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Lingbaoite, $AgTe_3$, a new silver telluride from the Xiaoqinling gold district, central China

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Abstract

Lingbaoite, $AgTe_3$, is a new silver telluride discovered in the S60 gold-bearing quartz vein, Xiaoqinling gold district, central China. The new mineral is named after Lingbao city, the municipality of which covers a major part of the Xiaoqinling gold district. Lingbaoite is only microscopically visible and occurs within pyrite as small composite inclusions (<50 μm) that commonly consist of lingbaoite, sylvanite, and chalcopyrite, and locally of bornite, galena, altaite, and stützite. The largest lingbaoite grain is about 30 × 12 μm in size. At least two stages of gold and telluride mineralization are recognized in the lingbaoite-bearing sample set. The first stage is characterized by the deposition of lingbaoite, native tellurium, and sylvanite, within the commonly observed mineral assemblages of lingbaoite + sylvanite + chalcopyrite and sylvanite + native tellurium + stützite. The second stage is characterized by the deposition of Bi-bearing minerals and native gold, within the commonly observed mineral assemblages of rucklidgeite + altaite + volynskite ± hessite ± petzite and rucklidgeite + gold ± altaite.

Lingbaoite is opaque and exhibits no internal reflections. In plane-polarized reflected light, lingbaoite shows a creamy yellow reflection color. The calculated density is 7.06 g/cm^3. Seventeen WDS spot analyses from 17 different lingbaoite grains gave an empirical formula of $Ag_{0.946}Fe_{0.134}Cu_{0.008}Pb_{0.003}Te_{2.841}S_{0.067}$. When considering Ag and Te as the only two essential structural components, the empirical formula is $Ag_{1.00}Te_{3.00}$.

The EBSD and SAED data confirm the structural identity of lingbaoite and synthetic $AgTe_3$. Synthetic $AgTe_3$ is trigonal, space group $R3m$, with a = 8.645 Å, c = 5.272 Å, V = 341.2 Å^3, and Z = 3. The unit-cell parameters of lingbaoite are: a = 8.60 (5) Å, c = 5.40 (18) Å, V = 346 (9) Å^3, and Z = 3. Synthetic $AgTe_3$, and by analog lingbaoite, can be viewed as silver-stabilized cubic tellurium, which is an ordered (1:3 Ag:Te) analog of the α-polonium structure (i.e., simple cubic crystal structure). Synthetic $AgTe_3$ becomes a stable phase at above 0.4 GPa, but can also occur in a metastable state at atmospheric pressure.

Lingbaoite probably formed through the cooling of polymetallic melt droplets within the hydrothermal system. Lingbaoite and associated minerals (e.g., sylvanite, native tellurium) reveal a previously unrecognized but perhaps common magmatic-hydrothermal process in the Xiaoqinling gold district, which precedes the precipitation of native gold, suggesting that gold mineralization in the Xiaoqinling gold district involves multiple superimposed processes of gold enrichment.

Keywords: Lingbaoite, $AgTe_3$, new mineral, silver telluride, polymetallic melt, magmatic-hydrothermal origin