Goldschmidt 2025 Abstract
https://doi.org/10.7185/gold2025.28381

A zircon and apatite perspective on the nature of the Paleoarchean continental crust

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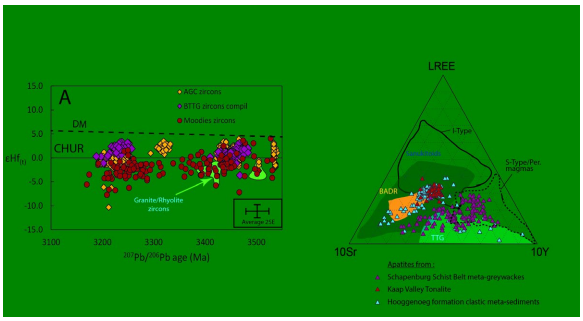

Detrital zircons and apatites are key mineral archives as they allow to investigate the composition of continental crust that has not been preserved in the geological record. This is particularly relevant to the Archean context, where large volumes of the Earth's earliest crust have been lost/reworked, leaving behind metamorphosed supra-crustal sediments/volcanic rocks and Na-rich plutonic bodies of the TTG suite. We conducted a study of detrital zircons and apatites sampled at different levels of the stratigraphy of the Barberton Greenstone Belt, South Africa and analyzed them for U-Pb-TREE (trace and rare earth elements; both zircon and apatite) and Hf-O isotopic compositions (zircon). Detrital zircons from Moodies-age (ca. 3.2 Ga) sediments show ages between 3.57 and 3.21 Ga and εHf(t) between 0 to -5.0 throughout this range. The negative εHf(t) matches that of zircons of ca. 3.40-3.54 Ga felsic volcanic sequences and from 3.56-3.25 Ga granitic pebbles in conglomerate layers [1]; but contrast with the positive εHf(t) of zircons from the Barberton TTG suite (from 0 to +5.0). The negative- εHf(t) zircons also show higher Ti content and Nb/Yb ratios than TTG zircons, supporting their crystallization from a compositionally different magma. Apatites from ca. 3.4 to 3.2 Ga clastic meta-sediments and greywackes show LREE-Y-Sr contents similar to apatites crystallized in modern calc-alkaline suites or sanukitoids but distinct from those of apatites of the TTG suite. These data collectively suggest that the Paleoarchean continental crust used to be more diverse in composition than the currently exposed, binary TTG-mafic supracrustal association. Among the "hidden" crustal components revealed by this study, K-rich rocks of granitic/rhyolitic composition seemed to have represented a substantial part of the Archean uppermost continental crust, as they produced about half of the detrital zircons analyzed so far in the Barberton Greenstone Belt. We suggest that the Paleoarchean crust was vertically zoned with a K-rich upper crust (granitic) and Na-rich middle crust (TTG) but that only the latter part survived to our time.

[1] Sanchez-Garrido et al. PhD thesis, 2012, 24.