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THE ILOVITSA PORPHYRY CU-AU DEPOSIT: VEIN SEQUENCE,SULFIDE DEPOSITION AND FLUID INCLUSION STUDY

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Abstract

The Ilovitsa porphyry Cu-Au deposit is located 30 km away from the town of Strumitsa, SE FYR Macedonia. It is hosted in a Triassic granite (251.90 ±0.89 Ma, Georgiev et al. 2013).The latter intrudes into the metamorphic rocks of the Vertiscos-Ograzhden Unit of the Serbo-Macedonian massif. Formation of the Ilovitsa deposit is related to the intrusion of multiple Tertiary porphyry intrusions (called the Ilovitsa Stock) and dykes. The Ilovitsa stock that hosts the Cu-Au mineralization is made up by two main intrusions with a similar granodioritic composition dated by ID-TIMS at 30.31 ±0.05 Ma and 30.13±0.03 Ma (Georgiev et al. 2013). The authors have determined that the ages of the dykes are between 28.8 and 29.6 Ma.

The main goal of the present study is to distinguish the relative timing of different vein types, vein minerals and related hydrothermal alteration. In addition, we determined the temperature conditions of their formation based on a fluid inclusion study where appropriate fluid inclusion assemblages were found. For that purpose 7 drill holes were sampled and around 80 samples were collected for laboratory analyses. Cross-cutting relationships were used to distinguish the relative timing of vein formation. SEM-CL petrography was then used for identification and textural correlation between successive quartz types, sulfidesand fluid inclusion assemblages. Representative fluid inclusion assemblages were selected for further analyses by microthermometry. Hydrothermal veins were named according to their mineral assemblages and quartz textures. All analyses were performed at ETH Zurich.

We have distinguished several successive vein types: Magnetite or quartz-magnetite veinlets are up to few cm thick with potassic alteration. Quartz, where present, is granular with a homogeneous CL-gray luminosity. Barren quartz veins are divided into two subtypes: granular and crystalline quartz veins. Granular quartz veinlets are thin, with irregular walls and are related to potassic alteration. The quartz grains are anhedral with CL-dark luminescence. Crystalline quartz veins are composed of subhedral to euhedral quartz crystals that have oscillatory zoning ranging in luminosity from CL-gray to CL-bright. Data from microthermometry of brine inclusions show that they were formed at temperature higher than 600 °C. Generally, these veins were reopened and filled with minerals from later mineral assemblages in the central parts. Magnetite-bornite-chalcopyrite veinlets are rare in Ilovitsa. Pyrite-chalcopyrite±hematite form thin veinlets cutting the earlier vein types. Inclusions of gold in chalcopyrite are observed. These veins typically contain only minor amounts of CL-dark luminescent quartz. Fluid inclusions suitable for microthermometry undoubtedly connected to the formation of this quartz were not found that is why we could not constrain the temperature of formation of these veins. Quartz-molybdenite veins commonly contain open spaces lined by euhedral quartz crystals with oscillatory zoning. Generally, symmetric lines of molybdenite flakes, growing adjacent to the vein walls, are observed. Based on microthermometry of brine inclusions, we determined that these veins are high temperature (T > 600°C). Quartz-pyrite veins with sericitic alteration cut all of the above described veins. These veins contain only small amounts of CL-dark luminescent quartz and pyrite.Microthermometry data of two-phase fluid inclusions showed that they were formed at a temperature around 290°C. Quartz-galena-sphalerite (±pyrite, chalcopyrite) veins are widely distributed in Ilovitsa. Quartz forms idiomorphic crystals with oscillatory zoning. Microthermometry data of two-phase fluid inclusions trapped in sphalerite crystals show temperatures between 300 °C and 270 °C. Quartz-carbonate veins were formed during a post-ore stage. Carbonates are found in thin veinlets as well as in voids of earlier formed veins.

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