Ilovitsa porphyry Cu-Au deposit: sequence of vein formation and sulfide deposition

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Introduction

Ilovitsa porphyry Cu (Au) deposit is located in south-eastern Macedonia, 30 km from the town of Strumitsa. It is hosted in the Serbo-Macedonian Massif. Formation of Ilovitsa deposit is related to the intrusion of multiple Tertiary porphyry intrusions and dykes (predominantly granodioritic in composition, also mingling enclaves are observed) hosted in granites, intruded into metamorphic rocks of Vertiskos-Ograzhden Unit. The main goal of the present study is to distinguish the relative timing of different dykes, vein types, vein minerals and ore deposition, and related hydrothermal alteration. For that purpose 7 drill holes were sampled and around 80 samples containing various vein and alteration types were collected for laboratory analyses. Cross-cutting relationships were used to distinguish the relative timing of vein formation. Scanning electron microscope cathodoluminescence (SEM-CL) petrography was then used for identification and textural correlation between successive quartz types and sulfide distribution. Hydrothermal veins were named according to mineral assemblages and quartz textures.

Time relations of veins and mineralization

We have distinguished several successive vein types: an early quartz-magnetite; barren quartz veins; magnetite-bornite-chalcopyrite; pyrite-chalcopyrite; quartz-molybdenite; quartz-pyrite; quartz-galena-sphalerite and quartz-carbonate. *Magnetite or quartz-magnetite veinlets* are up to few cm thick with potassic alteration (mostly biotite and less K-feldspar). Quartz, where present, is granular with homogeneous CL-gray luminosity. *Barren quartz veins* are divided into two subtypes: granular quartz veinlets 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, oriented perpendicular to straight vein walls. The crystals have oscillatory zoning ranging in luminosity from CL-gray to CL-bright. Vein centers may have open spaces. Often the veins are reopened and filled with pyrite and chalcopyrite in the central parts. *Magnetite-bornite-chalcopyrite veinlets* are rare in Ilovitsa. They are thin and have irregular walls. *Pyrite-chalcopyrite±hematite* form thin veinlets cutting the earlier vein types. These veins typically contain only minor amount of CL-dark luminescent quartz. *Quartz-molybdenite veins* commonly contain open spaces lined by euhedral quartz crystals overgrowing a more granular zone along the vein walls. Often symmetric lines of molybdenite flakes, growing adjacent to the vein walls, are observed in these veins. Molybdenite forms also thin veinlets that cut crystalline quartz veins. *Quartz-pyrite veins* with sericitic alteration cut all of the above described veins. Often they are observed in the central parts of earlier formed veins. These veins contain only small amounts of CL-dark luminescent quartz and pyrite. *Quartz-galena-sphalerite (±pyrite, chalcopyrite) veins* are widely spread in Ilovitsa. Quartz forms idiomorphic crystals with oscillatory zoning. *Quartz-carbonate veins* are formed during a post-ore stage. Carbonates are found in thin veinlets as well as in voids of earlier formed veins. In some of these quartz generations different fluid inclusion types were distinguished and described, and several fluid inclusion assemblages were analyzed by microthermometry and LA-ICP-MS. It is necessary to study additional fluid inclusions in order to determine the P-T-X evolution of hydrothermal fluids during the different mineralization stages. Such analyses are currently performed in our group.