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Large Geochemical Datasets Applied to the Study of Continental Volcanism

G. LANG FARMER[1] AND MOUSUMI ROY[2]

[1]University of Colorado Boulder
[2]University of New Mexico
Presenting Author: lang.farmer@colorado.edu

Online volcanic geochemical databases (GEOROC, PetDB, NAVDAT) and published large data compilations [1] now allow regional space-time-compositions patterns in continental volcanic provinces to be easily investigated. In Southwest North America (SWNA) a regional analysis demonstrates that Cenozoic, small volume, "post-subduction", mafic to intermediate volcanic rocks such as "SCORBA" (Southern Cordillera Basaltic Andesites) and bajaites, all share sources in continental lithospheric mantle (CLM) that was refrigerated and metasomatized during Late Cretaceous and younger subduction of oceanic lithosphere beneath the continent. Collectively, these rocks are recognizable because even the most mafic (> 6 wt. % MgO) rocks show significantly higher mean concentrations and higher variances for aqueous fluid mobile elements (large ion lithophile elements, such as Rb, Sr, Ba, Pb), and more variable HFSE ratios (e.g. Ta/Th; Fig. 1), than primary mafic volcanic rocks in either island arcs (IAB) or oceanic islands (OIB). These characteristics are best attributed to variable loading of CLM in aqueous fluid mobile elements during active subduction when fluids ascended and froze in the CLM. The trace element heterogeneity was inherited by small volume mafic melts produced diachronously across SWNA as the base of the CLM was exposed to upwelling asthenosphere after subduction ceased in the mid-Cenozoic. A regional approach to identifying mafic volcanic rocks derived from metasomatized CLM can be applied to any "post-orogenic" volcanic province worldwide. In southern Tibet, small volume, Oligocene and younger, high-K mafic volcanism is widespread and attributed to melting of metasomatized Asian CLM after the collision of Asia and India continents at ~50Ma. Mafic to intermediate composition volcanic rocks have high mean abundances and high variances for not only the LILE but also for fluid immobile LREE and Th (Fig.2). The latter observation is consistent with the hypothesis that metasomatism of the Asian CLM involved silicic melts of subducted crustal material originally derived from the Precambrian Indian subcontinent.

[1] Yakovlev et. al. (2019), *Earth and Planetary Science Letters* 520, 115-126

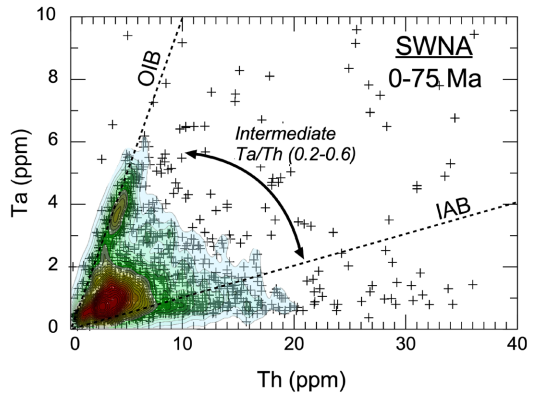

Fig. 1**- Whole rock [Ta] vs. [Th] for Late Cretaceous and younger volcanic rocks from 45-65 wt % SiO_2 in southwestern North America. Colored area is 2-D histogram of entire data set (n~2,100). Intermediate Ta/Th (0.2 to 0.6) are common in <40 Ma rocks but rare in oceanic settings and likely represent melting of CLM metasomatized by slab-related **aqueous fluids.

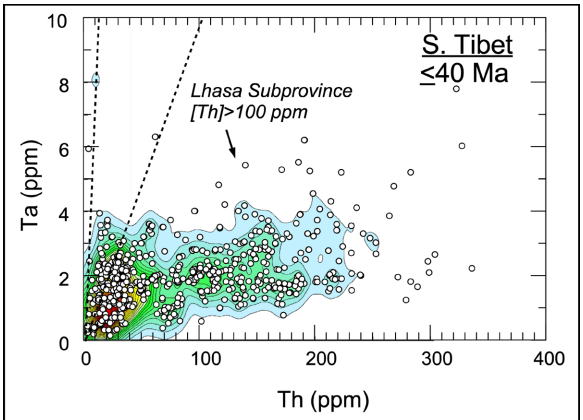

***Fig. 2**- Whole rock [Ta] vs. [Th] for < 40 volcanic rocks from 45-65 wt % SiO_2 in southern Tibet. Colored area is 2-D histogram of entire data set (n~900). High-K, high [Th] rocks in Lhasa subprovince likely derived from CLM source metasomatized by **silicic melts**.*