Petrogenesis of alkaline arc basaltic andesites at Volcan Chichinautzin in the central Mexican Volcanic Belt

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In order to study the processes of melt differentiation unique to orogenic andesites, we investigated a co-genetic series of mildly alkaline arc basaltic andesites (53-57 wt% SiO_2) from the monogenetic Chichinautzin volcano in the central Mexican Volcanic Belt (MVB). The Chichinautzin magmas have end member character in the MVB, being highly enriched (e.g. Nb =21-36 ppm) and displaying moderate fractionation typical of subduction zone magmas (e.g. Ce/Pb =9-12; Nb/La =0.7-0.9). This signature indicates melt origin from a subarc mantle that has been influenced by components from the subducting slab.

Major and trace elements form coherent trends in Harker-type diagrams. Silica increases with time, concurrent with the development of an incipient arc signature in the youngest melts (e.g. Nb/U decreases from 35 to 20). The Sr and Nd isotope ratios are strongly and inversely correlated with each other, but are uncorrelated with silica. While Sr and Nd isotopes of the earliest melts overlap with subarc mantle compositions, the subsequent lavas are first isotopically more evolved. However, the youngest, most siliceous and most fractionated melts have the most primitive isotope ratios.

The isotopic variability precludes fractional crystallization as primary cause of melt differentiation, and constrains source heterogeneity. The data cannot be reconciled with a binary mixing model of primitive mantle melts with components from the upper plate crust. We propose that the Sr and Nd budget of the mantle source is controlled by a highly enriched, Sr- and Nd- carrying slab component, and that the temporal evolution reflects the progressive change from a sediment-richer slab component to a component with larger relative contributions from the subducting basaltic crust. Ni-rich olivines suggest that the mantle metasomatism was coupled with the formation an olivine-free pyroxenite source lithology that produces primary siliceous arc melts that pass the ~40-47 km thick arc crust almost unchanged.

Complex crustal assembly of ‘Mt. Shasta’ High-Mg Andesite (HMA): Evidence from mineral componentry

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HMA lava from Whaleback shield volcano (N. flank of Mt. Shasta) has been proposed as a primitive mantle-derived magma. In contrast, Streck *et al.* [1] showed this rock to be a mixture of disequilibrium minerals and ultramafic xenocrysts in a hybrid andesitic matrix. To further evaluate the hybrid character of this lava, EMP and LA-ICPMS analyses and BSE images were used to characterize the phenocrysts and quantitatively map their distribution in a single thin section.

Half of larger pyroxene crystals (> 200 µm; N= 190) contain cores with Mg# (60-75) consistent with growth from ~dacitic, liquids, 37% show distinct resorption or patchy zoning features indicative of xenocrystic origin, and the rest consist of cpx or opx crystals (Mg# = 80-90) compatible with derivation from basaltic magma(s). The microphenocryst population (< 200 µm, N=105) contains the same mineral types. Volumetrically dominant ‘dacitic’ and xenocrystic minerals clearly grew prior to the mixing event that produced HMA magma whereas overgrowth rims & ~40% of micophenocrysts formed later, probably shortly before eruption. Anhedral and overly large Fo_{92-94} olivines also are interpreted as xenocrystic, whereas smaller skeletal Fo_{87} olivines grew rapidly from hybrid melt.

Cpx trace element contents vary systematically with Mg#. Elevated REE contents and negative Eu anomalies seen in evolved (Mg# 66-75) cpx are indicative of growth from fractionated silicic melts. Intermediate Mg# cpx have lower REE abundances whereas Mg#87 cpx have the lowest REE concentrations (with strongly upward convex REE patterns) and lower La/Sm than intermediate Mg# cpx. Maximum La/Sm, La/Yb, or Sr (i.e., strongest ‘adakitic’ signature) are seen in intermediate composition (~Mg#80) cpx. Other trace elements, such as Y, Zr, and Sc, correlate with decreasing Mg# leading to a Sr/Y range from 8 to 2. However, if Sr/Y is corrected for increased partition of Y into cpx of silicic vs. mafic melts, Sr/Y variations in the melt are minimized or even reversed. Therefore, there is no clear indication that HMA liquid in equilibriutm with highest Mg# of observed mafic silicates ever existed at Mt. Shasta prior mixing. A direct mantle origin is doubtful.

[1] Streck *et al.* (2007) *Geology* **37**, 351.