Evolution of a mantle wedge: Basalts from the Colville and Kermadec Ridges

M.R. HANDLER[1]*, R.J. WYSOCZANSKI[2] AND E.M.F. BURGER[1]

[1]SGEES, Victoria University of Wellington, New Zealand (*correspondence: Monica.Handler@vuw.ac.nz)
[2]NIWA, PO Box 14901, Wellington, New Zealand

The Kermadec Arc intra-oceanic arc system has been active for at least the last 17 Ma. Volcanic rocks extracted from much the same location over this period allow the composition and fluxing of the mantle wedge to be investigated over a prolonged period of subduction.

The Southern Kermadec Arc consists of the active Southern Kermadec Arc volcanic front and the Havre Trough back-arc system bound by two sub-parallel ridges, the Colville Ridge to the west and Kermadec Ridge to the east. These ridges represent the proto-Kermadec volcanic arc split by the opening of the Havre Trough at c. 6 Ma. Here, we will present the first major and trace element data, Sr and Pb isotopic data and mineral chemistries of lavas from this remnant arc and compare them with the currently active Southern Kermadec Arc and Havre Trough back arc basin.

The ridge samples comprise highly porphyritic basalts. The crystal cargoes of the ridge crest samples are dominated by plagioclase that span the compositional range observed in the modern arc, extending to very primitive compositions (An ≤ 98). By contrast, samples dredged from a knoll on the Kermadec Ridge contain abundant olivine (Fo ≤ 94; NiO ≤ 0.5 wt%) and pyroxene phenocrysts. Preliminary trace element data suggest a mantle wedge source that was less depleted than the modern wedge (e.g. N-MORB normalised HREE concentrations ~ 0.6 – 1.0), and already polluted with both fluid-mobile element enrichments (e.g. Ba/Nb = 84 – 300) and a sediment melt component (e.g. $(La/Sm)_N$ = 1-2). These data suggest that the fluid flux into the mantle wedge has been broadly similar through the life of the arc system, however the mantle wedge has become more depleted and has had less of a sediment melt component added with time.

Insights into the Galápagos plume from uranium-series isotopes of recently erupted basalts

HEATHER K. HANDLEY[1], KIM BERLO[2], CHRISTOPH BEIER[3], SIMON TURNER[1] AND ALBERTO E. SAAL[4]

[1]GEMOC, Department of Earth and Planetary Sciences, Macquarie University, Sydney, NSW 2109, Australia.
[2]Department of Earth Sciences, University of Oxford, Oxford OX1 3PR, UK.
[3]GeoZentrum Nordbayern, Universität Erlangen-Nürnberg, Schlossgarten 5, D-91054 Erlangen, Germany.
[4]Department of Geological Sciences, Brown University Providence, Rhode Island 02912, United States.

Uranium-series isotopes (^{238}U-^{230}Th-^{226}Ra-^{210}Pb), major element, trace element and Sr-Nd isotopic data are presented for recent (< 60 years old) Galápagos archipelago basalts and are interpreted in terms of chemical fractionation by magmatic processes. Volcanic rocks from all centres (Fernandina, Cerro Azul, Sierra Negra and Wolf volcano) display ^{230}Th excesses (4-15%) and steep rare earth element patterns indicative of residual garnet during partial melting of the mantle source. Rare earth element (REE) modelling suggests that only a few percent of garnet is involved. Correlation between (^{238}U/^{232}Th), radiogenic isotopes and Nb/Zr ratio suggests that the U/Th ratio of Galápagos volcanic rocks is primarily controlled by geochemical source variation and not fractionation during partial melting. Unexpectedly, the lowest (^{230}Th/^{238}U) is not observed at Fernandina (supposed centre of the plume) but at Wolf volcano on the 'periphery' of the plume. Small radium excesses are observed for all samples with (^{226}Ra/^{230}Th) ranging from 1.107 to 1.614. ^{226}Ra-^{230}Th disequilibria do not correlate with other U-series parent-daughter nuclide pairs or geochemical data, suggesting modification at shallow levels on timescales relevant to the half-life of ^{226}Ra (1600 years). ^{226}Ra and ^{210}Pb excesses are inconsistent with interaction of magma with cumulate material unless decoupling of ^{210}Pb (or an intermediate daughter, such as ^{222}Rn) occurs prior to modification of Ra-Th disequilibria. The intriguing correlation of $(^{210}Pb/^{226}Ra)_0$ with Nb/Zr and radiogenic isotopes requires further investigation but may suggest possible control via magmatic degassing and accumulation related to source heterogeneities.