Origin of low U/Th lavas at El Reventador Volcano, Ecuador

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Young arc lavas are often characterized by ($^{230}Th/^{238}U$) < 1 and high U/Th. These traits are typically interpreted as signs of recent fluid addition to the mantle wedge, since U is more fluid mobile than Th. However, some arc lavas have low U/Th, less than or equal to that of the mantle wedge, requiring sources and/or processes which lower U/Th of the magma.

To illustrate, we present U-series plus other isotopic and geochemical data from El Reventador, an active volcano in the Ecuadorian Andes. The lavas erupted between > 8 Ka and 2016. They are characterized by ($^{230}Th/^{238}U$) = 0.90-1.19, though most have ($^{230}Th/^{238}U$) < 1.1. U/Th = 0.305-0.388, less than that of the depleted mantle, which = 0.50-0.52 [1].

We investigate two possible models for generation of low U/Th in Reventador lavas. In the first model, addition of melted eclogite to the mantle results in primitive magmas with low U/Th [2]. This process is consistent with adakite-like compositions observed throughout the region. Alternatively, crustal assimilation could yeild low U/Th, since regional assimilants have low U/Th = 0.198, and $D_U > D_{Th}$ in areas of thick crust where garnet is present. This is supported by correlations between U/Th and isotope ratios such as $^{206}Pb/^{204}Pb$ and ε_{Nd}. While sediment has been shown to lower U/Th in some arcs [3], addition of a sediment melt would likely raise U/Th in the Reventador magmas, since the sediment is predominantly carbonate with high U/Th [4].

[1] Sims and Hart (2006). *EPSL* **245**, 743-761. [2] Kessel *et al.* (2005). *Nature* **437**, 724-727. [3] Reubi *et al.* (2014). *EPSL* **391**, 1349-1374. [4] Plank, (2005). *J. Petrol* **46,** 921-944.