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# Global trends in silica (and other major element) abundances among high-Mg# arc-front stratovolcanoes

**STEPHEN J TURNER**, SARAH JUSTUS, ALEXANDER HAMMERSTROM AND KELLY BRIGHAM

University of Massachusetts Amherst

Presenting Author: stephenjudsonturner@gmail.com

Systematic global variations in both major [1,2] and trace element [3,4] compositions of convergent margin lavas are well established. Compared to oceanic arc lavas, continental arc lavas are enrichened in incompatible elements and $SiO_2$ and depleted in MgO, FeO, and CaO. Individual volcanoes that do not accord with this general trend are usually associated with intra-arc rifting or subducting ridges or fracture zones, etc. There is little question that continental magmas are more susceptible to crustal contamination, that most have differentiated more extensively, or that that arc lavas are generally disequilibrium assemblages of melts and crystals from various sources. It is notable, however, that compositional offsets between continental and oceanic arcs persist to high Mg#s that near equilibrium with mantle olivine. Though magma mixing and polybaric fractionation are the norm in continental arcs, prior studies [1,3,4], have demonstrated that it is difficult to account for global arc compositional trends by these processes. Multiple lines of evidence support a mantle origin for high-Mg# continental arc lava incompatible element enrichment, which may arise in part due to lower extents of mantle melting that result from the colder and higher-pressure wedge thermal structure beneath continents [3]. Here, we re-evaluate the scarce high-Mg# lavas that have erupted from the main edifices of continental arc-front stratovolcanoes and find that they are ubiquitously enriched in $SiO_2$ and depleted in CaO and MgO. Magma mixing or olivine accumulation can (and probably do) produce some high-Mg# andesites, though correlations between major and trace elements in these arc samples are suggestive of a deeper origin. An empirically calibrated melting model shows how the deep, low degree melts expected in continental arcs, which will be enriched in alkalis and $H_2O$, might later re-equilibrate with shallower peridotite to produce high primary $SiO_2$ (e.g., [5]). If this process is common in continental arcs, there are clear implications for the growth of the continental crust.

[1]Plank and Langmuir (1988), EPSL 90 349-370 [2]Farner and Lee (2017), EPSL 470 96-107 [3]Turner et al. (2016), Nature Geoscience 9, 772–776 [4]Turner and Langmuir (2022), Journal of Petrology [5]Wood and Turner (2009), EPSL 283 59–66