

Zhengminghuaite, $\text{Cu}_6\text{Fe}_3\text{As}_4\text{S}_{12}$, a new sulfosalt mineral from the Zimudang Carlin-type gold deposit in southwestern Guizhou, China

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ABSTRACT

Zhengminghuaite, ideally $\text{Cu}_6\text{Fe}_3\text{As}_4\text{S}_{12}$, is a new Cu-Fe arsenosulfosalt found in the Zimudang Carlin-type gold deposit in southwestern Guizhou, China. It occurs as irregular, commonly fractured grains of several to a few tens of micrometers in the brecciated gold ores and is paragenetically associated with the late ore-stage mineral assemblage, including realgar, orpiment, pyrite, chalcopyrite, arsenopyrite, aktashite, christite, quartz, and calcite. Zhengminghuaite is opaque with a metallic luster and a conchoidal or uneven fracture. The Vickers microhardness (VHN_{10}) is 219 kg/mm^2 (range 192–247 kg/mm^2), and the calculated density is 4.77(5) g/cm^3 . In reflected light, zhengminghuaite is whitish gray with weak bireflectance (whitish gray to pinkish tinted gray), very weak anisotropy, and no internal reflection. Electron microprobe analyses give the empirical formula $(\text{Cu}_{5.92}\text{Hg}_{0.08})_{\Sigma 6.00}(\text{Fe}_{1.59}\text{Hg}_{1.07}\text{Zn}_{0.37})_{\Sigma 3.03}(\text{As}_{3.94}\text{Sb}_{0.02})_{\Sigma 3.96}\text{S}_{11.93}$ on the basis of total cations = 13, with the simplified formula $\text{Cu}_6(\text{Fe,Hg,Zn})_3(\text{As,Sb})_4\text{S}_{12}$. Zhengminghuaite is trigonal, with space group $R\bar{3}$. Unit-cell parameters determined from the single-crystal X-ray diffraction data are as follows: $a = 13.5373(17)$ Å, $c = 9.2354(13)$ Å, and $V = 1465.7(4)$ Å³ ($Z = 3$). The eight strongest lines in the X-ray diffraction pattern are [d (Å) (I , %) (hkl)]: 3.0785 (67) (003), 3.0670 (100) ($\bar{1}\bar{3}\bar{1}$), 2.6586 (89) ($\bar{1}\bar{3}\bar{2}$), 1.8825 (97) (134), 1.8773 (82) (520), 1.6060 (89) (135), 1.6028 (81) (523), and 1.6012 (83) (26 $\bar{1}$). The crystal structure of zhengminghuaite belongs to the nowackiite group and can be described as formed by (0001) layers composed of corner-sharing FeS_4 and CuS_4 tetrahedra that delimit two triangular cavities. Zhengminghuaite is the Fe-dominant analog at the divalent cations site of nowackiite ($\text{Cu}_6\text{Zn}_3\text{As}_4\text{S}_{12}$) and aktashite ($\text{Cu}_6\text{Hg}_3\text{As}_4\text{S}_{12}$). Paragenetic relationships indicate that zhengminghuaite and associated Hg- and Tl-sulfosalts precipitated in response to the increase in sulfidation state and decrease in temperature of the late-ore stage hydrothermal fluid.

Keywords: Zhengminghuaite, nowackiite group, sulfosalt, crystal-structure refinement, Carlin-type gold deposit, Zimudang, Southwest China