Paper Number: 5362

U-Pb, O and Hf isotope study of detrital zircon from lower Palaeozoic sandstones sitting on the Precambrian unconformity of Saudi Arabia.

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The supercontinent Gondwana formed by successive orogenic cycles between c. 900-500 Ma along the East African orogen (EAO). At the northern end of the EAO, the Arabian-Nubian Shield (ANS) represents one of the largest extents of juvenile Neoproterozoic crust on Earth. Subsequent to shield-wide emplacement of post-tectonic granitoids, the ANS experienced repeated erosion, peneplanation, and the underlying crystalline basement became strikingly flat with erosional relief well within 10m. This continental-scale peneplanation affected the entire Middle East and North Africa and became the platform for deposition of voluminous siliciclastic Palaeozoic sediments that blanketed northern Gondwana. The provenance of these sediments remains poorly understood. Earlier studies, based solely on zircon U-Pb ages, suggested that predominantly Neoproterozoic-aged zircon in Cambrian-Ordovician sequences in Israel and southern Jordan could be sourced from the juvenile ANS crust [1, 2]. However, a recent Lu-Hf study on these dated zircons reveal that most have Hf isotopic compositions inconsistent with a juvenile source(s) [3] raising the possibility that these Neoproterozoic-aged zircons could be derived from any Neoproterozoic or older crust reworked along the EAO and highlighting the limitations of assigning provenance based on age alone.

In this study, we present a combined U-Pb, O, and Hf study of zircon from the lower Palaeozoic Wajid and Saq units in Saudi Arabia and Jordan. Palaeocurrent indicators yield consistent and reliable northerly sediment transport directions [4] and our samples were collected to maximise the geographical distribution and diversity of the underlying basement and/or source region. In particular, while samples from the northern part of the shield are expected to contain juvenile zircon from the shield, those to the south are likely to contain material sourced from parts of the EAO and surrounding terranes that are not dominated by juvenile granitoids, for example Palaeoproteroic to Neoarchaean terranes of Yemen.

The zircon U-Pb age spectrum in our samples is dominated by Neoproterozoic-aged zircons with peaks of varying proportions at c. 2.7-2.5 Ga, 2.2-1.9 Ga, and 1.1-0.9 Ga. The occurrence of the 1.1-0.9 Ga ages requires distal sources, as rocks with these ages are not known from the ANS. The O-in-zircon data show a secular variation that mirrors global compilations, indicating increased crustal recycling during the Neoproterozoic and Phanerozoic. The Hf-in-zircon data show variations within age peaks, with Neoproterozoic zircon showing the most extreme variation. Only the southernmost sample contains significant amounts of zircon with Palaeoproterozic to Archaean Hf model ages, which are only present as minor components in the other samples. These attributes suggest multiple and distal sources for the

Palaeozoic sequences deposited on the ANS. The combined U-Pb, O-, and Hf- isotopes thus provides an opportunity to evaluate juvenile crust generation vs. recycling in the hinterland of Gondwana.

References:

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