THE PICKING TABLE

JOURNAL OF THE FRANKLIN-OGDENSBURG MINERALOGICAL SOCIETY

VOL. 57, NO. 1 – SPRING 2016

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- Tilasite: A New Assemblage From Sterling Hill
- Lime Crest Quarry's Aluminum-Rich Assemblages
- Fluorescent Opal From Franklin and Ogdensburg

www.FOMSNJ.org

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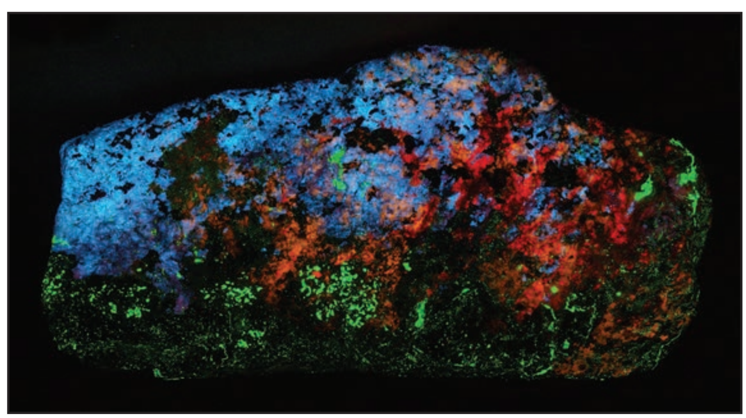

A spectacular fluorescent specimen from the John L. Baum collection, shown here under shortwave UV: margarosanite (intergrown with feldspar), axinite-(Mn), clinohedrite, and willemite, along with nonfluorescent hendricksite, andradite, and franklinite. This specimen, now no. 7472 of the Franklin Mineral Museum, measures 8.5" × 4.1" × 3.5" (21.5 × 10. 5 × 9 cm).

THE PICKING TABLE

VOL. 57, NO. 1 – SPRING 2016

About the Front Cover

The far southeastern wall of the Lime Crest Quarry, as seen during a summer 2000 FOMS field trip. Dark-colored gneisses in the upper part of the quarry overlie the lighter-colored Franklin Marble. This is the part of the quarry that yielded the corundum and spinel assemblages described by Warren Cummings in this issue of *The Picking Table. Photo courtesy of Bernard Kozykowski.*

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The Picking Table is the official publication of the Franklin-Ogdensburg Mineralogical Society, Inc. (FOMS), a nonprofit organization, and is sent to all members. *The Picking Table* is published twice each year and features articles of interest to the mineralogical community that pertain to the Franklin-Ogdensburg, New Jersey, area.

Members are encouraged to submit articles for publication. Articles should be submitted as Microsoft Word documents to Richard J. Keller, Jr. at: PTMemberFeedback@gmail.com.

The views and opinions expressed in *The Picking Table* do not necessarily reflect those of FOMS or the editors.

FOMS is a member of the Eastern Federation of Mineralogical and Lapidary Societies, Inc. (EFMLS).

The Picking Table is printed on acid-free, chlorine-free paper.

Spring and Summer 2016 Activity Schedule

COMPILED BY TEMA J. HECHT
600 WEST 111TH STREET, APT. 11B
NEW YORK, NY 10025
thecht@att.net

SATURDAY, MARCH 19, 2016

9:00 AM – NOON
FOMS Field Trip
Collecting at the Taylor Road site.
Meet at the Franklin Mineral Museum.
Park, and walk from there. Fee charged.

10:00 AM – NOON
FOMS Micro Group – pending
Franklin Mineral Museum.
Call Ralph Thomas, 215-295-9730, for more information.

1:30 PM – 3:30 PM
FOMS Meeting
Franklin Mineral Museum.
Lecture: *Processing Ogdensburg Ore and Other Perspectives From the Past*, by Peter Kern.

SATURDAY AND SUNDAY, APRIL 2–3, 2016

****27th Annual North Jersey Gem, Mineral & Fossil Show**
***New Location:* Midland Park High School,**
250 Prospect St., Midland Park, N.J.
Saturday: 10:00 AM – 6:00 PM Sunday: 10:00 AM – 4:00 PM
Admission: $5.00 per person; $4.00 per senior adult;
free admission for children under 12 and uniformed scouts.

FRIDAY, SATURDAY, AND SUNDAY, APRIL 8–10, 2016

****5th Annual NY/NJ Mineral, Fossil, Gem & Jewelry Show**
New Jersey Convention & Expo Center, Raritan Center
97 Sunfield Avenue, Edison, N.J.
Friday: NOON – 9:00 PM
Saturday and Sunday: 10:00 AM – 6:00 PM
Admission: $10.00 per adult; $5.00 for children aged 5 to 12;
free admission for children under 5 years old.

SATURDAY, APRIL 16, 2016

9:00 AM – NOON
FOMS Field Trip
Collecting at the former B. Nicoll Quarry
(now Technology General Corp.), Franklin, N.J.
Directions: From Franklin Avenue, take Cork Hill Road ¼ mile south to 12 Cork Hill Road on the right; follow sign to Technology General Corp., and park on left as directed. Walk to the collecting site, which is to the south along the former railroad bed and just beyond the south end of the former B. Nicoll Quarry, to the right along the embankment.
Members are cautioned to stay out of the quarry and away from the quarry walls that define the edge of the high ground of the collecting areas.

10:00 AM – NOON
FOMS Micro Group – pending
Franklin Mineral Museum.
Call Ralph Thomas, 215-295-9730, for more information.

1:30 PM – 3:30 PM
FOMS Meeting
Franklin Mineral Museum.
Lecture: *Synthetic Gemstones and Industrial Minerals*, by John Sanfaçon.

3:30 PM – 4:15 PM
MINERAL OF THE MONTH — RHODONITE
Bring your specimens for show-and-tell and discussion after the lecture.

6:00 PM
****Annual Museum Members-Only Mineral Sale and Auction**
Franklin Mineral Museum.

SATURDAY AND SUNDAY, APRIL 23 AND 24, 2016

44th Annual NJESA Gem & Mineral Show
Held in conjunction with the
21st Annual FOMS Spring Swap-and-Sell.
Sponsored by the New Jersey Earth Science Association,
the Sterling Hill Mining Museum,
and the Franklin-Ogdensburg Mineralogical Society, Inc.
Franklin Middle School, Washington St., Franklin, N.J.
NJESA Show hours:
Saturday, 9:00 AM – 5:30 PM; Sunday, 10:00 AM – 5:00 PM
Swap-and-Sell hours:
Saturday, 8:00 AM – 5:30 PM; Sunday, 9:00 AM – 5:00 PM
Admission: $6.00 per person, children under 14 free with paying adult.
For Swap-and-Sell information,
contact Chet Lemanski after 8:00 PM at 609-893-7366.

Banquet and Auction
Saturday evening at the GeoTech Center, Sterling Hill Mining Museum.
Admission limited to 60 people.
Social hour: 5:30 PM – 6:30 PM
All-you-can-eat buffet: 6:30 PM – 9:30 PM
Banquet tickets are $20.00 each and include all food,
coffee, tea, and soft drinks. **BYOB!!**

Silent auction: 5:30 PM – 7:30 PM
Live auction: 7:45 PM
Both auctions are for the benefit of all three show sponsors:
NJESA, FOMS, and SHMM.

****Field Collecting: Super Dig**
Sterling Hill Mining Museum.
Organized by the Delaware Valley Earth Science Society (DVESS).
Schedule: Saturday, 9:00 AM – 11:00 PM
$21.00 per person includes extended mine tour and registration.
FOMS members are covered by our club insurance!
$1.50 per pound for material collected. Preregistration required;
see **www.uvworld.org** for more information.

****Sterling Hill Garage Sale**
Christiansen Pavilion, Sterling Hill Mining Museum.
Saturday and Sunday, 10:00 AM – 3:00 PM

****Collecting on the Mine Run Dump and in the Fill Quarry, Passaic Pit, and "Saddle" area.**
Sterling Hill Mining Museum, **Sunday only**.
9:00 AM – 3:00 PM **(Open to the public!)**
Fees for mineral collecting:
$5.00 admission plus $1.50/lb for all material taken.

SUNDAY, MAY 1, 2016

NOON
****Annual Volunteer Appreciation and Miners Day Tribute**
Franklin Mineral Museum.
Including special program and a concert by the famous Franklin Band.
!!! Attendance by invitation only. !!!

SATURDAY AND SUNDAY, MAY 14 AND 15, 2016

****NORTH JERSEY MINERALOGICAL SOCIETY SWAP & SALE**
9:00 AM – 5:00 PM
Sterling Hill Mining Museum.

SATURDAY, MAY 21, 2016

9:00 AM – NOON
FOMS Field Trip
Collecting at the Hamburg Quarry of Eastern Concrete Materials, Inc., on Route 23 just north of Hamburg.
Meet at the scale house to sign releases. Hard hats, leather shoes (preferably steel tipped), gloves, and safety glasses **required.**
Weight of individual specimens is limited to 25 lbs.
Bulk collecting/loading of specimens is strictly prohibited.

10:00 AM – NOON
FOMS Micro Group – pending
Franklin Mineral Museum.
Call Ralph Thomas, 215-295-9730, for more information.

12:30 PM – 3:30 PM
FOMS BBQ and Swap-and-Sell
Christiansen Pavilion, Sterling Hill Mining Museum.
YOU *MUST* RSVP BY MAY 2 to Tema Hecht: fomsnj@gmail.com.
!!! THIS BBQ IS FOR FOMS MEMBERS ONLY !!!

SATURDAY, JUNE 18, 2016

8:45 AM – NOON
FOMS Field Trip
Collecting at the Braen Franklin Quarry,
Cork Hill Road, Franklin, N.J.
If gate is open, drive through and park to the left of the gate. Please don't block the roadway. Meet at the scale house to sign releases. Hard hats, leather shoes (preferably steel tipped), gloves, and safety glasses **required.**
Participants MUST arrive by 8:45 AM to register! Members will then be escorted to the collecting site. Latecomers prohibited!

10:00 AM – NOON
FOMS Micro Group – pending
Franklin Mineral Museum.
Call Ralph Thomas, 215-295-9730, for more information.

1:30 PM – 3:30 PM
FOMS Meeting
Franklin Mineral Museum.
Lecture: *Collecting Minerals by Boat in Alaska*, by Ted Johnson.

3:30 PM – 4:15 PM
MINERAL OF THE MONTH — ESPERITE
Bring your specimens for show-and-tell and discussion after the lecture.

6:00 PM – 10:00 PM
****Night Collecting on the Mine Run Dump and in the Passaic Pit and "Saddle" area.**
Sterling Hill Mining Museum.
Fees for mineral collecting:
$5.00 admission plus $1.50/lb for all material taken.
Eye protection, flashlight, hammer (carpenter's claw hammers not allowed), and UV lamp advised.
!!! Open to Sterling Hill Mining Museum members only. !!!

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Scheduled activities of the FOMS include meetings, field trips, and other events. Regular meetings are held on the third Saturdays of March, April, May, June, September, October, and November, and generally comprise a business session followed by a lecture. FOMS meetings are open to the public and are held at 1:30 PM, usually in Kraissl Hall at the Franklin Mineral Museum, 30 Evans St., Franklin, N.J. (check listings for exceptions).

Most FOMS field trips are open only to FOMS members aged 13 or older. Proper field trip gear required: hard hat, protective eyewear, gloves, sturdy shoes.

**Activities so marked are not FOMS functions but may be of interest to its members. Fees, and membership in other organizations, may be required. Any information in this schedule, including fees, is subject to change without notice.

President's Message

MARK DAHLMAN
11906 SCOVELL TERRACE
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contactmdd@gmail.com

Thanks to all of you who prepared and staffed our club table in April at the NY/NJ Metro show in Edison. Thanks in advance to those of you helping at the NJESA Show in Franklin at the end of April too. As busy as that show weekend is, taking part is always enjoyable and it really helps our club. There are lots of ways to help such as show setup, letting in the Pond dealers, helping with the banquet and auction, staffing the club table, putting in an exhibit, or tearing down on Sunday. It's a full weekend, with a lot of chances for you to be part of it.

Another chance to catch up with friends will be in May when, instead of our regular meeting, we'll have a cookout, swap, and sale for FOMS members. The event will be at the Sterling Hill Mining Museum's Christiansen Pavilion on our normal meeting day, Saturday, May 21, following the field trip. Bring some rocks to swap or sell if you'd like, enjoy lunch, and take some time to talk with other FOMS members. You must RSVP since we need to know how much food to buy. Members should RSVP to Tema Hecht at **fomsnj@gmail.com**. Watch for more information on our Facebook page and our society website, **www.fomsnj.org**.

Recently FOMS members generously donated time and money to modernize the TV in the Franklin Mineral Museum's Kraissl Hall where we hold our meetings. A new 75″ 4K TV now hangs in Kraissl Hall. The museum will be able to use this display for presentations, and FOMS will also benefit by using it during our meetings. The TV, along with a new, larger projector screen, also recently donated by FOMS members, will make presentations in the museum that much more enjoyable.

Finally, new members are a healthy sign for any club. Why not sponsor one? If you know people who might enjoy being in FOMS, consider bringing them to our meeting or giving them a membership for their first year. After all, we need to encourage people who will be around to buy our collections when the time comes. While on the subject of money, don't forget that FOMS will gladly provide you with a letter acknowledging any donations you care to make to our 501(c)(3) charitable organization. With such tax-deductible contributions, FOMS can continue to support scientific and educational earth-science activities. Please contact our treasurer, Denise Kroth, if you'd like to help. ⚒

From the Editor's Desk

RICHARD J. KELLER, JR.
13 GREEN STREET
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FranklinNJ@hotmail.com

Another winter has passed, and now we have another six months of FOMS activities, as well as new issues of *The Picking Table*, to look forward to.

You will notice that this issue includes two mineral show reports penned by Dr. Steven Kuitems, DDS. As the editor of the *PT*, I must assume responsibility for overlooking Dr. Kuitems' spring 2015 show report in the last *PT*; it was submitted on schedule but fell between the cracks as we were uploading articles for layout. This was an oversight that I can assure you won't happen again. Both reports are here in their full glory, as Steven's efforts should not be in vain due to an editorial oversight.

Also, you may have noticed that we don't follow any strict guidelines about what to include in the *PT*. Including things such as "Letters From the Past," old photographs, and articles about personal experiences in the Franklin-Ogdensburg area all fit in well with our format. So kick that around and see what you come up with.

So, without further ado, sit back and enjoy this issue of *The Picking Table*. ⚒

Happenings at Sterling Hill

WILLIAM KROTH
PRESIDENT, STERLING HILL MINING MUSEUM
30 PLANT STREET, OGDENSBURG, NJ 07439
bill.kroth@shmmuseum.org

As 2016 begins, we are gearing up for another record year of attendance and revenue, while still working toward completion of several important projects.

Our "polishing program" continues with many new visual and comfort improvements that are being immediately noticed and positively received by our visitors. First, our main museum (Zobel Hall) received a thorough cleaning, including power-washing all of our large display boulders. All of the case exteriors were cleaned from top to bottom. Tom Hauck, along with tour guide Tony Luisi, painted the entire floor with three coats of commercial gray epoxy. Now the floor is one uniform color instead of a patchwork of bare concrete and red and gray paint. To give a nice finishing touch, gray-and-black tweed commercial carpeting was installed in the long gallery adjacent to the Oreck cases. This area is quieter, feels more luxurious, and is a fitting enhancement to the wonderful Oreck mineral display. The project was not without its pitfalls. While working in the Oreck gallery, I accidentally broke one of the large panels of thick tempered glass. Upon pricing a replacement panel, I was stunned to learn that it would cost more than $300! Several days later, Sussex County Glass Company, in nearby Sparta, donated a replacement panel in support of our educational programs. So, there are indeed "good neighbors"!

John Gumbs, our Safety Officer and also a tour guide, is completing the arduous task of replacing many of the scratched and cracked acrylic display windows in our Warren Museum. John fabricated these cases more than 20 years ago, and although the cases have held up nicely, many of the plastic windows have been scratched to the extent that the view is compromised. While the windows are down we have a great opportunity to clean, inspect, and upgrade our ultraviolet lights.

Jersey Central Power and Light has completed the installation of a separate power line to our upper, rental property, and master electrician Bob Leatham is completing the electrification of many of the buildings. We will now have power to our vehicle repair garage and to all of our tenants, as well as improved security and communications.

With the price of oil at a record low, we decided that this past season was a great time to pave the rough and cracked concrete area along the east side of the Geotech Building. Deicing salts had taken their toll on the existing concrete walkway to the extent that we had a tripping hazard. Hardyston Paving gave us a terrific price and did a great job in overlaying the entire area with 2.5 inches of asphalt paving. Now the area is smooth and rainwater drains perfectly.

Not to forget our main objective, EDUCATION. Jeff Osowski is wrapping up our video project, and it should be completed by the time this publication goes to print. Conceived last March, our team of Ron Mishkin and Jason Winkler, under Jeff's direction, has added a very informative audio track to an old but wonderful film, originally produced by the New Jersey Zinc Company, on underground mining operations at Sterling Hill. The video has also been digitally enhanced by Jason. All aspects of the mining operation as depicted in this 60-year-old film are now clearly explained by ex-miner Ron. While we have not yet made our final decision, a CD of this film may be made available in our gift shop, or we may simply post it on the museum webpage.

So again, I would like to personally thank all of our staff and friends who are making the Sterling Hill Mining Museum so successful! Please stop by to see our many upgrades.

Franklin Mineral Museum Report

MARK BOYER
PRESIDENT, FRANKLIN MINERAL MUSEUM
32 EVANS STREET
FRANKLIN, NJ 07416

In 2015, the Franklin Mineral Museum marked its 50-year anniversary on the weekend of October 10-11, 2015, with cider and donuts, banners, and fall decorations. That same weekend, museum board member Richard Bostwick spoke at the joint Friends of Mineralogy/Fluorescent Mineral Society symposium in Kelso, Washington, where our museum helped exhibit two cases of our local minerals. Here in Franklin, at our museum-sponsored gem and mineral show, the September weather couldn't have been finer and the number of participating dealers inside and out was excellent. Originally put on by the now defunct local Kiwanis, the Franklin mineral show will celebrate its 60th anniversary this year.

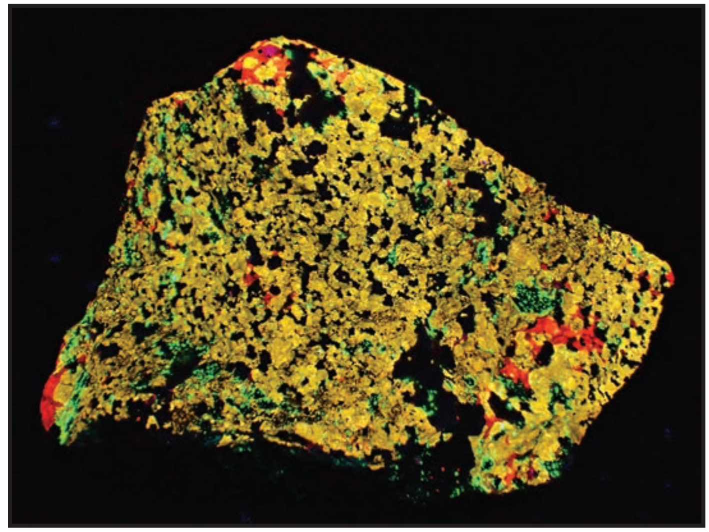
The museum board of trustees welcomes two new members in 2016, Mark Dahlman and Allison McHose. Mark, as you know, is also current FOMS president, and Allison is a former N.J. State Assemblywoman and currently Franklin Borough Town Manager. All of our museum staff is returning this spring, ready to help our guests enjoy their visit.

Visitors to the Franklin Mineral Museum this year will notice dramatic enhancements to our mineral exhibits. Over the winter, Steve Misiur cleaned and repainted mineral cases in Welsh Hall and inspected and serviced all of the museum's UV lamps. New interpretive signage of enduring professional quality has been added throughout the museum. An exhibit of local iron mining and milling has been started, and our geology exhibit in Kraissl Hall has added some spectacular specimens.

Dr. Earl Verbeek has settled into his role as museum curator. In addition to spearheading the exhibit upgrades mentioned above, Earl is engaging with mineralogists and geologists who are in the process of investigating the mysteries of the minerals in our collections. These investigators may soon be describing some new-to-science mineral species from the area.

This winter, the museum acquired several notable mineral specimens, among them John Kolic's own kolicite, donated to the museum by John's brother, Dennis. It is considered to be the finest kolicite in existence, and it is on display in our local minerals room. Also donated to the museum by Earl Verbeek is a large manganberzeliite specimen. And our friend Jim Van Fleet presented to the museum examples of fluorescent tilasite.

If you think that the Buckwheat Dump is too picked over to find anything worthwhile, check out the accompanying photo of cuspidine found at our fall 2015 night dig. Dru Wilbur found four specimens of cuspidine, evidently the left-behind remnants of a larger piece found earlier that evening by someone who was misinformed that it was sphalerite! Other recent night-dig finds have turned up a few surprises such as radiating willemite, scheelite, and powellite.



This is one of four specimens of cuspidine found by Dru Wilbur on the November 7, 2015, night dig at the Buckwheat Dump. This beauty measures 2.8 × 1.6 × 1.2 inches (7 × 4 × 3 cm). *Dru Wilbur photo.*

A number of media-related developments are taking place at the museum. On December 15, the museum participated in the filming of a cable-TV documentary on the history of the zinc industry. The film crew was so impressed with our museum and our story that they want to revisit us and film some more. When aired, this show will be a great promotion for the local museums. Our museum has also contracted the services of a professional Web designer to completely rebuild our website, which will be rolled out incrementally this year. One of the site's features will be an online store for mineral and gift shop sales year-round. And thanks to the generous donation and volunteer efforts of the Franklin-Ogdensburg Mineralogical Society, a new 75″ monitor and projector will enhance video presentations in Kraissl Hall.

In May, the esteemed journal, *The Mineralogical Record*, will publish a special issue devoted to the mineral collections of the Northeast United States. Our museum will be featured in a four-page section highlighting choice examples of our mineral heritage. In organizing our archives, we have turned up some amazing vintage photos of the Franklin, N.J., iron and zinc industry, as well as several photo albums of N.J. Zinc Co. operations across the country. Plans are to reproduce select images in future issues of *The Picking Table*. And in case you're wondering about the color book project, please be assured that it ***will*** happen. Current work to ensure its quality and accuracy will shape the book into the landmark publication it deserves to be, but since this is a time-consuming endeavor, we're guardedly not announcing a release date until the content is fully developed.

Coming up on April 16, 2016, is the museum's annual members-only auction and sale. Please come out to support the museum as we are poised to enjoy many exciting developments this year.

The Franklin Mineral Museum has given the world's finest kolicite specimen a good home. Specimen measures 2.6 × 1.6 × 1.2 inches (6.5 × 4 × 3 cm). *Earl R. Verbeek photo.*

The Franklin Mineral Museum

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32 Evans Street/P.O. Box 54, Franklin, NJ 07416
(Between Main Street and Buckwheat Road)
Phone: 973-827-3481
www.franklinmineralmuseum.com

Exhibited by means of guided tours: Franklin-Sterling Hill mineral specimens, educational exhibits in mining methods and history, including a life-size replica of underground workings, artifacts, gemstones, zinc uses, and a 32-foot-long fluorescent mineral display.

Included in the tours is the Jensen-Welsh Memorial Hall, built especially to contain the Wilfred Welsh collections of fossils, Native American relics, and worldwide minerals and rock specimens assembled for teaching purposes.

Mineral collecting on the Buckwheat Dump. Ample parking. Picnic grounds. Gift shop offering for sale: local and worldwide minerals, fluorescent specimens, agate slabs, onyx carvings, UV lamps, hammers, mineral books, T-shirts, postcards, and much more.

Separate admission fees to the Museum and the Buckwheat Dump. Admission to the Museum includes guided tour.

OPERATING SCHEDULE:

Open to the public

March – Weekends Only

April 1 – December 1

Monday through Friday: 10 AM – 4:00 PM

Saturday: 10 AM – 5:00 PM

Sunday: 11 AM – 5:00 PM

Closed Easter, July 4th, and Thanksgiving

Groups by reservation, please

Franklin, New Jersey
"The Fluorescent Mineral Capital of the World"

Summary of F.O.M.S. Field Trip Safety Rules and Regulations

Every F.O.M.S. member should be familiar with the rules for our field trips, not only for his or her own safety and that of others, but also to maintain the good reputation of the F.O.M.S., which has given its members access to many unique and important collecting localities. The following is a summary of our field trip rules.

INSURANCE COVERAGE AND LIABILITY WAIVERS. The F.O.M.S. maintains liability insurance coverage for its members under a policy sponsored by the Eastern Federation of Mineralogical and Lapidary Societies (EFMLS). Events are therefore restricted to F.O.M.S. members unless otherwise advertised, and proof of active F.O.M.S. membership must be presented when requested. It is the responsibility of all F.O.M.S. members to sign any required Waiver of Liability statements before entering a collecting area.

POSTED TIMES. Collecting begins no sooner than, and lasts no later than, advertised collecting times, unless otherwise modified by the F.O.M.S. Field Trip Coordinator. Due to safety and security regulations on field trips to active quarries, latecomers risk being denied access to the collecting site.

ELIGIBILITY. Children under 13 years of age are ineligible for collecting events unless otherwise authorized by the F.O.M.S. official in charge. Persons who appear intoxicated or under the influence of drugs, or whose judgment or physical ability to collect appears to be impaired, are also ineligible to collect.

COLLECTING AREA LIMITS. Collecting is restricted to designated areas. Areas which are off-limits to collecting may be indicated by signs, fences, ropes, tape, etc., or the instructions of the F.O.M.S. field trip staff. Collecting is strictly prohibited within 30 feet of a vertical or overhanging rock wall; in areas above mine entrances; within three feet of a cliff edge, ledge, or quarry bench; and on an incline either above or below a collector who is already in position. Vehicles are restricted to authorized parking areas or as designated by the F.O.M.S. official in charge.

CLOTHING. Proper footgear, headgear, gloves, and safety goggles or safety glasses are mandatory! Rugged boots or shoes, preferably with steel safety toes, should be worn. Sneakers, sandals, or other flimsy footgear are ***not*** allowed! Hard hats should be worn on all collecting trips, and ***must*** be worn on all trips to operating quarries or on other field trips so designated. Gloves should be worn to protect the hands when breaking or handling rock. Safety goggles or glasses (with shatterproof lenses) should always be worn when breaking rock, or when other collectors nearby are doing so. Sunburn protection (such as sunblock and hats) is advisable.

TOOLS. Proper tools should be used. Choose substantial rock or masons' crack hammers, sledge hammers, and cold chisels for breaking rock. Common carpenters' hammers, wood chisels, screwdrivers, and the like are unacceptable since they can break or chip when used on rock. Mushroom heads on chisels should be ground away to prevent flying metal chips.

RESPECT FOR PROPERTY. ***Do not litter!*** Carry all your trash out with you. Don't leave metal tools behind, as they can cause severe damage to rock crushers. Do not throw anything, particularly rocks! Above all, do not touch, deface, damage, or vandalize quarry equipment or private property.

COMPLIANCE AND PENALTIES. Failure to observe F.O.M.S. safety rules and regulations and failure to obey the instructions of an F.O.M.S. staff member are considered grounds for immediate eviction from F.O.M.S. events. Repeat violators will be barred from future field trips.

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Collecting under F.O.M.S. auspices is not a right but a privilege. Field trip areas are open to collecting only because of the F.O.M.S.'s excellent safety record, and injury or property damage on a field trip could lead to permanent canceling of that trip locality. When you collect, please observe all safety regulations, collecting protocols, and any verbal instructions from the Field Trip Coordinator.

The 2015 Franklin Mineral Shows

STEVEN M. KUITEMS, DMD
14 FOX HOLLOW TRAIL
BERNARDSVILLE, NJ 07924

The 43rd Annual New Jersey Earth Science Association Gem & Mineral Show

April 25 and 26, 2015

This NJESA show program was dedicated to the memory of three well-known mineral dealers and friends of mineral collectors: Thomas A. Benson (1937–2014), Donald S. Lapham, Jr. (1931–2014), and Sarna D. Strom (1933–2014). May they rest in peace. This year's exhibits included 15 cases of minerals in white light and 10 cases of fluorescent minerals. There were 23 dealers indoors at the Franklin School, and a two-day total of about 100 dealer/swappers at the FOMS-sponsored swap-and-sell outside on the school grounds.

The white-light exhibits presented a full spectrum of lapidary, mineral, and fossil specimens. The Franklin Mineral Museum's show-stopper case was simply titled "Uvite"and displayed the many crystal forms and colors (brown, green, yellow-green, greenish-brown) of this member of the tourmaline group from the Franklin Marble. (Thanks to the IMA, we will now have to get used to calling it fluor-uvite.) Dr. Brad Plotkin had "A Case of the Greens": 100% prehnite from New Jersey, with many forms of the mineral from historic localities and collections. Steve Sanford's case, "Pushing the Envelope," displayed a variety of Sterling Hill specimens showing hydrothermal alteration of the ore, especially envelopes of other minerals surrounding sphalerite. "Interesting Rocks" was the unassuming title of Richard and Elna Hauck's case, which showcased specimens most collectors have only read about or seen in pictures: slabs of exotic agate and jasper, a polyhedral agate from Brazil, and a septarian nodule that looked like a turtle. Juan Gonzalez's case of "Coconut Geodes and Agates" grabbed my attention with a pair of amethyst-lined geodes from Chihuahua, Mexico, that reminded me of Mickey Mouse.

Bob Horn deserves a Most-Specimens-In-One-Case Award for his display of trap rock minerals from Millington, N.J. These included several superb pink pectolites and the peculiar spherical prehnites typical of this locality. Derek Yoost filled his case of "Amazing Ammonites" with several large coiled species, one partly uncoiled and a few polished examples. A variety of fossils from New Jersey was presented by Arlene Castleman: graptolites, sharks' teeth, shells, and footprints of New Jersey's scaly creatures from Eubrontes (large) to Batrachopus (tiny). One of Brendan and Connie Dunn's cases,

Jeff Wilson, current president of North Jersey Mineralogical Society, and proud member of the FOMS. *Tema Hecht photo.*

"Diverse Calcite Forms," ranged from sand calcite crystals out of Rattlesnake Butte, South Dakota, to outstanding calcite crystals on amethyst crystals from Rio Grande do Sul, Brazil. Their other case displayed eleven polished cross-sections of petrified wood with a range of colors (gray, green, red, yellow) and growth patterns. Bernard Kozykowski's two cases, simply titled "Classics," fulfilled expectations with bright green smithsonite, red crocoite crystals from Tasmania, fantastic cubes of golden pyrite in matrix from Navajun, Spain, and a truly classic plate of azurite crystals from Bisbee, Arizona.

The Morris Museum offered New Jersey classics, including crystals of willemite, franklinite, rhodonite, and a large augite, var. jeffersonite. Your reporter displayed "Common to Uncommon Minerals From the Mines at Franklin and Ogdensburg, N.J." with a large plate of leucophoenicite crystals in barite as a centerpiece, and an intriguing vein specimen, half

Mark Boyer really goes for a nice pair of jugs. *Tema Hecht photo.*

Heather Moldovany puts her stamp of approval on her recent purchase. *Tema Hecht photo.*

yellow andradite and half green microcline, that drew many curious viewers. Pat Hintz went further afield to wow us with the gem and lapidary treasures now coming from southwest Greenland. My favorites were ruby corundum from recent mining efforts and bright pink tugtupite from Kvanefjeld, in the Ilimaussaq Alkaline Complex.

The ten cases of fluorescent minerals on the darkened Franklin School auditorium stage had a constant flow of observers, with UV-blocking goggles available at the stage entrance. The Franklin Mineral Museum kept its No. 1 (pole) position with "Underground Rainbows." This caseful of classics included a superb barite in calcite from the 700 level at Sterling Hill, First-Find and fibrous wollastonites from Franklin, several willemite and calcite vein specimens, and a particularly bright example of clinohedrite on hardystonite: a colorful rainbow, indeed. Next was the Sterling Hill Mining Museum's display of specimens from the John Kolic collection, including three fine margarosanites and a superb roeblingite nodule.

The traditionally titled "Franklin Delights" case of Steven and Daniel Kuitems included a "green-eye" wollastonite from Sterling Hill, a surprisingly large cuspidine and willemite in calcite from the Buckwheat Dump, and a Kuitems-collected specimen of willemite crystals in calcite from the Passaic Pit at Sterling Hill. Next in line was Denis DeAngelis's "Longwave Latitude" case with bright pink aragonite crystals in the center, flanked by a rare Italian phosgenite and a multicolor Sterling Hill sphalerite. Also in longwave mode was Brendan and Connie Dunn's case, "Longwave Classics," which included a large, bright fluorite from Cumberland, England, a yellow-green–fluorescing zincite from the dump of the NJZ smelter in Palmerton, Pennsylvania, and a very bright orange-fluorescing sodalite from Kangerlussuaq, Ilimaussaq Alkaline Complex, Greenland. Richard Keller returned the viewers' attention back to shortwave Franklin classics with "Some of These and a Little of Those," a colorful mix of willemite pattern pieces, clinohedrites, and barites. Pat Hintz's case, "Worldwide Fluorescent Clunkers," featured seven oversize but bright specimens, notably a calcite with dolomite from Långban, Sweden, and a showy tugtupite from Taseq Slope, Ilimaussaq Complex, Greenland.

Then we reached two utterly remarkable, and for this show unique, cases from two Maryland fluorescent mineral compadres. Andy Muir's display, "Into the Twilight Zone (of Patterned Fluorescent Response)," presented a wild and wooly caseful of calcites and fluorites with distinctive and different fluorescent patterns, featuring a remarkable Challenger Cave, Mexico, calcite rhomb with internal phantoms fluorescing blue and pink. (Editor's note: Sadly, Andy passed away unexpectedly in early August. He will be missed as an exhibitor and cheerful presence at our shows.) Jeff Cessna presented "So What Does It Do Under Midwave?"— the first all-midwave-UV display in our show's history. This showcase included calcite from all over, local willemite and sphalerite, a magenta-fluorescing spinel, and halite crystals on sagebrush from the Salton Sea, California.

The last case in line was Andrew Mackey's dazzling "It's Green," which pulled out all the stops with sixteen brilliantly fluorescing willemites from Franklin and Sterling Hill. It was encouraging to see such a wonderful variety of excellent displays at this year's NJESA show, and I wish to thank all the volunteers who made it possible to enjoy it. ⚒

The 59th Annual Franklin-Sterling Gem & Mineral Show
September 26 and 27, 2015

After madly pursuing the offerings for sale inside the school and outside at the swap, I always pause and savor the displays that collectors and museums have put together for the enjoyment of all the show's attendees. In life, sometimes quality trumps quantity, and so it was at the 2015 fall show. Any collector who appreciates the best of what our local mines produced would not have been disappointed by either the white-light or fluorescent displays.

We'll begin the white-light displays with Phamily Minerals' case of large rhodonite specimens from Franklin. Among the great rhodonite specimens from a half-dozen localities worldwide, the large blocky crystals from Franklin are unique and distinctive, and this case was full of them. The largest specimen was a cluster of interpenetrating crystals in a V configuration, and opposite this was one of the largest tabular crystals known. Next was the display of your reporter and his son, Daniel, "Franklin Classics, From Common to Rare," with an old-time Franklin Furnace ruby corundum in the center, and a cut and polished gemmy willemite honoring the memory of Gary Grenier. Mark Mayfield's case of Franklin and Ogdensburg minerals, "Found on the Dumps," demonstrated conclusively that classic Franklin specimens, from thumbnail to miniature sizes, can still be self-collected locally. To have preserved an undamaged one-inch pyrite cube is quite a feat, and Mark's tabular rhodonite crystal is superb.

The Franklin Mineral Museum's case, "Local Color," displayed a full spectrum of local mineral colors, all vivid, and rarely seen in this quality: blue vesuvianite, rich reddish-purple hodgkinsonite, rare green antlerite, and bright pink rhodonite, all from Franklin, and lavender-pink cherty sussexite from the Sterling Mine. My favorite was another Sterling Hill classic, a polished slab of burgundy-colored friedelite. Richard and Elna Hauck presented "Miners' Art," a case of mining collectables that included seven glass bottles of "sand art" made with layers of different minerals, often collected from the Wilfley tables in the Franklin mill which sorted the crushed ore and gangue minerals by specific gravity. Some layers were the ore minerals franklinite (black), willemite (green), and zincite (red), while others were the gangue minerals calcite (white), andradite (yellow-brown), and rhodonite (pink), Each layer was carefully poured into the bottle, tamped down, and often poked to form zig-zag layers and other patterns.

The row of daylight cases ended with Earl and Lois Verbeek's "A Few Things From Our Basement." The "things" included fine red zincite crystals on matrix from Franklin, a canary-yellow zincite vein from the Sterling Mine, and a large native copper from Franklin. That's some basement you've got, Earl and Lois.

Alex and Gary Kerstanski obviously are enjoying themselves at the Saturday evening FOMS banquet. *Tema Hecht photo.*

After borrowing UV-blocking goggles, Daniel and I entered the Franklin School's darkened stage, where the glowing rocks were. Starting at the back, we encountered Dr. Phil LaPorta's monster margarosanites, some with willemite and clinohedrite and one with willemite and wollastonite. To many collectors, such specimens are among the rarest and most desirable from Franklin, and all these large beauties had been collected underground by Dr. Phil's father Philip C. LaPorta (1920–1977). Just imagining being in the mine and finding these killer specimens made me shiver, and when I remember what was displayed, it still brings a smile to my face. The next case in line, Andrew K. Mackey's "Willemite," showed 21 green-fluorescing specimens of the same mineral with different visual textures, grain sizes, and fluorescent intensity. After this was "A Mixed Bag," Richard Keller's title for a range of colorful fluorescent minerals from the Franklin and Sterling mines. Front and center was a classic violet-fluorescing hardystonite in blocky elongated crystals, shot through with green-fluorescing veinlets of willemite, in a red-fluorescing calcite matrix. Several large orange-fluorescing clinohedrites with willemite and calcite flanked a large lemon-yellow–fluorescing esperite, while my eyes were drawn to a willemite that looked like an African tribal mask with large elongated green eyes.

Brilliant local color was Denis DeAngelis's theme in his case of "Shortwave Sunshine." Outstanding were several bright

Richard and Elna Hauck display several cultural aspects of mining: sheet music, commemorative knives, sand bottles, and figurines. *Tema Hecht photo.*

Steven Phillips displays one of the Franklin classics. *Tema Hecht photo.*

blue margarosanites, in particular a margarosanite with bright red-fluorescing axinite-(Mn), and a large deep-red–fluorescing bustamite with willemite and hardystonite. Your reporter and his son, Daniel, presented “Franklin Delights,” with a most brilliant yellow-fluorescing esperite and a number of willemite and calcite “pattern pieces” including dead-zone willemite veins in calcite, and a sphere of Sterling Mine willemite and calcite with exsolution willemite in tephroite. Your reporter could not help bringing a favorite mimetolith, “Puff, the Magic Dragon,” a hardystonite creature being replaced by esperite and outlined in green willemite. Also included were an unusual Franklin radial pectolite with prehnite (fluorescing orange and bluish pink, respectively), a Sterling Hill johnbaumite with barite in calcite (orange, white, and red), and a green willemite cross in violet-blue hardystonite.

Closer to the stage entrance were the museum cases: the Sterling Hill Mining Museum’s “Wacky Wollastonites From Sterling Hill,” and the Franklin Mineral Museum’s “Coming Into the Dark.” The wollastonites in question were “wacky” or at least unusual in their fluorescence, not the orange-to-yellow hues typical of Sterling Hill wollastonite but a hard-to-describe pinkish-lavender of moderate brightness. Note that some of these “wacky” specimens are enlivened by green-fluorescing coatings that may be green-fluorescing opal but have not been analyzed. The Franklin Mineral Museum filled its case with Franklin classics such as turneaureite in calcite and some Sterling Hill surprises that included fluorescent zincite with sphalerite, and willemite that glowed eerily through its matrix of gypsum.

Thanks to all who made these displays happen. Between selecting the specimens, bringing them in and setting them up, and then taking them down and hauling them home, it’s a lot of work, but sharing these minerals’ special beauty with the public and fellow collectors is always worthwhile. ⚒

The Vandall King and Fair Lady Janet Nemetz. *Tema Hecht photo.*

Lois and Earl Verbeek, feeling no pain. *Tema Hecht photo.*

Tilasite From Sterling Mine, Ogdensburg, New Jersey: A Newly Recognized Assemblage

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In 2015 Jim Van Fleet purchased from Claude Poli a specimen identified as "smithsonite," indicating the locality as Sterling Hill. The specimen, labeled P561, featured a white, fine-grained coating of secondary minerals—the purported smithsonite—on a dark matrix of massive franklinite with subordinate willemite. Under shortwave ultraviolet (UV) light, parts of the specimen fluoresced bright green, followed by a prolonged green phosphorescence, and parts of the coating fluoresced red, with a bright but brief red phosphorescence. Under longwave UV, however, the coating fluoresced bright orange-yellow, and additional seams and thin veins of the same material were visible throughout the matrix. The green and red fluorescences were ascribed to the usual willemite and calcite, respectively, but the origin of the orange-yellow longwave fluorescence was unknown.

Dr. Earl Verbeek studied this specimen under a stereo microscope, using both white and UV light. He observed that there are two sets of veinlets, not just one, transecting the specimen. The veinlets of the first set, containing the orange-fluorescent mineral, are long and sinuous, parallel to one another, and generally 1 mm or less in thickness. Also present are willemite veinlets, but these are far shorter, quite irregular, and present only locally in the specimen; many are mere films. In a few places the secondary willemite veinlets cut across the ones containing the orange-fluorescent mineral, so at least some of the secondary willemite is younger.

Jim Van Fleet also inspected the specimen under a microscope, with the aid of a longwave UV lamp, and observed that the orange-yellow fluorescence of the coating was due to small, submillimeter grains of a yellowish-tan mineral embedded in the white coating (Fig. 1), and that only these grains were fluorescing. A sample of this coating was removed and crushed in an attempt to separate the minerals of which it is composed. However, it proved difficult to separate the tan grains from the white mineral(s) since both were quite fragile. To try to confirm that the fluorescent response was limited to the tan grains, part of the crushed sample was washed in weak (10%) HCl acid, and rinsed. This removed the tan mineral from the sample and completely quenched the orange-yellow fluorescence. Soaking a larger piece of the matrix with associated vein/coating minerals in strong 1 molar HCl acid completely removed both the tan mineral and the white coating, leaving only willemite and franklinite. We had now confirmed that the orange fluorescence was limited to the tan mineral, and that this mineral was readily soluble in dilute HCl, but we had almost no clues to its identity.

Figure 1. Tan grains of tilasite embedded in white carbonate. Field of view is about 3.5 mm across. *Jim Van Fleet photo.*

Analysis moved to the geology laboratory at Bucknell University, and a sample of the tan grains in white powder was run through a 3-hour X-ray diffraction (XRD) test. The instrument used was a Philips (now PANalytical) X'Pert Pro MPD powder diffractometer with a Cu-Kα radiation source.

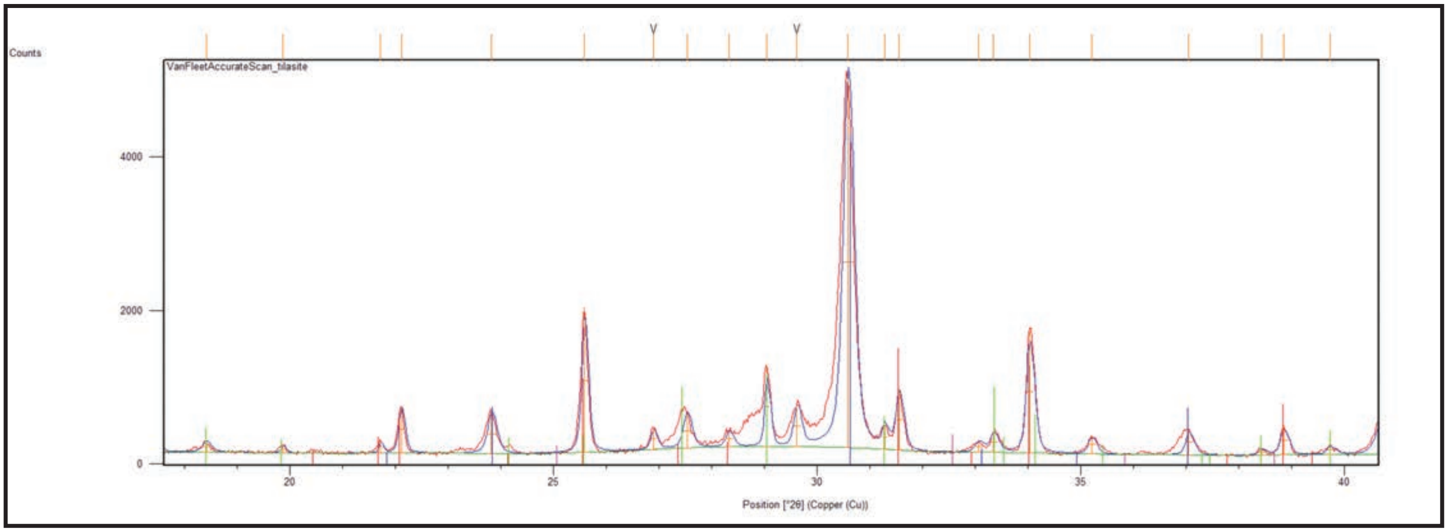

Figure 2. X-ray diffraction pattern of the tan, orange-fluorescent mineral embedded in the white coating on specimen P561. Vertical green lines indicate expected peak positions for tilasite; lengths of lines are proportional to relative intensity (height) of peak in reference pattern. Corresponding lines for kutnohorite are in blue, for sphalerite in red, and for smithsonite (no matches) in magenta. Short lines along upper margin of diagram show positions for all 22 observed peaks; the two peaks labeled with "v" symbols do not match the reference peaks for any of the three minerals identified.

X-ray settings were 45 kV and 40 mA. The analysis software used was X'Pert Highscore, which matches the resulting diffraction peaks to mineral IDs in an internal library.

This initial XRD test yielded a maximum peak of over 1,690 counts, and indicated the presence of tilasite [$CaMg(AsO_4)F$], magnesian kutnohorite, and calcite. This "hasty" analysis required follow-up. A fresh sample was prepared, and a 14-hour XRD test was conducted. This second test yielded a maximum peak of over 4,900 counts, and identified tilasite, kutnohorite, and willemite in the sample. A note here on the process: XRD testing requires the destruction of a small sample of the rock under investigation. The material is crushed, and carefully sorted under a microscope, sometimes with the help of UV light. Sometimes breaking or scraping a sufficient sample from the matrix is a challenge, and it is always possible for two samples from the same rock to vary in content.

Our suspected minerals at this point were willemite (from the secondary veins), kutnohorite and/or magnesian calcite present as a white coating, and yellow grains of tilasite. The test results for tilasite (Fig. 2) were reasonably good, with observed peaks matching the known strong reflections (d-spacings) for this mineral at 3.73 Å, 3.48 Å (39% relative intensity), 3.07 Å, and 2.63 Å (33.5% relative intensity). Matching peaks for weaker reflections were present at 5.06, 4.81, 4.46, 3.24, 2.85, 2.68, 2.34, 2.26, 1.74, and 1.68 Å. Four of these peaks, two strong ones and two weak ones, are also close to the XRD pattern for willemite. Only one of these matching peaks is also found in the XRD reference pattern for kutnohorite, and only one also matches the pattern for magnesian calcite. So, without much overlap, the XRD analysis showed peaks conforming to the diagnostic patterns for tilasite, willemite, kutnohorite, and calcite. It can be noted that the XRD results conclusively eliminated smithsonite as a possible match, as none of the diagnostic peaks for that mineral were present.

At this point a review of the literature found little supporting information. Fred Parker had first reported tilasite from Sterling Hill in *The Mineralogical Record* in 1978, but from an assemblage quite different from that of the current specimens under study. The Mindat website shows photographs of several specimens with an assemblage physically similar to that of the current specimen, but from a different locality, the Djebel Guettara manganese deposit in Skikda Province, Algeria. The information on Mindat highlights some ambiguity concerning the fluorescent response of tilasite. The presence or absence of fluorescence, or color of fluorescence, are of little value in identifying the mineral. It is noted that the mineral is soluble in acid, consistent with the findings mentioned above, but this, too, is of little help, for many minerals are soluble in dilute acid. The literature review thus provided some interesting facts but added little to what we already knew about the identities of the minerals in the Sterling Hill specimens. Additional supporting data were desired to substantiate the X-ray identification of tilasite.

Dr. Chris Daniel, Mineralogist at Bucknell University, then offered to provide SEM/EDS chemical analyses of the specimen to supplement the XRD data. Under SEM magnification, the coating is obviously multimineralic and is quite fine-grained, with individual grains on the order of 10-50 µm across. Focusing on a field of about 1.5 mm, seven spots (Fig. 3) were deliberately chosen for analysis of the

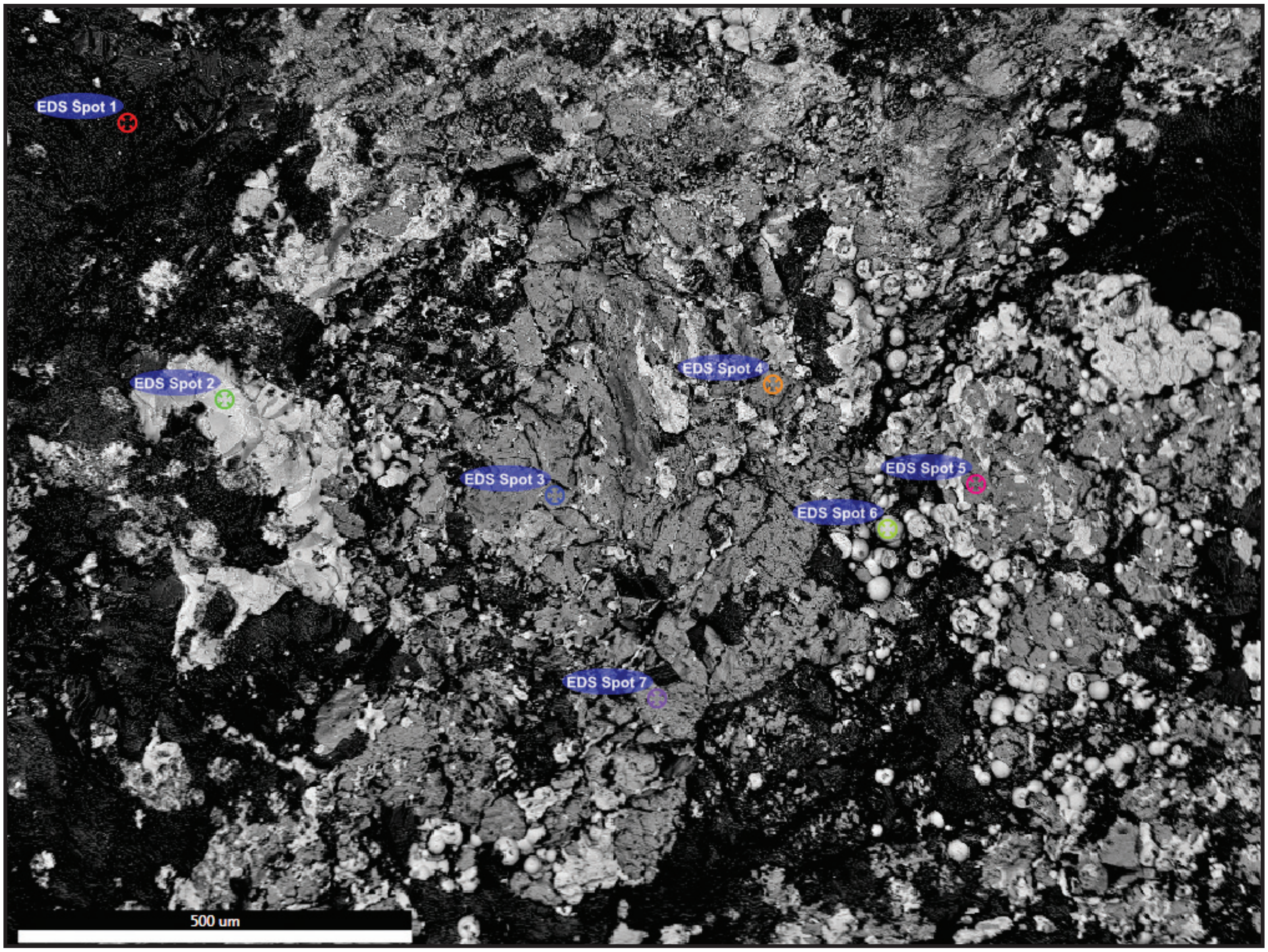

Figure 3. SEM image of part of the white, multimineralic coating analyzed for this paper. The field of view in this image is about 1.5 mm across; note scale bar at lower left (500 μm = 0.5 mm). Chemical analyses were made at the spots indicated; spots 3, 4, 5, and 7 are tilasite (gray).

different minerals present. The settings were 15 kV high voltage and 36,000 counts per second, with spot size adjusting to count rate (it varied a little, from about 2-8 nm). The test was run at a low vacuum pressure of 0.35 torr.

EDS spot 6 is centered on one of many ~10 μm spherules that the EDS analysis indicated is zinc sulphide (ZnS), and may possibly be sphalerite. Tiny spherules of sphalerite have often been found before at Sterling Hill in encrustation assemblages. Spot 2 is centered over a patch of white crust, and the analysis suggests a mixture, perhaps of sphalerite and hydrozincite, with a little carbonate, possibly calcite or kutnohorite. Many of the "white crusts" from Franklin and Sterling Hill are mixtures of low-temperature minerals like this, and they are frequently so fine-grained and intergrown that they are not readily separated by sight, or even under low magnification with a stereo microscope. Spot 1 may be the franklinite matrix, and shows as black in the SEM image. Spots 3, 4, 5, and 7 are the mineral that is suspected to be tilasite; these show as gray areas in the SEM photo and correspond to one of the yellowish-tan grains seen under the microscope. Of those four spots, the EDS analyses for all of them showed *only* the presence of the elements in tilasite (Mg, Ca, As, F), and for three of them the quantitative data are in fair agreement with Parker's published analyses of that mineral. EDS analyses are "semiquantitative," giving relative percentages of the elements present. Calculating a chemical formula for the mineral under study is often not possible, or at least not advised, from EDS data alone. It is thus certainly gratifying, and significant, to find three analyses that pretty well match that of known tilasite:

Elements	Parker	Spot #3	Spot #4	Spot #5	Calculated
CaO	26.11	20.99	21.76	24.74	25.22
MgO	18.84	13.23	13.15	12.25	18.13
As_2O_4	51.51	50.09	51.83	51.77	51.70
F	6.85	10.72	9.18	7.82	8.85

Note that the SEM/EDS performed "quant analysis with oxides," with a possible error of +/- 9%. In addition, it should be noted that this test was conducted on a rock specimen placed in the SEM equipment without any sample preparation. In ideal circumstances, the specimen should be cut or ground flat, polished, carbon-coated, and mounted on a stage to collect the most accurate readings.

Given that the XRD analysis produced a pattern with 14 peaks matching that of tilasite, and the EDS analyses produced chemical data in close agreement with the composition of that mineral, we regard the identity as well established. The evidence thus suggests that the specimen, though labeled smithsonite, is in fact a mass of willemite and franklinite traversed by thin veins of altered kutnohorite and calcite containing abundant, tiny, anhedral grains of tilasite and sphalerite. This represents a newly reported assemblage for tilasite, and one that may be more widely represented than had been previously recognized.

ACKNOWLEDGEMENTS

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Aluminum-Rich Mineral Assemblages at Lime Crest Quarry, Sparta Township, New Jersey

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OVERVIEW

Over the years, the marble exposed in the Lime Crest Quarry has yielded many specimens of the aluminum-rich minerals corundum (Al_2O_3) and spinel ($MgAl_2O_4$). The distribution of the occurrences of corundum and spinel within the Lime Crest Quarry was never mapped. Until the mid-1990s it never occurred to the author, or apparently to anyone else, that the distribution of these minerals might not be random and might be important. It is a glaring example of the truth of the old adage that "outcrops answer only those questions that are put to them."

A continuous stratigraphy is more readily discernible at the Lime Crest Quarry than at most other exposures of the Franklin Marble. Many layers within the marble contain significant amounts of silicate minerals, such as norbergite, micas, and amphiboles. At the Lime Crest Quarry, many of the silicate mineral-rich layers are extensive both along strike and down dip. They are also conformable with the contact between the marble and the overlying gneiss. The distinct and extensive layering was also noted by Meredith et al. (2003) during a study of stable isotopes in the Franklin Marble.

The silicate mineral-rich layers are numerous enough and continuous enough that when viewed from a distance they mimic, and may represent, the original sedimentary layering. This was most striking in the long, high southeastern wall in the southern half of the pit. Sometime around 1994 to 1995, a lens of spinel-rich material was exposed in the toe of the lowermost bench in this area. The lowermost bench also exposed stratigraphically conformable boudins, perhaps 6 to 8 feet thick, of a dark, almost black, fine-grained rock. The spinel occurrence was situated approximately 25 feet beneath the "black rock" horizon. A year or two earlier, a lens of corundum-bearing material had been exposed a few tens of yards to the north. It was also approximately 25 feet stratigraphically beneath the "black rock." The layer containing the spinel and corundum concentrations seen in the early to mid-1990s could be traced upward to a site on the second bench below the surface, at the southwest end of the pit, where the author collected his first corundum in May 1971. This part of the quarry was then being finished to its present configuration and has remained unchanged since that time. It was a "light-bulb moment."

Based on my best recollection of the period from 1970 to circa 1995, the pods of aluminum-rich minerals were found at progressively lower elevations as the width of the southern half of the pit expanded toward the southeast. The southeastern wall and the benches parallel to it in the southern half of the quarry curved and cut across strike. As each bench retreated southeastward, successive exposures of pods of aluminum-rich mineral assemblages on any given bench migrated southward.

In the middle and northern parts of the quarry, the stratigraphy of the marble is more difficult to trace because of a lack of active mining and large amounts of quarry debris. However, the scattered occurrences of aluminum-rich mineral assemblages seen in these areas after 1995 appeared, as nearly as could be determined, at the same stratigraphic horizon as those in the southern portion of the pit. This includes the last significant corundum-assemblage occurrence, found in 2001 along the southeast side of a small pit near the northern end of the property, beyond the access road to the "granite" plant. It appears, based on field observations currently (2015) available, that the spatial distribution of the aluminum-rich mineral assemblages is conformable with the general layering in the marble.

ALUMINUM-RICH MINERAL OCCURRENCE

Corundum (Al_2O_3) and spinel ($MgAl_2O_4$) are the key species in two distinct aluminum-rich mineral assemblages within the Lime Crest Quarry. The spinel assemblage typically includes norbergite and phlogopite, ± pyrrhotite, and the corundum assemblage includes rutile, phlogopite, and an amphibole, ± margarite. These aluminum-rich mineral assemblages are found as isolated, pod-like bodies in the marble that are typically 10 to 25 feet thick and as much as a few tens of feet long. There is a strong tendency for the pods to contain either one assemblage or the other. Overlap is uncommon, but when seen, it is usually spinel in a corundum assemblage. A similar dichotomy between a spinel-phlogopite assemblage and a corundum (ruby)-amphibole assemblage was noted by Sutthirat et al. (2008) in the marble-hosted Luc Yen ruby deposit in northern Vietnam.

Palache (1935) notes that corundum is widespread in the Franklin Marble and continues, “In the pockets the corundum is associated with one or more of the minerals spinel, rutile, graphite, edenite, pyroxene, garnet, titanite, and phlogopite.” At the Lime Crest Quarry, the corundum assemblage is relatively simple and consistent, although the proportions of individual mineral species may vary substantially.

Corundum at Lime Crest is usually embedded in calcite and/or dolomite. In some cases the carbonate mineral volume is sufficiently large that well-formed corundum crystals up to several inches long have developed. In other instances corundum may appear to be embedded in amphibole, but in many such cases it is contained within a shell or kernel of carbonate.

Palache’s description of the occurrence of spinel in the marble is more tentative: He gives only corundum, rutile, phlogopite, and hornblende as associated minerals, and he describes spinel, as with corundum, as typically occurring in “pockets.” Most of Palache’s text discusses the various colors of crystals that have been found. There is neither a mention of norbergite nor an indication that Palache was familiar with the simple, consistent, spinel-bearing mineral assemblage typical of the Lime Crest Quarry.

It is interesting that Palache describes both corundum and spinel as occurring in “pockets,” suggesting isolated, spatially limited concentrations similar to those found in the Lime Crest Quarry. Also, there is a tantalizingly vague mention of “an irregular chain of pockets containing corundum [that] is said to have extended from Sterling Hill to Franklin.” As at the Lime Crest Quarry, none of these mineral occurrences were mapped, so their significance, if any, is mostly lost.

As noted previously, at the Lime Crest Quarry there is a strong tendency for the “pockets” to contain either a corundum-rich or a spinel-rich mineral assemblage. The origin of these mineral assemblages, their dichotomy, and their apparent spatial distribution on a single, conformable horizon derives from a long sedimentary and metamorphic history. The principal aspects of this history are discussed in following sections.

CARBONATE DEPOSITION

The principal environments of carbonate deposition do not seem to have changed greatly through the eons. They tend to be warm, shallow sites where local restricted lagoons and tidal flats may occur. In these situations, large areas may be exposed every time the tide recedes.

Carbonate sedimentation has always been restricted to environments where the influx of detrital material is low. The acid-insoluble component of carbonate rocks is generally low, ranging from a fraction of 1% up to slightly more than 20%. Beyond this amount there is an abrupt cutoff, and few examples exist of lithologies intermediate between typical carbonate rocks and calcareous or dolomitic shales and mudrocks. The insoluble material is typically a mixture of clay minerals, clay-size quartz, organic matter, and pyrite. The relative amounts of the materials that make up the insoluble portion of a carbonate rock vary considerably from place to place.

Among the components of the insoluble fraction of carbonate rocks, one of the less common and more irregularly distributed is diaspore, AlO(OH). Diaspore can become part of carbonate rocks in the same manner as clay minerals and quartz, either as detrital sediment brought in by flowing water, or wind-blown fallout. It can also be derived by lateritic weathering (prolonged weathering under tropical conditions) of the clay minerals contained within the carbonate sediment.

Based on recent sophisticated age determinations (Volkert et al., 2010), the Franklin Marble is now interpreted as a carbonate shelf sequence deposited on the less active, continent-ward side of a back-arc basin (see Fig. 8, Volkert et al., 2009). Volkert et al. (2010) have interpreted many potassium feldspar gneisses within the supracrustal sequence that includes the marble to be metarhyolites, while many of the associated amphibolites have the characteristics of metabasalt. Discrimination between gneisses originating from volcanic precursors and grossly similar gneisses derived from sedimentary rocks is based on geochemical factors such as major element ratios and trace element contents.

The presence of bimodal volcanic rocks within a sedimentary/volcanic sequence is a common feature of back-arc basins. “Bimodal volcanics” is jargon meaning that silica-rich volcanic rocks, such as rhyolites and dacites, occur in close proximity to silica-poor basalts. Bimodal volcanic rocks are typical of back-arc environments because it is here that the rhyolitic volcanism, characteristic of convergent plate tectonics, is closely juxtaposed with the basaltic volcanism of divergent plate tectonics.

METAMORPHISM

Granulite and amphibolite facies marble is a prime lithology for the crystallization of corundum and spinel because it is deficient in silica and in other elements that, with aluminum, would otherwise meld into common rock-forming minerals such as feldspars, pyroxenes, and micas. Peck et al. (2006) have shown that throughout its extent, from Orange County, New York, to Phillipsburg, New Jersey, the Franklin Marble and other probably correlative marble bodies experienced granulite facies metamorphism involving peak metamorphic temperatures of 769 ± 43° C and pressures ranging from 4 to 6 kb. This would be more than sufficient to push the reaction

(1) 2 Diaspore ↔ Corundum + H_2O

to the right. If dolomite or high magnesian calcite is present, then reaction

(2) Corundum + Dolomite ↔ Spinel + Calcite + CO_2

will also be driven to the right as temperature increases. There are a number of other possible reactions that will produce corundum, such as

(3) Muscovite ↔ K-feldspar + Corundum + H_2O

but they involve mineral phases that are uncommon in the Franklin Marble and are absent, even as relics, from the corundum and spinel mineral assemblages at Lime Crest.

Like corundum, there are reactions other than reaction 2 that produce spinel, such as

(4) Garnet + Calcite → Spinel + Clinopyroxene + Dolomite + CO_2

However, like reaction 3 they involve mineral phases that are uncommon or absent from the spinel mineral assemblage at Lime Crest. Thus, most or all of the spinel at Lime Crest Quarry was probably produced by reaction 2, where corundum in the presence of dolomite reacted to form spinel and additional calcite.

EVAPORITES

The Franklin Marble contains a number of concentrations of boron-bearing minerals, most commonly fluoborite but also sinhalite, serendibite, and warwickite. Also, fluorine is widespread, even pervasive, in some of the common silicate mineral phases in the marble such as edenite and phlogopite to the point where, in some cases, they've been described as the new species fluoroedenite and fluorophlogopite. There are other examples of fluorine enrichment, including fluor-uvite, which also contains boron. Although the Franklin Marble does not preserve evaporite minerals as such, several investigators (Kearns, 1977; Swihart and Moore, 1989; Volkert, 2001; Volkert et al., 2005) have suggested that the prevalence of boron- and fluorine-bearing minerals in the Franklin Marble is evidence of pre-existing evaporites.

SKARNS

As noted by Volkert et al. (2005), the Franklin Marble contains many bodies of skarn-like mineral assemblages that exhibit no metamorphic fabric. Even though these rocks are composed of multiple mineral species, they have neither the distinct layering or banding nor the preferential orientations (foliation and lineation) of flat minerals, like micas, or long minerals, such as amphiboles, that typically develop as minerals crystallize in the plastic, ductile deformation environment of high-grade metamorphism.

In short, the skarn-like bodies don't look like the gneisses common in the Lime Crest region, or even many of the silicate mineral-rich lithologies within the marble. Rather the minerals of the skarns, including minerals such as phlogopite and amphibole, crystallized with more or less random orientations and distributions. This is true of both the corundum- and spinel-bearing assemblages at Lime Crest. The lack of metamorphic fabric in the skarns is interpreted to indicate post-Ottawan recrystallization of the original metamorphic rock.

The Ottawan orogeny, circa 1050 to 1025 million years before present, was the compressional mountain-building episode that brought the rocks of the New Jersey Highlands to their peak metamorphic grade. The Ottawan orogeny resulted from the collision of Laurentia, the proto-North American continent, with Amazonia, the proto-South American continent. The nearest modern example is the collision of the Indian subcontinent, the proxy for Amazonia, with central Asia, the proxy for Laurentia, to produce the Himalaya Mountains.

In many continental collision situations, pressure on buried rocks rises rapidly at first and then begins to slow. Conversely, temperature rises more slowly at first but then accelerates to a peak. Pressure typically begins to decline before temperature reaches its peak. By the time peak temperature is reached, pressure is often declining rapidly. Therefore, there is often an extended period during which pressure—the force that creates metamorphic fabric, including foliation, lineation, and gneissic banding—has abated, while temperatures remain high enough for recrystallization to occur where enough fluid is present.

Recrystallization can occur under either metasomatic or isochemical conditions. Metasomatism, by definition, requires the pervasive addition or removal of chemical components of a rock by the interaction of the rock with an aqueous fluid. This implies that there is a widespread fluid flux through the environment. On the other hand, isochemical recrystallization occurs in a closed system and doesn't involve any significant addition or removal of chemical components except for H_2O and CO_2. The fluid involved is locally derived, and its movement away from its site of origin is limited. The mineral assemblage of the recrystallized rock may change, but the bulk chemistry remains the same. The rock stewed in its own juices.

ASIAN RUBIES AND THE FRANKLIN MARBLE

Considerable work has been done in the past 15 years on the geology of gem corundum, especially ruby. Prices for top-quality rubies in the 5- to 8-carat range have exceeded \$500,000/carat. That kind of money gets attention and drives funding for research to develop exploration models.

Nearly all high-quality rubies come from high-grade metacarbonate rocks like the Franklin Marble. The pre-eminent example is the Mogok Stone Tract in Myanmar (Burma), source of much of the world's best gem ruby and spinel. Unfortunately, Lime Crest is not Mogok, but the work on gem ruby deposits may provide some insights into the formation of skarns in the Franklin Marble. Several papers have been published on the genesis of ruby deposits in a region of southern and southeastern Asia stretching from Tajikistan and Afghanistan to northern Vietnam. Giuliani et al. (2003) found that the fluid present during the crystallization of gem corundum was dominated by CO_2 derived from the devolatilization of carbonate. The CO_2-rich fluid was also sulphidic due to the reduction of sulphate from anhydrite by organic matter. Salts, predominantly chlorides and sulphates, are commonly present in fluid inclusions with the CO_2-rich fluid.

Garnier et al. (2008) found that ruby occurred in concordant layers within Asian marble whose protolith had been enriched in clay minerals and organic matter, was evaporitic, and often was dolomitized. Prograde metamorphism produced corundum both from diaspore (reaction 1) and by the destabilization of muscovite (reaction 3). In dolomitic environments, furthur increases in temperature converted corundum to spinel (reaction 2). The fluid present during prograde metamorphism initially was H_2O-rich, but the H_2O was progressively taken up by the crystallization of micas, amphiboles, and other hydroxyl-bearing mineral species. In the period immediately following peak temperature, the operative fluid contained no more than traces of H_2O and was dominated by CO_2 and molten salts.

During the retrograde phase of metamorphism, the CO_2-molten salt fluids effectively mobilized aluminum, as well as Cr and other trace elements. Because the system was rich in CO_2, additional corundum was produced principally by the destabilization of spinel (reaction 2, now reversed) and, to a lesser degree, in some localities, again by the destabilization of mica (reaction 3). The corundum that crystallized in the retrogressive environment had a higher tendency of being gem quality than that formed earlier.

Giuliani et al. (2015) studied fluid inclusions in rubies from across southern and southeastern Asia. Fluid inclusions are cavities, usually microscopic, that contain trapped volumes of the fluid from which the host mineral crystallized. At normal temperature, the cavities usually contain fluid, a vapor bubble, and, often, minerals crystallized from the fluid after trapping. The studied fluid inclusions from Asian rubies provided strong evidence that in virtually all the marble-hosted deposits, two immiscible fluids were present during ruby crystallization: (1) sulphidic CO_2 and (2) molten salts. The salts contained mostly chlorides, sulphates, and nitrates but also carbonates and fluorides. Molten salts are proposed to be the principal factor in the crystallization of ruby corundum. Study of the composition of the salts suggests both marine and continental inputs. This is consistent with deposition in a shoreline tidal-flat environment.

Like the skarns of the Franklin Marble, the Asian ruby deposits are retrograde features that formed after the development of metamorphic fabric ceased. Both Garnier et al. (2008) and Giuliani et al. (2015) stress that recrystallization was not metasomatic but took place in a closed environment. All the components of the marble and its mineral assemblages could be accounted for by what was likely or demonstrably contained in the original carbonate sediment.

DISCUSSION

The distribution of occurrences of aluminum-rich mineral assemblages at Lime Crest Quarry suggests that they represent a single, extensive, conformable horizon within the original limestone. Volkert et al. (2005) indicated that it was unclear whether the unfoliated skarns represented the isochemical recrystallization of materials in place or were the product of metasomatic recrystallization that included the introduction and/or loss of chemical components due to interaction of the rocks with a fluid that originated outside the immediate site. The extent and apparent stratabound nature of the aluminum-rich horizon at Lime Crest suggest the former.

If, as currently interpreted, the sediments that later became the Franklin Marble were deposited on a shelf on the continent-ward side of a back-arc basin, then they may represent a period of relative tectonic quiescence. The key word here is "relative," since back-arc basins are tectonically active even on their passive sides. This is indicated by the presence of bimodal volcanic rocks in the carbonate-bearing sedimentary-volcanic sequence. Even during carbonate deposition, these environments were not immune to crustal movement.

The most striking feature of the corundum-spinel horizon at Lime Crest is the dichotomy between the two distinct mineral assemblages in both composition and space. This suggests that the aluminum-rich lenses are not boudins of an originally continuous sedimentary bed but represent discrete pockets of accumulation of aluminous minerals, most likely clays and diaspore, on a subaerially exposed erosion surface. It is not unlikely that the shelf sediments of the proto-Franklin

Marble were raised above sea level for a time and developed a horizon(s) that was eroded and weathered. There is no evidence, at present, to suggest that subaerial exposure of the carbonate sediments involved any sort of deformation such as tilting or folding. The horizon bearing the aluminum-rich lenses may instead represent a disconformity, a break in sedimentary deposition that shows signs of erosion and weathering but is, on all but the smaller scale, conformable with the sedimentary beds both above and below it.

The occurrence of aluminum-rich minerals at Lime Crest in isolated lenses on a stratabound surface has some similarities with descriptions in the literature of karst bauxite. However, most karst bauxite that has been studied is iron-rich, and its metamorphic product is emery, very different from anything seen at Lime Crest. However, the iron-rich composition is a function of the source material (lateritic continental silicate rocks), not the basic process. The small amounts of iron in the aluminum-rich mineral assemblages at Lime Crest suggest that there was little or no input of lateritic weathering products from a remote, noncarbonate source. Aluminum enrichment of the precursor materials at Lime Crest appears to be due mostly to local agents acting on locally derived materials.

Evaporites worldwide are commonly associated with carbonate sedimentation. In carbonate-depositing environments, ephemeral ponds, local tidal pools, and salt flats may be common. Seawater trapped in pools on a tidal flat migrates outward into the surrounding sediment, is wicked upward, and evaporates, resulting in deposition of its salt content. Evaporation of the seawater may also result in dolomitization, as explained next.

Upon the evaporation of modern seawater, the first salt to deposit is gypsum. This has been true since approximately 1.3 billion years before present, just before the deposition of the Franklin Marble. The removal of calcium by the deposition of gypsum leaves the remaining brine relatively enriched in magnesium. As the dissolved salts in the evaporating brine become increasingly concentrated, the specific gravity of the brine increases. The brine eventually becomes heavy enough to displace seawater, sink into the sediment and saturate its pore space. The composition difference between the two fluids greatly retards remixing, allowing the magnesium-enriched brine to react with the aragonite of the recently deposited carbonate sediment and convert it to highly magnesian calcite or dolomite. The extent (lateral and vertical) and the intensity of the dolomitization in a subaerial environment depend on the circumstances of the particular site.

The development of shallow depressions on the upper surface of the carbonate shelf sequence required a period of marine regression, complete emergence, and subaerial exposure to allow the development of shallow, incipient karst topography. This was followed by resubmergence and continued sedimentation. During the regressive and transgressive intervals, conditions for tidal flat evaporite deposition and dolomitization could have occurred. The effect of dolomitization on the development of a karst is unknown. Evaporite minerals are unlikely to have survived karstification, but may have been reintroduced during the marine transgression and partially preserved by resumed sedimentation.

Whatever the details of its development, the end product appears to have been the burial of an irregular surface pockmarked with depressions containing evaporites and aluminum-enriched debris, mainly clays and diaspore. The karst depressions had developed on a surface that had been dolomitized in a limited, patchy manner. The principal difference among the depressions was the presence or absence of dolomite. Dolomite is essential not only in converting corundum to spinel, by reaction 2, but also in maintaining the stability of spinel during the retrograde metamorphism.

In carbonate rock environments, which have a limited number of mineral phases, corundum is stable at substantially lower temperatures and pressures than spinel. In the prograde phase of the metamorphic cycle, corundum would crystallize first in all the aluminum-enriched sites. As temperature continued to increase, corundum would remain stable in sites where there was less dolomite and reaction 2 couldn't proceed. As temperature reached the level of upper amphibolite and lower granulite facies metamorphism at sites that were dolomitized, corundum reacted with dolomite and was converted to spinel by reaction 2.

The details of these mineral assemblages at Lime Crest have not been studied sufficiently to estimate their petrogenesis with sufficient precision. However, visually perceivable examples of the retrogression of spinel to corundum have not been reported, and examples of corundum embedded in calcite with little or no dolomite are common. This suggests that both corundum and spinel are of prograde origin and formed through reactions 1 and 2. However, since neither the corundum-bearing nor the spinel-bearing skarns exhibit metamorphic texture, they must be the product of the later, declining-pressure phase of the metamorphic cycle. It appears that during the later stages of the Ottawan orogeny, the activity of magnesium remained high enough and that of CO_2 low enough so that reaction 2 did not reverse to produce additional corundum during the retrograde cycle. The role of evaporite salts has not been studied at Lime Crest, but the amounts available were likely less than in the Asian ruby localities described by Garnier et al. (2008). Thus, although the skarns recrystallized during the retrograde metamorphic phase, as indicated by the lack of metamorphic fabric, both corundum and spinel within them remained stable, and a second generation of corundum did not form.

Volkert et al. (2005) proposed that the skarn-like rocks that lacked metamorphic fabric might be the products of metasomatism. Metasomatism often means the recrystallization of a rock by hydrothermal fluids, including the introduction of chemical components from outside the immediate area. However, the mineral assemblages of the aluminum-rich horizon at the Lime Crest Quarry contain no components that are inconsistent with the local environment or with having formed in a closed system.

It may be that Lime Crest is not Mogok because (a) the carbonate protolith was not sufficiently dolomitic to generate enough CO_2 to drive reaction 2 to the left during retrogression, or because (b) the marble of the Asian ruby localities did not experience karstification, which at Lime Crest (c) resulted in insufficient evaporitic salts to adequately mobilize aluminum and trace elements. Corundum and spinel that crystallized during prograde metamorphism simply recrystallized without undergoing the key transformative process that Giuliani et al. (2015) ascribed to the action of molten evaporitic salts. Although it is very likely that *some* evaporitic salts were present in the Franklin Marble during metamorphism, their role in the formation of skarns is unknown.

It remains to be seen whether or not all of the skarns in the Franklin Marble, borne of late-stage recrystallization, are characterized by unusual compositions, such as high boron or fluorine or aluminum, that suggest the original presence of evaporitic salts. It is also as yet undetermined what sort of fluid(s) facilitated the post-orogenic recrystallization. There are still questions to ask and evidence to search for. Some of the answers may lie in the tiny samples of that fluid trapped inside the corundum and spinel crystals in our mineral cabinets.

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Fluorescent Opal From the Franklin-Ogdensburg Area, New Jersey

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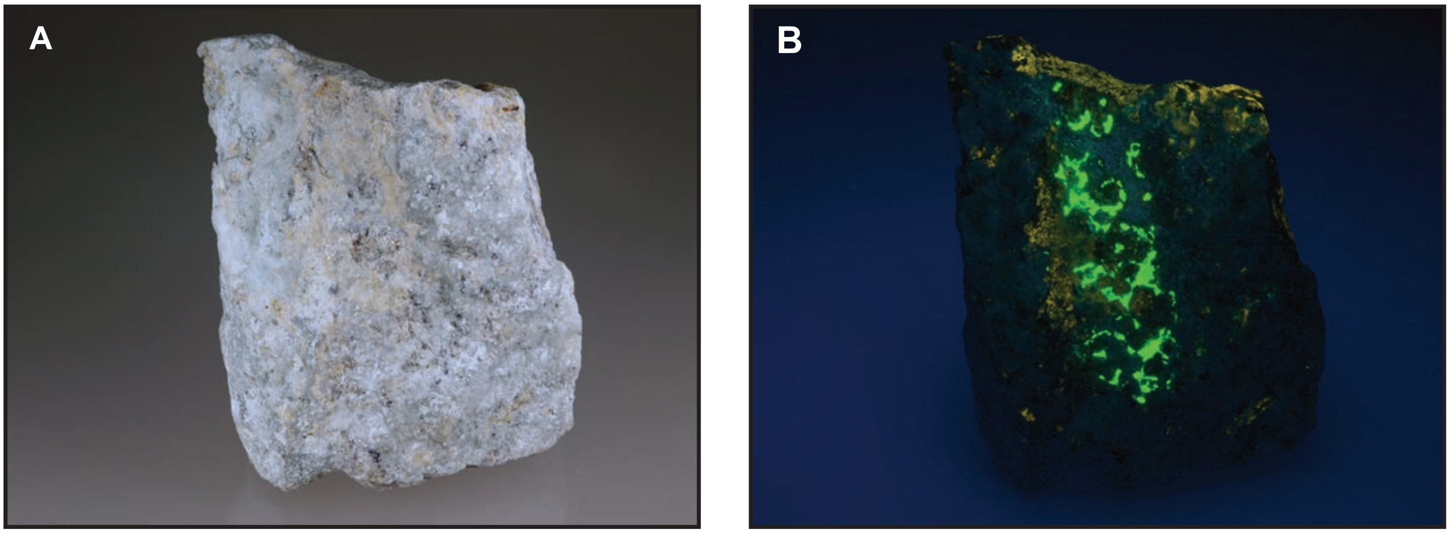

Figure 1. A patchy encrustation of calcite and opal on marble from the Whispering Woods subdivision in Sparta Township. A, daylight view; B, same specimen under shortwave UV. The yellow-fluorescent mineral is norbergite; green is opal. Specimen measures 5.1 × 4.0 × 3.0 inches (13 × 10 × 7.5 cm). *Earl R. Verbeek photos.*

INTRODUCTION

Opal, $SiO_2•nH_2O$, is a mineral well-known to almost all mineral collectors. It occurs at thousands of localities worldwide and has been found in numerous igneous, metamorphic, and sedimentary rock types, generally as a low-temperature, late-stage mineral that occurs as coatings on fractures, cavity fillings, and replacements of other minerals. Mindat, the most extensive on-line mineralogical database, lists opal from 41 of our 50 states. It may thus come as a surprise that opal was not listed as a local mineral species by either Charles Palache (1935) or Pete J. Dunn (1995) in their definitive monographs on Franklin-Sterling Hill minerals. Indeed, it was not until 2009 that opal was proven to occur within the formal Franklin-Ogdensburg area (Kuitems et al., 2009), when a single specimen collected from the Buckwheat Dump in Franklin was shown through optical and chemical data to be that species.

The opal in the Franklin specimen occurred with a pink carbonate mineral as a coating on massive, dark brown tephroite containing exsolution lamellae of willemite. A faint green fluorescence was visible from the coating and is probably to be ascribed to the opal, though the weathered black surface of the coating and the presence of exsolution willemite beneath it prevented a definitive determination. The purpose of the present paper is to describe several additional specimens of opal from the formal Franklin-Ogdensburg area and to clarify the nature of its fluorescence. Three of these specimens are from Franklin (all on different matrixes), and the fourth is from a local housing development in the Franklin Marble near Sterling Hill.

SPECIMEN 7308, FRANKLIN MINERAL MUSEUM COLLECTION

This specimen (Fig. 1), formerly in the Robert Hauck collection, was collected ca. 2001 from the Whispering Woods subdivision, along the north side of Sterling Hill Road, less than 1,000 feet (330 m) from the entrance gate to the Sterling Hill Mining Museum. Masses of Franklin Marble were at that time being blasted and the land recontoured during the initial stages of development. A decade later the specimen came to the Franklin Mineral Museum, where it is currently on display in the fluorescent mineral room. The matrix is pale gray, medium-

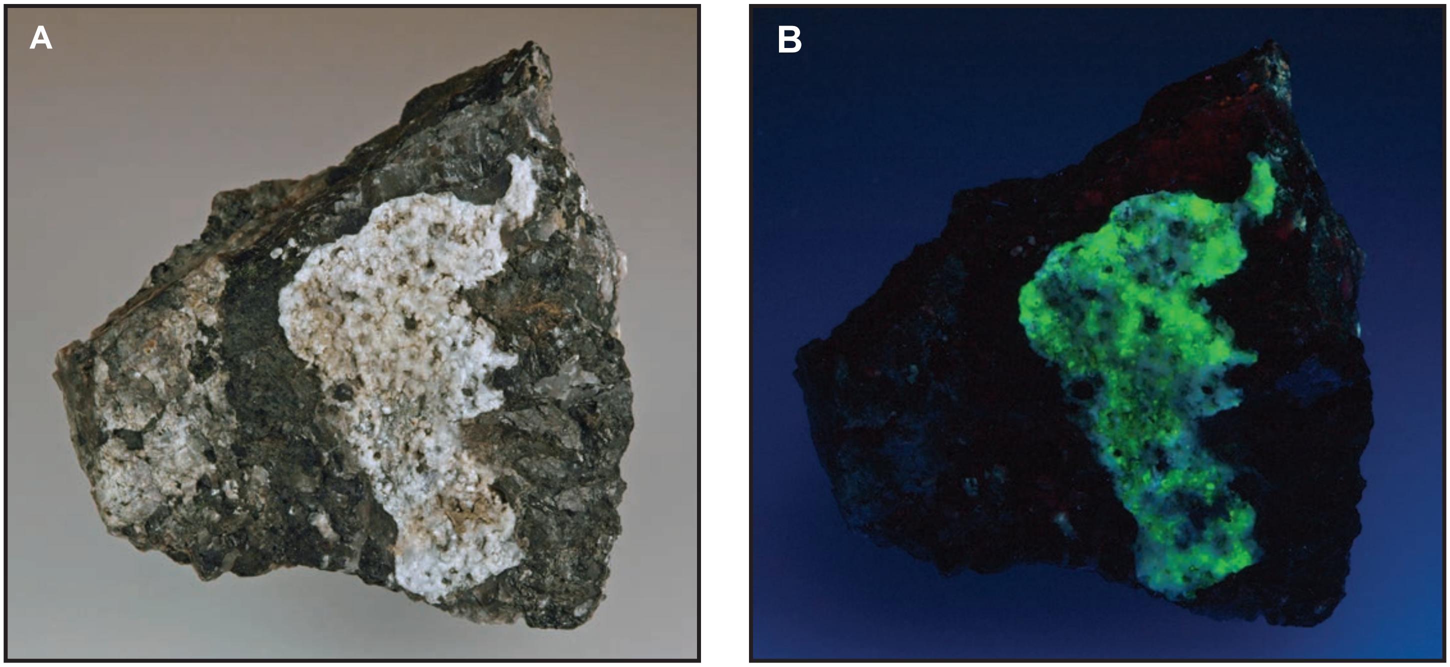

Figure 2. Intergrown opal and calcite coating a fracture surface in calcium-silicate "skarn" from Franklin. A, daylight view; B, same specimen under shortwave UV. In this specimen, the pale blue fluorescence of the calcite can clearly be seen. Specimen measures 3.1 × 2.6 × 1.6 inches (8 × 6.5 × 4 cm). *Earl R. Verbeek photos.*

grained Franklin Marble containing straw-yellow norbergite, tiny black scales of graphite, and small grains of violet-colored fluorite, all abundant, plus irregularly distributed, small grains of a nearly colorless mica (probably phlogopite) and tiny, sparse grains of pyrite. Three surfaces of this specimen are fractures, the broadest of which bears the opal. The marble on this fracture face has been etched by solution, locally bringing grains of graphite, fluorite, and norbergite into low relief. However, a small part of this surface preserves graphite slickenlines, showing that it formed originally as a minor fault with negligible displacement, probably one-half inch (1.3 cm) or less.

Also preserved on this surface are patchy coatings of post-faulting minerals. The most abundant of these is extremely fine-grained, ranges in color from white to orange-tan, and is probably a carbonate, but has not yet been tested. In places it is seen to be layered, the lower layer of pale yellowish tan color and the upper, thinner one bone white. Upon this has been deposited the opal in discontinuous, patchy coatings. The opal is colorless, transparent, of vitreous luster, and has a microbotryoidal outer surface. Fragments of this material proved to be optically isotropic with a refractive index between 1.432 and 1.460, consistent with the range of refractive indices reported for this mineral by Phillips and Griffen, 1981 (1.430 to 1.460) and by Deer et al., 1992 (1.441-1.459). The optical qualities of this mineral, together with its physical appearance, leave little doubt as to its identity.

The opal fluoresces yellowish-green under all three conventional wavelengths of ultraviolet (UV) light and is brightest under shortwave (SW) UV, moderately bright under medium-wave (MW) UV, but weak under longwave (LW) UV. As in much common opal worldwide, the green fluorescence is probably due to impurities of the uranyl ion, UO_2^{2+}, but the emitted light has not yet been examined with a spectroscope to determine if the uranyl vibration peaks are visible.

SPECIMEN 2247, MARK BOYER COLLECTION

This specimen (Fig. 2), from the Buckwheat Dump at Franklin, is from one of the calcium-silicate lenses interleaved with the ores from the Franklin mine and consists of a layered sequence of gray, medium-grained feldspar; a coarse-grained, black mineral, probably an amphibole; and coarse-grained, red-fluorescent calcite. The upper surface of this specimen is fairly flat and encrusted with calcite and opal over much of its area. The calcite appears to be of at least two generations, the earlier of which forms a pale tan to yellowish-tan, patchy coating consisting in some places of tiny platelike crystals, and in others of a layer of densely intergrown grains. This early calcite is mostly covered by later calcite and opal. The opal (var. hyalite) is colorless, with vitreous luster and a microbotryoidal to globular outer surface, as is typical of this variety. It is implanted either directly on the specimen surface or lies upon calcite of the earlier generation, and in turn is intergrown with and locally overlain by calcite of the later generation. This later calcite is white, slightly translucent to opaque, occurs in knobby masses of tiny intergrown crystals, and is volumetrically the dominant component of the encrusting minerals.

A microscopic fragment of the suspected opal was removed, placed on a glass slide within a drop of immersion oil of refractive index (RI) of 1.460 (upper limit for opal), and subjected to optical examination. The fragment was optically isotropic, and its low relief (e.g., near invisibility) immediately revealed it to have an RI not far different from that of the index oil. Observation of the Becke lines showed the grain to have the lower RI. A second grain immersed in oil of RI = 1.432 showed, through its even lower relief and behavior of colored Becke lines, that the RI of the oil is nearly identical to that of the grain. As with the first specimen described above, the isotropic nature of the mineral, its low refractive index, and its visual appearance seem sufficient to establish its identity as opal. The opal fluoresces bright yellowish-green under all three wavelengths of UV light, brightest SW, markedly less bright MW, and quite weak LW.

SPECIMEN 2826, MARK BOYER COLLECTION

This specimen (Fig. 3), also from the Buckwheat Dump, is a layered mass of pale gray, medium-grained Franklin Marble containing, in some layers, abundant small (1-2 mm) grains of black franklinite and tiny, sparse grains of LW blue-fluorescing sphalerite. Other layers, generally coarser-grained, are devoid of these minerals. The calcite in all of the layers fluoresces bright orange-red SW, but some of the larger calcite grains show a blue to bluish-red fluorescence MW, a response seen often before in calcite from the Buckwheat Dump. Much of the broad, upper surface of this specimen is fairly flat and discolored, and is visibly a little darker than the rest of the specimen. Under a binocular microscope, the calcite on this surface has a frosted appearance due to dissolution etching. The calcite is locally pitted, and in many places removal of some of the calcite in solution has brought the embedded franklinite grains into low relief. This surface is evidently a fracture that at one time was part of the fluid-flow network of the rock mass.

At least two minerals are visible on this surface. The earlier of the two, as yet unidentified, is medium bluish-gray to silvery gray, very fine-grained, and possibly a chlorite-group mineral. The other is the opal, which fluoresces green. The opal forms a thin, patchy, nearly transparent coating, within which the specimen appears almost as if varnished, its softly glistening luster contrasting with the duller luster of the etched calcite nearby. The surface of the opal is smooth and rounded throughout, though of irregular, "bumpy" shape.

A tiny piece of the green-fluorescent material, about 0.5 mm across, was removed, placed on a glass slide within a drop of immersion oil, and then crushed to smaller fragments for optical examination. Most of the fragments were obviously calcite, but among them were some that were optically isotropic, of low relief, and with a refractive index (RI) < 1.460, the upper limit for opal. This opal fluoresces moderately bright green SW, shows only a faint green fluorescence MW (and then only with the lamp held almost against the specimen), and a weak green fluorescence LW.

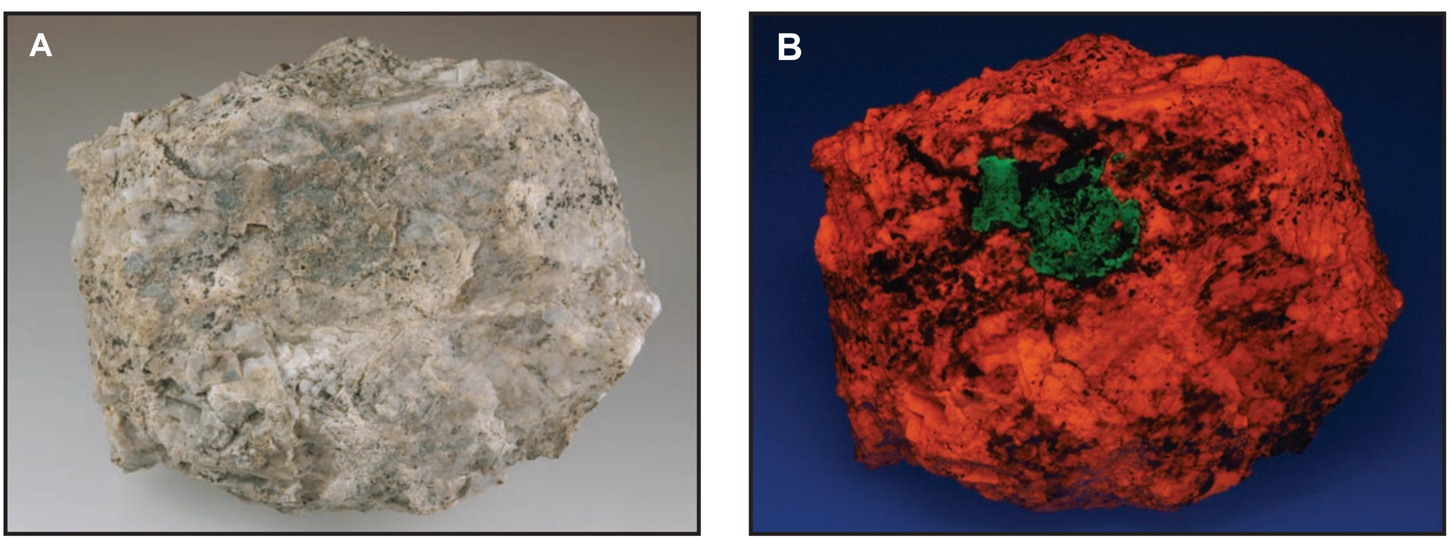

Figure 3. Patchy coating of opal on a fracture surface in red-fluorescent calcite marble from the Buckwheat Dump at Franklin. A, daylight view; B, same specimen under shortwave UV. Specimen measures 5.5 × 4.7 × 2.8 inches (14 × 12 × 7 cm). *Earl R. Verbeek photos.*

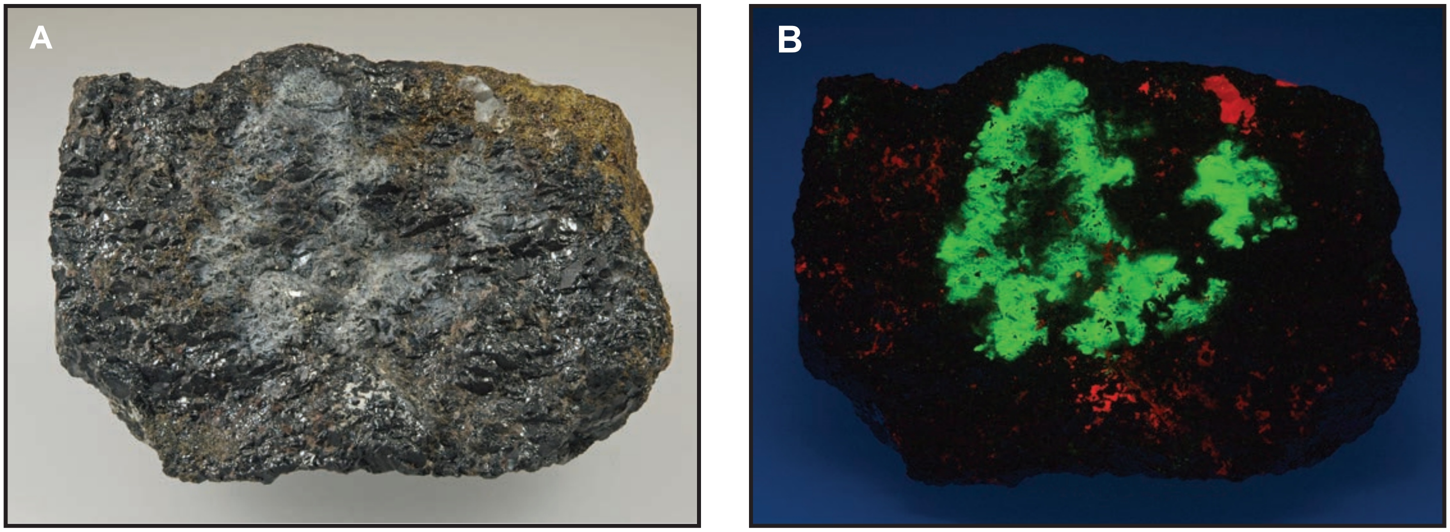

Figure 4. Thin film of intergrown calcite and opal on coarse-grained franklinite and andradite from Franklin. A, daylight view; B, same specimen under shortwave UV. Specimen measures 4.0 × 2.8 × 2.0 inches (10 × 7 × 5 cm). *Earl R. Verbeek photos.*

SPECIMEN 2477, MARK BOYER COLLECTION

Massive, coarse-grained franklinite bordered by brown, equally coarse-grained andradite is the matrix for this specimen (Fig. 4) of opal from the Franklin mine. As shown in the photo, the opal occurs as part of a thin, diaphanous film, but unlike the specimens previously described, the surface upon which it was deposited is not a planar fracture but a rough, irregular, and visually "fresh" break that shows no evidence of alteration or discoloration. The opal is intergrown with a nearly white carbonate mineral, probably calcite. The carbonate-opal film is too thin to have permitted removal of a flake of this material for optical examination, so the identity of the green-fluorescent mineral is based only on its appearance under a microscope, and its fluorescence.

LUMINESCENCE OF ASSOCIATED CARBONATE MINERALS

The luminescence of the carbonate mineral(s) associated with the opal on three of the four specimens examined share some common characteristics. Under shortwave UV the color of fluorescence is off-white, ranging from yellowish white ("cream," pale orange-tan, etc.) through white to bluish white (Fig. 2B), in all cases followed by a pale blue to bluish-gray phosphorescence of moderate (several seconds) duration. The colors of fluorescence and phosphorescence under MW and LW UV light are similar, but the brightness of fluorescence decreases in the order LW-MW-SW, whereas that of the phosphorescence decreases in the opposite direction. That is, the fluorescence of the carbonate coating is brightest LW, but the phosphorescence is brightest after SW excitation. These properties are consistent with (though not proof of) organic materials being the activators of fluorescence. If so, the nature of the luminescence underscores the generally low temperatures of formation of these minerals and of the opal intergrown with them.

DISCUSSION

Opal, a mineral only recently described from the Franklin-Ogdensburg area, and even then from just a single specimen, seems now to be much more common than once known. The four specimens here described show that the mineral occurs as late-stage encrustations on diverse rock types, including zinc ore, calcium-silicate "skarn," and the Franklin Marble. However, specimens *thought* to be opal have long been known to local collectors. Richard Bostwick (written commun., 2016), for example, noted that he collected specimens showing patchy green-fluorescent films in quartz-calcite veins in the Furnace Quarry at Franklin during the early 1960s, and Mark Boyer (oral commun., 2009) noted that a visually identical mineral, also showing bright green fluorescence, coated broad fracture surfaces in gneissic rocks exposed during road construction blasting in the area of the Edison mines, east of Ogdensburg, in the summer of 2000. More specimens probably reside in local collections. Green-fluorescent coatings suspected to be opal should be examined under magnification to see if the green-fluorescent mineral is glassy, colorless, and has a microbotryoidal to globular outer surface. Collectively these properties help to distinguish opal from other green-fluorescent minerals that form thin coatings, including monohydrocalcite, willemite, and various secondary uranium species, all of which occur in the Franklin-Ogdensburg area.

It is interesting to note that opal in the Franklin-Ogdensburg area is far younger than the rocks in which it formed. The zinc ores and the Franklin Marble hosting them are about 1,300 million years old, yet Dyer et al. (2008, p. 578) state that "the oldest known opals found on the Earth are only 65 million years old." Given that assertion, opal in the local area dates from the Paleocene Epoch or later.

ACKNOWLEDGEMENTS

I thank Mark Boyer for bringing to my attention the widespread nature of opal in the Franklin-Ogdensburg and neighboring areas and for allowing free access to his specimens for study.

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Richard and Elna Hauck at the tomb of Lazard Cahn (1865-1940), in Evergreen Cemetery in Colorado Springs, Colorado. Cahn's tombstone is in the shape of a giant cahnite crystal. Lazard Cahn was a well-known mineralogist, crystallographer, and mineral dealer who gave freely of his time and specimens to many who learned mineralogy by his side. The inscription at the base of his tomb (Scientist, Teacher, Friend) hints at the reverence in which he was held.

Scenes From the FOMS Field Trip to the Braen Franklin Quarry

October 17, 2015

The focus of most collectors was this pile of broken Franklin Marble freshly blasted from the east wall of the quarry. In this zone, pockets of weathered brown mud revealed corroded pyrite crystals. *Mark Boyer photo.*

The find of the day, or maybe the find of the *decade* at this quarry, was this roughly 4″ × 3″ (10 × 8 cm) partially corroded crystal of pyrite. Tony Santa Maria was the lucky and rightly proud collector. *Mark Boyer photo.*

Braen Stone Industries operates the Franklin Quarry on Cork Hill Road six days a week. *Mark Boyer photo.*

An Image From the Past

This previously unpublished photo, acquired from the archives of the N.J. Zinc Company, shows the ruins of the original iron furnace at Franklin Furnace, N.J., as viewed from the west. Note the use of raw fieldstone and the exposed wall of the stack's inner lining of firebrick.

The furnace was first built around 1770 by loyalist ironmaster William Potts. Due to fouling by "salamanders" (congealed masses of partially smelted ore), the furnace was torn apart and rebuilt several times. The furnace was repaired for the last time in 1854 by the New Jersey Franklinite Company. As last rebuilt, the furnace burned anthracite and used ore from Mine Hill to produce both pig iron and zinc oxide. It was put into blast in the winter of 1854 but ceased operation for good in the spring of 1855. This photo likely dates to some time prior to the early 1870s. By 1876 it was noted that all traces of the original furnace had disappeared.

A lime kiln constructed of cut stone was later erected on this site to produce flux for the 1874 Bessemer-process iron furnace that was located a short distance to the south. Photos taken in the early 1880s of these later ironworks clearly show the trim, square-cornered lime kiln surrounded by ancillary buildings. Today this site is in Mitchell Park, near the Franklin Borough police building. *Photo is used courtesy of the Franklin Mineral Museum archives.*

An unusual habit for chalcophanite: flat, branching rosettes of crystals encrusting one wall of a thin (0.1 inch, 2.5 mm), partly open vein in limonite matrix, from Sterling Hill. This specimen, no. 197 of the Franklin Mineral Museum, is on public display and was once part of Ewald Gerstmann's collection. Specimen size is 3.9 × 2.8 × 1.6 inches (10 × 7 × 4 cm); field-of-view in close-up photo is 1.6 inches (4.0 cm). *Earl R. Verbeek photos*.

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