Kirkiite $Pb_{10}(As,Bi)_6S_{19}$

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Crystal Data: Hexagonal and monoclinic, pseudohexagonal. *Point Group:* $6/m$ and $2/m$ (actual); 622 ($6/m$ $2/m$ $2/m$ apparent). Crystals are prismatic, to 100 μm, composed of stacked pseudohexagonal plates; as subhedral grains. *Twinning:* Polysynthetically twinned, common.

Physical Properties: Hardness = n.d. VHN = 150 (100 g load). D(meas.) = n.d. D(calc.) = 6.82

Optical Properties: Opaque. *Color:* Steel-gray; pale gray to white in reflected light. *Anisotropism:* Weak to strong. *Bireflectance:* Very weak.
R_1–R_2: (400) — , (420) 40.2–45.3, (440) 40.9–45.7, (460) 40.9–45.2, (480) 40.8–45.1, (500) 40.4–44.5, (520) 39.9–43.9, (540) 39.4–43.5, (560) 39.0–43.1, (580) 38.6–42.6, (600) 38.3–42.3, (620) 39.0–42.1, (640) 37.8–41.8, (660) 37.5–41.5, (680) 37.2–41.0, (700) 36.9–40.9

Cell Data: *Space Group:* $P6_322$ (apparent) $a = 8.69(5)$ $c = 26.06(10)$ Z = 2, actual *Space Group:* $P6_3/m$ $a = 8.70(5)$ $c = 25.97(10)$ Z = 2, or *Space Group:* $P2_1/m$ $a = 8.47(5)$ $b = 7.84(5)$ $c = 25.97(10)$ $\beta = 118.03°$ Z = 2

X-ray Powder Pattern: Kirki, Greece.
3.260 (100), 3.070 (70), 3.475 (60), 2.854 (60), 2.190 (50), 3.65 (50), 1.815 (50)

Chemistry:

	(1)	(2)	(3)
Pb	59.4	59.25	58.65
Bi	15.2	15.62	17.75
As	6.2	7.20	6.36
Sb	0.5		
S	17.4	17.15	17.24
Se		0.96	
Total	98.7	100.18	100.00

(1) Kirki, Greece; by electron microprobe, average of six analyses; corresponding to $Pb_{10.15}(As_{2.93}Bi_{2.57}Sb_{0.14})_{\Sigma=5.64}S_{19.21}$. (2) Vulcano, Italy; by electron microprobe, average of 12 analyses; corresponding to $Pb_{9.97}(As_{3.35}Bi_{2.61})_{\Sigma=5.96}(S_{18.65}Se_{0.42})_{\Sigma=19.07}$. (2) $Pb_{10}(As,Bi)_6S_{19}$ with As:Bi = 1:1.

Occurrence: In a hydrothermal Pb–Zn deposit (Kirki, Greece); in a volcanic fumarole, formed at about 470 °C (Vulcano, Italy).

Association: Cosalite, bismuthinite, bismuthian jordanite, seligmannite, levyclaudite, sphalerite, pyrite, galena (Kirki, Greece); sphalerite, cannizzarite (Vulcano, Italy).

Distribution: From the Aghios Philippos Pb–Zn deposit, near Kirki, Thrace, Greece [TL]. At the La Fossa crater, Vulcano, Lipari Islands, Italy.

Name: For Kirki, Greece.

Type Material: n.d.

References: (1) Moëlo, Y., E. Oudin, E. Makovicky, S. Karup-Møller, F. Pillard, M. Bornuat, and E. Evanghelou (1985) La kirkiite, $Pb_{10}Bi_3As_3S_{19}$, une nouvelle espèce minérale homologue de la jordanite. Bull. Minéral., 108, 667–677 (in French with English abs.). (2) (1986) Amer. Mineral., 71, 1278–1279 (abs. ref. 1). (3) Borodaev, Y.S., A. Garavelli, O.V. Kuzmina, N.N. Mozgova, N.I. Organova, N.V. Trubkin, and F. Vurro (1998) Rare sulfosalts from Vulcano, Aeolian Islands, Italy. I. Se-bearing kirkiite, $Pb_{10}(Bi,As)_6(S,Se)_{19}$. Can. Mineral., 36, 1105–1114.

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