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Lower Crustal Melt Genesis Following Slab Rollback: Insights from Melt Inclusions within Lower Crustal Granulite Xenoliths of the Geronimo Volcanic Field, SE Arizona.

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Rare silicate melt inclusions (MI) preserved in granulites and migmatites provide insights into anatectic processes within the lower crust. Pleistocene-age volcanics of the Geronimo Volcanic Field (GVF), SE Arizona, have entrained quartzofeldspathic orthogneiss and metadioritic granulite xenoliths that preserve such MI [1]. Consequently, the MIs present the unique opportunity to investigate melting processes that have shaped the crust of the southern Basin and Range. U-Pb zircon ages obtained from GVF xenoliths exhibit peaks at ~1.65 Ga, ~1.48 – 1.42 Ga, and 35 – 23 Ma [2]. These ages are interpreted to reflect accretion of the Mazatzal province to the North American craton, modification during the Picuris orogeny ca. 1.4 Ga, and further modification during Farallon shallow-slab rollback, respectively. Due to the nature of MI preservation, we interpret the thermal event associated with their formation to be related to Farallon slab rollback, but the mechanism by which they formed remains uncertain.

The GVF MI range in size from 5-30 μm and are more abundant in metadioritic than quartzofeldspathic xenoliths. Although MI shape can vary, they are generally ellipsoidal and consist of a quartz core completely encircled by a glassy rim. SiO_2 contents of MI rim glasses average ~75 wt%, similar to some high SiO_2 rhyolitic ignimbrites from the adjacent Eocene-Oligocene Boot Heel Volcanic Field [3]. Preliminary thermodynamic modeling in the NKCFMASHTOCr system using MAGEMin [4] suggests that such a composition cannot be generated through water-fluxed anatexis of the lower crustal metadiorites, as the silicate liquid in equilibrium with metadiorite mineralogy at lower crustal P-T conditions has lower SiO_2 (~67 wt%). In this presentation, we will report results from electron microprobe major element analyses, preliminary trace element data, and thermodynamic modeling of melting processes in the lower crust to confirm the mechanism behind the formation of the GVF MIs.

[1] Kempton et al., 1990, GCA v. 54; [2] Rader, 2021, MSc thesis, KSU; [3] McIntosh and Bryan, 2000, NMGS Guidebook; [4] Riel et al., 2022, Geochemistry, Geophysics, Geosystems v. 23.