Detrital chromite from Jack Hills: clarifying the zircon record

L.G. STADDON[1,2*], I.J. PARKINSON[1], M.S.A. HORSTWOOD[2] AND T. ELLIOTT[1]

[1]School of Earth Sciences, University of Bristol, Bristol, UK
[2]NIGL, British Geological Survey, Keyworth, Notts, UK.

Detrital zircon found within metaconglomerate at Jack Hills, a greenstone belt within the Narryer Terrane in the Yilgarn Craton, have been heavily used to elucidate crustal evolution in the Hadean and Archean. However, despite considerable geochemical and isotopic interrogation, how zircon formed and their inferences for wider geodynamic conditions within the early Earth remain controversial. Here we present major element chemistry and geochronology of detrital chromite from the same metaconglomerate locality, in a bid to clarify the zircon record of early crustal evolution within the Narryer Terrane.

Chromite exhibit variable rounding, from proximal euhedral octahedra to distal, spherical grains. Despite variable sedimentary reworking, the the only difference in mineral chemistry is observed with changing sample location. Detrital chromite display evidence of metamorphic diffusion with protolith Mg-Fe silicates, yielding lowered Mg# and elevated ZnO and MnO. Regardless of differences in metamorphic grade between samples, Cr#s are consistent (dominantly 54-62, up to 82). This, coupled with the low Fe_2O_3 content of chromite, suggests Cr#s are primary in origin. Variable Cr# precludes a komatiitic source [3], but observed Cr# fit well with chromite derived from layered intrusions [4].

Chromite yield high Os concentrations (13-70ppb) and low Re concentrations, suggesting that although Os isotopic compositions are likely robust, chromite are susceptible to Re mobility during metamorphism and fluid interaction. This is apparent from T_{RDs}: four samples yield T_{RDs} younger than host metasediment deposition ages of 2.65-3Ga. One sample shows a Re-depletion event at 1.8Ga, coinciding with the age of the main foliation of the Jack Hills greenstone belt. In spite of this, chromite yield T_{RDs} up to ~3.3Ga, and Eoarchean T_{MAs} of 3.5-3.6Ga. Comparison of chromite T_{MAs} with coupled Pb-Hf isotope data in zircon from the same sample may reveal further insights into crustal evolution in the Narryer Terrane, and the wider Yilgarn Craton.

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