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

*Earth Science Museum, 3215 W. Bethany Home Rd., Phoenix, AZ 85017*
*www.earthsciencemuseum.org, scote@earthsciencemuseum.org, 602-973-4291*

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## RECENT ESM EVENTS

By Shirley Coté, Ray Grant and Harvey Jong

The Earth Science Museum, one of 47 exhibitors at the recent Arizona Science Teachers Association Conference held at Grand Canyon University's Campus Arena, unveiled its new outreach table banner. The banner was designed by ESM's Alice LaBonte and Mardy Zimmerman and incorporated several elements of the ESM's new bookmark which is peppered with pictures of beautiful mineral specimens.

The Conference was attended by hundreds of science teachers from all over Arizona who participated in many of the over 50 workshops offered which focused on high quality teaching and included discussions of the Next Generation Science Standards.

The ESM attended the conference to interact directly with Arizona teachers to raise their awareness of our free, hands-on earth science education resources. This conference also gave us the opportunity to reach even more Arizona teachers through several of the other attending exhibitors who graciously offered to provide notice to their contacts of our then upcoming Earth Science Day.

ESM booth at ASTA Conference

### Earth Science Day – October 19th

Big thanks to Kelli Wakefield and Mesa Community College (MCC) Physical Science Department for hosting **EARTH SCIENCE DAY** at the Physical Science Building on the MCC campus.

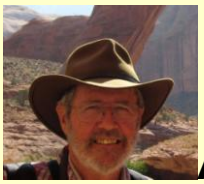
An estimated over 200 people joined in the festivities which featured planetarium shows, geologic mapping lectures and activities. ESM President, Harvey Jong, created eye catching posters, signs and planetarium tickets for the event.

The Arizona Leaverite Rock & Gem Society, Arizona SCITECH Festival, Maricopa Lapidary Society, and the Mineralogical Society of Arizona joined the ESM in displaying and discussing rocks, minerals & fossils. Several of the organizations had popular activities such as egg carton collections, spinning wheels and sales tables for the attendees.


AZ SCITECH table

Planetarium ticket

AZ Leaverites tables

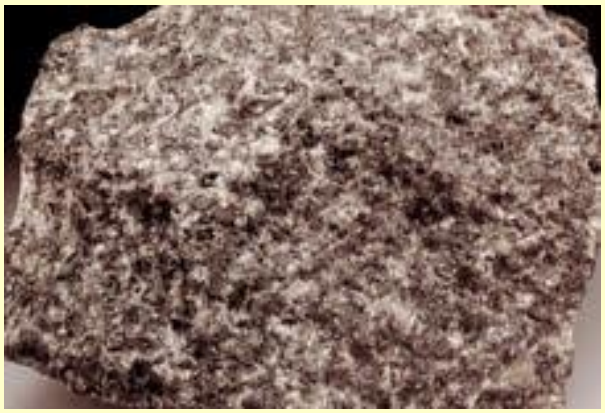


# Arizona Rocks 5

Text and photos by Ray Grant

The next igneous rocks for Arizona will be diabase and gabbro. In Arizona Rocks 1, the rock was basalt. When the basalt magma does not reach the surface to form a volcanic rock, it is intrusive and cools slowly forming larger crystals (just as more silica rich magmas form granite as intrusive and felsite as volcanic rock). This coarser grained intrusive rock is diabase or gabbro. Diabase is a term mainly used in the United States, in other countries it is referred to as dolerite or microgabbro. Diabase is an intrusive rock forming dikes or sills at relatively shallow depths so it cools rather quickly, not as fast as basalt, so the crystals are small, but usually visible. Gabbro would form at a greater depth. The minerals present are the same as in basalt, mainly pyroxene and plagioclase.

In Arizona the diabase formed in the Precambrian about one billion years ago. The best place to see it is at Salt River Canyon or in the Grand Canyon. An interesting sidelight, where the diabase intruded limestone it formed the asbestos deposits we find in Arizona. Gabbro is not common in Arizona.



Diabase/gabbro with pyroxene (black) and plagioclase (white).

Map of areas where diabase is found in Arizona (in black).

Diabase sills (dark colored) at the Salt River Canyon.

Diabase sill (bottom by river) intruded into limestone (white), Salt River Canyon

# EXPLORE YOUR WORLD!

## METEOR CRATER, ARIZONA

Text & photos courtesy Wikipedia and Dr. Ray Grant

Meteor Crater was created about 50,000 years ago when the local climate on the Colorado Plateau was much cooler and damper. At the time, the area was open grassland dotted with woodlands inhabited by woolly mammoths and giant ground sloths. It was probably not inhabited by humans; the earliest confirmed record of human habitation in the Americas dates from long after this impact.

Aerial view of Arizona Meteor Crater, September 2010

The object that excavated the crater was a nickel-iron meteorite about 50 meters (55 yards) across. Recent research suggests the speed of the impact at 12.8 kilometers per second (28,600 mph) with an impact energy estimated at about 10 megatons. It is believed that about half of the meteor's bulk was vaporized during its descent before it hit the ground with the remainder exploding upon impact, leaving little in the crater, but an estimated 30 tons have been recovered from the surrounding country side.

In 1891, Grove Karl Gilbert, chief geologist, U.S. Geological Survey, investigated the crater and concluded that it was the result of a volcanic steam explosion. This was not an unreasonable assumption, as the San Francisco volcanic field lies only about 40 miles to the west.

David Barringer was an early believer in the meteorite impact origin for the crater. In 1903 he staked mining claims and formed the Standard Iron Company to mine the meteorite. He believed there could be 100 million tons of pure iron-nickel buried beneath the crater. Barringer spent 27 years trying to locate a large deposit of meteoric iron, and drilled to a depth of 419 m (1,375 ft), but no significant deposit was ever found.

**Geology**

The impact created an inverted stratigraphy, so that the layers immediately exterior to the rim are stacked in reverse order to which they normally occur; the impact overturned and inverted the layers to a distance of one to two kilometers from the crater's edge. Specifically, climbing the rim of the crater from the outside, one finds:

- Coconino sandstone (sandstone formed 265 million years ago (mya)) nearest the top of the rim
- Toroweap Formation (limestone formed 255 mya)
- Kaibab Formation (dolomite formed 250 mya)
- Moenkopi Formation (mudstone formed 245 mya) nearest the foot of the rim

The Holsinger meteorite is the largest discovered fragment of the meteorite that created Meteor Crater and it is exhibited in the crater visitor center.

Mining equipment in the crater bottom from David Barringer's attempt to find the meteorite (1972 photo by Dr. Ray Grant)

Meteor Crater is today a popular tourist attraction privately owned by the Barringer family through the *Barringer Crater Company*, with an admission fee charged to see the crater. The Meteor Crater Visitor Center on the north rim features interactive exhibits and displays about meteorites and asteroids, space, the solar system and comets.

## SUPPORT THE ESM!

### EARTH SCIENCE INVESTIGATION TEAM

Become a team member where your contributions will help educate Arizona students about the earth sciences through hands-on outreach programs; create an Earth Science Education Center; and build an innovative, world-class museum.

Membership form located at the bottom of page 5.

## Announcements!

**Cretaceous Seas** opens December 7, 2013
Scout Geology Day December 7th too!
Something for every budding geologist!
AZ Museum of Natural History
53 N. Macdonald St., Mesa, AZ
www.azmnh.org

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**New Location**
Galarneau's Gems
Inside Christown Mall
1703 W. Bethany Home Rd #D003
Phoenix, AZ 85015
602-246-0144
www.galarneausgemstonesandrockshop.com

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**Other valley rock shops!**

North Mountain Visitor Center
12950 N. 7th St., Phoenix
www.northmountainvisitorcenter.org

Black Market Minerals
Inside Arizona Mills Mall off I-10 & US 60
www.blackmarketminerals.com

## Rock & Gem Shows

**November 2013**

**1-3—BLACK CANYON CITY, ARIZONA:** 37th Annual Rock-a-Rama; High Desert Helpers; High Desert Park; 19001 E. Jacie Ln.; Fri. 9-4, Sat. 9-4, Sun. 9-2
www.highdeserthelpers.org

**9-10—LAKE HAVASU CITY, ARIZONA:** Show and sale; Lake Havasu Gem & Mineral Society; LHC Community Center; 100 Park Ave.; Sat. 9-5, Sun. 9-4
www.lakehavasugms.org

**16-17—PAYSON, ARIZONA:** Annual show; Payson Rimstones Rock Club; Mazatzal Hotel & Casino Event Center; Hwy. 87 Mile Marker 251; Sat. 9-5, Sun. 10-4

**November 2013-December 2013**

**30-1—WICKENBURG, ARIZONA:** Show and sale; Wickenburg Gem & Mineral Show; Hassayampa Elementary School; 251 S. Tegner St.; Sat. 9-5, Sun. 10-4
Wickenburg Gem & Mineral Society

**January 2014**

**3-5-MESA, ARIZONA**
Phoenix Area's Largest Gem and Mineral Show the **42nd FLAGG GEM AND MINERAL SHOW at MESA COMMUNITY COLLEGE.**

FRIDAY, SATURDAY, SUNDAY,
JANUARY 3, 4, and 5, 2014
9AM TO 5PM EACH DAY
Go to **www.flaggshow.info** for more information and directions

A **sea stack** is a geological landform consisting of a steep and often vertical column or columns of rock in the sea near a coast, isolated by erosion. They are formed when part of a headland is eroded by the force of the sea crashing against the rock. The force of the water weakens cracks in the headland, causing them to later collapse, forming free-standing stacks or even a small island.

## ESM's Upcoming Meeting

The Earth Science Museum's next scheduled meeting is November 13th at the Burton Barr Library, located near Central Ave. and McDowel in Phoenix at 6:30 p.m. in Rm. B. Everyone is welcome to attend.

## JOIN THE ESM BOARD!

The ESM is recruiting new board members with skills in architecture, marketing and website development along with a VP of membership. If you are interested and have the skills in any of these areas, we welcome your expertise as a member of our board.

**Sea stacks** photo courtesy Wikipedia

## MANY THANKS TO OUR MAJOR DONORS!

AZ Leaverite Rock & Gem Society
www.azleaverite.org

Flagg Mineral Foundation
www.flaggmineralfoundation.org

Friends of the AZ Mining & Mineral Museum

Maricopa Lapidary Society

Mineralogical Society of AZ
www.mineralogicalsocietyarizona.org

White Mountain Gem & Mineral Club
www.whitemountain-azrockclub.org

Wickenburg Gem & Mineral Society
www.facebook.com/pages/Wickenburg-Gem-and-Mineral-Society/111216602326438

Staples Foundation
www.staplesfoundation.org

Stan & Susan Celestian
Russ Hart
Debbie Michalowski
Dennis & Georgia Zeutenhorst

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**ESI Team Membership Form**

_____ New Member _____ Renewal

Membership levels:

_____ **ESI Family $20**

_____ **ESI Individual $10**

_____ **ESI Student (16 & under) $5**

Membership benefits:

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

_ _ _ _ _ _ _ _ cut here _ _ _ _ _ _ _ _

Name: _____

Address: _____

City, State, Zip: _____

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Phone Number: _____

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Phoenix, AZ 85017

**Phone:**
602-973-4291

**Editor E-Mail:**
scote@earthsciencemuseum.org

*We're on the Web!*

*Visit us on* *and at:*

www.earthsciencemuseum.org

**Mission**
Establish an innovative, world-class destination museum in the Phoenix area dedicated to inspiring all generations about earth sciences.

**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.

Please join us at the next ESM board meeting Wednesday, November 13, 2013, at the Burton Barr Library in Phoenix at 6:30 p.m. Rm. B.

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