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GENETIC ASPECTS OF MINERALOGY IN SHALLOW LEVELS OF LOW SULPHIDATION TYPE EPITHERMAL SYSTEMS OF THE TOKAJ MTS., NE HUNGARY

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The Tokaj Mts. is located in the central-western part of the Tertiary–Quaternary volcanic arc of the Carpathians. They consist of a less differentiated, mostly andesitic–dacitic volcanic sequence of Badenian (15–13.5 Ma) age that is covered by a more differentiated series of medium- to high-potassic calc-alkaline andesitic–dacitic–rhyolitic volcanic rocks of Sarmatian–Pannonian (13–9 Ma) age in a north–south oriented graben-like structure. The Sarmatian–Pannonian, mostly subaerial and subordinately submarine andesitic–dacitic lava flows, extrusions and shallow intrusions are the most widespread and are related to small caldera-like structures, effusive cones and fissure volcanoes. The synchronous rhyolitic rocks form extrusions and various deposits in distal and proximal facies of dome-flow complexes as well as tuff units with large areal distribution. Locations of epithermal systems (12.5–10.8 Ma K/Ar age for adularia and alunite) in andesitic and rhyolitic rocks are controlled by the major faults of the graben. They also frequently occur in close spatial relationships to shallow subvolcanic andesite bodies in caldera-like structures. Exposures of low sulphidation type alteration and mineralization correspond to different levels of paleohydrothermal activity. The deepest levels, with about 200–500 m minimum paleodepth, are characterised by K-feldspar–sericite alteration surrounded by regional propylitisation along siliceous veins. Potassium feldspar replacing plagioclase of andesite and sanidine of rhyolite show sericitic alteration and Ba enrichment. Younger adularia in fractures and veins is fresh and has pure K-feldspar composition. Fluid inclusion data indicate 200–260 °C for boiling parent fluids. Degassing (CO_2 loss) generated by opening of veins explains the double appearance of K-feldspar. Boiling horizons are also marked by the presence of quartz pseudomorphs after bladed calcite and occurrences of euhedral scepter quartz in the cavities of host rocks. Textures of vein filling quartz correlate with crystallization temperature. These deepest levels are the predominant zones of Au-Ag enrichment with minor amount of Pb-Zn-Pb-Fe sulphides. The intermediate zone corresponds to about 100–200 m paleodepth where overprinting of acidic steam-heated alteration with alunite and kaolinite in funnel shaped bodies was generated by the drop of paleowater table during the hydrothermal activity. Neutralization of steam-heated fluids during lateral flow in permeable tuff units resulted illite-montmorillonite and montmorillonite zones around the acidic alteration funnels. The strongly silicified and brecciated bodies above this horizon consist of quartz, opal, barite, cinnabar and hematite with anomalies of As, Sb, Tl and erratic Au-Ag enrichments. Paleotemperatures for these zones are between 100 and 200 °C. The paleosurface of hydrothermal activity is marked by rarely preserved hot spring centers that consist of hydrothermal eruption breccias surrounded by sinter-like aprons of bedded-laminated silica deposits. Opal C, opal CT and chalcedony are associated with cinnabar, hematite and anomalies of Sb in this environment. Silica content of fluids outflowing from these hot spring centers deposited in local fresh water basins in forms of thick siliceous sediments. These silica layers are intercalated with bentonite and kaolinite beds and are characterised by Sb and As anomalies with erratic occurrence of realgar, orpiment and stibnite. Recognition of the position of an exploration field in the above described vertical zonation may also support the evaluation of potential for precious metals in other, less eroded low sulphidation type systems of the Carpathian volcanic belt.