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Polymetallic ores of the prehistoric copper mining area "Mauken Valley" (Brixlegg-Radfeld, Austria) as a possible source of Bronze Age Co-Ni bearing "fahlore-copper" metal artefacts in the Eastern Alps and the German Alpine Foreland

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The Mauken Valley is part of the Schwaz-Brixlegg Fe-Zn-Hg tetrahedrite-tennantite mining districts in the Tyrol. The studied area includes all mining sites between the lower Inn Valley in the north, the Alpach Valley in the west, the Gratlspitze ridge in the south and the Sommerauer Cliffs in the east.
Form the archaeological point of view this area bears a huge inventory of prehistoric mining and copper production records. Several surface- and underground mining sites were explored by fire setting during prehistoric times. 14C dated charcoal fragments from fire setting activities from the Moosschrofen and the mine Mauk D yield Late Bronze Age ages. In the immediate vicinity a Late Bronze Age ore beneficiation/separation installation was excavated in the Schwarzenbergmoos. Only a few hundreds meter down the Mauken Valley a Late Bronze Age copper smelting site was excavated. All these records indicate intensive copper mining and smelting during the Late Bronze Age. However, beginnings of “fahlore-copper” production in the lower Inn Valley even date back to the Neolithic/Early Bronze Age (Mariahilfbergl, Kiechlberg, Buchberg).
From the geological point of view the Mauken Valley region can be subdivided into two major geological units. The northern part consists of Triassic rocks of the Schwaz Triassic, which is a tectonic span of the Northern Calcareous Alps located to the south of the Inn Valley. The southern part of the Mauken area consists of the Devonian Schwaz Dolomite complex, which is part of the Northern Greywacke Zone. Even though the Schwaz Dolomite is the major copper-ore bearing unit in the Schwaz-Brixlegg region in the Mauken Valley copper ores are also hosted within the Anisian carbonates of the Schwaz Triassic.
The Fe-Zn-Hg tetrahedrite-tennantite ores are more or less monomineralic and are characterized by Sb/As ratios of ∼1 to 1.5, variable Fe/Zn/Hg ratios and low Ag concentrations (∼0.5 wt.%). It is very likely that from these ores the Late Bronze Age “fahlore-copper” artefacts were produced and disseminated in the Eastern Alps and the German Alpine Foreland. “Fahlore-copper” contains few wt.% Sb, As and up to one wt.% Ag.
The important copper phases in ores hosted in the Schwaz Triassic are again fahlore-group minerals, however, the tennantite component dominates (Sb/As ratios <1). In some occurrences Bi substitutes for Sb and As up to 2 wt.%. Tennantite is intergrown with Fe-Co-Ni bearing sulfides (arsenopyrite-gersdorffite-cobaltite; vaesite-cattierite, bravoite), galena, chalcopyrite, sphalerite, Ag-rich tennantite varieties and pearcite. The ore assemblage varies from mining site to mining site but the overall As-rich, Co-Ni-Bi dominated chemistry can be seen as a fingerprint of these Triassic ores. Thus the composition and mineralogy of the copper ores from the Schwaz Triassic can probably explain frequently occurring “fahlore-copper bronze artefacts” from Bronze Age hoards and settlements containing diagnostic Co, Ni, Bi as minor components.