Nittany Mineralogical Society Bulletin

Nittany Mineralogical Society, Inc., meeting in State College, Pennsylvania
Contact information on back page

August, 2020 **Visit our web site: www.nittanymineral.org** *Editor (see back page): David C. Glick*

August 19th Zoom meeting ONLINE: Show & Tell

We plan to try our first *ONLINE* Zoom meeting on August 19th. We'll plan to start at 7:30; it may take a while to get people connected, then we can do any questions & answers and announcements, and plan to start the Show & Tell portion at 8:00 p.m. Please bear with us as we are on the organizing side of a Zoom meeting for the first time.

If you think you might participate (including just watching), please email <xidg@verizon.net> from the email address that you plan to have access to during the meeting. (One way to do this is by replying to the email which announced this Bulletin.) We will email back to you the Zoom link and instructions. Please don't give that information out - if someone else wants to participate, it's open to all, they just need to email and get the Zoom link so that we can know who's who.

If you plan to do a Show & Tell segment (which should be no longer than 10 minutes), please plan in advance to have good lighting for the subject of your webcam, and a microphone that's not picking up extraneous noise.

We will have some information on the main page of the web site as well.

While We Can't Travel: Virtual Geo-Resources

We will continue to add to the interesting resources on the main page of our web site.

While many of us are stuck at home, museums and professional organizations may be offering new material to view on the internet. **Penn State's Earth & Mineral Sciences Museum and Art Gallery** has added more "virtual museum" postings since last month on <https://www.facebook.com/EMSMAAG/>. The AFMS Newsletter, Rock & Gem magazine, and others have links to virtual field trips; see the NMS web site for some links. *-Editor*

FEDERATION NEWS

Nittany Mineralogical Society, Inc., is a member of EFMLS, the Eastern Federation of Mineralogical and Lapidary Societies, and therefore an affiliate of AFMS, the American Federation of Mineralogical Societies. The **Federation leaders and our Society strongly encourage all members to read the monthly Federation Newsletters, available on their web sites**, which are linked from our web site, www.nittanymineral.org . We present brief summaries here in order to encourage readers to see the entire newsletters. There's a lot there!

The July (special edition) **EFMLS News** notes that the Wildacres Workshop August session has been cancelled. The October 22-26 EFMLS Convention in Hickory NC is still scheduled to take place. Going back to the regular June edition, various thoughts on virtual meetings and ways to deal with COVID restrictions are presented. The safety article discusses having the best emergency contact numbers & methods for all club members. An editorial provides an extensive list of scams (phone, text, email, etc.) to avoid; one new one is scammers pretending to be COVID-19 contact tracers in an effort to get personal information.

The **AFMS Newsletter** June issue safety article asserts that "Size Matters" for properly fitting COVID-19 masks. Juniors can be kept engaged with available programs, occasional e-mails, etc. One example is a weekly email contest, Name the Specimen – And It's Yours! Other articles include inferences made from Patagonian fossil beds, from a Cretaceous West Antarctic rainforest, and The Earth Is One Gigantic Novel, Just Waiting to be Read. *-Editor*

All of us at NMS sincerely hope that everyone is in good health and will continue to be well. We look forward to being together again.

From the collections

Dr. Charles E. Miller, Jr.

This is Part 2 in a series of articles showcasing images and specimens in the writer's collection.

Part 2: Granite pegmatites in Pennsylvania and Delaware

Pegmatites are exceptionally coarse-grained igneous rocks, usually of granitic composition. Major constituent minerals of granite pegmatites are quartz, feldspar, and mica. Large crystals (> 3 cm in length) and some unusual mineral associations (Figures 1-6) distinguish them from granites. These characteristics also make them appealing to collectors. They occur in irregular-shaped dike-like intrusive habits a few to hundreds of feet across, and represent either a late-stage fraction of a cooling igneous body, or the early melt in strata undergoing prograde metamorphism (recrystallization due to increased metamorphism). They are a haven for misfit elements, which give rise to a treasure trove for free-growing exotic minerals.

"Pegmatite" is a textural term and does not connote composition. In this way, it is similar to sandstone, another textural term. "Sandstone" connotes grain size (texture) and can be of any composition. However, the term is so misused that some think of sandstone as always made of quartz. Sandstone can be of any composition such as feldspar (arkoses), basalt (black sands of Hawaii), olivine (green sands of Hawaii), etc. The same is true for pegmatites. Their composition relates to the parent igneous body with which they are associated, varying accordingly.

The most identifying feature of pegmatites are large crystals, some of which can be extremely large. For example, spodumene crystals up to 50 feet in length are described in pegmatite at the Etta Mine of South Dakota. Equally impressive is a quarry, measuring 30 x 30 feet, in the Ural Mountains developed in a single, massive feldspar crystal. Some of the world's largest crystals of precious and semi-precious minerals are from pegmatites at Minas Gerais, Brazil. These and other pegmatites produce tourmaline, beryl, topaz, garnet, and sapphires.

Seminal work on granites, including granite pegmatites, was done at Penn State. Those studies involved Richard Jahns and C. Wayne Burnham. Some of their observations are summarized. Ground-floor hallways in Deike Building used to display polished granite slabs reflecting that research.

Introductory geology teaches that macro-sized crystals in igneous rocks are usually attributed to slow crystallization. The axiom is: longer cooling time

Figure 1: Pegmatite specimen (measuring 11” x 7.5” x 5”) showing a 2.6-inch-thick book of muscovite mica (right half of image). Delaware, 1973. Basal cleavage of the mica is well shown. Collected and photographed by the author. Note quarter for scale.

Figure 2: Pegmatite specimen (9" x 6" x 5") with 3-inch-thick book of muscovite mica. Other minerals include quartz and feldspar. Delaware, 1973. Note quarter for scale. Collected and photographed by the author.

produces larger crystals. When comparing aphanitic (too small to see with the unaided eye) and phaneritic (macro-size) igneous textures, one can see the aforementioned relationship. The former cooled faster than the latter. Pegmatites - obviously phaneritic igneous rocks - do not follow that paradigm. They represent the last and most hydrous portion of a magma to crystallize. Presence of low-viscosity hydrothermal fluids allows ions to be very mobile, facilitating growth of large crystals.

Figure 3: Hand specimen of muscovite mica (10” x 4.5” x 5.5”); Delaware, 1973. Note quarter for scale. Collected and photographed by the author.

This article references selected granite pegmatites in southeastern Pennsylvania and adjacent Delaware. They occur as dikes (Figures 7 and 8), many of which were mined for feldspar, kaolin, and mica. A long mining history has virtually depleted these pegmatites of economically valuable minerals. With cessation of mining, some remaining exposures became collecting localities. General Geology Report G33, Mineral Collecting in Pennsylvania, describes several pegmatite collecting sites. Unfortunately, some of those (Figure 8) are no longer accessible.

Figure 4: Black tourmaline (schorl) crystal (1.7" x 0.8") in matrix of feldspar, quartz, and muscovite mica. Collected and photographed by the author. Note quarter for scale.

Pennsylvania's pegmatites offer a wide variety of minerals. At one site, 29 minerals are identified. Of these, commercial interests principally focused on feldspar, kaolin, mica, and corundum. Feldspar is used in glassmaking, ceramics, paint, plastics, rubber, and toothpaste. In toothpaste, it serves as a polishing agent.

Consider that feldspar and human teeth have hardnesses of 6-6.5 and 5, respectively, on the Mohs Hardness Scale. Kaolin/kaolinite, a clay, is usually from chemical weathering of feldspar. Today, it is mostly used in paper production, ensuring a gloss on some paper grades. Originally, it was the primary ingredient in Kaopectate, an oral medication for diarrhea. Kaolin has an interesting association with climate. It mostly occurs in soils in hot, moist climates. Soil comparisons along a gradient toward cooler and drier climates show kaolinite decreases, whereas other clays such as illite and smectite, respectively, increase. These relationships are used to infer past climate changes. The principal form of mica mined is muscovite. It is used in electrical applications and as joint compounds to finish drywall and white foam in artistic aerosols. Corundum has a hardness of 9 on the Mohs Hardness Scale. This extreme hardness makes it suitable as an abrasive but it also has many other applications. Corundum has two primary gem varieties: ruby and sapphire, neither of which have been identified in referenced pegmatites.

Figure 5: Schorl tourmaline (6" x 3." x 12.5") in pegmatite. Delaware, 1973. Collected and photographed by the author. Note quarter for scale.

Of special note in the referenced pegmatites are the semi-precious silicate minerals tourmaline, beryl, and garnet. These are much less common constituents. Tourmaline occurs in a wide variety of colors. In the pegmatites, the black variety known as schorl (Figures 4-6) is most common. Schorl accounts for more than 95 percent or more of all tourmaline in nature. Beryl mostly occurs as crystals less 0.5 inches in length, but some have lengths of several inches. Emerald is green beryl. No emeralds are known from these pegmatites. Garnets are used as abrasives.

Figure 6: Schorl tourmaline in pegmatite. Delaware, 1973. Collected and photographed by the author. Note quarter for scale.

Pennsylvania's pegmatite quarries were small, by most comparisons. However, what they lacked in size they made up for in numbers. Older publications such as the 1932 Coatesville-West Chester Folio describe a plethora of pegmatite operations, long since abandoned.

Figure 8: Highly-weathered pegmatite in gabbroic gneiss. Coatesville, PA; 1973. Image by the author. This is no longer available for collecting. It is identified as the "Coatesville Pegmatite Locality" in Bulletin G33.

Figure 7: Pegmatite dike intruding gabbroic gneiss; Coatesville, PA; 1973. Image by the author.

The World of Minerals

The *World of Minerals* is a monthly column written by Dr. Vivien Gornitz on timely and interesting topics related to geology, gemology, mineralogy, mineral history, etc.

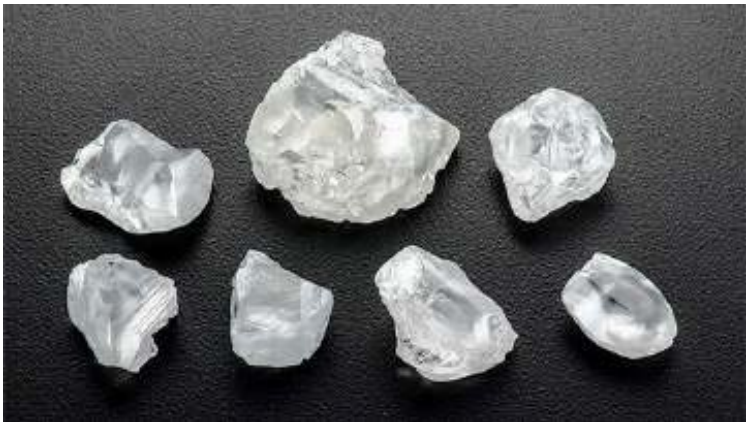
Inclusions in Giant Diamonds: A Window into the Earth's Interior

Dr. Vivien Gornitz

Bulletin of the New York Mineralogical Club, Inc.,
August 2018, Editor not shown
2019 AFMS Bulletin Editors' Contest
Original Adult Article Advanced Award, 3rd Place Winner

CLIPPIRs—a new class of diamonds

The world's largest and purest diamonds—the Cullinan, 3106 carats when found in 1905, the second largest—a 1,111 carat giant from the Karowe Mine, Botswana, and the sixth largest, the 812 carat Constellation from the same mine (auctioned in 2016 for $63.1 million) belong to a recently recognized elite class of diamonds—the CLIPPIRs. These exceptional gemstones are characterized by the large size, high degree of purity, overall scarcity of inclusions, and irregular shapes that bear signs of dissolution and etching. What few inclusions they harbor unveil the story of the origins—one that differs considerably from most other diamonds and sheds new light on the deep Earth.



Ordinary diamonds, in stark contrast to CLIPPIRs, crystallize within the mantle keel, a cold, rigid region of the Earth's upper mantle, 150-200 km (95-125 mi) deep. They are later brought to the surface by kimberlite[1],a magmatic rock composed of a mix of mantle minerals, volatiles, peridotite and eclogite—diamond host rocks, along with fragments of other rocks encountered on the upward journey. Characteristic inclusions differentiate diamonds from these two host rocks. Common peridotitic inclusions in diamond include olivine, emerald green Cr-diopside, purplish-red Cr-pyrope, and sulfides. On the other hand, orange grossular-almandine-pyrope and green omphacite (a diopside-jadeite pyroxene) typify an eclogitic origin.

[1] Two other rock types—lamproite and lamprophyre–less commonly also transport diamonds to the surface.

"CLIPPIR" is an acronym for **C**ullinan-like, **L**arge, **I**nclusion-**P**oor, **P**ure, **I**rregular, and **R**esorbed

A completely different suite of inclusions reside within CLIPPIRs. Among scarce inclusions, most commonly present is a metallic mixture of iron, nickel, carbon, and sulfur. These irregularly-shaped inclusions exhibit strong magnetism. A thin fluid film of methane (CH_4) and hydrogen (H_2) envelopes the inclusions and separates them from the surrounding diamond. Upon closer inspection, the inclusions consist of cohenite $(Fe,Ni)_3C$, Fe-Ni metal, pyrrhotite ($Fe_{1-x}S$), with minor iron chromium oxide, iron oxide (wüstite, FeO), and iron phosphate. These minerals, some of which also occur in meteorites, indicate a fairly oxygen-deficient source. Furthermore, the inclusions probably represent remnants of the molten metallic liquid associated with the growth of the diamonds. The observed assemblage of minerals within the inclusions presumably crystallized from the melt as pressures decreased on the way up to the surface.

Silicate inclusions have also been observed. These include a $CaSiO_3$-walstromite, larnite (ß-Ca_2SiO_4), a $CaSi_2O_5$ analog of titanite (which contains Ti), and wollastonite ($CaSiO_3$). The silicates are assumed to have recrystallized from a precursor $CaSiO_3$ analog of perovskite ($CaTiO_3$) during diamond transport upward toward lower pressure regimes. Majorite garnet—a high pressure form of garnet—also appears. The inclusions originated at estimated depths of 360 to 750 km (220-470 mi), which overlaps with the mantle transition zone (410-660 km; 255-410 mi) which lies between the upper and lower mantle.

What the CLIPPIRs reveal about the Earth's interior

The CLIPPIR inclusions greatly expand our understanding of deep mantle processes. The Earth's core is essentially composed of metallic iron admixed with a number of other elements, whereas the mantle consists of various silicate minerals that undergo changes in composition and crystal structure depending on temperature, pressure, and depth. CLIPPIR diamonds modify this traditional view. Molten iron, once thought confined to the upper core, appears to be

widely dispersed throughout the lower mantle transition zone. There, the molten metal plays an important geochemical role in influencing the distribution and recycling of many elements such as oxygen, carbon, nitrogen, hydrogen, and sulfur that dissolve in it. The metallic iron also helps regulate the oxidation state of the mantle, because iron is chemically reactive and can exist as the neutral metal, Fe^{3+}, and Fe^{2+}.

The carbon in CLIPPIRS offers other important clues. The carbon is strongly enriched in the lighter ^{12}C isotope relative to ^{13}C.Various geological and biological processes can alter the proportions of these two isotopes. Mantle $^{13}C/^{12}C$ isotope ratios vary over a very narrow range. By contrast, a strong ^{12}C enrichment relative to ^{13}C is characteristic of crustal materials of biologic origin, since living organisms preferentially incorporate more ^{12}C than ^{13}C into their metabolism. Eclogitic diamonds also display a broad range in carbon isotope ratios, veering toward enrichment in the lighter C. Eclogites generally originate as slabs of oceanic basalts and deep sea sediments dragged into the mantle by subduction. The ^{12}C enrichment in CLIPPIRs therefore implies that subduction processes may have extended to greater depths in the mantle than usually assumed. A subduction origin may also account for the presence of calcium in the silicate inclusions. Oceanic sediments containing calcite, $CaCO_3$, may have been the ultimate source of the Ca, although this is still speculative.

The largest diamonds, predominantly CLIPPIRs, disproportionately classify as type IIa diamonds, often of D color grade (perfectly colorless in the GIA classification). Type IIa diamonds are nearly devoid of nitrogen, N, impurities that often give the gemstones an undesirable yellowish hue. The lack of N implies that either the lower mantle is deficient in this element, or that the metallic mineral inclusions may have scavenged any N.

CLIPPIR diamonds, by virtue of their large size and near flawless character, represent highly desirable and expensive gemstones. However, these special treasures also offer an important window into the deep mantle, an otherwise remote and inaccessible region of the Earth.

Further Reading

Smith, E.M., Shirey, S.B., and Wang, W., 2017. The very deep origin of the world's biggest diamonds. Gems & Gemology, Winter 2017, 53(4):388-403.

Smith, E.M., Shirey, S.B., Nestola, F., Bullock, E.S., Wang, J., Richardson, S.H.,Wang, W., 2016. Large gem diamonds from metallic liquid in Earth's deep mantle. Science 354(6318):1403-1405.

July 12 Bellwood Field Trip Report

by Dr. Andrew Sicree

Junior Museum of Central Pennsylvania sponsored a fossil collecting trip and invited NMS members and guests. ***Thank you****, Junior Museum and Dr. Sicree! - Editor*

We had a great turnout at the I-99 Bellwood Exit in Blair County, about 10 cars for a total of about 30 people. Lots of young kids were in attendance; mostly people from Centre County, some people from Altoona.

It was sunny when we left State College but was raining at the site. We waited about 15 minutes and the rain stopped. Then we all went collecting. People spread out over the outcrop.

Some great fossils were found including a really nice cephalopod about three inches long, a large gastropod about one inch long (both big ones for that site). Several people collected some well-formed favositid corals. Everyone got some or lots of small smooth brachiopods (*Whitfieldia*), and lots of ostracods were found, too. There were minerals as well - we found calcite, dolomite, (including a nice calcite-lined vug) and one small quartz crystal. A good day!

Geo-Sudoku

by David Glick

This puzzle contains the letters CEIMOSTUV; one row or column spells a mineral in some pegmatites.. As usual, if you've read this issue, you've seen it. Each block of 9 squares, each row, and each column must contain each of the nine letters exactly once. The solution is on page 8.

T						V	U	I
	C	V		M				
		E		S		C		O
						U	V	C
	U			O	V	I	T	
	T	C	I					
						O		
S	V	O			C			
			O			M	C	U

NMS BOARD MEETING NOTICE

NMS members are invited to attend Board of Directors meetings, which are generally held at 7:00 p.m. about two weeks prior to the general monthly meeting, although we do not meet every month. **The next date has not been set due to the coronavirus situation.** Members who would like to attend should contact president David Glick to verify time and place; those who would like to have their discussion item placed on the agenda should contact him at least one week in advance of the meeting.

Some Upcoming Shows and Meetings

Our web site http://www.nittanymineral.org has links to more complete lists and details on mineral shows and meetings around the country. See www.mineralevents.com for more.

Most upcoming events have been canceled.
Verify show schedule before traveling!

EFMLS Convention rescheduled to October 22-26.

Geo-Sudoku Solution

T	S	M	E	C	O	V	U	I
O	C	V	U	M	I	T	E	S
U	I	E	V	S	T	C	M	O
E	O	I	S	T	M	U	V	C
M	**U**	**S**	**C**	**O**	**V**	**I**	**T**	**E**
V	T	C	I	E	U	S	O	M
C	M	U	T	I	E	O	S	V
S	V	O	M	U	C	E	I	T
I	E	T	O	V	S	M	C	U

INVITE A FRIEND TO JOIN THE SOCIETY

The Nittany Mineralogical Society prides itself on having among the finest line-up of speakers of any earth sciences club in the nation. Everyone is welcome at our meetings. If you'd like to be part of our Society, dues are $20 (regular member), $7 (student rate), $15 (seniors), $30 (family of two or more members, names listed). Those joining in March or later may request pro-rated dues. Your dues are used for programs and speakers, refreshments, educational activities, Bulletins, and mailing expenses. Please fill out a membership form (available at www.nittanymineral.org), make checks payable to "Nittany Mineralogical Society, Inc." and send them in as directed, or bring your dues to the next meeting.

We want to welcome you!

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The **Bulletin Editor** will welcome your submissions of articles, photos, drawings, cartoons, etc., on minerals, fossils, collecting, lapidary, and club activity topics of interest to the members. Please contact:

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Newsletter submissions are appreciated by the first Wednesday of the month. Photographs or graphics are encouraged, but please do not embed them in word processor files; send them as separate graphics files (TIF, or good to highest quality JPEG files, about 1050 pixels wide, are preferred). Please provide captions and name of photographer or artist.

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