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GOLD-OXYSULPHIDE FORMATION IN COPPER ORES IN THE GREYWACKE ZONE, AUSTRIA: A FLUID INCLUSION STUDY USING IR-MICROSCOPY

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Gold, associated with tetrahedrite, occurs in several abandoned copper deposits in the eastern Greywacke Zone, Austria. The ore mineralogy, the mineral chemistry and fluid inclusions in tetrahedrite and quartz were studied in detail from two occurrences at Larzenbach near Hüttau and St. Veit im Pongau.

Fluid inclusions in tetrahedrite, which is non-transparent in normal light, were studied using infrared (IR) microscopy. Tetrahedrite is transparent for infrared light when the arsenic content is below ~2.5 wt.% As. During heating of tetrahedrite there is a sudden decrease of transparency at about 120°C what disturbs observations of fluid inclusions above this temperature in arseniferous tetrahedrite. When temperature drops below 120°C tetrahedrite recovers its former transparency.

At room temperatures fluid inclusions in tetrahedrite are two phase liquid (L) + vapour (V) aqueous inclusions of low salinity (T_m –3 to –14 °C). Homogenisation temperatures (T_h, homogenisation V->L) range between 85 and 227 °C. Fluid inclusions occur isolated, in clusters and along trails. Composition of these fluid inclusions in tetrahedrite corresponds to one group of fluid inclusions in quartz showing similar low salinity (T_m –3 to –12°C) and range of homogenisation temperatures (T_h (V-> L) 71.5 – 250°C). Another group of higher saline aqueous two-phase (L+V) inclusions in quartz is not found in tetrahedrite.

Fluid inclusions within tetrahedrite are coeval with small solid inclusions of chalcopyrite, Au-oxysulphides and minor arsenopyrite and gold containing oxysulphide inclusions. These fluid and solid inclusions occur along healed fractures and microfractures within tetrahedrite. These microfractures are also guiding the replacement of As-poor tetrahedrite by arseniferous tetrahedrite; tetrahedrite close to the microfractures contains up to 3.16 wt.% of As. Arsenic was transported together with Au into and along these microfractures. It is suggested that exchange of As (from the fluid) for Sb (extracted from the tetrahedite lattice) was one of the key factors controlling the precipitation of gold. It seems, that Sb does not form as good Au transporting compounds as As ligands do.

Fluid inclusions confirm that the gold and associated gold-oxysulphides were precipitated at low temperatures (< c. 250 °C) from fluids of low salinity. Oxysulphides are associated with (a) native gold in un-weathered primary ores and (b) remobilised Cu-rich gold in weathered ores. We suggest that oxysulphides were the favoured species for the transport of gold in low-temperature hydrothermal and weathering fluids. The Austrian examples provide the best direct evidence known in nature for oxysulphides being involved in transport of gold in hydrothermal fluids. These unusual new phases seem to play a key role in precipitation and remobilisation of gold in some geological environments.