Hydrothermal Alteration Footprint of the Chelopech High-Sulfidation Cu-Au Epithermal Deposit, Bulgaria

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The Chelopech high-sulfidation (HS) Cu-Au epithermal deposit is located in Bulgaria, SE Europe, 75 km east of the capital Sofia and is part of Apuseni-Banat-Timok-Srednogorie Metallogenic Belt. The HS mineralisation is related to a Late Cretaceous (91.9±0.2 Ma) age magmatic complex which is represented as transition from shallow intrusive related phreatomagmatic environment to an underwater hydrothermal vent system, characterized by sulfide and sulphosalts-rich replacement zones associated with well-developed alteration and mineralisation zonation.

The alteration footprint has been identified and modeled, based on short-wave infrared (SWIR) analysis, whole rock geochemistry and drill logging data, systematically captured during the recent exploration and mining history of the deposit.

Based on SWIR data the core of the ore bodies is characterized by intense acid-sulfate alteration, including vuggy silica and APS minerals (K and Na alunite, svanbergite, woodhouseite), which laterally grades into silica-dickite-kaolinite alteration associated with Cu-Au-As-Ag-Te-Bi mineralisation assemblages. Low-crystallinity kaolinite forms a large diffuse envelope surrounding high sulfidation mineralisation, transiting at depth into a diaspore-pyrophyllite dominated facies that marks the lower extent of Cu mineralisation. There is a large phyllic halo, surrounding the Cu-Au orebodies, extending laterally and below, with relative enrichment of Pb-Zn-Mn-Tl-Ag. Detailed analysis of the SWIR spectral features provides vectoring within a wide range of illite-sericite mineral assemblages. Shifting of absorption at the 2200 nm wavelength, caused by aluminum hydroxyl vectors acidity and the sharpness of water or hydroxyl absorption feature at 1900 nm indicates degree of crystallinity, which increases at higher temperatures. The distal parts are presented by phengite-chlorite-smectite dominated mineral assemblage. The use of multielement whole-rock interpolants provides additional vector within this alteration footprint by quantifying feldspar destruction with Sr-Ca-Na depletion, tracing distal parts of the system with changes in Mg/Fe ratios, and identification of illite and APS minerals alteration with relative enrichment of K-Rb and Sr-K-Ca, respectively.