Paper Number: 612

# Origin and tectonic evolution of the NE basement of Oman – a window into the Neoproterozoic accretionary growth of India?

Alessio, B. L. [1], Blades, M. L.[1], Murray, G.[1], Thorpe, B.[1], Collins, A. S.[1], Kelsey, D. E.[1], Foden J.[1], Payne, J. L.[2], Al-Khirbash, S.[3]

[1]Centre for Tectonics, Resources and Exploration (TRaX), Department of Earth Sciences, The University of Adelaide, Adelaide, SA 5005, Australia. brandon.alessio@adelaide.edu.au
[2]Centre for Tectonics, Resources and Exploration (TRaX), School of Built and Natural Environments, University of South Australia, Australia
[3]Sultan Qaboos University, Al Khoudh 123, Muscat, Oman

---

Jebel Ja'alan contains one of few well exposed inliers of crystalline basement within the Sultanate of Oman. Similar to other inliers within the country, the basement of Jebel Ja'alan displays a distinct magmatic and metamorphic history. Unravelling this history is important for understanding the Neoproterozoic tectonic geography of Oman as well as the relationship between the Omani basement and the juvenile arc terranes of the Arabian–Nubian Shield (ANS) of western Arabia and east Africa. To better understand the origin and tectonic history of Jebel Ja'alan we present new U–Pb and Hf isotopic data from magmatic zircons, U–Pb isotopic data from monazite, $^{40}$Ar–$^{39}$Ar isotopic data from muscovite, and whole rock Sm–Nd isotopic data from various igneous lithologies in Jebel Ja'alan that help to define the timing of magmatic and metamorphic events, as well as the origin of igneous intrusions. We additionally present pressure–temperature (*P–T*) forward models (pseudosections) to constrain the metamorphic conditions and apparent thermal gradient experienced by the Jebel Ja'alan basement. These *P–T* conditions are then used in conjunction with trace element geochemical data obtained from igneous lithologies in Jebel Ja'alan to interpret the tectonic setting in which the Jebel Ja'alan basement formed.

Magmatic zircons sourced from the newly termed Ja'alan Granite, Kamil Granodiorite and Ali Gneiss provide U–Pb ages of *c.* 830 Ma that are interpreted as crystallisation ages. The Ali Gneiss protolith is interpreted to have a crystallisation age of 887 ± 5 Ma. Hafnium isotopes from these zircons display εHf(*t*) values ranging from +2.30 to +13.3, demonstrating that these grains originated from a juvenile source. Monazite grains sourced from the metasedimentary Hassan Schist yield a $^{207}$Pb/$^{206}$Pb weighted average age of 838 ± 12 Ma, interpreted to represent the timing of near-peak metamorphic conditions. $^{40}$Ar–$^{39}$Ar data obtained for muscovite grains from the Ja'alan Granite and Hassan Schist yield plateau ages of 831 ± 15 Ma and 830 ± 6 Ma, respectively. These ages are used to suggest that cooling of these lithologies occurred rapidly following peak metamorphism. Sm–Nd isotopic data were obtained for igneous lithologies located in southern Jebel Ja'alan. These data gave positive εNd values ranging between +0.56 and +6.78, again indicating a juvenile origin for the basement of Jebel Ja'alan. *P–T* modelling shows that the Hassan Schist reached peak conditions of around 4.2–6.2 kbar and 665–695 °C, suggesting metamorphism followed a Barrovian thermal gradient, approximately 112.1–158.3 °C/kbar. This thermal gradient in conjunction with rare earth element (REE) spider plots and tectonic discrimination diagrams suggests a volcanic arc setting for the Jebel Ja'alan basement.

This study proposes that the basement of Jebel Ja'alan formed in a juvenile volcanic arc environment during the Tonian, similar to basement found elsewhere in Oman, as well as in the ANS. However, age

constraints on basement formation are suggestive of basement in Jebel Ja'alan being *c.* 20–50 Ma older than that in the relatively well studied region of Mirbat, in the country's southwest. We suggest this age discrepancy represents westward arc accretion and migration in Oman occurring during the Tonian. This is in contrast to progressive eastward arc accretion in the eastern ANS of Saudi Arabia and Yemen. Our interpretation implies that the Omani basement is not an eastern extension of the ANS but instead accreted on to an eastern continent (Neoproterozoic India?) before the arc terranes of the eastern Saudi ANS had begun accreting onto the Saharan Craton.