



Wickenburg Gem & Mineral Society, Inc.

P.O. Box 20375, Wickenburg, Arizona, 85358

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www.wickenburggms.org

The purpose of this organization shall be to educate and to provide fellowship for people interested in

FOLIATED METAMORPHIC ROCKS — What are They? And a look at Slate, Phyllite, Schist, & Gneiss, Metaconglomerate

By Susan Celestian

Metamorphic Rocks are rocks that have been transformed. The agents of metamorphism are heat, pressure and chemically active fluids. Pressure may be the primary agent, as in deep burial of rocks, or along fault lines. This is called **dynamic metamorphism**. When heat alone effects change, it is called **thermal** or **contact metamorphism**, as what will occur where hot igneous rocks come in contact with cooler pre-existing rocks. Where heat and pressure are active agents, the result is **regional metamorphism**. This latter style is the most common, and is associated with major tectonic events, such as mountain building, and involves rocks over many square miles.

Metamorphism continued on page 5.....

CLUB CHRISTMAS PARTY TAKES A 'LEFT' --- NO A 'RIGHT'?

The club Christmas Party took place at 5:00pm on December 2nd. Everyone chatted while the food was set out, and there was a short business meeting, including voting for officers. Then Karen C sent the tables one-by-one to fill their plates (that is the people at the tables filled their plates). Dinner offered an opportunity to chat and meet new people.

After dinner, the white elephant gift exchange took place. Many fun gifts -- not all white elephant, however, there was literally a white elephant among the treasures that were unwrapped after the game.

Pictures of the party follow (photos by Stan Celestian), and I apologize for the fuzziness of some of them. Next year, we will have to use the flash! You guys move around too much ☺☺

Christmas continued on page 2.....

CLUB MINERAL SHOW A SUCCESS!

I have not been given any statistics about this year's show, however by all accounts, attendance seemed to be about the same as last year, and that was very good -- even Sunday had quite a few attendees. There were 42 vendors, and we certainly hope that they all did well!

Be sure to put next year's show on your calendar, and try to set aside some time to volunteer setting up, working the kid's table or fluorescent room, greeting vendors and visitors, running for the raffle, taking down, or other vital task. And do not forget to start a pile of nice rocks to donate to the silent auction. Let's ensure that the 2017 Wickenburg Gem and Mineral Show is a great one!

Show continued on page 9....

Don't miss the meeting on January 13, 2017

Dale is going to give a talk on his & Debbie's trip to South Dakota, and their search for Oligocene fossils.

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Meeting Minutes — December 2, 2016

The meeting was called to order by Craig at 6:10 PM. The pledge of allegiance was recited. There were 52 members, with eight new members and guests present. No minutes or treasurer's report were read due to the evening to be used mainly for the WGMS Christmas Party.

Ballots were handed out to elect the president and vice president for the next year.

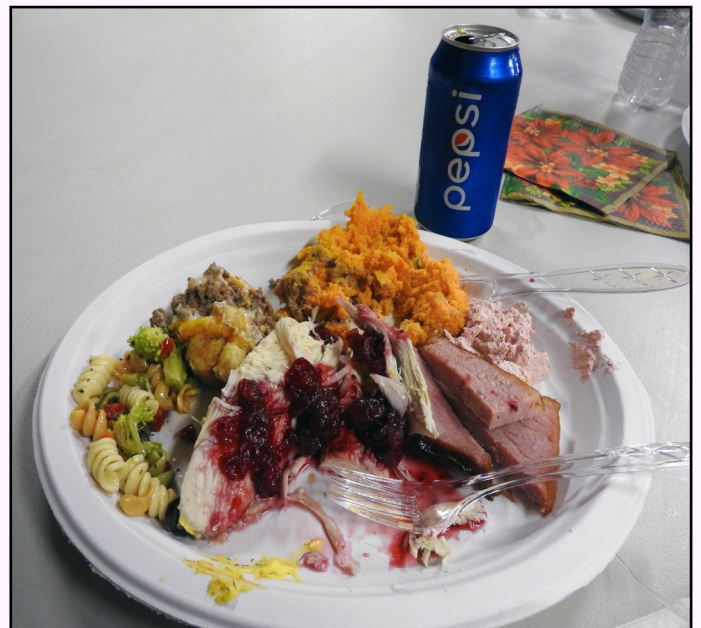
The monetary intake from the rock show was discussed with the silent auction bringing in about \$439, the raffle bring in about \$370, the gold nugget bringing in about \$269, the kid's table bringing in about \$166, and donation of about \$10. A more accurate report will be available at the next meeting.

There is a possibility of having a booth at the Gold Rush Days that are held in Wickenburg in February. The main purpose will be to let people know about the club and to sign up new members, however, we can sell another gold nugget, and have other activities if desired. People are needed to work at the booth.

The next meeting will be held on Friday, January 13, 2017. Dale will do a presentation, and Stan will do a presentation in February.

Thanks were given to all for all the help given at the recent rock show. The meeting was adjourned at 6:20 PM for the annual Christmas Party.

Respectfully submitted, Judy, Secretary



Christmas continued on page 3.....

.....Christmas continued from page 1

**LOTS
OF
GOOD
FOOD**



Ken F cuts the ham - YUM !!

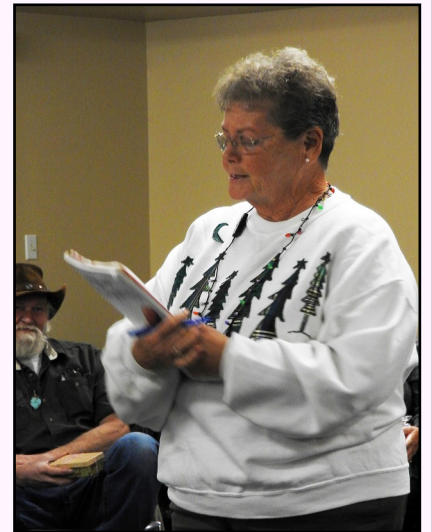
NOTES FROM THE EDITOR

Have a geological interest? Been somewhere interesting? Have pictures from a club trip? Collected some great material? Write a short story (pictures would be great). I'd like topic suggestions also.

Deadline for the newsletter is the end of the month.

Mail or Email submissions to:
Susan Celestian, editor
6415 N 183rd Av
Waddell, AZ 85355
azrocklady@gmail.com

.....Christmas continued from page 2



Karen C. orchestrated the gift exchange. Club members sat in a circle-- each with the gift they brought. Karen read a story, and whenever the word 'right' was read, all gifts were passed to the right; and when the word 'left' was read, they all were passed to the left. Left, right, right, right, left..... At the end of the story, whatever gift you were holding, was the one you took home.

LOTS OF FUN FELLOWSHIP



Bill C tingles with anticipation



Dale & Debbie K admire their gifts



Dolores and Lloyd C will be welcoming folk and fowl this winter



Terry W, John B, and Jason M eager with anticipation

Christmas continued on page 4.....

.....Christmas continued from page 3



Craig "The Elf" J



Bonnie W, Beth M, Joyce R, and Gary H harken to Karen's directions



Judy Z next to Jim E, shows off her Christmas present



Mel C will be getting happy this holiday!



Oh my ☺ -- now that is a white elephant gift!

Christmas continued on page 5.....

.....Christmas continued from page 4



For the third year in a row, the monkey candle holder made an appearance in the gift exchange. Delaine J was the lucky recipient. Hubby Rick admires from nearby.



Roma H shows off her shiny new coconut bra.

.....Metamorphism continued from page 4.....

As a guideline, metamorphism involves changes that exceed those involved in diagenesis (those changes that occur when sediments evolve into sedimentary rocks -- such as cementation), up through near-melting. Throughout metamorphism, the rocks behave as solids -- although often as mushy or plastic solids capable of flow. Ion exchange and recrystallization of minerals occurs, to produce mineralogy that is in equilibrium with the new temperature/pressure regime. As the regime changes, so too will the mineralogical and physical characteristics of the rock change. There are two main categories of metamorphic rocks (see Figure 1). For rock types, see Figure 3.

FIGURE 1 Types of Metamorphic Rocks

FOLIATED	These rocks display a sort of layering or parallel arrangement of minerals, that are flat or elongated (for example micas or tourmaline). Directed pressure forces the minerals to be arranged parallel to each other, and perpendicular to the pressure (see Figure 2).
NON-FOLIATED	When the minerals composing the parent rock are essentially equi-dimensional (for example, calcite or quartz), they are incapable of achieving any parallel arrangement. The resulting metamorphic rocks are dense and massive.

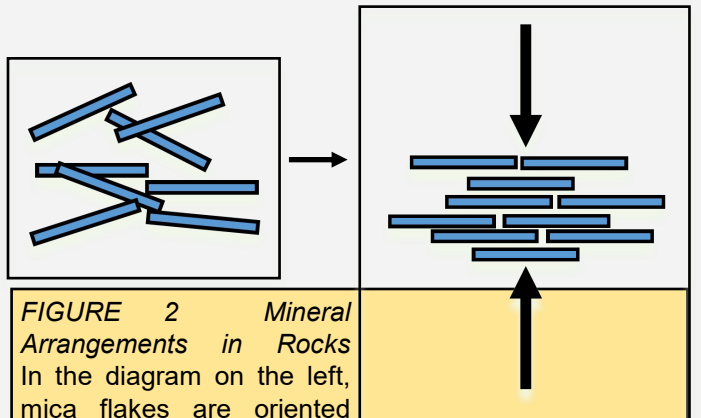


FIGURE 2 Mineral Arrangements in Rocks In the diagram on the left, mica flakes are oriented randomly, as they would be in a sedimentary rock. On the right, directed pressure has forced the mica crystals to align parallel to each other, and perpendicular to the pressure. Graphic by Susan Celestian

Metamorphism continued on page 6....

.....Metamorphism continued from page 4

FIGURE 3

METAMORPHIC ROCK CHART

FOLIATED: Rocks with 'layers' or banding	<p>SLATE: PARENT: mudstone, shale or sometimes basalt Breaks into 'layers' or sheets (slaty cleavage) Is denser/harder than shale, its parent rock No visible crystals, although has a bit more sheen than shale Black, gray, green, red</p>
	<p>PHYLLITE: PARENT: slate, mudstone, shale Very similar to slate, but larger crystal size (still invisible to naked eye) gives rock a satiny sheen ("phyllitic sheen")</p>
	<p>SCHIST: PARENT: mudstone, shale, granite or other igneous rock "Layers" (schistosity) Very shiny, due to now-visible crystals of micaceous minerals - biotite, chlorite, muscovite May have large, included crystals (porphyroblasts)</p>
	<p>GNEISS: PARENT: granite or sedimentary rock Black and white banding (due to the segregation of dark-colored, dense, and light-colored, less-dense minerals) Crystalline</p>
	<p>METACONGLOMERATE: PARENT: conglomerate Retains look of sedimentary conglomerate, but is much denser (breaks through the pebbles) Pebbles are squished, and elongated parallel to each other</p>
NON-FOLIATED: Rocks with no 'layers' or banding	<p>HORNFELS: PARENT: mudstone, shale, clay-rich sedimentary rock Non-descript, dark, fine-grained, dense</p>
	<p>MARBLE: PARENT: limestone or dolomite Fine to coarse-grained (latter is sugary-looking) Will fizz in acid (composition: calcite, dolomite) Soft</p>
	<p>QUARTZITE: PARENT: quartz sandstone Very dense Very hard (composition: quartz) MAY retain a bit of the original sandy texture</p>
	<p>METACONGLOMERATE: PARENT: conglomerate Retains look of sedimentary conglomerate, but is much denser (breaks through the pebbles)</p>
	<p>SERPENTINITE: PARENT: peridotite or Mg-rich gabbro/basalt Tends to be green-brownish, due to composition (serpentine-group)</p>
	<p>ANTHRACITE: PARENT: lignite, bituminous coal Black, shiny Conchoidal fracture Less dense than crystalline rock</p>

.....Metamorphism continued from page 6

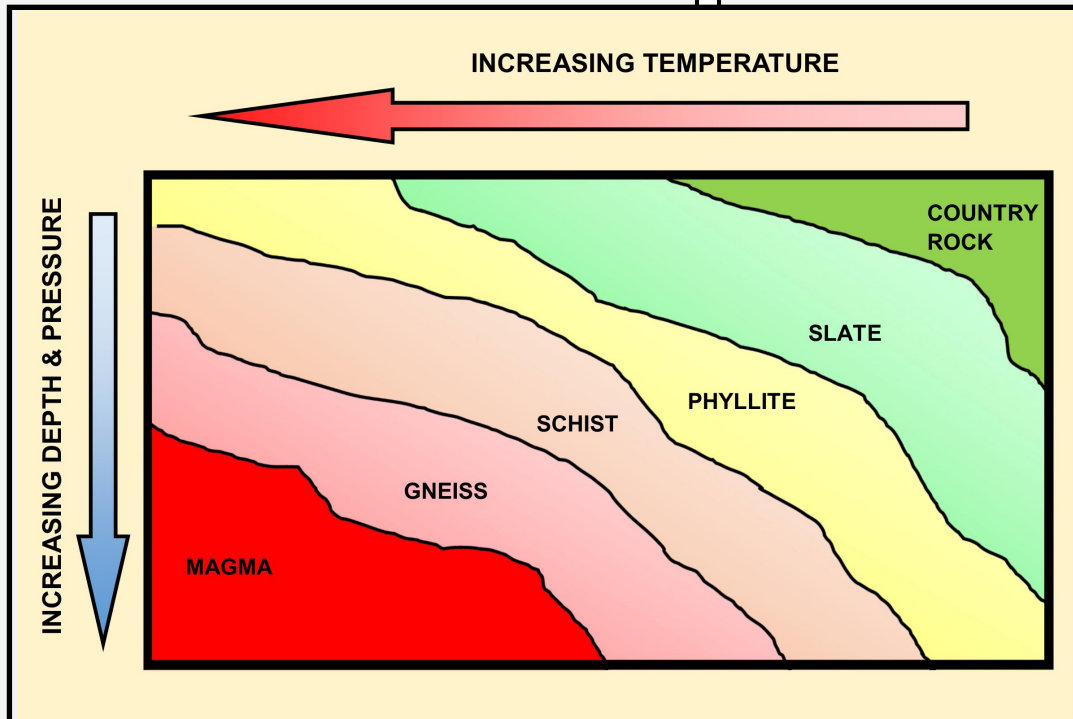
**FOLIATED METAMORPHIC ROCKS:
SLATE, PHYLLITE, SCHIST, GNEISS,
METACONGLOMERATE**

The foliated metamorphic rocks -- slate, phyllite, schist, and gneiss -- are listed in order from lowest- to highest-grade metamorphism. Low-grade metamorphic rocks were subjected to low temperatures (400-600° F) and pressures -- or high temperatures and low pressures, in the case of contact metamorphism; while high-grade metamorphic rocks were subjected to high temperatures (> 600° F) and pressures. They (like all metamorphic rocks) occur in inter-grading zones around a magma body. The affected area may be only a few inches wide, or may extend for many miles -- all depending on the size and temperature of the adjacent magma body. See Figure 4.

it all depends on the directions from which the pressure is exerted on the rock. There is not a major change in the mineralogy, although much of the clays re-crystallize into mica. Slate is denser than shale, and splits relatively easily into sheets, making it ideal as roofing shingles, pool table tops, flooring, and blackboards. See Figure 5.



FIGURE 5 Slate



PHYLLITE results from a bit higher-grade conditions. The micas begin to recrystallize into chlorite, and the crystals grow a bit larger -- although they are still not visible to the naked eye. However, the changes give phyllite a satiny sheen (*phyllitic sheen*). See Figure 6.

SCHIST results from increasing temperature and pressure, causing the chlorite of phyllite to re-crystallize into micas (often muscovite and/or sericite), that are stable at the revised temperature / pressure

FIGURE 4 Metamorphic Zones Where the heat is greatest, adjacent to the intruding magma body, the parent rock experiences the most extreme changes (high-grade metamorphism), and the metamorphic changes decrease in degree as you move away from the magma body, and the temperature declines. Graphic by Susan Celestian

SLATE is a low-grade metamorphic rock, predominately derived from a parent shale. As the clays and micas start to align, the rock takes on a platy characteristic (*slaty foliation*), that may or may not be parallel to the original sedimentary layers --

regime. At this point, the mica crystals are large enough to be seen with the naked eye. And those shiny flakes of mica give schist a sparkly appearance. The rough parallelism of the micas is called *schistosity*.

Metamorphism continued on page 8.....

.....Metamorphism continued from page 6

In addition, very often other minerals crystallize within the mica groundmass -- minerals such as garnet, tourmaline, staurolite, and kyanite. These minerals are called *index minerals*, because they indicate more specifically what the temperatures and pressures were at the time the rock formed. In order of lower to higher-grade conditions, some of the index minerals are: chlorite, biotite, garnet, staurolite, kyanite, sillimanite. These large accessory minerals growing in the mica are called -- lovers of big words will like this one -- *porphyroblasts*. See Figures 7-9.



FIGURE 7 *Tourmaline Mica Schist* This rock is from near Castle Hot Springs. Notice that even the tourmaline crystals (porphyroblasts) are exhibiting rough parallelism. *Photo by Stan Celestian*



FIGURE 8 *Garnet Mica Schist* Pretty red garnets polka-dot this schist from Emerald Creek, Idaho. *Photo by Stan Celestian*



FIGURE 9 *Pinal Schist* This specimen displays extreme buckling of the mica layers, under compressive pressure. *Photo by Stan Celestian*

GNEISS is the highest grade of metamorphism, having been taken to the point of almost melting. The primary minerals are feldspar, pyroxene, amphibole, and quartz. Those should sound familiar, as they are the main components of most igneous rocks, also. In the case of gneiss, the foliation exists not as layers, but as banding. (*gneissic banding*). The banding is the result of the segregation of dark (ferromagnesian) and light minerals (quartz, feldspar, mica). The temperature/pressure conditions are so extreme, that the rock becomes mushy, or plastic, and is capable of deformational flow. See Figures 10-12.



FIGURE 10 *Gneiss* This gneiss is classically gneissic banded, and exhibits undulations, due to deformation and flow. Locality - Planet Ranch Road, north of Bouse, Arizona *Photo by Stan Celestian*

.....Metamorphism continued from page 8

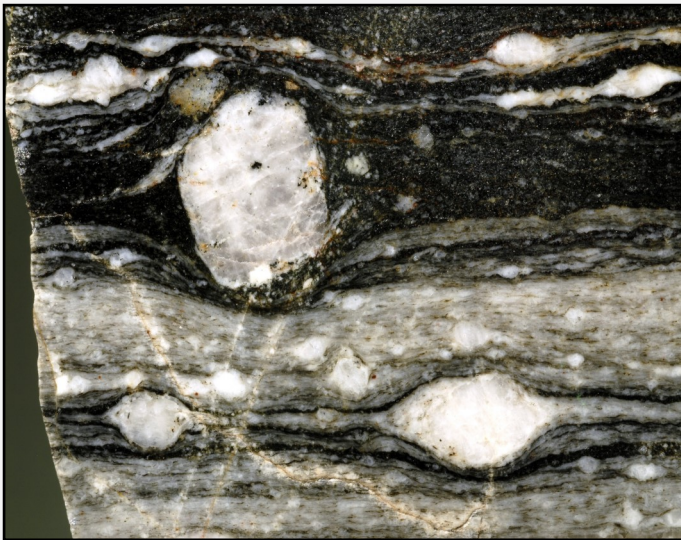


FIGURE 11 Augen Gneiss This gneiss is also beautifully banded, but it contains large streamlined porphyroblasts of feldspar and/or quartz. As the rock is compressed under extreme pressure, a mantle of new mineralization forms around the crystals, the crystals may rotate, and in the end streamlined, tapering clots dot the rock. These are called augen (German for 'eyes'). Photo by Stan Celestian



FIGURE 12 This is another augen gneiss. However, the augen are large garnets. Photo by Stan Celestian

METACONGLOMERATE is a rock type that can straddle the metamorphic fence, in the sense that it may be non-foliated or foliated. When the temperatures and pressures get high enough, the pebbles in the parent sedimentary conglomerate may become soft enough to flatten -- and they will flatten in a direction perpendicular to the direction of pressure, and hence lie parallel to each other. While the rock still looks very much like its sedimentary parent, with rounded pebbles, it is much denser. During the process of metamorphism, the edges of the pebbles become intergrown with the intervening matrix. When hit with a hammer, it will break through the pebbles (while a sedimentary conglomerate breaks around the pebbles.) See Figures 13 and 14.



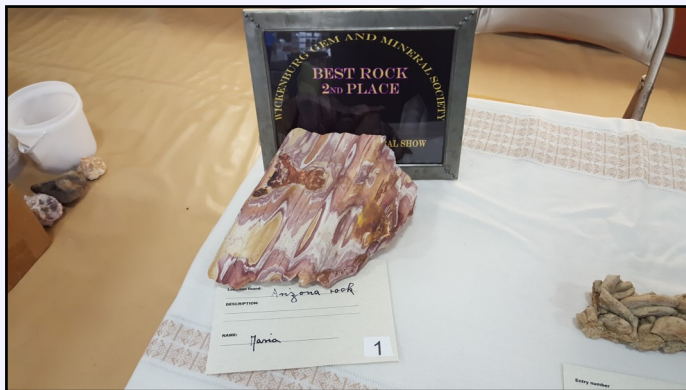
FIGURE 13 Metaconglomerate This rock, from the shores of Lynx Lake, near Prescott, Arizona, got smashed when it felt pressures of life building up. Photo by Stan Celestian



FIGURE 14 This metaconglomerate has been sawn, exposing the intimacy of the pebble/matrix boundary -- this is a very dense rock. (Enlarge the view for a closer look!) Photo by Stan Celestian

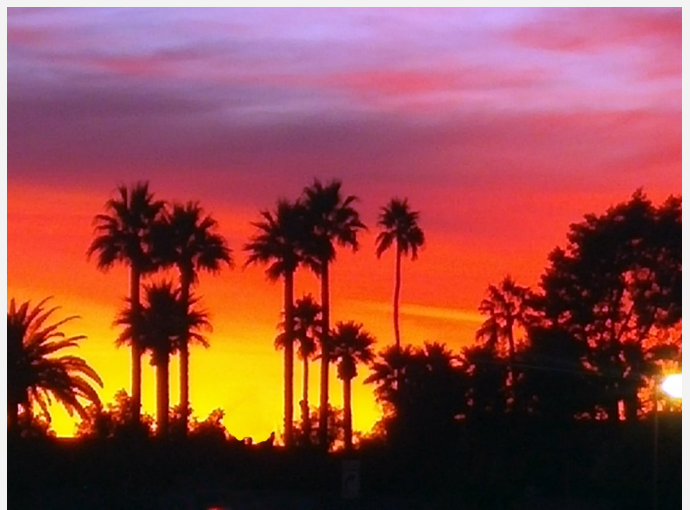
.....Show continued from page 1

It looks like there was some stiff competition in the BEST ROCK COMPETITION! Here are the winners, and their adjacent competitors:



Start looking for a candidate for next year's contest! Remember, it should be interesting, funky, beautiful, ugly -- and durable enough to be handled by the general public. *Photos by Rick Jones*

"Folded Transformations" -- Origami of Robert J Lang, on exhibit until January 29, 2017 in the Brody Botanical Center at Huntington Gardens, San Marino, CA



This spectacular sunset occurred on December 14th. The photo was taken from Litchfield Park, Arizona, by Susan Celestian, with her cell phone.

BLM CHANGING RULES

<https://www.federalregister.gov/documents/2016/12/07/2016-29244/paleontological-resources-preservation>

To: ROCKHOUNDING COLLEAGUES IN THE ROCKY MOUNTAIN FEDERATION OF MINERALOGICAL SOCIETIES

From: Mike Nelson, Colorado Springs Mineralogical Society, RMFMS PLAC Chairman

Re: Proposed collecting rules for invertebrate fossils on BLM land

On March 30, 2009, the Paleontological Resources Preservation Act (PPRA) became law on lands managed by various agencies of the federal government. Although the Senate Interior Appropriation Subcommittee in 1999 asked federal agencies to prepare a report on fossil resource management, most rockhounds and many professional paleontologists believed any new regulations (in my opinion) would be written to protect vertebrate fossils. However, unbeknownst to most fossil collectors, the United States Forest Service (USFS) published (May 23, 2013) draft regulations concerning the collection of invertebrate fossils on land managed by the agency. The comment period was 60 days and the Agency received few legitimate (non-form letters) concerns. Candidly, the proposal caught many rockhounds "off guard" and it was tough to organize informational responses. In my opinion, rockhounds lost many, many collecting privileges associated with invertebrate fossils. However, in defense of the USFS, the Agency was simply interpreting tenants of the PPRA, and that is the magic word---interpretation.

This week in December 2016 proposed regulations for lands under the jurisdiction of the Department of Interior (Bureau of Land Management [BLM]; National Park Service [NPS]; Fish and Wildlife Service [FWS]; Bureau of Reclamation [BR]) were published in the Federal Register and became available for comments. I would request that rockhounds and clubs interested in collecting invertebrate fossils from Interior lands examine these proposed rules and offer comments. As with USFS regulations, the proposed Interior rules are quite restrictive and will involve virtually any rockhound or collector of invertebrate fossils. In addition, Interior interpretations of PPRA rules differ somewhat from those of the USFS. The Federal Register is not easy bedtime reading; however, this new proposal is critical to future collecting. If you observe sections or rules that are disagreeable, please construct reasonable responses and send comments to the appropriate address. Your comments should be personal (individual or club) as form letters are not really successful.

December and January are holiday seasons for many rockhounds and many club newsletters are taking time off from publishing. Therefore, the RMFMS Board thought it imperative that clubs/members receive this "call for action" via e-mail.

You may find the proposed rules at: <https://www.federalregister.gov/documents/2016/12/07/2016-29244/paleontological-resources-preservation>

Please remember as you comment: Provide first and last name, city, state, & country. All other fields of information are optional. Keep in mind that much of this information is publicly viewable.

Comments may be typed in the box provided or they may be uploaded as attachments (Word docs or PDFs only).

Comments may be brief or in-depth/well-researched. Comments with facts to support them are much more useful (e.g., examples of overlooked scenarios). Keep comments civil and straightforward. Comments using offensive terms, threats, or other inappropriate language will be disregarded.

UPCOMING AZ MINERAL SHOWS

Monthly - Tempe, AZ Gallery TCR , 906 S Priest, #107; Sat 9-6; Free. For dates, go to: https://www.facebook.com/pg/gallerytcr/events/?ref=page_internal

November 19-20 - Apache Junction, AZ Apache Jct Rock and Gem Club; Skyline High School, 845 S Crimson Rd, Mesa, AZ; Sat 9-5, Sun 10-4; Admission: \$3, students \$1, children free.

November 19-20 - Payson, AZ Payson Rimstones Rock Club; Payson High School Longhorn Gym, 310 S McLane Rd; Sat 9-5, Sun 10-4; Admission: \$2, children free.

November 26-27 - Wickenburg, AZ Wickenburg Gem and Mineral Club; Hassayampa Elementary School, 251 S Tegner St; Sat 9-5, Sun 10-4; Admission: Free.

January 1 - February 29 - Quartzsite, AZ For show schedules <http://www.desertusa.com/cities/az/quartzsite.html>

January 6-8 - Mesa, AZ Flagg Foundation; Mesa Community College, Dobson, north of US 60; Daily 9-5; free.

January 20-22 - Globe, AZ Gila County Gem and Mineral Society; Gila County Fairgrounds, 900 E Fairgrounds Rd, Globe, AZ 85501; Sat 9-5, Sun 10-4; \$3/person, \$5/couple, students and children free.

February 9-12 - Tucson, AZ Tucson Gem and Mineral Society; Tucson Convention Center, 260 S Church St; Thurs-Sat 10-6, Sun 10-5; Admission: \$13, under 14 free with adult.

February 18-19 - Apache Junction, AZ Apache Jct Rock and Gem Society; Skyline High School Gymnasium, 845 S Crismon Rd; Mesa, Arizona 85208; Sat 9-5, Sun 10-4; \$3/adult, \$1 students, children under 12 free. <http://www.ajrockclub.com/About Who We are AnnualShow.html>

March 25-26 - Anthem, AZ Daisy Mountain Rock and Mineral Club; Boulder Creek High School Gym, 40404 N Gavilan Peak Pkwy; Sat 9-5, Sun 10-4; \$3/adult, \$2 seniors/students; children free.



If you are travelling, a good source of shows AND clubs is <http://www.the-vug.com/vug/vugshows.html> or <http://www.rockngem.com/ShowDatesFiles/ShowDatesDisplayAll.php?ShowState=AZ> For out-of-the-country shows: <http://www.mindat.org/shows.php?current=1>

A good source for a list of Arizona Mineral Clubs and contact information is http://whitemountain-azrockclub.org/Public_AZ_Clubs_Links.html

UPCOMING WGMS FIELD TRIPS

No trips scheduled at this time.

DATES SUBJECT TO CHANGE

If you all have some place that you would like to go, let Marty H. 602-469-7770 or Craig J. 208-681-4770 know. This is your club. Let's go out and have some fun.

CONSIDER VOLUNTEERING TO PLAN OR HELP PLAN TRIPS. YOU WOULD NOT NEED TO LEAD EVERY TRIP, BUT KEEP THINGS ON TRACK

Dues are past due!

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

If you ever have photos from a club field trip, send a couple to Dale, for posting on the website.

Officers and Chairperson

- President:** Craig Jones.....208-523-9355
- Vice President:** Martin Hagan..... 602-469-7770
- Secretary:** Judy Zimmerlee..... 517-652-1355
- Treasurer:** Debra Keiser..... 928-684-1013
- Program Director:** Dale Keiser..... 928-684-1013
- Publicity:** currently open position
- Membership:** Roma Hagan 602-469-7662
- Editor:** Susan Celestian 602-361-0739
- Field Trip:** Craig J, Bob B, Marty H
- Show Chair:** Beth Myerson.....480-540-2318
- Scholarship Chair:** Steve Hill..... 928-533-3825
- Historian:** Jeanine Brown..... 928-684-0489

Meetings are held the **2nd Friday** most months at **Coffinger Park banquet room**. Potluck dessert at 6:30 pm. Business meeting at 7:00 pm. **Exceptions: February and December** meetings are held on the **first Friday of the month**. We do not meet in the summer — **no meetings in June, July or August.**

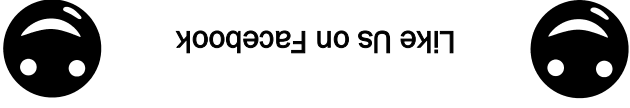
Membership Dues: \$15.00 Adults per Person \$ 5.00 Juniors and Students

Meeting Dates for 2017

Wickenburg: Jan 13, Feb 3, Mar 10, Apr 14, May 12, Sept 8, Oct 13, Nov 10, Dec 1

Stanton meets Thursday after the Wickenburg meetings. Jan 19, Feb 9, Mar 16, Apr 20, May 18, Sept 14, Oct 19, Nov 16, Dec 7 (subject to change)

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