# Upper continental crust compositional evolution as constrained by Ti isotopes in diamictites

NIKITHA S. SAJI[1], RICHARD M. GASCHNIG[2], ROBERTA L. RUDNICK[3] MARC-ALBAN MILLET[1]

[1]School of Earth and Ocean Sciences, Cardiff University, UK
[2]Department of Environmental, Earth and Atmospheric Sciences, University of Massachusetts Lowell, USA
[3]Department of Earth Science and Earth Research Institute, University of California, Santa Barbara, USA

Secular variations in continental crust composition as represented in terrigneous sedimentary rocks or juvenile crustal additions have been previously linked to global geodynamic changes [1,2]. Ti stable isotopes have recently emerged as a proxy for crustal compositons [3]. Using the near-constant positive $\delta^{49}$Ti values measured in shales of ages 3.5 Ga to present, Greber *et al.* (2017) suggested that emerged crust was predominantly felsic since 3.5 billion years ago [4]. The use of Ti isotopes as a proxy for crustal composition, however, has recently been called into question [5].

In this study, we revisit the compositional evolution of upper continental crust uing the glacial diamictite composites of Gaschnig *et al.* (2016) that belong to four age intervals - 2.9, 2.4, 0.7 and 0.3 Ga [6]. The diamictites show resolvable temporal variations, with mean $\delta^{49}$Ti increasing from values similar to that measured by Greber *et al*. (0.20±0.02‰; 95% c.i.) in the Archean/Paleoproterozoic to 0.30±0.03‰ by Neoproterozoic and decreasing further down to 0.23±0.03‰ in the Paleozoic. We use three component mixing models based on $\delta^{49}$Ti values and Ni/Lu ratios to estimate average upper crust $SiO_2$ contents through time, considering both plume and arc end-members as appropriate. The increase in $\delta^{49}$Ti from Archean to Neoproterozoic is consisent with increasing crustal thickness facilitating increased magma differentiation and crustal reworking. The decrease in $\delta^{49}$Ti thereafter is possibly linked to crustal destruction exceeding crust generation as a result of onset of cold subduction that enhances subduction erosion [7].

[1] Dhuime, B. et al. *Nat. Geo*. 8, 552-555 (2015) [2] Tang, M. et al. *Science* 351(6271), 372-375 (2016) [3] Millet, M.-A. et al. *EPSL* 449, 197–205 (2016) [4] Greber, N. D. et al. *Science*, 357(6357), 1271-1274 (2017) [5] Deng, Z. et al. *PNAS* 116 (4), 1132-1135 (2019) [6] Gaschnig, R. M.. et al. *Geo. et Cosmo. Act.* 186, 316–343 (2016) [7] Brown, M. & Johnson, T. *American Mineralogist* 103, 181–196 (2018)