Guettardite $Pb(Sb, As)_2S_4$

Crystal Data: Monoclinic. *Point Group:* $2/m$. As acicular crystals, to 2 mm, the faces of which are irregularly streaked parallel to the axis of elongation; also as small anhedral grains. *Twinning:* Polysynthetic twinning on {100}, common in polished section.

Physical Properties: *Cleavage:* Perfect on {001}. *Fracture:* Conchoidal. *Tenacity:* Very brittle. Hardness = n.d. VHN = 180–197 (50 g load). D(meas.) = 5.26 D(calc.) = 5.39

Optical Properties: Opaque. *Color:* Grayish black; in polished section, white with reddish internal reflections. *Luster:* Metallic. *Pleochroism:* Relatively strong.
R_1–R_2: (470) 37.6–42.6, (546) 36.1–41.2, (589) 34.8–39.3, (650) 32.8–36.7

Cell Data: *Space Group:* $P2_1/a$. $a = 20.05(5)$ $b = 7.95(2)$ $c = 8.44(2)$ $\beta = 101°46(10)'$
$Z = 8$

X-ray Powder Pattern: Madoc, Canada.
3.52 (100), 2.795 (90), 4.19 (50), 3.90 (50), 2.670 (50), 2.653 (50), 2.335 (40)

Chemistry:

	(1)	(2)	(3)
Pb	38.8	38.50	38.94
Cu		0.49	
Sb	24.1	23.57	22.88
As	12.2	13.61	14.08
S	24.1	23.46	24.10
Total	99.2	99.63	100.00

(1) Madoc, Canada; by electron microprobe, corresponding to $Pb_{1.01}(Sb_{1.07}As_{0.88})_{\Sigma=1.95}S_{4.05}$. (2) Pitone quarry, Italy; by electron microprobe; corresponding to $Pb_{1.04}Cu_{0.04}(Sb_{1.00}As_{0.94})_{\Sigma=1.94}S_{3.78}$. (3) $Pb(Sb, As)_2S_4$ with Sb:As = 1:1.

Polymorphism & Series: Dimorphous with twinnite.

Occurrence: Of low-temperature hydrothermal origin, in marbles (Madoc, Canada; Seravezza, Italy).

Association: Pyrite, sphalerite, wurtzite, galena, stibnite, orpiment, realgar, enargite, tetrahedrite, zinkenite, jordanite, bournonite, sterryite, boulangerite, jamesonite, sartorite (Madoc, Canada); zinkenite, boulangerite, semseyite, jordanite, enargite (Silverton, Colorado, USA).

Distribution: From Madoc, Ontario, Canada [TL]. At the Brobdingnag mine, near Silverton, San Juan Co., Colorado, USA. In the Jas Roux deposit, 10 km east of Chapelle-en-Valgaudemar, Hautes-Alpes, France. At the Pitone, Tognetti, and Ceragiola marble quarries, near Seravezza, Tuscany, Italy. From Novoye, Khaydarkan, Fergana Valley, Alai Range, Kyrgyzstan.

Name: Honors Jean Etienne Guettard (1715–1786), French mineralogist and geologist.

Type Material: Canadian Geological Survey, Ottawa, 12167; Royal Ontario Museum, Toronto, Canada.

References: (1) Jambor, J.L. (1967) New lead sulfantimonides from Madoc, Ontario. Part 2 – Mineral descriptions. Can. Mineral., 9, 191–213. (2) (1968) Amer. Mineral., 53, 1425 (abs. ref. 1). (3) Bracci, G., D. Dalena, P. Orlandi, G. Duchi, and G. Vezzalini (1980) Guettardite from Tuscany, Italy: a second occurrence. Can. Mineral., 18, 13–15. (4) Mozgova, N.N., N.S. Bortnikov, Y.S. Borodaev, and A.I. Tzépine (1982) Sur la non-stoechiométrie des sulfosels antimonieux arséniques de plomb. Bull. Minéral., 105, 3–10 (in French with English abs.). (5) Jambor, J.L., J.H.G. Laflamme, and D.A. Walker (1982) A re-examination of the Madoc sulfosalts. Mineral. Record, 13, 93–100.