



EARTHQUAKE

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

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

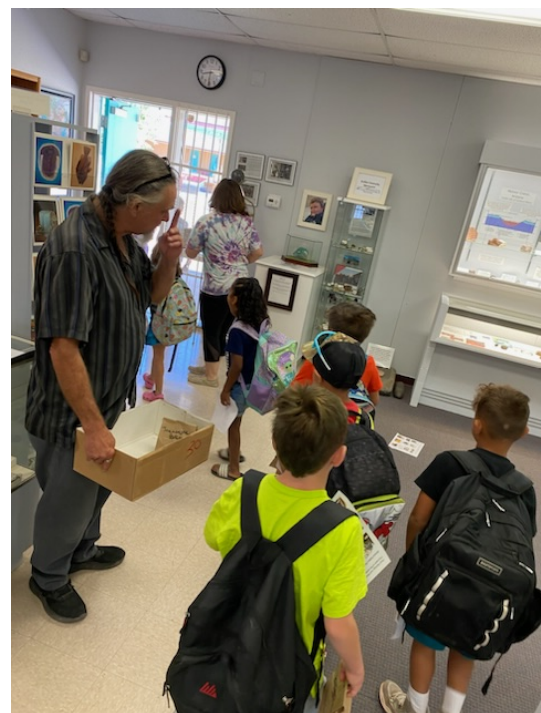
Mardy Zimmermann, Outreach Coordinator

The Pinal Geology and Mineral Museum wants to thank the ESM and Mardy Zimmermann for helping us set up the egg cartons in the Museum, and supplying us with samples for the program. For a dollar kids get to pick out 12 specimens in an egg carton. Kids who don't have a dollar can have one free as we had a donation specifically for kids that could not afford one.



Kids working on their egg carton collections, they are from a home school group of 41 parents and kids that visited the Museum in June.

A group of 58 kids plus counselors from the Coolidge Parks and Recreation Summer Camp visited the Museum in June. They answered questions about the exhibits and each got a treasure bag with some mineral and fossil specimens.



New Global Geopark Additions

By Harvey Jong

Summer is prime vacation time for many people, and parks, ranging from local to international, represent a popular destination. One option at the international level involves the United Nations Education, Scientific, and Cultural Organization's (UNESCO) Global Geopark Network (GGN).

Global Geoparks Network (GGN)

The GGN was founded in 2004 in partnership with the International Union of Geological Sciences (IUGS). The network of geoparks was established to conserve the Earth's geological heritage and to promote sustainable research and development. Each geopark is selected as a unified geographical area where sites and landscapes of international geological significance are managed with a holistic concept of protection, education, and sustainable development. These locations feature this distinctive logo:



UNESCO Global Geoparks Network Logo

Graphic by UNESCO, Sciences de la terre, - PD - , via Wikimedia Commons

and the following video depicts the diverse environments that are being preserved by the geoparks.

[Ctrl+click to view UNESCO Global Geoparks Video](#)

This video provides an overview of Global Geoparks which are located in 48 countries.

On June 6, 2023, the GGN announced 18 new Global Geoparks which brings the total number of geoparks to 195¹. The new locations include:

- Caçapava, Brazil
- Quarta Colônia, Brazil
- Lavreotiki, Greece
- Ijen, Indonesia
- Maros Pangkep, Indonesia
- Merangin Jambi, Indonesia
- Raja Ampat, Indonesia
- Aras, Iran (Islamic Republic of)
- Tabas, Iran (Islamic Republic of)
- Hakusan Tedorigawa, Japan
- Kinabalu, Malaysia
- Waitaki Whitestone, New Zealand
- Sunnhordland, Norway
- Bohol, Philippines
- Jeonbuk West Coast, Republic of Korea
- Cabo Ortegal, Spain
- Khorat, Thailand
- Mourne Gullion Strangford, United Kingdom of Great Britain and Northern Ireland
- Kütralkura, Chile (major extension)

For this article, we'll do some armchair travel and visit the new Global Geopark at Ijen, Indonesia.

Ijen UNESCO Global Geopark

The Ijen Geopark is located at the easternmost tip of Java Island in Indonesia. The geopark encompasses an area of 4,723 km² (1,824 mi²) and includes two districts, Banyuwangi and Bondowoso Regencies. We will focus on the attractions in Bondowoso which includes the following groups of sites (Mastika et al., 2023):

¹ A current list of Global Geoparks can be found at this [web page](#) which organizes the geoparks by country. Note that so far no geoparks are located in the United States which may be related to past U.S. withdrawals from UNESCO.

Nine geological sites

1. Basaltic Lava Blawan
2. Blawan Hot Springs Complex
3. Ijen Acid Crater Lake
4. Ijen Blue Fire
5. Ijen Megasari Caldera Wall
6. Gentongan Waterfall
7. Plalangan Lava Flows
8. So'Onsolor Stone Park
9. Wurung Crater

Two biological sites

1. Coffee Plantation of Bondowoso
2. Rainbow Forest

Five cultural sites

1. Butha Cermee Cave
2. Butha Sumber Canting Cave
3. Patik Kopi Dance
4. Maskuning Kulon Megalithic Site
5. Singo Ulung



Annotated Indonesia Map Indicating the Location of Java

After Uwe Dederling map, - CC_BY_SA-3.0, via Wikimedia Commons



Annotated East Java Map Indicating the Location of Ijen Geopark in Bondowoso

After Mandamaruta map, - CC_BY_SA-4.0 International, via Wikimedia Commons

An overview of the geopark's attractions is presented in the following video:

[Ctrl+click to view Ijen Global Geopark video](#)

This video provides a sample of the different visitor experiences available at the Ijen Geopark.

Ijen Geological Sites

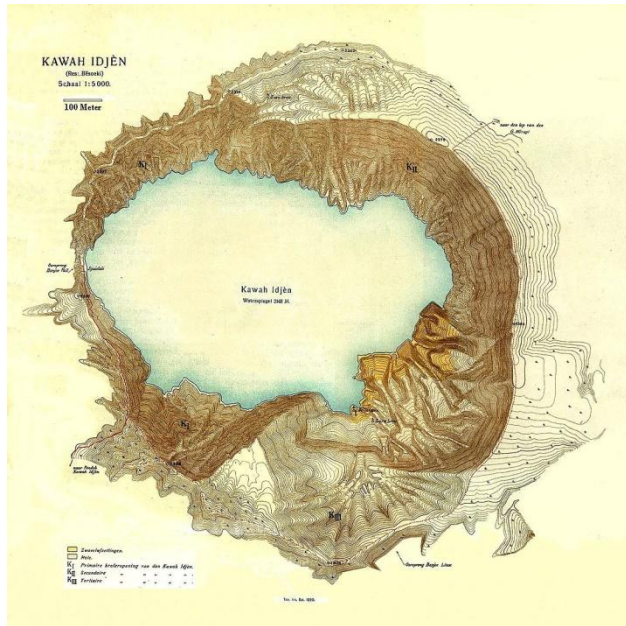
The Ijen geological sites are part of a volcanic complex which consists of several stratovolcanoes and cinder cones and a 20 km (12.4 mi.) wide caldera. The only currently active volcano is Kawah Ijen which hosts the world's largest natural hyperacidic lake [by volume, 27.5 million cubic meters (7.26 billion gallons)].



Satellite Photo of the Kawah Ijen Area

NASA Earth Observatory image by Jesse Allen, - PD, via Wikimedia Commons

This image was captured by the Landsat 8 spacecraft on August 23, 2013. The craters of several other volcanoes are visible around the Kawah Ijen crater.



Map of Kawah Ijen

1920 map from the text *De geologie en geomorpologie van den Idjen en analyse van merkwaardige watersoorten op het Idjen hoogland* by G. L. L. Kemmerling and H. W. Woudstra, 1921, - copyrighted work reproduced with permission, via Wikimedia Commons

The lake has a green to turquoise blue color with floating deposits of sulfur spherules.



Crater Lake of the Kawah Ijen Volcano

Ardhanragil photo, - CC_BY_SA-4.0 International, via Wikimedia Commons

Lake waters are hot with temperatures $>30^{\circ}\text{C}$ (86°F), while the acidity is extreme with a pH of <0.3 (Delmelle et al., 2000). (Note that the acid in automotive lead-acid

batteries has a nominal pH of 0.8). The acidic $\text{SO}_4\text{-Cl}$ waters are caused by an inflow of hydrothermal waters charged with gases (SO_2 , H_2S , HCl , HF) from a hot magma chamber below the lake.

Active fumaroles form another distinctive feature of the Kawah Ijen volcano. The hot gases emitted from vents have temperatures around $170\text{-}245^{\circ}\text{C}$ ($338\text{-}473^{\circ}\text{F}$) and are supersaturated with sulfur. Native sulfur is deposited as these gases cool.



Overall View of the Fumaroles of the Kawah Ijen Volcano

Dennis Keller photo, - CC_BY_SA-2.0, via Wikimedia Commons



Close-up View of the Fumaroles

Candra Firmanyah photo, - CC_BY_SA-4.0 International, via Wikimedia Commons
A miner uses a steel bar to break up the sulfur into large pieces which are loaded into bamboo baskets.



Miner Carrying Sulfur from the Crater Lake
 Kondephy photo, - CC_BY_SA-3.0, via
 Wikimedia Commons

Miners typically make two trips down to the crater lake and haul 70-90 kg (154-198 lbs) of sulfur in baskets up a vertical path. The sulfur, then, is carried 5 km (3.1 mi) down a road from the lake.



Miner on His Way Downhill to the Sulfur Collection Station

Photo by CEphoto, Uwe Aranas, via Wikimedia Commons

Workers are paid based on the weight of the sulfur that they deliver, about \$12 for the two trips (Mukherjee, 2015).

Sulfur-mining started in the late 1780s and continues today. To enhance the amount of sulfur deposition, miners channel fumarolic gases and molten sulfur through pipes placed under vents.



Channeling Fumarolic Gases

Aditya Suseno photo, - CC0-1.0 Universal Public Domain Dedication, via Wikimedia Commons

A miner breaks up the sulfur that condenses from the pipes and onto the ground.

The sulfur stalactite specimen that is the centerpiece of the ESM's *Volcanic Rocks & Minerals* display was collected at the Kawah Ijen volcano.



Sulfur Stalactite

Harvey Jong photo, ESM Volcanic Rocks & Minerals specimen

Kawah-Ijen volcano, Java, Indonesia

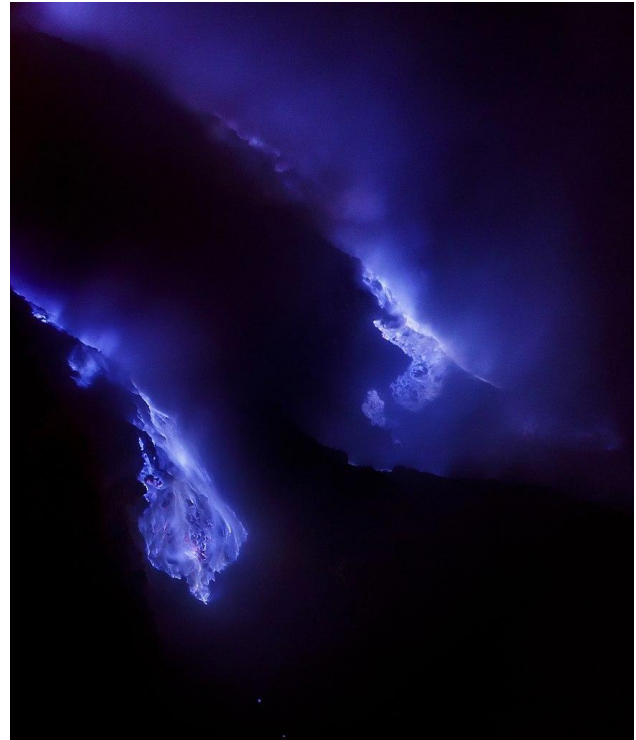
Dimensions: 9.9 x 4.8 x 4.3 cm

The Kawah Ijen volcano is also called the "Blue Fire" volcano. This nickname is based on the electric blue flames that are produced when hot, sulfur-bearing fumarolic gases ignite upon contact with oxygen in the atmosphere. The temperature of the gases may be up to 600°C (1,112°F), and the flames may reach up to five meters (16 ft) high. The flames, however, are only readily visible at night.



Blue Fire of the Kawah Ijen Volcano

Thomas Fuhmann photo, - CC_BY_SA-4.0 International, via Wikimedia Commons



Close-up View of the Blue Fire of the Kawah Ijen Volcano

Thomas Fuhmann photo, - CC_BY_SA-4.0 International, via Wikimedia Commons

[Ctrl+click to view video of the Blue Flames from Burning Sulfur](#)

This dramatic video shows views of the Kawah Ijen volcano at night.

Ijen Biological Sites

Java's geography and fertile volcanic soil provide an ideal environment for growing coffee. The Arabica coffee plant was introduced in 1696 by Dutch traders. Large plantations developed around the vicinity of the Ijen volcanic complex and were responsible for about 85% of the coffee production of East Java. Coffee trading became so lucrative in Java that coffee started to be referred to as "java".

One of the geopark's biological sites celebrates the cultivation of Arabica coffee. A plantation located near Kluncing Village provides a detailed look into the steps involved in coffee harvesting and processing

along with the area's biodiversity and conservation efforts.



Arabica Coffee Berries

Dzikra Imron photo, - CC_BY_SA-4.0 International, via Wikimedia Commons



A Large Coffee Plantation

Souvenir photo of Java, unknown photographer, circa 1890-1920, - CC_BY_SA-3.0 -, via Wikimedia Commons

Photo from the National Museum of World Cultures Tropenmuseum Collection

In the late 1800s, Dutch colonists established large coffee plantations on the Ijen Plateau. These farms were nationalized in the 1950's and managed as "Government Estates" where their size varies from 725-2,268 Hectares (1,792-5,604 acres).

A Closing Note

Aside from experiencing some amazing geological wonders and appreciating the rich cultural heritage, visiting Ijen Geopark offers a unique opportunity to enjoy a cup of java in Java. According to some coffee connoisseurs, Ijen coffee has a distinctive taste and aroma with a low balanced acidity level, soft texture, and nutty and chocolatey notes. Bersulang! (Indonesian word for "Cheers!")



A Cup of Java

Ali Yahya photo, - CC0-1.0 UPDD, via Wikimedia Commons

References

Delmelle P., A. Bernard, M. Kusakabe, T.P. Fischer, and B. Takano (2000) Geochemistry of the magmatic-hydrothermal system of Kawah Ijen volcano, East Java, Indonesia. *Journal of Volcanology and Geothermal Research* 97(1-4): 31-53.

Mastika, I.K., S.S. Harsono, W. Khristianto, P. Oktawirani, and P.S. Hutama (2023) Creative strategies of local resources in managing geotourism in the Ijen Geopark Bondowoso, East Java, Indonesia. *International Journal of Geoheritage and Parks* 11:149-168.

Mukherjee, S. (2015) Sulfur miners of Kawah Ijen. *Yale Journal of International Affairs* 10(1).



AZ Mining, Mineral & Natural Resources Education Museum Update June 2023

<https://ammnre.arizona.edu/>

Catie Carter Sandoval

cscarter@email.arizona.edu

703.577.6449

Help support the museum at:

<http://tinyurl.com/SupportMM-NREMuseum>

On the development front, the University of Arizona and our design-build team continue to work out details and build a plan for the new museum. UofA administration is also in the process of developing a position description for a new Executive Director who will lead the charge in fundraising and project management, and ultimately oversee the daily operations of the museum. We expect that search to begin later this summer.

Earlier this month we invited the Payson Rimstones Rock Club to help move out some of our excess non-accessioned material in the basement “pit” and other storage areas. In order to renovate those areas, we need to clear them out and the goal is to ensure nothing is thrown away. With the help of several hardworking members from the club, we sent a good number of AZGS publications and flats of crushed rock and assorted minerals up to Payson where they will be used for education and outreach purposes, keeping in line with the mission of our museum. Thanks to all the Rimstones who helped out, and to friend of the museum Lynne Wheeler and club president Rollo Pool for helping coordinate the activities.

Finally, we enjoy seeing our specimens on display for the public in new locations, especially while the museum is still closed (see photo for our current display at Phoenix City Hall). If anyone has ideas about

collaboration with other museums or community institutions, please let us know. Thank you for your help - and support!



Payson Rimstones club members loading flats that will be taken to Payson.



Club member Tom assisting with the winch that lifts heavy buckets directly up and out of the pit.



Children and families enjoying our minerals on display in the ‘Mine to Medallion’ exhibit at the Gallery at Phoenix City Hall.



Arizona Rocks 121

Text and photos by Ray Grant

We are in the hottest time of the year and many people head to northern Arizona to cool off, so here are a number of good references for geological things to see and do at the higher elevations. This is a list of the Arizona Geological Survey's Down to Earth publications related to northern Arizona. To see them go to the Arizona Geological Survey website (<http://azgs.arizona.edu>), then to the Document Repository, and put the title of the DTE that you want to see in the search and you can download the publication.

DTE-7 Highlights of Northern Arizona Geology, compiled and edited by Robin Frisch-Gleason, 1998, 44 p.

DTE-10 Guide to Geologic Features at Petrified Forest National Park, by J.V. Bezy and A.S. Trevena, 2000, 48 p.

DTE-14 A Guide to the Geology of the Flagstaff Area, by J.V. Bezy, 2003, 56 p.

DTE-15 Roadside Geology: Wupatki and Sunset Crater Volcano National Monument, by S. L. Hanson 2003, 32 p.

DTE-16 A Guide to the Geology of the White Mountains and the Springerville Volcanic Field, Arizona, by J. V. Bezy and A. S. Trevena, 2003, 56 p.

DTE-20 A Guide to the Geology of Sedona and Oak Creek Canyon, by Bezy, J., 2012, 44 p.

Enjoy the geology and the cooler weather!



Oak Creek Canyon, lots of trees, part way to the coolest!



White Mountains, getting higher and cooler!



San Francisco Peaks, highest and coolest of all!



Pinal Geology & Mineral Museum

Pinal Museum and Society News

351 N. Arizona Blvd., Coolidge, AZ

Pinal Geology and Mineral Society next meeting

September 20, 2023

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

www.pinalgeologymuseum.org

Ray Grant ray@pinalgeologymuseum.org

SUMMER HOURS

Fridays 10-3

Here are some photos of recent donations to the Museum.

The quartz and one of the chrysocolla specimens have been added to the exhibits and the other specimens will be on sale in the gift shop. So come by on a Friday to see the changed exhibits or to buy a good specimen at a reasonable price.



Quartz, Carr Canyon, Cochise County, AZ; Chrysocolla, Malachite slabs, various Arizona localities

Vanadinite, Morocco



Arizona Rock and Gem Shows

White Mountain Gem and Mineral Club

Annual Show

July 14-16, 2023

Fri. & Sat. 9-5, Sun. 10-4

Adults \$4, Children with an adult free

Show Low Elks Lodge

805 E. Whipple

Show Low, AZ

Prescott Gem & Mineral Club

19th Annual Show & Sale

August 4-6, 2023

Fri. & Sat. 9-5, Sun. 9-4

Adults \$5, Seniors 65+, Vets, Students \$4

Children under 12 Free w/paid Adult

Findlay Toyota Event Center

3201 N. Main St.

Prescott Valley, AZ

Payson Rimstones Rock Club

Annual Show

September 15-17, 2023

Fri. 1-6, Sat. 9-5, Sun. 10-4

Children under 13 Free

Adults \$3 Friday, \$5 Saturday -Sunday

Mazatzal Hotel and Casino,

HWY 87 and Mile Marker 251

Payson, AZ

Mingus Gem & Mineral Club

Annual Show

September 22-24, 2023

Fri. 9-5, Sat. 9-5, Sun. 9-4

Free

Clark Memorial Clubhouse Auditorium

19 N. Ninth Street

Clarkdale, AZ

West Valley Rock & Mineral Club

Annual Show

October 6-8, 2023

Fri. & Sat. 9-5, Sun. 9-2

Adults \$3, Children under 13 free

Buckeye Arena

802 N. 1st Street

Buckeye, AZ

Huachuca Mineral and Gem Club

49th Annual Show

October 14-15, 2023

Sat. 9-5, Sun. 10-4

Free Admission & Parking

Sierra Vista Mall

2200 El Mercado Loop

Sierra Vista, AZ

Sedona Gem and Mineral Club

Annual Show

October 22-23, 2023

Sat. 10-5, Sun. 10-4

Adults \$5 Children 12 and under free

Sedona Red Rock High School

Hwy 89A at Upper Red Rock Loop Rd.

Sedona, AZ

Lake Havasu Gem & Mineral Society

53rd Annual Lake Havasu Gem

& Mineral Show

November 11-12, 2023

Sat. 9-5, Sun. 9-4

Adults \$2

Children 12 and under free

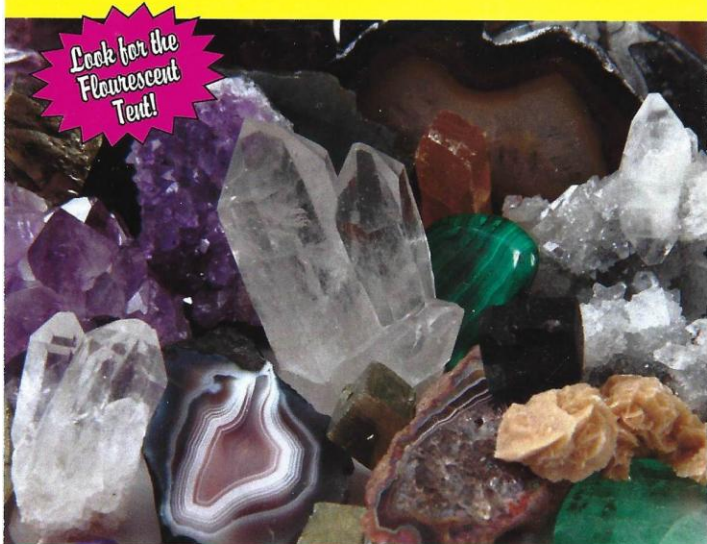
Aquatic Center

100 Park Avenue

Lake Havasu, AZ

PRESCOTT
GEM & MINERAL SHOW
19th Annual

SHOW & SALE
ROCKS • GEMS • JEWELRY



AUGUST, 4th
5th & 6th

FINDLAY TOYOTA EVENT CENTER

3201 N Main St - Prescott Valley
 (Corner of Glassford Hill & Florentine)

FRI & SAT 9-5, SUN 9-4

Admission is Cash Only - ATM Available

FREE PARKING!

\$5 Adults

\$4 Seniors 65+, Vets, Students
 Children under 12 FREE w/paid Adult

www.PrescottGemMineral.org

October 21 & 22
Sat 10-5 / Sun 10-4

Sedona Red Rock High School - 89A at
 Upper Red Rock Loop Rd, W. Sedona

Hourly Raffles
Grand Prize

Admission - \$5
 Children 12 & under Free





Apache Junction Rock & Gem Club

Meetings are on the 2nd Thursday
Next Meeting: September 14, 2023, 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 5, 2023, 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

Meetings are on the 1st Monday
(unless a Holiday then 2nd Monday)

Next Meeting: August 7, 2023, 7:00 pm

www.maricopalapidarysociety.com

@ North Mountain Visitor Center

12950 N. 7th St., Phoenix



Mineralogical Society of Arizona

Meetings are on the 3rd Thursday
(Except December & June)

Next Meeting: September 21, 2023,
11:00 am

Please go to their website for more information

www.msaz.org



Pinal Geology & Mineral Society

Meetings are on the 3rd Wednesday

Next Meeting: September 20, 2023, 7:00 pm

In person meeting

www.pinalgeologymuseum.org

@ Artisan Village

351 N. Arizona Blvd., Coolidge



West Valley Rock & Mineral Club

Meetings are on the 2nd Tuesday

Next Meeting: September 12, 2023, 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 6, 2023, 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 8, 2023, 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 2023, at 6:30 p.m.

BECOME A MEMBER!
Join the Earth Science Museum's



IS IT TIME TO RENEW YOUR MEMBERSHIP?
Please renew today! 😊😊😊

----- cut here -----
**ESM Earth Science Investigation
 Team Membership Form**
 _____ New Member _____ Renewal

Membership levels:

_____ ESI Family \$20

_____ ESI Individual \$10

Membership benefits:

- ◆ Monthly e-newsletter *Earthquake*
- ◆ Official team membership card
- ◆ Knowledge that your contribution is making a difference in earth science education.

MANY THANKS TO OUR MAJOR DONORS!

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 Flagg Mineral Foundation
www.flaggmineralfoundation.org
 Friends of the AZ Mining & Mineral Museum
 Maricopa Lapidary Society
<http://maricopalapidarysociety.com/>
 Mineralogical Society of AZ
www.msaz.org
 Payson Rimstones Rock Club
 Sossaman Middle School
 White Mountain Gem & Mineral Club
www.whitemountain-azrockclub.org
 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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 Stan & Susan Celestian
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Phone:
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Editor E-Mail:
 scote@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.

We're on the Web!

Visit us at:

www.earthsciencemuseum.org

NOTICE:
 ESM's next meeting will be at North Mountain Visitor Center, 12950 N 7th St, Phoenix, on Tuesday, TBA 2023, at 6:30 p.m.

THANK YOU FOR YOUR CONTINUING INTEREST & SUPPORT!!!

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