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Petrographic Study of the Magmatic Phases and Hydrothermal Vein Types from Degrmen Au-Cu Mineralization (Southern Serbia)

Szabolcs Orbán,[1,*] István Márton,[2] Ferenc Kristály,[3] Tamás Weiszburg,[1] Zsolt Benkó,[4] and Siniša Glisic[5]

[1]Eötvös Loránd University, Department of Mineralogy, Pázmány Péter setány 1/C, 1117, Budapest, Hungary
[2]Stockwork Geoconsulting Ltd, str. Prot. Aurel Munteanu, nr. 1, 405400, Huedin, Cluj, Romania
[3]University of Miskolc, Institute of Mineralogy and Geology, 3515, Miskolc-Egytemváros, Hungary
[4]Institute for Nuclear Research, Hungarian Academy of Sciences, Bem tér 18/c, Debrecen, 4026, Hungary
[5]Mineco Ltd, Mineco's Project Delivery Team

*Corresponding author: e-mail, szabolcs_orban@yahoo.com

The Degrmen Au-Cu porphyry mineralization is located in southern Serbia, at the western part of the Oligocene Lece magmatic complex, 230 km south of Belgrade. In this area (formerly named the "Kravarske Planine ore field"), exploration was conducted by the Serbian state from 1984 to 1987. Between 2011 and 2014, the Dunav Minerals doo exploration company completed preliminary resource drilling in the area, which proved the presence of a large, moderate-grade Au-Cu mineralized body.

The Lece magmatic complex forms a part of the Serbo-Macedonian-Rhodope province of the Tethyan metallogenic belt. It is characterized by lavas, breccias, and lapilli tuffs with dacitic to andesitic composition pierced by shallow-level dioritic intrusions. The complex is intruded into the metamorphic basement of the Serbo-Macedonian Massif and the ophiolites of the East Vardar zone along the Sava suture.

The aim of our study is a detailed characterization of the magmatic phases and the hydrothermal vein types occurring at the Degrmen Au-Cu porphyry mineralization. Samples were selected from three representative drill holes along a north-south section through the prospect. Investigations by transmitted and reflected polarized light microscopy, X-ray powder diffraction, and scanning electron microscopy (SEM) with energy dispersive spectrometry were performed.

The area of the Degrmen porphyry mineralization is composed by three porphyry stocks with subvertical pipe-like geometry, intruded into an andesitic volcanic and volcaniclastic sequence. The porphyry intrusive phases are separated by magmatic and hydrothermal breccias and several successive veinlets and associated alteration assemblages. The first (oldest) mineralized intrusion is elongated along an N-S direction. It is composed of fine- to medium-grained porphyritic microdiorite, comprising quartz, feldspar, amphibole, and biotite. This intrusion underwent strong sodic-calcic, potassic, moderate chloritic, and phyllic alterations. The second suite of intrusions, forming NW-SE–oriented pipe-like bodies, are composed of medium- to coarse-grained porphyritic microdiorite, comprising quartz, plagioclase, amphibole, and biotite. The second intrusion shows weak potassic, propylitic, and moderate phyllic alteration overprint. The first and second intrusions have the same primary mineralogical composition; only the alteration types vary. The third intrusion was formed as narrow dikes (1–10 m), and they underwent intensive phyllic and argillic alteration.

Copper is dominantly hosted by chalcopyrite (up to 30 μm size) or, rarely, bornite (usually as 1- to 10-μm inclusions in magnetite) and chalcocite in early M- and A-type veinlets or as dissemination associated with sodic-calcic and potassic alteration. Hypogene chalcocite and covellite frequently occur at the expense of chalcopyrite (as replacements) where primary porphyry mineralization-related assemblages are overprinted by late E-type epithermal veins. Gold and silver mineral phases (μm size, usually as electrum) were observed by SEM in association with copper sulfides in A-type veinlets.

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