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

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ESM OUTREACH UPDATE

Mardy Zimmermann, Outreach Coordinator

Due to the summer hiatus and record breaking heat wave, there are no new outreach activities to report. So, instead, we will briefly describe the upcoming Earth Science Week and this year's theme which ties into the next article.

Earth Science Week 2023

Poster courtesy of the American Geosciences Institute

The American Geosciences Institute (AGI) organizes this annual educational event which helps the public gain a better understanding and appreciation for the Earth sciences. The event will be held October 8-14, 2023, and the theme is "Geoscience Innovating for Earth and People". It will provide opportunities to explore both established and emerging technologies used by geoscientists. Innovations in these tools and techniques help in developing mineral and energy resources; understanding and mitigating natural hazards; and monitoring and solving environmental problems.

Focus Days

The week-long celebration includes focus days that present special interest topics:

Sunday, October 8
International Earthcache Day – explore the world with a GPS scavenger hunt.

Monday, October 9
Minerals Day – raise awareness and appreciation for minerals and mineralogy.

Tuesday, October 10
Earth Observation Day – learn about remote sensing as a powerful tool that provides a big picture view of our planet.

No Child Left Inside Day – encourage students to go outside and research Earth science like professional geoscientists.

Wednesday, October 11
National Fossil Day – promote the understanding and appreciation of fossils.

Thursday, October 12
Geoscience for Everyone Day – help young people from underrepresented communities explore geoscience careers.

Friday, October 13
Geologic Map Day – promote the use and study of geologic mapping.

Saturday, October 14 (*observed on October 21 in 2023)
International Archaeology Day – celebrate archaeology and the thrill of discovery.

Minerals Day Returns on Monday, October 9

The Mineralogical Society of America (MSA) and AGI have been leading the annual celebration of Minerals Day since 2020, and this celebration of minerals is returning on Monday, October 9, during Earth Science Week 2023. Minerals Day raises awareness of and appreciation for minerals among the general public as well as students and teachers of all ages and at all levels.

AGI and MSA have developed materials and collaborated with geoscience partners in government agencies, professional associations, private corporations, and other groups — such as museums, libraries, and rock and mineral clubs, to name just a few — to make an impact with Minerals Day.

Offering educators and families with innovative ways of providing young people with the education tools they need to succeed, AGI and MSA are proud to join forces through Minerals Day in rallying the minerals, mining, and mineralogical studies communities to help meet this challenge. Look for relevant information and resources on AGI's Minerals Day page and MSA's Minerals Day page.

Explore New Ways to Ensure 'No Child Left Inside'

Get in touch with your spirit of geoscience innovation in the great outdoors! Any day can be "No Child Left Inside" Day — a time for outdoor activities allowing young people to experience Earth science firsthand. And the NCLI Day Guide now offers lots of learning activities to help you do just that.

This free online guide provides everything you need to start planning your own NCLI Day event, including activities designed specifically for elementary, middle, and high school students.

Begin now to plan your NCLI Day event for Tuesday, October 11, during Earth Science Week 2022, when educators and young people nationwide will be wading into creeks, climbing hills, and searching the skies to learn Earth science. Or plan your own NCLI Day whenever it's most convenient for you.

Find AGI's NCLI Day Guide on the Earth Science Week website. Have a great NCLI Day!

Get Involved With Art for National Fossil Day

To celebrate the 14th annual National Fossil Day during Earth Science Week 2023, the National Park Service is hosting an art contest celebrating fossil resources and paleontological heritage.

Open to U.S. residents of any age, the contest focuses on the theme "The Rise of Ancient Life in our National Parks and Monuments." Your artwork can include one or more fossil representative, prehistoric organism, and/or prehistoric scene from one or more National Park Service sites but the artwork must include the name of the parks or monuments they come from. You also should indicate why you chose that particular fossil and park as your subject.

All submissions must be received by mail or email by 5 p.m. EST, September 29, 2023. The artwork will be judged by a panel on originality, creativity, quality and, most importantly, relevance to the topic. Winners are selected among entrants age 8 and under, 9-13, 14-18, and 18 and over. Four top entries in each age group will be selected including 1st Place, 2nd Place, 3rd Place and Honorable Mention. Read guidelines and download an entry form on the contest website.

View AGI's 'Faces of Earth' Television Series in HD

AGI's award-winning "Faces of Earth" series is now available on YouTube in full High Definition, allowing wider use in K-12 classrooms. From the cacophony that originated Earth 4.6 billion years ago to the changes that shape it today, AGI's "Faces of Earth" explores the natural processes of planet Earth - and humans' relation to those processes:

- "Building the Planet," episode one in the four-part series, travels back in time and strips away layers of Earth to witness the explosion that formed the planet.
- Earthquakes rumble, volcanoes explode, and lands transform as viewers explore the science behind plate tectonics in "Shaping the Planet," the second episode.
- In "Assembling America," the third installment, viewers explore how time and natural forces have shaped the United States.
- Finally, in "A Human World," viewers learn how Earth has shaped human evolution and how humans, in turn, are shaping the world - including concepts central to this year's Earth Science Week theme of "Geoscience Innovating for Earth and People."

Experience eye-popping images, exclusive interviews, and captivating commentary from distinguished geoscientists! See the series online.

Examine Natural Systems in 'Windows on Earth'

Science teachers and students can gaze through "Windows on Earth," an online educational project that features photographs taken by astronauts on the International Space Station. Each day, astronauts take hundreds of photos for science research, education, and public outreach.

This website provides free public access to virtually all of these photos, updated at least weekly. The site is operated by TERC, an educational non-profit, in collaboration with the Association of Space Explorers (the professional association of flown astronauts and cosmonauts), the Virtual High School, and CASIS (Center for Advancement of Science in Space). Technical support is provided by NASA's Crew Earth Observation Program.

Windows on Earth also operates software on the International Space Station, as a window-side aide to help astronauts identify priority targets for photography. The images help show Earth from a global perspective. All images are in the public domain, credited to NASA. Visit online.

Explore Geophysics During Earth Science Week 2023

The Society of Exploration Geophysicists (SEG), an Earth Science Week partner and AGI member society, offers programs for educators and students. For example, a distinguished lecturer series and an honorary lecturer series both enable

students to meet professional geophysicists, learn about groundbreaking research in the field of seismology, and obtain valuable career information.

Short courses offered through SEG not only enable seismologists to continue their education, but also help teachers to study seismology with introductory courses on seismic data processing. Meetings, forums, and workshops are also available. Check online for availability.

SEG members have access to journals, an online digital library, reference publications, meetings, workshops, networking, and employment referral. To learn more, visit SEG online.

PRI's Resources Let You Ponder Paleontology

The Paleontological Research Institution (PRI), an AGI member society, is much more than a natural history museum based in Ithaca, New York. PRI offers many education materials and opportunities for science teachers and students at all grade levels.

The online "Teacher Friendly Guide" gives brief geologic histories of every region of the United States. Also available online are photos and descriptions of the museum's fossil collections. Since 2003, PRI has offered the Museum of the Earth, which focuses on all of Earth's history and its life forms, with particular emphasis on the Northeastern United States.

Additionally, PRI has programs in research, publications, collections, and public outreach. Its paleontological research journal, "Bulletins of American Paleontology," first published in 1895, is the oldest in the Western Hemisphere. PRI's website is a great place to learn about paleontology, geology, and the Earth.

Dig Into Earth Science Education With USGS

A wealth of information on virtually every Earth science topic, from geology to oceans and coasts, is available from the U.S. Geological Survey (USGS), a longtime Earth Science Week partner.

Coral Reef Project USGS Curt Storlazzi photo

The USGS Educational Resources website includes lesson plans and other resources for K-12 students, educators, and others. Perfect for the Earth Science Week 2023 theme of "Geoscience Innovating for Earth and People," for example, resources target the latest information on issues including global change, natural hazards, water resources, geology, ecosystems, and more.

USGS has thousands of free images and over 69,000 searchable publications such as books, maps, and charts online. There's also the rich archives of the USGS Multimedia Gallery, including a podcast series on topics such as climate change, satellite monitoring, human health, and wildlife disease.

Using AI to Find New Mineral Occurrences

By Harvey Jong

Artificial intelligence (AI) is a rapidly evolving technology that seems to be everywhere. It promises to completely transform the world with faster, cheaper, and more accurate ways of doing things than humans. At least that's the hope and hype as presented in the media.

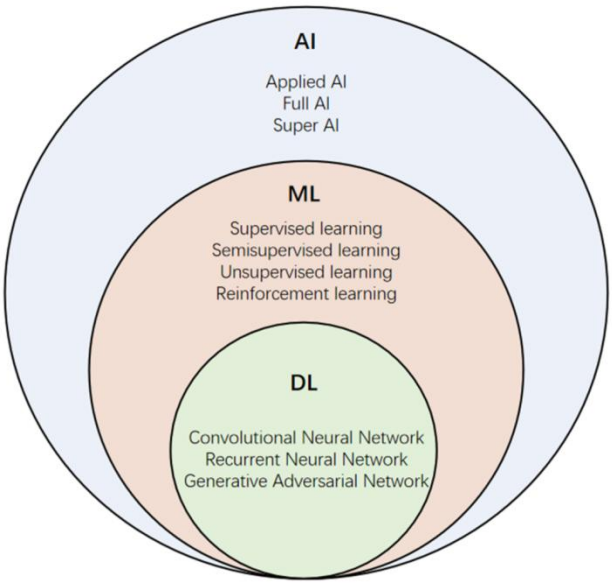
Will AI Augment or Overshadow Human Intelligence?
Graphic by Computer17293866, - CC_BY_SA-4.0-International, via Wikimedia Commons

AI has been applied to a variety of problems, such as self-driving cars, smart personal assistants, and diagnosing and treating chronic medical conditions. These problems have common attributes that involve huge amounts of data and complex relationships that are assumed to be relatively static.

Predicting new mineral occurrences represents a task with similar characteristics, and a recent paper (Morrison et al., 2023) in the *Proceedings of the National Academy of Sciences (PNAS) Nexus* described the application of machine learning in locating new minerals. This article will review the methods and findings presented in the research report.

What is Artificial Intelligence (AI)?

We will begin with a brief overview of AI. While AI has lately become one of the hottest buzzwords, the field of artificial intelligence actually began in 1956. It has experienced several ups and downs due to unrealistic assumptions about human intelligence; overly ambitious promises to meet or exceed human capabilities; and abandoning highly-touted development approaches. Efforts in the 21st century have been more successful with a focus on more specific tasks using mathematical algorithms and statistical models.



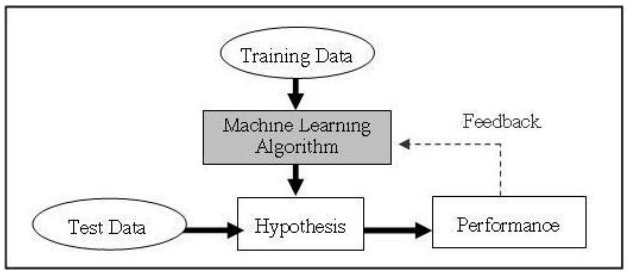
Main Types of Artificial Intelligence
Diagram from Wang et al., 2021, - CC_BY_SA-4.0 International, via Wikimedia Commons
Artificial intelligence encompasses general AI along with machine learning (ML) and deep learning (DL).

Artificial intelligence may be grouped into broad categories of general and narrow AI. General AI involves computer systems that can understand, reason, learn, and apply knowledge to solve complex problems much like humans. This has remained mostly theoretical as even the fastest supercomputers, such as HP's Frontier system which can perform 1.102 quintillion (10^{18}) floating point operations per second, require several minutes to simulate just one second of very basic human neural activity.

Oak Ridge National Laboratory's Frontier Supercomputer
OLCF at ORNL photo, - CC_BY_SA-2.0, via Wikimedia Commons
The Frontier supercomputer uses 9,472 AMD Epyc 7453 64 core 2 GHz CPUs and 37,888 Radeon MI250X GPUs; requires 21 megawatts of power; 6,000 gallons/minute of water to cool; and occupies a space of 680 m^2 (7300 sq. ft). The estimated cost is around $600 million.

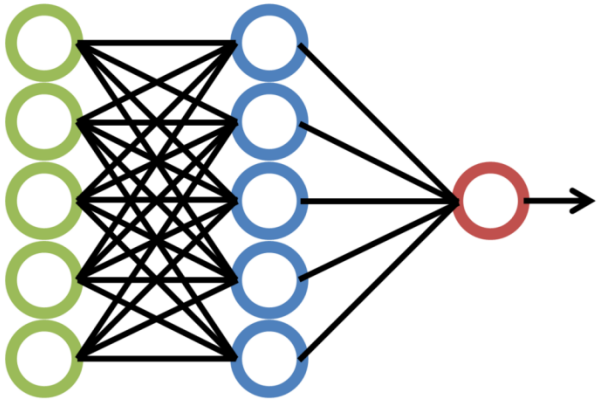
Narrow AI refers to systems that are designed to perform specific tasks. They excel in limited functions but lack general intelligence. Machine and deep learning represent two subsets of narrow AI which classify and analyze data and make predictions based on that analysis.

Machine learning (ML) targets low to moderate complexity decision-making tasks. It involves training by humans who define data features or patterns of interest. ML automates the building of models using algorithms to classify and analyze data and make predictions. The accuracy of these predictions may improve with repeated use and with human intervention.



Machine Learning Steps
Jinapattanah diagram, - CC_BY_SA-3.0, via Wikimedia Commons
A machine learning algorithm is trained using an initial dataset. The algorithm generates a hypothesis/prediction which is evaluated with test data, and the performance/accuracy is monitored providing feedback to refine the algorithm.

Deep learning (DL) focuses on more complex decision-making tasks. It uses artificial neural networks which is a computing approach that mimics how the human brain solves problems. These networks are constructed with multiple nodes or layers that are dedicated to performing specific functions. Although neural networks are set up by humans, they don't need training to identify desired data characteristics. Instead, DL systems independently discover and define features of interest in the data they analyze. This feature allows DL to find patterns and make predictions that humans may not be aware of. Significant computer processing power is required, and it may be difficult to audit or direct outputs.



Simplified Artificial Neural Network
Loxaxs diagram, - CC0 1.0 UPD Dedication, via Wikimedia Commons
This diagram depicts a simple three level neutral network made up of a layer of input nodes, a layer of hidden processing/recognition nodes, and an output node.

Predicting New Mineral Occurrences

Predicting the locations of new mineral occurrences is difficult given the complex interactions of the Earth's geological, chemical, and biological systems. Morrison et al. 2023 embraced this complexity and used multidimensional machine learning to identify patterns embedded in mineral occurrences and associations. The authors proposed mineral association analysis as a way of predicting new localities.

Mineral Association Analysis

Mineral association analysis is based on multi-correlations in mineral localities across the globe. The goal involves predicting:

1. Locations of as-yet unknown mineral occurrences for a given species
2. Mineral inventory at any given location on the Earth's surface or other planetary bodies

Dataset

The analysis depends on a matrix of mineral occurrences generated from the Mineral Evolution Database (Golden et al., 2019) which contains:

- 295,583 localities
- 45,472 age-associated locations
- 5,478 species (as of October 2020)

Combining mineral species with localities produces:

- 810,907 mineral-locality pairs
- 210,037 dated pairs

which represent a rather computationally intensive dataset. So, to demonstrate a proof of concept, the researchers selected the following data subsets:

- Geography – United States
  - 2,622 species
  - 93,419 localities
  - 8,139,004 association rules
- Geochemical – Uranium minerals
  - 5,439 species
  - 11,729 localities
  - 60,589,982 association rules
- Temporal – Archean Eon
  - 2,683 species
  - 1,498 localities
  - 30,916,618 association rules
- Temporal – Proterozoic Eon
  - 3,527 species
  - 3,100 localities
  - 52,435,569 association rules
- Temporal – Phanerozoic Eon
  - 2,882 species
  - 4,644 localities
  - 45,727,343 association rules

Algorithms and Limitations

Note that the above association rules are related to algorithms that were originally developed to analyze sales data from bar-code scanners and anticipate customer behavior (Agrawal and Srikant, 1994). Treating mineral co-occurrences as being analogous to the list of items purchased in a sales transaction, association rules can be generated by adjusting measures, such as support (how frequently a mineral or mineral assemblage appears in the data); confidence (probability of the occurrence of mineral list Y when mineral list X occurs); and lift (statistical dependence of a rule over the entire data set which represents the strength of association for a particular group of minerals).

To predict minerals occurring at a specific locality, all minerals found at the locality are extracted and compared with association rules. Due to computational limitations, however, association rules could be generated only for up to four minerals. This meant that at best permutations of three minerals would be considered in producing

rules that predict the likelihood of a mineral occurring at an unknown location.

Proof-of-Concept

Several proof-of-concept questions were used to evaluate the predictions generated by the mineral association analysis. These questions, subsequent queries, and results are presented below:

Can we gain a better understanding of the mineralogy of a Mars analogue location on Earth?

Tecopa, Mojave Desert, California
Ken Lund photo, - CC_BY_SA-2.0, via Wikimedia Commons

The Tecopa Basin in the Mojave Desert, Inyo County, California was used to represent the environment on Mars when NASA tested the scientific payload of the Perseverance rover. Currently, the minerals that are found in the area include:

analcime	opal
calcite	saponite
cristobalite	searlesite
montmorillonite	tridymite
muscovite	

A more detailed mineral inventory might offer insights into the processes and characteristics of this site and possibly on Mars. So, a query was constructed to predict other potential mineral occurrences. The predicted species along with confidence and lift values are shown in the following table (Morrison et al., 2023):

Mineral	Confidence	Lift
Hematite	0.76	8.8
Quartz	0.94	2.5
Kaolinite	0.75	23.3
Pyrite	0.88	3.7
Gypsum	0.74	18.1
Albite	0.71	18.3
Magnetite	0.74	8.3
Chalcopyrite	0.74	4.5
Sphalerite	0.71	5.1

Where can we find locations to study oxidation-hydration alteration of uraninite?

Uraninite Crystals
Rob Lavinsky photo, iRocks.com, - CC_BY_SA-3.0, via Wikimedia Commons
Swamp #1 quarry, Topsham, Sagadahoc County, Maine
Dimensions: 2.7 x 2.4 x 1.4 cm

An alteration sequence of uraninite may involve uranyl carbonates and uranyl sulfates. During the initial stages of

alteration, the uraninite oxidizes forming uranyl (UO_2) ion groups and reacts with dissolved carbonate and alkali element-bearing minerals. Minerals representative of this stage include rutherfordine, andersonite, and bayleyite. As the alteration continues, the carbonates become depleted, while dissolved sulfates from the oxidation of primary sulfides lead to uranyl sulfate complexes, such as schröckingerite and zippeite.

Minerals of interest:

Mineral	Chemical Formula
Rutherfordine	$(UO_2)CO_3$
Andersonite	$Na_2Ca(UO_2)(CO_3)_3 \cdot 6H_2O$
Bayleyite	$Mg_2(UO_2)(CO_3)_3 \cdot 18H_2O$
Schröckingerite	$NaCa_3(UO_2)(CO_3)_3(SO_4)F \cdot 10H_2O$
Zippeite	$K_2[(UO_2)_4(SO_4)_2O_2(OH)_2] \cdot (H_2O)_4$

To predict new unknown localities for the selected uranium species, investigators generated association rules with a maximum length of 4. An example of such a rule involves using the co-occurrence of *{Andersonite, Schröckingerite, Uraninite}* to identify likely sites that also include *{Zippeite}*. The results for zippeite are listed in the following table:

Predicted Locality	Grounded Truth?
Předbořice Deposit, Předbořice, Kutná Hora District, Central Bohemian Region, Czech Republic	Yes
Rožná I Mine, Rožná Deposit, Rožná, Žďár Nad Sázavou District, Vysočina Region, Czech Republic	No*
Eureka Mine, Castell-estaó, La Torre De Cabdella, La Vall Fosca, El Pallars Jussà, Lleida, Catalonia, Spain	No
Geevor Mine, Pendeen, St Just, Cornwall, England, UK	No*
Section 22 Deposit, Ambrosia Lake Sub-district, Grants District, McKinley Co., New Mexico, United States of America	No*
Jim Thorpe, Carbon Co., Pennsylvania, United States of America	No
Little Eva Mine, Yellow Cat Mesa, Thompsons District , Grand Co., Utah, United States of America	No*

Note that the grounded truth column refers to whether zippeite has been discovered and published in the literature since the prediction in October 2020. "No*" indicates the mineral was found at the county level.

Where can we find new deposits of critical minerals in the United States?

Allanite - An Example of a Critical Mineral

Kelly Nash photo, - CC_BY_SA-3.0, via Wikimedia Commons

Pacoima Canyon, San Gabriel Mountains, Los Angeles County, California
Dimensions: 3.8 x 3.8 x 1.0 cm

Critical minerals are considered to have strategic importance due to their key role in technological development and their potential for supply chain disruptions. These minerals include rare earth element and lithium-bearing species.

So, to demonstrate the ability to find new critical mineral deposits in the U.S., monazite-(Ce), allanite-(Ce), and spodumene were selected as minerals of interest.

Mineral	Chemical Formula
Monazite-(Ce)	$Ce(PO_4)$
Allanite-(Ce)	$CaCe(Al_2Fe^{2+})[Si_2O_7][SiO_4]O(OH)$
Spodumene	$LiAlSi_2O_6$

Using a maximum association rule length of 4, predictions of new critical mineral localities were generated. For allanite-(Ce), the association rule of {*gadolinite-(Y), microcline*, *muscovite*} ≥ {*allanite-(Ce)*} predicted 19 locations where the occurrence of allanite-(Ce) was later reported at 11 sites, and two localities involved finds at the county level.

How has mineralization and mineral associations changed through deep time?

To characterize the change of mineral occurrences throughout Earth's history, mineral association rules were examined for three time periods.

Eon	Time Span
Archean	> 2.5 Ga
Proterozoic	2.5-0.54 Ga
Phanerozoic	<0.54 Ga

Lift is one of the key measures that are calculated in applying association rules. It indicates the strength of association of mineral groups across a dataset. For the Archaen Eon, the lift tended to skew towards higher values, while the trend for the Phanerozoic Eon involved lower values. Lift values for the Proterozoic trended in between the two extremes.

The decrease in mineral association strength may be related to:

1. An increase in mineralizing environments and the diversity of mineral species.
2. Increasing abundance of common minerals in the Phanerozoic.
3. Sampling bias where rare minerals are underrepresented and weather-resistant species along with minerals of scientific or economic significance are overrepresented.

<u>Overall Observations</u>

Mineral association analysis adds a new powerful prediction tool for revealing hidden patterns in mineral data and finding new potential deposits. The algorithm, however, has scalability issues which currently make it too computationally intensive to apply for all known mineral occurrences on Earth. By expanding datasets to include other attributes, the approach may be extended beyond the Earth or to consider fossils or microbes along with minerals. This data-driven discovery process offers another way to explore the evolving Earth and planetary systems.

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

https://ammnre.arizona.edu/

Catie Carter Sandoval
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703.577.6449

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

The search for a Museum Director has begun! University of Arizona administration is currently accepting applications for a founding Director to begin immediately here in Phoenix. The job will consist of a combination of visioning and strategy, fundraising, and financial and personnel management.

From the official description: "The incumbent will be responsible for institutional vision and strategy: refining the vision for the institution as its founding Director through the development of a strategic plan and related documents (e.g., a business plan); overseeing a building renovation project by coordinating the efforts of partners in UA Planning, Design, and Construction and private design and construction firms; and stewarding relationships with key internal and external stakeholders (e.g., state government). The incumbent will also engage in fundraising: cultivating, soliciting gifts from, and stewarding major donors/prospects. In addition, the incumbent will manage finances and personnel: overseeing the daily operations of the museum, including staff hiring and supervision, guest management, budget planning, and expenditures; overseeing the development of exhibits and collections; and supervising the development and delivery of educational programming related to natural resources for public enrichment and engagement. Initially, the incumbent's effort will be heavily weighted toward tasks related to vision, strategy, and fundraising. After the museum's building is renovated (planned to be complete in 2025), the incumbent's effort in the area of managing finances and personnel will increase."

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 and search for "mining museum") or at https://tinyurl.com/AMMNRE. Please share with your colleagues and anyone who may be interested in being part of this incredible opportunity! Thank you!

Advisory Council members in front of the mining mural after a meeting at our building this month. The council, as designated in Senate Bill 1415 (2017), consists of members of Arizona's different natural resource industries and the public, Arizona legislators, and University administration. The purpose of the council is to provide advice and promote the mission of the museum.

Arizona Rocks 122

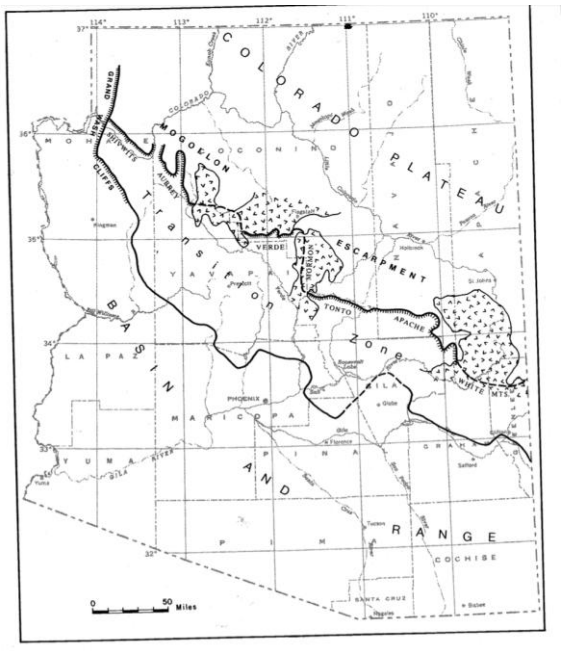
Text and photos by Ray Grant

The geologic feature in Arizona that is often mispronounced is the Mogollon Rim. It is muggy-yawn or muggy-own to locals. The rim rises over 2,000 feet from high desert to pine forest and the cooler weather that we are looking for this time of year. On maps the name is commonly used from near Show Low to Payson to near Pine. Geologists also use the term Mogollon Escarpment or Rim to mark the southern edge of the Colorado Plateau going 200 or more miles from the White Mountains to near Ash Fork in Yavapai County.

The Mogollon Rim was formed by faulting and subsequent erosion. It started to form around 20 million years ago, when the San Andreas Fault began to pull Southern Arizona apart forming the Basin and Range. Faulting was active along the rim until about 12 million years ago as the area to the south dropped down. The rim has been eroding and it is estimated to have eroded back about 2,000 feet per million years. The erosion resistant rocks forming the top of the rim are Kaibab Limestone and Coconino Sandstone, the same Paleozoic age rocks forming the top of the Grand Canyon. A good reference is H.W. Peirce, 1984, The Mogollon Escarpment, in Fieldnotes, v.14, no.2, from the Arizona Bureau of Geology (now the Arizona Geological Survey).

When you go up on the rim for the great views and to cool off, watch out for the Mogollon Monster (Arizona Bigfoot) that has been seen all along the rim.

Looking south from on the Mogollon Rim at the transition zone



Map showing Mogollon Escarpment from the Pierce reference

Mogollon Rim looking north from Payson towards Pine

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

The Pinal Geology and Mineral Museum recently hosted 30 students from a summer camp.

Kids enjoying the fluorescent minerals exhibit

Christine New and Bob Hole with the Pinal Geology & Mineral Museum set up a museum information table at the Coolidge School District's start of the school year meeting for teachers and staff. Everyone that stopped by the table received a polished stone with the stone's description; there were specimens to admire and other information about the museum. A few fourth grade teachers were given ESM teacher kits.

Christine and Bob also manned a museum information table at the Imagine School in Coolidge for their recent teacher and staff meeting handing out museum information and an identified polished stone.

Arizona Rock and Gem Shows

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

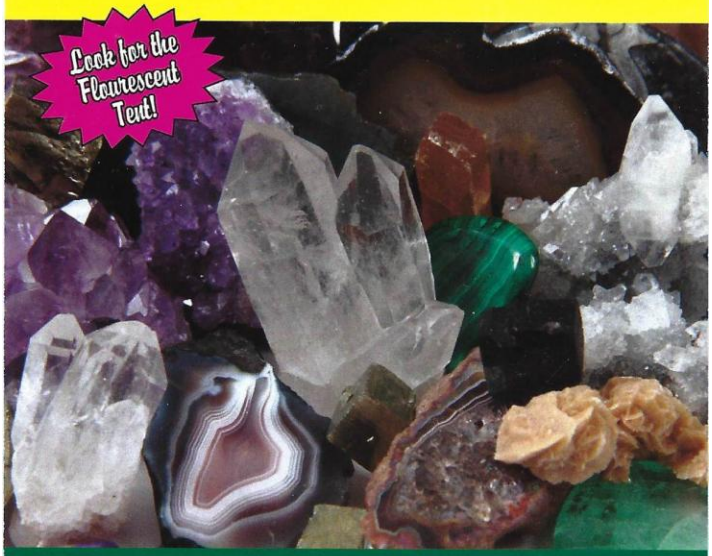
Huachuca Mineral and Gem Club
49th Annual Show
October 14-15, 2023
Sat. 9-5, Sun. 10-4
Free Admission & Parking
Sierra Vista Mall
2200 El Mercado Loop
Sierra Vista, AZ

Sedona Gem and Mineral Club
Annual Show
October 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
53nd 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

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

53rd Annual Lake Havasu Gem & Mineral Show
November 11 @ 9:00 am

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.msaaz.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! ☺☺☺

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

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

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

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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.

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Phone:
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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:
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!!!

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