$\delta^{94/90}$Zr variations in granites

H.M. KIRKPATRICK,[1] T.M. HARRISON,[1] M.-C. LIU,[1] E.A BELL,[1] F.L.H. TISSOT,[2] & M. IBAÑEZ-MEIJA[3]

[1]EPSS,UCLA, Los Angeles, CA 90095; hmkucla@gmail.com
[2]The Isotoparium, GPS Div., Caltech, Pasadena, CA, 91125
[3]EES, University of Rochester, Rochester, NY, 14627

Zr and other non-traditional stable isotope systems have the potential to reveal new information about magmatic processes. Recently, investigations of mass-dependent effects in igneous samples have revealed significant $\delta^{94/90}$Zr variability at both the mineral [1] and bulk-rock scales [2], indicating that Zr isotopes may be tracers of magmatic differentiation. As expected, single minerals show larger isotope effects than bulk rocks. More surprisingly, zircon-melt fractionation factors of opposite signs are derived from these two studies. Indeed, the bulk analyses of Hekla volcanic rocks (Iceland) [2] exhibit a positive correlation between $\delta^{94/90}$Zr and whole rock SiO_2 for rocks above zircon saturation, which the authors concluded was due to zircon crystallization and removal with $\Delta_{zircon-melt}$ = -0.5 ‰. In constrast, measurements of 42 individual zircon grains from a Duluth Complex anorthosite (MN) [1] documented >5 permil variations in $\delta^{94/90}$Zr, consistent with Rayleigh-type removal of isotopically heavy zircon with $\Delta_{zircon-melt}$ ~= +1 ‰.

To more fully understand the relationship between whole rock chemistry and intragrain variations, we undertook $\delta^{94/90}$Zr measurements on zircons within a zoned pluton. Six samples of the La Posta Pluton (CA), ranging in composition from hornblende-biotite tonalite to muscovite-biotite granodiorite (~64 to ~74 wt% SiO_2; [3]), along with a sample of the Cuyamaca gabbro cumulate (41.5 wt% SiO_2), were collected for MC-ICP-MS and SIMS analyses. Zr isotope measurement of whole rocks, single zircons, and hornblende crystals as well as in-situ trace elements in zircon are underway. We will compare the measured $\delta^{94/90}$Zr to indices of magmatic evolution such as whole rock SiO_2 and in-situ Th and U as well as other trace elements in zircon to better understand the relationships between Zr stable isotope variability and magmatic evolution.

[1] Ibanez-Meija and Tissot (2019) *Sci. Adv.*, **5**, eaax8648; [2] Inglis et al. (2019) *Geochim Cosmochim Acta* **250**, 311; [3] Clickenbeard and Walawender (1989) *Amer Miner* **74**, 1258