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Gilmarite, Cu$_3$ (AsO$_4$) (OH)$_3$, a new mineral: its description and crystal structure

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Abstract: Gilmarite, Cu$_3$ (AsO$_4$) (OH)$_3$, occurs at the old copper mines of Roua (Alpes-Maritimes, France), associated with cuprite, posnjakite, langite, clinoptyrolite, brochantite, malachite, vesignieite, cor­

nubite, olivenite, trippkeite, domeykite and djurleite. It forms rosettes (0.3 mm diameter) or isolated crystals (0.1 x 0.04 x 0.02 mm maximum dimension). The green-blue crystals are elongated along [101] or [100], flattened on (010) and have a good cleavage on {010}. They are not twinned. The mineral is triclinic, P 1, a = 5.445 (4), b = 5.873 (3), c = 5.104 (3) Å, α = 114.95 (3), β = 93.05 (5), γ = 91.92 (4)°, V = 147.5 (2) Å$^3$, Z = 1, D$_{meas}$ = 4.2 (1) and D$_{calc}$ = 4.28 g/cm$^3$. The strongest lines in the X-ray powder diffraction pattern (d$_{obs}$ in Å, (hkl), I$_{rel}$) are: 4.613, (001), 100; 4.580, (011), 50; 3.390, (101), 60; 2.713, (200), 40; 2.543, (012) (121), 40. Mohs’ hardness is ~3. Luster is vitreous transparent, streak is bluish green; crystals are biaxial (−) with α = 1.760 (5), β = 1.80 (1), γ = 1.83 (1) at 589 nm; 2V$_{obs}$ = 77 (4)$^o$, 2V$_{calc}$ = 80 (1)$^o$. Pleochroism is weak with γ = green; α, β = light green. The crystal structure was solved by direct methods (MoKα radiation) and refined using 1640 observed unique reflections to R = 0.062, R$_p$ = 0.041. Gilmarite is a polymorph of clinoclase, their structures are quite different. The structure of gilmarite is formed by infinite chains of CuO$_6$ octahedra and CuO$_5$ square pyramids extending along the b axis. These chains are connected via CuO$_5$ square pyramids to form sheets parallel to (001). The sheets are connected via AsO$_4$ tetrahedra.

Key-words: gilmarite, new mineral, powder pattern, crystal structure, arsenate, copper, hydrogen bonding.

Introduction

Gilmarite, Cu$_3$ (AsO$_4$) (OH)$_3$, is a new mineral discovered in samples collected by Danielle Mari, Gilbert Mari and Pierre Rolland in the old copper mines of Roua (North group, municipality of Guillaumes) which are situated NW of the Alpes-Maritimes department (France), about 50 km as the crow flies from Nice. This mineral is a poly­morp of clinoclase.

The mineral name honours Gilbert Mari (1944–), mineralogist, University of Nice-Sophia Antipolis, president of the Association of Naturalists of Nice and the Alpes-Maritimes, for the remarkable work he has done with his wife Danielle and Pierre Rolland on the old copper mines of this area (Mari, 1992). The mineral and mineral name have been approved by the Commission on New Minerals and Mineral Names of the International Mineralogical Association.

Type material is preserved in the Department of Mineralogy of the Natural History Museum of Geneva, Switzerland, under reference no. 477.006.

Occurrence

The Barrot Dome, in the north-eastern part of the Alpes-Maritimes area (France), is characterized by the presence of numerous showings of cuprifereous ore. This Dome consists of a small massif formed by an anticline, in which the Permian