Rathite $Ag_2Pb_{12-x}Tl_{x/2}As_{18+x/2}S_{40}$

Crystal Data: Monoclinic. *Point Group*: 2/*m*. Crystals prismatic to short prismatic and striated parallel to [100]. *Twinning*: Polysynthetic on {001}in some material.

Physical Properties: *Cleavage*: Perfect on {001}; parting on {010}. *Fracture*: Subconchoidal. Hardness = 3 VHN = 161 D(meas.) = 4.986-5.446 (varies with Tl content) D(calc.) = 5.31

Optical Properties: Not fully opaque. *Color*: Lead-gray, may tarnish to iridescence; grayish white in reflected light with deep red internal reflections. *Streak*: Chocolate-brown. *Luster*: Metallic to dull. *Pleochroism*: Strong. *Anisotropism*: Intense; olive-green or yellow and bluish violet. R_1-R_2: (400) 40.0-45.2, (420) 39.2-44.8, (440) 38.4-44.3, (460) 37.8-43.7, (480) 37.2-43.7, (500) 36.6-42.8, (520) 36.0-42.3, (540) 35.4-41.8, (560) 34.7-41.0, (580) 34.0-40.2, (600) 33.3-39.3, (620) 32.6-38.4, (640) 31.9-37.6, (660) 31.3-36.7, (680) 30.7-35.9, (700) 30.2-35.2

Cell Data: *Space Group*: $P2_1/c$. (Tl-poor) $a = 8.471(2)$ $b = 7.926(2)$ $c = 25.186(5)$ $\beta = 100.58(3)°$ Z = 1; (Tl-rich) $a = 8.521(2)$ $b = 8.005(2)$ $c = 25.031(5)$ $\beta = 100.56(3)°$ Z = 1

X-ray Powder Pattern: Binntal, Switzerland.
2.75 (100), 3.60 (80), 3.39 (70), 2.87 (70), 4.19 (60), 2.97 (60), 2.22 (50)

Chemistry:

	(1)	(2)	(3)
Pb	36.61	47.24	27.33
Tl	5.36	0.16	11.78
Ag	4.13	3.35	3.75
As	27.31	21.76	29.28
Sb	1.94	3.89	2.16
S	24.48	23.55	25.35
Total	99.82	99.95	99.65

(1) Binntal, Switzerland; by electron microprobe, average of 11 analyses; corresponds to $Ag_{2.00}Tl_{1.36}Pb_{9.24}(As_{19.08}Sb_{0.84})_{\Sigma=19.92}S_{40.00}$. (2) Lengenbach quarry, Switzerland; electron microprobe analysis; corresponds to $Ag_{1.70}Tl_{0.04}Pb_{12.47}(As_{15.88}Sb_{1.75})_{\Sigma=17.63}S_{40.17}$. (3) Lengenbach quarry, Switzerland; electron microprobe analysis; corresponds to $Ag_{1.76}Tl_{2.91}Pb_{6.67}(As_{19.77}Sb_{0.90})_{\Sigma=20.66}S_{39.99}$.

Occurrence: In crystalline dolostone with other Pb-As-S minerals.

Association: Liveingite, baumhauerite, sartorite, hutchinsonite, dufrénoysite, tennantite, pyrite.

Distribution: From the Lengenbach quarry [TL] and at Reckibach, Binntal, Valais, Switzerland.

Name: Honors Gerhard von *Rath* (1830-1888), Professor of Mineralogy, Bonn, Germany.

Type Material: University of Fribourg, Fribourg, Switzerland, B742.

References: (1) Palache, C., H. Berman, and C. Frondel (1944) Dana's system of mineralogy, (7th edition), v. I, 455-457. (2) Marumo, F. and W. Nowacki (1965) The crystal structure of rathite-I. Zeits. Krist., 122, 433-456. (3) Berlepsch, P., T. Armbruster, and D. Topa (2002) Structural and chemical variations in rathite, $Pb_8Pb_{4-x}(Tl_2As_2)_x(Ag_2As_2)As_{16}S_{40}$: modulations of a parent structure. Zeits. Krist., 217, 581-590. (4) (2004) Amer. Mineral., 89, 471 (abs. ref. 3). (5) Berry, L.G. and R.M. Thompson (1962) X-ray powder data for the ore minerals. Geol. Soc. Amer. Mem. 85, 152-153. (6) Criddle, A.J. and C.J. Stanley, Eds. (1993) Quantitative data file for ore minerals, 3rd ed. Chapman & Hall, London, 475. (7) Topa , D. and U. Kolitsch (2018) The crystal chemistry of rathite based on new electron-microprobe data and single-crystal structure refinements: the role of thallium. Minerals, 8, 466.