

# Siegenite

# (Ni, Co)<sub>3</sub>S<sub>4</sub>

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**Crystal Data:** Cubic. *Point Group:*  $4/m\bar{3}2/m$ . Crystals dominantly octahedral, to 1 cm; also massive, granular to compact. *Twining:* On {111}; may be polysynthetic.

**Physical Properties:** *Cleavage:* Imperfect on {001}. *Fracture:* Subconchoidal to uneven. Hardness = 4.5–5.5 VHN = 459–548 (100 g load). D(meas.) = 4.5–4.8 D(calc.) = 4.83

**Optical Properties:** Opaque. *Color:* Pale gray to steel-gray; tarnishes easily to copper-red or violet-gray. *Luster:* Metallic, brilliant on fresh surface.

R: (400) 42.8, (420) 43.2, (440) 43.7, (460) 44.3, (480) 44.8, (500) 45.4, (520) 45.9, (540) 46.6, (560) 47.2, (580) 48.1, (600) 49.0, (620) 50.0, (640) 50.8, (660) 51.6, (680) 52.4, (700) 53.2

**Cell Data:** *Space Group:*  $Fd\bar{3}m$ .  $a = 9.41$   $Z = 8$

**X-ray Powder Pattern:** Mine la Motte, Missouri, USA.

2.86 (100), 1.670 (80), 2.36 (70), 1.815 (60), 0.988 (50), 3.34 (40), 1.228 (40)

Chemistry:	(1)	(2)	(3)	(4)
Co	26.08	20.36	13.7	19.35
Ni	31.18	31.24	41.5	38.54
Fe	0.62	3.22	2.8	
Cu		3.16		
S	42.63	42.43	42.1	42.11
insol.	0.16			
Total	100.67	100.41	100.1	100.00

(1) Littfeld, Germany; corresponds to  $(\text{Co}_{1.33}\text{Ni}_{1.60}\text{Fe}_{0.03})_{\Sigma=2.96}\text{S}_{4.00}$ . (2) Mine la Motte, Missouri, USA; corresponds to  $(\text{Co}_{1.04}\text{Ni}_{1.61}\text{Fe}_{0.17}\text{Cu}_{0.15})_{\Sigma=2.97}\text{S}_{4.00}$ . (3) Schönbrunn deposit, near Ölsnitz, [Vogtland=Saxony or Thuringia ck??, not in Rand-McNally, mindat.org??] Germany; by electron microprobe, corresponds to  $(\text{Co}_{0.71}\text{Ni}_{2.14}\text{Fe}_{0.15})_{\Sigma=3.00}\text{S}_{4.00}$ . (4)  $\text{CoNi}_2\text{S}_4$ .

**Mineral Group:** Linnaeite group.

**Occurrence:** In hydrothermal veins with other Cu–Ni–Fe sulfides.

**Association:** Chalcopyrite, pyrrhotite, galena, sphalerite, pyrite, millerite, gersdorffite, ullmannite.

**Distribution:** In Germany, from the Siegen district, North Rhine-Westphalia [TL], as at Müsen and Littfeld. From near Brestovsko, central Bosnian Mountains, Serbia. At Kladno, Czech Republic. From Blackcraig, Kirkcudbrightshire, Scotland. In the USA, in the Mine la Motte, Madison Co.; fine crystals from the Buick mine, Bixby, Iron Co., and in the Miliken (Sweetwater) mine, Reynolds Co., Missouri. In Canada, from the Langis mine, Cobalt-Gowganda area, Ontario. At Shinkolobwe, Katanga Province, Congo (Shaba Province, Zaire). From Kilembe, Uganda. In the Kamaishi mine, Iwate Prefecture, and the Yokozuru mine, north Kyushu, Japan. From Kalgoorlie, Western Australia. Known from many other minor localities.

**Name:** For the occurrence in the Siegen district, Germany.

**Type Material:** n.d.

**References:** (1) Palache, C., H. Berman, and C. Frondel (1944) Dana's system of mineralogy, (7th edition), v. I, 262–265. (2) Pietzsch, C. and H. Kämpf (1993) Moessbauer investigations of siegenite – an attempt at structural analysis. Neues Jahrb. Mineral., Monatsh., 265–277. (3) Berry, L.G. and R.M. Thompson (1962) X-ray powder data for the ore minerals. Geol. Soc. Amer. Mem. 85, 76–77. (4) Criddle, A.J. and C.J. Stanley, Eds. (1993) Quantitative data file for ore minerals, 3rd ed. Chapman & Hall, London, 509.

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