U-Th-Pb systematics of Bishop Tuff zircon

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The geochronology of the Bishop Tuff has been studied for decades. It is closely tied to the numerical date of the Brunhes-Matuyama boundary, it's a template for the determination of timescales of magma-chamber growth, and, more recently, it has become a common reference point for the calibration of the ^{40}Ar-^{39}Ar technique and the inter-calibration of K-Ar and U-Pb systems. Here, we present new U-Pb and U-Th-Pb measurements by TIMS and SIMS (*SHRIMP II*), as well as new EPMA transects through time-equivalent sector zones. Our new TIMS dates are indisinguishable from previously published work[1]. Our SIMS dates are consistent with recently published SHRIMP-RG results[2], and show no evidence for the ~ 100 ka residence times indicated by older SIMS data[3].

We demonstrate the presence of 10's of ka of variability, even within individual grains. This implies that many dates (particularly bulk analyses) must be mixtures of zircon with different ^{206}Pb/^{238}U. In turn, this suggests that assumptions (often implicit) in the calculation of weighted-mean dates – for both bulk and microbeam techniques – may require careful evaluation for suites of zircon like these. Futhermore, a careful comparison of the Th/U systematics of zircon with glass from the Bishop Tuff seems to suggest that either they evolve along separate liquid lines of descent, or element partitioning varies. This has important petrological implications for the interpretation of zircon trace elements in this magmatic system and elsewhere. This evidence, plus strong crystal-face dependent trace element uptake, suggests that current models for ^{230}Th-deficit correction (~90 ka) can't achieve 1 ka-scale geochronology. We outline some alternative models that may provide accurate, if not precise, corrections. We also describe overlooked complications with SIMS data treatment that will increase published SIMS Bishop Tuff zircon dates by 7-8 ka.

[1] Crowley *et al* (2007) *Geology* **35** 1123-1126 [2] Chamberlain *et al* (2014) *J.Pet.* **55** 395-426 [3] Simon and Reid (2005) *EPSL* **235** 123-140