Pyrite Chemistry as a Tracer for Metallogenic Evolution in the Au-Ag-Te Kochbulak Deposit (Chatkal-Kurama Region, Uzbekistan)

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Pyrite trace element signature may contribute to untangle hydrothermal processes, particularly in cases with complex geochemistry and mineralogy such as gold-tellurides deposits. The Chatkal-Kurama region (Uzbekistan) is located in the Central Asian Orogenic Belt, specifically in the Middle Tien Shan Metallogenic Belt. It hosts the Valerianov-Beltau-Kurama magmatic arc, originated by the subduction of the Turkestan Ocean. From Middle-Late Ordovician to Early Permian, the geodynamic setting favoured magma ascent and storage in the crust, leading to the genesis of porphyry copper, epithermal and skarn ore deposits. One of these is the Au-Ag-Te Kochbulak deposit, which includes three different orebodies consisting of high- and low-angle veins and steep lenticular to tubular breccias. The geochemical signature, with positive anomalies of Te, Se, Sb, Cu, Zn, Pb and Bi, manifests in a complex mineral assemblage of sulfides, sulfosalts and tellurides associated with gold and electrum. A multi-stage ore-forming process has been identified, with cyclic input of hydrothermal fluids, including pre-ore, main-ore (subdivided into I, II, IIIa and IIIb phases) and post-ore stages. This complex process involves physico-chemical changes of the fluids, such as pH changes, decreasing T and changing fS_2 and fTe_2, in addition to reopening events of the mineralized veins.

In this work we determined by LA-ICP-MS the trace element composition of pyrite, which is present in the mineral assemblage at all stages. The variable Cu-Zn-As-Se-Ag-Te-Au-Bi-Pb contents in pyrite, joined to the identification of polymetallic inclusion, track the hydrothermal fluid evolution and suggest a role for low-melting-temperature Te-rich melts in scavenging Au from the fluid, providing insights into the genesis and evolution of this high-grade epithermal deposit. Defining the genesis of the Au-Ag-Te Kochbulak deposit will contribute to understanding the metallogeny of the Chatkal-Kurama epithermal deposits, in addition to providing constraints useful for the comprehension of epithermal gold-telluride deposits elsewhere.