Using thallium isotopes to trace slab fluxes in the Aleutian arc

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Large uncertainties exist regarding the amount of subducted slab material that is discharged into the mantle wedge and how these fluxes contribute dynamically and chemically to arc volcanism. In particular, it is interesting that sediment subduction is almost ubiquitous while many arc sections appear to have attenuated or almost absent sediment signatures. Other arcs have been inferred to carry strong chemical signatures from altered ocean crust, even though sediment subduction is clearly taking place.

The novel stable isotope system of the element thallium (Tl) has been proposed as a tracer for contributions of pelagic sediments and oceanic crust altered at low temperature from the subducting plate to the mantle wedge [1, 2]. The Tl isotope system is unique because the mantle is isotopically homogenous and depleted in Tl, whereas pelagic sediments and altered oceanic crust are enriched in Tl by several orders of magnitude and exhibit highly fractionated Tl isotope compositions [1, 2]. Thallium isotopes are, therefore, potentially suited to determine distinctive slab fluxes contributing to arc lavas.

We have measured Tl isotope compositions and concentrations for a suite of mainly basaltic lavas from the Aleutian arc [3]. Thallium isotope compositions form a positive trend with Sr/Y ratios whereby higher Sr/Y ratios are associated with Tl isotope compositions that are heavier than upper mantle. High Sr/Y has been interpreted as a signature of ocean crust melting [4], whereas heavy Tl isotope compositions almost exclusively are associated with ferromanganese marine sediments [2]. It is, therefore, unclear what the origin of this correlation is.

The present data set does not include adakites with extremely high Sr/Y from Adak Island, the type locality for the proposed ocean crust melts [4]. We will present further analyses of Tl isotopes for adakites in order to investigate the origin of Tl isotope variation in the Aleutians and their relation to slab fluxes.

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