DETRITAL ZIRCON EVIDENCE FOR VOLCANIC ARC-LIKE TECTONIC SETTING BY 3.7 Ga

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The nature of the early terrestrial crust and how it evolved through time, whether conventional plate tectonics operated in the Hadean and early Archean, and when it came into existence remain a topic of considerable debate. Here, we report U-Pb ages, Hf isotope composition, and trace element chemistry of Eoarchean detrital zircons from a chromite-bearing quartzite belonging to the Mahagiri Mesoarchean succession, Singhbhum Craton, eastern India [1]. Zircons furnish major concordant age populations at 3.95 Ga, 3.73 Ga, 3.55 Ga, 3.47 Ga, 3.36 Ga, 3.27 Ga, and 3.14 Ga. The ε_{Hf} of the 3.95 Ga and 3.7 Ga zircons are negative (-4.24 to -8.06 and -0.35 to -7.50 respectively), and define a trend in ε_{Hf} vs. time diagram consistent with their source granitoids having formed by intra-crustal reworking of a mafic protolith extracted from primitive mantle at 4.4–4.5 Ga. The younger (<3.6 Ga) zircons show larger variation in the ε_{Hf} (-9.19 to +3.17) but the majority of them have positive ε_{Hf}. The zircons have low P content (142–366 ppm) and relatively low REE and Y concentration indicative of I-type sources. The 3.95 Ga population has higher Nb/Th (0.070±0.010, σ) while the 3.73 Ga and younger zircons have significantly lower Nb/Th (0.032±0.012, σ). The Singhbhum detrital zircons thus record a transition from higher Nb/Th and crust-like Hf isotope composition at 3.95 Ga to lower Nb/Th coupled with mixed mantle- and crust-like Hf isotope composition post 3.73 Ga. Similar transition have been documented in the Jack Hills zircons and granitoids from the Acasta Gneiss Complex [2, 3]. On the modern Earth, such fractionation of Nb from Th occurs in volcanic arcs, which is also the locale where existing crust is recycled and juvenile components simultaneously added. The transition to lower Nb/Th and mixed Hf isotope composition by 3.7 Ga recorded in the Singhbhum detrital zircons therefore, marks the transition to granitoid production by deeper levels of melting of meta-basalts in arc-like tectonic environments.

[1] Mukhopadhyay *et al.* (2016) *Ore Geology Reviews* **72**, 1290-1306. [2] Bell *et al.* (2014) *Geochim. Cosmochim. Acta* **146**, 27-42. [3] Reimink *et al.* (2018b) *Earth's oldest rock* **2**, 329-347.