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Titanium isotopic composition of the Archean mantle

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The commonly held view is that refractory elements (e.g., Ti, Zr, etc) were completely condensed during cooling of solar nebula gas, such that all planetary materials have uniform stable isotopic fractionation for those elements. Accordingly, the only processes that could have fractionated those elements are associated with planetary differentiation. Titanium is particularly well suited to test the assumption that no stable isotopic fractionation should be present at a bulk planetary scales and that magmatic differentiation can be the sole culprit for any stable isotopic fractionation found. Indeed, Ti has relatively simple redox chemistry, is highly lithophile, and its isotopic composition can be measured precisely. Mass-dependent titanium isotopic fractionation has been measured in labs across the world [1-3] for over a decade, yet controversy persists as to the titanium isotopic composition of the Bulk Earth, chondrites, and whether the composition of the mantle evolved though time.

Initial studies of mass-dependent titanium isotope compositions in bulk chondrites have been found to be identical to Earth supporting the view that mass-dependent variations in $\delta^{49/47}$Ti are a result of magmatic differentiation [3]. Recently, several studies [2, 4] have challenged this view. If the Earth was indeed like chondrites to begin with, does that mean variability in $\delta^{49/47}$Ti is caused by mantle melting, fractional crystallization, and continental crust extraction? Deng et al. [5] suggested the same by measuring Archean mantle derived basalts but their observations were limited by number and variety of samples. We have measured a more expansive dataset of Archean basalts from the Pilbara and West Greenland terrains to elucidate the signatures observed from the mass-dependent titanium isotopic composition of the Archean mantle.

[1] Millet, M. A., et al. (2016). *EPSL*, **449**, 197-205.
[2] Deng, Z., et al. (2019). PNAS, **116(4)**, 1132-1135.
[3] Greber, N. D., et al. (2017). *GCA*, **213**, 534-552.
[4] Anguelova, M., et al. (2024). *GCA*.
[5] Deng, Z., et al. (2023). *Nature*, **621(7977)**, 100-104.