## Benleonardite $Ag_8(Sb,As)Te_2S_3$



**Crystal Data:** Tetragonal. *Point Group:* $4/m\ 2/m\ 2/m$, $\overline{4}2m$, $4mm$, 422, $4/m$, $\overline{4}$, or 4. As crusts and fracture fillings composed of grains and laths, to 100 $\mu$m. *Twinning:* According to some simple law.

**Physical Properties:** Hardness = n.d. VHN = 105–125, 117 average (25 g load). D(meas.) = n.d. D(calc.) = 7.76

**Optical Properties:** Opaque. *Color:* In polished section, very pale blue. *Anisotropism:* Moderate to strong, in tints of brown, blue, and gray. $R_1$–$R_2$: (400) 35.6–36.8, (420) 35.7–36.6, (440) 35.8–36.2, (460) 35.7–35.6, (480) 35.5–34.9, (500) 35.1–34.1, (520) 34.7–33.2, (540) 34.1–32.2, (560) 33.5–31.4, (580) 32.9–30.7, (600) 32.4–30.0, (620) 32.0–29.5, (640) 31.6–29.1, (660) 31.4–28.7, (680) 31.1–28.4, (700) 30.8–28.1

**Cell Data:** *Space Group:* $P4/mmm$, $P\overline{4}m2$, $P\overline{4}2m$, $P4mm$, $P422$, $P4/m$, $P\overline{4}$, or $P4$. $a = 6.603(5)$ $c = 12.726(6)$ Z = 2

**X-ray Powder Pattern:** Moctezuma mine, Mexico. 2.936 (100), 12.7 (70), 2.608 (35), 2.158 (35), 3.188 (30), 2.863 (25), 2.328 (20)

**Chemistry:**

| | (1) | (2) | (3) |
|---|---|---|---|
| Ag | 64.5 | 62.99 | 64.59 |
| Cu | 0.1 | 1.65 | |
| Sb | 7.3 | 5.33 | 9.11 |
| As | 1.4 | 1.70 | |
| Te | 18.7 | 19.06 | 19.10 |
| S | 8.0 | 8.33 | 7.20 |
| Total | 100.0 | 99.06 | 100.00 |

(1) Moctezuma mine, Mexico; by electron microprobe, average of 14 analyses, corresponding to $Ag_{7.80}Cu_{0.02}(Sb_{0.78}As_{0.24})_{\Sigma=1.02}Te_{1.90}S_{3.25}$. (2) Gies deposit, Montana, USA; by electron microprobe, average of four analyses; corresponding to $Ag_{7.53}Cu_{0.33}(Sb_{0.56}As_{0.29})_{\Sigma=0.85}Te_{1.93}S_{3.35}$. (3) $Ag_8SbTe_2S_3$.

**Occurrence:** In fractures in an intensely silicified rhyolitic vitrophyre (Moctezuma mine, Mexico); in a limestone-hosted disseminated Au–Ag–Te deposit (Mayflower mine, Montana, USA); in an epithermal Au–Ag-Te vein system along the contact between alkaline intrusives and sediments (Gies mine, Montana, USA).

**Association:** Silver, acanthite, hessite, cervelleite, pyrite, sphalerite, dolomite, quartz (Moctezuma mine, Mexico); tetrahedrite, hessite, gold, sphalerite (Mayflower mine, Montana, USA); hessite, tetrahedrite (Gies mine, Montana, USA).

**Distribution:** From the Moctezuma (Bambolla) mine, 12 km south of Moctezuma, Sonora, Mexico [TL]. In the Mayflower mine, Tobacco Root Mountains, Madison Co., and the Gies mine, Judith Mountains, Fergus Co., Montana, USA. From the Emperor mine, Vatukoula, and the Tuvatu Au–Ag–Te deposit, Viti Levu, Fiji Islands.

**Name:** For Dr. Benjamin Franklin Leonard (1921– ), of the U.S. Geological Survey, Denver, Colorado, USA.

**Type Material:** The Natural History Museum, London, England, 1985,354 and E.1611; National Museum of Natural History, Washington, D.C., USA, 165226.

**References:** (1) Stanley, C.J., A.J. Criddle, and J.E. Chisholm (1986) Benleonardite, a new mineral from the Bambolla mine, Moctezuma, Sonora, Mexico. Mineral. Mag., 50, 681–686. (2) (1988) Amer. Mineral., 73, 439 (abs. ref. 1). (3) Spry, P.G. and S.E. Thieben (1996) Two new occurrences of benleonardite, a rare silver–tellurium sulphosalt, and a possible new occurrence of cervelleite. Mineral. Mag., 60, 871–876.