Paraguanajuatite $Bi_2(Se,S)_3$

Crystal Data: Hexagonal. *Point Group:* $\overline{3}\ 2/m$. Intimately intergrown with guanajuatite.

Physical Properties: *Cleavage:* Perfect on {0001}. Hardness = 2 VHN = 27–50 (10 g load). D(meas.) = 6.2–7.0 D(calc.) = [7.704]

Optical Properties: Opaque. *Color:* Pale yellow, commonly tarnished lead-gray. *Luster:* Metallic. *Pleochroism:* Distinct in air. *Anisotropism:* Distinct.

R_1–R_2: (400) 46.9–56.2, (420) 47.5–56.6, (440) 48.0–56.8, (460) 48.6–57.2, (480) 49.3–57.7, (500) 49.9–58.0, (520) 50.2–58.1, (540) 50.3–58.2, (560) 50.2–58.1, (580) 50.0–58.0, (600) 49.7–57.8, (620) 49.2–57.4, (640) 48.6–56.8, (660) 48.1–56.2, (680) 47.4–55.5, (700) 46.9–55.0

Cell Data: *Space Group:* $R\overline{3}m$ (synthetic Bi_2Se_3). $a = 4.133$ $c = 28.62$ $Z = 3$

X-ray Powder Pattern: Synthetic Bi_2Se_3.
3.03 (100), 2.23 (60), 1.404 (40), 4.80 (30), 2.07 (30), 1.907 (30), 1.320 (30)

Chemistry:

	(1)	(2)
Bi	62.8	63.64
Se	36.4	30.08
Te		5.13
S	0.8	1.48
Total	100.0	100.33

(1) Mexico; by electron microprobe, corresponds to $Bi_{1.86}(Se_{2.85}S_{0.15})_{\Sigma=3.00}$. (2) Kawazu mine, Japan; by electron microprobe, corresponds to $Bi_{1.97}(Se_{2.47}Te_{0.26}S_{0.30})_{\Sigma=3.03}$.

Polymorphism & Series: Dimorphous with guanajuatite.

Mineral Group: Tetradymite group.

Occurrence: Intergrown with guanajuatite in contact metamorphic as well as in hydrothermal veins (Santa Catarina mine, Mexico).

Association: Guanajuatite, bismuthinite, ferroselite (Santa Catarina mine, Mexico).

Distribution: From Mexico, in Guanajuato, in the Santa Catarina [TL] and Leon mines. From Falun, Kopparberg, Sweden. At the Kawazu mine, Shizuoka Prefecture, Japan.

Name: From the supposed relation to guanajuatite.

Type Material: n.d.

References: (1) Ramdohr, P. (1948) Los especes mineralogicas guanajuatite y paraguanajuatite. Comite Direct. Invest. Recursos Minerales Mexico, Bol. 20, 1–15 (in Spanish). (2) (1949) Amer. Mineral., 34, 619 (abs. ref. 1). (3) Godovikov, A.A. and V.A. Klyakhin (1966) Guanajuatite and paraguanajuatite. Akad. Nauk SSSR, Sibirsk. Otdel., Geol. Geofiz., 7, 67–76 (in Russian). (4) (1967) Amer. Mineral., 52, 1588 (abs. ref. 3). (5) Shmizu, M., A. Kato, and S. Matsubara (1988) Hemusite and paraguanajuatite from the Lawazu mine, Shizuoka Prefecture, Japan. Mineral. J. (Japan), 14, 92–100. (6) Berry, L.G. and R.M. Thompson (1962) X-ray powder data for the ore minerals. Geol. Soc. Amer. Mem. 85, 28. (7) Sindeeva, N.D. (1964) Mineralogy and types of deposits of selenium and tellurium, 71–74. (8) Ramdohr, P. (1969) The ore minerals and their intergrowths, (3rd edition), 702–703. (9) Criddle, A.J. and C.J. Stanley, Eds. (1993) Quantitative data file for ore minerals, 3rd ed. Chapman & Hall, London, 413.