

Crystal Data: Orthorhombic. *Point Group:* $2/m\ 2/m\ 2/m$ or $mm2$. As crystals, elongated along [001], flattened on {010}, to 2 mm, in radiating groups.

Physical Properties: *Fracture:* Uneven. *Tenacity:* Brittle. Hardness = 2.5–3 VHN = 75–95, 87 average (25 g load). D(meas.) = n.d. D(calc.) = 6.83

Optical Properties: Opaque. *Color:* Silvery lead-gray; in reflected light, white with greenish tint. *Streak:* Lead-gray. *Luster:* Metallic. *Optical Class:* Biaxial. *Pleochroism:* Weak; white with greenish tint to gray-white with greenish tint. *Anisotropism:* Weak to moderate; dark brownish gray, dark yellowish gray, dark greenish gray. *Birefractance:* Weak.

R₁–R₂: (400) 38.4–43.5, (420) 37.2–39.2, (440) 35.4–36.1, (460) 34.4–34.5, (480) 33.2–33.4, (500) 32.6–32.8, (520) 32.2–32.3, (540) 31.9–32.0, (560) 31.6–31.7, (580) 31.3–31.4, (600) 30.9–31.1, (620) 30.7–30.7, (640) 30.5–30.5, (660) 30.2–30.3, (680) 30.0–30.0, (700) 29.6–29.7

Cell Data: *Space Group:* $Pn\bar{n}m$ or $Pnn2$. $a = 15.179(1)$ $b = 38.195(1)$ $c = 8.0745(5)$
Z = 16

X-ray Powder Pattern: Yunosawa mine, Japan.
3.395 (100), 2.819 (53), 2.739 (48), 3.705 (34), 2.870 (34), 4.47 (30), 2.981 (26)

Chemistry:	(1)	(2)
Pb	68.70	68.89
Tl	0.13	
As	12.45	12.45
S	18.64	18.66
Total	99.92	100.00

(1) Yunosawa mine, Japan; by electron microprobe, average of seven analyses; corresponds to (Pb_{3.99}Tl_{0.01})_{Σ=4.00}As_{2.00}S_{7.00}. (2) Pb₄As₂S₇.

Occurrence: A rare hydrothermal mineral formed at low temperatures in a barite veinlet in altered pumiceous pyroclastic volcanics.

Association: Jordanite, wurtzite, marcasite, galena, gratonite, canfieldite, tetrahedrite–tennantite, mimetite, barite.

Distribution: From the Yunosawa mine, Aomori Prefecture, Japan [TL].

Name: For the former *Tsugaru* Province, Japan, within which the mineral was found.

Type Material: University of Tokyo; National Science Museum, Tokyo, Japan, M-27594.

References: (1) Shimizu, M., R. Miyawaki, A. Kato, S. Matsuyama, F. Matsuyama, and K. Kiyota (1998) Tsugaruite, Pb₄As₂S₇, a new mineral species from the Yunosawa mine, Aomori Prefecture, Japan. *Mineral. Mag.*, 62, 793–799. (2) (1999) *Amer. Mineral.*, [not yet available??] (abs. ref. 1).