

# Pentlandite



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**Crystal Data:** Cubic. *Point Group:*  $4/m\bar{3}2/m$ . Massive, commonly in granular aggregates; rarely in crystals, to 10 cm, embedded in other sulfides.

**Physical Properties:** *Cleavage:* Parting on {111}. *Fracture:* Conchoidal. *Tenacity:* Brittle. Hardness = 3.5–4 VHN = 268–285 (100 g load). D(meas.) = 4.6–5.0 D(calc.) = 4.956

**Optical Properties:** Opaque. *Color:* Pale bronze-yellow; reddish brown when argentine. *Streak:* Pale bronze-brown. *Luster:* Metallic.

R: (400) 32.8, (420) 35.1, (440) 37.1, (460) 39.2, (480) 41.1, (500) 42.9, (520) 44.5, (540) 46.1, (560) 47.6, (580) 48.5, (600) 49.6, (620) 50.7, (640) 51.8, (660) 52.7, (680) 53.4, (700) 54.2

**Cell Data:** *Space Group:*  $Fm\bar{3}m$ .  $a = 9.928(1)$   $Z = 4$

**X-ray Powder Pattern:** Worthington mine, Sudbury, Canada.

1.775 (100), 3.028 (80), 1.931 (50), 2.896 (40), 5.780 (30), 2.301 (30), 1.307 (20)

Chemistry:	(1)	(2)	(3)		(1)	(2)	(3)
Fe	30.68	25.6	43.1	S	32.74	32.4	33.6
Ni	34.48	30.8	19.3	insol.	0.56		
Co	1.28	11.0	4.1	Total	99.74	99.8	100.1

(1) Worthington mine, Sudbury, Canada; corresponds to  $(\text{Ni}_{4.60}\text{Fe}_{4.30}\text{Co}_{0.17})_{\Sigma=9.07}\text{S}_{8.00}$ . (2) Mt. Colin, Australia; by electron microprobe; corresponds to  $(\text{Ni}_{4.16}\text{Fe}_{3.63}\text{Co}_{1.48})_{\Sigma=9.27}\text{S}_{8.00}$ . (3) Mt. Dun area, New Zealand; by electron microprobe; corresponds to  $(\text{Fe}_{5.89}\text{Ni}_{2.51}\text{Co}_{0.53})_{\Sigma=8.93}\text{S}_{8.00}$ .

**Polymorphism & Series:** Forms a series with cobalt pentlandite.

**Mineral Group:** Pentlandite group.

**Occurrence:** Commonly intimately associated with pyrrhotite; in ultramafic rocks and perhaps derived from them by magmatic segregation; also found in mantle xenoliths and undersea “black smoker” deposits; rarely in meteorites.

**Association:** Pyrrhotite, troilite, chalcopyrite, cubanite, mackinawite, magnetite.

**Distribution:** The most important ore of nickel, occurring at many localities. From Craignure, near Inverary, Strathclyde, Scotland [TL]. At Wheals Jane and Falmouth, Kea, Cornwall, England. In Norway, from Espedalen, near Lillehammar, Opland. At Outokumpu, Vuonos, Miihkali, and Hietajärvi, in east Finland; in west Finland at the Hitura nickel deposit; and in north Finland at Rarrua. In South Africa, from the Rustenburg district, in the Merensky Reef, Bushveld complex, Transvaal. In New Zealand, in the Mount Dun area, Nelson Province. In Australia, in northwest Queensland, at Lime Creek and Mount Colin; from Coolgardie and Kambalda, 56 km south of Kalgoorlie, Western Australia; and at the Lord Brassey mine, Heazlewood, Tasmania. In the Kamishi mine, Iwate Prefecture, Japan. In Canada, from a number of mines at Sudbury, Ontario, and in the Voisey’s Bay Ni–Cu–Co deposit, Labrador.

**Name:** To honor Joseph Barclay Pentland (1797–1873), Irish natural scientist and historian, who first noted the mineral.

**Type Material:** The Natural History Museum, London, England, 26622–26223.

**References:** (1) Palache, C., H. Berman, and C. Frondel (1944) Dana’s system of mineralogy, (7th edition), v. I, 242–243. (2) Hall, S.R. and J.M. Stewart (1973) The crystal structure of argentine pentlandite  $(\text{Fe, Ni})_8\text{AgS}_8$ , compared with the refined structure of pentlandite  $(\text{Fe, Ni})_9\text{S}_8$ . *Can. Mineral.*, 12, 169–177. (3) Riley, J.F. (1977) The pentlandite group  $(\text{Fe, Ni, Co})_9\text{S}_8$ : new data and an appraisal of structure-composition relationships. *Mineral. Mag.*, 41, 345–349. (4) Criddle, A.J. and C.J. Stanley, Eds. (1993) Quantitative data file for ore minerals, 3rd ed. Chapman & Hall, London, 424.

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