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Possible genetic link between I-type granite and orogenic gold deposits in Egypt (metamorphic-magmatic interaction?)

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The orogenic gold deposits are a distinctive type of deposits that revealed unique temporal and spatial association with an orogeny. Where, the system of gold veins and related ore minerals was confined to hydrothermal solutions formed during compressional to transpressional deformation processes at convergent plate margins in accretionary and collisional orogens, with the respect to ongoing deep-crustal, subduction-related thermal processes.
In Egypt, most of vein-type and dyke-type gold mineralization are restricted to granitic rocks or at least near of granitic intrusion that seems to have had an important influence on gold mineralization. Shear zone-related, mesothermal gold deposits of Fatira and Gidami mines in the northern Eastern Desert of Egypt are found within granitic bodies or at the contact between granites and metavolcanic rocks. The hosting-granitic rocks in Fatira and Gidami areas are mainly of granodioritic composition (I-Type granite) which is related to calc-alkaline magmatic series. However, Fatira granitoids were developed within island arc tectonic settings related to mature island arc system (Late-orogenic stage), at relatively low temperature (around 660° C) and medium pressure between (5 – 10 Kbar). On the other hand, Gidami granitoids were developed during the collision stage in continental arc regime related to active continental margin (Syn-orogeny), which were crystallized at relatively high temperature (700-720° C) and low pressure (around 0.1 Kbar).
The ore mineralogy includes pyrite, chalcopyrite, sphalerite, covellite, ilmenite, goethite ± pyrrhotite ± pentlandite ± galena ± molybdenite. Native gold is detected only in Gidami mineralization as small inclusions within pyrite and goethite or as tiny grains scattered within quartz vein (in close proximity to the sulfides). In Fatira deposits, it is detected only by microprobe analysis within the crystal lattice of pyrite and jarosite. Fluid inclusions study for the mineralized ores revealed two main groups of fluid inclusions in both areas: A) Aqueous inclusions (H_2O-NaCl±KCl system), and B) Carbonic inclusions (H_2O-CO_2-NaCl±CH4). A drop of pressure during the migration of these fluids to shallower depths along the shear zones was the main reason for phase separation. Isochores calculation from microthermometric results proved that, the P–T boundary conditions outlined for Fatira gold deposits are of 275° to 297° C and between (0.2 – 1.2 Kbar); and of 277° to 300° C and between (0.2 - 1 Kbar) for Gidami gold deposits. The normalization Chondrite patterns of rare earth elements (REEs) for the gold-ore deposits with the surrounding I-type granitic rocks exhibit an obvious similarity and positive correlation. The geological, mineralogical, geochemical and fluid inclusions studies revealed a genetic link between gold mineralization and intrusion of calc-alkaine granitic magma. Whereas, The granitic magma acts as a supplier for the ore-bearing fluid and as a heat source for metamorphic processes, leading to hydrothermal convection currents.