

**Crystal Data:** Tetragonal. *Point Group:*  $4/m\ 2/m\ 2/m$ . Scaly; commonly earthy, pulverulent, massive.

**Physical Properties:** Hardness = 2.5 D(meas.) = 8.9–9.2 (synthetic). D(calc.) = [8.92]

**Optical Properties:** Semitransparent. *Color:* Scarlet to brownish red, may have a yellowish tint; red in transmitted light. *Streak:* Yellow-orange. *Luster:* Dull to slightly greasy.

*Optical Class:* Uniaxial; may be weakly birefringent with anomalous green interference colors.

*Pleochroism:* Strong; *X* = deep reddish brown; *Z* = nearly colorless. *Orientation:* Extinction parallel; elongation negative.  $n = 2.42(2)$  (Li).

**Cell Data:** *Space Group:*  $P4_2/mbc$  (synthetic).  $a = 8.811(5)$   $c = 6.563(3)$   $Z = 4$

**X-ray Powder Pattern:** Synthetic.

3.38 (100), 2.903 (50), 2.787 (45), 2.632 (30), 1.775 (30), 3.113 (20), 1.903 (20)

**Chemistry:**

	(1)	(2)
PbO <sub>2</sub>		34.89
Pb <sub>3</sub> O <sub>4</sub>	97.02	
Fe <sub>2</sub> O <sub>3</sub>	2.70	
ZnO	0.26	
PbO		65.11
CaO	trace	
SiO <sub>2</sub>	trace	
Total	99.98	100.00

(1) Santa Marta, Spain. (2)  $\text{Pb}_2^{2+}\text{Pb}^{4+}\text{O}_4$ .

**Occurrence:** A rare secondary mineral in some highly oxidized lead-bearing mineral deposits; may form during mine fires.

**Association:** Galena, cerussite, massicot, litharge, lead, wulfenite, mimetite.

**Distribution:** Many localities, but only in small amounts. In Germany, at Langhecke, Hesse; Badenweiler, Baden-Württemberg; Bleialf, Eifel district; Horhausen, Rhineland-Palatinate, and many other places. At Mies (Mežica), Slovenia. From Leadhills, Lanarkshire, Scotland. At Castelberg, near St. Avold, Moselle, France. From Långban, Värmland, Sweden. At Sarrabus, Sardinia, Italy. In the Tchah Khuni and Tchah Milleh mines, near Anarak, Iran. From Tsumeb, Namibia. In the USA, in the Jay Gould mine, Alturas Co., Idaho; an important ore in the Leadville district, Lake Co., Colorado; in the Tonopah-Belmont mine, Osborne district, Maricopa Co., Arizona. From Eschuchapa, Guerrero, and other places in Mexico.

**Name:** From the Latin, through Spanish, for *cinnabar*, which was once adulterated with red lead oxide, now applied exclusively to that compound.

**References:** (1) Palache, C., H. Berman, and C. Frondel (1944) Dana's system of mineralogy, (7th edition), v. I, 517–519. (2) Liso, M.J., J. Guixa, C. Galindo, and A. Lopez (1980) Study on minium of Santa Maria (Badajoz) [Spain]. *Comun. Reun. Cient. Soc. Esp. Mineral.*, 2nd., 189–195 (in Spanish). (3) (1982) *Chem. Abs.*, 97, 167–168 (abs. ref. 2). (4) Gavarri, J.-R. and D. Weigel (1975) Oxydes de plomb. I. Structure cristalline du minium  $\text{Pb}_3\text{O}_4$ , à température ambiante (293 K). *J. Solid State Chem.*, 13, 252–257 (in French with English abs.). (5) (1959) *NBS Circ.* 539, 8, 32.