Hammarite $Pb_2Cu_2Bi_4S_9$

Crystal Data: Orthorhombic. *Point Group:* $2/m\ 2/m\ 2/m$ or $mm2$. As short prisms or needles.

Physical Properties: *Cleavage:* Good on {010}. *Fracture:* Flat conchoidal. Hardness = 3–4 VHN = 186 D(meas.) = 6.74 D(calc.) = 7.05

Optical Properties: Opaque. *Color:* Steel-gray with red tint. *Streak:* Black. *Luster:* Metallic.
R_1–R_2: (400) 39.7–43.6, (420) 39.8–43.7, (440) 39.8–43.8, (460) 39.9–44.0, (480) 40.1–44.1, (500) 40.3–44.4, (520) 40.2–44.6, (540) 40.1–44.6, (560) 40.0–44.7, (580) 39.9–44.7, (600) 39.8–44.6, (620) 39.6–44.4, (640) 39.4–44.1, (660) 39.1–43.7, (680) 38.8–43.3, (700) 38.6–42.9

Cell Data: *Space Group:* *Pbnm* or $Pbn2_1$. $a = 33.7726(8)$ $b = 11.5857(3)$ $c = 4.01$ $Z = 4$

X-ray Powder Pattern: Dzhida deposit, Russia.
3.63 (10b), 3.14 (10b), 4.01 (9b), 3.56 (8), 2.83 (8b), 2.00 (8), 1.973 (8)

Chemistry:

	(1)	(2)	(3)
Pb	27.40	23.13	24.87
Cu	7.60	7.69	7.63
Bi	47.59	49.00	50.18
S	17.01	17.57	17.32
rem.	0.04	2.71	
Total	99.64	100.10	100.00

(1) Gladhammar, Sweden; remnant is insoluble; corresponds to $Pb_{2.24}Cu_{2.03}Bi_{3.86}S_{9.00}$.
(2) Dzhida deposit, Russia; remnant Zn 1.78%, SiO_2 0.50%, Ag 0.17%, Sb 0.14%, Fe 0.05%, Sn 0.05%, Te 0.02%, Se 0.004%; corresponds to $Pb_{1.83}Cu_{1.99}Bi_{3.85}S_{9.00}$. (3) $Pb_2Cu_2Bi_4S_9$.

Occurrence: Of hydrothermal origin.

Association: Paděraite, pekoite, bismuthinite, chalcopyrite, grossular, andradite (Băiţa, Romania); pyrite, sphalerite (Dzhida deposit, Russia).

Distribution: From Gladhammar, Kalmar, Sweden [TL]. In the Dzhida Mo–W deposit, and from Inkur, Transbaikal, Russia. At Băiţa (Rézbánya), and from Baia Borşa, Baia Mare (Nagybánya), Romania. Found in the Loch Shin monzogranite, near Lairg, Scotland. From along the Avoca River, Co. Wicklow, Ireland. At the Felbertal tungsten mine, Salzburg, Austria. In the Victoria district, Doña Ana Co., New Mexico, and from the Outlaw mine, Round Mountain district, Nye Co., Nevada, USA. In the Julcani district, Peru.

Name: For the locality at Gladhammar, Sweden.

Type Material: Swedish Museum of Natural History, Stockholm, Sweden.

References: (1) Palache, C., H. Berman, and C. Frondel (1944) Dana's system of mineralogy, (7th edition), v. I, 482. (2) Povilatis, M.M., N.N. Nozgova, Y.S. Borodaev, V.M. Senderova, and G.N. Ronami (1969) The first occurrence of hammarite in the USSR. Doklady Acad. Nauk SSSR, 187, 886–889 (in Russian). (3) Mumme, W.G., E. Welin, and B.J. Wuensch (1976) Crystal chemistry and proposed nomenclature for sulfosalts intermediate in the system bismuthinite–aikinite (Bi_2S_3–$CuPbBiS_3$). Amer. Mineral., 61, 15–20. (4) Horiuchi, H. and B.J. Wuensch (1976) The ordering scheme for metal atoms in the crystal structure of hammarite, $Cu_2Pb_2Bi_4S_9$. Can. Mineral., 14, 536–539. (5) Pring, A. (1995) Annealing of synthetic hammarite, $Cu_2Pb_2Bi_4S_9$, and the nature of cation-ordering processes in the bismuthinite-aikinite series. Amer. Mineral., 80, 1166–1173. (6) Topa, D., E. Makovicky, and W.H. Paar (2002) Composition ranges and exolution pairs for the members of the bismuthinite–aikinite series from Felbertal, Austria. Can. Mineral., 40, 849–869. (7) Criddle, A.J. and C.J. Stanley, Eds. (1993) Quantitative data file for ore minerals, 3rd ed. Chapman & Hall, London, 220.