Thallium isotope compositions of subducted eclogites: constrains on the origin of ocean island basalts

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Thallium (Tl) isotope compositions of ocean island basalts (OIBs) have been proposed as a novel tracer of subducted oceanic crust and sediments in OIB sources[1,2,3]. In order to further investigate if deep mantle recycling eventually resurfaces through mantle upwelling to form OIB magmatism, we need to know if oceanic crust that went through an active subduction zone retains the Tl isotope compositions recorded in hydrothermally altered oceanic crust and authigenic pelagic sediments. We measured samples of subducted oceanic crust from five different locations: Zambezi Belt, Zambia; Cabo Ortegal complex, Spain; Raspas Complex, southwest Ecuador; Syros island, Greece; Tian Shan, northwest China. Samples from Cabo Ortegal and Raspas Complex exhibit Tl isotope compositions similar to their protoliths, which are low-temperature altered oceanic crust. Tian Shan and Zambian samples have invariant Tl isotope values that are identical to upper mantle and suggest metasomatic overprint by metamorphic fluids. Syros samples display Tl isotope compositions similar to or heavier than upper mantle, which likely arose from metasomatic fluids derived from surrounding mélange matrix that are known to contain metasediments. Each of the three Tl isotope ranges observed for subducted oceanic crust samples here are mirrored by individual OIB locations. Cabo Ortegal and Raspas Complex samples display Tl isotope compositions indistinguishable from St. Helena, which suggests that the HIMU component likely comprises subduction modified low-temperature altered oceanic crust. Zambia and Tian Shan samples have Tl isotope values identical to Iceland lavas, whereas Syros samples overlap with Hawaiian lavas. Therefore, our data support a conclusion whereby Tl isotope compositions of oceanic crust and sediments can be traced through the subduction process and eventually is expressed largely unmodified in OIBs.

[1] Blusztajn et al., 2018 Chem. Geol. 476, 292-301
[2] Nielsen et al.,2007 Earth Planet. Sci. Lett.264,332-345
[3] Nielsen et al., 2006 Nature, 439, 314-31