Agardite-(Y) $YCu^{2+}_6(AsO_4)_3(OH)_6 \cdot 3H_2O$

Crystal Data: Hexagonal. *Point Group*: 6/*m*. Crystals are acicular hexagonal prisms, elongated along [0001], a few mm long, may be stepped or hollow tubes; in radiating fibrous aggregates.

Physical Properties: Hardness = n.d. D(meas.) = 3.61-3.72 D(calc.) = 3.66(4)

Optical Properties: Semitransparent. *Color*: Blue-green to yellow-green.
Optical Class: Uniaxial (+). ω = 1.701-1.723 ε = 1.777-1.815

Cell Data: *Space Group*: $P6_3/m$. a = 13.583(2) c = 5.895(2) Z = 2

X-ray Powder Pattern: Bou Skour mine, Morocco.
11.73 (10), 2.938 (8), 2.451 (8), 4.43 (7), 3.54 (7), 2.692 (6), 2.558 (6)

Chemistry:	(1)	(2)		(1)	(2)		(1)	(2)
As_2O_5	31.50	32.28	RE_2O_3	1.2		Gd_2O_3		0.62
P_2O_5		0.03	La_2O_3		2.68	CuO	45.35	44.50
SiO_2		0.15	Ce_2O_3		0.44	PbO		4.60
Bi_2O_3		0.04	Pr_2O_3		0.21	CaO	2.60	0.65
Al_2O_3		0.20	Nd_2O_3		1.15	H_2O	11.35	[10.47]
Y_2O_3	7.5	4.08	Sm_2O_3		0.08	Total	99.50	[102.18]

(1) Bou Skour mine, Morocco; contains very little malachite and quartz; spectrographic analysis of RE = La 0.01%, Pr, Nd 0.3%, Sm 0.15%, Gd, Tb 0.04%, Dy, Ho, Er 0.01%, Tm, Yb, Lu 0.025%; corresponds to $[(Y,RE)_{0.38}Ca_{0.12}]_{\Sigma=0.50}(Cu_{5.86}Ca_{0.23})_{\Sigma=6.09}[(AsO_4)_{2.83}(OH)_{0.68}]_{\Sigma=3.51}(OH)_6 \cdot 3H_2O$.
(2) Santa Lucia mine, Sardinia, Italy; by electron microprobe, H_2O calculated from stoichiometry; corresponds to $(Y_{0.38}Pb_{0.22}La_{0.17}Nd_{0.07}Gd_{0.04}Al_{0.04}Ce_{0.03}Pr_{0.01}Ca_{0.03})_{\Sigma=0.99}(Cu_{5.91}Ca_{0.09})_{\Sigma=6.00}$ $[(AsO_4)_{2.97}(SiO_4)_{0.03}]_{\Sigma=3.00}(OH)_6 \cdot 3H_2O$.

Mineral Group: Mixite group.

Occurrence: In the oxidation zone of some copper deposits.

Association: Azurite, malachite, chrysocolla, cuprite, copper, mimetite, quartz.

Distribution: In the Bou Skour mine, Djebel Sarhro, Morocco. At Mutoshi, Katanga Province, Congo (Shaba Province, Zaire). From the Luisito mine, Anora, Córdoba Province, Spain. At Schneeberg, Saxony; in the Clara mine, near Oberwolfach, Black Forest, Germany. In France, from the Cap Garonne mine, near le Pradet, Var, and Chessy, near Lyon, Rhône. In Wheal Alfred, Cornwall, England. At the Gwaithyrafon mine, Cwmsymlog, Wales. On Sardinia, Italy, from the Santa Lucia and Sa Duchessa mines, near Iglesias. At Hayasi, Setoda, Ikuchi Island, Hiroshima Prefecture, Japan. From Broken Hill, New South Wales, Australia. In the USA, from the Tintic district, Juab Co., Utah; in the Mohawk mine, Clark Mountains, San Bernardino Co., California; and at Granite Gap, San Simon district, Hidalgo Co., New Mexico. A few other localities are known but may require confirmation as dominantly yttrian.

Name: Honors Jules *Agard*, geologist, Bureau de Recherches Géologiques et Minières, Orléans, France, and a suffix for dominant yttrium.

Type Material: Serv. Geol. Maroc, Rabat, Morocco; National School of Mines, Paris, France; The Natural History Museum, London, England, 1978,24.

References: (1) Dietrich, J.E., M. Orliac, and F. Permingeat (1969) L'agardite, une nouvelle espèce minérale, et la problème du chlorotile. Bull. Soc. fr. Minéral., 92, 420-434 (in French, English abs.). (2) (1970) Amer. Mineral., 55, 1447-1448 (abs. ref. 1). (3) Aruga, A. and A. Nakai (1985) Structure of Ca-rich agardite, $(Ca_{0.40}Y_{0.31}Fe_{0.09}Ce_{0.06}La_{0.04}Nd_{0.01})Cu_{6.19}[(AsO_4)_{2.42}(HAsO_4)_{0.49}](OH)_{6.38} \cdot 3H_2O$. Acta Cryst., C41, 161-163. (4) Olmi, F., C. Sabelli, and G. Brizzi (1988) Agardite-(Y), gysinite-(Nd) and other rare minerals from Sardinia. Mineral. Record, 19, 305-310. (5) Olmi, F., C. Sabelli, and R.T. Ferroni (1991) A contribution to the crystal chemistry of mixite group minerals from Sardinia (Italy). Neues Jahrb. Mineral., Monatsh., 487-499. (6) Morrison, S.M., K.J. Domanik, M.J. Origlieri, and R.T. Downs (2013) Agardite-(Y), $Cu^{2+}_6Y(AsO_4)_3(OH)_6 \cdot 3H_2O$. Acta Cryst., E69, i61-i62.