American Mineralogist, Volume 108, pages 1993–1994, 2023

New Mineral Names: Heavy metal and minerals from China

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Abstract

This issue of New Mineral Names summarizes new species that contain toxic heavy metals and rare earth elements with a partial focus on new minerals found in China. All these new minerals have potential uses for environmental and technological applications, and their origins reflect historical mining or cultural significance. Here we look at fluorbritholite-(Nd), napoliite, scenicite, evseeite, haitaite-(La), dongchuanite, liguowuite, and gysinite-(La).

Fluorbritholite-(Nd)

Fluorbritholite-(Nd) (Holtstam 2023), ideally $Ca_2Nd_3(SiO_4)_3F$, is named for being the Nd member of the britholite group. The mineral has been known as a possible new mineral since 2007 (Smith and Nickel 2007) with the Commission of New Minerals Nomenclature and Classification (CNMNC) code UM2007-044. However, its structure still needed to be determined. Fluorbritholite-(Nd) occurs as small anhedral grains of less than 250 μm, and their extraction resulted in smaller crystals for suitable single-crystal X-ray diffraction experiments.

Fluorbritholite-(Nd) was found on a boulder in the dumps of the Malmkärra Mine in Sweden. The Malmkärra mine (Geijer and Magnusson 1944) started Fe-ore operations in 1664 and stayed open until the mid-1930s. This area of Sweden is well known for rare earth element minerals. Ytterby is ~150 km (~90 mi) away, which is the location where Y was first found by Carl Axel Arrhenius. Several REE minerals are also found here, including bastnäsite-(Ce), gadolinite-(Nd), ulfanderssonite-(Ce), and västmanlandite-(Ce) to name a few.

The authors estimate that there is approximately 83 000 t of waste rock with a potential REE grade of 0.55 wt%. Typical economic cut-off grades for REE are around 1.0 wt%, but this can depend on host rock geology and extraction methods. The rock extraction has already occurred at the Malmkärra mine, potentially allowing lower-grade ore to be economically viable.

Fluorbritholite-(Nd) is hexagonal ($P63/m$), with a = 9.5994(3) Å, c = 6.9892(4) Å, V = 557.76(5) Å^3, and a calculated density of 4.92(1) g/cm^3. The mineral and its name have been approved by the CNMNC International Mineralogical Association (IMA 2023-001). The type material is stored at the Swedish Museum of Natural History (Stockholm, Sweden) under catalog number GEO-NRM 20220221.

Napoliite

Napoliite (Kasatkin 2023), ideally Pb_2OFCl, is named after the city of Naples (Napoli in Italian). The extraction of napoliite came from a fumarole that developed after the 1944 eruption of Mt. Vesuvius. The type specimen of napoliite was collected about 1 m below the surface at the eastern rim of the Gran Cono crater.

Napoliite is tetragonal ($P4_2/mcm$), with a = 5.7418(11) Å, c = 12.524(4) Å , V = 412.9(2) Å^3, and a calculated density of 7.797 g/cm^3. The mineral and its name have been approved by the CNMNC (IMA 2022-073). The holotype specimen is deposited at the Fersman Mineralogical Museum of the Russian Academy of Sciences (Moscow, Russia) with catalog number 5885/1. A part of the holotype specimen is deposited at the Museo della Natura e dell'Uomo (University of Padova, Italy) with catalog number MMP M23222.

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

Scenicite

Scenicite (Kampf 2022), ideally $[(UO_2)(H_2O)_2(SO_4)]_2{\cdot}3H_2O$, is named after the Scenic mine in the White Canyon, Utah, where holotype specimen was found. Since then, more scenicite was found approximately 10 mi away at the Green Lizard, Markey, and Givaway-Simplot mines in Red Canyon, Utah. The first crystals found, and the best crystals for structure determination, came from the Scenic mine.

The Scenic mine is in the Chinle Formation, a famous Upper Triassic deposit rich in uranium. During the height of uranium mining in the Southwest U.S., the White Canyon produced about 10 million pounds of uranium oxide (U_3O_8) from 1946 through 1965 (Malan 1969). Other notable deposits and features in the Chinle Fm. are the Petrified Forest National Park, Zion National Park, Grand Staircase-Escalante National Monument, Ghost Ranch dinosaurs in New Mexico, and Monument Valley in Utah. All these places are closed to collecting without permits. As of 2023, the White Canyon and Red Canyon mines are also closed for collecting.

Scenicite is orthorhombic ($Pca2_1$), with a = 21.2144(15) Å, b = 6.8188(3) Å, c = 11.2554(6) Å, V = 1628.18(16) Å^3, and a calculated density of 3.497 g/cm^3. The mineral and its name have been approved by the CNMNC (IMA 2021-057). The description is based on one holotype specimen from the Scenic mine and one cotype specimen from the Green Lizard mine. Both are deposited at the Natural History Museum of Los Angeles County (Los Angeles, California, U.S.A.) with catalog numbers 76153 (holotype) and 76154 (cotype).

Evseeite

Evseeite (Pekov 2023), ideally $Na_2Mg(AsO_4)F$, was named in honor of the Russian mineralogist Aleksanr Andreevich Evseev (b. 1949), and belongs to the antiperovskite (or inverse perovskite) structure type. Antiperovskite structures are used in fast ion conductivity of Li for potential use in batteries (e.g., Xia 2022), materials for superconductivity (e.g., Oudah 2016) and giant magnetoresistance (e.g., Liu 2023), and as materials that possess zero thermal expansion (e.g., Song 2011).

Evseeite was found in the Arsenatnaya fumarole at the second scoria cone of the Northern Breakthrough of the Great Tolbachik Fissure Eruption (eruption active from 1975–1976). Arsenatnaya is on the hottest fumarole, with temperatures reaching 500 °C at the deepest measured areas. The specimens were collected in 2018 from hot zones 1.5–2 m below the surface. The fumaroles around the Tolbachik volcano continue to produce many new mineral species. As of July 2023, 23 new mineral species have been described.

Evseeite is orthorhombic ($Pbcn$), with a = 5.3224(1) Å, b = 14.1255(3) Å, c = 12.0047(3) Å, V = 902.53(4) Å^3, and a calculated density of 3.37 g/cm^3. The mineral and its name have been approved by the CNMNC (IMA 2019-064). The holotype specimen is deposited in the Fersman Mineralogical Museum (Moscow, Russia) with catalog number 96701.

0003-004X/23/0010–1993$05.00/DOI: https://doi.org/10.2138/am-2023-NMN108106

Haitaite-(La)

Haitaite-(La) (Wang 2022), ideally (La,Ce)(U^{4+},U^{6+},Fe^{2+})(Fe^{3+},Al)$_2$(Ti,Fe^{2+},Fe^{3+})$_{18}O_{38}$, is named after the sampling locality where it was found in the Haiti uranium ore district in 2019 in Mai County, Sichuan Province, China. The mineral occurs in the external contact zone between a Neoproterozoic (~800 Ma) alkali feldspar granite pluton and its Mesoproterozoic (~1700 Ma) mica schist wall rock.

Sichuan Province is rich in uranium ore and produces large crystals of uraninite (up to 1 cm long). As China ramps up uranium ore exploration and production, there is a high probability that many more uranium mineral descriptions will still come from this area as China ramps up uranium ore exploration and production in the next few years. As with the next mineral, dongchuanite, this area has been extensively mined and known for its high production of copper since the 7th century.

Haitaite-(La) is trigonal ($R\bar{3}$), with a = 10.3678(5) Å, c = 20.8390(11) Å, V = 1939.9(2) Å^3, and a calculated density of 4.99 g/cm^3. The mineral and its name have been approved by the CNMNC (IMA 2019-033a). The type material is archived in the Geological Museum of China (Beijing, China) with catalog number M13859.

Dongchuanite

Dongchuanite (Li 2023), ideally $Pb_4^{6+}Zn^{4+}Zn_2(PO_4)_2(PO_4)_2(OH)_2$, is named after its locality at the Dongchuan Copper mine. This mine is located in the northeast of Yunnan Province, approximately 160 km north of Kunming City.

The Dongchuan region was an essential Chinese copper ore deposit. It was made famous for copper production and the supply of raw materials for minting coins for ancient dynasties (Kim 2018), particularly the Qing (Manchu) dynasty (1644–1912). Mining at this site dates back to the Tang dynasty (618–907 CE) (Can 2012).

Dongchuanite is triclinic ($P\bar{1}$), with a = 4.7620(10) Å, b = 8.5070(20) Å, c = 10.3641(19) Å , α = 97.110(17)°, β = 101.465(17)°, γ = 92.273(18)°, V = 407.44(15) Å^3, and a calculated density of 6.06 g/cm^3. The mineral and its name have been approved by the CNMNC (IMA 2022-011). The holotype specimen is stored at the Geological Museum of China (Beijing, China) with catalog number M26148.

Liguowuite

Liguowuite (Xue 2022), ideally WO_3, is aimed after Li Guowu (b. 1964) in recognition of his contributions to new mineral research, including tewite and wumuite. Liguowuite was found near Nanyang village, Yunnan Province, about 125 km east of Dongchuan. Liguowuite crystals are granular, found as inclusions, and in veins between tewite and wumuite.

Liguowuite belongs to the non-stoichiometric perovskite group and is the first reported example of A-site vacant single perovskite as an oxide mineral for this group. Non-stoichiometric perovskites have several technological uses due to their unique properties and tunability (Haeussler 2018) for new photovoltaic and thermoelectric devices, gas and electrochemical sensors, and catalysts. These non-stoichiometric perovskite minerals owe their unique properties to induced defect vacancy sites in the structure, which are tunable by chemical doping with different metals in the octahedral and vacancy site in the perovskite.

Liguowuite is monoclinic ($P2_1/n$), with a = 7.32582(18) Å, b = 7.54767(18) Å, c = 7.71128(18) Å, β = 90.678(3)°, V = 426.348(19) Å^3, and a calculated density of 7.22 g/cm^3. The mineral and its name have been approved by the CNMNC (IMA 2020-097). Type material has been deposited at the China University of Geosciences Museum (Beijing, China) under catalog number 21K005, and at the Geological Museum of China (Beijing, China) under catalog number M16121.

Gysinite-(La)

Gysinite-(La) (Wu 2023), ideally $PbLa(CO_3)_2(OH)\cdot H_2O$, is named in honor of Marcel Gysin (1891–1974), Professor of Mineralogy, University of Geneva, who worked for several years in the Shaba Province of Zaire, where this mineral originated. The type locality of Gysinite-(Nd) is in Zaire (Sarp 1985).

Gysinite-(La) is found in lujavrite rock (a nepheline-syenite type igneous rock) from the Saima alkaline complex, Liaoning Province, northeast China. The Saima complex has been mined for its uranium resource for the past few decades. Since 2015 it has also been explored for Nb and rare earth element (REE) resources.

Gysinite-(La) belongs to the ancylite group of minerals, and this whole group consists of REE carbonates. Though there are more well-known REE ore minerals such as bastnäsite, monazite, and xenotime, the ancylite group minerals (e.g., synchysite) have been used for radiometric dating of geological materials (e.g., Li 2021), and their continued research and study may lead to an improved understanding of REE ore diagenesis and resources.

Gysinite-(La) is orthorhombic (*Pmcn*), with a = 5.0655(2) Å, b = 8.5990(3) Å, c = 7.3901(4) Å, V = 321.90(2) Å^3, and a calculated density of 5.007 g/cm^3. The mineral and its name have been approved by the CNMNC (IMA 2022-008). The type material is deposited at the Geological Museum of China (Beijing, China) with catalog number M16133.

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