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Geology, Ore-microscopy and Fluid inclusion study on Auriferous Quartz Veins at the Gidami Gold Mine, Eastern Desert of Egypt

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The gold deposits are represented by auriferous quartz veins and aplitic dykes that are cutting through granitic rocks. The main lode of gold is confined to two principal veins occupying fracture zones and fissures. The main auriferous vein is striking mainly NNW-SSE with dipping 85° NE, it extends up to 450 m with an average thickness 120 cm. The second vein is striking NW-SE and dipping 60° E, it extends for 150 m with an average thickness 35 cm. The gold bearing veins are made up of fine grained quartz that is always massive, milky-white with reddish or greenish tint. They commonly include vugs, some of them are occasionally filled with iron oxides, carbonate and clay minerals. Sometimes the quartz veins enclose remnants of altered wall rock materials as an indication for the metamorphic or syntectonic nature of the veins. Brecciation, comb layering, swelling and nodules manganese dendrites are usually detected.

The microscopic examination for thin and polished sections of auriferous quartz veins revealed that quartz and calcite are the predominant minerals commonly associated with accessory minerals (fluorite, apatite, zircon, muscovite and sericite). Ore mineral assemblage is found as disseminated sulfide minerals (pyrite, sphalerite, chalcopyrite, molybdenite, pyrrhotite covellite, galena and pentlandite). Ilmenite and goethite are the main iron oxide mineral phases. Gold most commonly occurs as small inclusions within pyrite or goethite. Gold also occurs as tiny grains scattered within quartz vein (in close proximity to the sulfides) or as disseminated grains in the altered wall rocks. Hydrothermal alteration includes silicification, kaolinitization, sericitisation, carbonatisation confined to a delicate set of veins.

Petrography and microthermometry of fluid inclusions revealed that the majority of inclusions are of primary/pseudosecondary nature that occur in clusters and along growth zones or along intra-granular planar trails (pseudosecondary inclusions). Two types of samples were taken from the auriferous quartz vein; samples from the outer zone (Rim) and samples from the inner zone (Core). With respect to number of phases present at the room temperature (20 °C) there are two main groups of fluid inclusions can be recognized in both zones: A) two-phase – aqueous inclusions (Type I) and B) three-phase – carbonic-rich inclusions (Type II). Type I inclusions could be further subdivided into two sub-types (H_2O-NaCl±KCl) and (H_2O-NaCl±MgCl2) systems, based mainly on the eutectic temperature (Teu). For (H_2O-NaCl±KCl) system, eutectic temperatures range from -22.1 °C to -23.9 °C at the rim and from -22.7 °C to -23.5 °C at the core. Values of homogenization temperatures (Th) are between (190.4 °C - 273.1 °C) at the rim and between (217 °C - 281.1 °C) at the core. Salinity has a range of (0.73 to 4.7 mass% of NaCl) at the rim and (0 to 1.65 mass% of NaCl) at the core. For (H_2O-NaCl± MgCl2) system, eutectic temperatures range from -32.7 °C to -35 °C at the rim and from -33.9 °C to -34.2 °C at the core. Values of homogenization temperatures are up to 376.1 °C at the rim and between (310.6 °C - 480.2 °C) at the core. Salinity has a range of (2.15 to 3.8 mass% of NaCl) at the rim and (2.15 to 3.65 mass% of NaCl) at the core. Type II inclusions of (H_2O–NaCl-CO_2±CH4) system, most of them were homogenized to liquid state and the other were homogenized to vapour or rarely to critical state. The total homogenization temperature ranges between (260 °C - 340 °C) at the rim with low salinity (0 – 4.2 mass% NaCl equiv.) and density of range (0.49 – 0.86 g/cc). Within core samples, the total homogenization temperature ranges between (299.9 °C - 408.8 °C) with salinity (3.73 – 4.78 mass% of NaCl equiv.) and density of range (0.61 - 0.87 g/cc). These data are consistent with transportation of gold as a bisulphide complex, likely due to decreases in sulphur activity accompanying fluid unmixing.