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ABSTRACT

The El-Genena El-Gharbia Intrusion (GEI) is unmetamorphosed reversely zoned layered intrusion emplaced in the south Eastern Desert of Egypt. It pertains to the Late-Precambrian Pan-African younger basic-ultrabasic intrusions (El-Gaby et al., 1988).

The GEI occurs as a funnel-shaped body of moderate to high relief, intruded along a fault extending NW-SE. It comprises mainly three co-genetic successive pulses having sharp intrusive relationship against each other. The earliest pulse (outer unit) builds up uralitized gabbro intercalating coarse-grained lensoidal bodies of hornblende gabbro characterized by hypidiomorphic granular texture. The subsequent pulse (middle unit) is formed of steeply dipping outward layered sequences, each sequence starts at the base with a melanocratic olivine-gabbronorite followed upwards by olivine gabbronorite and ends with leucocratic olivine gabbronorite and olivine norite. The latest pulse (inner unit) is made up mainly of dunite intercalated with subordinate layers of harzburgite and lherzolite. Mineral analyses showed that there is a considerable overlap in compositional range in the three pulses. The constituent minerals in the Peridotite unit covers compositional ranges of Fo$_{82-79}$, Mg$^\#_{\text{Cpx}}$ 84-88, Mg$^\#_{\text{Opx}}$ 78-84, and An$_{73-59}$, while they are Fo$_{84-71}$, Mg$^\#_{\text{Cpx}}$ 77-86, Mg$^\#_{\text{Opx}}$ 74-82, An$_{81-76}$ in the layered gabbro unit and Mg$^\#_{\text{Cpx}}$ 78-74, and An$_{83-78}$ in the uralitized gabbro unit. Application of two pyroxenes thermometer yields crystallization temperatures of about 1050-950°C for solidification of the inner and middle rock units while application of amphibole plagioclase thermometer yields temperatures of about 900-850°C for solidification of the hornblend gabbro in the outer rock unit. Application of the clinopyroxene geobarometer indicates a crystallization pressure ranging from 7 to 5.9 kbar.

Whole rock and mineral chemistry indicate that the rock units constituting GEI were derived from one parental melt. The GEI does not possess a chilled margin and contemporaneous dykes to infer the composition of the parental melt. The co-precipitation of Ca-rich and Ca-poor pyroxenes, the delayed precipitation of iron oxides and the development of quartz bearing late differentiates, however, imply that the parental melt had tholeiitic affinity. The limited presence of Ca-amphibole in the late differentiates of hornblende gabros indicate that the parental melt was water undersaturated, but the crystallization of anhydrous phases in the early stages would increase gradually the water in the melt and stabilize the Ca-amphibole in the final stage of crystallization. Application of the olivine-orthopyroxene-spinel oxygen geobarometer for the peridotite and layered gabbro units define $\Delta \log_{10}(f_O)$ FMQ ranging from -2.43 to -1.56 while ilmenite-titanomagnetite thermometer for the last differentiates of hornblende gabros defines $\Delta \log_{10}(f_O)$ FMQ ranging from +375 to +2.2, confirming a crystallisation system with respect to oxygen.

The observed reverse sequence of GEI is attributed to successive tapping of vertically stratified, deeper level magma chamber, whereby the magma had more evolved compositions upwards. The tapping most probably happened due to the rejuvenation and re-opening of a major fault extending NW-SE. Successive tapping of this stratified magma chamber would result in the formation firstly of uralitized gabbro unit, then the layered gabbro unit and finally the peridotite unit. The reverse zonation in GEI therefore did not result from differentiation in situ, but accumulated from successive magma pulses tapped from single stratified magma chamber.

References