Using Trace Elements in Olivine Phenocrysts to Test Models of Melt Differentiation at Convergent Margins: Constraints from Times Series in Monogenetic Volcanoes in the Central Transmexican Volcanic Belt

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Models of subduction zone magmatism ascribe the andesitic composition of arc magmas to crustal processes, such as crustal assimilation and/or fractional crystallization, that basaltic mantle melts experience during their ascent through the upper plate crust. However, results from time series study of olivine-phyric high-Nb basalts and basaltic andesites from two monogenetic arc volcanoes (V. Chichinautzin and Texcal Flow) that are constructed on the ~45 km thick continental basement of the central Transmexican Volcanic Belt (TMVB) are inconsistent with this model. Instead, ratios of radiogenic isotope and incompatible trace elements suggest that these volcanoes were constructed through multiple individual melt batches ascending from a progressively changing mantle source. Moreover, the high Ni contents of the olivine phenocrysts, together with their high mantle-like $^{3}He/^{4}He$ =7-8 R_a with high crustal $\delta^{18}O$ oliv = +5.5 to +6.5‰ (n=12) point to the presence of secondary 'reaction pyroxenites' in the mantle source that create primary silicic arc magmas through melt-rock reaction processes in the mantle. Here we present additional trace element concentration of the high-Ni olivines by electron microprobe (Mn, Ca) and laser-ablation ICPMS (Li, Cr and V) analysis in order to test this model. Olivine Li (2-7 ppm) and Mn (1170- 2810 ppm) increase with decreasing forsterite ($Fo_{88.7}$ to $Fo_{74.9}$), while Cr (29-364 ppm), V (4-11 ppm) and Ca (825-2390 ppm) decrease. Quantitative modeling shows that these trends in their entirety cannot be controlled by fractional crystallization under variable melt water H2O or oxygen fugacity (fO2), or cocrystallization of Cr-spinel. Instead, the variations support the existence of compositionally distinct melt batches during earliest melt evolution. Moreover, the trace element trends are qualitatively consistent with a model of progressive source depletion by serial melting (shown in olivine Ca, V and Cr) that is triggered by the repetitive addition of silicic slab components (shown by olivine Li). These findings suggest mantle source variations are not eliminated despite the thick crust these magmas pass during ascent.