Exploring mantle source and process effects using iron isotopes in Southwest Indian ridge basalts

Mikael Motte*[1], Antoine Bezos[1], Marine Paquet[2], Marion Rivoal[1], and Frédéric Moynier[2]

[1]Laboratoire de Planétologie et Geosciences LPG Nantes – Nantes université - UFR des Sciences et des Techniques, CNRS : UMR6112 – France

[2]Institut de Physique du Globe de Paris – Institut National des Sciences de l'Univers, Université de la Réunion, Institut de Physique du Globe de Paris, Centre National de la Recherche Scientifique, Université Paris Cité – France

Résumé

The geochemical diversity of Southwest Indian ridge (SWIR) basalts stems from the interplay of various mantle sources (peridotite ± pyroxenite or ± granulite), melting processes, and melt/rock interactions (1-4). Recent advances in non-traditional stable isotopes (e.g., Fe) have opened up new possibilities to reexamine the origin of the geochemical heterogeneity of Mid Oceanic Ridge Basalts (MORB). We measured the iron isotope compositions of 27 basaltic glasses sampled along the SWIR axis between 64◦E and 69◦E. These glasses show substantial variations in MgO (6.1–9.5 wt.%), Na_8.0 (2.5–4.1 wt. %, Na2O corrected for the effect of fractional crystallization) and La_N/Sm_N (0.4–1.3, N for CI chondrite normalization), which are commonly used to assess the degrees of magma differentiation, mantle melting and source heterogeneity, respectively. Samples have δFe (per mil deviation of the Fe/Fe from the IRMM-014 standard) ranging from +0.06 ± 0.03 ‰ to +0.16 ± 0.05 ‰ with an average value of +0.10 ± 0.03 ‰, similar to MORB literature data (6). Fractional Crystallization (FC) alone cannot account for the whole range in δFe and therefore heterogeneity in primary melts compositions are needed. Although no global correlation is observed between Na_8.0 and δFe_corr. (corr. refers to values corrected for the effect of FC), basalts from the easternmost SWIR – also known to be one of the deepest and coldest area of the global ridge system – tend to show increasing δFe with decreasing degrees of partial melting. Yet, models of iron isotopic fractionation during mantle melting fail to account for the elevated δFe_corr values. Consequently, we have developped quantitative models to evaluate the effects of source heterogeneity, and melt/rock reactions on Fe isotopes.

(1) Meyzen et al. (2005), G3, 6, Q11K11

(2) Standish et al. (2008), G3, 9, Q05004

(3) Paquet et al. (2016), G3, 17, 4605– 4640

(4) Lissenberg & Dick (2008) EPSL, 271(1), 311– 325

(6) Guo et al. (2023), EPSL 601, 117892

Mots-Clés: Isotopes stables, Fer, Magma, Dorsale océanique

*Intervenant