Tazieffite, Pb$_{20}$Cd$_2$(As,Bi)$_{22}$S$_{50}$Cl$_{10}$, a new chloro-sulfosalt from Mutnovsky volcano, Kamchatka Peninsula, Russian Federation

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ABSTRACT

Tazieffite, ideally Pb$_{20}$Cd$_2$(As,Bi)$_{22}$S$_{50}$Cl$_{10}$, is a new mineral from the high-temperature fumaroles of the Mutnovsky volcano, Kamchatka Peninsula, Russian Federation. It occurs as tiny, slender, needle-shaped crystals, up to 400 µm long and 10 µm across, generally forming fibrous aggregates. Tazieffite is closely associated with greenockite, galena, mutnovskite, kudriavite, and Cd-rich canizzarite. Other minerals spatially associated are pyrite, anhydrite, and cristobalite. Tazieffite is silvery-gray in color, occasionally with a magenta tint when it forms aggregates of extremely fine needles. It has a black streak and metallic luster. In plane-polarized incident light, tazieffite is weakly bireflectant and weakly pleochroic from dark gray to a blue-gray. Between crossed polars, the mineral is weakly anisotropic, without characteristic rotation tints. Reflectance percentages measured in air ($R_{\text{min}}$ and $R_{\text{max}}$) for a single grain are 33.9, 34.1 (471.1 nm), 32.8, 33.0 (548.3 nm), 32.4, 32.6 (586.6 nm), and 30.9, 31.1 (652.3 nm), respectively. Electron microprobe analyses yield the following ranges of concentrations: Pb 41.88–44.14 (avg. 43.90), Cd 0.87–1.16 (avg. 1.03), Sn 0.31–0.69 (avg. 0.48), Bi 20.43–22.94 (avg. 21.90), As 6.64–10.73 (avg. 9.46), S 16.10–17.48 (avg. 16.58), Se 0.82–1.28 (avg. 1.04), Cl 2.39–2.77 (avg. 2.63), Br 0.09–0.15 (avg. 0.12), I 0.27–0.58 (avg. 0.42). The empirical chemical formula, calculated on the basis of 44 cations, is Pb$_{20.06}$(Cd$_{0.04}$Sn$_{0.36}$In$_{0.02}$)$_{21.50}$(As$_{12.48}$Bi$_{10.11}$)$_{222.64}$(S$_{50}$)$_{71.36}$(Cl$_{14}$)$_{10}$(Br$_{13}$)$_{27.65}$. Tazieffite is closely related to the halogen-sulfosalt vurroite, Pb$_{20}$Sn$_2$Bi$_2$S$_{50}$Cl$_{10}$, both from a chemical and structural point of view. It represents the (Cd,As)-dominant of vurroite, according to the coupled heterovalent substitution Sn$^{4+}$ + 2S$^2-$ → Cd$^{2+}$ + 2Cl$^-$.

INTRODUCTION

The fumarole system of Mutnovsky volcano (Kamchatka Peninsula, Russian Federation) is certainly an interesting and promising source of new and rare minerals. Not long after the find of the unusual iodine-bearing sulfosalt, mutnovskite [Pb$_2$As$_5$(I,Cl,Br)], at this site (Zelenski et al. 2006), another new and interesting phase, tazieffite [Pb$_{20}$Cd$_2$(As,Bi)$_{22}$S$_{50}$Cl$_{10}$], has been discovered among sublimes collected from the area. Tazieffite is a complex sulfosalt containing Cl and Cd as essential chemical constituents together with major Pb, As, and Bi. After kudriavite, (Cd, Pb)Bi$_2$S$_4$ (Chaplygin et al. 2005), the new mineral represents the second sulfosalt containing Pb, Cd, and Bi found in nature, and the first having also As as an essential constituent. Tazieffite shows strong similarity with vurroite, Pb$_{20}$Sn$_2$(Bi,As)$_{22}$S$_{50}$Cl$_{10}$, recently discovered in high-temperature