Continental crust as a source component for NW Central American Arc lavas?

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Our group evaluates along and across arc geochemical variations from various volcanoes and volcanic centres in the NW Central American Volcanic Arc from NW Nicaragua to Guatemala. Additional data from several Guatemalan continental crust samples as well as Cocos Plate sediments help to clarify the potential endmember compositions for the observed trends.

Subduction input from the subducting Cocos Plate consists of carbonate to hemipelagic sediments, seawater altered and unaltered igneous crust and serpentinites. Slab dip decreases while the thickness of the continental crust increases beneath the volcanic front (VF) from a maximum in central Nicaragua to NW Guatemala. Continental crustal thickness also increases behind the VF.

Our comprehensive geochemical data set consists of major elements, a wide variety of trace elements and Sr-Nd-Pb-Hf-O isotope data. As shown previously by the Carr group, ratios of fluid mobile to less fluid mobile elements (e.g. Ba/La, Ba/Th and U/Th) decrease and Pb isotope ratios increase systematically from Nicaragua to Guatemala. The $^{143}Nd/^{144}Nd$ and $^{176}Hf/^{177}Hf$ isotope ratios decrease systematically from Nicaragua to Guatemala. These geochemical variations suggest a decreasing role for a hydrous fluid component and an increasing role for a sediment or continental crustal melt component in volcanic rocks towards Guatemala (NW) along the VF and behind the volcanic front (BVF). Samples from the back arc in Honduras have the most mid-ocean-ridge basalt (MORB) like compositions and are believed to represent the composition of the mantle wedge. Samples from the Nicaraguan VF have similar Nd but higher Sr isotope compositions most likely reflecting enrichment with slab derived fluids containing a subducted sediment or seawater Sr component.

A positive correlation in $^{206}Pb/^{204}Pb$ vs. $^{207}Pb/^{204}Pb$ isotope ratios for VF and BVF volcanic rock samples from El Salvador and Guatemala trends towards the granitic basement in Guatemala. Combined εNd vs εHf isotope data for VF and BVF samples from Nicaragua to Guatemala tend from high εNd and εHf MORB like compositions towards continental crust like compositions with increasingly lower εNd and εHf values. Supplementary εNd vs εHf isotope data from Guatemalan continental crust and Cocos Plate sediment samples provide further support for a continental crustal component in the generation of the NW CAVA magmas.

Melt/wallrock interaction shown by silicate melt inclusions in peridotite xenoliths from Pannonian Basin

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Samples

Primary silicate melt inclusions (SMI) in clinopyroxene (cpx) rims and secondary ones in orthopyroxenes (opx) along healed fractures from two equigranular amphibole-bearing spinel lherzolite xenoliths representing the subcontinental lithospheric mantle (Szigliget, Pannonian Basin, Hungary) have been studied. Microthermometry of dense CO_2-bearing fluid inclusions, associated with SMI, was also carried out.

Discussion

Electron microprobe analysis reveals in both xenoliths that cpx and opx are zoned, especially in terms of basaltic major elements. Cores of both cpxs show trace element distribution close to the primitive mantle. Rims display an overall enrichment with high positive anomalies in Th, U and moderate LREE content, as an indication for metasomatism. The pargasitic amphiboles, formed after rims of the cpx, exhibit elevated Rb, Ba, Nb, Ta and moderate LREE content. The SMI are composed mostly of silicate glass and dense CO_2 bubble. The primary SMI show evidence for significant crystallization on the wall of the host cpx. The major element composition of glass in SMI, regardless of xenoliths and host minerals, covers a wide range, mostly with trachyandesitic composition. The SMI, either primary or secondary ones, are extremely enriched in incompatible elements (particularly in U, Th, La, Zr) with a slight negative Hf anomaly.

Conclusion

The development of zoned pyroxenes, and the trapping of primary SMI in the cpx rims happened after the partial melting and subsequent crystallization of cpxs, most probably due to an interaction between a hot volatile-rich mafic melt and mantle wallrock. This interaction resulted in evolved silicate melts, which filled microfractures in opxs, leading to the formation of secondary SMI and, via metasomatism, the development of zoned pyroxenes. Most probably the formation of amphiboles is not related to this evolution.