

AGARDITE-(La), A CHEMICALLY COMPLEX RARE-EARTH ARSENATE FROM
THE GALLINAS DISTRICT, LINCOLN COUNTY, NEW MEXICO

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Agardite-(La) is a new mineral species found at two mines in the Gallinas district, Lincoln County, New Mexico. The mineral forms grass-green to dull-green tufts of acicular prismatic crystals about 1-10 μm thick and 100 μm long. At the Red Cloud fluorite mine it occurs in vugs in a mineralized breccia containing fluorite, quartz, bastnaesite, and barite. The breccia is developed along a fault zone in Permian sandstone near an intrusion of Tertiary trachyte porphyry. At the nearby Red Cloud copper mine, small amounts of agardite-(La) occur in vugs containing chrysocolla, malachite, azurite, quartz, mimetite, vanadinite, conichalcite, wulfenite, mottramite, and cerussite, within chalcocite-galena-bornite-pyrite-fluorite ore.

The chemical formula of agardite-(La), computed from averaged microprobe analyses of four crystals from the Red Cloud fluorite mine by normalizing to 30 cation charges and assuming an ideal H_2O content and OH- as required for charge balance, is $(\text{Cu}_{5.50}\text{Zn}_{.01}\text{Fe}_{.02}\text{Pb}_{.06}\text{Ca}_{.42})\Sigma_{6.01}(\text{Al}_{.36}\text{Y}_{.02}\text{La}_{.29}\text{Ce}_{.21}\text{Pr}_{.03}\text{Nd}_{.08}\text{Sm}_{.01}\text{Gd}_{.02})\Sigma_{1.02}[(\text{AsO}_4)_{2.74}(\text{VO}_4)_{.02}(\text{SiO}_4)_{.25}(\text{SO}_4)_{.02}]\Sigma_{3.03}(\text{OH})_{5.76} \cdot 3\text{H}_2\text{O}$. This can be generalized to $(\text{Cu,Ca})_6(\text{La,Ce,Al})(\text{AsO}_4,\text{SiO}_4)_3(\text{OH})_6 \cdot 3\text{H}_2\text{O}$. The relative abundances of the rare-earth elements in agardite-(La) and in the associated bastnaesite are similar.

The selection of the best name and ideal formula for this mineral has been complicated because no single element constitutes a majority of the trivalent cations in it; Al is most abundant, but the lanthanide REE taken together compose 63% of the trivalent cations. The name agardite-(La) has been approved by the I.M.A.; to specify more information, the mineral can also be referred to as agardite-(La,Ce). The ideal end member formula is $\text{Cu}_6\text{La}(\text{AsO}_4)_3(\text{OH})_6 \cdot 3\text{H}_2\text{O}$, but the maximum observed proportion of this end member is only 31%. Agardite-(La) is isostructural with agardite-(Y), mixite, goudeyite, and petersite. It is hexagonal, space group $\text{P6}_3/\text{m}$ or P6_3 , $a = 13.586(4)$, $c = 5.931(5)$ Å, $V = 948.1(5)$ Å³, $Z = 2$, $D(\text{meas.}) = 3.65(5)$, $D(\text{calc.}) = 3.62(1)$, uniaxial (+), $\omega = 1.715(2)$, $\epsilon = 1.795(2)$.