Gratonite $Pb_9As_4S_{15}$

Crystal Data: Hexagonal. *Point Group:* $3m$. Crystals, to 5 mm, prismatic by elongation ‖ [0001] with $\{11\bar{2}0\}$ prominent; $\{02\bar{2}1\}$ is well developed and commonly the only terminal form; massive.

Physical Properties: *Tenacity:* Brittle. Hardness = 2.5 VHN = 130–146 (100 g load). D(meas.) = 6.22(2) D(calc.) = 6.17

Optical Properties: Opaque. *Color:* Dark lead-gray; in polished section, white, distinctly yellow against galena. *Streak:* Black. *Luster:* Metallic. *Pleochroism:* Very weak.
R_1–R_2: (400) 38.7–39.8, (420) 38.0–39.3, (440) 37.6–38.4, (460) 37.1–37.6, (480) 36.5–36.9, (500) 36.1–36.4, (520) 36.0–36.2, (540) 36.1–36.2, (560) 36.3–36.4, (580) 36.6–36.6, (600) 36.7–36.7, (620) 36.3–36.4, (640) 35.7–35.8, (660) 34.8–35.0, (680) 33.8–34.1, (700) 33.0–33.3

Cell Data: *Space Group:* $R3m$. $a = 17.758(14)$ $c = 7.807(6)$ $Z = 3$

X-ray Powder Pattern: Cerro de Pasco, Peru.
3.43 (100), 3.74 (80), 2.86 (70), 2.71 (70), 2.20 (60), 2.05 (60), 1.746 (40)

Chemistry:

	(1)	(2)	(3)
Pb	71.12	71.0	70.49
Fe	0.39		
As	10.82	11.0	11.33
Sb	0.21		
S	17.38	18.0	18.18
Total	99.92	100.0	100.00

(1) Cerro de Pasco, Peru. (2) Rio Tinto, Spain; by electron microprobe. (3) $Pb_9As_4S_{15}$.

Occurrence: In vugs in hydrothermal copper ores.

Association: Realgar, pyrite, sphalerite, pyrrhotite, arsenopyrite, enargite, tetrahedrite–tennantite, jordanite, canfieldite, hutchinsonite.

Distribution: In the Excelsior mine, Cerro de Pasco, Peru [TL], in large crystals. At the Santa Lucia deposit, Cuba. In abundance, in large crystals in the Blei-Scharley mine, Upper Silesia, Poland. At Zvezdel, Bulgaria. From Wiesloch, near Heidelberg, Black Forest, Germany. In the Lengenbach quarry, Binntal, Valais, Switzerland. On the Isle of Man, from the North Laxey mine. At Rio Tinto, Huelva Province, Spain. From Tsumeb, Namibia. In the Yunosawa mine, Aomori Prefecture, Japan.

Name: In honor of Louis Caryl Graton (1880–1970), Professor of Mining Geology, Harvard University, Cambridge, Massachusetts, USA.

Type Material: Harvard University, Cambridge, Massachusetts, USA, 94611.

References: (1) Palache, C., H. Berman, and C. Frondel (1944) Dana's system of mineralogy, (7th edition), v. I, 397–398. (2) Ribar, B. and W. Nowacki (1969) Neubestimmung der Kristallstruktur von Gratonit, $Pb_9As_4S_{15}$. Zeits. Krist., 128, 321–338 (in German with English abs.). (3) Criddle, A.J. and C.J. Stanley, Eds. (1993) Quantitative data file for ore minerals, 3rd ed. Chapman & Hall, London, 212.