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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April 2025
Volume 14, Issue 4

ESM OUTREACH UPDATE

By Tony Occhiuzzi, photos by Diana Occhiuzzi
Mardy Zimmermann, Outreach Coordinator

ESM Outreach Program recently gave two presentations with the 6th graders at Hughes Elementary School located in the Mesa Elementary School District and the 4th graders at Sopori Elementary School located in the Sahuarita Unified School District South of Tucson in the town of Amado, AZ. Both presentations were made by Tony Occhiuzzi with organizational help from his wife Diana, rock and mineral samples from Mardy Zimmermann, Catie Carter-Sandoval and Kelli Wakefield plus chemicals from the Mesa Community College Chemistry Dept.

On November 26, 2024, the 1st presentation was at Hughes Elementary School to Ms. Hope Flynn and her 6th grade homeroom class. She assisted in presenting the notes needed on the physical properties of rocks and assisted with passing out the Lab Kits for her class. After giving a short introduction of each specimen needed for the lab activity, large display samples were made available for student viewing and examination. To check on the student's retention, a short identification quiz was given at the end of the activity, and it was interesting to see each group challenging their classmates nearby. Each 6th grade student received an Egg Carton with 12 labeled samples for their personal keepsake.

Tony's lesson always ends with his Chemistry Demo's, which have become his trademark entertainment called, "Is It Science or Is It Magic?" He states that he loves to surprise them with a background story and demo for the "The Genie," "Elephant's Toothpaste," and the closer which he calls "A Shot of Red Eye." The look on their faces is very rewarding to observe.

Tony and students at Hughes Elementary

On March 17th, 2025, the 2nd presentation was given at Sopori Elementary School to Mrs. Mary Gaston and her 4th grade

homeroom class. One of her homeroom boys loves rocks and minerals, and she asked if we could help him with some samples. Tony decided to make a surprise visit to her class located south of Tucson. The principal, Robert Beachy, said the students love their teacher and Mrs. Gaston calls them "The Motley Crew."

This presentation was designed very special for the 4th graders, it started off with the Earth in Space and a short overview of the Solar System, including the Inner Planets and the Outer Planets. To introduce the Earth's rocks, Tony explained the formation of igneous, sedimentary, and metamorphic rocks with a simple handout for the students to read along while viewing large samples. Student questions were answered with positive reinforcement and surprise gifts.

The homeroom class only had 15 students, so Egg Cartons with 12 specimens along with magnifying glasses were given to each student, along with an empty Egg Carton with instructions for the students to collect samples from around their home. Diana Occhiuzzi then treated the class to green four-leaf clover St Patrick's Day cookies and a variety of gift drawings to enrich the afternoon. The day ended with some chemistry demos called, "Is It Science or Is It Magic?"

Tony's reward arrived the next week with Thank You Notes, rock drawings, and e-mails from students to help identify their personal collected samples they found nearby. Samples included manganese oxide with a dendritic pattern showing branch-like features, a variety of quartz, and a barrel shaped crystal. Mrs. Gaston's 4th graders now truly believe, "Everybody Needs a Rock."

Tony and students at Sopori Elementary School

Answers to last month's mineral questions.

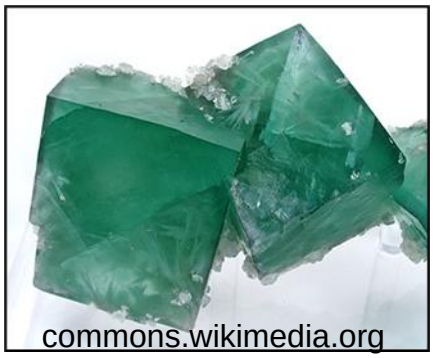
By Shirley Coté

This mineral is soft enough to be scratched by your fingernail. What is it? This is gypsum.

This mineral has a pearly luster, can be scratched with your fingernail and feels greasy. What is it? This is talc.

Does this mineral have fracture or cleavage? This is muscovite mica which has perfect basal cleavage and has the tenacity of being elastic. What does elastic mean?

Elastic means that the mineral will bend to a certain point and when let go it will return to its previous shape, but if bent to its breaking point it fractures with uneven and rough surfaces.



Does this mineral have cleavage or fracture? What is this mineral and what is its crystal habit? This is the mineral fluorite and its crystal habit is cubic with four directions of cleavage which will form an octahedron.

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Grape agate photo by Stan Celestian

Rhodochrosite photo by D. Duffy

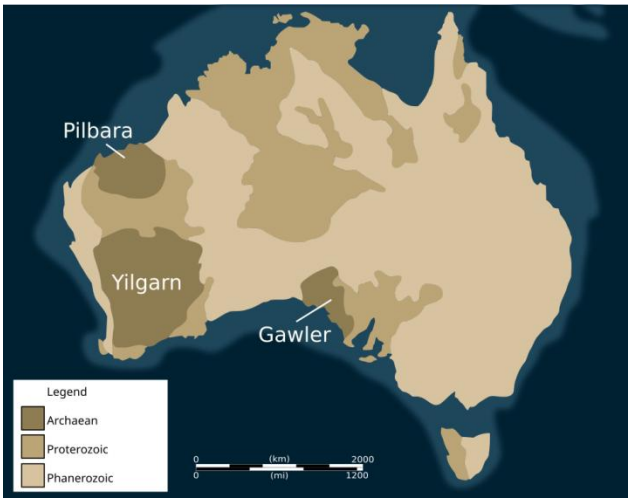
A New Discovery of the Earth's Oldest Meteorite Impact Structure
By Harvey Jong

This article is a follow-up to the February 2025 newsletter which mentioned that the 2.2 billion year old crater remnants near Yarrabubba Station in Western Australia represent the oldest known meteorite impact structure. A new discovery of a feature more than one billion years older has been reported in a recent *Nature Communications* article (Kirkland et al., 2025). The crater was also found in Western Australia, but its location is north of Yarrabubba in the Pilbara region.

Locations of the Oldest Meteorite Impact Structures
NordNordWest map, - CC_BY_SA-3.0 Germany, via Wikimedia Commons
The red circle indicates the location of the newly discovered structure in the Pilbara region, while the black circle corresponds to the Yarrabubba remnants.

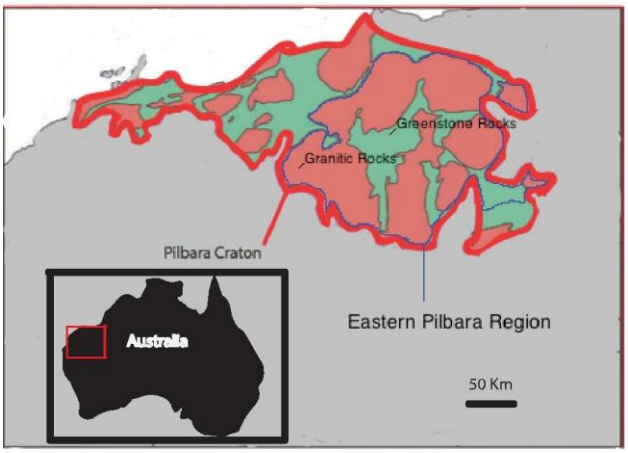
Geologic Setting of the Pilbara Region

The Pilbara region includes one of Australia's three Archaean (4.03 to 2.5 billion years ago) cratons, the old and stable parts of the continent. The name is derived from either the Aboriginal word *bilybara* for "dry" or the Aboriginal word *pilbarra* for the salt-water mullet found in the local rivers.



Australia's Three Archaean Cratons and Surrounding Basement Rocks
Woudloper map, - CC_BY_SA-4.0 International, via Wikimedia Commons

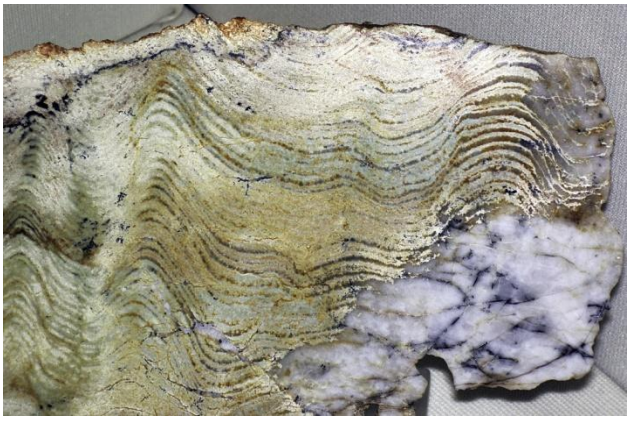
The Pilbara Craton is one of only two relatively unaltered occurrences of the Earth's early crust. (The Kaapvaal Craton in South Africa is the other site.) The exposed crustal rocks are up to 3.8 billion years old, while the area's intrusive granitic domes and greenstone belts are about 3.5 to 3.2 billion years old.



Map of the Pilbara Craton
Ebuhyo1 map, - CC_BY_SA-4.0 International, via Wikimedia Commons
This map shows the granitic and greenstone rocks that make up the Pilbara Craton. The blue outline indicates the boundaries of the Eastern Pilbara region where the meteorite impact structure was discovered.

For billions of years, the area has experienced a minimal amount of tectonic activity, and this stability has helped preserve the early evolution of the Earth. Zircon crystals from the region have been dated from 3.80 to 3.55 Ga, while the age of the most ancient exposed rocks is around 3.52 Ga (Kemp et al., 2015). (Note that the oldest known zircon crystals, which have been dated to 4.375 billion years old, were found in the adjacent Yilgarn Craton in the Jack Hills area.)

Fossilized evidence of early life forms, such as stromatolites, was uncovered in the Strelley Pool Chert formation near Marble Bar. This formation is one of the rock units that make up a small greenstone structure known as the North Pole Dome.



Polished Stromatolite Sample
James St. John photo, Cranbrook Institute of Science specimen, - CC_BY_SA-2.0, via Wikimedia Commons
East Strelley Greenstone Belt, Pilbara Craton, Western Australia, Australia
The layered structures of this sample were created by microbial activity which has been dated to around 3.43 billion years ago.

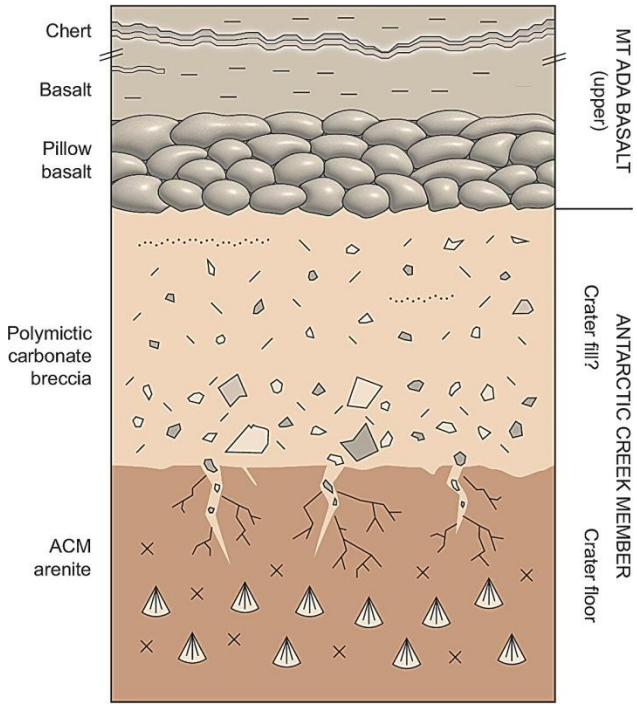
North Pole Dome

The North Pole Dome is part of a relatively little deformed greenstone belt.

View of the North Pole Dome Area
Screen capture from Strata of Pilbara – North Pole Dome video, via https://www.youtube.com/watch?v=PLJo3RBC0eA&ab_channel=BerndNicolaisen

Located within the dome's basaltic greenstones is a distinctive 20 m (65.6 ft) sedimentary deposit known as the Antarctic Creek Member (ACM). This layer consists of silicified and carbonate-altered felsic to mafic volcaniclastic rocks, chert, argillite, arenite and jaspilite intruded by dolerite. Spherules have been found in the ACM which were interpreted as a result molten silicate

droplets ejected from a global impact event (Byerly et al., 2002). The spherules suggested the possibility that additional evidence of a meteorite impact, such as shatter cones, might be preserved in the ACM.



Stratigraphic Sequence of the North Pole Dome

Fig. 3 from (Kirkland et al., 2025) – CC_BY-NC-ND, via nature.com

This diagram shows that shatter cones occur in a layer overlain by carbonate breccias and basalts.

Shatter Cones

Shatter cones are unique geological structures that form as a result of high-velocity impacts. A meteor impact releases a tremendous amount of energy that generates a high-pressure shockwave. The shockwave causes the surrounding rock to experience intense compression and deformation. This pressure can lead to a characteristic cone-shaped fracture pattern with jagged, radiating lines which reflect the shocked-induced stress.

Fieldwork started in 2021 in a small area of the North Pole Dome. This activity eventually uncovered an outcrop in the ACM with shatter cones appearing more-or-less continuously for at least several hundred meters. The cones are visible as hut-like structures with some several meters tall (Kirkland et al., 2025).

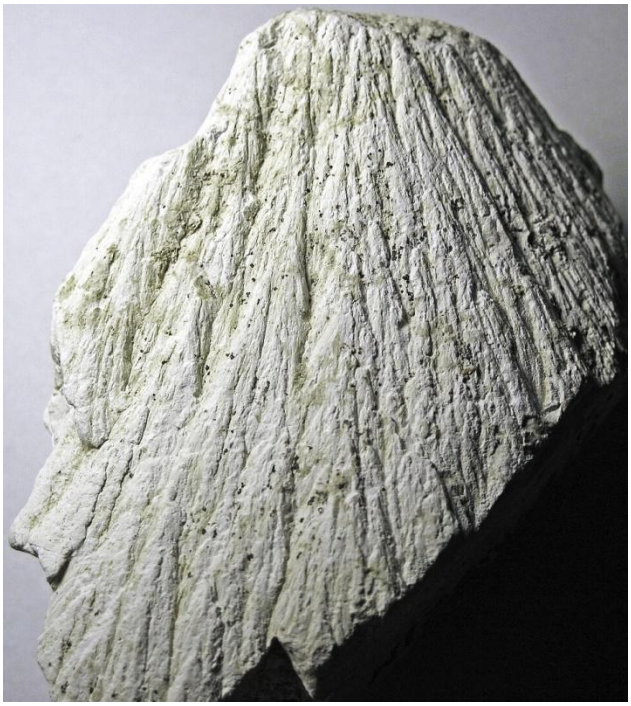
Large Shatter Cones in the North Pole Dome Area

Chris Kirkland, Curtin University photo, via scitechdaily.com

Close-up of Shatter Cones Found Within the Antarctic Creek Member

Fig 2. From (Kirkland et al., 2025), - CC_BY-NC-ND, via nature.com

The shatter cones are well preserved and include striated and "horse-tailed" conical features comparable to the samples that were first discovered in Steinheim, Germany.



Shatter Cone from Germany
James St. John photo, - CC-BY_SA-2.0, via Wikimedia Commons
Steinheim Impact Crater, Baden-Wūrttenberg, Germany

The age of the shatter cones is around 3.47 Ga based on stratigraphic constraints of the ACM. The ACM contains detrital zircon grains which have an age of 3,470 ± 2 Ma (Byerly et al., 2002). These zircons set a maximal age of the deposit. Above the ACM layer is the Mount Ada Basalt that has been dated to 3,469.2 +1.8/-1.2 Ma (Hickman, 2021). This dating establishes the site as the Earth's oldest known impact crater.

Significance of the New Discovery

According to Chris Kirkland, the lead author of the *Nature Communications* article, the new meteorite impact structure may refine our understanding of how the Earth's crust formed and the origins of life. The energy associated with this impact along with similar events could have played a role shaping the early crust by either pushing one part of the crust under the other or by forcing magma deep in the mantle to rise towards the surface. In addition, the impact may have created environments, such as hot water pools, for the development of microbial life[1].

References

Byerly, G.R., D.R. Lowe, J.L. Wooden, and X. Xie (2002) An Archean impact layer from the Pilbara and Kaapvaal Cratons. *Science* 297:5585, 1325-1327.

Hickman, A. (2021) East Pilbara Craton: a record of one billion years in the growth of Archaean continental crust. *Geological Survey of Western Australia* Report 143, 198 p.

Kemp, A.I.S. A.H. Hickman, C.L. Kirkland, and J.D. Vervoot (2015) Hf isotopes in detrital and inherited zircons of the Pilbara Carton provide no evidence for Hadean continents. *Precambrian Research* 261: 112-116.

Kirkland, C.L., T.E. Johnson, J. Kaempf, B.V. Ribeiro, A. Zametzer, R. Hugh Smithies, and B. McDonald (2025) A Paleoarchean impact crater in the Pilbara Craton, Western Australia. *Nature Communications* 16, 2224, 5 p.

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[1] Samuel Jeremic, "World's oldest impact crater found, rewriting Earth's ancient history," curtin.edu.au, March 06, 2025, https://www.curtin.edu.au/news/media-release/worlds-oldest-impact-crater-found-rewriting-earths-ancient-history/

Arizona Rocks 143

Text by Ray Grant

In past Arizona Rocks we talked about gold and copper. This month we will look at some native silver from Gila County. An early specimen found in the late 1800s is a thirty-pound nugget of silver. Many authors say that this rounded nugget that looked like a globe is the origin of the name for the city of Globe. According to Arizona Place Names the town was named before the nugget was found and was named after a local mine called the Globe Mine. The silver nugget origin for the name is more exciting to people, and the real name for Globe may never be known.

The silver comes from the Richmond Basin District north of Globe, and there has been a recent discovery of silver in the area. In 1919 using a metal detector over 770 pounds of silver nuggets were found in a dry arroyo called Mexican Mine Canyon. One of the silver nuggets weighs 417 pounds. The area is now under claim and a drilling program was started to find the source of all this silver. The largest nuggets are found near a quartz vein so this is believed to be the source, but no silver was seen in the vein.

Thirty-pound silver nugget, possible origin for the name of the city of Globe,
Smithsonian specimen and photograph

Silver nuggets found in 2019 north of Globe, largest in center weighs 417 pounds,
on exhibit at the Arizona Alfie Norville Gem and Mineral Museum in Tucson,
Ray Grant photograph

Pinal Museum and Society News

351 N. Arizona Blvd., Coolidge, AZ

Pinal Geology and Mineral Society next meeting

May 21, 2025

Meetings are the third Wednesday at 7pm, doors open at 6:00

www.pinalgeologymuseum.org

Ray Grant ray@pinalgeologymuseum.org

Pinal Geology and Mineral Museum
September – May hours are Wednesday – Saturday from 10-4, admission is free.
Groups can arrange special visits please call 520-723-3009.

May program is - Travels, minerals and geology in Australia by Ray Grant.

Bogged trying to get across the river

Wave Rock Western Australia

AZ Mining, Mineral & Natural Resources Education Museum Update April 2025

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 April 16th, Catie and Marta attended the Arizona Mining Association's annual event, 'Mining Day at the Capitol.' This was Marta's second time attending Mining Day, and it was a great opportunity to connect with mining companies, legislators, and supporters of Arizona's robust mining industry. We were able to chat with various company representatives and learn more about developing mining projects and new technologies. We also connected with our newest Advisory Council member, Senator David Gowan (District 19).

Additionally, Bill Yedowitz recently assembled a small group of devoted millmen to assess the outdoor equipment and perform any needed repairs. The group included Andre and Rod from the Superstition Mountain Museum and AMMNRE Museum volunteer Jim. The millmen assessed the crusher, mucker and stamp mill and spent a half day performing repairs. In particular, they worked on the stamp mill's belt, making sure it was not moving out of place as the wheel turned. With the equipment in good shape and recent landscaping cleanup and concrete pressure-washing by the University's facilities team, our outdoor space looks pretty good.

Thanks to all for your support and more good news to come.

Executive Director Marta and Sen. Gowan at Mining Day at the Capitol.

Andre and Bill working on the primary jaw crusher.

Millmen working on the belt of the Swallow Mine 5-stamp mill.

Sun City Rockhound Mineral Museum
Sundial Recreation Center
14801 N. 103rd Ave.
Sun City, AZ 85351

The museum offers private party tours for schools, clubs and individuals. We'd love to show off our museum to your club or private group. If you are interested, please contact the museum at scrockmuseum@gmail.com.

Food Truck Wednesday at the Museum and Sundial Recreation Center. The event will take place on Wednesday May 14th from 4:30PM to 7:30PM. The museum will be offering guests the opportunity to do a scavenger hunt with prizes (rocks of course).

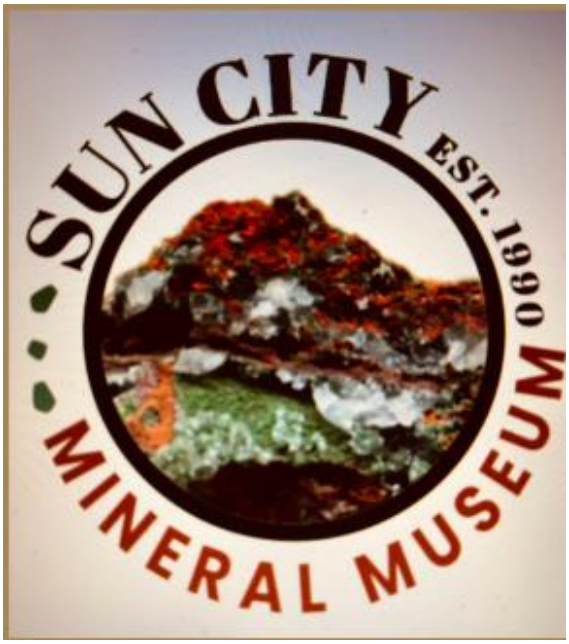
The museum is gearing down for the summer months' reduction in hours. Starting May 1st through September 30th the museum will only be open on Saturday's from 10AM to 1PM. This gives the museum the opportunity to work on other projects.

This summer the museum will be going through renovation with painting, installing new cabinets and electrical work. As we are making room for the renovations it gives us the perfect opportunity for the club to switch displays, create new ones and donate excess minerals and fossils to other museums.

In other news, the museum now has a website. Please take a minute to view it at scrockmuseum.com.

C. Sandoval photo

Winter Hours
October – April
10 am to 1 pm
Closed Thurs., & Sunday
Summer Hours
May-September 10am-1pm
Saturdays only



Screen shots from their website

Arizona Rock and Gem Shows

Annual show
Mohave County Gemstoners

May 3, 4, 2025

Sat. 9-5, Sun. 9-4
Free admission and parking
Mohave County Fairgrounds
2600 Fairgrounds Blvd.
Kingman, AZ

Apache Junction Rock & Gem Club
Meetings are on the 2nd Thursday
Next Meeting: May 8, 2025, 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: May 6, 2025, 6:30 p.m.
www.dmrmc.com
@ Anthem Civic Building
3701 W. Anthem Way, Anthem, AZ

Maricopa Lapidary Society, Inc
Meetings are on the 3rd Tuesday
Next Meeting: May 20, 2025, 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 June & December)
May 15, 2025
@ 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: May 21, 2025, 7:00 pm
www.pinalgeologymuseum.org
351 N. Arizona Blvd., Coolidge

West Valley Rock & Mineral Club
Meetings are on the 2nd Tuesday
Next Meeting: May13, 2025, 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 May 1, 2025, 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: May 9, 2025, 7:00 pm
www.wickenburggms.org
@ Coffinger Park Banquet Room
175 E. Swilling St., Wickenburg, AZ

ESM's Meeting Notice

ESM's next meeting will be at North Mountain Visitor Center, 12950 N. 7th St., Phoenix, on Tuesday, TBA 2025, at 6:30 p.m.

BECOME A MEMBER!

Join the Earth Science Museum's

esi: Earth Science Investigation team

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

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

Anita Aiston	Will & Carol McDonald
Peter & Judy Ambelang	Debbie Michalowski
Stan & Susan Celestian	Janet Stoeppelmann
Russ Hart	Dennis & Georgia Zeutenhorst

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Editor E-Mail:
scote@earthsciencemuseum.org

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

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