major and trace element concentrations were performed using an ESI New Wave™ UP193FX excimer LA-ICP-MS system coupled to a ThermoFisher ELEMENT XR at the Geochemistry Program (NHMFL). The spot size was 20 µm, with 5-second dwell time at 50 Hz, and 1.7 GW/cm^{2}power density. Analysis were calibrated using well known standards using established techniques [1]. Nd and Hf fractions were separated using established techniques [2]. Nd, Hf and Os isotopic compositions were measured using a ThermoFisher Neptune multi-collector ICP-MS. Os was separated from leached whole rock samples. Samples were digested either in Carius tubes at 300°C or in high pressure asher (Anton Paar). Os was separated using solvent extraction [3] and purified by micro-distillation [4].

Results and Discussion

^{187}Os/^{188}Os ratios range from 0.1192 to 0.1332 with one outlier at 0.14997. This range is similar to that found by Liu et al. [5] which is from 0.1139—0.1306. Re-depletion ages are calculated to be between 0.08 and 1.28Ga as well as several unrealistic ages (either future ages or older than the age of the Earth). The age range is not much different than the ages calculated from Nd and Hf isotopes systems, which are, in general, also less than 1.5Ga. This despite the large range in Hf and Nd isotopic composition, 300 and 25 epsilon units, respectively. However, the ages calculated for the different systems do not correlate (see Fig. 1). The same holds for the isotopic compositions, which are also not correlated. This lack of correlation indicates that different processes have to control the individual systems. One would have expected that the Re-depletion ages would be the oldest, because any depletion would almost quantitatively remove the Re. Thus the Os-isotopes show that the MORB source has to be re-enriched

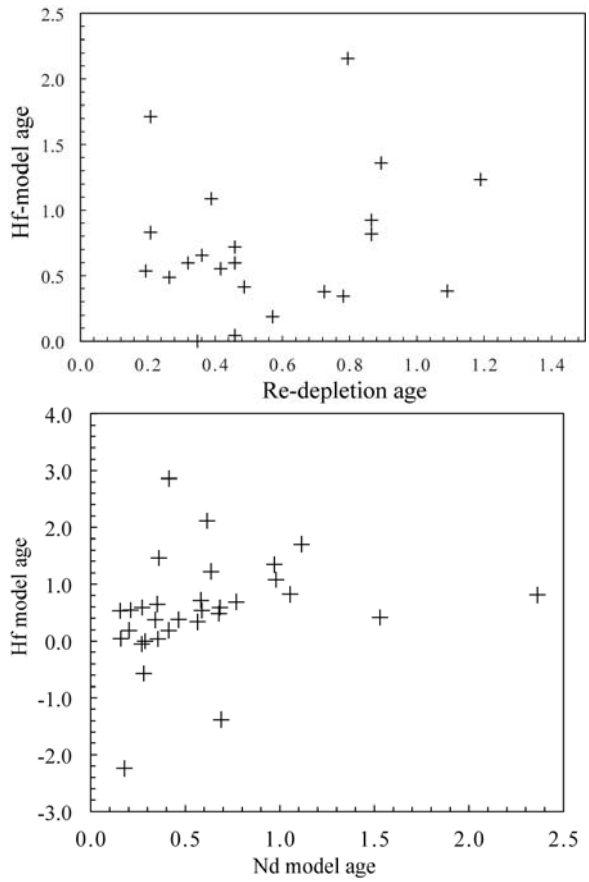

Figure 1: Ages for Gakkel Ridge peridotitesBoth Re-depletion ages and Nd model ages do not show correlations with Hf isotope ratios.

Conclusions

The radiogenic Hf and unradiogenic Os isotopes indicate that extremely depleted material exists in the MORB source. These extremely depleted components seem undersampled in the basalts.

Acknowledgements

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References

1. M. Gaboardi, M. and Humayun, M., J. Anal. Atom. Spec. **24**, 1188-1197 (2009).
2. Stracke, A. et al., Geochem. Geophys. Geosys. **4**, 2001GC000201 (2003).
3. Shen, J J et al., Geochim. Cosmochim. Acta **60** (15), 2887-2900 (1996).
4. Roy-Barman, M. and Allègre, .J., Earth Plan. Sci. Lett. **129**, 145-161 (1995).
5. C.-Z. Liu, C.Z. et al., Nature **452**, 311-315 (2008).