International Mineralogical Association

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MINERALS AND IMA-CNMNC: THE CONTRIBUTION OF VOLUNTEER SCIENTISTS TO THE COMMUNITY

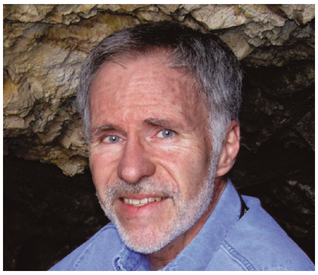
Minerals are essential components of the Earth and other planetary bodies. Consequently, the study of minerals holds an immense significance, primarily for the fields of geosciences and materials science.

For this reason, in 1958, the International Mineralogical Association (IMA) established commissions to address various aspects of mineralogy. These commissions encompassed the Commission on New Minerals and Minerals Names, as well as the Commission on Classification of Minerals. In 2006, these two commissions were merged into the Commission on New Minerals, Nomenclature and Classification (CNMNC), which currently oversees all matters pertaining to systematic mineralogy.

The CNMNC approves new mineral species regularly, with over a hundred new species being accepted each year in recent times. Existing species are classified in groups or supergroups, their chemical formulae are standardized, and criteria are defined for establishing new species. Occasionally, certain species may lose their status (discreditation) if they no longer meet the chemical and/or structural requirements for being a valid individual species. However, it is also possible for a mineral to be revalidated, and valid species may undergo renaming or redefinition processes.

All of this work is made possible thanks to the members of the CNMNC, who are all volunteers working to enhance the knowledge of mineral sciences. They are 32 voters from all over the world who assess all mineral-related proposals in accordance with the IMA-CNMNC guidelines. Their diligent efforts guarantee the adherence to these guidelines. The letter notifying the approval of a new mineral, the creation of a group, or the establishment of a new nomenclature scheme is accompanied by comments from CNMNC members. This letter serves as a certification for the approval and grants access to the valuable comments made by the CNMNC to the editors and reviewers of the journal.

Information on approved new minerals and nomenclature/classification issues is published every two months in the CNMNC Newsletter, which has been published since 2010 in *Mineralogical Magazine* and since 2017 in the *European Journal of Mineralogy* open access. To date, there have been 77 issues of the Newsletter. Additionally, the CNMNC website offers a regularly updated list of valid mineral species, known as "The New IMA List of Minerals – A Work in Progress". This list includes newly approved mineral species and their corresponding formulae.



Tony Kampf

Igor Pekov

Nikita Chukanov

Among the scientists who have made significant contributions to the discovery of new minerals, the podium is currently occupied by Anthony R. Kampf (Natural History Museum of Los Angeles County, USA) with 358 approved species, followed by Igor Pekov (Lomonosov Moscow State University, Russia) with 306 approved species, and Nikita V. Chukanov (Russian Academy of Sciences, Chernogolovka, Russia) with 264 approved species.

The groupings (groups, supergroups, and families) with the largest number of mineral species are listed in Table 1. For them, a systematic revision has been carried out in the last years by several dedicated CNMNC subcommittees.

Table 1 SELECTED GROUPS, SUPERGROUPS, OR FAMILIES IN ORDER OF ABUNDANCE.
a: number of species as of today; ***b***: number of species at the time the report was approved by the CNMNC.

References for papers describing the related nomenclature can be found at the CNMNC website (http://cnmnc.units.it).

Grouping	*a*	*b*
Amphibole	116	84
Zeolite	108	85
Spinel	61	56
Mica	57	34
Alunite	52	46
Seidozerite	50	44
Hydrotalcite	50	44
Apatite	48	36
Columbite	41	39
Tourmaline	39	17
Alluaudite	39	35
Pyrochlore	38	7
Tetrahedrite	37	11
Garnet	37	32
Epidote	35	20
Labuntsovite	30	19
Pyroxene	30	20

In this communication, we intend to clarify the distinction between the terms "mineral substance" and "mineral species." A mineral substance refers to tangible matter found in the environment naturally, whereas rephrasing from G. Carobbi (Trattato di Mineralogia, USES, Firenze, 1971), a mineral species is not an independent entity found in nature, but rather a construct resulting from agreed-upon conventions, i.e., it is an ideal entity. For that reason, all mineral species must pass through the CNMNC-approval process.

The number of mineral substances is truly remarkable and incalculable, encompassing all chemically homogeneous solid phases that have formed through geological processes throughout the universe. To date, the number of recognized mineral species is just above 6000, meticulously documented in the "The New IMA List of Minerals – A Work in Progress."

Ferdinando Bosi, **Frédéric Hatert**, **Stuart J. Mills**, and **Marco Pasero**

BATONIITE

The 2023 “Mineral of the Year” award has been assigned to batoniite. The mineral was discovered in a sample collected at the Cetine di Cotorniano mine, Siena Province, Tuscany, Italy, and was fully characterized by a research team lead by Daniela Mauro from the Department of Earth Sciences, University of Pisa, Italy.

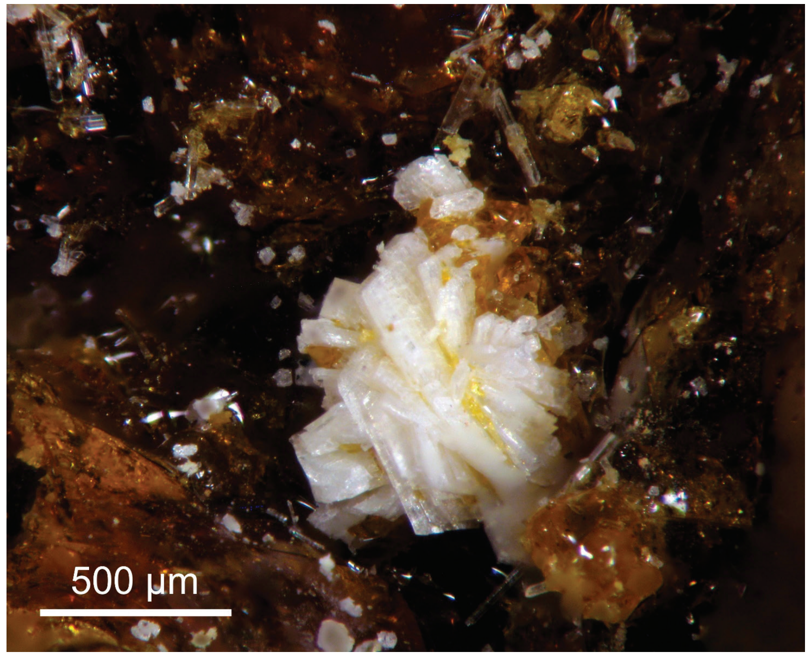
More precisely, batoniite was found in the Garibaldi tunnel, the lowest mining level of the Cetine di Cotorniano mining complex, and occurs as hemispherical aggregates up to 1 mm in diameter, formed by {011} tabular crystals. Crystals are colorless to white, and are transparent. Associated minerals are gypsum and a low-crystalline Al–Fe sulfate not yet characterized.

The ideal chemical formula of batoniite is $Al_8(SO_4)_5(OH)_{14}(H_2O)_{18}\cdot 5H_2O$ and it is the first natural species containing the $[Al_8(OH)_{14}(H_2O)_{18}]^{10+}$ polyoxocation. Thus, it is a new addition to the small number of polyoxometalates that currently represent less than 1% of all recognized mineral species.

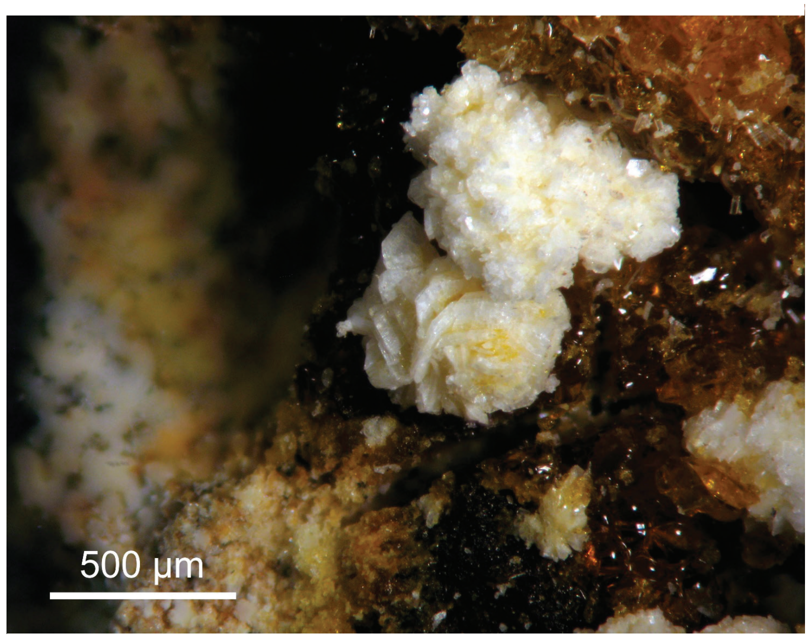
Batoniite is triclinic with space group *P*-1. Its unit-cell parameters are a = 9.1757(6) Å, b = 12.0886(9) Å, c = 20.9218(15) Å, α = 82.901(3)°, β = 87.334(3)°, γ = 86.999(2)°, V = 2297.8(3) Å^3, Z = 2. The crystal structure has been refined by single-crystal X-ray diffraction data to R = 9.2%. The structure is characterized by isolated $[Al_8(OH)_{14}(H_2O)_{18}]$ polyoxocations, H-bonded to five interstitial (SO_4) and five H_2O groups. The mineral name is after Massimo Batoni (b. 1948), for his contribution to the knowledge of Italian mineralogy.

Batoniite is the first Italian “Mineral of the Year,” and it is the fifth new mineral species discovered at the Cetine di Cotorniano mine, after brizziite, cetineite, onoratoite, and rosenbergite.

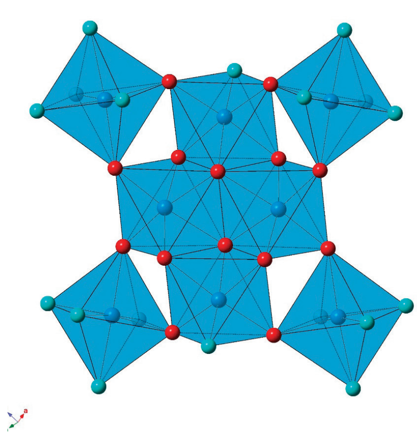
The full description of the new mineral has been published in the *European Journal of Mineralogy*: Mauro D, Biagioni C, Sejkora J, Dolníček J, Škoda R (2023) Batoniite, $[Al_8(OH)_{14}(H2O)_{18}]$ $(SO_4)_5\cdot 5H_2O$, a new mineral with the $[Al_8(OH)_{14}(H_2O)_{18}]^{10+}$ polyoxocation from the Cetine di Cotorniano Mine, Tuscany, Italy. European Journal of Mineralogy 35: 703-714, doi: 10.5194/ejm-35-703-2023



Aggregate of white tabular crystals of batoniite with colorless crystals of gypsum and orange-brown resinous unidentified, low-crystalline, Al-Fe sulfate. Garibaldi tunnel, Cetine di Cotorniano mine, Siena Province, Tuscany, Italy. Type material, Natural History Museum of Pisa University, catalogue number 20028. PHOTO D. MAURO.



Aggregates of white tabular crystals of batoniite with orange-brown resinous unidentified, low-crystalline, Al-Fe sulfate. Garibaldi tunnel, Cetine di Cotorniano mine, Siena Province, Tuscany, Italy. Type material, Natural History Museum of Pisa University, catalogue number 20028. PHOTO D. MAURO.



The polyoxocation $[Al_8(OH)_{14}(H_2O)_{18}]$ observed in batoniite. Red and light blue circles represent (OH) and (H_2O) groups, respectively. Blue polyhedra are Al-centered octahedra.

COSTA RICA JOINS THE INTERNATIONAL MINERALOGICAL ASSOCIATION: EXPANDING THE GEOGRAPHICAL SCOPE OF THE GLOBAL MINERALOGICAL COMMUNITY

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Members of the Mineralogy Commission, College of Geologists of Costa Rica

Costa Rica is a small country (51,179 km²) located in Central America. Geologically, it is relatively young, with the oldest rocks dating back only to 200 million years (Middle Jurassic). However, most rocks are less than 120 million years old, with some being as young as a few years due to active volcanism. Tectonically, the country is bounded by the subduction of the Cocos plate under the Caribbean plate and the Panama microplate. Given its geological youth, mineral deposits are not abundant, and the mining tradition is limited. Despite this, several types of deposits are notable:

- Manganese nodule deposits in oceanic basement rocks (ophiolites *s.l.* of the Nicoya Peninsula), commercially exploited during and after the First World War.
- Cyprus-type copper deposits in oceanic basement rocks (ophiolites *s.l.* of the Nicoya Peninsula).
- Chromite deposits associated with serpentinized peridotite (ophiolites *s.l.* of Santa Elena).
- Polymetallic copper-lead-zinc deposits, particularly present in Lower Miocene volcanic and volcaniclastic rocks.
- Porphyritic copper deposits associated with Upper Miocene intrusive bodies.
- Low-sulfidation epithermal gold deposits associated with Neogene volcanism.
- Alluvial gold deposits associated with Pliocene–Pleistocene sediments, sourced from ancient oceanic basement volcanism (ophiolites *s.l.* of Osa-Punta Burica and Golfito).
- Pleistocene bauxitic laterite deposits.
- Native sulfur related to Late Quaternary extinct and active volcanoes.

Metallic gold and copper mining in Costa Rica began approximately 1,700 years ago with the Amerindians, prior to the Spanish conquest and colonization. However, colonial mining in the 17th and 18th centuries was very artisanal until the first epithermal gold findings were technically exploited in 1821. These studies of economic geology and mining activities led to the arrival of foreign geologists (from the USA, England, Germany, Switzerland), who described the first minerals associated with economically significant metallic deposits, as well as those present in igneous and sedimentary rocks. With the establishment of the *Direction of Geology, Mines and Oil* (*Dirección de Geología, Minas y Petróleo*) in 1960 and the Central American School of Geology (*Escuela Centroamericana de Geología*) in 1969, Costa Rican professionals began to investigate more into petrography, mineralogy, and economical deposits, including specialized courses.

Several peculiarities, aside from the previously described deposits, make Costa Rica an interesting country for investigating mineralogical aspects: a) the existence of hyperacidic crater brines lakes in active volcanoes, current examples of high-sulfidation environments, including sulfur small cones, sulfur pahoehoe flows, and sulfur pools; b) the existence of the *Cueva de los Minerales*, the volcanic cave with the most diverse variety of minerals in the world; c) the second-known occurrence worldwide of the zeolite tschernichite; d) a great variety of quartz in its most diverse crystalline forms and colors, including blue chalcedony; and e) a wide variety of minerals in igneous alkaline, calc-alkaline, and tholeiitic rocks.

The recent creation of a Mineralogy Commission within the College of Geologists of Costa Rica will enable further advancements in mineralogy through specific research and discussion panels, working alongside mining and economical geologists and in archaeometallurgy investigations. Several studies are currently underway, with initial results expected in 2025.

For the College of Geologists of Costa Rica, through its Mineralogy Commission, it is a true honor to belong to the IMA, with the expectation of strengthening research ties and inviting colleagues from other entities to collaborate.

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