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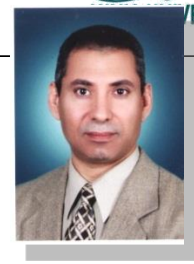


Name : Prof. Dr. Esam S. Farahat

Dept. : Geology

Title : Neoproterozoic podiform chromitites in serpentinites of the Abu Meriewa–Hagar Dungash district, Eastern Desert, Egypt: Geotectonic implications and metamorphism

F. F. Abu El Ela and **Esam S. Farahat**

Journal : Island Arc, 19, 151-164 (2010)**.**

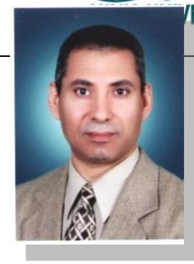
DOI: 10.1111/j.1440-1738.2009.00689.x **Impact Factor:** 1.03

Abstract :

Podiform chromitites hosted in serpentinites (after harzburgite and dunite) and talc-carbonate rocks from the Abu Meriewa–Hagar Dungash district (MHD), Eastern Desert of Egypt, together with metagabbros, pillow metavolcanics, and metasediments, form an ophiolitic mélange formed during the Neoproterozoic Pan-African Orogeny. The chromitites show massive, disseminated, and nodular textures. Chromite cores in chromitites have high and restricted ranges of Cr# (0.65–0.75) and Mg# (0.64–0.83), implying primary compositions not affected by metamorphism. Therefore, they are used as reliable indicators of parent magma composition and tectonic affinities of these highly metamorphosed rocks. On the contrary, the altered rims are high-Cr, low-Fe3+ spinel (rather than ferritchromit) enriched in Cr, Fe, and Mn, and depleted in Al and Mg (Cr# = 0.75–0.97, Mg# = 0.29–0.79), due to equilibration with interstitial silicates during regional metamorphism up to transitional greenschist–amphibolite facies at about 500–550°C. The primary chromite compositions suggest derivation from a high-Mg tholeiitic, to possibly boninitic, parental magma in a supra-subduction zone (arc–marginal basin) environment, similar to the spatially associated metavolcanic rocks. The MHD chromitites are most probably formed by melt–rock interaction mechanisms. The high Cr# of the investigated chromites suggests high degrees of partial melting of a depleted harzburgite source by interaction with primitive basaltic melt of deeper origin followed by mixing. Such Cr-rich chromites are common in chromitites from the Eastern Desert of Egypt, implying broad thermal anomalies, possibly linked to an important geodynamic feature of the Arabian–Nubian Shield (ANS) evolution. This could revive interest in models that involve asthenospheric uprise, related to plume interaction or most probably due to oblique convergence of arc terranes during early evolution of the ANS.

Keywords :

Chromitites, Egypt, Neoproterozoic, ophiolites, Pan-African, serpentinites



Name : Prof. Dr. Esam S. Farahat

Dept. : Geology

Title : Geotectonic significance of Neoproterozoic amphibolites from the Central Eastern Desert of Egypt: a possible dismembered sub-ophiolitic metamorphic sole

Esam S. Farahat

Journal : Lithos, 125, 781-794 (2011)**.**

DOI: 10.1016/j.lithos.2011.04.009 **Impact Factor:** 3.12

Abstract :

Supra-subduction zone ophiolites in the Egyptian Central Eastern Desert (CED) occur as clusters in its northern (NCEDO) and southern (SCEDO) parts, displaying abundant island arc–boninitic and MORB/islandarc geochemical affinities, respectively. An amphibolite belt, including the investigated massive to slightly foliated Wadi Um Gheig (WUG) amphibolites, is exposed in the southeast most of the NCEDO thrusting over the El Sibai gneissic association and intruded by late- to post-orogenic granitoids and gabbros. The WUG rocks are metamorphosed under epidote amphibolite to common amphibolite facies. The amphiboles are calcic and represented by actinolitic hornblende to magnesio-hornblende in the epidote amphibolites and magnesio- to ferro-hornblende in the amphibolites. Plagioclase composition varies from pure albite (An3–8) in the epidote amphibolites to andesine and labradorite (An36–65) in the amphibolites. The estimated P–T conditions are in favor of their metamorphism under epidote amphibolite (c. 550–600 °C and 2–3±1.5 kbar) and amphibolite (c. 618–720 °C and 3–6±1.5 kbar) facies. The peak metamorphic conditions point to a burial depth of c.15–20 km.

Geochemically, the WUG amphibolites show basaltic to andesitic compositions of tholeiitic affinity. They display LILE-enriched MORB-normalized patterns with negative Nb anomalies characteristic of the subduction-related rocks. However, their chondrite-normalized rare-earth element (REE) patterns vary from LREE-depleted (LaN/YbN=0.29 to 0.49) to LREE-enriched (LaN/YbN=2.97 to 3.74). Few samples show major and trace element contents typical of boninitic rocks, including U-shaped REE pattern. On the standard tectonic discrimination diagrams the WUG amphibolites plot mostly in the island-arc fields with some samples of MORB and boninitic affinities. Greenschist facies metamorphosed NCEDO obviously share these geochemical characteristics, implying formation in the same tectonic environment, i.e. forearc basin. This argues that the WUG amphibolites likely represent remnants of a dismembered metamorphic sole beneath the NCEDO. Their formation possibly involves intra-forearc basin thrusting followed by emplacement of ophiolite as imbricated stack of dismembered thrust slices in an accretionary wedge setting. This revives interests in geotectonic model in which the CED represents a forearc–arc–back-arc system above a southeastdipping subduction zone.

Keywords :

Amphibolites, ANS, Ophiolites, Geochemistry, Metamorphic sole, Egypt

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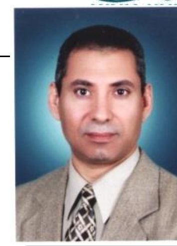

Name : Prof. Dr. Esam S. Farahat

Dept. : Geology

Title : Post-collisional magmatism in the northern Arabian-Nubian Shield: The geotectonic evolution of the alkaline suite at Gebel Tarbush area, south Sinai, Egypt.

Esam S. Farahat and Mokhles K. Azer

Journal : Chemie der Erde (Geochemistry), 71, 247-266 (2011)**.**

DOI: 10.1016/j.chemer.2011.06.003 **Impact Factor:** 1.53

Abstract :

Post-collisional alkaline magmatism (~610–580 Ma) is widely distributed in the northern part of the Neoproterozoic Arabian-Nubian Shield (ANS), i.e. the northern part of the Egyptian Eastern Desert and Sinai. Alkaline rocks of G. Tarbush constitute the western limb of the Katharina ring complex (~593±16 Ma) in southern Sinai. This suite commenced with the extrusion of peralkaline volcanics and quartz syenite subvolcanics intruded by syenogranite and alkali feldspar granite. The mineralogy and geochemistry of these rocks indicate an alkaline/peralkaline within-plate affinity. Quartz syenite is relatively enriched in TiO_2, Fe_2O_3, MgO, CaO, Sr, Ba and depleted in SiO_2, Nb, Y, and Rb. The G. Tarbush alkaline suite most likely evolved via fractionation of mainly feldspar and minor mafic phases (hornblende, aegirine) from a common quartz syenite parental magma, which formed via partial melting of middle crustal rocks of ANS juvenile crust. Mantle melts could have provided the heat required for the middle crustal melting. The upper mantle melting was likely promoted by erosional decompression subsequent to lithospheric delamination and crustal uplift during the late-collisional stage of the ANS. Such an explanation could explain the absence or scarce occurrence of mafic and intermediate lithologies in the abundant late to post-collisional calc-alkaline and alkaline suites in the northern ANS. Moreover, erosion related to crustal uplift during the late-collision stage could account for the lack or infrequent occurrence of older lithologies, i.e. island arc metavolcanics and marginal basin ophiolites, from the northern part of the ANS.

Keywords :

Arabian-Nubian Shield, Sinai, Post-collisional, A-type rocks, Ring complex

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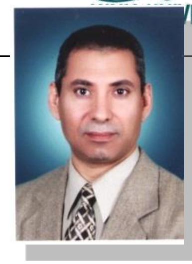

Name : Prof. Dr. Esam S. Farahat

Dept. : Geology

Title : Petrogenetic and geotectonic significance of Neoproterozoic suprasubduction mantle as revealed by the Wizer ophiolite complex, Central Eastern Desert, Egypt

Esam S. Farahat, G. Hoinkes and A. Mogessie

Journal : International Journal of Earth Science 100, 1433-1450 (2011).

DOI: 10.1007/s00531-010-0592-4 **Impact Factor:** 1.98

Abstract :

Ophiolite complexes, formed in a suprasubduction zone environment during Neoproterozoic time, are widely distributed in the Eastern Desert of Egypt. Their mantle sections provide important information on the origin and tectonic history of ocean basins these complexes represent. The geochemistry and mineralogy of the mantle section of the Wizer ophiolite complex, represented by serpentinites after harzburgite containing minor dunite bodies, are presented. Presence of antigorite together with the incipient alteration of chromite and absence of chlorite suggests that serpentinization occurred in the mantle wedge above a Neoproterozoic subduction zone. Wizer peridotites have a wide range of spinel compositions. Spinel Cr# [100Cr/(Cr ? Al)] decrease gradually from dunite bodies (Cr# = 81–87) and their host highly depleted harzburgites (Cr# = 67–79) to the less depleted harzburgites (Cr# =57–63). Such decreases in mantle refractory character are accompanied by higher Al and Ti contents in bulk compositions. Estimated parental melt compositions point to an equilibration with melts of boninitic composition for the dunite bodies (TiO2 = *\0.07–0.22 wt%; Al2O3 = 9.4–10.6 wt%), boninitic-arc tholeiite for the highly depleted harzburgites (TiO2 =\0.09–0.28 wt%; Al2O3 = 11.2–14.1 wt%) and more MORB-like affinities for the less depleted harzburgites (TiO2 = *\0.38–0.51 wt%; Al2O3 = 14.5–15.3 wt%). Estimated equilibrium melts are found in the overlying volcanic sequence, which shows a transitional MORB–island arc geochemical signature with a few boninitic samples. Enrichment of some chromites in TiO2 and identification of sulfides in highly depleted peridotites imply interaction with an impregnating melt. A two-stage partial melting/melt–rock reaction model is advocated, whereby, melting of a depleted mantle source by reaction with MORB-like melts is followed by a second stage melting by interaction with melts of IAT–boninitic affinities in a suprasubduction zone environment to generate the highly depleted harzburgites and dunite bodies. The shift from MORB to island arc/boninitic affinities within the mantle lithosphere of the Wizer ophiolite sequence suggests generation in a protoarc-forearc environment. This, together with the systematic latitudinal change in composition of ophiolitic lavas in the Central Eastern Desert (CED) of Egypt from IAT–boninitic affinities to more MORB-like signature, implies that the CED could represent a disrupted forearc-arc-backarc system above a southeast-dipping subduction zone.

Keywords :

Pan-African, ANS, Ophiolites, Serpentinites, Spinels, Egypt

Name : Prof. Dr. Esam S. Farahat

Dept. : Geology

Title : Neoproterozoic calc-alkaline peraluminous granitoids of the Deleihimmi pluton, Central Eastern Desert, Egypt: implications for transition from late- to post-collisional tectonomagmatic evolution in the northern Arabian–Nubian Shield

Esam S. Farahat, R. M. Zaki, C. Hauzenberger and M. Sami

Journal : Geological Journal, 46, 544-560 (2011)**.**

DOI: 10.1002/gj.1289 **Impact Factor:** 1.08

Abstract :

The widely distributed late-collisional calc-alkaline granitoids in the northern Arabian–Nubian Shield (ANS) have a geodynamic interest as they represent significant addition of material into the ANS juvenile crust in a short time interval (630–590 Ma). The Deleihimmi granitoids in the Egyptian Central Eastern Desert are, therefore, particularly interesting since they form a multiphase pluton composed largely of latecollisional biotite granitoids enclosing granodiorite microgranular enclaves and intruded by leuco- and muscovite granites. Geochemically, different granitoid phases share some features and distinctly vary in others. They display slightly peraluminous (ASI¼1–1.16), non-alkaline (calc-alkaline and highly fractionated calc-alkaline), I-type affinities. Both biotite granitoids and leucogranites show similar rare earth element (REE) patterns [(La/Lu)N¼3.04–2.92 and 1.9–1.14; Eu/Eu¼0.26–0.19 and 0.11–0.08, respectively) and related most likely by closed system crystal fractionation of a common parent. On the other hand, the late phase muscovite granites have distinctive geochemical features typical of rare-metal granites. They are remarkably depleted in Sr and Ba (4–35 and 13–18 ppm, respectively), and enriched in Rb (381–473 ppm) and many rare metals. Moreover, their REE patterns show a tetrad effect (TE1,3¼1.13 and 1.29) and pronounced negative Eu anomalies (Eu/Eu¼0.07 and 0.08), implying extensive open system fractionation via fluid–rock interaction during the magmatic stage. Origin of the calc-alkaline granitoids by high degree of partial melting of mafic lower crust with subsequent crystal fractionation is advocated. The broad distribution of late-collisional calc-alkaline granitoids in the northern ANS is related most likely to large areal and intensive lithospheric delamination subsequent to slab break-off and crustal/mantle thickening. Such delamination caused both crustal uplift and partial melting of the remaining mantle lithosphere in response to asthenospheric uprise. The melts produced underplate the lower crust to promote its melting. The presence of microgranular enclaves, resulting from mingling of mantle-derived mafic magma with felsic crustalderived liquid, favours this process. The derivation of the late-phase rare-metal granites by open system fractionation via fluid interaction is almost related to the onset of extension above the rising asthenosphere that results in mantle degassing during the switch to post-collisional stage. Consequently, the switch from late- to post-collisional stage of crustal evolution in the northern ANS could be potentially significant not only geodynamically but also economically.

Keywords :

late-collisional granitoids; rare-metals; Neoproterozoic; geotectonics; Arabian–Nubian Shield; Egypt

Name : Prof. Dr. Esam S. Farahat

Dept. : Geology

Title : Late Neoproterozoic volcano-sedimentary successions of Wadi Rufaiyil, southern Sinai, Egypt: A case of transition from late- to post-collisional magmatism

Mokhles K. Azer and **Esam S. Farahat**

Journal : Journal of Asian Earth Sciences 42, 1187-1203 (2011)**.**

DOI: 10.1016/j.jseaes.2011.06.016 **Impact Factor:** 2.22

Abstract :

The Neoproterozoic Wadi Rufaiyil volcano-sedimentary successions are exposed in southern Sinai (Egypt), at the northernmost segment of the Arabian–Nubian Shield (ANS). Two eruption phases have been recognized within these successions; both of them are intercalated with the Hammamat Clastics. The lower unit is composed predominantly of andesite to dacite and less commonly tuffs, while the upper one comprised mainly rhyolite with subordinate dacite–rhyodacite and their pyroclastics. The lower Hammamat Clastics are intermediate in compositions, contrary to the upper ones which are acidic and more mature. Geochemically, the volcanic rocks are mostly high-K calc-alkaline, corresponding to andesite through dacite–rhyodacite and rhyolite. Evolved parts of the younger phase (i.e., rhyolite) have transitional character to alkaline A-type magma, related most likely to their high fractionated nature rather than a switch in the tectonic regime. REE patterns are characterized by fractionated LREE [$(La/Sm)_n$ = 2.50–3.38] and nearly flat HREE [$(Gd/Lu)_n$ = 1.16–1.62], where the most evolved variants display prominent negative Eu anomalies (Eu/Eu = 0.04–0.46). Dokhan Volcanics and associated Hammamat Clastics from Sinai and the Egyptian Eastern Desert (ED) share these geochemical characteristics. The Wadi Rufaiyil lavas display geochemical characteristics of both pre-collisional arc-type and post-collisional within-plate environments, suggesting eruption in a transition from late- to post-collisional tectonic setting. The integrated data point to generation by partial melting of mafic lower crust and/or upper mantle source to produce andesitic–dacitic (tonalite) magma with subsequent extensive fractional crystallization. The extrusion of the Wadi Rufaiyil volcanics was likely associated with extensive denudation of the pre-630 Ma orogenic edifice as well as the 630–600 Ma late-collisional products. Such a scenario implies delamination of thick lithosphere root during late- to post-collisional stage, facilitating the upwelling of hot asthenopsheric material and surface uplifting of northern ANS. This may have been the trigger to transition into the widespread post-collisional alkaline A-type magmatism at ~600 Ma.

Keywords :

Neoproterozoic, Arabian–Nubian Shield, Dokhan Volcanics, Geochemistry, Tectonic setting, Post-collisional