ALTERATION, STABLE ISOTOPE AND FLUID INCLUSION CHARACTERISTICS OF THE CU-PORPHYRY TYPE AND RELATED HIGH SULPHIDATION TYPE MINERALIZATION IN THE TERTIARY ANDESITIC ROCKS OF THE VELENCE MOUNTAINS, HUNGARY

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In the eastern part of the Velence Mts. an andesitic volcanic structure of Upper Eocene–Oligocene age is exposed. A diorite intrusion beneath the caldera-like structure is known from the 1200 m deep Pázmánd-2 borehole. Subvolcanic andesite dykes and necks also intrude Variscan granitic rocks in the western part of the Velence Mts. Vertical and horizontal zonation of hydrothermal alteration in the epithermal zones consists of a central part with leached, silicified and brecciated quartz, rutile ± alunite rich rock surrounded by a transition zone with pyrophyllite, topaz, alunite ± diaspore, zunyite, kaolinite and illite minerals. This is fringed by kaolinite-illite and chlorite-sericite-smectite zones. The alteration pattern indicates interaction of acidic fluids in the massive silica zone and decreasing acidity towards the margins and depth. The diorite intrusion beneath the epithermal zones shows K-silicate (biotite and K-feldspar) and propylitic (chlorite, smectite) alteration and quartz-calcite-pyrite stockwork with pyrite, chalcopyrite, bornite and magnetite disseminations. δD = -85 – -88‰ and $\delta^{18}O$ = 8,1–8,8‰ data for hornblende and primary biotite from Tertiary unaltered andesite dikes and necks intruding the Variscan granite indicate that their parent magma degassed during solidification. Hydrothermal minerals (illite, pyrophyllite) from epithermal zones have much higher δD (-32 – -45‰) and lighter $\delta^{18}O$ (-1.4 – +2.5‰) values suggesting that fluids responsible for alteration also had a meteoric component in addition to magmatic water. Coexistence of gas-rich and liquid-rich inclusions in quartz crystals from the brecciated silica bodies of epithermal zones indicates boiling of hydrothermal fluids. Homogenization temperatures of liquid-rich inclusions are between 220 and 380 °C. Coexisting pyrophyllite and diaspore suggest a temperature between 270 and 360 °C. Salinities of inclusion fluids are highly variable between 1 and 12 NaCl equiv. wt% and occurrences of elevated salinities indicate that a chlorine-rich, presumably magmatic fluid mixed with meteoric water. Quartz veinlets in the subvolcanic diorite intrusion contain aqueous and vapor phase rich liquid-vapor, and daughter mineral (halite, sylvite, hematite and other unknown solids) bearing polyphase fluid inclusions. This assemblage suggests that boiling of hydrothermal fluids also occurred at the subvolcanic level. Homogenization temperatures are from 270 to 520 °C and salinities are broadly varied from 13–20 to 31–47 NaCl equiv. wt%, and from 23–24 $CaCl_2$ equiv.wt% to 55–79 NaCl+KCl equiv.wt%. Occurrence of high salinity inclusions indicates presence of magmatic fluids in the hydrothermal system. Thus stable isotope and fluid inclusion data equivocally support that the diorite intrusion released a magmatic fluid phase, which played role not only in the formation of the Cu-porphyry type mineralization but also in the hydrothermal processes of the shallow epithermal zones.

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