Putoranite $Cu_9(Fe,Ni)_9S_{16}$

Crystal Data: Cubic. *Point Group:* $4/m\ \overline{3}\ 2/m$. Rarely as crystals; typically as small grains, to 0.1 mm, finely intergrown with mooihoekite, in aggregates. *Twinning:* Polysynthetic.

Physical Properties: Hardness = n.d. VHN = 263 (50 g load). D(meas.) = n.d. D(calc.) = 6.14

Optical Properties: Opaque. *Color:* Pale yellow in reflected light, similar to mooihoekite and chalcopyrite. *Anisotropism:* Nickelian variety distinctly anisotropic.
R: (400) — , (420) — , (440) — , (460) 24.4, (480) 25.1, (500) 30.0, (520) 31.8, (540) 38.0, (560) 40.0, (580) 41.2, (600) 41.2, (620) 40.9, (640) 41.9, (660) 41.6, (680) 41.2, (700) 41.0

Cell Data: *Space Group:* *Pn3m* (by analogy to synthetic material). $a = 5.30$ Z = 3

X-ray Powder Pattern: Oktyabr mine, Russia.
3.05 (10), 1.873 (9), 1.596 (6), 1.081 (5), 1.216 (3), 2.65 (2), 1.326 (2)

Chemistry:

	(1)	(2)
Cu	35.68	32.99
Fe	31.22	32.11
Ni	0.51	1.63
S	32.49	33.14
Total	99.90	99.87

(1) Oktyabr mine, Russia; by electron microprobe, average of seven samples; corresponding to $Cu_{8.87}(Fe_{8.83}Ni_{0.14})_{\Sigma=8.97}S_{16.00}$. (2) Do.; by electron microprobe, average of twelve samples, corresponding to $Cu_{8.04}(Fe_{8.90}Ni_{0.43})_{\Sigma=9.33}S_{16.00}$.

Occurrence: In massive Cu–Ni-sulfide ores (Oktyabr mine, Russia); in Cu–Ni mineralization in peridotite (Sopcha massif, Russia).

Association: Mooihoekite, talnakhite, cabriite, cubanite, pentlandite, magnetite, galena, sphalerite, platinum group minerals, silver, alabandite, valleriite, mackinawite, manganoan shadlunite, djerfisherite (Oktyabr mine, Russia).

Distribution: In Russia, from the Oktyabr mine, Talnakh area, Noril'sk region, western Siberia [TL], and in the Sopcha massif, Monchegorsk pluton, Kola Peninsula.

Name: For Putoran Mountain, east of Noril'sk, Russia.

Type Material: A.E. Fersman Mineralogical Museum, Academy of Sciences, Moscow, Russia, 81312.

References: (1) Filimonova, A.A., T.L. Evstigneeva, and I.P. Laputina (1980) Putoranite and nickel-bearing putoranite – new minerals of the chalcopyrite group. Zap. Vses. Mineral. Obshch., 109, 335–341 (in Russian). (2) (1981) Amer. Mineral., 66, 638–639 (abs. ref. 1).