

## Editorial

### Geology and Tectonic Setting of the Arabian-Nubian Shield

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The Arabian-Nubian Shield (ANS) lies at the northern part of the East African Orogen (EAO) or East African Antarctic Orogen (EAAO) and represents the upper crustal equivalent of the high-grade Mozambique Belt (MB). The juxtaposition of the ANS low-grade basement rocks and the MB high-grade rocks is documented in various domains, particularly in southern Ethiopia and Kenya. The ANS itself is considered by some workers as the largest tract of juvenile Neoproterozoic continental crust on Earth, and is regarded by others as a major suture zone separating east- and west-Gondwanalands. It is dominated by Neoproterozoic juvenile arcs, post-amalgamation depositional basins ( $\approx$  forty basins all over the ANS), voluminous granitoid and gabbroic intrusions, and enclaves of pre-Neoproterozoic crust. This collage was evolved during much debatable late Cryogenian–Ediacaran (650–542 Ma) depositional, tectonic, metamorphic and intrusive events. The closing 100 Ma of the Neoproterozoic crustal growth of the ANS has attracted the attention of Precambrian structural geologists and at least four models or paradigms have been proposed; infracrustal-, Turkic-type-, hot-spot-, and arc-assembly- orogenic models. Infracrustal model, whereby ophiolites and island-arc volcanics and volcanoclastics were thrust over an old craton consisting of high- grade gneisses, migmatites and remobilized equivalents; the contact is Pan-African thrusting. The high-grade rocks are suggested to be exposed in a number of tectonic windows, forming domal-like structures or swells; e.g. Beitan, Hafafit, Meatiq, Sibai and El-Shalul in the Nubian segment of the ANS. However, recent isotopic and geochronologic studies challenge this interpretation. According to the Turkic-type orogenic model, much of the ANS were formed in broad fore-arc complexes. The Hot-spot Model envisaged the evolution of the ANS due to accretion of oceanic plateaux formed by upwelling mantle plumes. The arc assembly model is favored by most ANS

researchers, whereby EAO (EAAO) juvenile crust was generated around and within a Pacific-sized ocean (Mozambique Ocean). Within the frame of this model, the ANS is regarded in recent publications as an "accretion-obduction-type Orogen" in which stacking of thin-skinned nappes was achieved by oblique (transpressional) convergence of boundary plates. Moreover, numerous attempts have been made to classify the northern extension of the EAO (i.e. ANS) into multiple amalgamated tectonic terranes, such as: Halfa, Bayuda, Barka, Hager-Tokar, Ghedem, Haya, Gebeit-Gabgaba, Gerf (South Eastern Desert), Asir, Jeddah, Hijaz, Madyan, Afif and Rayn. Contacts separating these terranes comprise original suture zones (ophiolites-decorated mega shears), cryptic major shear zones and post-amalgamation fault zones. Several ANS terrane accretion (assembly/suturing/amalgamation/convergence) events have been discriminated and precisely dated. Among these events, the oldest was that creating the Bir Umq-Nakasib Suture; the oldest accretionary zone throughout the entire ANS. The youngest event was responsible for the formation of the Late Neoproterozoic brittle-ductile shears (e.g. Yiba and Hamisana Shear Zones), and the NW- to NNW-oriented sinistral transpressional Najd Shear System, as well as its conjugate NE- to NNE-oriented dextral transpressional mega shears (e.g. Ad-Damm and Wadi Fatima Shear Zones). The deformation patterns and structural fabrics observed within, and in the vicinity of, sutures and shear zones revealed that the ANS experienced final accretion to the Saharan Metacraton (existed to the west) concurrent with Gondwana assembly through progressive oblique convergence of East- and West-Gondwanalands.

In this special issue, we invited Peter Johnson to write a review on the tectonic setting of the ANS and the entire EAO. He has a preference to write a brief review on current geochronologic and isotopic datasets under the title "Review of an expanding geochronologic and isotopic data base: importance for tectonic modeling in the Arabian-Nubian Shield". We were pleased to start this special issue with Johnson's excellent review. The author illustrates the critical contribution that these types of data make to robust,

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meaningful understanding of the tectonic setting and extent of the shield. Without reliable geochronology there is no accurate lithostratigraphy or temporal sequencing of deformation and metamorphic events; without isotopic data there is little insight into magma genesis or crustal recycling. The geochronologic and isotopic data reveal that some ANS sedimentary, volcanic and igneous rocks contain pre-Neoproterozoic material as xenocrysts and possible glaciogenic clasts, but give no evidence that the ANS otherwise overlies older crust.

Ibrahim Gaafar and Hatem Aboelkhair contributed the special issue by a good article "Analysis of Geological and Geophysical datasets for radioelement exploration in Kab Amiri area, Central Eastern Desert, Egypt". Hatem Aboelkhair and others integrated airborne gamma ray spectrometry (AGRS) and ETM<sup>+</sup> remote sensing data to identify and map uraniferous alteration zones hosted in Kadabora pluton (Central Eastern Desert, Egypt), as well as to locate the higher radiometric mineralization areas, identifying their migration path, and to differentiate between mineralization types. Mahmoud Elsaïd and others applied the feature oriented principal component selection (FPCS) and spectral angle mapper (SAM) techniques on ASTER L1B imagery for mapping the common alteration minerals within Elmissikat-Eleridiya district; one of the most important uranium localities in northern Nubian Shield. ASTER VNIR-SWIR bands were used effectively in delineating Sericite, kaolinite, chlorite, illite and hematite, where ASTER TIR was most effective in delineating silica which associates and could be used as pathfinders for radioactive mineralizations

within the Elmissikat-Eleridiya area. The resulted alteration maps presented by the authors show good coincidence with the uranium explored sites and suggested further similar localities that could be used for the development of uranium exploration sites within the studied area. Ashraf Emam and others integrated remote sensing with geochemical data to discriminate between various lithologies of island arc assemblage covering Marahiq area, South Eastern Desert of Egypt.

Osama Kassem and Zakaria Hamimi applied finite strain technique for deformed lithologies in Al Amar Suture (Eastern Arabian Shield); the youngest accretion event in the entire ANS. The main points emerging from their study are: (1) the strain ellipsoids have oblate strain symmetry, (2) there is no significant difference in the deformation behavior between  $R_f/\phi$  and Fry methods in the investigated lithologies, (3) accumulation of finite strain in the area was not accompanied by significant volume change, (4) the finite strain in various lithologies has the same order of magnitude, (5) the various lithologies show great similarity in order of deformation, and (6) the obtained finite strain data conflict the suggestion that nappes in orogens resulted from simple-shear deformation.

Finally, Bahaeldin Sadagah was invited to write a paper on "rock slope stability problem modeling and remediation of the Arabian Shield rocks".

We hope that this special issue will add much more contribution to the ANS which represents the northern extension of the EAO.

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