Tracking the source of Cu, Ag and Au in intraoceanic Kermadec arc glasses, SW Pacific

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Although it has been long known that Au, Ag and Cu-rich mineralization preferably occur at convergent plate margins, we have yet to identify processes causing their enrichment beneath volcanic arcs. Glasses from the intraoceanic Kermadec arc front volcanoes, north of New Zealand, are ideal for studying these processes. Here we present major, trace element and Au, Ag and Cu metal data from volcanic glasses from 14 Kermadec arc front volcanoes that span the ~1300 km along the arc. These data reveal a notable increase in Nb/Yb (and Ce/Yb, La/Sm, Th/Yb) from <0.2 to >0.2 at ~32°S, which correlates with the steepening and shortening of the subducting Pacific slab. Although generally higher than that in mid ocean ridge basalts, Cu, Ag, Au and S contents in moderately mafic glasses (Mg#>30) remain generally similar all along the arc. High Cu (>233 ppm), Ag (>49 ppb) and Au (up to 15 ppb), but relatively low S (<74 ppm) contents and Nb/Yb are, however, found in basaltic andesitic glasses from Putoto (northern Kermadec Arc) and Tangaroa (southern Kermadec Arc). Thus we suggest that the mantle beneath these volcanoes underwent high-degree partial melting or experienced greater previous melt extraction (e.g., through crust formation in the back-arc). High temperatures required to form high-degree melts or to re-melt a depleted sub-arc mantle, may also melt mantle-hosted sulfides. This, together with slab-derived mantle metasomatism via fluids may help to release Cu, Ag and Au to be incorporated into partial melts before their ascent to the seafloor.