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Pan-African dextral transpressive duplex and flower structure in the Central Eastern Desert of Egypt

Mohamed A. Abd El-Wahed [a,b,*], Samir Z. Kamh [a,b]

[a] Geology Department, Faculty of Science, Tanta University, Tanta 31527, Egypt
[b] Geology Department, Faculty of Science, Omar Al Mokhtar University, Libya

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ABSTRACT

The NE–SW trending Mubarak shear belt in the Central Eastern Desert (CED) of Egypt records the structural features of a transpression regime. Structural interpretation of satellite data and field observations indicates the presence of two episodes of deformation. The less dominant D_1 deformation is related to sinistral movement along NW–SE trending Wadi Abu Dabbab shear zone and formation of F_1 tight to isoclinal non-cylindrical folds and thrust fan as a consequence of transpression. The thrust fan includes ESE- to SE-dipping thrusts in the ophiolitic mélange and S- to SSW-dipping thrusts in the northern part of the metagabbro–diorite complex. The transpression-related sinistral shear regime is superimposed by the dominant D_2 dextral transpression along NE–SW trending Wadi El-Umra shear zone. This dextral shearing is characterized by development of NNE- to NE-trending S_2 cleavage, strike-slip duplex, NNE- and NE-trending F_2 folds, and NNW-directed thrusts. These two events represent a single progressive phase associated with sinistral transpressional deformation, which is related to a younger E–W shortening event. E–W directed shortening is due to oblique convergence between East and West Gondwana along the Mozambique belt. Transpressional structures in the NE–SW trending Mubarak–Barramiya shear belt indicate highly oblique convergence leading to wrench-dominated dextral transpression and development of a major flower structure between Wadi Mubarak and Hafafit dome occupying the whole width of the CED.

1. Introduction

During the past two decades transpression involving oblique convergence has been utilized to explain the deformation kinematics in the Eastern Desert of Egypt (Wallbrecher et al., 1993; Greiling et al., 1994; Fritz et al., 1996; Loizenbauer et al., 2001; Makroum, 2001; Bregar et al., 2002; Fritz et al., 2002; Abd El-Wahed, 2003; Makroum, 2003; Helmy et al., 2004; Shalaby et al., 2005; Abd El-Wahed, 2007, 2008; Abdeen et al., 2008; Abd El-Wahed and Abu Anbar, 2009; Abd El-Wahed, 2010; Shalaby, 2010). Transpression is a characteristic feature of obliquely convergent mobile belts and involves a combination of pure shear and simple shear models to interpret structural features within a narrow zone of deformation (Harland, 1971; Jones et al., 1977; Sanderson and Marchini, 1984; Holdsworth and Strachan, 1991; Corsini et al., 1996; Jones and Strachan, 2000; Woodcock and Rickards, 2003; Kim et al., 2004; Reddy and Occhipinti, 2004; Matin, 2006; Dehler et al., 2007; Abd El-Wahed, 2008; Sarkarinejad et al., 2008; Goscombe and Gray, 2008; Abd El-Wahed and Abu Anbar, 2009; Kumar and Prasannakumar, 2009; Johnston and Gutierrez-Alonso, 2010; Karniol et al., 2008). Transpressional orogens involving the middle and lower crust have been documented from different crustal blocks. Classic examples are the Caledonian Orogen in NE Greenland (Holdsworth and Strachan, 1991), the Pan-African Mozambique belt (Shackleton and Ries, 1984), the Pan-African Kaoko belt in Namibia (Goscombe et al., 2003; Knopásek et al., 2005), Southern Uplands of SE Scotland (Tavarnelli et al., 2004), southern Capricorn Orogen, Western Australia (Reddy and Occhipinti, 2004), Kushtagi schist belt, India (Matin, 2006), Azeite shear zone, southeastern Brazil (Dehler et al., 2007), Sanandaj–Sirjan metamorphic belt, Zagros mountains, Iran (Sarkarinejad et al., 2008), Al Jabal Al Akhdar, Libya (El Amawy et al., in press), Itlava–Itaperurna section, northern state of Rio de Janeiro, Brazil (Karniol et al., 2008), Madagascar (Tucker et al., 2007; Raharimahefa and Kusky, 2008), Cauvery shear zone, southern Granulite Terrain, India (Chetty and Bhaskar Rao, 2006), Salem–Attur shear zone, south India (Kumar and Prasannakumar, 2009) and Sikkim Himalaya, India (Bhattacharyya and Mitra, 2009; Matin and Mazumdar, 2009).

The Wadi (the Arabic word for ephemeral water course) Mubarak shear belt (Figs. 1 and 2) is part of the Central Eastern Desert (CED) of Egypt and is characterized by a prevalence of NE- and ENE-trending tectonic fabrics and NNW-directed thrusts, discordant to NW-trending tectonic fabric prevailing in the CED. The Eastern Desert of Egypt is part of the Arabian–Nubian Shield (ANS) which formed when Rodinia disintegrated between 900 and 800 Ma ago, as inferred from

* Corresponding author. Tel.: +20405440662; fax: +20403350804.
E-mail address: mawahed23167@yahoo.com (M.A. Abd El-Wahed).

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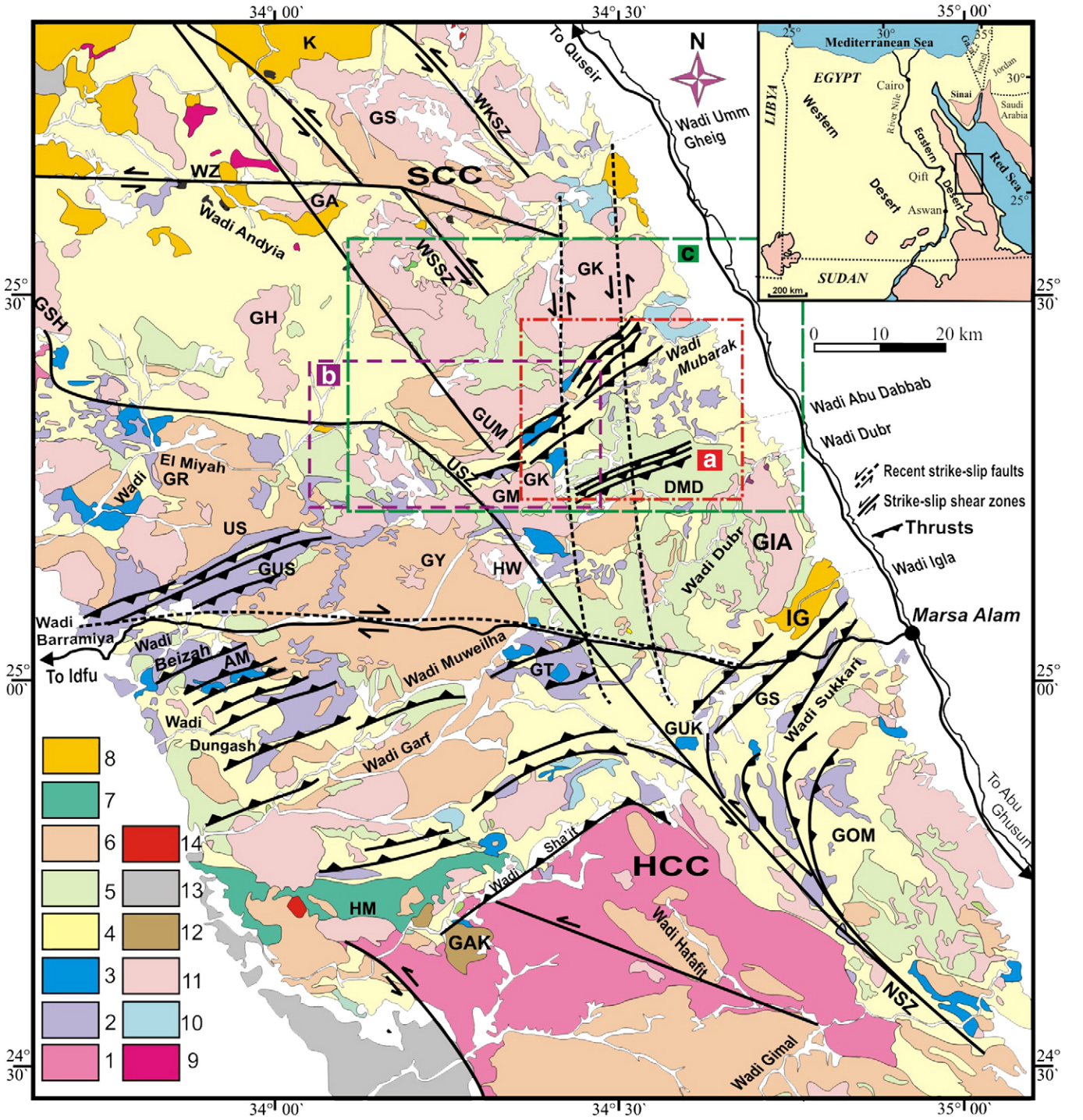

Fig. 1. Geological map or the southern part of the Central Eastern Desert of Egypt (modified after Klitzch et al., 1987) 1; gneisses, 2; serpentinites, 3; ophiolitic metagabbros, 4; metavolcanics and metasediment, 5; syn-tetonic intrusive metagabbros, 6; syn-tectonic granite, 7; Dokhan volcanics, 8; molasse sediments, 9; felsites, 10; gabbros, 11; post to late tectonic granites; 12: ring complex, 13; Natash volcanics and 14; trachyte plugs. GAK; Gebel Abu Khruq, HCC; Hafafit core complex, GOM; Wadi Ghadir ophiolitic melange, HM; Hamash gold mine, NSZ; Wadi Nugrus shear zone, GS; Gebel Sukkari and Sukkari gold mine, GUK; Gebel Um Khariga, IG; Igla molasse basin, DMD; Dubr metagabbro–diorite complex, GIA; Gebel Igl Al-Ahmar, HW; Gebel Homrat Waggad, GY; Gebel El-Yatima, GUS; Gebel Umm Salim, US; Gebel Umm Saltit, GK; Gebel Abu Karanish, GM; Gebel Al Miyyat, USZ; Um Nar shear zone, GUM; Gebel El-Umra, GK; Gebel Kadabora, GA; Gebel Andyia, GH; Gebel El-Hidilawi, GU; Gebel Umm Atawi, GSH; Gebel El Shalul, GR; Gebel El Rukham, SCC; Sibai core complex, GS; Gebel Sibai, WZ; Wadi Zeidon, WSSZ; Wadi Sitra shear zone, WKSZ; Wadi Kab Ahmed shear zone, K; Kareim molasse basin. Area labeled (a) is the present study area, area labeled (b) is mapped and studied by Shalaby et al. (2005) and area labeled (c) is mapped and studied in detail by Abu El-Ela (1985) and Akaad et al. (1995, 1996) and structurally investigated by Makroum (2001). The major structures are after Akaad et al. (1993), Fritz et al. (1996, 2002), Bregar et al. (2002), Helmy et al. (2004), Shalaby et al. (2005) and Abd El-Wahed (2008, 2010).

Fig. 2. (a) Geological map of the eastern part of Wadi Mubarak shear belt. Wadi; the Arabic word for ephemeral water course and Gebel; Arabic word for mountain (b) cross section A–A' showing thrust fan around Wadi Ahu Dabbab shear zone, (c) cross section B–B' showing thrust duplexes around Wadi El-Umra shear zone. Strike-slip shear zones are shown with circle symbols indicating, sense of slip (block with circled X symbol moves away from the observer).