

Maturity of Archean sandstones and ancient detrital zircons

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Hadean detrital zircons are often fully rounded by abrasion in Archean chemically mature quartz arenites. In younger rocks, super-maturity and rounding indicate long aeolian transport distances, long residence times, high energy environments, and reworking of multi-cycle sands. Does this apply to Archean sediments?

1030 detrital zircons were dated from basal sandstone of the ca 3.4 Ga Strelley Pool Fm at Unconformity Ridge, above the ABDP8 drill hole, Pilbara Craton. The sample is from ~2m above the ca 3.5 Ga Coonterunah Fm at one of the oldest known angular unconformities and weathered landsurfaces. Detrital-Qz grains are elevated and variable in $\delta^{18}\text{O}$ ($12.6 \pm 2.7\text{‰}_{\text{VSMOW}}$) suggesting hydrothermal alteration of a volcanic source before erosion. Syntaxial Qz-overgrowths are surrounded by micro-Qz cements. Detrital grains, including chromite, rutile, leucoxene, pyrite, and chert clasts are variably rounded. Some zircons have well-preserved crystal faces and edges, but 55% of dated grains are fully rounded. Pb-Pb ages were surveyed by IMS-1280 in a search for Hadean zircons counting 20s on ^{207}Pb , ^{206}Pb and ^{204}Pb in multicollector mode after 30s presputtering. Model $^{207}\text{Pb}/^{206}\text{Pb}$ ages are surprisingly constant and average 3510 Ma with little scatter beyond analytical uncertainty. No older ages were found. Fully rounded zircons average 3509 Ma, identical to less rounded crystals. Ages are also identical to small suites of higher precision U-Pb analyses [Buick et al. 1995, Nature; Nelson 2005 GSWA; Van Kranendonk et al. 2008 Pre-C Res]. The tight range of ages within 100 myr of deposition suggest a local source of zircons, dominantly Coonterunah rhyolites, and that Archean chemical weathering and aeolian abrasion were more aggressive than today due to CO_2 -rich atmosphere and absence of land plants. Continent-scale land masses are not required.

