Routhierite $Tl(Cu, Ag)(Hg, Zn)_2(As, Sb)_2S_6$

Crystal Data: Tetragonal. *Point Group:* $\overline{4}2m$. As anhedral grains, to 300 μm, and as veinlets. *Twinning:* Fine polysynthetic lamellae seen in polished section.

Physical Properties: *Cleavage:* Two perpendicular. Hardness = n.d. VHN = 148 (25 g load). D(meas.) = n.d. D(calc.) = 5.83

Optical Properties: Opaque. *Color:* Violet-red; in polished section, bluish white, with strong internal reflections. *Luster:* Metallic. *Pleochroism:* Weak. *Anisotropism:* Weak. R_1–R_2: (400) 31.7–34.0, (420) 31.3–33.2, (440) 30.9–32.4, (460) 30.5–31.7, (480) 30.0–31.2, (500) 29.5–30.9, (520) 28.9–30.5, (540) 28.1–30.0, (560) 27.1–29.1, (580) 26.3–28.1, (600) 25.5–27.3, (620) 25.0–26.6, (640) 24.5–26.1, (660) 24.1–25.7, (680) 23.8–25.2, (700) 23.5–24.8

Cell Data: *Space Group:* $I\overline{4}2m$ (by analogy to stalderite). a = 9.977–9.986 c = 11.290–11.348 Z = 4

X-ray Powder Pattern: Jas Roux, France.
4.146 (100), 2.989 (100), 2.495 (90), 3.525 (80), 1.870 (70), 1.763 (70), 1.827 (60)

Chemistry:

	(1)	(2)	(3)
Tl	20.4	19.7	20.21
Cu	3.9	3.8	6.28
Ag	3.8	4.2	
Hg	34.7	34.4	39.67
Zn	2.0	2.1	
As	13.2	13.2	14.82
Sb	2.6	2.9	
S	19.6	19.6	19.02
Total	100.2	99.9	100.00

(1) Jas Roux, France; by electron microprobe, corresponding to $Tl_{0.98}(Cu_{0.60}Ag_{0.35})_{\Sigma=0.95}(Hg_{1.70}Zn_{0.30})_{\Sigma=2.00}(As_{1.73}Sb_{0.21})_{\Sigma=1.94}S_{6.00}$. (2) Do.; by electron microprobe, corresponding to $Tl_{0.95}(Cu_{0.59}Ag_{0.38})_{\Sigma=0.97}(Hg_{1.68}Zn_{0.32})_{\Sigma=2.00}(As_{1.73}Sb_{0.23})_{\Sigma=1.96}S_{6.00}$. (3) $TlCuHg_2As_2S_6$.

Occurrence: In hydrothermal deposits in dolostone (Jas Roux, France).

Association: Realgar, stibnite, pierrotite, sphalerite, pyrite, smithite (Jas Roux, France); pyrite, stibnite, realgar, cinnabar, parapierrotite, molybdenite, sphalerite, tetrahedrite–tennantite (Hemlo deposit, Canada).

Distribution: From the Jas Roux deposit, 10 km east of Chapelle-en-Valgaudemar, Hautes-Alpes, France [TL]. At the Vorontsovskoye gold deposit, Serov district, Northern Ural Mountains, Russia. In the Hemlo gold deposit, Thunder Bay district, Ontario, Canada.

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Type Material: National School of Mines, Paris, France.

References: (1) Johan, Z., J. Mantienne, and P. Picot (1974) La routhiérite, $TlHgAsS_3$, et la laffittite, $AgHgAsS_3$, deux nouvelles espèces minérales. Bull. Soc. fr. Minéral., 97, 48–53 (in French with English abs.). (2) (1975) Amer. Mineral., 60, 947 (abs. ref. 1). (3) Harris, D.C. (1989) The mineralogy and geochemistry of the Hemlo gold deposit, Ontario. Geol. Surv. Canada, Econ. Geol. Report 38. [??pages??] (4) Graeser, S., H. Schwander, R. Wulf, and A. Edenharter (1995) Stalderite $TlCu(Zn, Fe, Hg)_2As_2S_6$ – a new mineral related to routhierite: description and crystal structure determination. Schweiz. Mineral. Petrogr. Mitt., 75, 337–345. (5) Criddle, A.J. and C.J. Stanley, Eds. (1993) Quantitative data file for ore minerals, 3rd ed. Chapman & Hall, London, 486.