5.1.P10

Extreme compositional variability of the mantle-plume related magmas from Mauritius Island, Indian Ocean

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Three distinct phases of volcanism, related to the Deccan-Reunion mantle-plume, occurred over a time span of nearly 8 million years on the island of Mauritius, Indian Ocean. The rock suites are represented by transitional basalts (Older Series, 7.8-5.4 Ma), highly undersaturated basalts (Intermediate Series, 3.5-1.9 Ma), and K-poor alkali basalts (Younger Series, 0.7-0.17 Ma). Bulk rock compositions of 52 analysed samples (including 30 boreholes), as well as the compositions of olivine and spinel, reveal extreme compositional variations in the Mauritius magmas.

Two compositional groups are identified based on the major and trace element compositions. Group 1 basalts have higher MgO (7.6-13.6 wt%) and lower K_2O (0.2-0.5 wt%) and La/Sm (2.1-3.5) compared to Group 2 compositions (MgO 6.2-9.2 wt%; K_2O 1.0-1.5 wt%; La/Sm 3.6-4.1). Chondrite-normalised REE patterns show that the degree of both LREE enrichment and LREE/HREE fractionation increases from Group 1 to Group 2 compositions. The degree of enrichment does not correlate with MgO. High Gd/Yb ratio in both groups (1.8-2.9 in Group 1 and 2.7-3.4 in Group 2) indicate the presence of residual garnet in the source region. When the compositions with different MgO content are plotted together, a cross-cutting relationship in the HREE is observed, which can be attributed to crystal fractionation as well as the presence of variable amounts of garnet in the source. A strong positive Sr anomaly (Sr/Sr*~1.1-1.8; Sr* calculated by normalising to measured Pr) is observed in the Group 1 samples.

Petrographic and mineralogic studies also confirm the presence of two distinct groups. Primitive olivine (Fo_{87-80}) in Group 1 rocks is characterised by increasing CaO (0.2 to 0.3 wt%), whereas in Group 2 rocks olivine (Fo_{86-80}) show decreasing CaO (0.4 to 0.3 wt%). Olivine-hosted inclusions of spinel also show very strong compositional differences between groups 1 and 2 in terms of Al_2O_3 (34-48 and 11-19 wt% respectively), TiO_2 (0.4-1.6 and 2.7-7.9 wt%) and Cr# (16-30 and 41-70 mol% respectively).

Unusually Al-rich compositions of spinel taken together with positive Sr anomaly in Group 1 rocks suggest assimilation of crustal gabbros by the plume magmas. Thus, constraints on the origin of recorded compositional variations and trends must await the study of radiogenic isotopes before the effects of mantle source heterogeneities and melting are considered.

5.1.P11

He-isotope characteristics of geochemically enriched basalts from the Snaefellsnes Peninsula, western Iceland

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In order to define the nature and origin of the enriched component in the mantle beneath the off-axis Snaefellsnes Peninsula, western Iceland, $^3He/^4He$ analyses have been performed on olivine and pyroxene phenocrysts separated from mildly alkaline basalts. The most enriched basalts erupted in Snaefellsnes are characterised by radiogenic $^{87}Sr/^{86}Sr$ (0.7034 - 0.7035), less-radiogenic $^{143}Nd/^{144}Nd$ (0.51292 - 0.51300) and low Zr/Nb (3.5 – 4.0), relative to the compositions of basalts erupted in Iceland's rift-zones. The compositions of Snaefellsnes basalts are typical of the enriched component in the North Atlantic mantle, which is thought to be derived from a recycled source, possibly the upper part of subducted oceanic lithosphere. Measured $^3He/^4He$ values correlate strongly with the isotopic ratios and Zr/Nb. The most enriched compositions are found at the western tip of the peninsula, in the Snaefellsjokull volcanic system, and are characterised by the lowest $^3He/^4He$ values (7.5 - 8.3 R_A). The highest $^3He/^4He$ (11.0 - 11.6 R_A) are associated with the most depleted basalts of the Ljosufjoll system in the easternmost part of the peninsula. The observed geographical variation is most easily explained by the presence of a greater proportion of a low-$^3He/^4He$, more fusible, enriched component beneath Snaefellsjokull.

The He-Sr-Nd isotope composition of Snaefellsnes basalts are similar to the more extreme enriched basalts from Jan Mayen located to the north of Iceland. Both Jan Mayen and Snaefellsnes basalts can be distinguished from enriched basalts erupted elsewhere in off-axis Iceland, on the basis of Nb-Y-Zr and in Pb-Sr and Pb-Nd isotope space. Preliminary Pb isotope determinations on the Snaefellsnes samples indicate that their He-Pb compositions might be explained by mixing between a young recycled component (with low $^3He/^4He$ and radiogenic $^{206}Pb/^{204}Pb$) and a depleted plume component (high $^3He/^4He$ and less-radiogenic $^{206}Pb/^{204}Pb$). A comparison of these data with new data from other off-axis regions provides evidence for the existence of at least two enriched components in the North Atlantic mantle, each characterised by distinct He-Sr-Nd-Pb isotope compositions, and which may be derived from either different parts of a subducted slab or recycled material of different ages.