Mixing two enriched and distinct mantle sources beneath Lucky Strike segment, 37º N on the Mid-Atlantic Ridge

P.L. FERREIRA[1], B.J. MURTON[2] AND CLIVE BOULTER[2]

[1]INETI, Alfragide, Portugal (pedro.ferreira@ineti.pt)
[2]Southampton Oceanography Centre, Southampton, UK

New major and trace element, and Nd-Sr isotopic, data on samples from the Lucky Strike Segment are presented. All samples studied are enriched mid-ocean ridge basalts (E-MORB), but different degrees of enrichment are identified. Three distinct compositional groups can be established: - in Group 1, the lavas have the highest "more incompatible/less incompatible" (MI/LI) element ratios, $^{87}Sr/^{86}Sr$ and the lowest $^{143}Nd/^{144}Nd$ ratios. These lavas have a degree of enrichment between those of E-MORB and OIB and are spatially restricted to the central part of the axial volcano. Group 3 lavas have the smallest "MI/LI", $^{87}Sr/^{86}Sr$ and the highest $^{143}Nd/^{144}Nd$ ratios. The lavas present REE and multi-element patterns typical of E-MORB and were collected throughout the Lucky Strike segment (from 37º12,0' to 37º27,3' in latitude). Group 2 lavas have chemical characteristics intermediate between those of groups 1 and 3 in terms of trace and isotope compositions, have the maximum dispersion in the different element or element ratios, and present an enrichment degree between those of group 1 and 3 lavas.

Relationships between various incompatible trace element ratios (e.g. La/Sm versus Nb/Zr), together with Sr and Nd isotopic ratios, or between both (e.g. La/Sm versus $^{143}Nd/^{144}Nd$) show clearly a continuous chemical trend, defined by group 2 basalts, progressively connecting the chemical characteristics shown by groups 1 and 3. The justification for that trend being the result of mixing processes was tested, and a good fit of the mixing lines to the data was obtained. Moreover, since the mixing processes between a depleted mantle source (N-MORB type), and a highly enriched source (Plume type) are frequently postulated to explain the origin of E-MORB type basalts (identical to those of group 3), calculation of the mixing lines were extended to a N-MORB end-member, and good fits were also obtained. These results show that mixing could be invoked to explain the chemical diversity among the Lucky Strike segment magmas, involving an N-MORB type source end-member and an enriched end-member similar to that assumed to generate the basalts from group 1. Hence, the existence of two distinct (both enriched) mantle sources beneath Lucky Strike segment could be postulated.

Evaluating the relative roles of hydrothermal alteration at a single crystal scale: Sr isotope micro-sampling study of eruptive and intrusive magmatic rocks from Skye

L. FONT, D.G. PEARSON, J.P. DAVIDSON, C.G. MACPHERSON, G.M. NOWELL AND R.N. THOMPSON

Department of Earth Sciences, University of Durham, Durham DH1 3LE, UK. (laura.font@durham.ac.uk, d.g.pearson@durham.ac.uk, j.p.davidson@durham.ac.uk, c.g.macpherson@durham.ac.uk, g.m.nowell@durham.ac.uk, r.n.thompson@durham.ac.uk)

The Skye Tertiary igneous rocks (NW Scotland) are characterised by wide variations in wholerock Sr, Pb and Nd isotopic ratios. These are interpreted to result from magma mixing and contamination by upper and lower crust. In addition, both lavas and intrusives (particularly in the southern Skye) have low $\delta^{18}O$ values due to extensive interaction with heated meteoritic ground waters. Since both Sr and Pb are mobile during hydrothermal alteration, at least some, whole rock Sr and Pb isotopic compositions are likely to have been significantly modified in some cases, complicating the quantification of crustal contamination processes. In this study we examine Sr, Pb and O isotopic ratios of the micro-drilled portions of feldspars and olivine phenocrysts, from lavas and dykes occurring at varying distances from the Skye centre of the hydrothermal circulation centre, as defined by oxygen isotopes. This will allow us to better constrain the origin of both, the phenocryst and wholerock isotopic variations. In particular, it is crucial to differentiate between variations caused by hydrothermal alteration and by magmatic processes. By evaluating alteration processes at a crystal scale we shall develop sample selection criteria for detailed isotopic studies of magma mixing and crustal contamination. This will improve understanding of the detailed mechanisms of magmatic evolution and crustal contamination in flood basalt regions.