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Tracking detrital zircon provenence – Pb-Pb and oxygen isotope integrated record from Late Paleoproterozoc metasedimentary rocks of the Fennoscandia-Sarmatia junction zone

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Oxygen isotope compositions of zircon grains are a sensitive tracer of mantle provenance, melts interaction in the crust, and temperature-dependent fluid activity. The provenance of Svecofennian metasedimentary rocks, known only from deep boreholes that penetrated Precambrian basement in NE Poland, close to the Fennoscandia and Sarmatian junction zone, is a longstanding question that has yet to be fully resolved. We present an investigation focused on oxygen isotope (SHRIMP) analyses of detrital zircon populations from Late Paleoproterozoic clastic rocks, in order to trace and characterize potential sources. Detrital zircon geochronology studied previously shows a dominant Paleoproterozoic population at 2.1–1.9 Ga, a subordinate late Archean population at 2.9–2.7 Ga and rare, early Archean grains up to 3.4 Ga. There is also a marked lack of detrital zircon grains of the age range 2.6–2.1 Ga. The maximum deposition age of the sequence is 1.86–1.83 Ga [1]). This age distribution is similar to the age populations of detrital zircon from metasedimentary rocks of Svecofenennian domains exposed in Sweden and Finland. The sequence was metamorphosed to greenshist and amphibolite facies at ca. 1.83 Ga [2]. The new $\delta^{18}O$ data are combined with the $^{207}Pb/^{206}$ Pb age record on the same non- metamict zircon grains (cores and rims).

The $^{18}O/^{16}O$ ratio is expressed as $\delta^{18}O$ relative to standard mean ocean water SMOW. The results are reported relative to the zircon FC1 (5.4 ‰). For the Archean zircon population, their detrital cores have $\delta^{18}O$ values from 3.5±0.11‰ to 5.9 ±0.19‰, with average of 4.92±0.2‰. Individual values document a volumetrically, prevalent source of mantle-like δ^{18} O composition. The dominant Paleoproterozoic zircon group reveal considerable variability ranging from 1.12 ±0.09‰ to 7.78±0.20‰ , however an average of 5.95±0.26‰ suggests a significant amount of `igneous mantle-derived material' mixed with components of slightly elevated oxygen isotope signatures. In contrast, the $\delta^{18}O$ values of the metamorphic overgrowths are near-uniform, ranging between 8.28 ±0.08‰ and 9.78. ±0.09‰ and reflect a low temperature interaction with metamorphic fluids.

Taking to account the records from detrital zircon cores we conclude that most of the grains came from the newly mantle-derived crust. The west Sarmatian active continental margin has been interpreted as the remnants of Paleoproterozoic (2.1–2.0 Ga) juvenile crust that would have been active immediately inboard of the basin at the same time as the sediments were being deposited. These events predate the oblique collision of the protocontinents of Fennoscandia, Sarmatia and Volgo-Uralia at 1.82–1.80

Ga. The Pb-Pb and $\delta^{18}O$ isotope values provide a time-integrated record of the evolution of Fennoscandia- Sarmatia junction zone.

References:

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