Hf, Sr, Nd and Pb isotopes in primitive Tongan lavas: Constraining mobility in slab fluids

C.W. DALE[1], C.G. MACPHERSON[1], D.G. PEARSON[1], G.M. NOWELL[1], S.J. HAMMOND[2] AND R.J. ARCULUS[3]

[1]Dept of Earth Sciences, Durham University, Durham, DH1 1LE, U.K. (christopher.dale@durham.ac.uk)
[2]Dept of Earth Sciences, CEPSAR, The Open University, Milton Keynes, MK7 6AA, U.K.
[3]Dept of Earth & Marine Sciences, Australian National University, ACT 0200, Australia

This study presents new Hf, Sr, Nd and Pb isotope data for a suite of glassy submarine basalts and basaltic andesites dredged from the Fonualei Rift zone and the Tongan arc north of Tongatapu.

The Tongan arc is a prime example of an intra-oceanic arc with a geochemical signature dominated by prior depletion of the mantle wedge and a slab-fluid input. Depletion of the mantle wedge is thought to increase northwards along-arc, and probably results from melt extraction during the opening of the Lau backarc basin. In addition, trace element and isotope compositions indicate that the northern extremity of the arc contains a contribution from volcaniclastic material derived from the subducted Louisville Ridge Seamount Chain, and possibly an input from 'Samoan-type' mantle.

Southern submarine volcanoes (south of Fonualei) have trace element characteristics (e.g. extremely high Ba/Th ratios) indicative of slab fluid being the major subduction flux along this part of the arc. Lower $^{143}Nd/^{144}Nd$, higher $^{206}Pb/^{204}Pb$ and elevated Ta/Nd in samples north of Fonualei are consistent with proposals by previous authors that these melts have a greater input from subducted volcaniclastic sediments or the Samoan plume (most likely the former on account of their ^{208}Pb-^{206}Pb systematics). However, the new sample suite permits better resolution on the spatial extent of such a signature. The volcaniclastic input (or plume influence) increases from the central Fonualei rifts northwards to the Mangatolu triple-junction and is greatest at volcano 'O', north of Tafahi.

Due to the depleted nature of the mantle wedge and the predominance of slab fluids along much of the arc, the new Hf data provide an ideal opportunity to re-evaluate the immobility of high field strength elements (HFSE) in subduction zone fluids.

Is Lichades the northern end of the Hellenic Volcanic Arc? Clues from helium isotopic composition in gases

W. D'ALESSANDRO[1], L. BRUSCA[1], K. KYRIAKOPOULOS[2]

[1]Istituto Nazionale di Geofisica e Vulcanologia, Palermo, Italy (w.dalessandro@pa.ingv.it)
[2]University of Athens, Greece (ckiriako@geol.uoa.gr)

The Hellenic Volcanic Arc (HVA) straddles across the Southern Aegean Sea. Its activity started in the late Pliocene and it comprises many volcanic systems most of which are considered active at present. The westernmost active volcanic systems is considered to be Methana, a peninsula in the Saronikos Gulf and remnants of Plio-Pleistocene volcanic activity are found at Sousaki, some tens of km further north, close to the isthmus of Corinth.

About 100 km further north, in the northern Evoikos Gulf, sparse trachy-andesitic volcanic rocks of Quaternary age crop out. The most important of these form the islet of Lichades. Although this volcanic system is generally considered to be due to back-arc extension, recently Papoulia *et al*. (2006), on the basis of seismological studies, consider it to be the most northern end of the HVA.

The area is also affected by distensive tectonic that formed a graben between the island of Evia and mainland Greece, limited on both sides by a series of important direct fault systems. Along these tectonic structures many thermal springs (water temperatures 40 - 90 °C) are found. Most of these are characterised by the presence of a CO_2-rich gas phase whose helium isotopic composition ranges from 0.06 to 1 R/R_a. The estimated mantle contribution, excluding the atmospheric component on the basis of the measured He/Ne ratio, ranges between 0.7 and 12 %, considering a mantle end-member of 8 R/R_a. The highest mantle contribution (4-12 %), found on both sides of the graben, close to the Lichades volcano at Kammena Vourla and Aedipsos, is well correlated with the crustal thinning observed by Makris *et al*. (2001).

Shimizu *et al*., (2005) observed that the highest R/R_a values measured in gas manifestations along the HVA decrease from about 6 to 0.4 in the north-western direction. A similar trend, observed in the volcanic systems of southern and central Italy (from 7.3 to 0.5 R/R_a in the north direction), is attributed to the progressive contamination of the mantle source with crustal material (Parello *et al*., 2000). The similar geologic history and the geographic closeness of the Greek region could suggest a similar process governing the trend of helium isotopic composition in the HVA. If this would be confirmed by further studies, the mantle contribution to the gases collected close to Lichades would be even greater.

References

Makris *et al*., (2001) *Tectonophys*. **341**, 225-236.
Papoulia *et al*., (2006) *Tectonophys*. **423**, 97-106.
Parello *et al*., (2000) *Earth Planet. Sci. Lett.* **180**, 325-339
Shimizu *et al*., (2005) *J. Volc. Geoth. Res.* **140**, 321-339.