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Secular change in the age of TTG sources during the Archean from in-situ Sr and Hf isotope analysis by LA-MC-ICPMS

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Much of the continental lithosphere developed during the Archean, which was an Eon of change in terms of global geodynamics and geochemical cycles. Uncovering the causal links between crust forming processes and prevailing geodynamic mechanisms is crucial for understanding the origins and composition of the present-day continental lithosphere. Pristine Archean crust is scarce yet can be found in cratons worldwide. Many of these occurrences comprise rocks of the tonalite-trondhjemite-granodiorite (TTG) suite, which represent a prevalent component of the Archean continental crust. TTGs are generally considered to have formed by partial melting of amphibolite or eclogite source rocks that had basaltic precursors originally extracted from a depleted mantle (e.g., [1]). The age of the source rocks (i.e., the time between the basalt extraction from the mantle and TTG formation) can be determined from the initial radiogenic isotope compositions of TTGs, provided that the P/D ratio of the source can be reliably estimated and is significantly different from that of the depleted mantle.

Based on this principle, we estimated the age of basaltic sources of TTGs from cratons of different age and paleogeography from initial $^{87}Sr/^{86}Sr$ compositions determined by in-situ Sr isotope analysis of primary igneous apatite (LA-MC-ICPMS). The $^{87}Sr/^{86}Sr$ of these apatites show that prior to 3.4 Ga TTGs were derived from relatively old mafic sources and that the average time between formation of basaltic material from the mantle and subsequent remelting under amphibolite to eclogite facies conditions decreased drastically during the Paleoarchean. This secular change

indicates a rapid global increase in the efficiency of TTG production or the emergence of a new TTG-forming process at c. 3.4 Ga [2].

In this contribution we explore this hypothesis by comparing the $^{87}Sr/^{86}Sr$ signature of the TTGs with their trace-element compositions, as well as with $^{176}Hf/^{177}Hf$ zircon data for these rocks and contemporary TTGs from other studies. This combined geochronological, isotope and geochemical analyses will provide new constraints on the age of TTG sources during the Archean and will allow investigation into the nature and probable causes of the apparent rejuvenation at 3.4 Ga, as indicated by Sr isotopes.

[1] Hoffmann, J.E. et al. (2011) *Geochim. Cosmochim. Acta* 75, 4157-4178.

[2] Caton, S., et al., (in review) *Chem. Geol.*