Experimental insights into slab-mantle interactions in subduction zones: melting of adakite-metasomatized peridotite and the origin of the "arc signature"

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We have examined experimentally mass transfer processes from the slab to the mantle wedge under circumstances in which the agent of metasomatic exchange is a hydrous melt (i.e., adakite). When the ratio of adakite melt to peridotite is very low, cryptic metasomatism of the mantle wedge occurs, whereas at higher melt:rock ratios (~25-30% adakite), the mantle wedge is modally metasomatized, with amphibole forming at the expense of original olivine in the peridotite. Low-degree melting of cryptically metasomatized peridotite from the Kamchatkan sub-arc mantle at 1.6 GPa and 1100°C produces andesitic liquid (57-58 wt% SiO_2, Mg# = 0.64) possessing the key geochemical characteristics of the 'arc signature', as measured by ion microprobe (see below). Similarly, liquids in equilibrium with amphibole-bearing pyroxenites (high melt:rock ratios) at the same P-T conditions also possess this same geochemical fingerprint. This suggersts that the 'arc signature' is effectively preserved and transferred during mantle metasomatism and that primary magmas derived from such a hybrid source, resembling high-magnesian andesites (HMAs), can be produced over a broad range of conditions by melting of peridotite that has been cryprtically or modally metasomatized by slab-derived adakitic liquids.