

Formation of Native Copper in a Deep Marble-Hosted Cu-Au-Ag Skarn System at Dumitru Potok, Serbia

Mariana Kelly Segovia-More¹, Kalin Kouzmanov¹, Alexandra Tsay¹, Massimo Chiaradia¹, Elitsa Stefanova², Jelena Zivanovic³, Mladen Zdravkovic³, Vuk Milic³, Ivana Suzić³, Ivan Krumov³, Istvan Marton³, Stefan Metodiev³

¹Department of Earth Sciences, University of Geneva, Geneva, Switzerland, ²Geological Institute, Bulgarian Academy of Science, Sofia, Bulgaria, ³DPM Metals Inc., Toronto, Canada

The Dumitru Potok prospect, in the vicinity of the recently discovered Čoka Rakita high-grade gold skarn deposit, in the Late Cretaceous Timok Magmatic Complex (eastern Serbia), hosts deep stratabound Cu–Au–Ag mineralization in a marble-skarn altered limestone, spatially associated to a dioritic porphyry intrusion.

This contribution aims to reconstruct ore-forming processes and redox evolution in the prospect, studying samples along an east–west transect defined by eight drill holes. Field relationships, supported by petrographic observations (optical microscopy, QEMSCAN, CL) define a skarn system with prograde garnet- and locally pyroxene-bearing assemblages overprinted by an intensive retrograde alteration. Sulfide–oxide assemblages comprise chalcopyrite, bornite, chalcocite, digenite, magnetite, hematite, goethite and native copper as major phases, recording multiple mineralization episodes.

A pronounced lateral zonation is recognized. To the east, a typical hypogene Cu sulfide mineralization hosted in garnet-rich skarn is dominant, while to the west a sulfur-deficient copper mineralization, including native copper at ~1 km depth, associated with native Au, Ag, and Bi, chalcocite and digenite, is present. This mineralization is hosted in strongly oxidized garnet skarn where primary garnet is partially to extensively replaced by quartz–carbonate–goethite assemblage, overprinted by later quartz–calcite with minor chalcocite. This mineral association defines an unusual mineralization style within the system.

EPMA data indicate near-stoichiometric compositions of primary sulfides, suggesting limited chemical re-equilibration. In contrast, LA–ICP–MS trace element data reveal enrichment in Au, Ag, Zn, and Pb in goethite, consistent with late-stage metal redistribution under oxidizing conditions.

The occurrence of native copper in a deep hydrothermal setting, decoupled from typical supergene Cu oxide environment, points to non-classical formation mechanisms. Ongoing Cu isotope analyses aim to determine whether native copper formation reflects redox-driven sulfide dissolution and reprecipitation or a distinct hydrothermal pulse, providing new constraints on metal transport and precipitation in carbonate-hosted systems.