Titanite petrochronology in the Fish Canyon Tuff

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The petrologic complexity of the archtypical 'monotonous intermediate' Fish Canyon Tuff (FCT) has been previously established by a variety of mineralogical and geochemical proxies [1-2], and the unusual storage and eruptive dynamics of the FCT have been delineated by several geochronological studies [3-5]. Titanite is an apparent equilibrium phase in the penultimate FCT magma, and can be linked petrographically to hornblende crystals that preserve up-temperature core-to-rim zoning profiles. As a reactive, trace element-rich phase, we hypothesized that titanite may record an intracrystalline record of magma chamber dynamics. Titanite crystals from the same separate analyzed in [4] were oriented and doubly-polished to yield characteristic wedge-shaped cross-sectional wafers approximately 300 μm in thickness. BSE imaging guided LA-ICPMS analyses of a full suite of trace elements using a 25 μm beam diameter and crater depth on multiple locations across both sides of the wafer.

Most titanite crystals are characterized by large variations in trace elements, including at least two generations of REE-enriched, actinide-poor, low Sr, large Eu anomaly cores overgrown by REE-depleted, actinide-rich, high Sr domains with small Eu anomalies and distinctive concave-up middle to heavy REE patterns. Trace element contents and patterns correlate strongly with Eu anomaly; intermediate compositions are abundant and spatially correlated to reaction zones between core and rim domains.

Within the context of the batholithic rejuvenation model for the FCT magma [1-2], these trace element variations are interpreted to record the partial melting of a differentiated crystalline FCT precursor and its hybridization with a more 'mafic' flux. ID-TIMS dating of end-member titanites confirm older ages (*ca* 28.4 to 29.0 Ma) for cores and define a younger age for rejuvenation of *ca* 28.2 Ma, consistent with recent U-Pb zircon and ^{40}Ar/^{39}Ar studies [5-7].

[1] Bachmann & Dungan (2002) *American Mineralogist* **87**, 1062–1076. [2] Bachmann, Dungan & Lipman (2002) *Journal of Petrology* **43**, 1469–1503. [3] Bachmann *et al* (2007) *Chemical Geology* **236**, 134–166. [4] Schmitz & Bowring (2001) *Geochimica et Cosmochimica Acta* **65**, 2571–2587. [5] Wotzlaw *et al* (2013) *Geology* **41**, 867–870. [6] Rivera *et al* (2011) *Earth and Planetary Science Letters* **311**, 420–426. [7] Kuiper *et al* (2008) *Science* **320**, 500–504.