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Using radiogenic and stable Nd isotopes to trace secular evolution of the Archean crust: Insights from the SWASA collection

DR. ALEX J MCCOY-WEST, PHD[1], S. AMREI LADWIG[2], JEAN-FRANÇOIS MOYEN[3], MARC-ALBAN MILLET[4], EMILIE BRUAND[5], OLIVER NEBEL[2] AND PETER A CAWOOD[2]

[1]IsoTropics Geochemistry Laboratory, James Cook University
[2]Monash University
[3]Laboratoire de géologie de Lyon: Terre, planètes, environnement
[4]Cardiff University
[5]Laboratoire Magmas et Volcans
Presenting Author: alex.mccoywest@jcu.edu.au

For decades radiogenic Nd isotopes have formed a cornerstone of studies seeking to understand crustal growth and evolution [1-3]. Recent analytical advances mean we can now simultaneous obtain radiogenic and stable Nd isotope compositions [4-5], allowing us to reconstruct not just the temporal history of a magmatic rock, but also the processes involved in its formation. Studies of the chemical and isotopic composition of the Archean crust remain hindered by sampling biases and the lack of reference suites that have been systematically measured for multiple geochemical tracers. To this address this need a large collection of 154 samples of various lithologies (but with a strong emphasis on granitoids) ranging in age from ca. 3.6 Ga to 2.7 Ga were collected from across the Kaapvaal craton and Limpopo belt in southern Africa (the SWASA collection). The wide range of crystallisation ages and the progressive stages of craton assembly they record, make this an ideal sample set for accessing temporal changes in magmatic compositions related crustal evolution.

We present Nd isotope data for 67 samples from across the region and age spectrum. The radiogenic Nd compositions are consistent with previous determinations with depleted mantle model ages mostly ranging from 3.0 to 3.7 Ga, and crustal residence times of up to 0.5 Ga. Stable Nd istope compostions ($\delta^{146/144}$Nd) range from -0.11‰ to +0.12‰ which is 3 times more variability than seen in modern basalts [6]. Above 70 wt % SiO_2 the proportion of samples resolvable heavier than the bulk silicate Earth increases substantially. Post tectonic high-K granites (after 2.8 Ga) dominate the samples with heavier $\delta^{146/144}$Nd, with the main phase trondhjemite-tonalite-granodiorite samples possessing more normal $\delta^{146/144}$Nd, consistent with a temporal change in the source compositions of the granoitoids.

[1] DePaolo (1980) *GCA* 44, 1185; [2] Allegre & Rousseau (1984) *EPSL* 67, 19; [3] Rosas & Korenaga (2018) *EPSL* 494, 42; [4] McCoy-West et al. (2017) *EPSL* 480, 121. [5] McCoy-West et al. (2020) *JAAS* 35, 388; [6] McCoy-West et al. (2021) *GCA* 293, 575.