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Evolution of the eastern Arabian basement - geochronologic and isotopic constraints from Socotra and basement inliers in Oman.

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The Arabian-Nubian Shield (ANS), a tectonic collage of late-Neoproterozoic arc terranes, represents the northward extension of the East African Orogen formed during amalgamation of East and West Gondwana. The western arc terranes were formed and assembled at ca. 870-700 Ma while the eastern arc terranes are somewhat younger, at ca. 740-620 Ma [1]. Despite this apparent younging to the east, broadly consistent with progressive arc accretion along the margin of West Gondwana, the oldest (Paleoproterozic to Neoarchean) components of the ANS are located along its eastern margin in the Khida region of Saudi Arabia [2] and the terranes of Yemen [3]. There is then a gap of >800 km to the east before the next basement exposures occur in the Marbat region of southern Oman [4]. These 850 – 790 Ma juvenile arc rocks have closer affinity to the older juvenile western arc terranes of the ANS than with the younger but more evolved eastern arc terranes or the continental terranes exposed at the eastern margin. They have been proposed to reflect arc accretion at the opposing margin of the Mozambique Ocean, i.e. along East Gondwana [4]. In order to further investigate the nature and possible affinities of the eastern Arabian basement, we report zircon U-Pb (SIMS) geochronological and whole-rock Nd isotopic results from rocks exposed on Socotra (Yemen) and in the basement inliers of Jebel Ja'alan and Qalhat in Oman.

Prior to Miocene rifting of the Gulf of Aden, Socotra occupied a position immediately to the east of the Marbat block and it provides a critical eastward extension of dominantly igneous basement of arc affinity. The oldest components are ca. 860 Ma granodiorites from the easternmost outcrops at Ras Momi; slightly younger ages of ca. 850-840 Ma have been obtained from the western Shuab, Ras Kadama and Qulansiya areas. A ca. 800 Ma component is ubiquitous, occurring either as a discrete igneous crystallisation age or as an overprint on older rocks that resulted in Pb-loss. Nd isotopes indicate that these rocks are dominantly juvenile. Metasediments are rare on Socotra: a single sample from the Shuab inlier yields a spread of zircon ages from ca. 1060 to 800 Ma with a single discordant grain of >2350 Ma. Granite of the Haggier Mountains and related rhyolites yield ca. 720 Ma ages and represent the youngest igneous component in the basement of Socotra.

The basement inliers of Jebel Ja'alan and Qalhat are located ca. 750 km NE of the Marbat region and potentially lie further to the east relative to the inferred suture. Both inliers expose tonalitic gneisses and metasediments intruded by granodiorites and granites of the Ja'alan batholith. The gneisses yield ages of ca. 900-880 Ma and zircon of ca. 900 Ma are a dominant component in the sampled metasediments. The Ja'alan batholith yields ages of ca. 840 -825 Ma, similar to those obtained in Socotra and the Marbat region. Nd isotopes indicate that these rocks range from juvenile to slightly more evolved, with $\varepsilon_{Nd}(t)$ from +2 to +8.

Together the basement inliers of Oman and Socotra document increasing age and increasing continental influence to the east, consistent with progressive development of arc rocks onto the eastern margin of Gondwana and mirroring the western part of the orogen. The absence of any older components to the east implies that the pre-Neoproterozoic terranes identified in Yemen and Saudi Arabia are isolated exotic continental blocks incorporated into the orogen.

References:

[1] Stoeser D and Frost C (2006) Chem Geol 226:163-188
[2] Whitehouse M et al (2001) Gondwana Res 4:200-202
[3] Whitehouse M et al (2001) Precambrian Res 105:357-369
[4] Rantakokko et al (2014) Geol Soc London Spec Publ 392: 107-128