Geophysical Research Abstracts, Vol. 7, 10428, 2005
SRef-ID: 1607-7962/gra/EGU05-A-10428

Isotopic and geochemical constraints on the enriched mantle in the Iceland plume

A. Williams (1,2), **F.M. Stuart** (1), R.M. Ellam (1), G. Fitton (1)

(1) School of GeoSciences, University of Edinburgh, Edinburgh, UK

(2) Isotope Geosciences Unit, Scottish Universities Environmental Research Centre, East Kilbride, UK (f.stuart@suerc.gla.ac.uk)

Post-glacial basalts from Iceland's three flank-zones - Snaefellsnes Peninsula (SNP), Eastern Flank Zone (EFZ) and the southern Eastern Rift Zone (S-ERZ) - are mildly-alkaline and are enriched in incompatible trace elements compared to rift-zone tholeiites. They are generated by small-degree melting of fertile mantle source. New He-Sr-Nd-Pb isotope data from all three provinces distinguish them from each other, from other enriched basalt provinces in the North Atlantic, eg Jan Mayen, and from the rift-zone tholeiites.. The isotope and trace element data indicate that mixing between depleted and enriched mantle components in Iceland is complex, but trends in He-Sr, He-Pb isotopes and ^{3}He/^{4}He-Nb/Zr space can be explained by invoking three subtly different enriched end-members.

The 100 km-long SNP in western Iceland provides a natural transect along which to study variation in the geochemistry of enriched basalts with increasing proximity to the active rift-zones. Primitive basalts from each of the three W-E aligned Quaternary volcanic systems: Snaefellsjokull, Lysuskard and Ljosufjoll. ^{3}He/^{4}He of olivine phenocrysts range from 7.7 R_A in Snaefellsjokull to 11.6 R_A in easternmost Ljosufjoll. The easterly increase in ^{3}He/^{4}He mirrors changes in ^{87}Sr/^{86}Sr (0.7035–0.7032), ^{206}Pb/^{204}Pb (18.9–18.7) and Nb/Zr (0.30–0.15).

Snaefell and Oraefajokull (EFZ) have similar trace element compositions (Nb/Zr = 0.10 to 0.17) but are distinct in their isotopic compositions. Snaefell basalts are characterised by ^{87}Sr/^{86}Sr of 0.7032–0.7034 and ^{143}Nd/^{144}Nd = 0.5130, and ^{3}He/^{4}He and ^{206}Pb/^{204}Pb of Snaefell basalts are the lowest measured in this study (6.4-6.9 R_A; 18.5–18.6). These are isotopically similar to Jan Mayen and may be intrinsic

to the sub-North Atlantic mantle rather than the Iceland plume. Oraefajokull basalts have the most radiogenic ^{87}Sr/^{86}Sr compositions in Iceland ($\sim$0.7037) and are also unique amongst Icelandic basalts in that they plot above the Northern Hemisphere Reference Line in Pb isotope space. ^{3}He/^{4}He = 7.4–7.8 R_A. Basalts from the Vestmann Islands and Katla, Torfajokull and Eyjafjoll volcanoes (S-ERV) have the highest ^{3}He/^{4}He measured in the study (13.2–19.7 R_A). ^{3}He/^{4}He increases northwards, however, in contrast to the regional trend in the SNP. Nb/Zr (0.11–0.14), ^{87}Sr/^{86}Sr (0.7031–0.7033) and ^{206}Pb/^{204}Pb (19.0-19.4) also increase with^{3}He/^{4}He.

The enriched mantle source tapped by Oraefajokull not present anywhere else in Iceland and may be compositionally related to an EM-type mantle component. The second enriched end-member is characterised by ^{3}He/^{4}He < 6 R_A, ^{87}Sr/^{86}Sr > 0.7035 and ^{206}Pb/^{204}Pb > 19.4 and is present throughout the flank-zones. The third enriched end-member is distinguished by less radiogenic Pb. The isotopic characteristics of these two enriched end-members suggest they may be related to a young-HIMU-type mantle component..