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The behavior of Ti isotopes during continental batholith construction: insights from whole rock and mineral separates of the Tuolumne Intrusive Complex

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Stable isotopes of titanium (Ti) are fractionated during magmatic differentiation, resulting in the enrichment of heavy Ti isotopes in evolved melts [1]. The magnitude of Ti isotope fractionation during magmatic differentiation varies between different magmatic series [2]. Differences in redox conditions and melt chemistry, and therefore mineralogy, are interpreted to control the magnitude of Ti isotope fractionation during magmatic differentiation [2, 3]. While several studies have used Ti isotopes to interpret geodynamic processes such as continental crust production, few have evaluated the magmatic P-T-X conditions and mineralogical controls of Ti isotope fractionation during plutonism and continental batholith construction.

Here, we investigate the geochemical and Ti isotopic systematics of whole rocks and minerals from the Tuolumne Intrusive Complex (TIC) of the Sierra Nevada batholith in eastern California, USA. The TIC is a calc-alkaline batholith formed over a subduction zone, which represents the primary setting where new continental crust is produced. Five whole rock samples ranging from gabbro (50 wt. % SiO_2) to granite (75 wt. % SiO_2) and Ti-bearing minerals from each rock including titanite, amphibole, biotite, and magnetite, have been digested and spiked with a $^{47}Ti/^{49}Ti$ double spike and processed through Ti chemistry [4]. Ti isotopes of whole rocks and mineral separates are being analyzed by MC-ICP-MS. The geochemistry of minerals (e.g., Zr-in-titanite, Al-in-hornblende) from these rock samples suggest crystallization temperatures and pressures in the range of 685 to 760 °C at 2–3 kbar. We also note that the oxide phase (magnetite) of these rocks is Ti-poor, and that silicates (titanite, amphibole, and biotite) dominate the Ti budget of rock samples from the TIC. We aim to provide insights into the behavior of Ti isotopes in upper-crustal plutons during continental crust production and to evaluate the role of silicate minerals on Ti isotope fractionation during magmatic differentiation.

[1] Millet et al., (2016), *EPSL* 449, 197–205.
[2] Hoare et al., (2020), *GCA* 282, 38–54.
[3] Johnson et al., (2023), GCA 355. 1–12.
[4] Millet & Dauphas, (2014), *JAAS* 29, 1444–1458.