Geochemistry of Neoproterozoic Alaskan-type rocks (Egypt): variations of hydrous magma related to mantle heterogeneity

MOHAMED ZAKI KHEDR*[1] AND SHOJI ARAI[2,3]

[1]Department of Geology, Faculty of Science, Kafrelsheikh University, El-Geish Street, 33516, Kafrelsheikh, Egypt.

2Department of Earth Sciences, Graduate School of Natural Science and Technology, Kanazawa University, Kakuma, Kanazawa, Ishikawa 920-1192, Japan.

3Research and Development Center for Ocean Drilling Science, JAMSTEC, Yokosuka 237-0061, Japan.

*Corresponding author. Tel: +2-047-3215174, Fax:+2-047-3215175.E-ml: khedrzm@yahoo.com, khedrzm75@gmail.com

The Dahanib intrusions in the Southern Eastern Desert of Egypt, shows the concentric zonation, from dunites at the core, through chromitites, clinopyroxene-rich dunites, wehrlites, harzburgites, gabbronorites, and layered gabbros, to hornblende gabbros/diorites at the rim, similar to Alaskan-type complexes. These lithologies show typical cumulate textures and layering. Their clinopyroxene (Mg#s, 0.62–0.95) shows Fe, Mn and Na enrichment, but Al, Cr, Mg and Ti depletion with differentiation. Their chromian spinels have a wide range of Cr# (0.31–0.61) along with higher average contents of TiO_2 (0.7 wt.%) and Y_{Fe} (0.18) relative to the nearest ophiolitic peridotites due to their origin by crystal accumulation and reaction with interstitial melts/liquids. The olivines in cumulate peridotites are lower in foresterite (Fo_{83}–Fo_{92}) and NiO_2 (0.15–0.37 wt.%) relative to the nearest ophiolitic olivines because of the reaction with interstitial liquids and its parent melts. The large variations of lithology and chemistry as well as the occurrence of scattered chromitite clots in the Dahanib peridotites are related to continuous injection of primitive magmas and/or the reaction between the intercumulus liquids and the early cumulus crystals; this is associated with high rate of crystal segregation by multistage fractional crystallization. The changes in lithology type, mineral composition and chemistry between Dahanib intrusions and the nearest intrusions (distance ~ 50 km) suggest variations of their parental melts attributed to the mantle heterogeneity and the subducted-slab inputs. The clinopyroxenes (Cpxs) in peridotites and gabbroic rocks are depleted in LREE relative to HREE, similar to those of Cpx crystallized from asthenospheric melts. The mineral inclusions in spinel, chemistry of Cpx in peridotites (enriched in Al, Cr, Na, Ti, ΣREE=13.7) and Cpx equilibrium melts (6–100 times chondrite) suggest that the Neoproterozoic lithosphere were partially refertilized by trace asthenospheric melts. The early magmas were possibly enriched in Mg, Cr, Ni, Ti, V, and Sr, while the evolved types were rich in Fe, Mn, Na, Li, Zr, Co and REE contents via crystal accumulation and interaction with interstitial liquids. The Neoproterozoic island-arc magmas are tholeiitic affinity with high Fe, Mg, Na, Ti, Ni, Al, Cr, Sr and REE, but low in K and HFSE (Nb, Ta and Zr).