Hambergite $Be_2BO_3(OH,F)$

Crystal Data: Orthorhombic. *Point Group:* $2/m\ 2/m\ 2/m$. Typically well-crystallized, prismatic along [001] or dipyramidal, showing {110}, {021}, {010}, {100}, {210}, with another 20 forms known; {100} striated ‖ [001]; to 30 cm. *Twinning:* On {110}, commonly reticulated; contact twins may be markedly hemimorphic.

Physical Properties: *Cleavage:* On {010}, perfect; on {100}, good. *Tenacity:* Brittle. Hardness = 7.5 D(meas.) = 2.347–2.372 D(calc.) = 2.365

Optical Properties: Transparent to translucent. *Color:* Colorless, pale gray, pale yellow; colorless in transmitted light. *Luster:* Vitreous.
Optical Class: Biaxial (+). *Dispersion:* $r > v$, weak. $\alpha = 1.554$–1.560 $\beta = 1.587$–1.591 $\gamma = 1.628$–1.631 2V(meas.) = 87°

Cell Data: *Space Group: Pbca.* $a = 9.654(2)$–$9.776(3)$ $b = 12.194(2)$–$12.364(4)$ $c = 4.430(1)$–$4.440(2)$ $Z = 8$

X-ray Powder Pattern: Anjanabanoana, Madagascar.
3.81 (10), 3.13 (9), 4.53 (8), 3.19 (8), 2.40 (7), 2.21 (7), 2.13 (7)

Chemistry:

	(1)	(2)
B_2O_5	36.0	36.6
BeO	53.6	52.9
F	1.0	6.0
H_2O	8.8	6.7
$-O = F_2$	0.4	2.5
Total	99.0	99.7

(1) Anjanabanoana, Madagascar; corresponds to $Be_{2.04}B_{0.98}O_3[(OH)_{0.93}F_{0.05}]_{\Sigma=0.98}$. (2) Little Three mine, California, USA; corresponds to $Be_{2.00}B_{1.00}O_3[(OH)_{0.70}F_{0.30}]_{\Sigma=1.00}$.

Occurrence: An uncommon accessory mineral in granite pegmatites.

Association: Beryl, danburite, apatite, spodumene, zircon, fluorite, feldspar, quartz.

Distribution: From Helgeroa, Langesundsfjord, Norway. In the Czech Republic, from Ctidružice; Recice; Kracovice, near Tribic; Sušice; and elsewhere. From between San Ilario and San Piero in Campo, Elba, Italy. In Madagascar, from Imalo, near Mania; at Maharitra, on Mt. Bity; and large crystals from Anjanabanoana. In the USA, fine crystals from the Little Three mine, near Ramona, and the Himalaya mine, Mesa Grande district, San Diego Co., and in the Jensen quarry, Riverside Co., California; large crystals from the Zapot pegmatite, 25 km northeast of Hawthorne, Mineral Co., Nevada; at the Animikie Red Ace pegmatite, near Pine River, Florence Co., Wisconsin. In Pakistan, around Stak Nala and Drot, Gilgit-Skardu road, Northern Areas. In the Rangkul pegmatite field, eastern Pamir Mountains, Tajikistan. In Russia, from the Mokrusha mine, Ural Mountains, and in the Malkhan pegmatite field, Chite region, Transbaikal.

Name: Honors Professor Axel Hamberg (1863–1933), Swedish mineralogist and geographer.

Type Material: Swedish Museum of Natural History, Stockholm, Sweden, 332865; Natural History Museum, Paris, France, 10734; National Museum of Natural History, Washington, D.C., USA, 116994.

References: (1) Palache, C., H. Berman, and C. Frondel (1951) Dana's system of mineralogy, (7th edition), v. II, 370–372. (2) Switzer, G., R.S. Clarke, Jr., J. Sinkankas, and H.W. Worthing (1965) Fluorine in hambergite. Amer. Mineral., 50, 85–95. (3) Burns, P.C., M. Novák, and F.C. Hawthorne (1995) Fluorine-hydroxyl variation in hambergite: a crystal-structure study. Can. Mineral., 33, 1205–1213. (4) Richards, R.P. (1996) Twinned hambergite from the Gilgit district, Northern Pakistan. Can. Mineral., 34, 615–621.