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Mineralization stages of the unique shear zone-hosted "Felsit-type" Sn-polymetallic mineralization in the eastern Erzgebirge, Germany

Tom Járóka and Thomas Seifert
Department of Mineralogy, TU Bergakademie Freiberg, Germany

The polymetallic cassiterite-bearing mineralization of the “Felsit-type” is located in the NW of the Freiberg mining district within the Großschirma area. The mineralization is hosted by metamorphic rocks of the Preßnitzer Group unit that form the most northeastern part of the Erzgebirge metamorphic core complex. This geological unit is in the Großschirma area predominantly composed of two-mica gneisses and mica schists, whereas intercalations of muscovite-gneiss (“red gneiss”), amphibolites and metacarbonates occur less commonly. These metamorphic rocks were deformed by several NE-SW striking fault zones. The hydrothermal Sn-bearing fluids migrated within shear zones that developed primarily at the contact between different lithotypes. The shear zones are characterized by strong pervasive metasomatic alterations which were triggered by small chlorite-cassiterite-quartz-sulfide-veins. The rock-forming minerals are strongly corroded and displaced by the ore and gangue minerals within the shear zones. The bulk geochemistry of selected drill core samples feature grades up to 0.28 wt. % Sn, 0.15 wt. % Cu, 300 ppm Pb, 140 ppm Zn, 1.1 wt. % F, 250 ppm Li, 820 ppm Rb, 90 ppm Cs, and 130 ppm W.
Microscopic and geochemical studies of the samples show that the Sn-polymetallic mineralization of the “Felsit-type” can be distinguished into three different mineralization stages. The first one is dominated by chlorite and quartz. Cassiterite probably appears in two generations with different grain shapes: acicular ($< 1 – 100$ μm) and isometric cassiterite ($< 10 – 650$ μm). Smaller amounts of fluorite, rutile, apatite, and scheelite are also associated with the first stage. The second mineralization stage is dominated by pyrite which is the most abundant ore mineral of this paragenesis, while marcasite, chalcopyrite, pyrrhotite, galena, sphalerite, arsenopyrite, bismuthinite, and magnetite appear only subordinately. The third stage is dominated by carbonates that are often associated with some fine-grained hematite and limonite. Beside Sn an enrichment of F, Li, Rb, Cs and W suggest a genetic link between the Sn-polymetallic mineralization of the “Felsit-type” and the late Variscan Sn-W-association of the Erzgebirge. The Sn-W-association is not known in the Freiberg Ag-Pb-Zn vein-ore district. The origin of the Sn-W mineralization in the Erzgebirge is still under debate.