EARTHQUAKE
e-Newsletter about what's movin' and shakin' at the Earth Science Museum

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June 2024
Volume 13, Issue 6

ESM OUTREACH UPDATE

Mardy Zimmermann, Outreach Coordinator

May Outreach

With schools closed for the summer, there are no ESM outreach activities to report this month.

The Mineralogy and Deposits of Lithium

By Harvey Jong

Lithium represents a key element in the global transition to more sustainable energy technologies. Demand for the alkali metal has been forecasted to grow from 0.72 million tons in 2022 to around 3.06 million tons by 2030[1]. This demand, which is being driven by lithium-ion batteries for automotive and energy storage applications, has triggered a "lithium rush". We'll explore some aspects of this rush by reviewing the mineralogy and deposits of lithium.

Lithium Crystals

Fan Haocheng photo, - CC_BY_SA-4.0 International, via Wikimedia Commons

Since lithium is highly reactive, these crystals are stored in a glass vial with mineral oil. As a simple metal, lithium has a cubic crystal structure at room temperature and pressure. It undergoes, however, a transformation to a stacked hexagonal structure when the temperature is lowered to around 80 Kelvin (K).

Mineralogy of Lithium

Lithium was discovered in 1817 by Swedish chemist Johan August Arfwedson (1792-1841) while he was studying the mineral petalite ($LiAlSi_4O_{10}$).

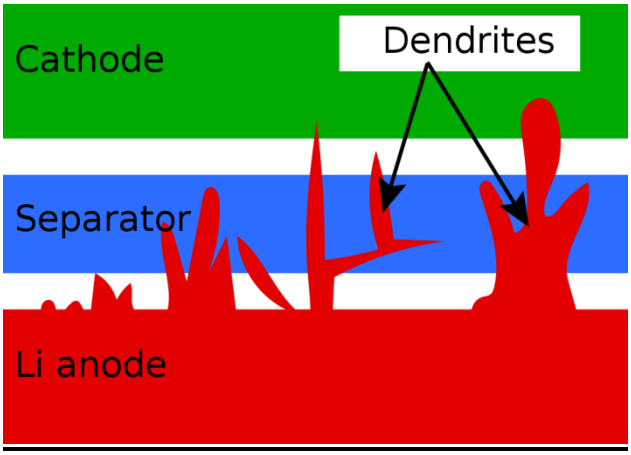
Lithograph of Johan August Arfwedson

Fehr and Miller of Stockholm illustration, - PD, via Wikimedia Commons

Lithium is the lightest of all metals with a density of 0.534 g/cm^3. This property combined with a high specific capacity (3.86 Ah/g) makes the element a preferred material for manufacturing light weight, rechargeable batteries. These batteries, though, have a drawback that if damaged

[1] From Alan Kennedy and Athul Alexander, "The Lithium Rush: Can We Meet Tomorrow's Lithium Demand," Visualcapitalist. December 11, 2023. https://elements.visualcapitalist.com/the-lithium-rush-can-we-meet-tomorrows-lithium-demand/

they are susceptible to internal short circuit failures involving the growth of dendrites. The batteries may catch fire or explode and produce potentially toxic fumes.

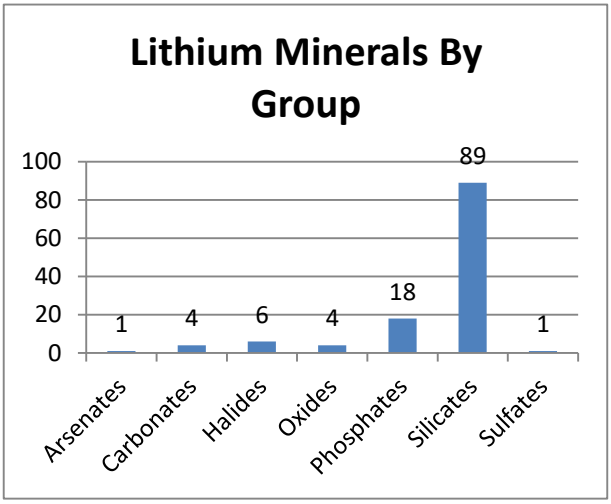


Growth of Dendrites in a Lithium Battery
Spk9264 diagram, - CC_BY_SA-4.0 International, via Wikimedia Commons

Physical damage or manufacturing defects may lead to the growth of lithium dendrites that penetrate a battery's separator and eventually reach the cathode leading to a short circuit.

Lithium Minerals

The current list of 6,050 International Mineralogical Association (IMA)-approved minerals includes 123 species that contain lithium[2]. Based on chemical composition, these lithium-bearing minerals may be divided into the following groups:



This diversity reflects the geologic history of mineral formation and the human history of mineral discovery. Using locality data, ages of formation, and trends in discovery, a model for lithium mineral ecology suggests that the total number of lithium species may range from 400 to 800 with a median of 548 (Grew et al., 2019). So, the focus on finding new lithium sources may lead to new mineral discoveries that will increase the species total closer to these numbers.

Lithium Concentration and Abundance

Lithium is found as a trace element in most geologic settings and is measured in parts per million (ppm). The upper continental crust contains an average of 20 ppm lithium which ranks about 30th among the elements behind copper. Note that among common rock or sediment types the highest lithium concentrations occur in shales (average 66 ppm), deep-sea clays (average 57 ppm) and low-calcium granites (average 40 ppm) (Bradley et al., 2017). These concentrations, however, are insufficient for forming an ore deposit or even a mineral with lithium.

So, the search for lithium sources focuses on minerals with significantly lithium content which may be expressed as a Li or Li_2O

[2] The total of 123 species is based on the searchable IMA list presented at rruff.info which indicates 6,006 approved minerals.

weight percentage (wt%). Note that a mineral's actual content may vary from its theoretical value since some minerals may form a solid solution series of lithium minerals or be part of a mixture with other minerals.

The abundance of a high content or grade mineral [typically measured in millions of tons (Mt)] is another important factor in determining if the lithium can be extracted in an economically viable manner.

Zabuyelite (Li_2CO_3)

The mineral with the highest lithium content (18.79 wt%) is zabuyelite, but its occurrences are limited to colorless, small (1.5-20 µm) crystals embedded in halite; doubly terminated crystals (up to 1.2 mm) in lithium-rich lake precipitates; or microscopic fluid inclusions in spodumene (Anderson et al., 2001). The mineral was discovered in 1987 and named for the Zabuye salt lake, Nagri, Tibet, China.

Synthetic Zabuyelite
RRUFF project photo and specimen

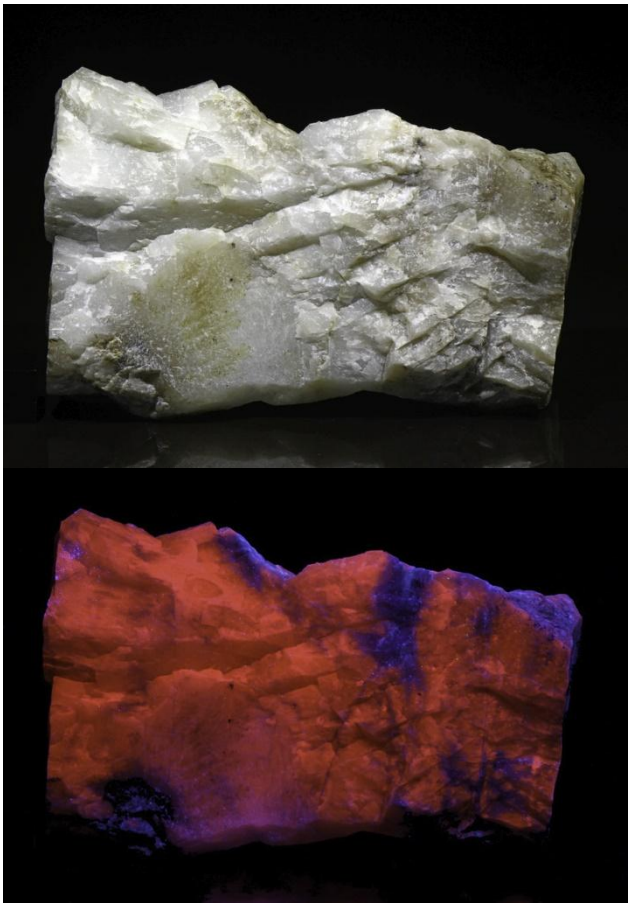
While natural zabuyelite is rather uncommon, the synthetic version is used in a variety of commercial products. The main application involves producing lithium-ion battery components, but the material also serves as a ceramic glaze; a key ingredient in carbon dioxide detectors; an alloying agent; curing cement and adhesives; treating bipolar disorder; and producing the bright red color in fireworks.

Eucryptite ($LiAlSiO_4$)

Eucryptite, which has a relatively high lithium content of 5.51 wt%, was first found in 1880 at the Fillow quarry in Brachville, Connecticut. The name is derived from the Greek for "well concealed" which refers to its intergrown occurrence with albite.

Eucryptite has been reported from a limited number of localities involving lithium-rich pegmatites. Large quantities sufficient for mining, however, occurred at only one location – the Bikita District in Zimbabwe (formerly Rhodesia) (Hurlbut, 1962). The mineral is noteworthy for a distinctive magenta-red fluorescence under short wave ultraviolet light.

Eucryptite
Rob Lavinsky photo, iRocks.com, - CC_BY_SA-3.0, via Wikimedia Commons
Fillow Quarry, Branchville, Redding, Fairfield County, Connecticut
9.3 x 7.0 x 2.8 cm
This specimen is from the type locality and has small eucryptite grains embedded in albite.



Eucryptite White and Short Wave UV Light
Stan Celestian photos, Mardy Zimmermann specimen, - Copyright ©2020 all rights reserved, reproduced with permission, via flickr.com
Midnight Owl Mine, Yavapai County, Arizona

Lithium Pegmatite Deposits

Pegmatites are very coarse-grained igneous rocks with intergrown crystals that may vary from 1 cm (0.4 in) to more than 1 m (3 ft). They may be classified by their mineralogical-geochemical characteristics, and one family of granitic pegmatites enriched by lithium, cesium, and tantalum are known as LCT pegmatites. LCT pegmatites account for about one-fourth of the world's lithium production (Bradley et al., 2017), and large deposits include Tonco in Canada, Greenbushes in Australia, and Bikita in Zimbabwe.

Open Pit of the Greenbushes Mine
Calistemon photo, - CC_BY_SA-4.0 International, via Wikimedia Commons
The Greenbushes Mine is located in Western Australia and is world's largest hard-rock lithium mine. The mine originally opened in 1888 as a tin producer, but activity shifted to lithium in 1983 after the discovery of a massive spodumene ore body. Record production was reported in 2022 with a quarterly output of 1.03 Mt of ore at an average grade of 2.42% Li_2O[3].

Main Lithium Pegmatite Ore Minerals

Mineral	Formula	Lithium Content (wt%)
Spodumene	$LiAlSi_2O_6$	3.73
Petalite	$LiAlSi_4O_{10}$	2.27
Lepidolite[4]	$K(Li,Al)_3(Si,Al)_4O_{10}(F,OH)_2$	3.58

[3] Anthony Barich, "Greenbushes hits record output as IGO expects spodumene revenue price to soar", January 31, 2022.
https://www.spglobal.com/marketintelligence/en/news-insights/latest-news-headlines/greenbushes-hits-record-output-as-igo-expects-spodumene-revenue-price-to-soar-68649047

[4] Note that in 1998 the IMA redefined lepidolite as a trilithionite-polylithionite series join that encompasses light micas with substantial lithium. The formula and Li content is based on the old species information.

Spodumene ($LiAlSi_2O_6$)

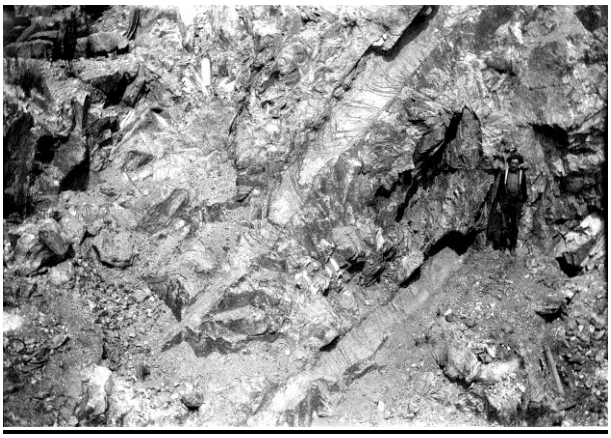
Spodumene was discovered in 1800 by Brazilian naturalist and statesman José Bonifácio de Andrada e Silva (1763-1838). As a member of a European geological and mineralogical expedition, he visited the Swedish island of Utö and collected samples from iron mine tailings. This material was used in identifying spodumene and another lithium-bearing mineral, petalite. The mineral name is based on the Greek word *spodumenos* which means "reduced to ashes" and alludes to the grayish-white material that is formed when the mineral is ignited.

Portrait of José Bonifácio de Andrada e Silva

Oscar Pereira da Silva (1867-1939) painting, - PD, via Wikimedia Commons

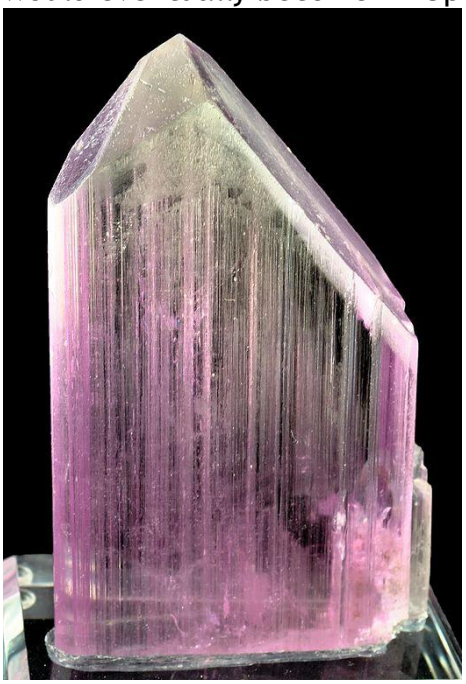
José Bonifácio de Andrada e Silva discovered four new minerals (spodumene, petalite, wernerite/scapolite, and "*allochroite*"/*andradite*) and eight other previously unknown species. Note that "allochroite" was later shown to be same as andradite which James D. Dana named after Andrada e Silva in 1868.

Spodumene may occur in a variety of colors ranging from colorless, yellow, light green, emerald-green, or pink to violet. Although it is a main ore of lithium, the mineral is also used as a gem material. Pink varieties are known as kunzite, while hiddenite is the green variation.



Gigantic Spodumene Crystals
USGS photo, - PD, via Wikimedia Commons
Etta Mine, Black Hills, Pennington County, South Dakota

This formation includes the molds of two huge crystals. The mine worker on the center right provides a size comparison. Note that the Etta Mine started as a tin mine but shifted to spodumene production in 1898. The mine was the principal lithium producer in the United States during the 1920s. At that time, the demand for lithium included patent medicines, such as lithium water. One such product was named "Bib-Label Lithiated Lemon-Lime Soda" which would eventually become "7 Up".



Spodumene Var. Kunzite

Rob Lavinsky photo, iRocks.com, - CC_BY_SA-3.0, via Wikimedia Commons
Nuristan Province, Afghanistan
12.5 x 7.4 x 2.2 cm

Kunzite is the best known gem variety of spodumene. It is named after American mineralogist and gemologist George F. Kunz (1856-1932) who first identified the variety. The pink-violet color is due to trace amounts of manganese.

Spodumene Var. Hiddenite

Rob Lavinsky photo, iRocks.com, - CC_BY_SA-3.0, via Wikimedia Commons

Hiddenite, Alexander County, North Carolina

2.7 x 0.5 x 0.4 cm

The first specimens of hiddenite were found around 1879 near White Plains, Alexander County, North Carolina. The spodumene variety was named hiddenite after American mineralogist William E. Hidden (1653-1918). The distinctive color has been attributed to the presence of chromium and vanadium.

Petalite ($LiAlSi_4O_{10}$)

As mentioned earlier, petalite was discovered in 1800 by Brazilian naturalist and statesman Jose Bonifacio de Andrada e Silva (1763-1838).

The name is derived from the Greek word *petalon* for leaf which refers to the mineral's perfect basal cleavage. Petalite may occur as colorless, white, gray, or pink tabular monoclinic crystals. Locations with large deposits include:

- Mt Marion, Kalgoorlie, Western Australia (71.3 Mt at 1.37% Li_2O)
- Araçuaí, Minas Gerais, Brazil
- Karibib, Namibia (11.24 Mt at 0.43% Li_2O)
- Tanco Pegmatite, Bernic Lake, Manitoba, Canada

Petalite
Stephen E. Fritz photo, - CC_BUY_SA-3.0, via Wikimedia Commons
Araçuaí, Jequitinhonha Valley, Minas Gerais, Brazil
12 x 9 cm

Prospecting activity in Brazil's Jequitinhonha Valley has identified 45 potential lithium deposits, and the area has been dubbed "Lithium Valley" as some initial mining operations have produced up to 270,000 tons per year of 5.5% Li_2O concentrate.

Petalite
Rob Lavinsky photo, iRocks.com, - CC_BY_SA-3.0, via Wikimedia Commons
Shengus, Roundu District, Gilgit-Baltistan, Pakistan
13.4 x 10.9 x 7.3 cm
1.1 kg (2.4 lb)
The Roundu District was originally part of Pakistan's Skardu District which is a well-known source for a variety of gemstones. This large single crystal was mined around October 2008.

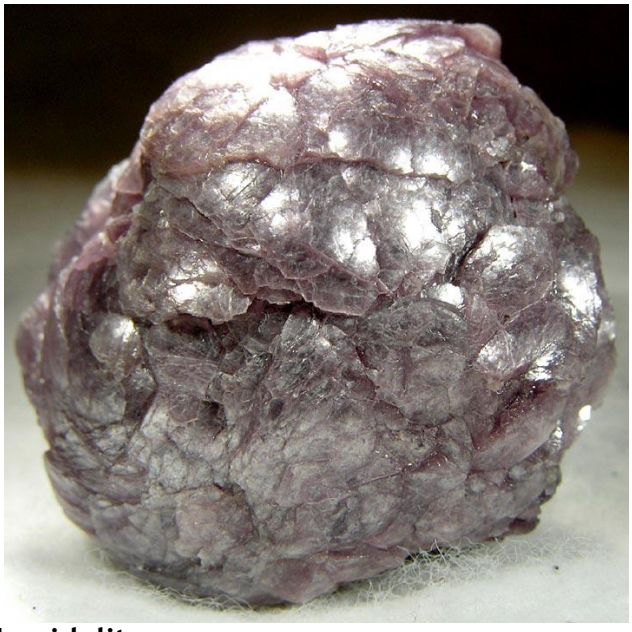
Faceted Petalite
Don Guennie photo, - CC_BY_SA-4.0 International, via Wikimedia Commons
12.66 ct
The occurrence of gem quality petalite is rather rare so faceted gemstones are usually small ranging from 1-10 cts.

Lepidolite

Lepidolite previously referred to a lithium-bearing mica species that was described in 1792 by German chemist Martin Klaproth (1743-1817) using material collected from the Rožná pegmatite, Moravia, Czech Republic. The name is derived from the Greek words *lepidos* for scale and *lithos* for stone.

The definition of lepidolite, however, changed when the IMA introduced a new mica nomenclature in 1998. It is now designated as any trioctahedral mica on or close to the trilithionite $[K(Li_{1.5}Al_{1.5})(AlSi_3O_{10})(F,OH)_2]$-polylithionite $[KLi_2Al(Si_4O_{10})(F,OH)_2]$ series join.

Lepidolite
Eurico Zimbres photo, - CC_B&_SA-2.0 Brazil, via Wikimedia Commons
Conselheiro Pena, Minas Gerais, Brazil
4 x 4 cm
This mica "book" displays the characteristic hexagonal form and purple color.



Lepidolite
Rob Lavinsky photo, iRocks.com, - CC_BY_SA-3.0, via Wikimedia Commons
Minas Gerais, Brazil
3.6 x 3.1 x 22.cm
This unusual specimen consists of shell-like layers and is known as “ball” lepidolite.

Lepidolite Sphere and Rough
Rob Lavinsky photo, iRocks.com, - CC_BY_SA-3.0, via Wikimedia Commons
Stewart Mine, Pala, Pala Mining District, San Diego County, California
6 x6 x 6 cm
Large chunks of lepidolite from the Stewart Mine have been used in making spheres of very uniform, rich color. In the late 19th and early 20th century, the mine worked massive pods of lepidolite that occurred in a pegmatite-aplite dike. It was reopened in the late 1960s as a gem mine and produced exceptional specimens of elbaite, morganite, and kunzite.

A rare specimen of yellow lepidolite, from an exciting new find in Brazil!

Rob Lavinsky, iRocks.com - CC-BY-SA-3.0
via Wikimedia Commons
Itinga, Jequitinhonha valley,
Minas Gerais, Southeast Region, Brazil
Size: 6.1 x 4.9 x 3.1 cm

Lithium Brine Deposits

Due to their low cost of production, brine deposits represent about 66% of global lithium sources. These deposits occur in a variety of geologic environments, but the most common type involves continental saline desert basins which are also known as salars. They are made up of sand and brine water with dissolved salts of lithium and other elements. The lithium content of brines is measured in milligrams per liter (mg/l), and brines over 200 mg/l are considered economically viable. Solar evaporation is used to concentrate the lithium which leads to an inherently slow extraction process that may require 10-24 months.

The largest lithium brine deposits are located in Argentina, Bolivia, and Chile which has been called the “Lithium Triangle”. Lithium recovery is facilitated by the hot, arid climate and considerable open space of these sites. In addition, the brines contain high lithium concentrations, such as Chile’s Salar de Atacama Mine which has been measured at 2,211 mg/l.

Satellite View of Salar de Atacama Mine
NASA/METI/AIST/Japan Space Systems and U.S./Japan ASTER Science Team image, - PD, via Wikimedia Commons
Image acquired August 21, 2017
The Salar de Atacama Mine produces 27% of the world's annual supply of lithium. The lithium brines occur 40 m (131.2 ft) below the surface and are pumped into large evaporation ponds.

Satellite View of the Silver Peak Lithium Project
NASA/METI/AIST/Japan Space Systems and U.S./Japan ASTER Science Team image, - PD, via Wikimedia Commons
Image acquired June 29. 2013
The Silver Peak Lithium Project in Esmeralda County, Nevada is currently one of two operating lithium mines in the U.S. The site has been in operation since 1964 and consists of numerous deep wells and evaporation ponds.

Lithium Clay Deposits

About 7% of current global lithium reserves involve lithium clay deposits. These deposits occur as sediments associated with or adjacent to centers of silicic volcanism (Benson et al., 2023). Lithium content may vary from 0.4 to 2.4 wt%, but the high tonnage of material leads to an overall amount of lithium which is similar to or exceeds other types of deposits. Subsequently, efforts are focused on developing clay deposits as an alternative source to meet lithium demand.

Lithium-bearing clay minerals have a simple layered structure where lithium occurs in the space between layers. They are widely distributed in Europe, Asia, and America.

Some Lithium-Bearing Clay Minerals

Mineral	Formula	Li Content (wt%)
Lepidolite	$K(Li,Al)_3(Si,AL)_4O_{10}(F,OH)_2$	3.58
Zinnwaldite[5]	$KLiFeAl_2Si_3O_{10}(F,OH)_2$	1.47
Hectorite	$Na_{0.3}(Mg,Li)_3(Si_4O_{10})(F,OH)_2$	0.54

[5] Zinnwaldite, which is no longer considered a mica species, has been redefined by the IMA in 1998 as a series of trioctahedral micas on or close to the siderophyllite $[KFe^{2+}{}_2Al(Al_2Si_2O_{10})(OH)_2]$-polylithionite $[KLi_2Al(Si_4O_{10})(F,OH)_2]$ join that covers dark micas containing lithium. The formula and lithium content is based on information prior to the nomenclature change.

Jadarite	$LiNaSiB_3O_7(OH)$	3.16

Zinnwaldite [$KLiFeAl_2Si_3O_{10}(F,OH)_2$]

Lubor Ferenc photo, CC_BY_SA-4.0 International, via Wikimedia Commons

Cinovec/Zinnwald, border between Geermany/Czech Republic

This former mica species was named after the cross border town of Cinovec/Zinnwald where the original material was found. It was first described in 1845.

Hectorite [$Na_{0.3}(Mg,Li)_3(Si_4O_{10})(F,OH)_2$]

Hectorite

Dave Dyet photo, - PD, via Wikimedia Commons

Hectorite is a magnesian bentonitic clay mineral that was described in 1936 and named for Hector, San Bernardino County, California where it was found. The mineral is assigned a grandfathered status since it was reported before 1959, but it is considered as questionable.

Jadarite [$LiNaSiB_3O_7(OH)$]

Jadarite

Dungodung photo, Natural History Center of Serbia specimen, - CC_BY_SA-4.0 International, via Wikimedia Commons

Jadarite was discovered in 2007 and is named after the type locality, the Jadar Basin in western Serbia. The mineral has a lithium content of 3.16 wt % and appeared in the news because its chemical composition is similar to the fictional "kryptonite" described in the *Superman* movies. The Jadar Basin site is still under development, but it is believed to be one of the largest lithium deposits in the world with an estimated reserve of 118 Mt of ore at 1.8% Li_2O.

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Side Note on the Lithium Rush in Arizona

The rush to find new lithium sources has also made its way to Arizona. In northwestern Arizona near the Nevada border, exploration efforts are focusing on the sedimentary lithium deposits of the Big Sandy Formation. The formation consists of flat-lying lacustrine (ancient lake bottom) rocks with thick tuffs. The tuffs have altered to zeolites, potassium feldspar, clays and silica minerals (Thomspon et al., 2023).

In 2019, Arizona Lithium, an Australian owned mining company, conducted a 37-hole drilling program in the Big Sandy area. Using two cut-off grades, it found potential resources of 32.5 Mt of ore with a Li grade of 1,850 ppm (cut-off grade of 800 ppm) and 12.7 Mt with Li grade of 2,360 ppm (cut-off grade of 2000 ppm). The property covers approximately 25 km^2 (9.65 mi^2), and only 4% of this area has been explored.

The clay deposit at Burro Creek was originally mined for the magnesium-bearing mineral saponite $[(Ca,Na)_{0.3}(Mg,Fe)_3(Si,Al)_4O_{10}(OH)_2 \cdot 4H_2O]$, but activities have now shifted to lithium. The subsurface clay deposits are being explored by Bradda Head Lithium, a mining firm based in the British Virgin Islands. Drilling completed in 2023 indicates a resource of 17 Mt with a Li grade of 940 ppm.

References

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Aerial View of the Big Sandy River Area
Formulanone photo, - CC_BY_SA-2.0, via Wikimedia Commons
The Big Sandy River is located near U.S. Route 93 and flows past Wikieup south of Kingman.

Arizona Rocks 133

Text & photos by Ray Grant

Dinosaurs, dinosaurs, dinosaurs, and much more! Last month I wrote about the Southwest Paleontological Society that meets at the Arizona Museum of Natural History in Mesa. Looking back, I found that there has not been an Arizona Rocks about the museum. I had a photograph of their fossil mammoth in number 87 but nothing about the museum.

So, I took a trip to the Arizona Museum of Natural History since I had not been there for several years. It is amazing and I recommend that you visit. Plan to spend some time as there is a lot to see, but the fossils are the best. There are fossils from every age, but the dinosaurs are world class. After you see the dinosaurs check out the minerals, meteorites, archeology, mining, or pan for some gold (pyrite).

For hours, days open, and more information go to the website - https://www.arizonamuseumofnaturalhistory.org

AZ Mining, Mineral & Natural Resources Education Museum Update June 2024

https://ammnre.arizona.edu/

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Help support the museum at:
http://tinyurl.com/SupportMM-NREMuseum

Over the first weekend in June, we participated in the Mineralogical Society of Arizona's 4th Phoenix Heritage Mineral Show, installing a display together with the Alfie Norville Gem & Mineral Museum. Our joint case, installed by Susan and Elizabeth from the Tucson museum, featured specimens from recent donations to both of our museums by collector Bob Weaver. We included fluorite, the show theme, along with "Curator's Picks" from Arizona and across the nation. Some of those unusual specimens included orpiment from Nevada, manganocalcite from Wisconsin, and prehnite after glauberite from New Jersey. The display also featured information about both our museums with links to our websites, which was a great opportunity for promotion. Executive Director Marta Bones attended the show and was able to meet new stakeholders and friends of the museum. We are thankful to MSA for including us and look forward to the next show.

Plans for July include working with our Governor-appointed Advisory Council on museum planning and fundraising. Thank you for your continued support!

Photo: Bob Weaver Tribute Case on display at the Phoenix Heritage Show. Photo courtesy of M. Bones.

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Please enjoy these mineral photos by Stan Celestian.

Quartz Japan Law Twin

Grape agate

Pinal Museum and Society News

351 N. Arizona Blvd., Coolidge, AZ

Pinal Geology and Mineral Society next meeting

September 18, 2024

Meetings are the third Wednesday at 7pm, doors open at 6:30

Everyone is welcome!

www.pinalgeologymuseum.org

Ray Grant ray@pinalgeologymuseum.org

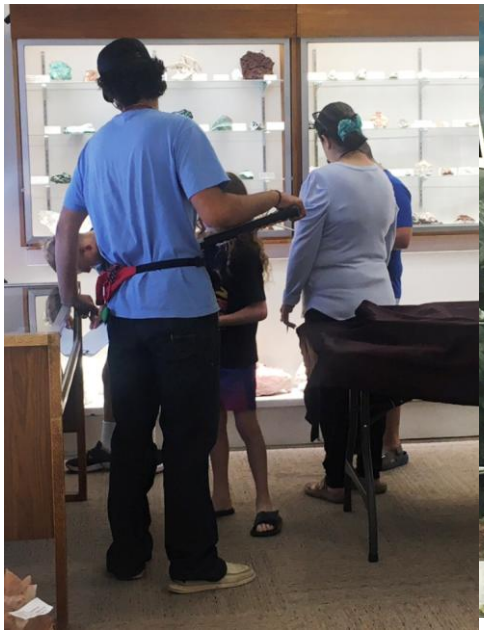
Pinal Geology and Mineral Museum

Summer hours for July & August, are Fridays from 10 to 3, admission is free.

Groups can arrange special visits please call 520-723-3009.

Museum will open 4 days again starting week of September 2nd admission is free.

On Wednesday June 19, the Pinal Geology and Mineral Museum had 100 kids from the City of Coolidge summer Kids Kamp visit the Museum. They came in four groups, and worked with museum volunteers on question sheets about the exhibits. They all received a treasure bag with mineral and fossil specimens and information about the Museum to take home.



Photos by Christine New

SUN CITY ROCKHOUND MINERAL MUSEUM
SUNDIAL RECREATION CENTER
14801 N. 103RD AVE.
SUN CITY, AZ 85351
scrockmuseum@gmail.com
623-428-6442

C. Sandoval photo

WINTER HOURS
OCTOBER – APRIL
10 AM TO 1 PM
CLOSED THURS., & SUNDAY
SUMMER HOURS
MAY-SEPTEMBER 10AM-1PM
SATURDAYS ONLY

Sun City Rockhound Club members turn their attention to inside museum activities to stay cool.

By Carol Bankert-George Vice President

Summer months bring a reduction in our mineral museum hours. May through September we are open Saturday only 10am to 1pm. Reduced hours give club members the opportunity to plan and work on new installations in the museum, along with annual specimen cleaning. Club members with additional help from Catie Sandoval from AZ Mining, Mineral & Natural Resources Education Museum, Bob Holmes, local meteorite collector and our current museum intern, Krysten Sarkissian (geology major at Estrella Mountain Community College) are working with the museum on several new displays.

As reported in the May ESM Newsletter, Catie with AMMNREM finished installing the Banquet of Rocks – the Rockhound Café. Many of you remember this display at the AZMMM before it closed. Always a favorite with young and old alike!

June finds us working with Bob Holmes on a display of meteorites and meteor-wrongs. When complete we hope to have approximately 40 specimens on display. The installation should be completed by mid-July.

The club is also working on two new displays featuring Arizona rocks and minerals. These two new displays were inspired by AMMNREM when we recently found an intact teachers study collection box distributed in the 1990's by the Arizona Mining and Mineral Museum and the Arizona Department of Mines and Mineral Resources. The kit outlines 78 minerals and rocks found in Arizona. Several are not included in the kit; however, the museum will use specimens from our collection to complete.

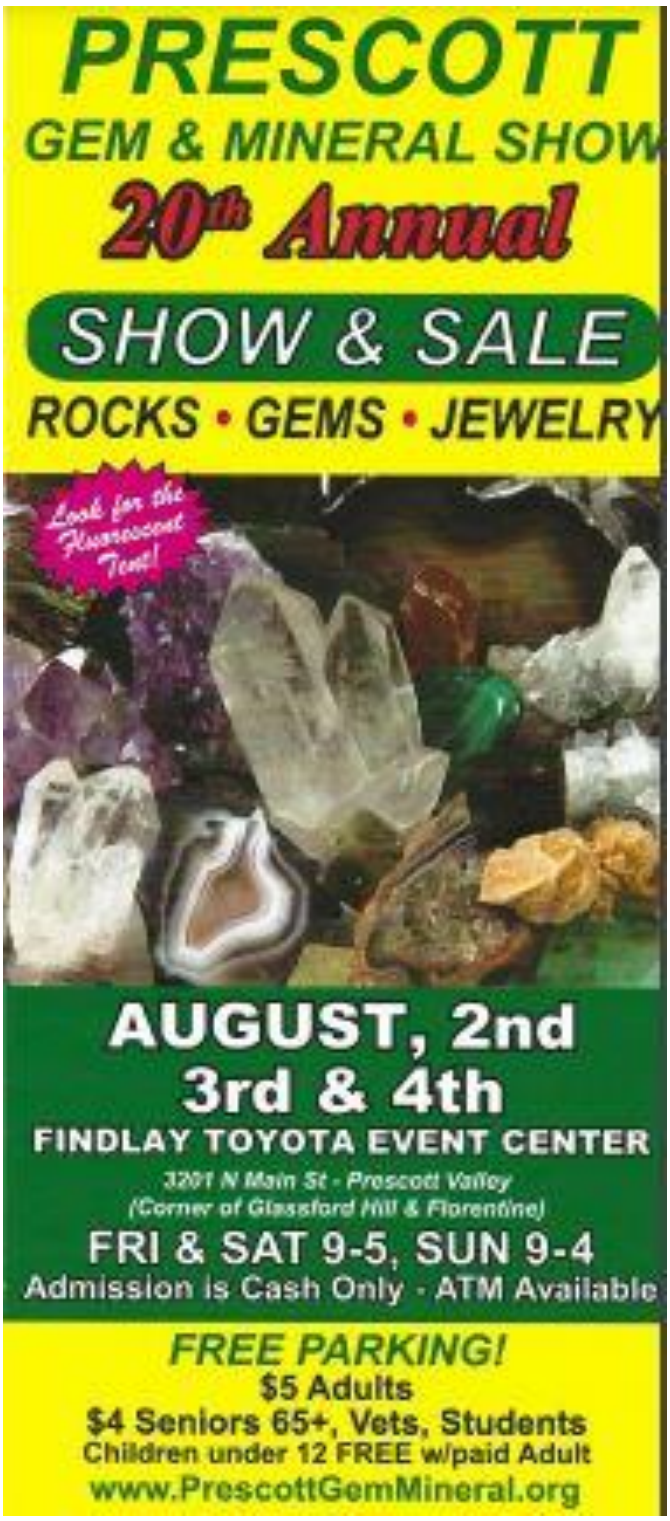
Look for updates on our progress in the next ESM newsletter.

The museum does offer private party tours. Clubs and private individuals interested can contact the museum at scrockmuseum@gmail.com.

Catie Sandoval working with museum intern Krysten Sarkissian on Rockhound Cafe display.

Bob Holmes, meteorite collector working with museum intern Krysten Sarkissian on new meteorite and meteor wrong display.

Arizona Rock and Gem Shows



Apache Junction Rock & Gem Club
Meetings are on the 2nd Thursday
Next Meeting: July 11, 2024, 6:30 pm
www.ajrockclub.com
@ Club Lapidary Shop
2151 W. Superstition Blvd., Apache Jct.

Daisy Mountain Rock & Mineral Club
Meetings are on the 1st Tuesday
(unless a Holiday then 2nd Tuesday)
Next Meeting: September 3, 2024, 6:30 p.m.
Please go to their website for more info
www.dmrmc.com
@ Anthem Civic Building
3701 W. Anthem Way, Anthem, AZ

Maricopa Lapidary Society, Inc
Note: New meeting day
Meetings are on the 3rd Tuesday
Next Meeting: August 20, 2024, 7:00 pm
www.maricopalapidarysociety.com
@ North Mountain Visitor Center
12950 N. 7th St., Phoenix, AZ

Mineralogical Society of Arizona
Meetings are on the 3rd Thursday
(Except December & June)
Thursday, September 19, 2024, 7:30 p.m.
Franciscan Renewal Center, (Piper Hall),
5802 E. Lincoln Drive, Scottsdale, AZ
www.msaaz.org

Pinal Geology & Mineral Society
Meetings are on the 3rd Wednesday
Next Meeting: September 18, 2024, 7:00 pm
In person meeting
www.pinalgeologymuseum.org
351 N. Arizona Blvd., Coolidge

West Valley Rock & Mineral Club
Meetings are on the 2nd Tuesday
Next Meeting: July 9, 2024, 6:30 pm
www.westvalleyrockandmineralclub.com
@ Buckeye Community Veterans Service Center
402 E. Narramore Avenue, Buckeye, AZ

Gila County Gem & Mineral Society
Meetings are on the 1st Thursday
(unless a Holiday then the next Thursday)
Next Meeting: July 4, 2024, 6:30 pm
www.gilagem.org
Club Building
413 Live Oak St, Miami, AZ

Wickenburg Gem & Mineral Society
Meetings are on the 2nd Friday
(February & December on the 1st Friday)
Next Meeting: September 13, 2024, 7:00 pm
www.wickenburggms.org
@ Coffinger Park Banquet Room
175 E. Swilling St., Wickenburg

ESM's Meeting Notice

ESM's next meeting will be at North Mountain Visitor Center, 12950 N. 7th St., Phoenix, on Tuesday, TBA 2024, at 6:30 p.m.

BECOME A MEMBER!

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MANY THANKS TO OUR MAJOR DONORS!

AZ Leaverite Rock & Gem Society

Flagg Mineral Foundation
www.flaggmineralfoundation.org

Friends of the AZ Mining & Mineral Museum

Maricopa Lapidary Society
http://maricopalapidarysociety.com/

Mineralogical Society of AZ
www.msaaz.org

Payson Rimstones Rock Club
https://www.rimstonesrockclub.org/

Sossaman Middle School

White Mountain Gem & Mineral Club
www.whitemountain-azrockclub.org

Sun City Rockhound Club & Mineral Museum
https://suncityaz.org/recreation/clubs/rockhound-club-mineral-museums/

Wickenburg Gem & Mineral Society
http://www.wickenburggms.org
www.facebook.com/pages/Wickenburg-Gem-and-Mineral-Society/111216602326438

West Valley Rock and Mineral Club
http://www.westvalleyrockandmineralclub.com/

Staples Foundation
www.staplesfoundation.org

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We're on the Web!

Visit us at:

www.earthsciencemuseum.org

Mission
Our Mission is to excite and inspire all generations about earth sciences through educational outreach.

Vision
We envision a community where students and the general public have curiosity about, passion for, and understanding of the underlying principles of earth sciences.

For more information about the ESM, how to become a member or how to arrange for a school visit or Community function, go to: www.earthsciencemuseum.org.

NOTICE:
ESM's next meeting will be at North Mountain Visitor Center, 12950 N 7th St, Phoenix, on Tuesday, TBA 2024, at 6:30 p.m.

THANK YOU FOR YOUR CONTINUING INTEREST & SUPPORT!!!

Earth Science Museum
3215 W. Bethany Home Rd.
Phoenix, AZ 85017