

A snapshot of Gondwana assembly: Insights from plutonic rocks of the Ha'il terrane of the Arabian Shield

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The collision of East and West Gondwanaland led to the consolidation of the East African Orogen, the world's largest Neoproterozoic orogenic complex [1, 2]. This extensive geological feature stretches along eastern Africa and western Arabia [2]. The East African Orogen is divided into the Arabian-Nubian Shield (ANS) in the north and the Mozambique Belt in the south, and the ANS is one of the largest collages of Neoproterozoic juvenile continental crust on Earth [2]. Extensive crust generation in the ANS is associated with a Neoproterozoic supercontinent cycle bracketed by the break-up of Rodinia and the multiphase assembly of Gondwana [3]. The exact processes of crustal growth, particularly the timing of the formation of plutonic rocks in relation to the orogen, which accounts for most magmatism, remain unclear.

The ANS remained a single landmass until the Cenozoic, when the opening of the Red Sea split it into the Nubian Shield to the west and the Arabian Shield to the east. The Arabian Shield comprises eight distinct tectonostratigraphic terranes, separated by ophiolite-bearing suture zones and faults [3, 4]. This study presents in-situ zircon U-Pb ages and Hf isotope data, and whole-rock major and trace element composition of basement plutonic rocks from the Ha'il Terrane—one of the eight terranes of the Arabian Shield—to reconstruct their petrogenesis and place them within the broader geotectonic context of Gondwana assembly.

The 650 Ma diorites are highly metaluminous and exhibit an I-type affinity, whereas the 640 Ma granites are transitional between metaluminous and peralkaline and display ferroan, A-type, and alkalic granite affinities. The $\epsilon\text{Hf}_{(t)}$ values of all samples range from +8 to +11. The combined geochronological, isotopic and chemical data suggest that these rocks originated from the partial melting of an isotopically juvenile protolith and record a shift in magmatism from compressional syn-orogenic to extensional post-orogenic within the Ha'il Terrane at about 640 Ma.

REFERENCES

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