

New Mineral Names: Hydrous Minerals

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ABSTRACT

In this issue of New Mineral Names, a thematic approach is used to help provide context for advances and discoveries in mineralogy. There have been many new minerals described within the last year that have important H₂O-OH groups within the crystal structure and/or have been formed by hydrothermal processes. Here we investigate the newly discovered hydrous minerals: taniajacoite, strontioruizite, flaggite, steudelite, whiteite-(MnMnMn), zolotarevite, garpenbergite, dobšináite, galeacalolusite, reliancecite-(K), and hydroplumboelsmoreite.

TANIAJACOITE AND STRONTIORUIZITE

Both taniajacoite [SrCaMn₃³⁺Si₄O₁₁(OH)₄·2H₂O] and strontioruizite [Sr₂Mn₃³⁺Si₄O₁₁(OH)₄·2H₂O] (Yang et al 2021) were found in the N'Chwaning III mine, Kalahari manganese field in the Republic of South Africa. Taniajacoite is named in honor of Tania and Jaco van Nieuwenhuizen, who first found the mineral in South Africa. Strontioruizite is named for the strontium-dominant species that is isostructural with ruizite.

Both taniajacoite and strontioruizite have similar structures to ruizite, and the three minerals are difficult to distinguish visually as they can have similar color and morphology. Details of their formation conditions are not provided, but given the structural similarity to ruizite (Williams and Duggan 1977) and that ruizite is found in the same mine as both taniajacoite and strontioruizite, these new minerals likely crystallized from hydrothermal processes. In addition, the new minerals were found on weathered matrix, which helps support the secondary mineralization provenance.

Taniajacoite crystallized in space group *C1*, with $a = 9.1386(5)$ Å, $b = 6.2566(3)$ Å, $c = 12.0043(6)$ Å, $\alpha = 90.019(4)^\circ$, $\beta = 91.643(4)^\circ$, $\gamma = 89.900(4)^\circ$, $V = 686.08(6)$ Å³, and has a measured density of 3.05(2) g/cm³. Strontioruizite crystallized in space group *C2*, with $a = 9.1575(4)$ Å, $b = 6.2857(4)$ Å, $c = 12.0431(6)$ Å, $\beta = 91.744(4)^\circ$, $V = 692.90(6)$ Å³, and has a measured density of 3.20(2) g/cm³.

The two new minerals were approved by the Commission on New Minerals, Nomenclature and Classification (CNMNC) of the International Mineralogical Association (IMA 2014-107 for taniajacoite and IMA 2017-045 for strontioruizite). The cotype samples of the two new minerals have been deposited at the University of Arizona Mineral Museum and the RRUFF Project, Tuscon, Arizona, U.S.A. (catalog numbers 20009 and R140945 for taniajacoite) and catalog numbers 2148 and R160085 for strontioruizite).

FLAGGITE

Flaggite (Kampf et al. 2022a), ideally Pb₄Cu₃²⁺Te₆⁶⁺(SO₄)₂O₁₁(OH)₂(H₂O), is named in honor of Arthur L. Flagg (1883–1961) who was a mining engineer in Arizona. He was considered to be the foremost expert on Arizona minerals in his time and was founding member of the Arizona Mineralogical Society. In 1949, Flagg became the first curator of the Arizona Mineral Museum (later renamed to the Arizona Mining and Mineral Museum) in Phoenix, Arizona.

* All minerals have been approved by the IMA CNMNC. For a complete listing of all IMA-validated unnamed minerals and their codes, see <http://cnmnc.miam.jp/> (click on "IMA list of minerals").

Flaggite was found in the Grand Central Mine about 1 km south of Tombstone, Arizona, U.S.A. The Grand Central Mine is a Ag-Au-Pb-Cu-Zn deposit, and likely formed from acidic hydrothermal activity in cavities with alunite, backite, cerussite, jarosite, and rodalquilarite.

Structurally, flaggite is similar to bairdite, where both have step-like layers of octahedrally coordinated cations. The difference is that flaggite has one less step-like layer and that the sulfate groups have a different orientation.

Flaggite crystallized in space group *P1* with $a = 9.5610(2)$ Å, $b = 9.9755(2)$ Å, $c = 10.4449(3)$ Å, $\alpha = 74.8840(10)^\circ$, $\beta = 89.9940(10)^\circ$, $\gamma = 78.2190(10)^\circ$, $V = 939.97(4)$ Å³, and has a calculated density 6.212 g/cm³.

The mineral was approved by the IMA-CNMNC (IMA 2021-044). The description is based on one holotype and two cotype specimens deposited in the collections of the Natural History Museum of Los Angeles County, California, U.S.A., with catalog numbers 64499 (cotype), 64500 (cotype), and 76143 (holotype).

STEUDELITE

Stuedelite, (Chukanov et al. 2022), (Na₃□)[(K,Na)₁₇Ca₇]Ca₄(Al₂₄Si₂₄O₉₆)(SO₃)₆F₆·4H₂O, is a cancrinite group mineral and was named in honor of Ralf Strudel (1937–2021), was a German professor, chemist, and expert on sulfur chemistry.

Stuedelite was found in the Biachella Valley at the Sacrofano Caldera in Italy. It likely formed during late-stage volcanism, either from vapor deposition or by hydrothermal processes. Cancrinite group minerals can be a significant component in red mud, which is a byproduct of the bauxite aluminum industry. Cancrinite group minerals in the red mud are being explored as a remediation material to reduce phosphate from industrial waste waters (Xiaotian et al. 2022), and a review of cancrinite group minerals are presented elsewhere (Gatta and Lotti 2016).

Stuedelite crystallized in space group *P62c* with $a = 12.89529(15)$ Å, $c = 21.2778(3)$ Å, $V = 3064.21(8)$ Å³, and has a calculated density of 2.511 g/cm³.

The new mineral and its name were approved by the IMA-CNMNC (IMA 2021-007). The holotype specimen is deposited in the collections of the Fersman Mineralogical Museum of the Russian Academy of Sciences, Moscow, Russia (catalog number 5665/1).

WHITEITE-(MnMnMn)

The mineral whiteite (Moore and Ito 1978) was named in honor of John S. White, Jr., then editor of *Mineralogical Record* and Associate Curator of Minerals and Gems at the Smithsonian National Museum of Natural History, Washington, D.C. For a description of whiteite subgroup and jahnsite subgroup nomenclature see Kampf et al. (2019).

Whiteite-(MnMnMn) (Grey et al. 2021a), $\text{Mn}^{2+}\text{Mn}^{2+}\text{Mn}_2^{2+}\text{Al}_2(\text{PO}_4)_4(\text{OH})_2 \cdot 8\text{H}_2\text{O}$, occurs as sugary aggregates of blade-like crystals up to 0.1 mm long and as epitaxial overgrowths on whiteite-(CaMnMn). The new mineral was found in small vugs of a float boulder on the East dump of the Foote Lithium Company mine, Kings Mountain district, Cleveland County, North Carolina, U.S.A. The boulder had been excavated from a partially oxidized and altered part of pegmatite, where ground water had penetrated the pegmatite along natural fractures and leached primary and secondary minerals, such as fluorapatite and fairfieldite. Whiteite-(MnMnMn) was commonly found as laths on whiteite-(CaMnMn), suggesting a dissolution/epitaxial recrystallization paragenesis.

Whiteite-(MnMnMn) crystallized in space group $P2_1/a$ with $a = 15.024(3)$ Å, $b = 6.9470(14)$ Å, $c = 9.999(2)$ Å, $\beta = 110.71(3)^\circ$, $V = 976.2(4)$ Å³, and has a calculated density of 2.82 g/cm³.

The mineral and name were approved by the IMA-CNMNC (IMA 2021-049). Four cotype specimens from the Foote mine are housed in the mineralogical collections of the Natural History Museum of Los Angeles County, California, U.S.A. (catalog numbers 74374, 76149, 76150 and 76151).

ZOLOTAREVITE

Zolotarevite (Mikhailova et al. 2022), $\text{Na}_2\text{Zr}[\text{Si}_6\text{O}_{15}(\text{OH})_3] \cdot 2\text{H}_2\text{O}$, was named in honor of Andrey A. Zolotarev (b. 1982), a crystallographer from St. Petersburg State University, Russian Federation, in recognition of his contributions to the crystal chemistry and mineralogy of titano- and zircono-silicates.

The new hydrated microporous mineral was found at the Lovozero layered pluton, which is in the western part of the Kola Peninsula in Russia. Several zolotarevite crystals were recovered from a drill core at Mt. Kedykverpakhhk, in a layer of foyaite matrix.

Zolotarevite crystallized in space group $R\bar{3}m$ with $a = 10.294(6)$ Å, $c = 13.115(8)$ Å, $V = 1203.7(16)$ Å³, and has a measured density is 2.75(5) g/cm³.

This new mineral and its name were approved by the IMA-CNMNC (IMA 2020-076). The holotype material is deposited in the collections of the Geological and Mineralogical Museum of the Geological Institute, Kola Science Centre, Russian Academy of Sciences, Apatity, Russia (catalog number GIM 7910).

GARPENBERGITE

Garpenbergite (Holtz et al. 2022), $\text{Mn}_6\text{As}^{5+}\text{Sb}^{5+}\text{O}_{10}(\text{OH})_2$, was named for the location of discovery, Garpenberg, Sweden. Garpenberg is the oldest mining town in Sweden, with some mining dating back to at least the 1300s and possibly much earlier. In the Middle Ages, “garp” was a Swedish term for a German person¹. At that time, German miners were recruited to train Swedish miners in more effective mining practices.

The sample containing garpenbergite was collected in situ at the 900 m level of the Garpenberg Norra mine, in a hydrothermally altered skarn deposit. The new mineral occurs as heavily fractured, short-prismatic subhedral crystals of up to 1.5 mm in length.

Garpenbergite crystallizes in space group $Ibmm$ with $a = 8.6790(9)$ Å, $b = 18.9057(19)$ Å, $c = 6.1066(6)$ Å, $V = 1001.99(18)$ Å³, and has a calculated density of 4.47(1) g/cm³.

The new mineral species and its name have been approved by the IMA-CNMNC (IMA 2020-099) and the holotype specimen and thin-section are deposited in the Department of Geosciences, Swedish Museum of Natural History (catalog numbers GEO-NRM 20010351 and 20200040, respectively).

Note: ¹In some historic usages, the word ‘garp’, or ‘garper’, could have a negative connotation meaning “bragger” or “show-off” (Særheim 2019; Wolfert 2006).

DOBŠINÁITE

Dobšináite (Sejkora et al. 2021), $\text{Ca}_2\text{Ca}(\text{AsO}_4)_2 \cdot 2\text{H}_2\text{O}$, is named after its type locality Dobšiná, which represents the most important accumulation of Ni arsenides and sulfarsenides in the Western Carpathian Mountains of central and eastern Europe. In the past, the area was a significant producer of high-grade Ni and Co ores in Europe.

A mineral phase corresponding to dobšináite from the Tuva Autonomous Republic, Russia, was described in 1953 by Evgeniy I. Nefedov (Nefedov 1953). Nefedov provided an empirical formula $\text{Ca}_2(\text{Ca},\text{Mg})(\text{AsO}_4)_2 \cdot 2\text{H}_2\text{O}$, with some structural, optical, and physical property data. However, a detailed chemical analysis was missing. In his 1953 publication, Nefedov named the mineral belovite. A year later, another group (Borodin and Kazakova 1954) identified a different mineral in the apatite supergroup and also named it belovite-(Ce). Both groups, being Russian, likely wanted to honor Nikolai Belov, who was the former head of the Crystallography and Crystallochemistry Department at Moscow Lomonosov State University. To avoid confusion, Nefedov’s 1953 mineral description was renamed to arsenate-belovite, but upon reanalysis, it was found to be Mg dominant, not Ca dominant (Pierrot 1964). Pierrot’s new analysis gave arsenate-belovite the composition $\text{Ca}_2\text{Mg}(\text{AsO}_4)_2 \cdot 2\text{H}_2\text{O}$, but unfortunately, that composition and structure already corresponded to the mineral talnessite, and therefore arsenate-belovite was rejected. Dobšináite represents a new Ca- and As-dominant member of the roselite-group. The 1954 description of belovite-(Ce) is still a valid mineral name as of this writing.

Dobšináite crystallized in space group $P2_1/c$ with $a = 5.990(2)$ Å, $b = 13.013(4)$ Å, $c = 5.726(2)$ Å, $\beta = 108.47(3)^\circ$, $V = 423.3(3)$ Å³, and has a calculated density of 3.395 g/cm³.

The new mineral and its name have been approved by the IMA-CNMNC (IMA 2020-81). The holotype sample of dobšináite is deposited in the collections of the Moravian Museum in Brno, Department of Mineralogy and Petrography, Czech Republic (catalog number B12257).

GALEACLOLUSITE

Galeaclolusite (Grey et al. 2021b), $[\text{Al}_6(\text{AsO}_4)_3(\text{OH})_9(\text{H}_2\text{O})_4] \cdot 8\text{H}_2\text{O}$, is named in honor of Valérie Galea-Clolus (b. 1964) in recognition of her significant contributions to the mineralogy of the Cap Garonne deposits, Var, France. Galea-Clolus was President of the Association des Amis de Cap Garonne (friends of the mine) for many years and co-author of a book on the mine (Favreau and Galea-Clolus 2014). She was the first to map the uranium-rich zones and has found several new minerals and polytypes at the mine (e.g. gobelinite). Importantly, she has encouraged the study of the mineralogy of Cap Garonne through the museum and public outreach as well as making scientific access to the mine possible.

Galeaclolusite was found during an ongoing study of minerals from the Cap Garonne copper mine, and likely formed during supergene alteration. However, the mineral could have also formed from an alternation of bariopharmacoalumite because it is shown to have grown as needles radiating out from a fractured cube of bariopharmacoalumite.

Galeaclolusite crystallized in space group $Pnma$ with $a = 19.855(4)$ Å, $b = 17.6933(11)$ Å, $c = 7.7799(5)$ Å, $V = 2733.0(7)$ Å³, and has a calculated density is 2.27 g/cm³.

The new mineral and its name were approved by the IMA-CNMNC (IMA 2020-052). The holotype sample is housed in the mineralogical collections at Museums Victoria, Melbourne, Australia (catalog number M55455). A cotype used for optical measurements is in the collections of the Natural History Museum of Los Angeles County, California, U.S.A. (catalog number 74874).

RELIANCEITE-(K)

Relianceite-(K) (Kampf et al. 2022b), $\text{K}_4\text{Mg}(\text{V}^{4+}\text{O})_2(\text{C}_2\text{O}_4)(\text{PO}_3\text{OH})_4(\text{H}_2\text{O})_{10}$ was recovered from the former Reliance mine, Maricopa County, Arizona, U.S.A. In 1922, the Rowley Copper Mining

Company was reorganized as the Reliance Copper Company to raise funds through stock offerings. Although the effort was unsuccessful and renamed again as Rowley Mines, Inc. in 1927, the mine has often been referred to as the Reliance mine.

The new mineral was found in a hot and humid area of the Rowley mine, in an unusual bat guano-related, post-mining assemblage of phases that include a variety of vanadates, phosphates, oxalates, and chlorides, some containing NH_4^+ .

Relianceite-(K) crystallized in space group Pc with $a = 12.404(7) \text{ \AA}$, $b = 9.014(6) \text{ \AA}$, $c = 13.260(8) \text{ \AA}$, $\beta = 100.803(10)^\circ$, $V = 1456(2) \text{ \AA}^3$, and has a calculated density is 2.111 g/cm^3 .

The new mineral and name were approved by the IMA-CNMNC (IMA 2020-102). The holotype specimen is deposited in the collections of the Natural History Museum of Los Angeles County, Los Angeles, California (catalog number 75275).

HYDROPLUMBOELSMOREITE

Hydroplumboelsmoreite (Yuan et al. 2021), ideally $(\text{Pb}, \square)_2(\text{W}, \text{Fe}^{3+})_2\text{O}_6(\text{H}_2\text{O})$, is named for the hydrated Pb-dominant member of the elsmoreite group. Interestingly, this is a redefinition of the discredited mineral jixianite, which was a pyrochlore group mineral. Jixianite was discredited because of the absence of detailed structural description and lack of adequate chemical analysis necessary in the new nomenclature scheme for the pyrochlore supergroup that was approved by the IMA-CNMNC (Atencio et al. 2010). Jixianite was later reclassified as a “questionable” species (Christy and Atencio 2013).

The specimen used for this modern description was a cotype obtained from Lui Jianhang, who had first found jixianite in 1979. The authors also visited the original type locality and recovered more specimens of hydroplumboelsmoreite. The mineral occurs in a hydrothermal tungsten-bearing lead deposits in the Yanhe tungsten deposit, Jixian County, China (now renamed Jizhou District in Tianjin City).

Hydroplumboelsmoreite crystallized in space group $Fd\bar{3}m$ with $a = 10.3377(5) \text{ \AA}$, $V = 1104.77(16) \text{ \AA}^3$, and has a calculated density of 7.47 g/cm^3 .

The new mineral and its name have been approved by the IMA-CNMNC (IMA-21C) and replaces “jixianite.” The type specimen of hydroplumboelsmoreite has been registered within the collections of the Geological Museum of China, Xisi Yangrou hutong No. 15, Xicheng District, Beijing, China (catalog number M16125).

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