Penroseite $(Ni, Co, Cu)Se_2$

Crystal Data: Cubic. *Point Group:* $2/m\ \overline{3}$. As reniform masses with radiating columnar structure.

Physical Properties: *Cleavage:* Perfect on {001}; distinct on {011}. *Fracture:* Subconchoidal. *Tenacity:* Brittle. Hardness = 2.5–3 VHN = 500–583 (100 g load). D(meas.) = 6.58–6.74 D(calc.) = 6.7

Optical Properties: Opaque. *Color:* Lead-gray; in polished section, creamy grayish white. *Streak:* Black. *Luster:* Metallic, tarnishes rapidly.
R: (400) 40.2, (420) 40.1, (440) 40.1, (460) 40.2, (480) 40.4, (500) 40.7, (520) 41.1, (540) 41.5, (560) 41.9, (580) 42.3, (600) 42.8, (620) 43.3, (640) 43.6, (660) 44.0, (680) 44.1, (700) 44.2

Cell Data: *Space Group:* $Pa3$. $a = 5.991$ $Z = 4$

X-ray Powder Pattern: Colquechaca, Bolivia.
2.68 (100), 2.45 (100), 1.806 (90), 1.599 (40), 3.02 (30), 1.662 (30), 1.151 (30)

Chemistry:

	(1)	(2)
Ni	22.9	12.5
Co	3.2	9.2
Cu	2.1	5.7
Se	71.7	72.3
Total	99.9	99.7

(1) Colquechaca, Bolivia; by electron microprobe, corresponds to $(Ni_{0.84}Co_{0.12}Cu_{0.07})_{\Sigma=1.03}Se_{1.97}$.
(2) Hope's Nose, England; by electron microprobe, corresponds to $(Ni_{0.46}Co_{0.34}Cu_{0.20})_{\Sigma=1.00}Se_{2.00}$.

Polymorphism & Series: Dimorphous with kullerudite.

Mineral Group: Pyrite group.

Occurrence: In hydrothermal veins.

Association: Naumannite, clausthalite, gersdorffite, tiemannite, pyrite, chalcopyrite (Pacajake mine, Bolivia); clausthalite, sederholmite, trüstedtite (Kuusamo, Finland).

Distribution: From the Pacajake mine, Hiaco, 24 km east-northeast of Colquechaca, Potosí, Bolivia [TL]. At Shinkolobwe, Katanga Province, Congo (Shaba Province, Zaire). From Hope's Nose, Torquay, Devon, England. In Germany, in the Harz Mountains, at Tilkerode. At Kuusamo, northeastern Finland.

Name: In honor of Dr. Richard Alexander Fullerton Penrose, Jr. (1863–1931), American economic geologist, of Philadelphia, Pennsylvania, USA.

Type Material: The Natural History Museum, London, England, 1926,1; Harvard University, Cambridge, Massachusetts, 87472; National Museum of Natural History, Washington, D.C., USA, 95302, R7247.

References: (1) Palache, C., H. Berman, and C. Frondel (1944) Dana's system of mineralogy, (7th edition), v. I, 294–296. (2) Early, J.W. (1950) Description and synthesis of the selenide minerals. Can. Mineral., 35, 337–364. (3) Ramdohr, P. (1969) The ore minerals and their intergrowths, (3rd edition), 806–807. (4) Criddle, A.J. and C.J. Stanley, Eds. (1993) Quantitative data file for ore minerals, 3rd ed. Chapman & Hall, London, 422.