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The effect of the Najd shear deformation on the Pan-African belt of the central Egyptian Nubian Shield: a synthesis for the post-collision tectonic events

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ABSTRACT

This study concerns the structural setting of the central Egyptian-Nubian Shield (El Shalul area) utilizing field-structural, remote sensing, petrological and geochemical data. The exposed basement comprises ophiolitic-mélange, arc-related metavolcanics, metasediments, metagabbro-diorites and granitoids. The area experienced two stages of deformation, pre-Najd (~850–630 Ma) and Najd-related (~630–580 Ma). The pre-Najd stage is represented by the assembly of arc-terranes and their N-ward extrusion while the Najd-related stage encompasses three deformation phases. D_1 is post-collision extensional event, depicting lateral spreading of tectonic terranes and NW-ejection of ophiolites. The emplacement of El Shalul granite (~630 Ma) and deposition of molasse sediments in E-W and NW-SE extensional basins (Zeidun and Meesar) are D_1- related. Following extension is a protracted phase of compression, shearing and transpression. It was commenced with NW-SE shortening (D_2) and deformed the extensional basins by folding and thrusting with mild effect on the other basement units. Sinistral shearing (D_{3a}) and transpression (D_{3b}) along the NW-trending faults superseded the D_2 compression, while dextral shearing (D_{3c}) on the ENE-WSW and NE-SW faults overprinted the NW-SE penetrative structures and controlled the emplacement of post-granitic dykes. The significant conclusions of this study include (1) El Shalul granite complex is a large alkaline granitic sheet emplaced during a post-collision extensional regime and suffered the subsequent ~630–580 Ma top-to-NW sinistral shearing and SW-directed thrusting (not a gneissic core complex) and (2) The NW-SE and NE-SW structural trends are not conjugated.

1. Introduction

The Egyptian Eastern Desert (ED) is a prominent segment of the western Arabian-Nubian Shield (ANS) and comprises a complete succession of the Neoproterozoic basement complex (Fig. 1). This complex is characterized by a juvenile crust that is composed of ophiolitic and island arc rock collages and was injected by several phases of granitic intrusions that are different in their mineralogical composition and geochemical affinities. Along-strike, the NW-trending ED terranes show remarkable variation in lithology and metamorphic grades, regional tectonic deformation (structural fabrics and trends) and tectonic regime (e.g. extensional, compresional and transpresional). In addition, the location and nature of the major tectonic boundaries between these terranes are conjectural. Although the popular three fold division of the ED into Northern, Central and Southern provinces (NED, CED and SED, respectively) (Stern and Hedge, 1985; El Gaby et al., 1988) has a wide agreement as it correlates well with the change in lithological characteristics along the ED, it needs further reassessment where for example the geothermal gradient and geophysical behavior of the brittle-ductile transition underneath the ED should be taken in consideration (e.g. Stern, 2017). To find the way to decipher the thermal-tectonic-metamorphic history of the ED tectonic terranes, regardless of the previous claims and others, the origin of gneissic core complexes (gneissic domes) and the mode of emplacement and tectonic setting of the different granitic phases should be considered.

The origin of gneissic core complexes and their kinematic relation to the Najd Fault System (NFS) in the CED and SED, along with the mechanism of their exhumation nearby the Hammamat-type molasse basins, have been extensively discussed in the last few decades. The exact origin and exhumation mechanism of these complexes is controversial (e.g. Abu Alam and Stüwe, 2009; Abu Alam et al., 2014; Hamimi et al., 2019; Fowler and Hamimi, 2020), despite the connection with the

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