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# Late Neoproterozoic layered mafic intrusion of arc-affinity in the Arabian-Nubian Shield: A case study from the Shahira layered mafic intrusion, southern Sinai, Egypt

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## | ABSTRACT |

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The Shahira Layered Mafic Intrusion (SLMI), which belongs to the late Neoproterozoic plutonic rocks of the Arabian-Nubian Shield, is the largest layered mafic intrusion in southern Sinai. Field relations indicate that it is younger than the surrounding metamorphic rocks and older than the post-orogenic granites. Based on variation in mineral paragenesis and chemical composition, the SLMI is distinguished into pyroxene-hornblende gabbro, hornblende gabbro and diorite lithologies. The outer zone of the mafic intrusion is characterized by fine-grained rocks (chilled margin gabbroic facies), with typical subophitic and/or microgranular textures. Different rock units from the mafic intrusion show gradational boundaries in between. They show some indications of low grade metamorphism, where primary minerals are transformed into secondary ones. Geochemically, the Shahira layered mafic intrusion is characterized by enrichment in LILE relative to HFSE (e.g. Nb, P, Zr, Ti, Y), and LREE relative to HREE [(La/Lu)<sub>n</sub>= 4.75–8.58], with subalkaline characters. It has geochemical characteristics of pre-collisional arc-type environment. The geochemical signature of the investigated gabbros indicates partial melting of mantle wedge in a volcanic-arc setting, being followed by fractional crystallization and crustal contamination. Fractional crystallization processes played a vital role during emplacement of the Shahira intrusion and evolution of its mafic and intermediate rock units. The initial magma was evolved through crystallization of hornblende which was caused by slight increasing of H<sub>2</sub>O in the magma after crystallization of liquidus olivine, pyroxene and Ca-rich plagioclase. The gabbroic rocks crystallized at pressures between 4.5 and 6.9kbar (~15–20km depth). Whereas, the diorites yielded the lowest crystallization pressure between 1.0 to 4.4Kbar (<10km depth). Temperature was estimated by several geothermometers, which yielded crystallization temperatures ranging from 835° to 958°C for the gabbros, and from 665° to 862°C for the diorites. Field, petrological, geochemical and mineralogical characteristics of the SLMI are akin to the Egyptian layered mafic-ultramafic intrusions of volcanic-arc setting, not ophiolitic rocks.

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**KEYWORDS** | Neoproterozoic. Arabian-Nubian Shield. Sinai. Layered mafic intrusion. Volcanic-arc.