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

Crystal Data: Hexagonal. *Point Group*: 6/*m*. Crystals acicular, prismatic, to 3 mm, in tufted groups, spherical rosettes.

Physical Properties: Hardness = n.d. D(meas.) = 3.65(5) D(calc.) = 3.62(1)

Optical Properties: Semitransparent. *Color*: Grass-green to dull green, yellowish green to intense bluish green, rarely nearly colorless.
Optical Class: Uniaxial (+). ω = 1.715(2) ε = 1.795(2)

Cell Data: *Space Group*: $P6_3/m$. a = 13.586(4) c = 5.931(5) Z = 2

X-ray Powder Pattern: n.d. ; presumably very similar to agardite-(Y).

Chemistry: (1) Red Cloud fluorite mine, New Mexico, USA; analysis not given, by electron microprobe, average of analyses on four crystals, $(OH)^{1-}$ calculated for charge balance; stated to correspond to $(Al_{0.36}La_{0.29}Ce_{0.21}Nd_{0.08}Pr_{0.03}Y_{0.02}Gd_{0.02}Sm_{0.01})_{\Sigma=1.02}(Cu_{5.50}Ca_{0.42}Pb_{0.06}Fe_{0.02}Zn_{0.01})_{\Sigma=6.01}$ $[(AsO_4)_{2.74}(SiO_4)_{0.25}(VO_4)_{0.02}(SO_4)_{0.02}]_{\Sigma=3.03}(OH)_{5.76}\cdot 3H_2O$.

Mineral Group: Mixite group; Nd and Ce have also been noted as dominant rare-earth elements, but the corresponding species have not been fully described.

Occurrence: In small amounts in the oxidized zone of hydrothermal mineralized breccia and polymetallic mineral deposits (Red Cloud mines, New Mexico, USA).

Association: Fluorite, bastnaesite, barite, quartz (Red Cloud fluorite mine, New Mexico, USA); chrysocolla, malachite, azurite, mimetite, vanadinite, conichalcite, wulfenite, mottramite, cerussite, quartz (Red Cloud copper mine, New Mexico, USA); smithsonite, aurichalcite, hydrozincite, azurite, cuprian adamite, calcite, chrysocolla, zincaluminite, gibbsite (Kamariza mine, Greece).

Distribution: From the Red Cloud fluorite and copper mines, Gallinas district, Lincoln Co., New Mexico, USA. In the Kamariza mine, Laurium, Greece (Ce > La in part). In England, from Wheal Alfred, Phillack, Cornwall (Nd-rich); at the Brandy Gill and Deer Hills mines, Caldbeck Fells, Cumbria. At the Clara Mine, near Oberwolfach, and other localities in the Black Forest, Germany (Ce > La in part). From the Sa Duchessa mine, near Iglesias, Sardinia, Italy (Nd-rich in part, some with Ce > La).

Name: By analogy to agardite-(Y), with its rare-earth content dominated by lanthanum.

Type Material: National Museum of Natural History, Washington, D.C., USA, 148987, 148988.

References: (1) Modreski, P.J. (1983) Agardite-(La), a chemically complex rare-earth arsenate from the Gallinas district, Lincoln Co., New Mexico. In: Anthony, J.W., Ed., Oxidation mineralogy of base metal deposits: Fifth Joint Mineralogical Society of America - Friends of Mineralogy Symposium, Tucson, Arizona. (2) Fehr, T. and R. Hochleitner (1984) Agardite-La, ein neues Mineral von Lavrion, Griechenland. Lapis, 9(1), 22, 37 (in German). (3) (1985) Amer. Mineral., 70, 871 (abs. ref. 2). (4) Golubev A.M., E. Brücher, A. Schulz, R.K. Kremer, and R. Glaum (2020) La- and Lu-agardite - preparation, crystal structure, vibrational and magnetic properties. Zeitschrift für Naturforschung B Chemical Science, 75, 191-199.