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

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ESM OUTREACH UPDATE

Mardy Zimmermann, Outreach Coordinator

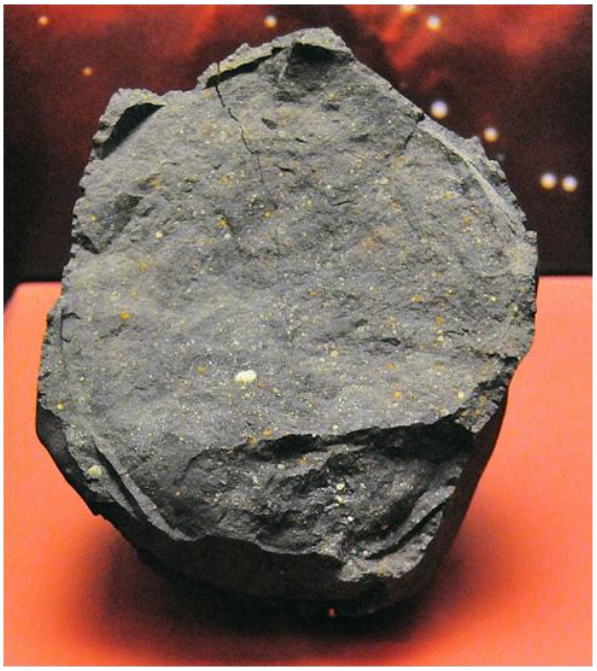
May Outreach

There are no ESM outreach activities to report this month.

Earth's Oldest Rocks and Minerals

By Harvey Jong

We'll follow up last month's article on earliest earthquakes by exploring some of the oldest rocks and minerals found on the Earth. It is interesting to note that the oldest known sample didn't originate on the Earth. This specimen is part of the Murchison meteorite that fell in 1969 near Murchison, Victoria, Australia. A group of cosmochemists studying pre-solar materials found that the meteorite contains some tiny silicon carbide grains (around 2-4 μm) which may have formed 7 Ga ago, about 2.5 billion years older than the age of the Earth and our Solar System (Heck et al., 2020).



Murchison Meteorite

Basilicofresco modified version of an Art Bromage photo, National Museum of Natural History specimen (5450.1), - CC_BY_SA-3.0, via Wikimedia Commons

Weight: 1.81 kg (3.99 lb)

The Murchison meteorite is a carbonaceous chondrite that has been studied extensively. Over 100 kg (220 lb) of fragments have been collected over an area larger than 13 sq km (5.0 sq mi). Individual pieces may weigh up to 7 kg (15 lb).

Age of the Earth

The age of the Earth represents a key reference point in discussing its oldest rocks. Estimating the age, however, is complicated by several factors, such as the continuous recycling of the crust by plate tectonics and determining when the Earth-Moon system was actually formed after Theia, a hypothesized ancient planet, collided with the early Earth.

Theia Collides with the Early Earth

Memomiguel illustration, - CC_BY_SA-3.0, via Wikimedia Commons

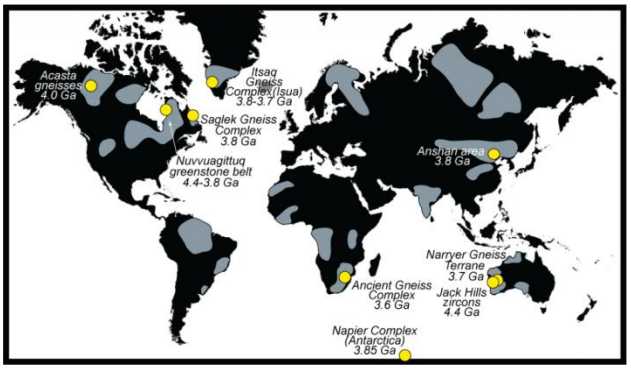
According to the giant-impact hypothesis, Theia, a planet about the size of Mars, collided with the Earth around 4.5 billion years ago. The resulting ejected debris coalesced to form the Moon, while the cores of the two bodies fused together leading to the Earth's larger than expected core.

Currently, the accepted age of the Earth is estimated to be 4.54 billion years old ± 50 million years. This value is based on radiometric dating of lead isotopes of several meteorites including Arizona's Canyon Diablo meteorite. Note that meteorites have been used to avoid potential mixing and unmixing effects of terrestrial samples due to plate tectonics, weathering, and hydrothermal circulation. The meteorite ages, though, exhibit a spread of 4.53 to 4.58 billion years. The 50 million year variance has been interpreted as the time required for the accretion of the Earth (Tillman, 2021).

Oldest Known Earth Rocks and Minerals

The oldest Earth rocks and minerals are usually found in cratons, the ancient cores of the continents. How cratons formed and survived relatively unchanged for billions of years remain a subject of debate among geoscientists.

A similar controversy surrounds which sample represents the oldest known Earth rock. We'll take a brief tour of some past and present contenders for the distinction of being the oldest example.



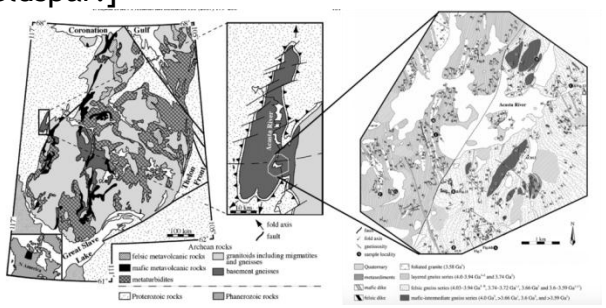
Locations of Some of the Earth's Oldest Rocks and Minerals

Jonathan O'Neil map from *Historical Geology* online textbook, - CC_BY_SA-NC-4.0 International, via opengeology.org

The oldest rock and mineral occurrences are indicated by the yellow dots, while the gray areas depict the associated cratons.

Acasta Gneiss Complex (4.0-4.2 Ga)

One recognized contender for oldest Earth rock was discovered near the Acasta River in Canada's Northwest Territories. Named for the river, the Acasta Gneiss Complex (AGC) is situated on the northwestern edge of the Slave Craton. It includes a variety of highly deformed and metamorphosed tonalite, trondhjemite, and granodiorite (TTG) rocks. [Note that these intrusive rocks have typical granite composition (quartz and feldspar) but contain only small portion of potassium feldspar.]



Geological Maps of Acasta Gneiss Complex

Youknowwhoiwillbe maps, - CC_BY_SA-4.0 International, via Wikimedia Commons

The above maps are from Iizuka et al., 2007. The left and center maps indicate the location of the area relative to the Slave Province which is in the northwestern part of

the Canadian Shield. The detailed view on the right shows the interspersed series of mafic (dark gray, 3.6-4.0 Ga), felsic (light gray, 3.6-4.03 Ga), and layered gneisses (medium gray, 3.74-4.0 Ga).

Extensive Foliated Rocks in the Acasta Gneiss Complex
Annie Bauer photo, - CC_BY_NC-SA-4.0 International, via travelinggeologist.com

Close-up View of an Acasta Gneiss Outcrop
Annie Bauer photo, - CC_BY_NC-SA-4.0 International, via travelinggeologist.com

Acasta Gneiss Fragment
Pedroalexandrde photo, Natural History Museum in Vienna specimen, - CC_BY_SA-3.0, via Wikimedia Commons

Acasta River, Great Bear Lake, Northwest Territories, Canada

Zircon ($ZrSiO_4$) commonly occurs as an accessory mineral in many rocks including those of the AGC. AGC rocks were first dated in 1984 using uranium-lead (U-Pb) isotope analysis which established an age of 3.48 Ga. Subsequent sampling and dating of zircon xenocrysts have refined the age to 4.2 Ga (Iizuka et al., 2006).

Acasta Gneiss Fragment
Emmanuel Douzery photo, Prof. Hervé Martin, Université Blaise Pascal de Clermont-Ferrand specimen, - CC_BY_SA-4.0 International, via Wikimedia Commons

Nuvvuagittuq Greenstone Belt (3.8-4.3? Ga)

Nuvvuagittuq Greenstone Belt (NGB) is located along the northeastern edge of Hudson Bay in Canada. It is part of the Superior Craton and is comprised of metamorphosed mafic to ultramafic volcanic and sedimentary rocks.

Although the NGB rocks represent some of the oldest known Earth rocks, there is an unresolved controversy regarding their age. One measurement using U-Pb dating on zircons found in granite intrusions indicates an age of 3.75 Ga (Cates and Mojzsis, 2007). The intrusions, which cut the belt, are younger than the NGB, so the analysis establishes only a minimum age. Further studies by these investigators revealed that zircons in quartz-"biotite" schists have a maximum age of 3.78 Ga.

Using samarium-neodymium (Sm-Nd) dating of intruding gabbros, another group of geoscientists arrived at an age of 4.28 Ga (O'Neil et al., 2008). This age, however, may not reflect the NGB, but may instead be an isotope artifact from the melting of earlier pre-existing rocks. Since zircon dating represents the "gold" standard in establishing rock ages, the validity of the older age remains in doubt.

Location of the Nuvvuagittuq Greenstone Belt

Drhood2938 map, - CC_BY_SA-4.0 International, via Wikimedia Commons

Nuvvuagittuq Greenstone Belt is indicated by the red circle, while brown area corresponds to the Mingo Block, one of the largest high-grade metamorphic regions of the Canadian Shield.

Rock Outcrop at Porpoise Cove, Northern Quebec, Nuvvuagittuq Greenstone Belt, Canada

NASA photo, - PD, via Wikimedia Commons

The metamorphosed volcanosedimentary rocks of this outcrop may have ages greater than 4.0 Ga.

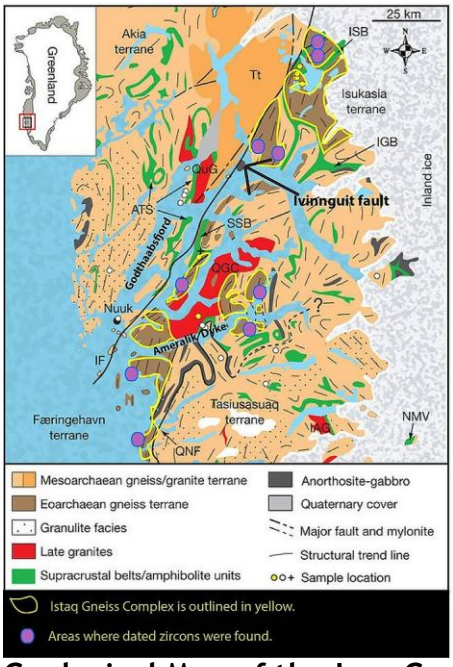
Garnet Paragneiss (“Faux-amphibolite”)
James St. John photo, - CC_BY_SA-2.0, via Wikimedia Commons
Western Ungava Peninsula, Eastern side of Hudson Bay, Northwestern Quebec, Canada
Width: 3.0 cm

A paragneiss is a gneiss that formed by the metamorphism of sedimentary rock. This specimen contains garnet, cummingtonite amphibole, “biotite” mica, quartz, plagioclase, anthophyllite, and cordierite. Based on Sm-Nd dating, its age has been determined to be 4.28 Ga, which would make it the oldest known Earth rock.

Banded Iron Formation Specimen
Daderot photo, Redpath Museum, McGill University specimen, - CC0-1.0 UPD, via Wikimedia Commons
Porpoise Cove, Northern Quebec, Nuvvuagittuq, Canada
The NGB includes a prominent Banded Iron Formation (BIF) that marks the transition of basaltic and andesitic rock compositions and may potentially include evidence of early biological activity. This metamorphosed magnetite and quartz sample has been dated to 3.8 Ga.

Itsaq Gneiss Complex (3.6-3.7 Ga)

The Itsaq Gneiss Complex, which is situated in southwestern Greenland, was the first site where pre-3.6 Ga crust was discovered. The area is dominated by polyphase gray gneisses derived from intrusive tonalities, granites, quartz-diorites, and ferro-gabbros. The great age of these rocks was recognized in 1972 (Moorbath et al., 1972).



Geological Map of the Isua Greenstone Belt
A bre.clare. map, - CC_BY_SA-4.0 International, via Wikimedia Commons
The Istaq Gneiss Complex is outlined in yellow. It consists of two major rock sequences – a southern sequence which has

an age of ~3.8 Ga and a younger northern ~3.7 Ga sequence.

Southwestern Greenland
Modified Copernicus Sentinel-2 image data, European Union, Free access granted under EU law, via Wikimedia Commons
Image acquired July 22, 2022
Nuup Kangerlua is a 160 km (99.4 mi) long fjord that was formerly known as Godthabsfjord. The fjord's exposed bedrock includes greenish gneiss that has been informally called "greenlandite". (Note that there are several different and confusing usages of greenlandite. It may also be synonymous with grolandite, a rock subtype consisting essentially of hornblende and hyperstene; gem aventurine; columbite; or almandine garnet.)

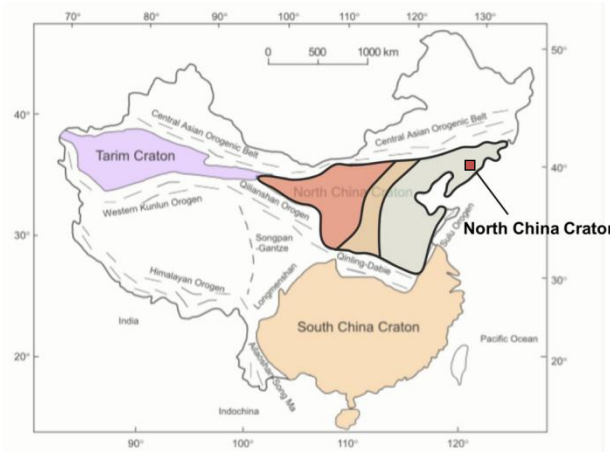
Isua, Southwestern Greenland
Peter Haproff photo, - CC_BY_SA-4.0 International, via Wikimedia Commons
The Isua Greenstone Belt is part of the North Atlantic Craton and is located on the edge of an inland ice cap 150 km (93.2 mi) northeast of Nuuk, the capital of Greenland.

Greenlandite (Fuchsite-Quartz Gneiss)
James St. John photo, - CC_BY_SA-2.0, via Wikimedia Commons
Undisclosed locality, Godthabs fjord area or Nuuk area, southwestern Greenland
About 2.35 cm across
This highly metamorphosed rock contains fuchsite (chromium variety of muscovite mica) and quartz. It is from a formation that has been dated to 3.8 Ga.

Graphitic Banded Iron Formation
James St. John photo, Field Museum of Natural History specimen (FMNH Li 9223), - CC_BY_SA-2.0, via Wikimedia Commons
Isua Supracrustal Belt, southwestern Greenland
The specimen is from a weakly metamorphosed banded iron formation that has been dated to 3.8 Ga. It contains graphite that may have involved metamorphic decomposition of siderite ($FeCO_3$).

Anshan Area (3.8 Ga)

The Anshan area is located in Liaodong Province, northeastern China and is part of the North China Craton.

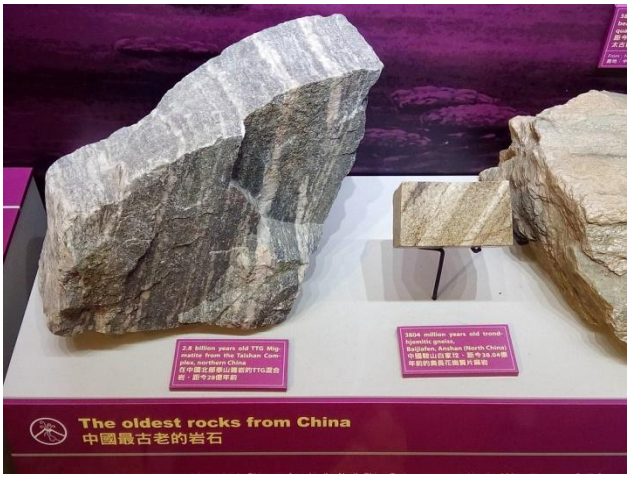


Location of the Anshan Area in the North China Craton

HelenHYW map, - CC_BY_SA-4.0 International, via Wikimedia Commons

The location of the Anshan area is indicated by the red square.

The area includes three distinct complexes with ages of 3.1-3.8 Ga identified by U-Pb dating of zircons. The Baijiafen quarry is the site where the 3.8 Ga rocks were first discovered in 1992 (Liu et al., 1992). These rocks are mainly composed of strongly mylonitized trondhjemitic gneisses. (Note that mylonitized refers to extreme micro fracturing due to mechanical forces applied in a specific direction, while trondhjemitic involves a rock subtype with plagioclase, quartz, and alkali feldspar that is no more than 10% of the total feldspar content.)



Rock Samples from the Taishan Complex and Anshan Area

Chingo Meaopim photo, University of Hong Kong, Xu Shifen Geological Museum specimens, - CC_BY_SA-4.0 International, via Wikimedia Commons

The specimen on the left is a 2.8 Ga TTG migmatite (a composite rock with a felsic part formed through partial melting and a mafic portion that is largely unchanged) from the Taishan Complex. The block in the middle is made of a 3.8 Ga trondhjemitic gneiss from the Baijiafen quarry.

Ancient Gneiss Complex (3.2-3.6 Ga)

The Ancient Gneiss Complex (AGC) of Eswatini (formerly Swaziland) is situated southeast and south of the Barberton Greenstone Belt. It includes structurally complex and highly metamorphosed portions of the eastern Kaapvaal Craton. The AGC is mainly composed of a deformed TTG suite of gneisses that range in age from 3.20 to 3.66 Ga.

Geological Map of Eswatini

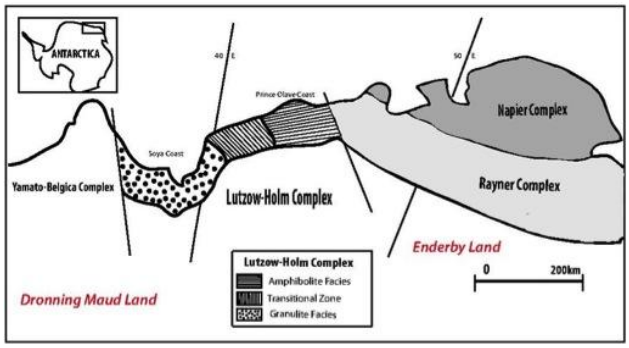
https://www.researchgate.net/figure/Geological-map-of-Swaziland-modified-from-Wilson-1980-1982-Kroener-et-al-1989-Kroener_fig1_268441663

Fig 1 from Suhr et al., 2015 shows the different lithological units that make up Eswatini

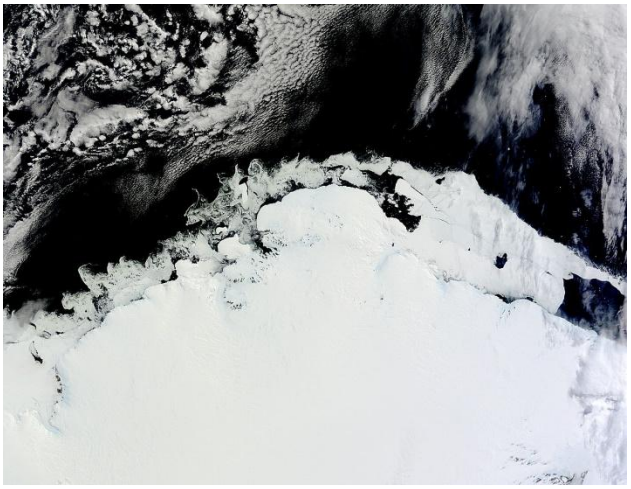
Tsawela Tonalitic Gneiss
Adayding photo, - CC_BY_SA-4.0 International, via Wikimedia Commons
This sample is from the Tsawela Gneiss which is one of the four main lithological units of the AGC. The mineral makeup includes plagioclase, quartz, "biotite", and hornblende.

Napier Complex (3.85 Ga)

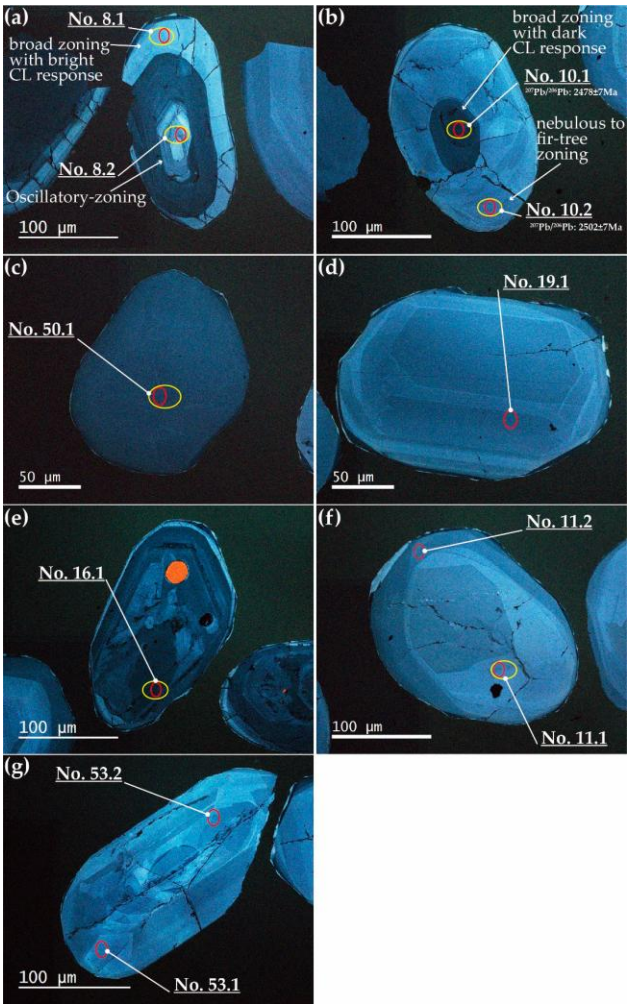
The Napier Complex, which is located in eastern Antarctica, has attracted the attention of geoscientists for many years. In 1982, zircons in a granitic orthogneiss (gneiss formed from the metamorphism of igneous rock) were reported to have an age > 3.8 Ga. The site is also the first recognized occurrence of ultra-high temperature (UHT) metamorphism. The UHT conditions occurred around 2.5 Ga and included some of the highest regional metamorphic temperatures (approaching 1100 °C) that have been recorded (Król et al., 2022). The complex contains mainly pyroxene-quartz feldspar and garnet-quartz feldspar gneisses with minor amounts of pyroxene and mafic granulite.



Map of the Four Metamorphic Complexes, of Enderby Land, Eastern Antarctica
Cagsonbanks812 map, - CC_BY_SA-2.0
The Napier Complex represents the oldest of the geological units, dating to the Archaean (4.031 to 2.5 Ga).



Satellite Image of Enderby Land, Eastern Antarctica
LANCE/EOSDIS Rapid Response Team/NASA Goddard Space Flight Center photo, - PD, via visibleearth.nasa.gov
Image acquired February 19, 2014
The first documented sighting of Enderby Land was made in 1831 by John Biscoe, the captain of an expedition seeking new sealing grounds. He named the area after his employer, the Enderby brothers.



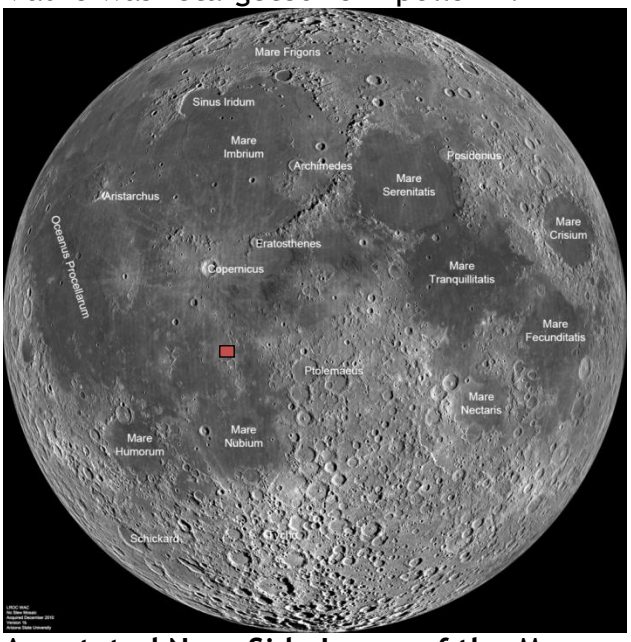
Cathodoluminescence (CL) Images of Napier Complex Zircons

Figure 3 from Takehara et al., 2020, - CC_BY_SA-4.0 International, via mdpi.com/journal/minerals

These zircons, which are from garnet-bearing quartz feldspar gneiss, were used to measure the age of the UHT region. The U-Pb dating produced an age peak of 2,501 Ma.

Fra Mauro Formation, Moon (4.33-4.35? Ga)

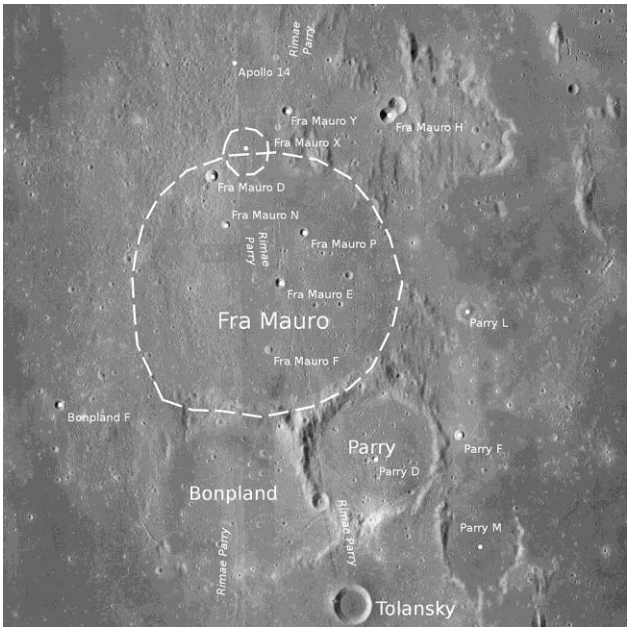
Our next contender involves a somewhat speculative sample from the Fra Mauro Formation which is located on the near side of the Moon, north of the Mare Nubium (Sea of Clouds) and south of the Mare Imbrium (Sea of Rains). Since scientists believed the area could provide samples of material that originated deep below the lunar surface, it was selected as the landing site for the Apollo 13 mission. But since Apollo 13's in-flight accident prevented a landing, Fra Mauro was retargeted for Apollo 14.



Annotated Near Side Image of the Moon

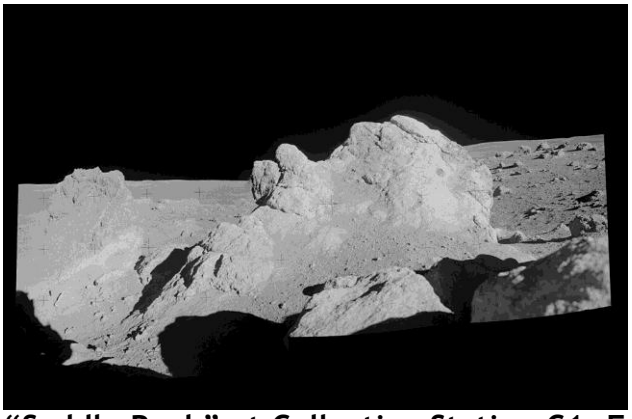
NASA/Goddard Space Flight Center/Arizona State University photo, - PD, via Wikimedia Commons

This mosaic image was assembled from ~1300 photos acquired by the Lunar Reconnaissance Orbiter mid-December 2010. The red rectangle indicates the location of the Fra Mauro Formation.



Craters of the Fra Mauro Formation

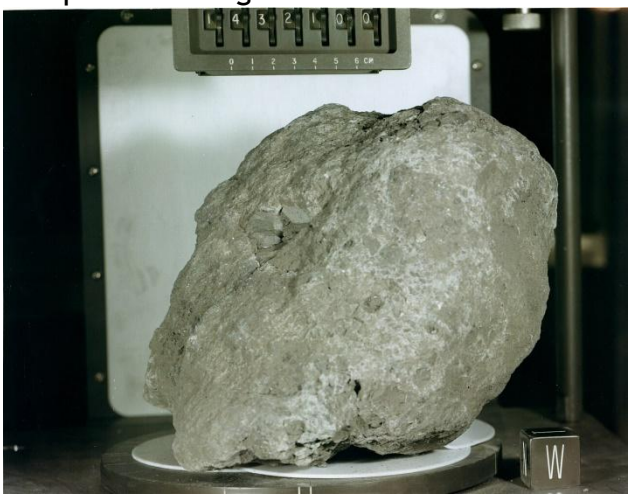
NASA/LRO_LROC Team photo, - PD, via Wikimedia Commons



"Saddle Rock" at Collecting Station C1, Fra Mauro Landing Site

NASA/Alan Shepard/Edgar Mitchell photo, - PD, via Wikimedia Commons

A total of 43 kg (94 lb) of Moon rocks were brought back by the Apollo 14 astronauts. Most of the samples were breccias, rocks composed of fragments of other older rocks.



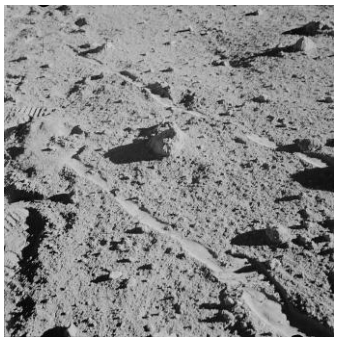
Lunar Sample 14321 "Big Bertha"

NASA/Johnson Space Center photo, - PD, via Wikimedia Commons

Collecting Station C1, Fra Mauro Formation, Moon

Weight: 9.0 kg

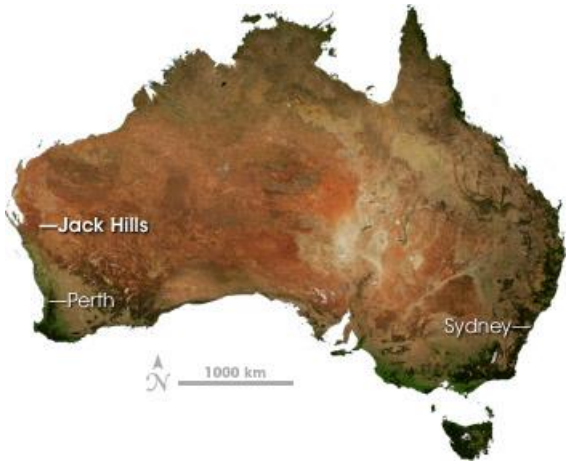
This football-sized, 962 g (33.9 oz) breccia contains abundant fragmental clasts. A rather unusual hypothesis has been proposed for the origins of a 2 cm felsic fragment embedded in the rock. According to Bellucci et al., 2019, this unique clast contains minerals with oxidation states that would require conditions not present on the Moon. So, it may have originally formed on the early Earth and was blasted away by an asteroid impact. The chip landed on the Moon which at that time was three times closer to the Earth than it is today. The fragment was later incorporated as a lunar breccia. In 1971, the Apollo 14 astronauts returned the sample to Earth. Some zircon grains in the clast have an age around 4.33-4.35 Ga.



Big Bertha on the lunar surface prior to collection. It is above the exact center of the photo and lies between the wheel tracks made by the Modular Equipment Transporter (MET) or rickshaw-type portable workbench.

Jack Hills Zircons (4.4 Ga)

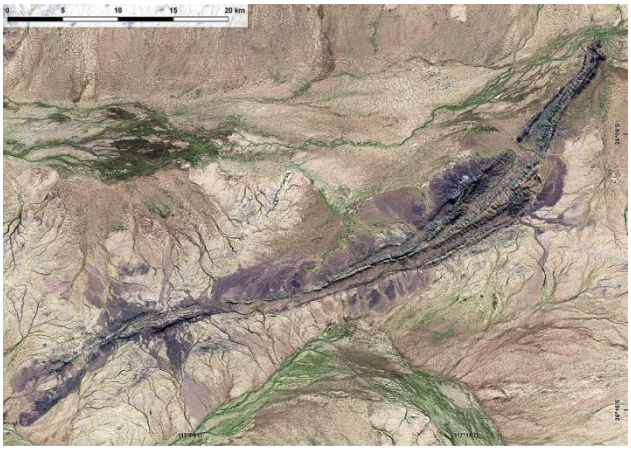
The Jack Hills in Western Australia will be the final stop of our tour of the Earth's oldest rocks and minerals. The Jack Hills are located in the Narryer Gneiss Terrane of the Yilgarn Craton. The site is the source for the oldest known mineral that originated on the Earth – detrital zircons that have been dated to 4.404 Ga ± 8 million years (Wilde et al., 2001).



Satellite Image of Australia with the Location of the Jack Hills

NASA Earth Observatory photo, - PD, via Wikimedia Commons

The Jack Hills are about 800 km (500 mi) north of Perth.



Satellite Image of Jack Hills, Western Australia, Australia

Gretarsson image based on Landsat 5/NASA data, - CC_BY_SA-4.0 International, via Wikimedia Commons

Image data was acquired July 14, 2009.

The Jack Hills consist of a roughly 80 km (50 mi) long formation of highly eroded sedimentary and metamorphic rocks. Numerous dry streambeds run through the reddish rocks and sparse vegetation.

Jack Hills Quartz Pebble Metaconglomerate

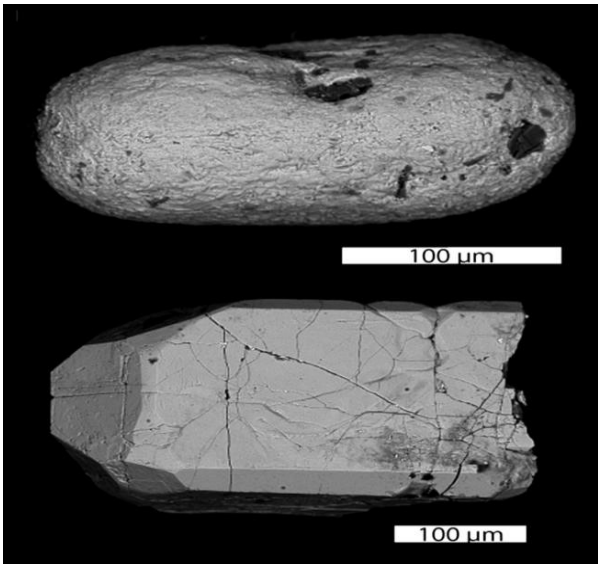
James St. John photo, Cranbrook Institute of Science, Bloomfield Hills, Michigan specimen - CC_BY_SA-2.0, via Wikimedia Commons

In 1984, some metamorphosed sedimentary rocks were sampled as part of a mapping survey of the Jack Hills area. These rocks included quartz metaconglomerates with detrital zircon grains. An initial U-Pb dating of one grain indicated an age of 4.276 Ga ± 6 million years.

Polished Slab of a Quartz Pebble Conglomerate

James St. John photo, Cranbrook Institute of Science, Bloomfield Hills, Michigan specimen, - CC_BY_SA-2.0, via Wikimedia Commons

The deposition age of the Jack Hills metasedimentary rocks is somewhat controversial since it appears to vary with location. Studies since the initial discovery have reported zircons with U-Pb ages that range from 3.046 Ga ± 9 million years to 4.404 Ga ± 8 million years (Cavosie et al., 2019). In addition, the accuracy may be compromised by the redistribution of lead isotopes during different zircon crystallization events. This lead mobilization may alter isotope ratios ($^{207}Pb/^{206}Pb$) and introduce uncertainty in the age measurements.



Backscatter Electron Micrographs of Jack Hills Zircon Crystals
Aaron Cavosie/John Valley photo, -PD, via Wikimedia Commons
The Jack Hills zircon grains are small (largest is ~ 1 mm) and may exhibit different forms. The upper specimen shows abrasion, while the lower crystal displays original facets.

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Arizona Rocks 132

Text by Ray Grant
(Photos from SPS website)

If you are interested in fossils, here is group that you might be interested in joining. The Southwest Paleontological Society (website: swpaleosociety.com) meets at the Arizona Museum of Natural History in Mesa. They meet on the **2nd Tuesday of each month** from 7:00 pm to 9:00 pm in the Arizona Museum of Natural History Research Facility across from the Museum on the N.W. corner of Pepper and Macdonald

The following information is from the SPS website: "SPS is led by experienced paleontologists who guide its members in the skill and knowledge required in the process of collecting and preparing delicate fossil specimens. SPS supports the programs and the goals of the Arizona Museum of Natural History. SPS is open to all adults and children with an interest in paleontology. Trips are held periodically throughout the year. Field trips range from one day family outings to several days. Members will be notified in advance. The experience and the thrill of discovering the bones of a long extinct animal-possibly the first such bones ever found!!! Experience hands-on preparation of fragile fossil specimens for museum exhibits and collections!

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

https://ammnre.arizona.edu/

Catie Carter Sandoval
cscarter@email.arizona.edu
703.577.6449

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

The Mineralogical Society's 4th Phoenix Heritage Mineral Show is quickly approaching on June 1st & 2nd (see flyer on page 17) and we are looking forward to sharing a joint case with the Alfie Norville Gem and Mineral Museum, our sister museum under the University of Arizona in Tucson. The display will showcase some incredible mineral specimens from recent donations to both of our museums by collector Bob Weaver. We are including several specimens of fluorite – the show theme – along with "Curator's Picks" from Arizona and the United States. Thank you to MSA for granting us an opportunity to share our new additions with the public at this show! If you see our case, let us know what you think.

Meanwhile, we continue working on museum planning under new Executive Director Marta, who is working closely with our Governor-Appointed Advisory Council. We also have some new exhibits in the works and encourage our supporters to visit the latest rendition of the Banquet of Rocks, "Rockhound Cafe," at the Sun City Rockhounds Mineral Museum at the Sun Dial Recreation Center (open Saturdays 10-1 during the summer months). The display is extra special as it was curated jointly with club members and includes some pieces from the personal food rock collection of members Joe and Eliz Chan.

Thank you all for your continued support and have a great summer!

Rockhound Cafe exhibit at the Sun City Rockhound Mineral Museum

Lunch and dinner plates on display at the Rockhound Cafe

Sun City Rockhounds in front of our mineral exhibit at the Arizona Senate building

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 starting week of June 3rd, 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.

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

Update on Sun City Rockhound Club & Mineral Museum artifact donation to the Study of Ancient Lifeways and Technologies (SALT) Organization

By Peter Huegel, SALT Board Member

Four members of Study of Ancient Lifeways and Technologies (SALT) were tasked with sorting through the various boxes of stone pieces donated to us by the Sun City Rockhound Club & Mineral Museum. We spent a little over 5 hours sorting through the pieces. The pieces were divided into several groups including "Debitage".

"Debitage" is the lithic debris and discards - waste material - found at the sites where stone tools and weapons were made. It is the detached and discarded rock pieces produced as the tool maker reduces the rock to the piece, they will form into a tool such as an arrowhead, or stone knife.

So, what do you do with debitage? It was decided to have the knappers (*One who shapes conchoidal fracturing stone through the process* of lithic reduction to manufacture stone tools) of SALT complete what was started possibly many centuries ago by the person who was making a stone tool. In this way we could indeed "Send the past into the future" and utilize the donation for educational purposes. The knappers teach at every SALT meeting and will now be using and teaching with the debitage donated by Sun City Rockhound Club. We are confident the result will be projectile points of various kinds that were begun by some ancient person and now will be completed by a SALT teacher or student.

It is my personal hope that by utilizing these ancient pieces and knowing it was originally started by someone in the distant past, both the knappers and their students will sense the history involved in their project and that sense of history will guide their hands and minds as they complete their project.

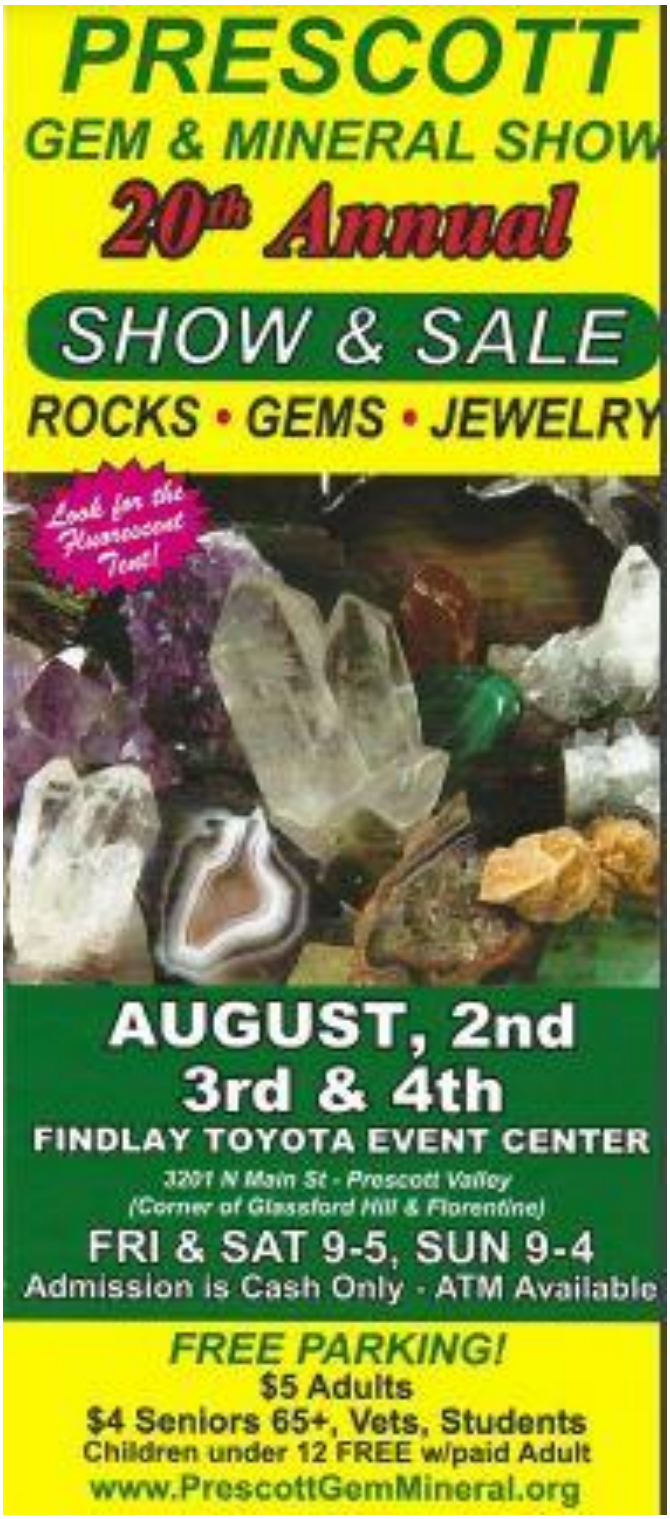
When I announced the project at our SALT meeting one of our best knappers, Luis Ahumada, took it upon himself to be the first to use the ancient debitage. He chose a piece that he knew would be difficult and yet he succeeded. A piece of ancient discarded debitage is now a beautiful projectile point.

I have attached a photo of the original piece of debitage and the projectile point Luis created from it. Thanks again to you and your organization for helping us with our Study of Ancient Lifeways and Technologies and our mission to educate others.

Knapper Luis Ahumada

Find us on: Facebook: Sun City Rockhounds

Arizona Rock and Gem Shows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GEM & MINERAL SHOW
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$4 Seniors 65+, Vets, Students
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www.PrescottGemMineral.org


Clarkdale Rocks
Gem & Mineral Show
"53rd Show"
Show & Sale
September 27-29, 2024
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19 N. Ninth Street, Clarkdale, AZ 86324
FRI & SAT 9am - 5pm, SUN 9am - 4pm
Free Admission
Mingus Gem & Mineral Club
mingusgem.club
Crystals • Minerals • Gems • Jewelry • Fossils
Cabochons • Findings • Rock Slabs
Geode Splitting • Daily Raffles
Jr. Rockhound Room Activities
and much more!

Apache Junction Rock & Gem Club
Meetings are on the 2nd Thursday
Next Meeting: June 13, 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: June 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: June 18, 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)
Sat., June 22, 2024, 11:00 a.m.
Members only Meeting & Pot Luck
at LGF Natural History Gallery
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: June 11, 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: June 6, 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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_____ 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

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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.

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