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Lianbinite, $(NH_4)(C_2H_3O_3)(C_2H_4O_3)$, a new glycolate mineral from the Santa Catalina Mountains, Tucson, Arizona, U.S.A.

HEXIONG YANG[1,*], XIANGPING GU[2,†], WARREN LAZAR[1], RONALD B. GIBBS[1], AND ROBERT T. DOWNS[1]

[1]Department of Geosciences, University of Arizona, 1040 E. 4th Street, Tucson, Arizona 85721-0077, U.S.A.
[2]Guanghua School of Gems and Art Design, Jiangxi Institute of Applied Science and Technology, Nanchang, Jiangxi 330100, China

ABSTRACT

A new organic mineral species, lianbinite, ideally $(NH_4)(C_2H_3O_3)(C_2H_4O_3)$, was discovered from the western end of Pusch Ridge in the Santa Catalina Mountains, north of Tucson, Arizona, U.S.A. It occurs as bladed or acicular crystals, associated with baryte, fluorite, glecklerite, jarosite, jimkrieghite, quartz, and rasmussenite. Lianbinite is colorless, transparent with a white streak and vitreous luster. It is brittle and has a Mohs hardness of 1–1½; cleavage is perfect on {100}. No parting or twinning was observed. The calculated density is 1.497 g/cm^3. The chemical composition of lianbinite was determined with a Thermo Finnigan DELTAplus XL Elemental Combustion System equipped with a mass spectrometer, yielding an empirical formula $(N_{0.98}H_{4.06})(C_{1.98}H_3O_3)(C_{1.99}H_3O_3)$, or $N_{0.98}C_{3.97}H_{11.06}O_6$, on the basis of 6 O apfu.

Lianbinite is the natural counterpart of synthetic $(NH_4)(C_2H_3O_3)(C_2H_4O_3)$, which is isostructural with synthetic $K(C_2H_3O_3)(C_2H_4O_3)$ and $Rb(C_2H_3O_3)(C_2H_4O_3)$. It is monoclinic with space group $P2_1/c$, and unit-cell parameters $a = 3.91305(11)$, $b = 18.7499(4)$, $c = 10.7214(2)$ Å, $\beta = 107.444(2)°$, $V = 750.45(3)$ Å^3, and $Z = 4$. The crystal structure of lianbinite contains two forms of glycolate units: glycolate anions (GAs) and glycolic acid molecules (GMs). These two units are linked together by hydrogen bonds to form a three-dimensional network with two kinds of channels extending along [100]. The large channel is surrounded by O atoms, with $(NH_4)^+$ groups situated inside, whereas the small one is enclosed by H atoms. The discovery of lianbinite, together with eight other glycolate minerals documented thus far, implies that glycolate minerals may be rather widespread in nature, thus serving as a potential reservoir for biologically fixed carbon.

Keywords: Lianbinite, organic mineral, glycolate, crystal structure, X-ray diffraction, Santa Catalina Mountains