Influence of slab composition on Th and REE in arc and back arc lavas: Subduction of Louisville Smts, Tonga

PETER J. MICHAEL[1]*, STÉPHANE ESCRIG[2], ANTOINE BÉZOS[3] AND CHARLES LANGMUIR[4]

[1]Dept. of Geosciences, Univ. Tulsa, 800 S. Tucker Dr., Tulsa, OK, 74104, USA (*correspondence: pjm@utulsa.edu)
[2]École Polytech. Féd. Lausanne, Lausanne, CH-1015, Switzerland stephane.escrig@epfl.ch
[3]Lab. Planet et Geodynamique, Univ. de Nantes, Nantes, France, Antoine.Bezos@univ-nantes.fr
[4]Dept. Earth & Planet Sci, Harvard Univ, Cambridge, MA, USA 0213 langmuir@eps.harvard.edu

The temperature of the subducted oceanic slab has been proposed to exert a major influence on the REE and Th content of subduction zone magmas *via* partitioning between slab fluids and stable, REE-rich phases like allanite [1,2]. We show that REE and Th in Tonga arc and back-arc lavas are also closely related to the composition of the slab that is being subducted. Valu Fa Ridge (VFR) and seamount lavas show spikes in $Th_{8.0}$, Th/La, Th/Ba and La/Sm at locations that are in line with the subducted Louisville Seamount Chain (LSC): at 22.7°S and 22.9°S respectively, while Tonga arc has elevated values near Ata island (22.34°S). The REE and Th enrichments are correlated with Pb, Sr and Nd isotopic variations that trend towards a LSC influence. (We differ from suggestions [3] that the enrichment around Ata I. is a local enrichment of the mantle wedge. The lack of Nb enrich-ment shows this is not the case). The spikes in Th and REE, and the change in Th/La and Th/Ba of subduction-related lavas is similar in magnitude to the along-trench changes in the composition of subducting altered oceanic crust (AOC), due to LSC [4,5]. The strong signal of LSC in VFR and Tonga arc indicates that Th and REE in slab fluids were not entirely modulated by temperature *via* allanite, and that AOC composition was also very influential. If slab geotherm-ometers using REE in lavas [2] are valid, the additional REE from LSC could result in overestimates of 50°C or more. The AOC-lava correlation also means that higher Th, Th/Ba etc. in lavas are not entirely reliable indicators of deep vs. shallow fluid input [6] or a sediment component. Also, significant Th may be mobilized by fluids from cold slabs.

[1] Klimm *et al* 2008 *J.Petrol,* **49**. [2] Plank *et al* 2009 *Nature Geosci* doi:10.1038/NGEO614. [3] Timm *et al* 2013 Nat.Comms. DOI: 10.1038/ncomms2702. [4] Castillo *et al* 2009 *Lithos* 112. [5] Beier *et al* 2011 *G-cubed 12*. [6] Pearce *et al* 2005 *G-cubed 6*.