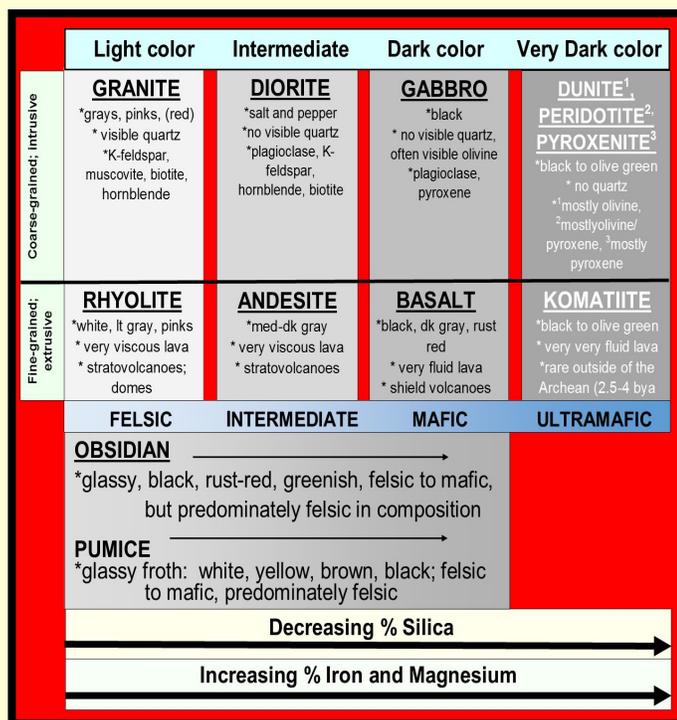


## COARSE-GRAINED IGNEOUS ROCKS — Diorite & Gabbro

By Susan Celestian

Intrusive (or Plutonic) - form at depth, beneath Earth's surface

To review — intrusive igneous rocks cool very slowly, giving atoms enough time to link up, and build visible crystals. These rocks will be coarse-grained — comprised of interlocking crystals of various minerals. This month we will look at diorite and gabbro.



**FIGURE 1 IGNEOUS ROCK CHART**, showing the relative compositions and relationships of the igneous rocks. *Table by Susan Celestian*

**DIORITE** is the relative uncommon compositionally intermediate igneous rock (See Figure 1). It is very similar to granite (discussed in December's newsletter), except there are no visible crystals of quartz, and the feldspar component is largely sodium-rich plagioclase.

*Diorite/Gabbro continued on page 5.....*

## PRESIDENT'S VIEW

Last month I thanked the outgoing officers for their service, and welcomed our new Executive Board. I would be remiss to not give thanks, as well as credit for work well done to a number of members that have made a difference in this past year. Specifically Dan Janko. Dave Haneline, and Rick and Jane Jackson.

Dan Janko is one of the founders of the Daisy Mountain Rock and Gem Club. I first met Dan at a club in Black Canyon City. Dan's interest in rocks and minerals was evident immediately. His passion has led him to travel far and wide in pursuit of some of the most fabulous gems I have ever seen. Dan was instrumental supporting the initial call for the club to hold a rock and gem show, and in bringing the show to reality. He served for a time on our Executive Board in the past term, bringing his love of rocks, and a level head for business, to the Board. He is a man of many interests and demands on his time forced him to leave the Board. We are all better off because of his efforts and thank him for all he has done on the Club's behalf.

Dave Haneline may not be a founding member but he has been active in the club since shortly after its inception. He has served as club treasure, he has worked on the field trip committee, and is a member of that hard-working committee to this day. His knowledge of mineral identification has made him a go-to person for new and old members alike. Recently, Dave worked to bring our books into good stead in order to aid in Cynthia Buckner's assumption of the treasurer's post. He has been an advocate for fluorescent collecting that has been an influence on many of us, and he worked hard to bring

*President's View continued on page 4.....*

## INSIDE THIS ISSUE

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## Board Meeting Minutes — January 3, 2017

The meeting was called to order by President Ed Winbourne at 5 p.m. Those present were Ed Winbourne, Cynthia Buckner, Whit Revelle, Jim Reed, Bob Salter, Stan Celestian, and Victoria Peterson.

**Motion:** Upon motion made by Victoria and unani- mously carried, the December Executive Commit- tee and Membership Meeting minutes were approved.

### WHAT IS AND SHALL BE THE FOCUS OF THE CLUB:

There was discussion as to what type of club are we trying to build, should our focus be on building membership valley wide, and how should we as a club direct our efforts. There was consensus that our club is to provide education on the Arizona geological uniqueness and importance to our community through outreach to schools, literature, field trips and meetings as well as scholarships to local students in the scientific fields.

There was further discussion on providing information and resources to teachers and possibly hosting workshops/meetings to provide teachers with substantive education on the rocks and minerals in our area. This would be accomplished by presentations from our club geologists and those familiar with field trips, samples for their classrooms, as well as information on club members who would be willing to speak to their students.

This discussion will continue at the February meeting.

### SHOW PREPARATIONS:

Ed stated the Show Committee has had a slow start, and the Marketing Committee needs assistance. Dahlia has said show fliers will be ready this week. The Show Committee will be meeting Friday, January 6.

Stan suggested we have an Education Table at the show. Consensus was to provide a table at the show in the vicinity of the Membership table with information of an educational nature.

Jim Reed presented the following show report and update:

Thirty-one vendors are returning and 19 vendors so far have returned signed contracts and remittance; fees have been collected and transferred to Treasurer Cynthia. We have room for 35 vendors and have 13 "qualified" vendors on our wait list. Jim will begin filling vacancies mid-January. He stated vendors are

extremely positive about our show, especially the assistance our club members provide such as setting up and taking down, and the marketing of the show which we provide.

### **Further action required:**

- 1) Need additional personnel to manage tickets (purchase of and sale)
- 2) Marketing Committee needs additional personnel to disseminate fliers
- 3) People to staff the show: tickets, security, raffle, entry, set up and take down
- 4) Decision on fluorescent display

### NEWSLETTER, MEET UP SITE AND WEBSITE:

Ed said outreach tools of the newsletter, web site and Meet Up site need to be built up and overseen. Consensus of those present was the Newsletter is very professional and educational; Meet Up site has brought the club new members but does need to be overseen and the club website is underutilized and needs direction. Nancy Gallagher has done a great job in getting the website up and running.

### **Further action required:**

Need volunteer to oversee Meet Up Site as well as Club website.

### FINANCIAL REPORT:

Ed stated the Club is in good financial shape. Cynthia will provide the financial report to club members via email this week.

There was discussion on how to use the Club funds. There was discussion relative to increasing the scholarship fund to \$1,000 from \$500. This will be discussed at the Executive meeting in April.

The possibility of the Club funding a lapidary site was again brought up. Jim mentioned the cost of rental of a facility, equipment needed, utilities, staffing, etc. Consensus was it would be of great appeal to club members to have such a facility; however, the Club is not at present in the financial condition to afford these expenditures as well as the on-going expenditures of this type of facility in the future. The possibility of a lapidary facility will be an on-going discussion.

There being no further business, the meeting was adjourned at 6:15 p.m.

Respectively submitted,  
Victoria Peterson, Secretary

**General Meeting Minutes — January 3, 2017**

President Ed Winbourne called the meeting to order at 6:40 p.m.

Speaker:

Ed introduced Wayne (Bud) Walker as the speaker. Wayne is a geologist who has worked many years in the Missouri area. He spoke about the mineralization of the Southeast Missouri Mining Districts and mentioned the Southeast Missouri District is the largest lead district in the world; the lead is free of impurities, and the three world class sub-districts generate one billion tons of ore. Wayne gave an interesting talk and answered members' questions.

Raffle:

Thank you to Dave Haneline and Dan Allred for donating the raffle items; winners were: Jim Reed, Lynnea Aanderud, Shelley Houser, Lavinia Struble, Bob Salter, and Whit Revell.

Executive Committee Report:

Ed gave a summation of the Executive Committee Meeting stating the Club needs member's participation in the show. There was discussion relative to the direction of the Club and how to use the club's financial resources. Many Members attending enthusiastically voiced approval of the idea of a Lapidary Facility.

Victoria read the Club By Laws, Article II – Purpose. Section 1: The purpose of this Club shall be to promote and further the interest and education in geology, mineralogy and lapidary arts

Minutes of the Executive Committee meeting and Membership Meeting will be emailed to membership.

Volunteer Report:

Victoria reminded everyone dues are due! These dues must be paid by January to remain an active member. She stated we have new members: Susan Gardner, Bill and Shelley Houser, and our Speaker tonight – Bud and Ann Walker. Welcome!!

Show Report:

Ed stated the Show still needs people to work on tickets, security, and marketing. Howard Roose agreed to take show flyers to the Flag show in

Mesa this coming weekend. Jim Reed gave a report on the up-coming show and stated all but two of the vendors are returning this year. The two that are not returning stated health reasons. There is a waiting list of vendors wanting to participate, and Jim will complete the vendor participation process by mid- January. The show will provide spaces for 35 vendors this year; up two from 2016. He mentioned in response to the idea of a Lapidary Facility which the Club would sponsor, that the Club is not presently in the financial position to proceed with the facility.

Financial Report:

Cynthia reported as of the end of the 2016 the club's checking balance was \$22,261.15. She also stated the club has changed to calendar year reporting as opposed to the previous fiscal year reporting. The Club financial report from Oct. 2015 through Dec. 2016 has been completed and reviewed by former Treasurer Dave Haneline, and will be sent to members this week via email.

Field Trip Committee:

Stan Celestian informed everyone the Field Trip schedule is finalized and listed in the Newsletter. He mentioned that those interested in participating be sure and observe the requirements for the field trip site as to the type of vehicle necessary. He reiterated that if it says 4-wheel and/or high clearance vehicle – it means just that. A regular vehicle or truck may not be able to traverse the terrain.

There being no further business, the meeting adjourned at 8:15 p.m.

Respectively submitted,  
Victoria Peterson, Secretary

DMRMC next meeting – Tuesday, February 7, 2017  
6:30 p.m., Anthem Civic Center; Wire  
Wrapping Class – before meeting at 4:30



*President's View continued from page 1*

about the fluorescent display at last year's show. We all owe Dave a debt of gratitude for all he has done for our club. He has made us a better club by his efforts.

Rick and Jane Jackson are also owed a thank you from all of us. Bob Salter met Rick and talked him into joining us. When he first joined, Rick was recently retired, and quickly impressed everyone with his knowledge of minerals and many talents, particularly his photographic abilities and his energy. Rick headed up the field trip committee for a time, leading one of our most memorable trips, the trip to Sheep's Bridge for blue agate. Rick served for a time on the Executive Board. His talents are evident in the beautiful poster he conceived and designed for the 2016 show. He also established our web site, something we had wanted to do for some time, but none of us felt competent to take on. Rick has returned to work, but still has found time to go on fieldtrips and is helping out with the 2017 show.

Jane Jackson took on the treasurer's job on very short notice, and immediately kept us current with our federal and State obligations. When we established the membership committee, Jan stepped forward to give that committee direction. The marketing of our 2016 show has a lot to do with Jane's hard work and imagination. Jane has found herself busy with the duties of being a grandmother, that take up much of her time these days, but she has still found time to help out with this year's show. A look back at the last year without a thank you to the Jacksons would be an unforgivable omission. Rick and Jane deserve our heartfelt thanks.

We are a small club that is trying to do big things. We have accomplished much in our seven years, and it is because of the efforts of members like Dan, Dave, Rick, and Jane, that we have come as far as we have. A special thanks to them is in order.

Ed Winbourne, President

## UPCOMING FIELD TRIPS

**WHEN:** Saturday January 21, 2017

**WHERE:** DRAGON MINE

**WHAT:** Muscovite Mica (pink/lilac), Tourmaline, and Quartz Geodes and Thunder Eggs, Agate

**MEET:** McDonalds in Wickenburg (be ready to go at 9:00 AM sharp!)

**WHEN:** Saturday February 4, 2017

**WHERE:** AQUARIUS MOUNTAINS

**WHAT:** Garnet Crystals in Rhyolite

**MEET:** McDonalds in Wickenburg (be ready to go at 8:00 AM sharp!)

**WHEN:** Saturday March 4, 2017

**WHERE:** PLANET MINE

**WHAT:** Hematite, Chrysocolla, Malachite

**MEET:** TBD

**WHEN:** Saturday April 1, 2017

**WHERE:** Kohl's Ranch Area

**WHAT:** Zebra Agate, Peach colored agate, Fossils of the Naco Formation

**MEET:** TBD

**WHEN:** Saturday and Sunday, April 8,9, 2017

**WHERE:** Round Mountain

**WHAT:** Agate, Geodes, Quartz

**MEET:** TBD

**WHEN:** Saturday May 6, 2017 (tentative)

**WHERE:** Reserve Bank Mine

**WHAT:** Copper Minerals, Underground Tour

**MEET:** McDonalds in Wickenburg (Time TBD)

**WHEN:** Saturday June 3, 2017

**WHERE:** Lynx Creek

**WHAT:** Gold

**MEET:** TBD

*Other field trips are being considered and information will be posted in the monthly newsletter and described at meetings, or via email.*

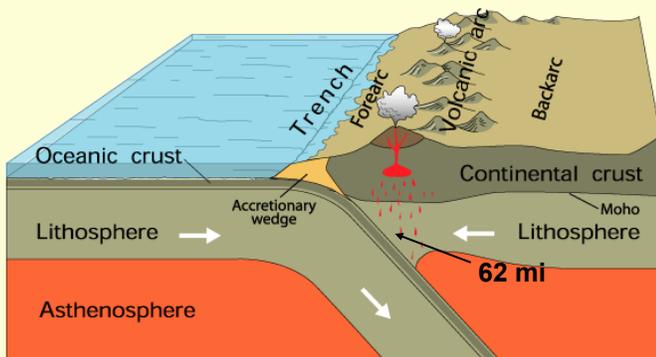
**DATES SUBJECT TO CHANGE**

...Diorite/Gabbro continued from page 1

Other minerals that may be present are amphiboles (such as hornblende), pyroxene, and biotite.

There are about equal parts light-colored and dark-colored minerals, giving diorite a “salt and pepper” look. So -- a black and white coarse-grained igneous rock, with no visible quartz, can be visually identified (at least tentatively) as diorite.

As with granite, most diorite forms in convergent zones, where two tectonic plates collide. Magma resulting from the partial melting of oceanic crust, rises through the granitic rock of the continental crust, incorporates some of that into the original magma, thus changing its composition to the more intermediate composition of diorite. Should this magma explode out of the Earth’s surface, it would form andesitic continental arc or island arc volcanoes. Of course, diorite forms as that magma cools far below the Earth’s surface, forming batholiths, dikes, and sills. See Figure 2.

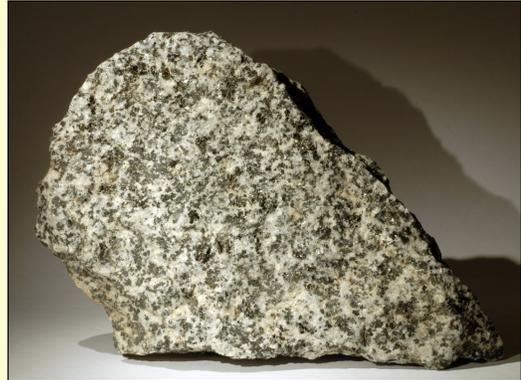


**FIGURE 2 OCEANIC-CONTINENTAL CONVERGENCE**  
 Where an oceanic plate collides with a continental plate, the oceanic plate with subduct.  
 Graphic courtesy of the USGS

Diorite textures and compositions, can vary. What all diorites have in common are:

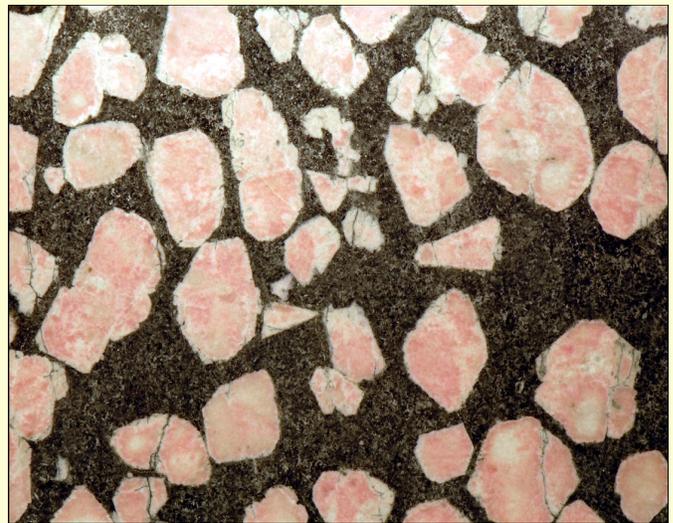
- ◆ Basic components of light-colored sodium-rich plagioclase and dark-colored amphiboles/pyroxenes or biotite
- ◆ Coarse-grained
- ◆ Typically medium-dark gray; salt and pepper

Figures 3-6 illustrate some diorites.



**FIGURE 3 DIORITE** This classically “salt and pepper” rock is a diorite, from a batholithic intrusion exposed along I-8, in California (close to Arizona). If you enlarge the image on your monitor, it becomes very clear that the black crystals are biotite, and there are no glassy grains of quartz.

*Photos by Stan Celestian*



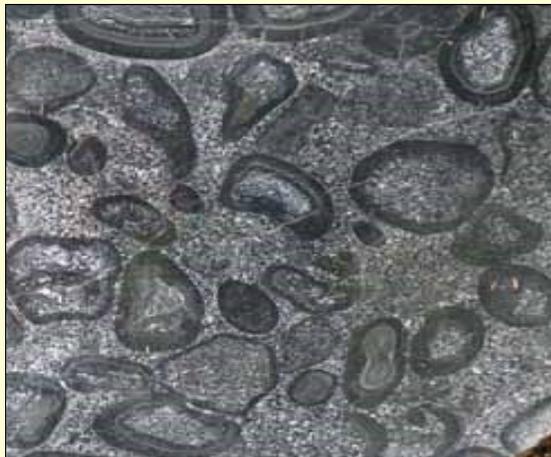
**FIGURE 4 PORPHYRITIC DIORITE** The big pink feldspar crystals make this Australian rock an attractive lapidary material, nicknamed Pink Marshmallow Stone. *Photo by Stan Celestian*

*Diorite/Gabbro continued on page 6.....*

....Diorite/Gabbro continued from page 5



**FIGURE 5 ALMANDINE in DIORITE** Garnets up to 3 feet in diameter polka-dot the diorite in the garnet mines around Gore Mountain, NY. The garnet was mined as an abrasive, from the late 1800s to the 1980s. In 1969, this garnet was named the New York State Gemstone. *Photo by Stan Celestian*



**FIGURE 6 ORBICULAR DIORITE** This California oddity is on display in front of the USGS building in Menlo Park, CA. Orbicular diorite forms when magmatic fluids, loaded with rock fragments, cool. With cooling, minerals deposit on the fragments, in repeated layers. *Photo courtesy of the USGS (cropped)*

For a look at a spectacular orbicular diorite that occurs in Finland, go to

[http://www.kristallin.de/orbiculite/orbicular\\_rocks1.htm](http://www.kristallin.de/orbiculite/orbicular_rocks1.htm)

<http://fineartamerica.com/featured/orbicular-diorite-rock>

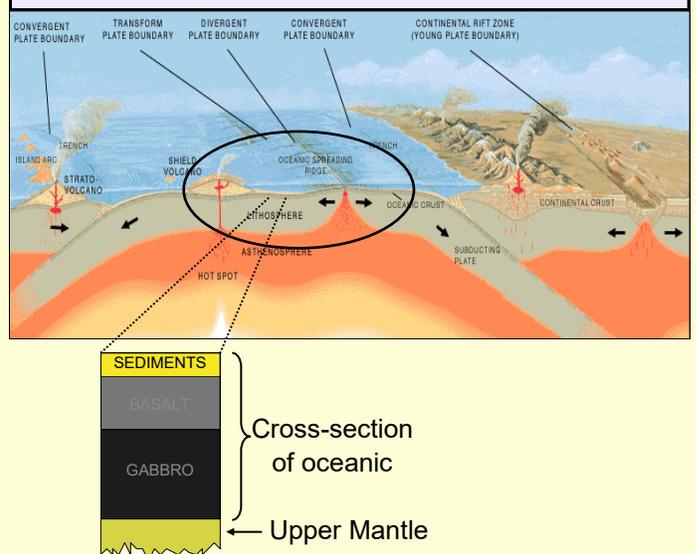
**GABBRO** is the coarse-grained and compositionally mafic (See Figure 1). It is largely composed of pyroxene (such as augite) and calcium-rich plagioclase, with more minor amounts of amphibole and olivine.

What all gabbros have in common are:

- ◆ Basic components pyroxene and calcium-rich plagioclase with amphibole and olivine (iron-rich minerals)
- ◆ Coarse-grained
- ◆ Dense
- ◆ Dark-colored: black to greenish-black

Most gabbro forms at divergent plate boundaries and hot spots — associated with basalt. It is the primary component of the base of the oceanic crust. See Figure 7. It will be found within the continental crust, where oceanic crust has been thrust up and incorporated within folded and faulted mountains, where continents collide and beneath where flood basalts bury continental landscapes (such as the Columbia River basalts of Washington and Oregon, or the Deccan Plateau of India), and wherever basaltic magma cools at depth. See Figures 8-9.

**FIGURE 7 GABBRO AT OCEAN CRUST** Partial melting of the asthenosphere, where oceanic crusts fractures above upwelling convection currents, results in the formation of basalt and gabbro to build ocean crust. The inset is a close view of the layers comprising the ocean crust. *Image courtesy of the USGS*

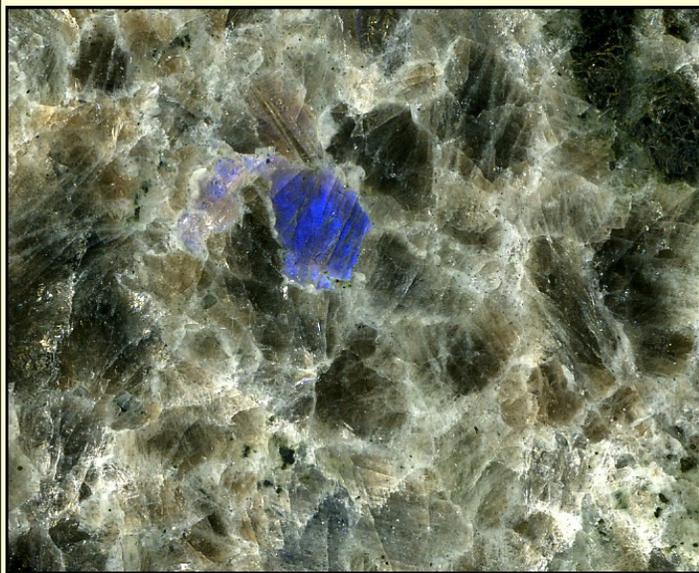


Diorite/Gabbro continued on page 7.....

....Diorite/Gabbro continued from page 6



**FIGURE 8 GABBRO** This is the gabbro that formed about 1 billion years ago, at the Barton Mines Corporation's Gore Mountain Garnet Mine, in North River, New York. It is called an *amphibolite*, as the primary minerals comprising the rock are amphiboles (such as hornblende), although pyroxenes, plagioclase, olivine, and biotite are additional components. The red areas are most commonly almandine garnets. The shiny spots are the large cleavage surfaces on the hornblende and feldspar. *Photo by Stan Celestian*



**FIGURE 9 GABBRO** This gabbro is called an *anorthosite*, and is composed of mostly Labradorite, a calcium-rich plagioclase feldspar, famous for its play of colors (labradorescence), and also known as Spectrolite or moonstone. This is the Nain Anorthosite (1.29-1.35 billion years old), from the Ten Mile Bay Quarry, Nain, Canada (on Labrador coast).

*Photo by James St. John, posted to Wikipedia Creative Commons*

A request from a researcher, for material:

For years, Dr. Joseph B. Lambert (Northwestern University, Department of Chemistry) and I have been studying plant exudates (resins, gums, and phenolics), copal (partially polymerized resin), and amber (fossilized resin) as part of my research program with the Paleobiology Department, Smithsonian Institution, National Museum of Natural History. Links to some of our recent papers are included below for reference and I will be happy to send the pdf of a few other papers, if requested.

<https://blaypublishers.files.wordpress.com/2016/11/lambert-et-al-2016-leb-43215-2321.pdf>

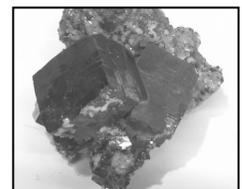
<https://blaypublishers.files.wordpress.com/2016/02/lambert-et-al-leb-34-japanese-amber.pdf>

<https://blaypublishers.files.wordpress.com/2015/07/lambert-et-al-nmr-monocot-exudates1.pdf>

<https://blaypublishers.files.wordpress.com/2015/01/leb-24-1-30-lambert-et-al.pdf>

I am interested in expanding our analyses of these materials and I am reaching out to as many gem and mineral clubs in the United States as possible to request small samples of plant exudates, copal, and amber with good geographical and botanical provenance data. We only need samples of about 100 milligrams (approx. the volume of a new eraser on a school pencil) in our NMR studies. If you have samples and would like us to analyze them (for free), please contact me at [blayj@si.edu](mailto:blayj@si.edu) or at [blayajorge@gmail.com](mailto:blayajorge@gmail.com). Please, do not send samples at this time. If we think that your samples are new to our analyses, I will contact you and provide mailing instructions. Thank you for your consideration of this request.

Sincerely and gratefully, Jorge Santiago-Blay, PhD



January speaker Wayne Walker and his wife. Above is a galena from a Southeast Missouri District lead mine. *Photos by Stan Celestian*

**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](https://www.facebook.com/pg/gallerytcr/events/?ref=page_internal)

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

**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; St 9-5, Sun 10-4; \$3/adult, \$1 students, children under 12 free. <http://www.ajrockclub.com/AboutWhoWeareAnnualShow.html>

**March 25-26 - Anthem, AZ** Daisy Mt. Club Show and Sale, Boulder Creek HS, 40404 N. Galvin Peak Parkway; Sat 9-5, Sun 9-4; Admission: \$3/adult, \$2/seniors & students; children free.

**June 2-4 - Flagstaff, AZ** Coconino Lapidary Club Gem, Mineral and Jewelry Show, Silver Saddle Outdoor Market, Hwy 89N & Silver Saddle Rd (3.5 mi north of Flagstaff Mall); 9-4 daily; Admission: free.

If you are travelling, a good source 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](http://whitemountain-azrockclub.org/Public_AZ_Clubs_Links.html)

**NOTE FROM THE EDITORS**

Have a geological interest? Been somewhere interesting? Have pictures from a club trip? Collected some great material? Send us pictures -- or write a short story (pictures would be great). We encourage topic suggestions also.

Deadline for the newsletter is the 22nd of the month.

Mail or Email submissions to:

Susan Celestian  
6415 N 183rd Av  
Waddell, AZ 85355  
azrocklady@gmail.com

And here is a note from a California lapidary blogger, inviting us to join here online:

Lapidary Lovers – a blog just for us!

Lapidary lovers now have a blog just for us! [www.LapidaryWhisperer.com](http://www.LapidaryWhisperer.com) has just come online and I hope you will check it out. It's an online community for lapidary lovers where I'll post a new blog entry every other Wednesday.

Yes, rocks and slabs whisper and tell me what they want to be, then I commit lapidary on them to bring out their stories.

I'd love to hear what you think about the blog. Please write me directly at [Donna@LapidaryWhisperer.com](mailto:Donna@LapidaryWhisperer.com) or if the comment box isn't showing at the bottom of the blog entry, click on "No Comment" at the bottom and the comments block will appear.

Let's enjoy this wonderful art and craft together!

Your Lapidary Whisperer, Donna Albrecht

**Officers and Chairpersons**

- President:** Ed Winbourne.....[ewinbourne@gmail.com](mailto:ewinbourne@gmail.com)
- Vice President:** Bob Salter
- Secretary:** Victoria Peterson
- Treasurer:** Cynthia Buckner
- Publicity:** Kathy Marvin
- Membership:** Victoria Peteson.....  
[g.victoriapeterson@yahoo.com](mailto:g.victoriapeterson@yahoo.com)
- Editors:** Susan & Stan Celestian.....  
[azrocklady@gmail.com](mailto:azrocklady@gmail.com)
- Field Trip:** Bob Salter
- Show Chair:** Ed Winbourne

Meetings are held the **1st Tuesday of the month** at the **Anthem Civic Building**, 3701 W Anthem Way, Anthem, AZ 85086. Business meeting at 6:30 pm. We do not meet in the summer — **no meetings in June, July or August.**

The purpose of Daisy Mountain Rock & Mineral Club is to promote and further an interest in geology, mineralogy, and lapidary arts, through education, field experiences, public service, and friendship.

**Membership Dues: \$20.00 Adults per Person  
\$25.00 Family**

**Meeting Dates for 2017**

Jan 3, Feb 7, Mar 7, Apr 4, May 2, Sept 5, Oct 3,  
Nov 7, Dec 5

# Garnets from the Aquarius Mountains

By Stan Celestian (text and illustrations)



The term **GARNET** is used to describe a family of closely related minerals. All are silicates that contain either Magnesium (Mg), Iron (Fe), Manganese (Mn) or Calcium (Ca). In fact, the metals can substitute within the structure, so that a Garnet may be a mixture of types. All of the Garnets have very similar crystal structure and physical properties.

## The most common Garnets

**Andradite**  $\text{Ca}_3\text{Fe}^{3+}_2\text{Si}_3\text{O}_{12}$

**Grossular**  $\text{Ca}_3\text{Al}_2\text{Si}_3\text{O}_{12}$

**Uvarovite**  $\text{Ca}_3\text{Cr}_2\text{Si}_3\text{O}_{12}$

**Almandine**  $\text{Fe}^{2+}_3\text{Al}_2\text{Si}_3\text{O}_{12}$

**Spessartine**  $\text{Mn}_3\text{Al}_2\text{Si}_3\text{O}_{12}$

**Pyrope**  $\text{Mg}_3\text{Al}_2\text{Si}_3\text{O}_{12}$

(Aquarius Mountain Garnets are a Almandine/ Spessartine mix.)

## Less common Garnets

**Goldmanite**  $\text{Ca}_3(\text{V},\text{Al},\text{Fe}^{3+})_2\text{Si}_3\text{O}_{12}$

**Knorringite**  $\text{Mg}_3\text{Cr}_2\text{Si}_3\text{O}_{12}$

**Majorite**  $\text{Mg}_3(\text{Fe},\text{Al},\text{Si})\text{Cr}_2\text{Si}_3\text{O}_{12}$

**Morimotoite**  $\text{Ca}_3\text{TiFe}^{3+}\text{Si}_3\text{O}_{12}$

**Kimzeyite**  $\text{Ca}_3(\text{Zr},\text{Ti})_2(\text{Si},\text{Al},\text{Fe}^{3+})_3\text{O}_{12}$

**Schorlomite**  $\text{Ca}_3(\text{Fe}^{3+},\text{Ti})_2(\text{Si}_3\text{O}_{12})$

**Calderite**  $(\text{Mn},\text{Ca})_3(\text{Fe}^{3+},\text{Al})_2\text{Si}_3\text{O}_{12}$

## Rare

**Hibschite**  $\text{Ca}_3\text{Al}_2(\text{SiO}_4)_{3-x}(\text{OH})_{4x}$  (where x is 0.2 to 1.5)

**Katoite**  $\text{Ca}_3\text{Al}_2(\text{SiO}_4)_{3-x}(\text{OH})_{4x}$  (where x is 1.5 to 3)

## GARNET PHYSICAL PROPERTIES

**Color:** Garnets come in a large variety of colors including red, brown, black, green, yellow, orange, pink, white, colorless, and they can be multicolored. Bluish garnet has not been observed.

**Streak:** Colorless

**Hardness:** 6.5 to 8.0

**Transparent** to opaque

**Density:** 3.5 to 4.3

**Luster:** Vitreous, adamantine to dull

**Cleavage:** None and displays conchoidal fracture

**Tenacity:** Brittle, behaves like glass when broken



Garnets continued on page 10.....

.....Garnets continued from page 9

## CRYSTAL FORMATION

The Aquarius Mountains are the result of successive volcanic eruptions that took place between 7 and 9 million years ago. After the formation of the rhyolite, hot gases were still present and moving through the already solidified rock. These hot gases contained an abundance of water, in the form of **superheated** steam. As this fluid (gas) passed through the cracks, produced by the flow and contraction of the cooling rock body, it carried many dissolved ions to areas of lower temperatures and pressures. This change caused the ions to begin to deposit out of the gases, thus creating crystals of garnets and topaz, along with minor amounts of hematite, and fluorite.



**The Aquarius Mountains of Arizona** The dark cliffs are the rhyolite and below the rhyolite are lighter-colored beds of tuff and volcanic agglomerate. The dark color of the rhyolite is a surface coating, produced by weathering. Below this thin veneer, is a very light-colored rock. It is within the upper rhyolite that the garnets are found.

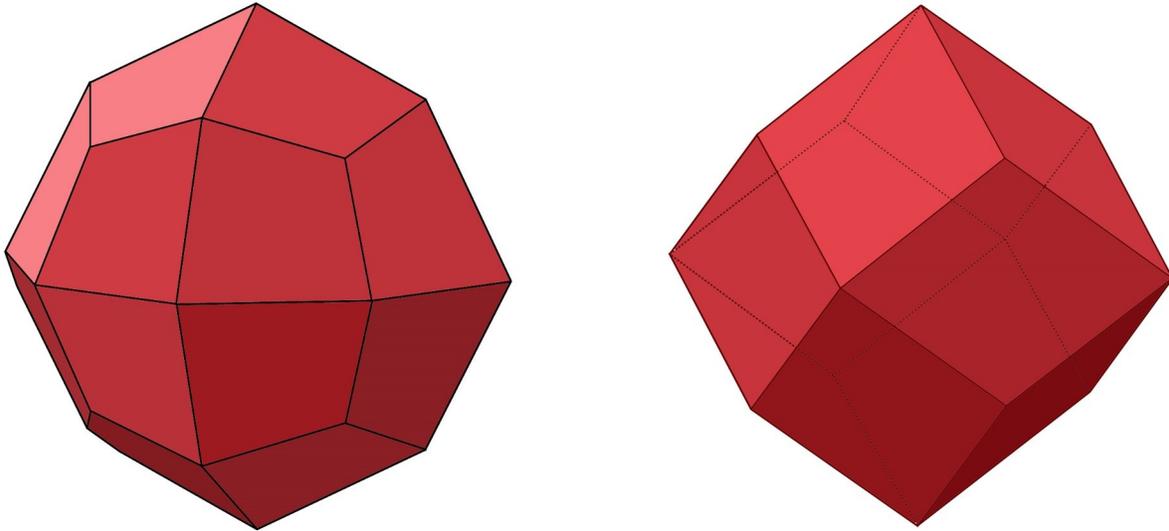
*Photo by Stan Celestian*

The garnets at Aquarius Mountain, more specifically, Lion Springs, on Elephant Mountain (if you are looking at a topographic map), are trapezohedral crystals modified by dodecahedral faces. See the description on page 11.

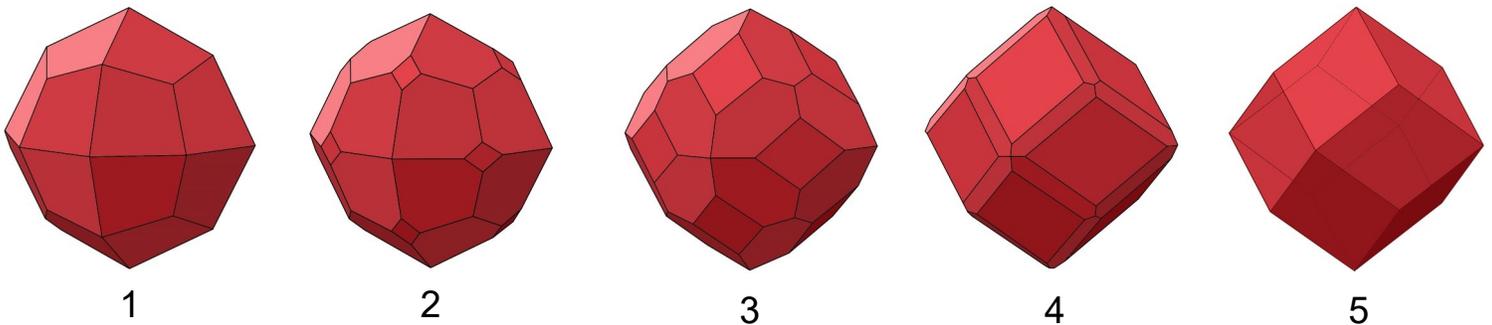
*Garnets continued on page 11.....*

.....Garnets continued from page 10

This diagram illustrates the basic **trapezohedron** (left) and the **dodecahedron** (right). These are crystal forms within the cubic crystal system.



Combining the forms in different amounts can create this sequence:

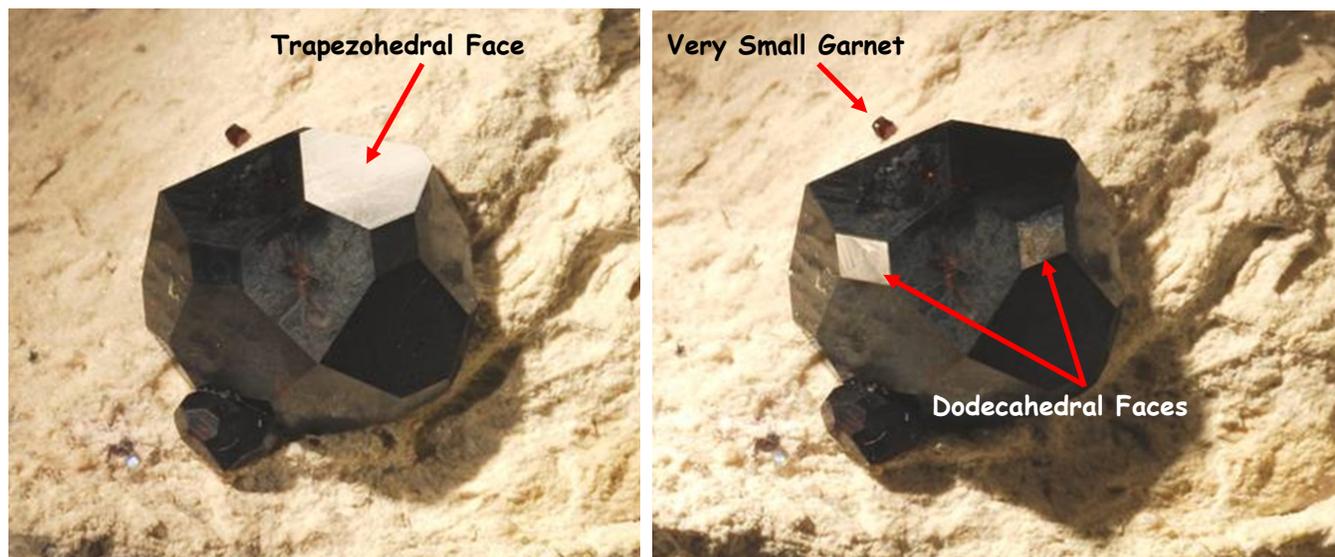


This sequence shows a trapezohedron (1) being progressively modified so that the end result is a dodecahedron (5). In diagram (2) the corners of the trapezohedron have been truncated by small dodecahedral faces (diamond shaped). In (3) the dodecahedral faces become bigger. In (4) the dodecahedral faces have dominated the crystal so it looks more like a modified dodecahedron, rather than a trapezohedron. In (5) the transition is complete.

In the Aquarius mountains, the most common forms found in the garnet crystals are variations on (2) with the dodecahedron faces a little smaller or a little bigger. Because crystal growth is not perfect, in many cases the faces are distorted producing faces that are stretched longer in one direction or another. Some dodecahedral faces may be missing entirely.

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Here are some examples of the crystal faces displayed by the garnets of the Aquarius Mountains.

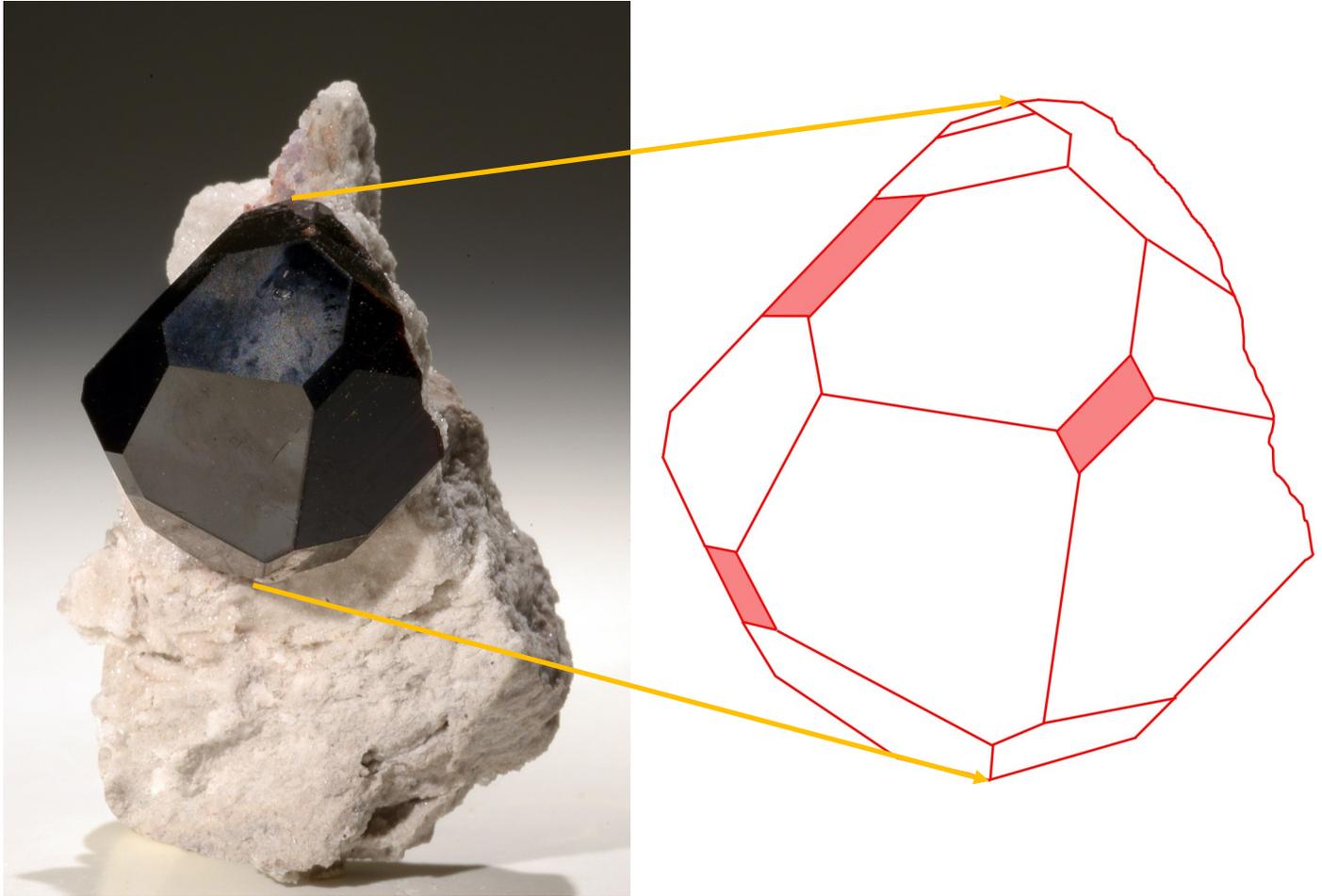


This pair of pictures (of the same crystals) shows a trapezohedral face on the left image that is brightly reflecting light. With a change in the direction of lighting, the right image shows smaller dodecahedral faces reflecting light. Note also the very small crystal above this larger crystal. It is just under 1 mm in size. A close-up view of this crystal is below.



Even this very small crystal show the combination of forms of the trapezohedron modified by dodecahedral faces.

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This pair of images shows the garnet perched on a piece of rhyolite and a line drawing of the crystal faces. In the line drawing the dodecahedral faces have been shaded. Note the distorted shapes of the dodecahedral and trapezohedral faces.



This crystal displays primarily trapezohedral faces. The light-colored crystal attached on the right is a topaz crystal. Attached to the topaz is a very small hematite crystal. Two small hematite crystals are also just above the garnet crystal.

One last comment on the collecting of the garnets. In the crystal collecting community, it is much more preferred to keep the crystal on matrix (the surrounding rock), rather than breaking it free of the matrix.