



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

November 2014
Volume 3, Issue 11

ESM NEWS and RECENT EVENTS

By Shirley Cote, Ray Grant and Harvey Jong

OUTREACH REPORT - OCTOBER, 2014

By Mardy Zimmermann

Despite many schools taking a week or two off for "Fall Break", the ESM Outreach program continued to increase services to students and the community. In October, we served 261 students in 4 schools compared to 97 students in 4 schools last October. Schools served this October were Archway Academy, TLC Preschool Casa Grande, Esperanza Elementary, and American Schools. Community Outreach numbers also continue to increase. A big event in October was the Gila County STEMfest in Payson where we served 278 people and made several school and community contacts. Lynne Wheeler, ESM Outreach Volunteer and member of the Payson Rimstones Rock Club will be serving them. In addition we served 115 at Earth Science Day and EarthFest Educator's Night, for a total of 393. To date totals for 2014-15 are: Schools 946, and Community 486 (1432) vs. 2013-214: Schools 486 and Community 411 (897).

STAPLES FOUNDATION GRANT AWARD



The ESM Board members would like to thank Chris Whitney-Smith, ESM Board member and Staples associate, for his recommendation for another grant award.

For the third year in a row, the Earth Science Museum received a grant from the Staples Foundation 2 Million and Change Program. This year, the ESM was awarded \$5,000 to help continue its free school outreach program which includes providing teachers with kits containing books on geology, rocks, minerals, and fossils along with rock, mineral, and fossil samples.

The ESM set up a booth at Arizona Forward's 10th Annual EarthFest Educators Night. This event was held on October 28th at the Desert Botanical Garden and featured 48 exhibits where teachers learned about educational opportunities relating to the environment and earth science. The ESM displayed materials from its new *Properties of Minerals* program along with rock, mineral, and fossil kits.



Mardy arranges various outreach kits at EarthFest
Photo by Harvey Jong

About 70 teachers visited the booth which resulted in several requests for classroom presentations.

ARIZONA SCIENCE TEACHERS ASSOCIATION (ASTA) CONFERENCE

The ESM was one of the non-profit exhibitors at the Arizona Science Teachers Association (ASTA) Conference. The conference was held on November 7-8 at Northern Arizona University's North Valley Phoenix Campus. The theme was "Let's Build Science", and the museum was able to build awareness of its educational outreach program. 112 teachers from across the state stopped by our booth and were excited about the free hands-on classroom activities for elementary and middle school students.

The exhibit space at the ASTA Conference was smaller than last year's, but we managed to put together an attractive display that featured our new pull up banners.



Mardy and Alice staff the ESM booth at the ASTA Conference
Photo by Harvey Jong

We also debuted a new periodic table of elements poster that included colorful images of the mineral sources for various elements. These posters will be used with the *Properties of Minerals* program and given to schools at no charge after the presentation. The posters were acquired using a generous donation from the White Mountain Gem and Mineral Club. (See following article.)



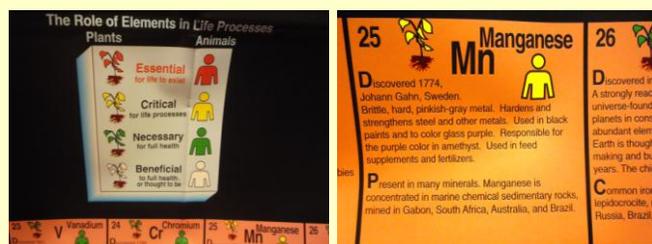
Mardy with four "future science teachers" at the ASTA Conference
Photo by S. Coté

WHITE MOUNTAIN GEM AND MINERAL CLUB

<http://www.whitemountain-azrockclub.org/>

The ESM Board members would like to thank the members of the White Mountain Gem and Mineral Club for their \$600 donation in support of the Earth Science Museum.

With these funds, the ESM is able to; once again, upgrade its Outreach Program Teacher Kits, this time with the addition of the double-sided, vinyl "Blue Marble" periodic table of the elements.



Some of the many educational features of this poster!
Photo by S. Cote

Anyone can obtain this colorful and extremely informative "Blue Marble" poster from the Minerals Education Coalition (MEC) which is a program run by the Society for Mining, Metallurgy and Exploration Foundation (SMEF).

Teachers are especially encouraged to visit the MEC website at:

<http://www.mineralseducationcoalition.org/>

There, you will find K-12 activities and teaching ideas, smart board lessons, an interactive periodic table of the elements, downloadable Fact Sheets on the minerals used in a cell phone, a hybrid car or in LED lights just to name a few, a mineral database and other great curriculum and informational resources.



Arizona Rocks 18

Text and photos by Ray Grant

The second group of sedimentary rocks (the first was the clastic rocks) is the chemical sedimentary rocks. These rocks form from the material that goes into solution during weathering and then precipitates out to form new rocks. Calcium, sodium, magnesium and potassium are the major elements forming these rocks. Calcium being the most common of these elements combines with CO_2 to form the mineral calcite. The sedimentary rock made up of calcite is limestone.

Limestones can be quite varied in appearance, but they all will be made of calcite and will react to hydrochloric acid making them easy to identify. The color can be variable including black, gray, tan, or pink depending on trace elements present. They can be fine-grained or coarse grained. They will often contain fossil fragments and may be composed mainly of fossils (Coquina is a limestone made up of all fossil shells.) The shells qualify as limestone because they are also made of calcite.

Limestone weathers by going back into solution, so in humid areas it weathers quickly, and in arid regions like Arizona it weathers slowly and forms cliffs. The Kaibab formation is mainly limestone and forms the rim of the Grand Canyon. The Redwall limestone makes the largest cliff in the canyon; a good educational program about the Redwall is at http://repository.azga.gov/sites/default/files/dlio/files/nid1572/gootee_redwall_limestone_gts_2014.pdf.

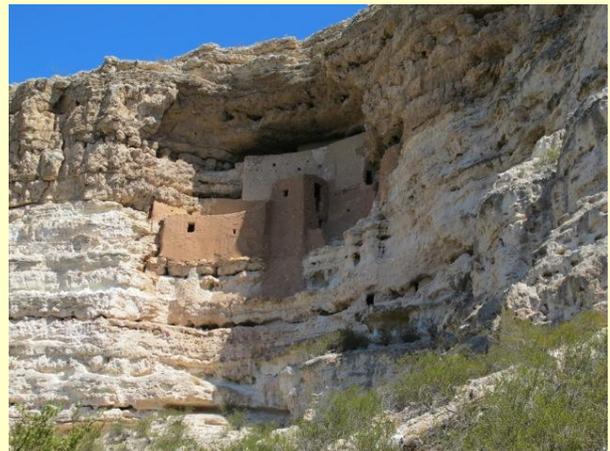
The closest place to see limestone in the Phoenix area is along route 60 going east from Superior. The Escabrosa limestone (same age as the Redwall, Mississippian) and Naco limestone (Pennsylvanian age) are found there. Marine fossils can be found in this area in the limestone formations.



Grand Canyon, Kaibab Limestone (Permian) forming the rim and Redwall Limestone (Mississippian) forming the cliffs of Horseshoe Mesa in the foreground



Naco Limestone (Pennsylvanian) along route 60 just east of Superior



Montezuma Castle National Monument with limestone that formed in a lake in the area about 8 million years ago



Montezuma Well National Monument - a collapsed limestone sinkhole 11 miles north of Montezuma Castle (Will Munny photo via Wikipedia)



Martin Formation fossils in limestone (Devonian) Northeast of Payson (S. Coté photo)



Muav Limestone (Middle Cambrian) underlies the Redwall Limestone (Mississippian). Locally underlies Temple Butte Limestone (Devonian) that fills narrow paleovalleys cut into the unconformity separating the Redwall Limestone from the Muav Limestone (NPS photo via Wikipedia)



Kartchner Caverns State Park - Big Room Escabrosa Limestone (Mississippian Age) in the Whetstone Mountains in southeastern AZ (Mike Lewis photo via Wikipedia)

Other caves in Arizona that are open to the public are Colossal Cave near Vail, AZ, south of Tucson and Grand Canyon Caverns east of Peach Springs, in northwestern AZ, along old route 66.

Interestingly, during the 1950's scientists, at Grand Canyon Cavern's, allegedly began searching for the source of fresh air one encounters in the Cavern's depths. It is said that the engineers set off a significant number of red flares in the Snowball cavern room and once it all dissipated engineers searched for many days in the surrounding countryside for signs of seepage from the earth's surface but no smoke was ever seen. It is said that a few weeks afterward rangers who worked at Grand Canyon National Park reported seeing red smoke seeping from the rocks in the canyon walls nearly 63 miles to the north of the Caverns close by the village of Supai. (Via Wikipedia)

EON	ERA	PERIOD	MILLIONS OF YEARS AGO
Phanerozoic	Cenozoic	Quaternary	1.6
		Tertiary	66
	Mesozoic	Cretaceous	138
		Jurassic	205
		Triassic	240
	Paleozoic	Permian	290
		Pennsylvanian	330
		Mississippian	360
		Devonian	410
		Silurian	435
		Ordovician	500
Proterozoic	Late Proterozoic Middle Proterozoic Early Proterozoic		570
			2500
Archean	Late Archean Middle Archean Early Archean		3800?
Pre-Archean			

Reference Geologic Timescale (USGS)

EXPLORE YOUR WORLD!

CANYONLANDS NATIONAL PARK

Text & photos from NPS.gov



Cedar Mesa Sandstone spires in Elephant Canyon
NPS photo by Neal Herbert

Canyonlands National Park (Utah) is a showcase of geology. In each of the park's districts, Island in the Sky, The Maze, The Needles, and Horseshoe Canyon, visitors can see the remarkable effects of millions of years of erosion on a landscape of sedimentary rock.

Most of the rock found in Canyonlands today came from distant mountain ranges like the ancestral Rockies and even the Appalachians. For millions of years, rock was broken down and carried here by wind and water, creating deposits that eventually became distinct layers of sedimentary rock.

Some layers were laid down by rivers, their sandy channels surrounded by swamps and lakes. Wind brought some of the thickest layers, creating vast sand deserts or dune fields on the shores of an ancient sea.

The accumulating rock created a geologic "layer cake," with most of the material hidden below the surface. There were no canyons: only vast plains gently sloping into the distance.

But change was coming. . .

Many of the rocks exposed in Canyonlands were deposited near sea level. Today, the average elevation here is over 5,000 feet above sea level - a significant uplift.

Canyonlands is part of a region call the "Colorado Plateau," an area that stands high above the surrounding country. About 20 million years ago, movement in the Earth's crust began to alter the

landscape of North America, building modern landforms like the Rocky Mountains, Nevada's Basin and Range, and the Colorado Plateau. Some geologists believe that the plateau has risen as much as 10,000 feet since the uplift began.

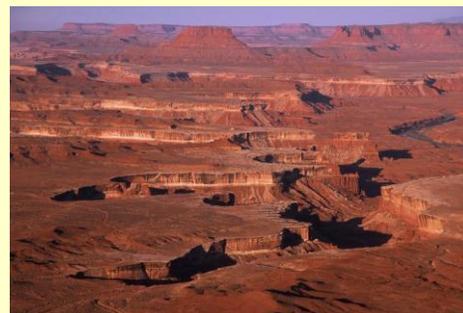
These movements also created cracks where melted rock rose from deep inside the Earth. In some places, it cooled before reaching the surface, creating pockets of harder, igneous rock within the surrounding sedimentary layers. Eventually, erosion exposed these harder deposits, creating the isolated mountain ranges visible from Canyonlands: the La Sals, Henrys and Abajos.

Today's landscape is one of erosion. As this area gradually rose, rivers that once deposited sediment on the lowlands began to remove it from the emerging plateau. The Green and Colorado Rivers began carving into the geologic layer cake, exposing buried sediments and creating the canyons of Canyonlands.

However, the rivers aren't the only force of erosion. Summer thunderstorms bring heavy rains that scour the landscape. Some layers erode more easily than others. As softer rock dissolves away, layers of harder rock form exposed shelves, giving the canyon walls their stair-step appearance. Occasionally, a slab of harder rock will protect a weaker layer under it, creating balanced rocks and towers. Great examples of this are visible in Monument Basin at the Island in the Sky and the Land of Standing Rocks in the Maze.

Water also seeps into cracks in the rock, eroding and widening them until only thin spires remain, like those found in the Needles.

As the work of erosion continues, today's geologic displays will eventually disappear, making way for future wonders.



Canyonlands NP from the Green River Overlook, in the Island in the Sky district
Phil Armitage photo via Wikipedia

The Island in the Sky mesa rests on sheer sandstone cliffs over 1,000 feet above the surrounding terrain.

ESM's Upcoming Meeting

The Earth Science Museum's next scheduled Board meeting on December 10th, 2014, at the Burton Barr Library, located near Central Ave. and McDowel in Phoenix at 6:30 p.m. in Rm. A. Everyone is welcome to attend.

BECOME A MEMBER!

Join the Earth Science Museum's



----- cut here -----

**ESM Earth Science Investigation
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.

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
<http://www.wickenburggms.org>
www.facebook.com/pages/Wickenburg-Gem-and-Mineral-Society/111216602326438

Staples Foundation
www.staplesfoundation.org

Anita Aiston
Stan & Susan Celestian
Russ Hart
Will & Carol McDonald
Debbie Michalowski
Dennis & Georgia Zeutenhorst

----- cut here -----

Name: _____

Address: _____

City, State, Zip: _____

Email: _____

Phone Number: _____

Mail form & payment to: Earth Science Museum
3215 W. Bethany Home Rd., Phoenix, AZ 85017
For Office Use Only

Card given/mailed: _____

Database updated: Distribution Lists updated:

Card ID # _____ Expires: _____

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

Phone:
 602-973-4291

Editor E-Mail:
 scote@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, December 10, 2014, at the Burton Barr Library in Phoenix at 6:30 p.m. Rm. A.

We're on the Web!

Visit us on  and at:
www.earthsciencemuseum.org

THANK YOU FOR YOUR CONTINUING INTEREST & SUPPORT!!!

**EARTH SCIENCE MUSEUM
 NON-PROFIT BOARD OF DIRECTORS**

Harvey Jong	President
Mardy Zimmermann	VP Outreach
Robin Evans	Treasurer
Shirley Coté	Secretary/Asst. Treasurer
Doug Duffy	Ray Grant
Bob Holmes	Alice La Bonte
Tony Occhiuzzi	Tom Parks
Chris Whitney-Smith	Jayne Wright

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

