



# EARTHQUAKE

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

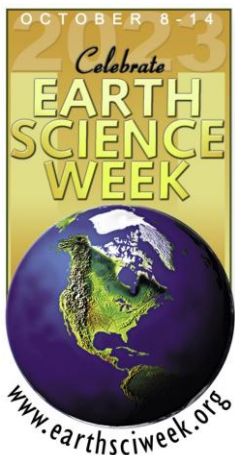
Earth Science Museum, 3215 W. Bethany Home Rd., Phoenix, AZ 85017  
[www.earthsciencemuseum.org](http://www.earthsciencemuseum.org), [scote@earthsciencemuseum.org](mailto:scote@earthsciencemuseum.org), 602-973-4291

August 2023  
Volume 12, Issue 8

## ESM OUTREACH UPDATE

**Mardy Zimmermann, Outreach Coordinator**

Due to the continued record breaking heat wave, there are no new outreach activities to report this month.



The American Geosciences Institute (AGI) organizes this annual educational event which helps the public gain a better understanding and appreciation for the Earth Sciences.

Poster courtesy of the American Geosciences Institute

ESM board members Shirley Coté, Doug Duffy, Bob Holmes and Harvey Jong will participate in Save Our Mountains Foundation's "Geology Day at North Mountain Visitor Center" in celebration of the upcoming Earth Science Week Oct. 8-14.

**Saturday, October 14, 2023**

**12950 N. 7<sup>th</sup> Street, Phoenix**

**9 a.m. to 3 p.m.**

At 9:30 a.m. Harvey Jong, President of the Earth Science Museum will present:

### **Volcanoes in the News, in History, and in Arizona**

Volcanoes on Earth are openings in the crust where lava, ash, and gases escape. Volcanic

activity has and continues to play a major role in shaping our planet and human history. This presentation provides an overview of how and where volcanoes form, the different types of volcanoes, and classification of eruptions. Numerous examples are described including recent eruptions, such as the Hunga Tonga and Mauna Loa volcanoes; historic eruptions, such as Vesuvius, Krakatoa, and Mount St. Helens; and volcanic fields in Arizona, such as the San Francisco field near Flagstaff. It concludes with an introduction and invitation to explore the Earth Science Museum's *Volcanic Rocks & Minerals* display which features samples from several famous volcanoes.

Bob Holmes will have a display on meteorites and will answer your questions about them. Is your specimen a meteorite or a "meteor wrong"? Bring your specimen and find out!

Doug Duffy will oversee demonstrations of cabochon cutting and faceting of gemstones. There will also be wire wrap demonstrations.

Shirley Cote will have sample specimens of metamorphic, sedimentary and igneous rocks to examine.

At 1:00 p.m. Alex Richardson, Grand Canyon Geology professor and Save Our Mountains Foundation at NMVC volunteer, will give a talk on the "Geology of North Mountain."

The Maricopa Lapidary Society (MLS) will be celebrating their 75<sup>th</sup> Anniversary and will have silent auctions throughout the day.

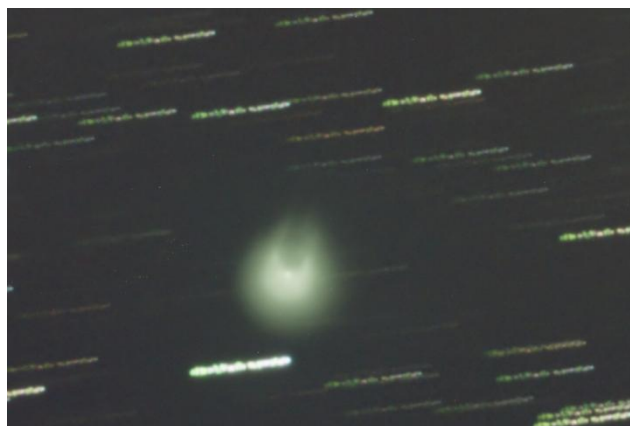


MLS 75<sup>th</sup> Anniversary Cake and Beverages to be served - *While they last!*

## Volcanic Comet

By Harvey Jong

Volcanoes and comets have been frequent subjects of past newsletter articles, so recent news about a “volcanic comet” naturally represented a “must-explore” topic. Reports of a volcanic comet involved a sudden outburst observed with Comet 12P/Pons-Brooks on July 20, 2023. The massive eruption resulted in the comet becoming five magnitudes brighter (about a 100X increase); however, it still remains a relatively dim object with a magnitude of 11.6. Currently, a 6-inch telescope and very dark skies are needed to see the comet which is near the constellation Draco.



### Outburst of Comet 12P/Pons-Brooks

Juan Iacruz photo, - CC\_BY\_SA-4.0-International, via Wikimedia Commons

This photo, which was captured at the J87 Observatory in La Cañada, Ávila, Spain, shows the comet one week after the outburst. The comet has been described as having sprouted horns or being shaped like the Millennium Falcon from the *Star Wars* movies. Note that the greenish color is an imaging artifact.

### Comet 12P/Pon-Brooks

Comet 12P/Pon-Brooks has an orbital period of 71 years and is classified as a Halley-type comet (comets with a period of 20-200 years). The 12P designation was assigned by the Minor Planet Center which maintains a list of periodic comets that have been observed on at least two occasions. The

Pons-Brooks portion of the name refers to Jean-Louis Pons (1761-1831), the French astronomer who discovered the comet in 1812, and William Robert Brooks (1844-1921), the British-born American astronomer who later recovered the comet in 1883. Both astronomers are noted as prolific discoverers of new comets with Pons finding 37 comets and Brooks spotting 27 comets.



**Jean-Louis Pons  
(1761-1831)**

Portrait by unknown artist,  
- PD, via Wikimedia  
Commons



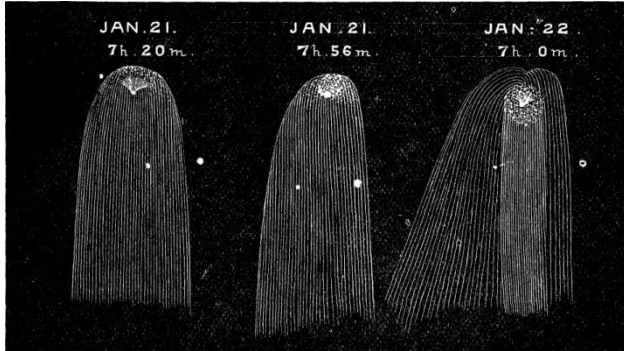
**William Robert  
Brooks (1844-1921)**

Portrait by unknown artist,  
- PD, via Wikimedia  
Commons  
From The National  
Cyclopaedia of American  
Biography, Volume 5,  
1907, p. 198

Comet 12/Pons-Brooks is recognized as one of the brightest known periodic comets with a fairly high absolute magnitude of around 4-5 (Meyer, et al. 2011). At the time of its initial discovery on July 12, 1812, the comet was not visible to the naked eye, and Pons described it as small, having ill-defined nebulosity, and without a tail. It brightened becoming visible by August 13 and displayed a tail about 2 degrees long. (Note that the width of a full moon is about ½ degree across). Around mid-September, the comet probably reached its maximum brightness with an estimated magnitude of 4.

The comet was rediscovered by William Robert Brooks in September 1883 as a faint

object with a magnitude of 10. It was later determined to be the comet of 1812. The comet became visible to the naked eye in November and reached a peak brightness of magnitude 3 in January 1884.



**Sketches of the 1884 Apparition of Comet 12P/Pons-Brooks**

Herbert Couper Wilson drawing, PD, via Wikimedia Commons

On June 20, 1953, Comet 12P/Pons-Brooks was recovered at a very dim magnitude of 17.5 by American astronomer Elizabeth Roemer (1929-2016) at the Lick Observatory. An outburst on July 1<sup>st</sup> increased its brightness to magnitude 13. Several subsequent outbursts occurred, and by late April 1954 Comet 12P reached a maximum magnitude of 6.4. Its tail was half a degree long.



**Astronomer Elizabeth Roemer (1929-2016)**

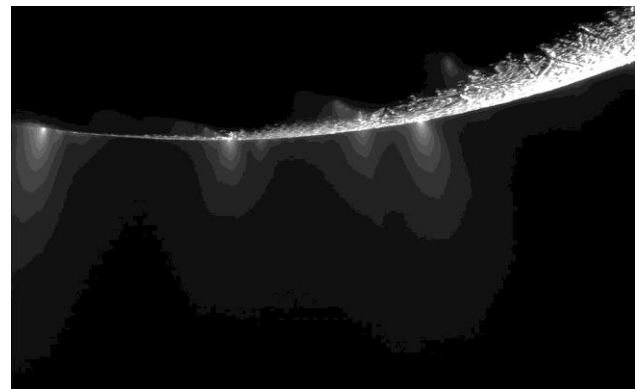
University of California photo, Acc. 90-105 - Science Service, Records, 1920s-1970s,

Smithsonian Institute Archives, via Wikimedia Commons

Elizabeth “Pat” Roemer (1929-2016) studied comets and minor planets. She was well known for detecting the return of 79 periodic comets, discovering two new asteroids, and co-discovering Jupiter’s moon Themisto. She was a professor at the University of Arizona and established the UA’s Department of Planetary Sciences. Asteroid 1657 Roemera was named in her honor.

### Cryovolcanism

Comet outbursts have been attributed to cryovolcanism which is defined as the extrusion of liquids and vapors of materials that would be normally frozen at the surface of an icy body. Since there is no direct equivalent on Earth, cryovolcanism has been inferred from observational evidence, such as images captured by the Cassini-Huygens space probe. Potential cryovolcanoes have been identified on Saturn’s icy moons, Enceladus and Titan.

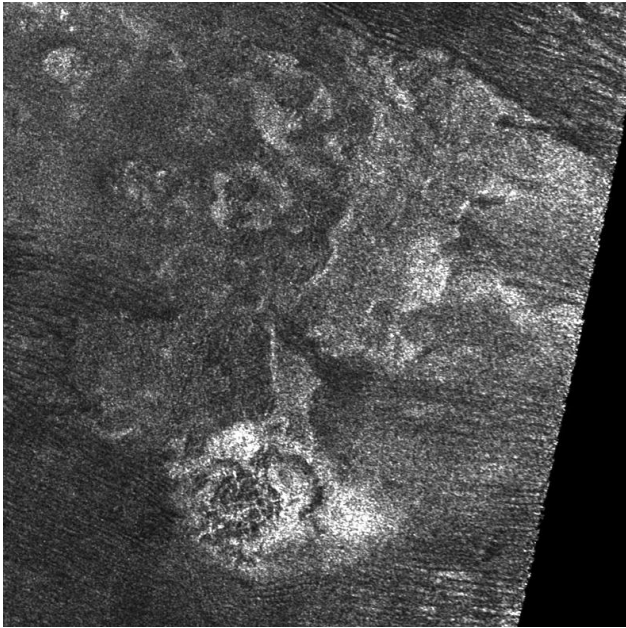


**Plumes Along the “Tiger Stripes” Near the South Pole of Enceladus**

NASA/JPL/SSI image, - PD, via Wikimedia Commons

Tiger stripes are the names given to fissures that spray icy particles, water vapor, and organic compounds into space. This image, which shows more than 30 individual jets, was captured during the Cassini spacecraft’s flyby of Enceladus on Nov. 21, 2009.





### Cassini Radar Image of the Titan Surface

NASA photo, PD, via Wikimedia Commons

This image is based on data captured during a 2007 flyover of Saturn's moon Titan. It depicts Doom Mons, a mountain peak located in the Southern Hemisphere of Titan, which is estimated to be 1,450 m (4,760 ft) high and has a diameter of about 70 km (40 mi). It may be a possible cryovolcano with a caldera (named Sotra Patera) and a flow feature (known as Mohini Fluctus).

Cryovolcanoes may not be limited to just icy moons and dwarf planets. Signs of cryovolcanic activity have also been observed with comets. Comet 29P/Schwassman-Wachmann 1 is particularly noteworthy for being the most active known periodic comet.



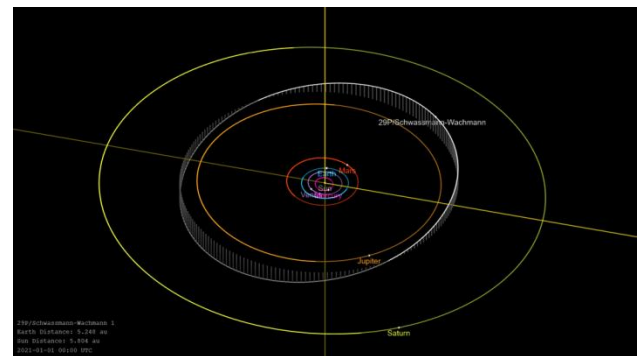
### Spitzer Space Telescope Image of Comet 29P/Schwassmann-Wachmann 1

Image courtesy of NASA/JPL/Caltech/Ames Research Center/University of Arizona, via photojournal.jpl.nasa.gov

This image was acquired in 2003 using the multiband imaging photometer of the Spitzer Space Telescope. It shows thermal infrared emission from micron-sized dust grains in the coma and tail of the comet.

The comet, designated 29 P by the Minor Planet Center, was discovered on Nov. 15, 1927 by astronomers Arnold Schwassmann (1870-1964) and Arno Arthur Wachmann (1902-1990). Traveling around the Sun in a nearly circular orbit between Jupiter and Saturn, it has an orbital period of 14.9 years.

The comet is a member of a relatively new class of solar system objects called "centaurs" which exhibit characteristics of both asteroids and comets. The name refers to mythological creatures that were a mixture of horse and human.



### Orbit of Comet 29P/Schwassmann-Wachmann 1

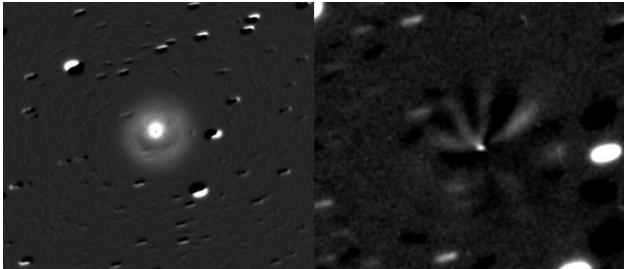
JPL Orbit Viewer image, - PD, via Wikimedia Commons

The comet's orbit is shown in white and has a low inclination of 9.4°.

Comet 29P is also very large with a nucleus estimated to be approximately 60 km (37.3 mi) across. Its most intriguing feature, however, involves fairly regular and sudden outbursts that occur every 52-65 days. Outbursts may involve isolated explosive

events, multiple eruptions, or rarely as a continuous or gradually increasing series of mini-outbursts. They reach a maximum in about two hours which suggests a possible cryovolcanic origin.

A potential mechanism for the outbursts has been proposed which involves solar heating of methane-rich ice that is under pressure beneath the comet's crust. The heat initially causes sublimation of CO and N<sub>2</sub> gases which are absorbed by the ice. An outburst occurs when further heating softens the crust and leads to a sudden explosive release of the dissolved gases and other particles. While some dust and debris are propelled into space, a significant amount of the ejecta is believed to fall back on the comet's surface and reseal the fissures (Miles, 2016). The process is repeated in a different area as the comet nucleus rotates and moves relative to the Sun.



**Outburst of Comet 29P on October 4, 2008**  
 Juan Iacruz photo, - CC\_BY\_SA-4.0 International, via Wikimedia Commons  
 These images, which were taken from the La Cañada Observatory, show expanding dust shells and jets of the comet's outburst.

### 2024 Total Solar Eclipse and Comet 12P/Pon-Brooks

On April 8, 2024 a total solar eclipse will cross North America with a narrow path of totality that will pass over Mexico, the United States, and Canada. (Note: a partial eclipse covering 64% of the Sun will be visible from Phoenix.)



### **Path of Totality Across the U.S. for the 2024 Solar Eclipse**

Map by NASA's Scientific Visualization Studio, - PD, via [svs.gsfc.nasa.gov](https://svs.gsfc.nasa.gov)

Around the same time, Comet 12 P/Pons-Brooks will make its closest approach to the Sun and is predicted to reach its maximum apparent brightness (estimated to be around magnitude 4.7 according to the Comet Observation Database, just visible with the naked eye). The eclipse and comet along with a few planets should be visible at the same time as shown in this simulated view:

### [Sky At Totality, April 8, 2024, Looking South](#)

A simulated view of the eclipse from southern Texas. Created by astrophotographer Dave Weixelman using SkySafari software.

This rare alignment promises to offer an unforgettable close encounter of the eclipse-cometary kind!

### References

Meyer, M., T. Kobayashi, S. Nakano, D.W.E. Green (2011) Comet 12P/Pons-Brooks: identification with comets c/1385 u1 and c/1451 a1. *International Comet Quarterly* 33: 115-127.

Miles, R. (2016) Discrete sources of cryovolcanism on the nucleus of Comet 29P/Schwassmann-Wachmann and their origin. *Icarus* Volume 272(1): 387-413.







## AZ Mining, Mineral & Natural Resources Education Museum Update August 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>

Over the summer, the University of Arizona has been working diligently with our design-build firm to prepare for renovations at our El Zaribah Shrine building at 1502 W. Washington St. So far, the schematic design process has included assessing the building's structure and foundation, electrical systems, roof, flooring, elevators, and more. We have reengaged the Governor-Appointed Advisory Council with regular meetings to share contractor updates and request their input about the mission and direction of the new museum. The council, as defined in Arizona Revised Statute (ARS) 27-111, consists of members from different natural resource industries, including mining, minerals, forestry, agriculture, livestock and tourism, the State Geologist, members of the public, a University of Arizona representative, and members of the Arizona state Senate and House of Representatives.

The search for a Museum Director also continues and we are still accepting applications online. The full description including duties and responsibilities, qualifications, benefits, compensation and link to apply can be found at the University of Arizona's Talent website (go to [talent.arizona.edu](http://talent.arizona.edu) and search for "mining museum") or at <https://tinyurl.com/AMMNRE>.

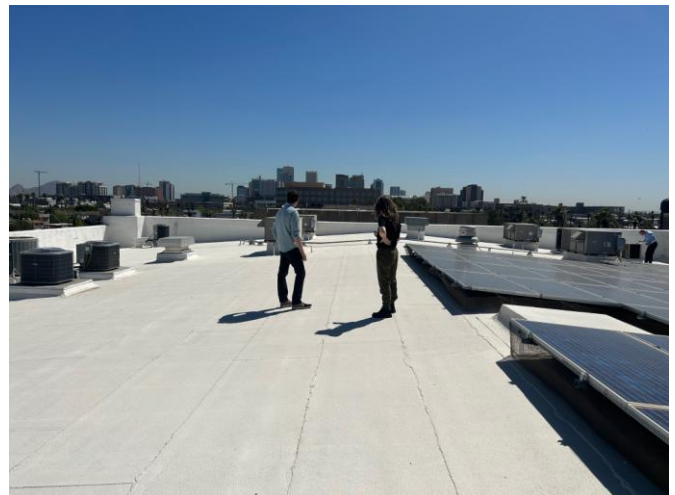
Thank you for your continued support and we look forward to an exciting and productive fall!



Contractors outside our building assessing some structural questions



Surveyor taking precise measurements of our building and the surrounding land



More roof assessments. Photo taken looking to the east towards downtown Phoenix



## Arizona Rocks 123

Text and photos by Ray Grant

Continuing with some places to cool off, in Arizona Rocks 97 and 99, I had places to visit in Springerville. I recently visited Springerville again (trying to cool off from the hottest July on record), and the dinosaurs are still in the visitors center (97) and you can still take a tour to the Casa Malpais Ruins (99).

The Heritage Center, 418 East Main St. in Springerville is where the ruins trip starts, but they also have a good free museum. There is lots of local history in the museum, but also some exhibits related to dinosaurs and the volcanoes in the area. Check their website for more information including hours of operation, <https://springervilleaz.gov/heritage-center>.

Springerville is in Springerville Volcanic Field (Arizona Rocks 98) that covers 1,158 square miles with over 400 volcanic eruptions. The museum has some good exhibits related to this volcanic activity including a path through an active volcano area. So if you have not been to Springerville and want to cool off, give it a visit.



Springerville Heritage Center



Path to volcanic area



Path in volcanic area



Exhibit with information about Springerville Volcanic Field





## 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](http://www.pinalgeologymuseum.org)

Ray Grant [ray@pinalgeologymuseum.org](mailto:ray@pinalgeologymuseum.org)

Starting on Wednesday September 6 through next May, we will have our hours of 10 to 4 Wednesday through Saturday, admission is free.

**Friday, September 1st hours 10 to 3 p.m.**

The September 20 program will be about Meteor Crater by Ray Grant.

Meteor Crater, Arizona is proclaimed by many to be the best meteorite impact site in the world. The official name is the Barringer Meteor Crater named for Daniel Moreau Barringer who staked mining claims over the crater in the early 1900s. Barringer's mining venture failed as the meteorite exploded on impact and is scattered over many square miles and is not buried in the bottom as Barringer proposed. The crater is still owned by the Barringer Company that operates it today as a tourist attraction.



Pinal Geology museum exhibit of Meteor Crater made and donated by Carleton Moore. Photo by Ray Grant



## Arizona Rock and Gem Shows

### 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. 1<sup>st</sup> Street

Buckeye, AZ

### Huachuca Mineral and Gem Club

49<sup>th</sup> 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 21-22, 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

### Wickenburg Gem & Mineral Society

Wickenburg Gem & Mineral Show

**November 25 & 26, 2023**

**Sat. 9-5, Sun. 10-4**

Free Admission

Hassayampa Elem. School

251 S. Tegner

Wickenburg, AZ



### Apache Junction Rock & Gem Club

Meetings are on the 2<sup>nd</sup> Thursday  
 Next Meeting: September 14, 2023, 6:30 pm  
[www.ajrockclub.com](http://www.ajrockclub.com)  
 @ Club Lapidary Shop  
 2151 W. Superstition Blvd., Apache Jct.



### Daisy Mountain Rock & Mineral Club

Meetings are on the 1<sup>st</sup> Tuesday  
 (unless a Holiday then 2<sup>nd</sup> Tuesday)  
 Next Meeting: September 5, 2023, 6:30 p.m.  
**Please go to their website for more info**  
[www.dmrmc.com](http://www.dmrmc.com)  
 @ Anthem Civic Building  
 3701 W. Anthem Way, Anthem, AZ



### Maricopa Lapidary Society, Inc

Meetings are on the 1<sup>st</sup> Monday  
 (unless a Holiday then 2<sup>nd</sup> Monday)  
 Next Meeting: September 11, 2023, 7:00 pm  
[www.maricopalapidarysociety.com](http://www.maricopalapidarysociety.com)  
 @ North Mountain Visitor Center  
 12950 N. 7<sup>th</sup> St., Phoenix, AZ



### Mineralogical Society of Arizona

Meetings are on the 3<sup>rd</sup> Thursday  
 (Except December & June)  
 Next Meeting: September 21, 2023,  
 7:30 pm  
 Franciscan Renewal Center, (Piper Hall),  
 8502 E. Lincoln Drive, Scottsdale, AZ  
**Please go to their website for more  
 information**  
[www.msaz.org](http://www.msaz.org)



### Pinal Geology & Mineral Society

Meetings are on the 3<sup>rd</sup> Wednesday  
 Next Meeting: September 20, 2023, 7:00 pm  
**In person meeting**  
[www.pinalgeologymuseum.org](http://www.pinalgeologymuseum.org)  
 @ Artisan Village  
 351 N. Arizona Blvd., Coolidge



### West Valley Rock & Mineral Club

Meetings are on the 2<sup>nd</sup> Tuesday  
 Next Meeting: September 12, 2023, 6:30 pm  
[www.westvalleyrockandmineralclub.com](http://www.westvalleyrockandmineralclub.com)  
 @ Buckeye Community Veterans Service  
 Center  
 402 E. Narramore Avenue, Buckeye, AZ



### Gila County Gem & Mineral Society

Meetings are on the 1<sup>st</sup> Thursday  
 (unless a Holiday then the next Thursday)  
 Next Meeting: September 7, 2023, 6:30 pm  
[www.gilagem.org](http://www.gilagem.org)  
 Club Building  
 413 Live Oak St, Miami, AZ



### Wickenburg Gem & Mineral Society

Meetings are on the 2<sup>nd</sup> Friday  
 (February & December on the 1<sup>st</sup> Friday)  
 Next Meeting: September 8, 2023, 7:00 pm  
[www.wickenburggms.org](http://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. 7<sup>th</sup> 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!**

- AZ Leaverite Rock & Gem Society
- Flagg Mineral Foundation  
[www.flaggmineralfoundation.org](http://www.flaggmineralfoundation.org)
- Friends of the AZ Mining & Mineral Museum
- Maricopa Lapidary Society  
<http://maricopalapidarysociety.com/>
- Mineralogical Society of AZ  
[www.msaz.org](http://www.msaz.org)
- Payson Rimstones Rock Club
- Sossaman Middle School
- White Mountain Gem & Mineral Club  
[www.whitemountain-azrockclub.org](http://www.whitemountain-azrockclub.org)
- Wickenburg Gem & Mineral Society  
<http://www.wickenburggms.org>  
[www.facebook.com/pages/Wickenburg-Gem-and-Mineral-Society/111216602326438](https://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](http://www.staplesfoundation.org)
- Anita Aiston
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- Russ Hart
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- Debbie Michalowski
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- Dennis & Georgia Zeutenhorst

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**Earth Science Museum**  
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**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](http://www.earthsciencemuseum.org).

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*We're on the Web!*

*Visit us at:*

[www.earthsciencemuseum.org](http://www.earthsciencemuseum.org)

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

**THANK YOU FOR YOUR CONTINUING INTEREST & SUPPORT!!!**

**EARTH SCIENCE MUSEUM  
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 Bob Holmes, Chris Whitney-Smith

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