Economic Geology, v. 103, pp. 405–424

Origin and Evolution of the Um Egat and Dungash Orogenic Gold Deposits, Egyptian Eastern Desert: Evidence from Fluid Inclusions in Quartz

B. A. Zoheir,

Department of Geology, Benha Faculty of Science, Benha 13518, Egypt

A. K. El-Shazly,†

Geology Department, Marshall University, Huntington, West Virginia 25725

H. Helba, K. I. Khalil,

Geology Department, University of Alexandria, Alexandria, Egypt

and R. J. Bodnar

Department of Geosciences, Virginia Tech, Blacksburg,Virginia 24061

Abstract

Shear zone-related, mesothermal gold deposits of Um Egat and Dungash in the Egyptian Eastern Desert are hosted by greenschist facies metavolcanic and/or metasedimentary rocks of Pan-African age. Both deposits comprise boudinaged quartz veins that show evidence of incipient recrystallization, and are similar in alteration style, structural control, and mineralogy. The ore mineralogy includes pyrite, arsenopyrite ± pyrrhotite ± chalcopyrite ± galena; gold occurs both in the veins, usually included in arsenopyrite, pyrite, or pyrrhotite next to fragments of altered country rocks, or disseminated in the alteration haloes. Arsenic in arsenopyrite and Al^{iv} in chlorite geothermometers indicate that wall-rock alteration and ore mineral precipitation occurred at temperatures between 400° and 250°C.

Fluid inclusions in vein quartz occur in clusters, or along trails. Three types of fluid inclusions were identified based on petrography and laser micro-Raman spectroscopy: (1) two-phase carbonic inclusions with CO_2 + CH_4 ± N_2 ± H_2O, (2) two-phase aqueous inclusions, and (3) three-phase aqueous-carbonic inclusions with CH_4. Final melting of ice (Tm_f) for most inclusions occurs at temperatures between –4° and 0°C, indicating a low salinity (<6.5 wt % NaCl equiv) for the aqueous fluid. Homogenization temperatures (T_h) for the two-phase aqueous and aqueous-carbonic inclusions range from 120° to >300°C, but cluster into two distinct groups for each type of inclusion. Inclusions from the same trail or cluster are commonly characterized by different degrees of fill or different T_h values.

Field, petrographic, and microthermometric data suggest that low-salinity aqueous-carbonic fluids interacted with graphite-bearing metasedimentary rocks to form CH_4 at T >400°C and P >3 kbars. These reduced fluids leached gold as they circulated through the metavolcanic rocks, carrying it in the form of bisulfide complexes. Interaction of these aqueous-carbonic fluids with the country rocks caused hydrothermal alteration and precipitated gold-bearing sulfides in the alteration zones. A drop of pressure during the migration of these fluids to shallower depths along the shear zones led to phase separation at T ≤300°C and P ≤2.3 kbars. Quartz crystallizing over a range of lower temperatures and pressures trapped carbonic and aqueous fluids as separate inclusions in clusters along pseudosecondary and secondary trails. Postdepositional deformation caused decrepitation of some inclusions, and the stretching and leakage of others, increasing T_h to >250°C. Deformation also remobilized the gold, depositing it as globules of higher fineness in secondary sites.

† Corresponding author: e-mail, elshazly@marshall.edu