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U-Pb Zircon Ages from K-feldspar Megacrysts Track Extent of Magma Mixing in the Tuolumne Intrusive Complex

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The spatial extent of mixing between separately emplaced batches of magma is a key component in understanding the incremental assembly of plutons. Potassium feldspar megacrysts (>3 cm length) in granitic rocks are hypothesized to record magma mixing and transport over hundred kyr timescales. In the Tuolumne Intrusive Complex (TIC), CA, dates from zircon inclusions within a single megacryst sample were used to estimate megacryst growth over ~500 kyr [1]. Chambers et al. interpreted it to have been transported between the porphyritic Half-Dome (pHD) magmatic unit into the ca. 0.5-3 km transitional contact with the Cathedral Peak (CP) subunit [1]. This has important implications about durations of magma mobility, and the extent and degree to which magmatic units were able to interact along contacts.

In this study, we build on those results by using ID-TIMS U-Pb ages, trace elements, and hafnium isotopes of zircon included in the cores and rims of multiple megacrysts, as well as the surrounding groundmass, from the pHD, the CP, and the transition zone between them to determine (1) if megacrysts from the TIC consistently grew over hundreds of kyr timescales, and (2) if the megacrysts record evidence of magma transport or mixing between the subunits. We find that the apparent growth durations of the megacrysts collected within the pHD-CP transition are highly variable, with some demonstrating protracted growth on the 100-kyr timescale and others with indistinguishable zircon age ranges between core and rim. This points to dynamic evolution of zircon cargo in the magma over the course of feldspar crystallization.

These results suggest that extended growth periods may not be required to generate the megacrystic size of K-feldspars, and that the growth histories and mechanisms of megacrysts within the same magmatic system are not necessarily uniform. Some megacryst ages from the transitional zone are consistent with transport from the pHD, but others are not. These data can be compared to the existing models for magma mixing in the TIC to assess the spatial extent of magma mixing between the pHD and the CP.

[1] Chambers, Memeti, Eddy, & Schoene (2020), *Geology* 48:4, 400-404.