Initial Sr- and Hf-Isotopes from Apatite and Zircon from the Western Dharwar Craton Constrain Early Archaean Crust-Mantle Evolution

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Crustal evolution models are primarily based on radiogenic isotope systematics with some preferential bias towards rocks formed after 3.0 Ga. The key problem is the lack of exposure of rocks older than 3.0 Ga and their common overprint by metamorphism and extensive deformation that obscure primary features including mineralogy and isotope systematics. This later (partial) reprocessing makes it difficult to obtain precise and accurate initial isotope compositions that can be used to reconstruct their petrogenesis. However, minerals such as apatite can preserve initial $^{87}Sr/^{86}Sr$ [1] and zircon can preserve initial $^{176}Hf/^{177}Hf$ [2]. In addition, the U-Pb system in zircon records the time of mineral growth. In combination with whole rock Rb-Sr and Sm-Nd isotope measurements on granitoid and volcanic rocks from greenstone belts in the western Dharwar Craton, this age and isotope information is particularly powerful to reconstruct crust-mantle evolution prior to 3.0 Ga.

Igneous zircon grains from TTG gneisses record U-Pb ages ranging from 3.4 to 3.1 Ga. Rare detrital zircons from metasediments yield a maximum $^{207}Pb/^{206}Pb$ age of 3.6 Ga. Single apatite crystals from granitoids yield initial $^{87}Sr/^{86}Sr$ ~0.7013 that indicate a maximum age of 3.7 Ga for their precursor. $^{87}Sr/^{86}Sr$ values in apatite from mafic rocks are close to the value expected for the BSE at that time. The combined information recorded by the different isotope systems implies that only small amounts of continental crust existed [3] prior to the formation of the Dharwar Craton and that the early mantle showed only minor depletion.

[1] Tsuboi and Suzuki (2003) *Chem. Geol.* **199**, 189-197 [2] Mezger and Krogstad (1997) *J. metamorphic Geol.* **15**, 127-140 [3] Dhuime et al. (2015) *Nature* **8**, 552-555