Pan African mafic-ultramafic cumulate intrusions SW Sinai massif: mineralogy, geochemistry and crustal growth

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Late Proterozoic mafic-ultramafic cumulates were intruded toward the end of the Pan African event (950–550 Ma). The rocks constitute cyclic units of repeated sequence: wehrlite, clinopyroxenites and gabbros, locally crossed by the dyke-like bodies of anorthosites and trondhjemites. Crystal fractionation apears to have occurred in an open system, where the cumulates involve the following cumulus assemblages, in sequences of increasing fractionation: (i) ol + opx + cpx + cr-spin, (ii) ol + cpx + cr-spin, (iii) ol + plag + cpx ± Hbl, (iv) plag + Hbl, (v) plag. Cryptic and phase layering indicate at least five to eight stratigraphic regressions to higher temperature assemblages. These regressions are interpreted as reflecting periodic replenishment of the magma chamber with fresh melt. Each batch of fresh melt is apparently mixed with the differentiated residue of the previous batch.The large reciprocal variations of Cr and Al in chromian-spinel and the strong correlation of increasing cr-number and decreasing mg-number, reflected a high degree of partial melting of an undepleted continental mantle source region. The peridotites and gabbros contain intercumulus

and cumulus hornblende respectively, which is rich in K_2O (0.2–0.7 wt%) with TiO_2/K_2O ratio varing between2 and2 respectively. The hydrous, K_2O-rich and TiO_2-poor nature of the peridotite magma might be due to addition of fluids to the mantle material before and/or during partial melting. The source of these fluids is attributed to a subducted slab. The mafic-ultramafic rocks of SW Sinai could therefore be considered as relict diapir generated above the subducted slab and ascended through the mantle wedge.

Introduction

The Egyptian Shield of Eastern Desert and southern Siani formed during the Pan African orogenic episode (*sensu lato*; 950–550 Ma) by initiation, maturation and amalgamation of island arc terrains - a similar scenario to that in Arabain Shield (Stern *et al.*, 1989). Vail (1988) envisaged massive intrusions of late to post tectonic granites, thrusting, strike-slip faulting and dykes emplacement during the final stage of the evolution process (650–500 Ma). The late- to post- orogenic ultramafic-mafic cumulates in concern, were intruded into the southern Sinai segment during the third episode (640–550 Ma) of crustal growth of the Sinai massif (Essawy and El-Metwally, 1992).

This work specifically concerns the mineralogical and geochemical evidences of the generation and evolution of mantle derived melt of the late to post orogentic ultramafic-mafic intrusions from the south-western Sinai massif. To acheive that 62 samples were chemically analysed by XRF and 25 samples were analysed by microprobe micro-analyser.

Petrography

The fractional crystallization in the mafic-ultramafic cumulates appears to have envolved the following cumulus assemblages (in sequence of increasing fractionation): (i) ol + opx + chr. spin + cpx, (ii) ol + cpx + chr-spin, (iii) ol + plag + cpx, (iv) plag + Hbl and (v) plag. The cumulate textures vary from orthocumulates, mesocumulates to adcumulates. In the cumulate rocks, features such as tabular (plagiocalse) lamination, rhythmic layering, isomodal accumulation and current laminations are locally well developed.

Mineral chemistry and geochemistry

The chemistry of the chromian-spinel of peridotites reveals (Fig. 1) affinities similar to that of the layered intrusions (Dick and Bullen, 1984). The chromian-spinel shows:cr-number 100Cr/(Cr + Al)) mostly more than 60 and mg-number (100 Mg/(Mg + Fe2*)) less than 60. Olivines vary in composition from $fo_{86.8}$ to $fo_{83.5}$. Hypersthene has average of $wo_{4.6}$ en_{68} $fs_{27.4}$ and diopside has average of $wo_{47.1}$ $en_{44.2}$ $fs_{8.4}$. Ca-plagioclase has an average composition of An_{91-45}. In terms of TiO_2-K_2O contents in magnesio-hornblendes of

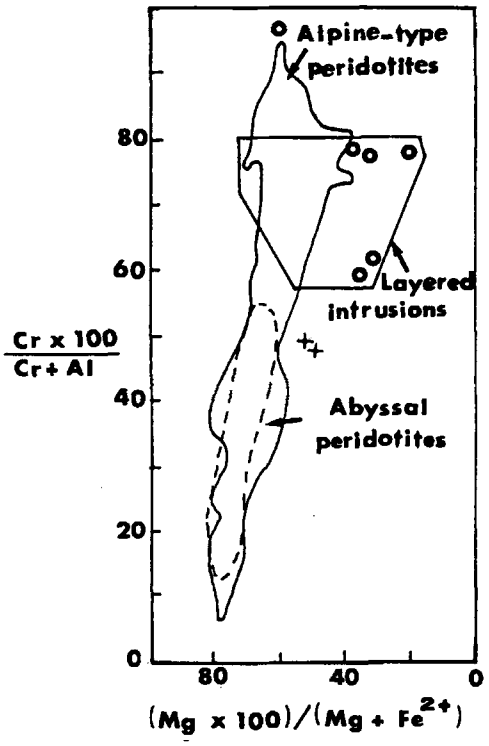

FIG. 1. Composition of chromian-spinel in ultramafic cumulates in terms of 100 Cr/(Cr + AL) versus 100 Mg/(Mg + Fe_{2+}) and discrimination fields are after Dick and Bullen (1984). Crosses denote wehrlites and opened circles indicate clinopyroxenites.

clinopyroxenite and gabbros, Fig. 2 depicts that these samples display the TiO_2/K_2O range (0.7–4) correlated with primitive continental basalts given by Ozawa (1988). Therefore the continental environment is a possible tectonic regime for the source primitive magma of peridotites and gabbros inconcern.

The rocks exhibit low values of Ba, Zr, and K_2O which are behaved incompatibly during the course of the crystallization of ultramafic and mafic units. While Sr and Rb are incompatible in ultramafic and are changed to be compatible in the mafic varities. The low values of incompatible

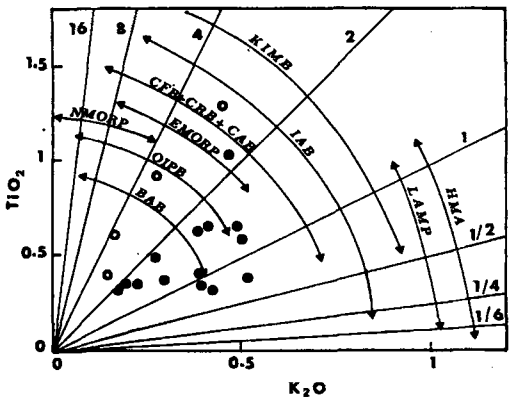

FIG. 2. TiO_2 versus K_2O contents of hornblende in clinopyroxenites (o) and gabbros (o). The range of TiO_2/K_2O ratio for primitive basalts are after Ozawa (1988): BAB = back-arc basin; NMORB, EMORB = N-type and E- type mid oceanic ridge basalts; OIPB = Oceanic intraplate basalt; CFB + CRB + CAB = Continental flood basalt, continental rift basalt and other ycontinental basalt; IAB = Island arc basalt; HMA = high magnesian andesite; KIMP Kimbelite and LAMP = Lamporite.

elements in ultramafic varities is consistent with the adcumulate nature of these rocks.

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