

**The 39th
Rochester
Mineralogical
Symposium**



April 19 – 22, 2012

S. ROBINSON '09

39th Rochester Mineralogical Symposium

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Special thanks to Don Gilmore for the elegant lucite logo and sign on the registration desk!

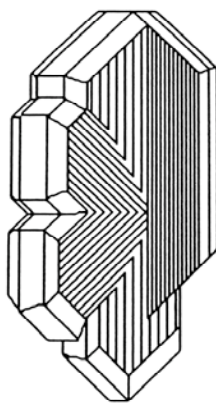


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Our warmest welcome to the 39th Rochester Mineralogical Symposium. We continue this year with our program designed to provide excellent speakers, new information, camaraderie, displays of extraordinary specimens, opportunities to acquire desired objects—all in a familiar and comfortable environment. Our speakers this year include several who have never lectured here before and others who are familiar faces. Most of their topics will be quite new to our collective experience. This year's Technical Session is again robust! We welcome numerous new attendees and hope you enjoy our meeting. We appreciate the continuing support of returning attendees. As usual, everything is different, yet everything is the same.

In Memorium

Jane Cooke (1935-2012)

We lost our dear friend Jane Cooke in January after a brief battle with pancreatic cancer. Jane was a long-time member of the Symposium Committee. She succeeded Harry Simon as treasurer and served in that capacity for many, many years until passing the torch to our current treasurer, Dan Imel. For all of her time as a member of the Symposium Committee, Jane was the lucid voice of reason who served to keep us on an even keel, to prevent overreaction, to stop ill-advised new initiatives, and the like. Jane was one of the faces of the RMS at the registration desk each year. She will be sorely missed.

PROGRAM

Thursday Evening, April 19, 2012

- PM 4:00-6:00** **Cocktails and Snacks – Hospitality Suite 400 (4th Floor)**
- 6:00-7:45** **Dinner – Baxter’s**
- 8:00-9:15** **MINERALS OF JAPAN – Alfredo Petrov**
- 9:15** **Cocktails and snacks in the Hospitality Suite on the 4th floor will be available throughout the rest of the evening. Dealers’ rooms will be open at this time. All of the dealers are located on the 4th floor.**

Friday Morning, April 20, 2012

- AM 9:00** **Announcements**
- 9:15-10:15** **MINERALS FROM A NATURAL SHALE FIRE – Dr. R. Peter Richards**
- 10:15** **Coffee Break**
- 10:30-11:30** **HISTORIC ORIENTED CRYSTAL PREPARATIONS BY THE FIRM OF STEEG AND REUTER, WITH NOTES ON A FEW AMERICAN MAKERS - Daniel E. Kile**
- 11:30-1:00** **Lunch Break**

Friday Afternoon, April 20, 2012

- PM 1:00** **CONTRIBUTED PAPERS IN SPECIMEN MINERALOGY - Dr. Carl A. Francis - Moderator**
- 1:00** **Exocontact tourmaline mineralization associated with granite**

pegmatites in Newry, Oxford County, Maine, USA – V. King.

- 1:15** Falsterite, a new zinc-bearing secondary phosphate from the Palermo #1 mine, North Groton, New Hampshire – **A. R. Kampf, S. J. Mills, W. B. Simmons, J. W. Nizamoff & R. W. Whitmore.**
- 1:30** Description and identification of “mountain leather” samples from New York State - **D. B. Bailey, J. R. Chiarenzelli, M. V. Lupulescu, M. A. Hawkins & K. M. Bart.**
- 1:45** Structure and chemistry of minerals in the Ca-As-P-(OH,F,Cl) apatite system: Johnbaumite, svabite, and turneaureite from Franklin and Sterling Hill, New Jersey – **L. G. Crimmins & J. Rakovan.**
- 2:00** Mineralogy of an unusual pegmatite, Stettin Pluton, Marathon County, WI – **T. W. Buchholz, A. U. Falster, & W. B. Simmons.**
- 2:15** Investigation of native copper nugget from Michigan reveals complex texture and chemistry – **M. Burke, T. B. Fischer & M. P. S. Krekeler.**
- 2:30** Xenotime-(Y), xenotime-(Yb) and dysprosian xenotime-(Y) from pegmatites in the Wausau Complex, Marathon County, WI – **A. U. Falster, T. W. Buchholz & W. B. Simmons.**
- 2:45** Hydrothermal mineralization in lithophysal cavities from the Taylor Creek Rhyolite, Sierra County, Southwestern New Mexico – **S. L. Hanson, A. U. Falster & W. B. Simmons.**
- 3:00** **Coffee Break**
- 3:15** Euhedra: A new program for generating life-like crystal models – **W. H. Tislar.**
- 3:30** Anomalous dispersion in titanite – **D. E. Kile & O. Medenbach.**
- 3:45** Preliminary report on the determination of the complex refractive index of opaque minerals – **C. Spencer.**
- 4:00** Deposition Japan Law quartz y-twins: Morphology and questions concerning the origins of Japan Law quartz twinning – **R. L.**

Morgan.

- 4:15** Obduction of an ophiolite complex (upper mantle and oceanic crust) on the continental crust of the Great Northern Peninsula, Newfoundland – **C. C. Reynard.**
- 4:30** An unusually coarsely crystalline calcite from the Yucatán Peninsula, Mexico – **J. Minges, M. P. S. Krekeler & D. Aldridge.**
- 4:45** Fluorapatite from a remarkable occurrence of graphite and associated minerals, Karo Pit, Block D, Merelani Hills, Tanzania – **J. M. Long, J. F. Rakovan, J. Jaszczak, D. Trinchillo, A. J. Sommer.**
- 5:00** Minerals of the tanzanite-prehnite association from Merlani Hills, Tanzania – **J. Simonoff & M. A. Wise.**
- 5:15** Preliminary electron microscopy investigation of naturally occurring cryptomelane from Xiangtan China – **H. A. Barrett & M. P. S. Krekeler.**
- 5:30** In search of why Charles Upham Shepard's minerals did not survive the test of time – **V. King.**
- 5:45-6:30 Shopping Break**

Friday Evening, April 20, 2012

- 6:30-8:00 Dinner – Baxter's**
- 8:15-9:15 NEWS FROM THE NORTH! MINERALS OF CANADA – Michael J. Bainbridge**
- 9:15-???** Continuation of "Shop'til You Drop", spirits, and Fellowship – 4th Floor

Saturday Morning, April 21, 2012

- AM 9:00-10:00** WHAT'S NEW IN MINERALS AND LOCALITIES, PART I – Jeffrey A. Scovil

10:00-10:20 MAINE MINERAL AND GEM MUSEUM – Gena Schwam

10:20-11:00 WHAT'S NEW IN MINERALS AND LOCALITIES, PART II –
Contributions from the audience.

11:15-12:15 MINERALS OF THE LAKE SUPERIOR IRON RANGES -
Dr. George W. Robinson

12:15-1:30 Lunch and Shopping Break

Saturday Afternoon, April 21, 2012

PM 1:30-2:30 DR. ANDREW FERNANDO HOLMES (1797-1860): AN EARLY
CANADIAN MINERAL COLLECTOR AND HIS COLLECTION – Dr.
Peter Tarassoff

2:30 Coffee Break

2:45-3:45 GEM DEPOSITS OF THAILAND AND CAMBODIA - Dr. Paula
Piilonen

Saturday Evening, April 21, 2012

5:15-6:30 SILENT AUCTION

7:00-8:30 Thirty-Sixth Annual Symposium Auction Dinner – Main
Ballroom

8:30 THIRTY-SIXTH ANNUAL SYMPOSIUM AUCTION

Sunday Morning, April 22, 2012

AM 9:00-10:00 MINES AND MINERAL COLLECTING IN CORNWALL, ENGLAND
– Dr. Woodrow Thompson

10:00-11:00 ONE OF THE NOTABLE MINERAL DISCOVERIES OF THE 1960S:
MINING FOR PURPLE APATITE AT THE PULSIFER QUARRY,

MT. APATITE, MAINE – Terry Szenics

11:00 End of the Symposium

See you next year for the
40th RMS:

**April 18-21,
2013**

Biographical Information for our Speakers

Editor's Note: This year we have a wealth of biographical information on our speakers. As a result, I have altered the format of the Program and only listed the titles of the talks. The biographical details appear here in the same order as the talks. The information below is based on what was provided by each speaker, sometimes lightly edited and supplemented by additional information available from public sources.

Alfredo Petrov

Version 1: Alfredo Petrov was born in England, where he found some used mineral books by Dana and Pough when he was 11 years old. These started him off on his lifelong passion for minerals. He went to school in England and Lebanon, graduated from high school in Ethiopia, and then went on to university in California to study geology and geomorphology. During his student years, he had a part-time job in the mineral department of the San Diego Natural History Museum.

Alfredo then worked for 4 years in Japan, editing research papers, before moving to Bolivia where he worked for 10 years in geological research, consulting for mining companies, and environmental projects. Since 2000, he has lived in the USA, where he sells mineral specimens, translates mineralogical literature from Spanish and German into English and guides field trips to mineral sites in several countries—his current favorite being Japan.

Some of his hobbies are also related to minerals: he collects micromounts of rare species, mainly from Bolivia, Argentina, Japan and California; writes articles for mineral magazines, including *The Mineralogical Record*, *Rocks & Minerals*, *Mineral News*, *Lapis*, *Lithographie*, and *Mineralien Welt*, and is active daily on the management team that runs the website <Mindat.org>. Outside the mineral world, he also likes hiking in mountains on tropical islands, growing cacti, reading novels (especially science fiction), and supporting environmental protection projects.

Version 2: Alfredo Petrov is an international vagabond who dissipated his youth in England, Germany, Lebanon, and Ethiopia, and then studied geology in San Diego, California. Like Butch Cassidy, Alfredo discovered that Bolivia was the perfect place to hide out from bill collectors, tax agents and cuckolded husbands. Having escaped to that remote country, he fell under the dubious influence of an itinerant California mineral dealer with the unlikely name of Rock Currier, under whose expert tutelage Alfredo began to eke out a living crawling around miserable dirty rat holes in South America's steaming jungles and freezing peaks, collecting stones to feed the insatiable cravings of northern hemisphere crystal addicts. Recently he moved to the USA to spy on American mineral collectors in an attempt to discover what it is they actually DO with all those ugly and peculiar rocks he has been foisting on them over the years. He supports himself during this ongoing quest by selling minerals, translating mineralogical literature into English, and guiding groups of foolhardy collectors to strange countries like Japan where they can energetically dig up crystals with their own eager grubby fingers.

Dr. R. Peter Richards

Pete Richards has been a mineral collector since he was 2 years old (photographic documentation available), although he admits that other interests have been more important at certain times in the interim. He grew up in the zeolite region of northern New Jersey, wishing he had adult friends who collected minerals and would take him into quarries. Instead, he picked up mineral-bearing bits of gravel in driveways and along railroad tracks, and eagerly accepted two-level hand-me-downs from a neighbor whose uncle collected frequently at the nearby Bound Brook Quarry. Summers in the pegmatite district of Maine were a strong boost to his interest in mineralogy, except that his mother limited him to one Ritz Cracker box full of rocks per trip....

Pete has a bachelor's degree from Oberlin College in Geology, a MS degree in Mineralogy and a Ph.D. degree in Paleocology from the University of Chicago. His main mineralogical interests involve the morphology of crystals, twinning, and epitaxy. He is the author of the early Macintosh versions of SHAPE. He has published papers on mineralogy in *The Mineralogical Record*, *Rocks & Minerals*, *The Canadian Mineralogist*, and Schweizer Strahler. He is currently a Consulting Editor for *Rocks & Minerals* magazine..

That's all avocation. To earn his living, Pete studies agricultural non-point pollution in Great Lakes tributaries. He is a senior scientist at the National Center for Water Quality Research at Heidelberg University in Tiffin, Ohio, which specializes in the study of land use/water quality interactions in the Lake Erie basin and the midwestern US in general. He thanks his research group for putting up with his avocational interest, and hopes to make mineral collectors of some of them, eventually.

Daniel E. Kile

Dan retired from the U.S. Geological Survey where he taught optical mineralogy and as adjunct faculty, at the Colorado School of Mines. Presently he is an adjunct faculty member of the Hooke College of Applied Sciences, Westmont, Illinois, and Scientist Emeritus, U.S. Geological Survey.

He is the recipient of the August Koehler award, conferred by the State Microscopical Society of Illinois, 2010, for contributions in polarized light microscopy and optical mineralogy.

Dan was an invited speaker at the RMS in 2003 (Development of the Petrographic Microscope), which was published as a monograph in *The Mineralogical Record* in 2003. He presented a paper in the Technical Session on "Mechanisms of Crystal Growth" in 2005.

He is the author of more than 120 articles and abstracts pertaining to mineralogy, geology, and environmental science, published in books, magazines and peer-reviewed journals, including *The American Mineralogist*, *The Canadian Mineralogist*, *Geochimica et Cosmochimica Acta*, and *The Mineralogical Record*. He is a two-time recipient of the Best Article award for *Rocks & Minerals* (for 2002 and 1991).

Dan is Curator, Scientific Instruments, Colorado School of Mines Geology Museum and former Editor and Publisher of the *Journal of the Microscopic Historical Society*. He earned a B. A. in microbiology and a B. S. in chemistry, both from the University of Minnesota.

Michael J. Bainbridge

Michael Bainbridge worked as a Cameraman and Director of Photography in film and television for ten years before switching to shooting things that don't move. He now specializes in photographing mineral specimens for museums and private collectors. Michael is a frequent guest speaker and lecturer on all topics geological and photographic, in venues from Westward Look and the Tucson Main Show, to the local college and his daughter's kindergarten class.

Also passionate advocate for the hobby, Michael is the co-founder of the Haliburton Geological Society, and Recreational Geology Project Coordinator for the Ontario's Highlands Tourism Organization. When he has money left from renovating the century home he shares with his wife, Brigitte – or time left over from playing with his young daughters, Naomi and Clementine, he can usually be found adding to his own collection of Canadian minerals.

Together with Lithographie and the Canadian Museum of Nature, and with help from the likes of Dave Bunk, Charlie Key, and George Robinson, Michael is currently working on a book about the first William W. Pinch collection, now at the Canadian Museum of Nature. Some of Michael's photographs can be viewed at his website <theoccurrence.ca>.

For tonight's lecture: Canada's a BIG place, eh – so how come you don't see more collectible minerals coming out? Well, there are any number of reasons why you might not know (like we don't like to share!), but there's no shortage of great specimens, or excellent opportunities to collect. News From the North will feature some of the best recent finds coast-to-coast-to-coast, and highlight some classics you might never have heard of.

Jeffrey A. Scovil

Jeff Scovil has been fascinated by the natural world since childhood, when he assembled his own “museum” with specimens of insect nests, butterflies, and other natural collections in his family's home in Westport, Connecticut. Jeff “started collecting minerals at the age of eight, and as the other natural history interests fell by the wayside, the passion for minerals stayed on. The gift of his first camera upon graduation from high school sparked a lifelong interest in photography. In 1971, the camera accompanied him to the American southwest on a trip to gather fossils for the American Museum of Natural History. In 1972, Scovil returned to the southwest for an archaeological dig of the Salmon Ruins in northwestern New Mexico. The next year he became the dig's laboratory photographer, and had the opportunity to hone his scientific close-up shots. Three years later Scovil combined two of his passions and began photographing minerals. Though the results were “less than spectacular,” he continued to follow his interest, perfecting the craft for 9 years before getting published in 1984 with an article in *Rocks & Minerals* magazine. His piece became the first of a series on mineral photography and was followed by appearances in the *The Mineralogical Record*. In 1990, Scovil began to turn his mineral photography hobby into a business. His hard work paid off. He is now Associate photographer for both *Rocks & Minerals* and *The Mineralogical Record*. He appears on the masthead as a contributor to *Lapis* (Germany), *Le Regne Mineral* (France), and *Lapis International*, and contributes to publications in Spain, Germany, and Poland, as well as *World of Stone* and the *Mineralogical Almanac* (Russia). His work has also appeared several times in Arizona Highways, including a special Gallery section devoted to his photos of Arizona minerals. For 22 years Jeff has run the Seminar in Mineral Photography at the Tucson Gem & Mineral Show as well as the Mineral Photography Competition. Twelve of the posters for the famous Tucson Gem & Mineral Show have featured Jeff's photographs. His work has also graced show posters in Ste. Marie-aux-Mines, Grenoble, Lyon and Paris (all in France); Siegen, Wolfach and Munich, Germany;

and Peshawar, Pakistan. He also lectures regularly at Mineral shows, symposia and for mineral clubs across North America and Europe. Additional highlights of his numerous accomplishments include photography for several seminal mineral books, including *Minerals* by George Robinson (Simon and Schuster, 1994), *Peterson Field Guides Rocks and Minerals* by Frederick H. Pough (Houghton Mifflin, 1996), numerous museums around the world, and his own book, *Photographing Minerals, Fossils, and Lapidary Arts* (Geoscience Press, 1996), the only book ever written on the subject. He has shot eleven posters for the Tucson Gem and Mineral Show and for twenty years has run the show's seminar in mineral photography, as well as the mineral photography competition. Scovil received the Carnegie Mineralogical Award in 2007. Jeff has provided "What's New in Minerals" on Saturday morning at the RMS since 1996.

Dr. George W. Robinson

George Robinson is the Gabriel Professor of Mineralogy and Curator of the A. E. Seaman Museum at Michigan Technological University. He earned a B.A. in geology from SUNY Potsdam and a Ph.D. in mineralogy from Queens University.

George taught high school earth science immediately after graduating, then became a lab instructor in mineralogy at Queens University while working on his doctorate. Thereafter, he was a self-employed field collector and mineral dealer for several years before joining the curatorial staff of the Canadian Museum of Nature. Since 1996, he has been curator of the A. E. Seaman Museum.

George has published more than 70 articles, archival papers, and chapters, as well as, dozens of abstracts. He and his collaborators have described ten new mineral species. He has also written several books, beginning with *Minerals of the St. Lawrence Valley* in 1971, and continuing with *Minerals* (1994) and *The Mineralogy of Michigan*, 2nd edition (2004). A book on the history of the mineral collections of the A. E. Seaman Museum, with R. Rann, is in press. A book on New York State minerals, *A Collector's Guide to the Minerals of New York State*, with S. Chamberlain, will be published in 2013.

George has served the mineralogy and mineral collecting community in myriad ways such as being an associate editor of *The Mineralogical Record* since 1982. He has served as a reviewer of abstracts for the RMS Technical Session since its inception. He chaired the RMS Saturday morning "What's New in Minerals" from 1985 to 1995. George has been an invited speaker at the RMS numerous times.

Currently he is designing and installing exhibits in the new A. E. Seaman Mineral Museum building at MTU. Today's talk arises from a project conducted jointly with Gene Laberge.

Dr. Peter Tarassoff

Peter Tarassoff is Honorary Curator of Mineralogy of the Redpath Museum at McGill University. He holds a bachelor's degree in metallurgical engineering from McGill University and a doctorate from the Massachusetts Institute of Technology (MIT). His professional career was in research and development in Canada's mining and metallurgical industry. His mineralogical passion goes back to his youth: his well-worn copy of *Dana's Textbook of Mineralogy* is dated 1949. While at MIT, he was a member of the Boston Mineral Club. On returning to Canada in 1962, he soon began collecting at Mont Saint-Hilaire where he has contributed to the discovery of a number of new

species. He has co-authored several articles on Canadian mineral localities in *The Mineralogical Record*, and written a number of biographical articles on mineral personalities for *Rocks & Minerals*. The mineral petarasite was named in his honor. He last spoke at the RMS in 1993. His talk today reflects his interest in the history of mineral collecting in Canada.

Dr. Paula Piilonen

Paula Piilonen is a research scientist at the Canadian Museum of Nature. She earned a B.Sc. in earth sciences from Laurentian University and a Ph.D. in earth sciences from the University of Ottawa. She was a post-doctoral fellow at the University of Marne-la-Vallée and the University of Ottawa.

She is an adjunct professor and lecturer at the University of Ottawa. She is also the New Mineral Editor for *The American Mineralogist*, a Councillor for the Mineralogical Association of Canada, the Canadian representative to the Commission on Minerals and Museums of the IMA, and a member of the Canadian Science Writers' Association.

Paula's current research projects involve sites in Norway, Namibia, Quebec, and Guinea. She and her colleagues from the CMN recently returned from a trip to Thailand and Cambodia—the subject of today's lecture.

Dr. Woodrow Thompson

Woody Thompson grew up in central New Hampshire, just a stone's throw from the Palermo Mine. He was already a mineral collector before majoring in geology at Dartmouth College, where he met his wife Louise. He later earned his Master's degree from the University of Vermont and Ph.D. from Ohio State University. His graduate theses were based on field work for the U.S. Geological Survey in Connecticut. In the New Haven Mineral Club, he met Charlie and Marcelle Weber, who introduced him to Mt. St-Hilaire and the Rochester Mineralogical Symposium. He was an easy convert and has attended this Symposium every year since 1980.

Woody has spent much of his career working for the Maine Geological Survey. He teaches courses and has collaborated on numerous research projects with the University of Maine (including field work in Antarctica), and has published extensively on the glacial geology of Maine and the White Mountains. He belongs to several professional societies in the U. S. and Canada, and is Secretary of the Friends of the Pleistocene.

Woody is best known in the mineral hobby as having chaired the Maine Mineral Symposium and co-authored three editions of the *Collector's Guide to Maine Mineral Localities*. He is also a Consulting Editor for *Rocks & Minerals* magazine. He belongs to the Russell Society in the UK, and has long been interested in the minerals and mining history of Cornwall, England.

Terry Szenics

Terry's interest in minerals started at 6 years old when his father took him to the American Museum of Natural History in Manhattan, New York City. After visiting the Morgan Hall of Gems and Minerals, it was a passion at first sight for young Terry. Growing up in dreary postwar Queens, New York in the 1950's, the natural world on display at the American Museum was very powerful medicine for a small impressionable child.

In 1960 Terry's family moved, luckily to Westwood, Bergen County, New Jersey. We say luckily because his new home was only 14 miles away from the famous basalt quarries of Paterson, New Jersey. As a young teen he would go on his English-racer bicycle to Paterson, with tools to collect at the New St. Quarries, and especially the famed Prospect Park Quarry, where at times he would sneak in at night, like other collectors did then, to avoid the guards.

At the tender age of 15-16, he was dealing in minerals, mostly from Paterson and Franklin, N.J., and even ran a few advertisements in the *Rocks & Minerals* magazine.

The subject of this presentation today, the mining of purple apatite specimens from the Pulsifer Quarry, Mt. Apatite, Auburn, Maine, started as a very lucky series of events for Terry. The success he had with the mining operations there in 1966 and 1967 put him firmly on the map as a field collector and mineral specimen dealer.

In 1967, he relocated the old "lost" famous Calvin Mitchell diopside location in Dekalb Junction, New York and was rewarded with hitting a pocket of fine gemmy diopside crystals. However, his stay there was short and only lasted one season.

Incidentally, he went international and was probably the first American dealer to bring back quantities of the orange grossular garnets from the Jeffrey Mine in Quebec. All these products were marketed through Commercial Mineral Corp. on West 48th Street in New York City, run by Mr. Ron Romanella and Herb Obodda at the time.

In 1968, he relocated the "lost" axinite location at Coarsegold, Madera County, California. This location had produced some of the finest crystallized axinites found in North America. Terry worked the location by hand that summer, but wasn't successful at finding new pockets of axinite.

In 1969, he met the famous collector Ed Swoboda of Los Angeles, California and worked for him reopening the Stewart Lithia Mine at Pala for gem pink tourmaline. They were successful beyond their wildest dreams. It was the subject of a colorful article for the *Lapidary Journal* magazine.

In 1974, Terry bought the Havey pegmatite quarry in Poland, Maine. The Havey Quarry was famous for pockets of some of the finest gem-green tourmaline found in the U.S. For Terry it was "coming back home," as from this quarry property one can look north across the river valley directly at the hill that is Mt. Apatite in Auburn.

He worked the quarry in 1976 and 1977 with fair success. But at the end of 1977, his life changed radically again. He was hired by an investment firm in Teaneck, New Jersey. His job was one most collectors would die for. He was to go travel to many foreign countries with an open company checkbook and buy the finest mineral specimens and gem crystals available. It was here Terry learned how to be a tough buyer and a true international businessman.

Already Terry spoke fluent Spanish and knew Portuguese. Essentially his operational base was Lima, Peru where for many years there he was one of the leading buyers and exporters of mineral specimens. At that time, before China came on stream, mineral specimens were just pouring out of the mines in Peru. He was in Bolivia, Argentina, Chile, Venezuela, and also India, Pakistan, Morocco and Nigeria for this company. But his most notable work for them was in Brazil, where he lived for a year. He was on hand in Brazil when the fabulous Jonas Lima tourmaline discovery was made, and was on hand to supply the logistics to get some of these iconic specimens out of the country—no easy task.

From 1986 to 2001, Terry was with the well-known Aurora Mineral Corp., of Freeport, Long Island, New York. Aurora is probably the biggest wholesaler on the east coast of amethyst geodes from Brazil and other mineral specimens. Terry complemented Aurora's strictly Brazilian merchandise by supplying everything saleable, mineral-wise, from Peru and Chile. He also spent 6 months living in Buenos Aires, Argentina buying and exporting very serious quantities of the beautiful Argentine rhodochrosite, both specimens and cut and polished to Aurora's business.

In 1983, Terry met a young woman mineral dealer in Lima, nee Marissa Leandro, and they had a business relationship for a few years. They were finally married, and in 1989 and 1990 their two sons, Michael and Matthew were born in Lima.

By 1991, Peru was falling apart economically and the terrorist activity was turning both living in Lima and the county side into a nightmare. Terry only remembers too well the sounds of car bombs going off in Lima at night, killing people and destroying property. This was no place anymore to raise a family or conduct a daily business. Today the terrorist group, the "Shining Path," has been destroyed and as a county, Peru is back on track with a solid economic footing, but in 1991 Terry had one choice only: to move his family, 2 very small children and a wife, to a peaceful, productive place. That place was Santiago, Chile.

Terry already had business relationships in Santiago for Aurora, mostly in cut and polished goods from cutting shops. Almost immediately on a trip to the Atacama Desert to the copper mines for mineral specimens, Terry discovered a small working copper mine, called the Manto de Tres Gracias, in the town of Diego de Almagro, that had the finest color of blue drusy chrysocolla known, and in quantity! It became an instant hit in the drusy jewelry market, and was a standard color much coveted for many years. It became Terry's best product ever, and it was amazing that this mine almost consistently produced this "drusy" for 12 years until 2003 when they mined out the ore body and shut the mine for good. But the best is yet to come.

In one buying trip to this drusy chrysocolla location, Terry and his wife stopped nearby in the small mining town of Inca de Oro. He visited a small mine there, known as the "Jardinera #1." He knew this mine as a source of green brochantite-green stained ore rock that was pretty and useful in carvings.

Almost immediately, he noticed an unusual green crystallized mineral in the ore piles waiting for shipment to the copper smelter. It was a pretty apple-green color. As there was quite a bit of molybdenum in this deposit, Terry rightly identified the mineral as cuprian-powellite, or calcium molybdate, colored green by traces of copper.

But there was another green mineral present. In one large piece of ore, Terry pulled away a sticky red clay from a small vug and beautiful platy dark green crystals made their appearance. They looked the world like torbernite, but Terry knew there wasn't any uranium present in this mine or any such mine in northern Chile. He felt it might be something exciting, even a new mineral!

As he knew the mine operators well from previous business, he was allowed to go through everything and collect any quantity of this new material he could find. He even went underground to where they were mining and found out they had just mined the area out. It was a one-in-a-million shot for Terry. To make a very long story short, the mineral was a new one, and was described by Dr. Carl Francis of Harvard University the following year, and named "szenicsite," for Terry and his wife. Terry feels he could never repay Dr. Francis for this honor bestowed on him.

Later discoveries in Chile were made by Terry and his selected "team." In 1995, Terry met a young Chilean mining engineer and field collector named Senor Arturo Molina. Along with Arturo and a hand-picked crew of several professional Chilean miners, Terry worked an unusual location in 1998, the Veta Negra Mine near Tierra Amarilla. This mine was rich in highly unusual arsenate minerals, and they collected a pocket of the world's finest villyaellenite specimens. (This mineral has been since renamed miguelromeroite.) Though the miguelromeroite is in micro-sized crystals, the exquisite peach-pink color and rarity made a hit with serious species collectors.

With Arturo Molina and miners, Terry mined quantities of some of the best micro lindgrenite found, at the San Samuel Mine, in Carrera Pinto. Other discoveries were the best crystallized lammerite found from The Guanaco Mine. From the same mine, they produced the new and beautiful guanacoite. At Sierra Gorda, far north in the northern Atacama Desert, they made a striking discovery of the world's best crystallized penfieldite at the Margarita Mine, and in quantity.

Penfieldite was formerly known only as sparse micro specimens from the Laurium, Greece (man-made) slags.

Near Tocopilla, in a very isolated bone-dry location in the middle of the Atacama Desert nitrate-mining terrain, Terry and company discovered (by GPS!!) another lost location, the Chapacase Mine, that produced beautiful bright-red chromian wulfenites. Also from there was found another very rare mineral- the chromate iranite, in unheard of quantities. One pocket produced over a kilo of iranite, a mineral formerly measured in parts of a gram!

All this work at these locations was done in dangerous abandoned mines. The mining work was done the old-fashioned way, by experienced miners drilling holes by hand with a single-jack and using sticks of dynamite.

The crowning achievement for all this work in the 10-year period from 1993 to to 2003 in Chile for Terry was the discovery, in the field, of 6 new mineral species: szenicsite from Inca de Oro, then lemanskiite from Guanaco, and cristelite, gordaite, changoite and herbersmithite from the San Fransisco Mine at Sierra Gorda. Also, in any specimen mining operation, there are still a few unknowns that eventually may turn out to be new species!

To conclude, in 1998 Terry moved his family to Long Island, New York, to the pleasant suburban town of Massapequa, where they still are located. Terry still visits Chile: his latest work in Chile is the mining, with mine company management's cooperation, of tonnage quantities of the ever-popular atacamite from the well-known La Farola Mine near Tierra Amarilla. This La Farola atacamite is probably the best known and most widely traded mineral specimen material from Chile.

Contributed Papers in Specimen Mineralogy

This year submitted abstracts were reviewed by a committee consisting of Dr. Carl Francis, Dr. Marian Lupulescu, Dr. George Robinson, Dr. Sarah Hanson, and Dr. Steve Chamberlain. Eighteen abstracts were submitted, accepted, and scheduled for platform presentations on Friday afternoon. The accepted abstracts follow.

EXOCONTACT TOURMALINE MINERALIZATION ASSOCIATED WITH GRANITE PEGMATITES IN NEWRY, OXFORD COUNTY, MAINE, USA. V. King, P.O. Box 90888, Rochester, NY 14609.

Exocontact mineralization and trace element studies have been used as an exploration tool for economic minerals that might occur in granite pegmatites. Most studies have focused on the host contact rock generally within a few meters of the granite pegmatite body. The granite pegmatites located near Halls Ridge, Newry, Maine are well-known producers of gem tourmaline as well as having visible tourmaline-rich exocontact mineralization. Although, no chemical exocontact data have ever been collected on the rock units in Newry, there have been many exposures of tourmaline-bearing assemblages on Halls Ridge where such studies would have proved useful if the granite pegmatites were not well-exposed. The only commercial sources of gem tourmaline in the area have been the Dunton Pegmatite and the Crooker Pegmatite. The two pegmatites are nearly touching in outcrop (~50 m), but small veins and stringers nearly connect (within 2 meters) the two pegmatites directly. The unit immediately to the northeast is the Maine Pegmatite sheet and to the northwest are the Scotty Pegmatite and the enormous Pegmatite 24, stratigraphically above that (Shainen and Dellwig, 1955; Barton and Goldsmith, 1968). These pegmatites cut the Plumbago Gabbro Pluton and show exocontact effects. The Scotty pegmatite displays black, flat radial fans of tourmaline in contact with the gabbro, but otherwise, the gabbro displays few hydrated alteration species on the contact. The pegmatites to the south and east of the Scotty Pegmatite have contact alteration assemblages characterized by complete replacement of the gabbro by chlorite-tourmaline schist. The schist foliation is locally conformable with the granite pegmatite contacts and the tourmaline extends in discrete dense layers from the contact to up to 2 meters into the chlorite schist. Tourmaline layer spacing is usually 1-10 cm. Tourmaline crystals vary dramatically in size from mere needles (1 x 5 mm) to stout crystals (2 x 5 cm). Terminations are frequently found on this tourmaline.

The internal margin of the keel of the pegmatites may be locally replaced by fine-grained dark brown tourmaline, while the wall zone contains sparse anhedral black tourmaline (usually schorl) in intergranular texture. The interior of both the Dunton and Crooker pegmatites have extensive development of cleavelandite replacement units and these units are characterized by relatively large subhedral tourmaline crystals. Many variations of color zoning are displayed by tourmaline in the Dunton Pegmatite. Progressive color zonation: black, blue, green, to pink may be seen, but there are many instances of “reversed” color progressions, red or green surrounded by blue or blue black. Pink overgrowths on blue black cores are not rare. The upper portion of the Dunton Pegmatite was noted for “watermelon”-zoned tourmaline prisms to 1x0.2 meters.

Within cleavelandite replacement units, blue rims (to 1 cm thick) developed on pre-existing triphylite pods (to 10 cm). Muscovite is commonly cut by green tourmaline rods, along ruling planes in the mica books as well as along the margins of the books.

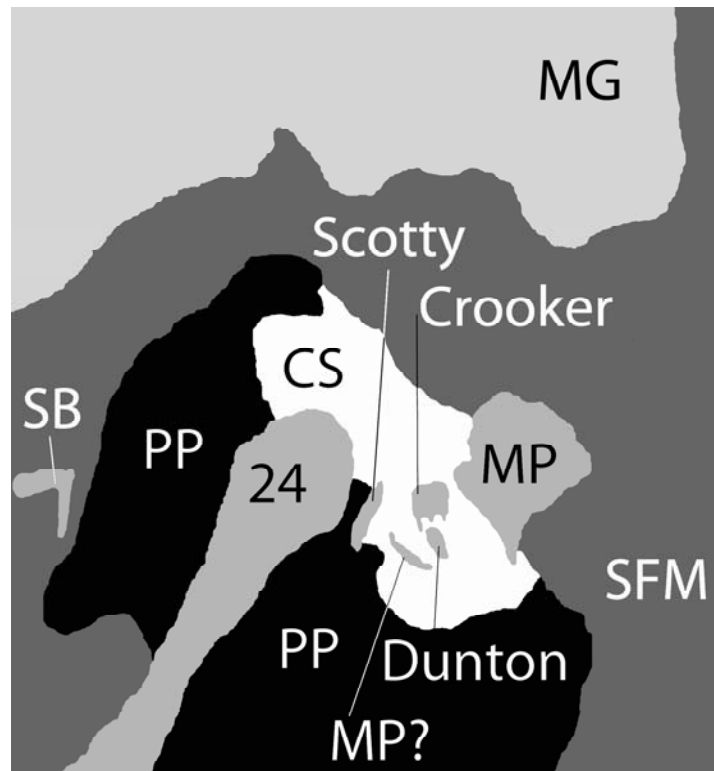
The commercially most significant tourmaline mineralization at Newry has been the

development of large (10 m) tourmaline-bearing pockets. The Crooker Pegmatite has yielded mostly gem indicolite (to 34 carats), while the Dunton is noted for yielding large rubellite (to 78 carats) and verdelite (to 45 carats) gems. The production of the Dunton Pegmatite has been estimated at 3 metric tons of gem tourmaline.

Literature Cited:

Barton, W. R., and Goldsmith, C. E. (1968) *New England beryllium investigations*. U.S. Bureau of Mines, Technical Report, 187p.

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MG-Mooselookmeguntic Granodiorite; PP-Plumbago Gabbro Pluton; CS-Chlorite Tourmaline Schist; SFM-Smalls Falls-Madrid Formations (metasedimentary); SB-Spodumene Brook pegmatites; 24-Pegmatite 24; MP and MP?-Main Pegmatite; Scotty, Crooker, and Dunton pegmatites. Dunton Pegmatite centered at 42°32'34"N, 70°43'24"W.

FALSTERITE, A NEW ZINC-BEARING SECONDARY PHOSPHATE FROM THE PALERMO #1 MINE, NORTH GROTON, NEW HAMPSHIRE. **Anthony R. Kampf¹, Stuart J. Mills², W.B. Simmons³, James W. Nizamoff^{3,4}, and R.W. Whitmore⁵**. ¹Mineral Sciences Department, Natural History Museum of Los Angeles County, 900 Exposition Boulevard, Los Angeles, CA 90007, USA; ²Geosciences, Museum Victoria, GPO Box 666, Melbourne 3001, Australia; ³Department of Earth and Environmental Sciences, University of New Orleans, New Orleans, LA 70148, USA; ⁴Omya, Inc., 39 Main Street, Proctor, VT 05765, USA; ⁵934 South Stark Highway, Weare, NH 03281, USA.

Falsterite, ideally $\text{Ca}_2\text{MgMn}^{2+}_2(\text{Fe}^{2+}_{0.5}\text{Fe}^{3+}_{0.5})_4\text{Zn}_4(\text{PO}_4)_8(\text{OH})_4(\text{H}_2\text{O})_{14}$, is a late stage secondary phosphate that occurs in a Zn- and Pb-rich phosphate/carbonate assemblage found along the margin of a 1.5 m triphylite crystal located in the core margin of the Palermo #1 pegmatite, North Groton, New Hampshire. The new species is named falsterite in honor of Alexander U. Falster (b. 1952) in recognition of his research on pegmatites and pegmatite minerals.

Falsterite forms extremely thin, blue-green rectangular plates and laths to 1mm that exhibit {010}, {100} and {001} forms. Crystals are transparent and typically flattened on {010}, elongate along [100] and exhibit lamellar twinning. The chemical composition of falsterite as determined by 7 averaged electron-microprobe analyses, is: CaO 6.36, MgO 2.13, MnO 8.10, ZnO 18.49, FeO 8.02, Fe_2O_3 8.90, Al_2O_3 0.02, P_2O_5 31.81, H_2O 16.17, total 100.00 wt% (FeO and Fe_2O_3 assigned and H_2O calculated on structural grounds). The empirical formula (based on 50 O atoms) is: $\text{Ca}_{2.02}\text{Mg}_{0.94}\text{Mn}^{2+}_{2.04}\text{Fe}^{2+}_{1.99}\text{Fe}^{3+}_{1.99}\text{Zn}_{4.05}\text{P}_{7.99}\text{O}_{32}(\text{OH})_4(\text{H}_2\text{O})_{14}$. Falsterite is monoclinic, $P21/c$, with the cell parameters: $a = 6.3868(18)$, $b = 21.260(7)$, $c = 15.365(5)$ Å, $\beta = 90.564(6)^\circ$, $V = 2086.2(11)$ Å³, and $Z = 2$. The structure of falsterite contains edge-sharing chains of $\text{Fe}^{2+}/\text{Fe}^{3+}\text{O}_6$ octahedra and corner-sharing chains of ZnO_4 tetrahedra along [100]. These chains are linked to one another by PO_4 tetrahedra, forming a sheet parallel to {010}. Mn^{2+}O_6 octahedra and CaO_7 polyhedra also link to this sheet, resulting in a thick slab. The slabs are bridged in the [010] direction by edge sharing dimers of MgO_6 octahedra, which link to the slabs by sharing edges with ZnO_4 tetrahedra in adjacent slabs. The structures of falsterite and schoonerite, while topologically quite different, share similar components and structural features.

Falsterite occurs in small cavities in a 10 to 30 cm thick alteration rind consisting mainly of siderite, fluorapatite and quartz along one side of a large triphylite crystal. This carbonate-rich zone also hosts a number of locally abundant sulfides, including pyrite, sphalerite, galena and chalcopyrite. A considerable fraction of the sulfides have been altered by aqueous phosphate- and carbonate-bearing solutions resulting in the formation of numerous secondary Zn- and Pb-bearing phosphate and carbonate species including phosphophyllite, parascholzite, schoonerite, keckite, smithsonite, pyromorphite and cerussite (Nizamoff et al., 2007). Falsterite has also been identified from the Estes quarry, West Baldwin, Maine, where it is associated with sphalerite, schoonerite, quartz, fairfieldite and muscovite.

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Nizamoff, J.W., Whitmore, R.W., Falster, A.U., and Simmons, W.B. (2007) Parascholzite, keckite, gormanite and other previously unreported secondary species and new data on kulanite and phosphophyllite from the Palermo #1 mine, North Groton, New Hampshire. *Rocks & Minerals*, 82:145.



Light microscope and SEM images of falsterite.

DESCRIPTION AND IDENTIFICATION OF “MOUNTAIN LEATHER” SAMPLES FROM NEW YORK STATE. **D. G. Bailey¹, J. R. Chiarenzelli², M. V. Lupulescu³, M. A. Hawkins³, and K. M. Bart⁴**, ¹Geosciences Department, Hamilton College, Clinton, NY 13323; ²Geology Department, St. Lawrence University, Canton, NY 13617; ³New York State Museum, Albany, NY 12230; ⁴Biology Department, Hamilton College, Clinton, NY 13323.

“Mountain leather” is an old term that has been used to describe a variety of fibrous minerals that form leather-like mats and masses. Related terms include “leatherstone”, “mountain cork”, “bargkoark”, “mountain paper”, “mountain veil”, “mountain hair”, and “mountain flax”. Dana (1837) defined mountain leather and mountain cork as: “*white varieties (of actinolite) composed of minute fibrous particles interlacing one another and forming a mass that will float on water*” (p.310). Subsequent studies (Heddle, 1878; Von Fersmann, 1908; Macksoud, 1939) revealed that samples of mountain leather belong to a number of distinct mineral species, the most common being asbestiform varieties of tremolite, chrysotile, kaolinite, sepiolite, and palygorskite. The goal of this project was to examine the 16 samples of “mountain leather” currently in the New York State Museum mineral collection to correctly identify the mineral species represented. Eleven of the samples are from the Balmat-Edwards mining district in the Adirondack Lowlands, one from the Hudson Highlands region, two from the Taconics (Stockbridge dolostone), one from the Manhattan Prong (Briarcliff marble), and one from an iron deposit in the north-eastern Adirondack Highlands (see table below).

The samples were examined optically, chemically analyzed with an EDS/SEM system, and analyzed by powder XRD. Of the sixteen samples, twelve belong to the clay mineral sepiolite group, the four remaining samples were unique, with one sample each of serpentine, actinolite, chlorite and calcite. The twelve sepiolite samples are quite variable in morphology. All are fibrous, but the fibers vary in length from 0.2 mm to 12 mm, and in diameter from <1 mm to ~ 5 mm. They also vary in morphology from being very straight, rigid, and aligned to being very sinuous and intertwined. Associated minerals tentatively identified with the sepiolite samples include calcite, dolomite, talc, pyrite, pyrrhotite, sphalerite, celestine, barite, gypsum, halite, and phlogopite.

Sepiolite belongs to the sepiolite-palygorskite group of clay minerals. This group has been studied extensively over the past 50 years because of the widespread occurrence in many soils and

sediments, and because of the large number of industrial applications (e.g. filtration, sorption). While sepiolite and palygorskite have complex and somewhat different structures, recent studies indicate there is complete solid solution between the two end-members (Garcia-Romero & Suarez, 2010). All of the sepiolite samples from New York have compositions close to the sepiolite end-member: $Mg_8Si_{12}O_{30}(OH)_4(OH_2)_2 \cdot 4H_2O$. Because sepiolite is stable at very low temperatures and pressures and can be precipitated directly from 25°C solutions (Wollast et. al., 1968), it is very likely that these samples of mountain leather from New York are all fracture-filling precipitates of low temperature hydrothermal origin. While clearly much younger than the rocks that host these deposits, the actual age of formation of the “mountain leather” is unknown.

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Specimen Locations / IDs

NYSM #	Town	County	Primary Phase
338.56	Lyon Mountain	Clinton	clinocllore
51.5.3/4.0-17	Pawling	Dutchess	sepiolite
338.54	Patterson	Putnam	sepiolite
20707	Brewster	Putnam	sepiolite
21402	Talville	St. Lawrence	sepiolite
21125	Pierrepont	St. Lawrence	sepiolite
2296	Balmat	St. Lawrence	sepiolite
10867	Balmat	St. Lawrence	sepiolite
13591	Balmat	St. Lawrence	sepiolite
20824	Balmat	St. Lawrence	sepiolite
20562	Balmat	St. Lawrence	sepiolite
2470	Sylvia Lake	St. Lawrence	lizardite
20543	Balmat	St. Lawrence	tremolite
1737	Edwards	St. Lawrence	sepiolite
13643	Balmat	St. Lawrence	calcite
23555	Thornwood	Westchester	sepiolite

STRUCTURE AND CHEMISTRY OF MINERALS IN THE Ca-As-P-(OH,F,Cl) APATITE SYSTEM: JOHNBAUMITE, SVABITE, AND TURNEAUREITE FROM FRANKLIN AND STERLING HILL, NEW JERSEY. **Laura G. Crimmins** and **John Rakovan**, Department of Geology and Environmental Earth Science, Miami University, 250 S. Patterson Avenue, Oxford, OH 45056-3656.

The Franklin and Sterling Hill ore deposits are unusual in their wide variety of apatite group minerals. Those in the Ca-As-P-(OH,F,Cl) system are of interest to mineralogists for a number of reasons including their potential use in environmental remediation. In-situ growth of apatite group minerals can be useful in the sequestration of metals such as arsenic and lead for environmental remediation. A number of studies have investigated the use of apatite group minerals for in-situ remediation of lead, however only a few studies have looked at arsenic remediation with either calcium or phosphate minerals. Arsenic contamination in soil and aquifers is affecting the health of people on almost every continent, and it is therefore important to understand and develop methods for arsenic remediation. One remediation technique that is being investigated involves direct injection of solutions into contaminated areas for in-situ stabilization of toxic elements within the structure of apatite group minerals. Understanding the structure and composition of solid solutions among these apatite group minerals will not only help elucidate the substitution mechanisms taking place during in-situ remediation, but this knowledge will also help increase understanding of the deposit in which these minerals formed.

This research focuses on determining the structure and composition of solid solutions among three arsenic bearing apatite minerals, johnbaumite ($\text{Ca}_5(\text{AsO}_4)_3\text{OH}$), svabite ($\text{Ca}_5(\text{AsO}_4)_3\text{F}$), and turneaureite ($\text{Ca}_5(\text{AsO}_4)_3\text{Cl}$), from Franklin and Sterling Hill, NJ. The rough chemical composition of the samples was determined using energy dispersive spectroscopy (EDS) on a scanning electron microscope (SEM), and more detailed chemistries are being collected using electron microprobe (EMP). Raman spectroscopy data are being compiled to provide a quick and convenient method for others to identify samples of near end-member johnbaumite, svabite, and turneaureite as well as solid solutions. The structures of the samples were determined using single crystal x-ray diffraction data and refined using the programs SMART, Saint, and Shelxtl from Bruker AXS, Inc. The diffraction data revealed some interesting trends along the P-As solid solution: as the relative amount of arsenic in the tetrahedral site increases, the unit cell dimensions and most bond lengths increase. The growth in dimensions and bond lengths are a result of the expansion of the tetrahedral site, which gets larger as the average size of the central cation gets larger. There is only one bond length that decreases with increasing arsenic in the structure, the Ca1-O1 bond length. This is a result of steric constraints placed on the Ca1 site by the bonded arrangement of tetrahedron to it.

MINERALOGY OF AN UNUSUAL PEGMATITE, STETTIN PLUTON, MARATHON COUNTY, WI. **Buchholz, T. W.**¹, **A. U. Falster**², and **W. B. Simmons**², ¹1140 12th Street North, Wisconsin Rapids, Wisconsin 54494, ²Department of Earth and Environmental Sciences, University of New Orleans, New Orleans, Louisiana 70148.

The Stettin Pluton is the oldest (1565 Ma \pm 3-5) (Van Wyck, 1994) and most alkalic of the four plutons comprising the Wausau Syenite Complex. It is comprised of a pyroxene syenite core surrounded by amphibole syenite and tabular syenite, with an inner core ring and an outer ring of nepheline syenite (Meyers et al, 1984). Small to moderate sized pegmatites are abundant in all phases of the pluton, and range from simple feldspar-rich bodies with few accessory minerals to more complex pegmatites with a series of unusual minerals.

Road construction in 2011 along a portion of Woodland Drive exposed a series of unusual, small to moderate-sized pegmatites. The pegmatites are all similar in their mineralogy and were emplaced into tabular syenite, now weathered to grus. The largest dike dips shallowly to the west, and is composed of upper and lower aplite units and a central core zone composed of coarse anorthoclase, microcline and albite. Small vugs (cm range or less) are common in the core zone and in bordering aplite. The pegmatite appears to be silica-saturated, as neither quartz, nepheline or other feldspathoids occur.

Zircon abounds in all phases of the pegmatite. Late patches of coarse albite in the core zone may contain unusual radiating strings of small, oriented zircon crystals, possibly representing replacement of a Zr-rich precursor such as elpidite. Zircons are enriched in Hf, ranging from 4.11 to 8.57wt. % HfO₂. The relatively uniform zircon compositions, and association with late albitized units, suggest mobilization and recrystallization of Zr as zircon during late albitization.

Pyrochlore-group minerals are locally abundant in core-zone phases. Pyrochlores are Ta-rich and compositionally uniform. Notably, Sc ranges from 0.022 to 0.054 wt% oxide%; but in all other pyrochlores in the Stettin intrusion Sc is below detection limits. The uniform composition, lack of zonation, association with late albite, overgrowth on zircon, and presence in miaroles suggests that pyrochlore also formed during late albitization.

Columbite-(Fe) occurs as minute grains in albite, core-zone aplite, and rare crystals in core-zone vugs. Microprobe analyses show significant enrichment in Mn and Ta.

Ilmenite is common as small platy crystals in albite, and pale blue brookite is locally abundant in core-zone material, probably formed by alteration of ilmenite. Small grains of cassiterite occur with ilmenite in core-zone albite. Pyrite and arsenopyrite are largely or partially altered to goethite pseudomorphs. Fluorite occurs as rare grains in clay-filled miaroles.

Rare earth element (REE) and Th minerals are scarce, unusual for the Wausau complex and particularly for the Stettin Pluton.

In summary, these associated pegmatites appear to be unusually fractionated for this alkalic environment, with significant enrichment in Zr, Hf, Nb, Ta, and Sn, and depletion in REE and Th coupled with extensive late albitization and recrystallization of primary mineralization into late stage phases.

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INVESTIGATION OF NATIVE COPPER NUGGET FROM MICHIGAN REVEALS COMPLEX TEXTURE AND CHEMISTRY. **Michelle Burke, Timothy B. Fischer, and Mark P.S. Krekeler.** Miami University department of Geology and Environmental Earth Science, 250 S. Patterson Avenue, 114 Shideler Hall, Oxford, OH 45056-3656.

While Arizona may now be the nation's leader in copper mining, this industry once boomed in Northern Michigan. The Keweenaw Peninsula is known for its extensive deposits of native copper. While some work has been done investigating native copper from this area, mostly in the form of

bulk chemical analysis, there is little investigation regarding mineralogical diversity and textural variation of native copper at the microscopic scale. This study utilizes scanning electron microscopy (SEM), transmission electron microscopy (TEM), and energy dispersive spectroscopy (EDS) to investigate micro and nanotexture variation as well as chemical composition of a representative native copper nugget from Houghton County. Textural analysis reveals a complex polycrystalline texture on the scale of tens of nanometers or smaller. These textures include approximately 3 to 20 (but up to 150) nanometer irregular circles or ovals that are enriched in copper relative to the Al-enriched matrix. Linear features are present in some of the circles/ovals and are interpreted as twins. These twinning textures do not occur in the Al-rich matrix. Mn-rich minerals are also present. Selected area electron diffraction (SAED) of these Mn-rich crystals indicates that they have nearly orthogonal nets and d-spacings of approximately 0.22 nm. SAED of the matrix reveals d-spacings of 0.25, 0.21, and 0.14 nm. Spot EDS analysis of more copper dominated regions of the sample indicates Au, Ag, Al, and Zr occur in solid solution. Scanning transmission electron microscopy (STEM)-EDS investigation shows that aluminum in the matrix is distributed fairly evenly, unlike the copper that occurs often in localized concentrations, especially in the enriched circle/ovals. Chemical analysis using EDS on the SEM show traces amounts of anorthite, and chrysocolla. Backscatter analysis also indicates that trace amounts of silver are present. Hundreds of papers have been published regarding TEM investigations of synthetic copper alloys. However, this is to our knowledge the only published study investigating native copper, and it shows that native copper from this area is far more complex than simple elemental copper as previously believed. Near term work expanding the project includes investigating inter-grown copper-silver nuggets from other localities to assess if silver shows the same level of complexity as some copper samples exhibit.

XENOTIME-(Y), XENOTIME-(Yb) AND DYSPROSIAN XENOTIME-(Y) FROM PEGMATITES IN THE WAUSAU COMPLEX, MARATHON COUNTY, WI. **A.U. Falster¹, T.W. Buchholz², Wm. B. Simmons¹**. ¹Department of Earth and Environmental Sciences, University of New Orleans, New Orleans, LA 70148. ²1140 12th St. N., Wisconsin Rapids, WI 54494.

The Wausau Complex is composed of a series of four anorogenic intrusions ranging in age from 1565 Ma \pm 3.5 for the alkalic Stettin pluton (Van Wyck, 1994) to 1505.9 \pm 2.7 Ma for the Nine Mile Granite (Dewane & Van Schmus, 2007). The complex is a precursor of the younger Wolf River Batholith.

Minerals bearing lanthanide elements, commonly referred to as the Rare Earth Elements (REE), are very abundant in the Stettin and Nine Mile intrusions of the Wausau Complex (Falster et al, 2000). The REE minerals in the complex are LREE-enriched (light rare earth element enriched), although several HREE-enriched (heavy rare earth element-enriched) mineral species do occur, notably, xenotime-group species.

Enrichment of specific HREE relative to Y is rare, but recent analyses of xenotime-(Y) intergrown with monazite-(Ce) and monazite-(Nd) in several small pegmatites in the Stettin pluton show strong enrichment in Dy and only moderate enrichment in Yb. Yb-dominant xenotime and dysprosian xenotime-(Y) also occur in the Nine Mile pluton. Concentrations of Dy₂O₃ reach up to 11.75 wt %, a level approaching the Dy-enrichment (maximum of 14.88 wt. % Dy₂O₃) from the Annie #3 claim, Manitoba (Masau et al., 2000). Lesser degrees of Dy and Yb enrichment have also been noted in xenotime-(Y) from border phases of the Dehnel ravine pegmatite, Stettin Pluton, in xenotime-(Y) from a greisen assemblage in the Maguire Pit associated with cassiterite,

ferberite/huebnerite and topaz in the Nine Mile pluton, in xenotime-(Y) from a pegmatite exposed in the Red Rock North pit off of Spring Brook Rd, and the Wimmer quarry, all in the Nine Mile pluton. A surprisingly high content of Yb₂O₃ and Dy₂O₃ in “xenotime” in the Koss quarry reached up to 15.55 wt. % Dy₂O₃ (slightly above the Dy-content of the Annie #3 claim “xenotime”) and up to 31.32 wt. % Yb₂O₃ which is Yb-dominant “xenotime”. It is peculiar that both Dy and Yb occur together as the stability of Dy-F complexes are about as strong as those of Y-F complexes. Yb-F complexes are considerably stronger (Gramaccioli et al., 1999). Thus, Yb>Y can be explained based on the stability of the Yb-F complex. It is also unclear why only in a small number of locations in the Wausau complex, Yb- and Dy-enrichments have been documented despite the fact that F has been widely found as either fluorite or F-rich micas. Chondrite normalized data show the expected enrichment of the even-numbered HREE (Gd, Dy, Er, Yb) in these “xenotimes”. One last comment: without the elevation in Dy in the Koss “xenotime”, Yb would not have been the dominant REE, which is necessary to shift the composition to xenotime-(Yb).

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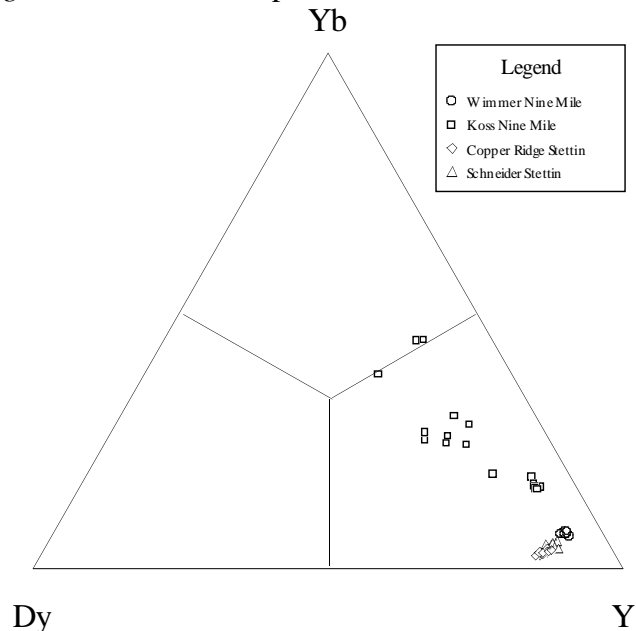


Fig. 1: Ternary plot of Y, Yb, and Dy in “xenotime” of the Wausau Syenite complex (plotted are apfu – atoms per formula unit).

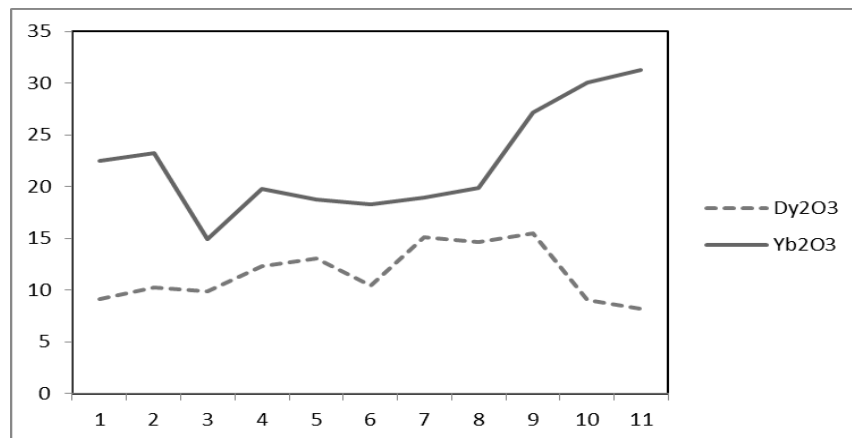


Fig. 2: X-Y plot of a traverse across a “xenotime” from the Koss quarry, showing the inverse correlation between Dy₂O₃ and Yb₂O₃ wt. %.

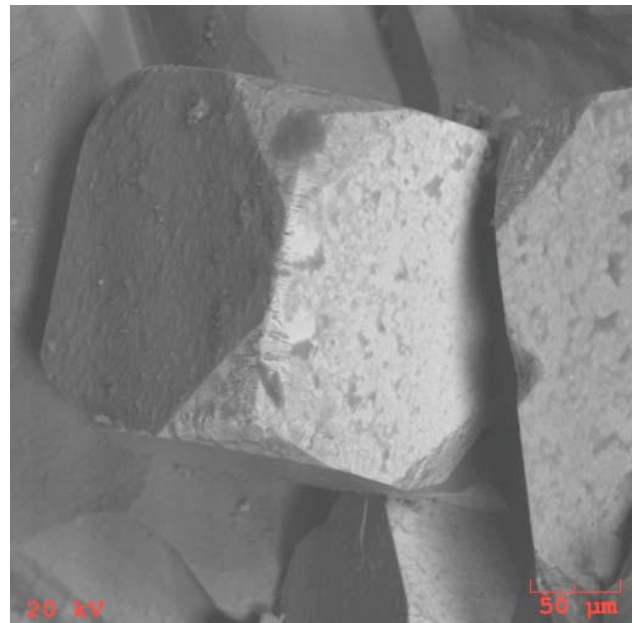
HYDROTHERMAL MINERALIZATION IN LITHOPHYSAL CAVITIES FROM THE TAYLOR CREEK RHYOLITE, SIERRA COUNTY, SOUTHWESTERN NEW MEXICO. **S.L. Hanson¹, A.U. Falster², and Wm. B. Simmons²**. ¹Geology Department, Adrian College, Adrian, MI 49221, ²Department of Earth and Environmental Sciences, University of New Orleans, New Orleans, LA 70148

The Oligocene Taylor Creek Rhyolite lies within the broad belt of Tertiary - Quaternary topaz rhyolites that extends from Montana, through Utah, Colorado, New Mexico and into central Mexico. The Taylor Creek Rhyolite, most notable for tin deposits, consists of 20 lava domes and flows that are part of the Mogollon Datil volcanic field in southwestern, NM. Topaz, bixbyite and hematite were recovered from lithophysal cavities in one of the more southern domes that forms Rounded Mountain in the Gila National Forest (map unit Tt3 of Duffield *et al.*, 1995).

Clear euhedral topaz crystals up to nearly 2 cm occur with overgrowths of associated bixbyite, hematite and quartz. As is typical for topaz from volcanic environments, they are fluorine rich with an average of only 1.3 mole percent substitution of OH for F.

Bixbyite occurs as black, lustrous, subhedral to euhedral crystals up to approximately 1 mm in size. Inclusions of quartz and alkali feldspar are abundant. Most of the bixbyite exhibits cubic {100} morphology, many with trapezohedral {211} modifications (figure to right). Rare octahedral {111} and dodecahedral {110} modifications were also observed. Most occur as isolated crystals, but clusters and rare penetration twins are also present. Edges of some of the cubes are corroded.

Hematite occurs as black, lustrous thin, pseudo-hexagonal plates that reach 200 microns in



maximum dimension. These crystals are generally weakly corroded.

Although pseudobrookite is locally abundant in the Taylor Creek Rhyolite, in the Black Range area (Lufkin, 1976), it was not observed at this location. Instead, the pseudobrookite appears to have exsolved into complex intergrowths of rutile and hematite.

This mineral assemblage is consistent with crystallization from a fluorine-enriched, high-temperature vapor phase that is released from the rhyolitic lavas.

Literature Cited:

DUFFIELD, W.A., RICHTER, D.H. AND PRIEST, S.S. (1995) Geologic map of the Taylor Creek Rhyolite and adjacent rocks, Catron and Sierra Counties, New Mexico. U.S. Geological Survey Map I-2399.

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EUHEDRA: A NEW PROGRAM FOR GENERATING LIFE-LIKE CRYSTAL MODELS. W. H. Tislar, 6536 Hocking Drive, Twin Lakes, MI 49965.

A number of commercially available software programs simulate 3D models of crystals. Modern computer simulation is much more convenient than the wooden models used in the past, and today's programs allow you to create intricate models that would be prohibitively expensive to fashion out of wood (or any other material). The set of features offered by the various modeling programs is roughly the same: model creation and editing, rotation, choice of model rendering modes (solid or wireframe) and choice of views (stereo pair, anaglyph stereo or monoscopic).

Euhedra is a new software program that offers a unique approach to modeling crystals. Rather than creating crystals that look like the old wooden models, Euhedra offers features that allow you to build crystals that look quite real. When a Euhedra model is displayed on the computer screen, it resembles a photograph of a real crystal, as shown in Figure 1; unlike a still photograph, however, the Euhedra on-screen model can be rotated, moved and otherwise manipulated.

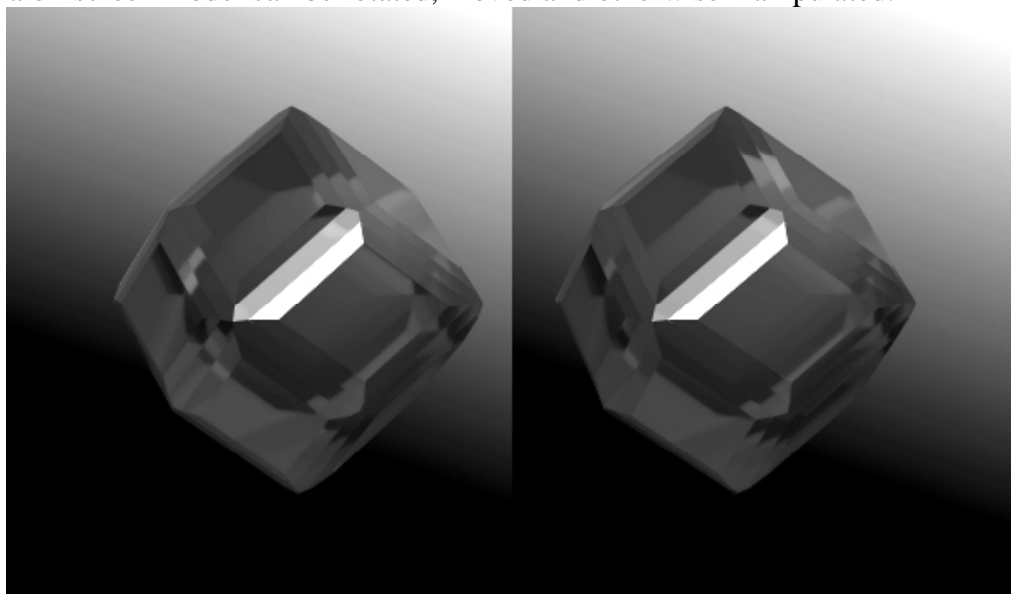


Figure 1. Screen capture from the Euhedra program, showing a simulation of a transparent spessartine crystal rendered as a stereo pair.

Euhedra is a unique crystal-modeling program that offers the features essential for simulating realistic crystals:

- optical controls for simulating metallic, dull, vitreous, adamantine and other lusters
- adjustable diffuse and specular model colors
- adjustable refractive transparency ranging from opaque to absolutely clear
- internal blurring to simulate light scattering for intermediate transparency settings
- adjustable background color and style (solid and gradient). The orientation of gradient backgrounds is adjustable.
- lamps that can be added, deleted and moved

The process for creating a crystal model using Euhedra is straightforward. A "New Crystal" panel lets you specify the crystal system, crystal class, unit cell measurements (optional) and crystal forms. The model is placed in a new or existing *scene*, which is the 3D space that contains the background, lamps and models. Other panels let you add more forms and faces to the model and to change the color, luster and transparency. A "Background Color" panel allows you to change the background color and orientation. Several panels provide an Import button that enables you to import data from existing model files.

Form faces, as well as individual faces of an existing model, can be scaled up or down with the + and - keys. The same keys can be used to scale the entire model up or down.

Once a scene has been created, it can be saved as an "esf" file. This is a simple, text-based file format that contains all of the information needed to restore a scene and its models using the Euhedra program.

Euhedra pushes the limits of computer-based crystal modeling by allowing the user to build life-like crystal models using intuitive, interactive tools. Additional features planned for future releases will give users even more capabilities for generating computer-based crystal models that look just like the real thing.

ANOMALOUS DISPERSION IN TITANITE. **D. E. Kile¹** and **O. Medenbach²**. ¹U.S. Geological Survey, Denver, Colorado; ²Ruhr University, Bochum, Germany.

Dispersion in biaxial minerals may be evidenced by color effects in interference figures; it is observed using crossed polarized light and converging illumination in white light, and yields information about crystal symmetry and optic orientation. Optic axis dispersion is caused by differences in optic angle ($2V$) relative to the wavelength of light, whereas other kinds of dispersion (e.g., horizontal, crossed, and inclined dispersion in monoclinic crystals) are caused by a change in the orientation of the optical indicatrix relative to crystallographic axes.

Titanite (CaTiOSiO_4), which crystallizes in the monoclinic system, typically shows a strong optic axis dispersion ($r > v$) that is evidenced by symmetrical red and violet color fringes on either side of the optic axes, along the optic plane. Its weak inclined dispersion is mostly camouflaged by the stronger optic axis dispersion.

Examination of an oriented titanite section, prepared by W. Harold Tomlinson (Pennsylvania) to show the Bxa (the acute angle between the two optic axes), revealed an optic angle of $\sim 31.8^\circ$ (5891), in addition to an unusual and previously unreported crossed dispersion. The initial assumption was that perhaps the section was of a mineral other than titanite. Microprobe analysis and X-ray investigation however confirmed that the sample was indeed pure titanite.

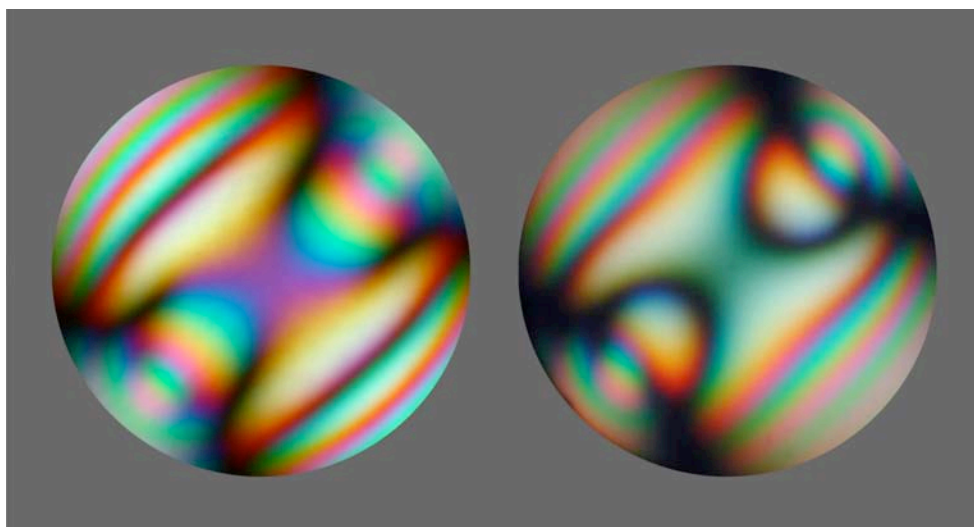
The anomalous crossed dispersion was then hypothesized to be caused by either a triclinic symmetry, wherein dispersion of any type is possible through shift of the optical indicatrix along any crystallographic direction, or by an improbable realignment of the optic vibration directions in a monoclinic crystal, with $Y = Bxa$, which could produce crossed bisectrix dispersion with rotation of the optic plane on the b axis. Triclinic symmetry has been previously reported for titanite (Lussier et al., 2009), although the slight deviation from monoclinic symmetry documented ($a = 89.78^\circ$, $b = 113.77^\circ$, $g = 90.25^\circ$) does not seem sufficient to create the substantial dispersion effects observed. Analysis of the Tomlinson grain by X-ray diffraction showed the crystal to be monoclinic ($b = 113.97^\circ$, with an error of $\pm 0.02^\circ$), without any evidence of twinning or other lattice defects or deformation, and with the optic plane parallel to (010), thus eliminating both of these hypotheses as a cause of the observed anomalous dispersion. Strain is also known to cause anomalous optical effects because crystal optics are very sensitive to lattice distortion or strain defects, but that seems not very likely for the Tomlinson crystal as it shows a uniform optical behavior throughout.

An effort was made to confirm this unusual dispersion in other samples of titanite. A second oriented Tomlinson titanite slide was examined, and showed the normal strong $r > v$ dispersion. Regrettably, as with most makers, locality information was not provided on either slide. A possible source material which might have been used by Tomlinson was provided by D.M. Organist, Delaware, whose firm succeeded Tomlinson's in 1958; the sample bears a Ward's Natural Science Establishment label on which is typed "Sphene, Tilly Foster mine, near Brewster, New York". The Tilly Foster mine, extensively worked for magnetite from 1853–1897, was a noted source for accessory minerals, including titanite. Thus, Tomlinson's business spanned an era (from ca. 1915 to 1958) when material from this mine would have been readily available. Unfortunately, only matrix remained on this sample, without any titanite. Accordingly, two other samples were obtained from this mine and examined; both again showed normal optic axis dispersion.

In conclusion, the anomalous and spectacular crossed dispersion observed in this sample of titanite could not be replicated, and the cause of this dispersion, not hitherto reported, remains a mineralogical enigma.

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Left: normal optic axis dispersion in titanite, showing strong $r > v$. *Right:* anomalous crossed dispersion in Tomlinson section. Note the completely different symmetry of the color effects around the emergent points of the optic axes.

PRELIMINARY REPORT ON THE DETERMINATION OF THE COMPLEX REFRACTIVE INDEX OF OPAQUE MINERALS. **Clyde Spencer**, 1858 Robinhood Drive, Fairborn, OH 45324.

Research on the complex refractive index (\tilde{N}) of opaque minerals was undertaken to provide an additional tool to assist with their identification. No special preparation is necessary other than the usual polished ore mount. However, an ellipsometer is necessary for calculating \tilde{N} :

$$\tilde{N} = n - ik$$

Where n = real part of \tilde{N} and ik = imaginary part of \tilde{N} ; $i = \sqrt{-1}$ and k = extinction coefficient.

The white-light color and polarization colors are used to identify polished opaque minerals. A more quantitative approach uses Vicker's microhardness and reflectance. However, reflectance is a function of the fundamental optical constants that constitute \tilde{N} . The reflectance at normal incidence in air is calculated from \tilde{N} as follows:

$$R = ((n - 1)^2 + k^2) / ((n + 1)^2 + k^2)$$

In lieu of measured reflectance, the calculated reflectance can be used to help identify a specimen not in the \tilde{N} database. Reflectance tends to be more constant than the n and k values, which may be a blessing or a curse. Minerals with reflectances near 50% have a considerable range in n , thus making it easier to differentiate them than by reflectance alone.

Linearly polarized light reflecting off a specimen with non-negligible k will have the reflected S- and P-components of the electric vectors out of phase by an angular amount Δ . The result will be an elliptically polarized reflection with an azimuth Ψ . Delta and psi vary with angle of incidence, and n and k .

As an alternative to expensive commercial ellipsometers for determining Δ and Ψ , one can adapt a polarizing microscope to function similarly. The setup used by the author is based on a Leitz Laborlux-Pol.

More than 120 different ore minerals were purchased, embedded, and polished. Most species have samples from more than one location. More than 1200 sets of readings were taken, with each set composed of 8 pairs of angles (Δ & Ψ). Most readings are in green light ($\approx 540\text{nm}$), and some in red light (632.8nm) as validations. All angles were entered into a spreadsheet, and complex arithmetic performed to convert to n and k .

There was some difficulty in obtaining pure, properly identified specimens. Early on, n and k provided evidence that sellers had misidentified specimens.

There should be little variation in the n and k of isotropic minerals, and indeed, magnetite has very little variation. Galena and pyrite are recommended as reflectance standards. However, there is considerable variation in their apparent n and k values, despite being isotropic. Since pyrite takes a good, consistent polish, these variations probably represent compositional variations of specimens from different localities. Large variations in values, with jamesonite and loellingite for example, are almost certainly the result of anisotropism. Their trends have different slopes; this also may be useful in identifying a mineral, as well as the mean location in the nk -feature space.

Several factors contribute to n and k variability:

- Anisotropism
- Quality of polish
- Surface contamination (moisture, tarnish)

- Compositional variations
- Instrumental/observational errors

A scatterplot of n and k shows no obvious differences between isotropic and anisotropic minerals, except generally larger standard deviation bars for the anisotropic minerals. Members of a particular anion group tend to group together in the nk -feature space. Thus, the probable anion group can be established by n and k , or at least some anions can be eliminated for an unknown by the scatterplot position. Optimally, minerals can be identified uniquely by their \tilde{N} . See Figure 1.

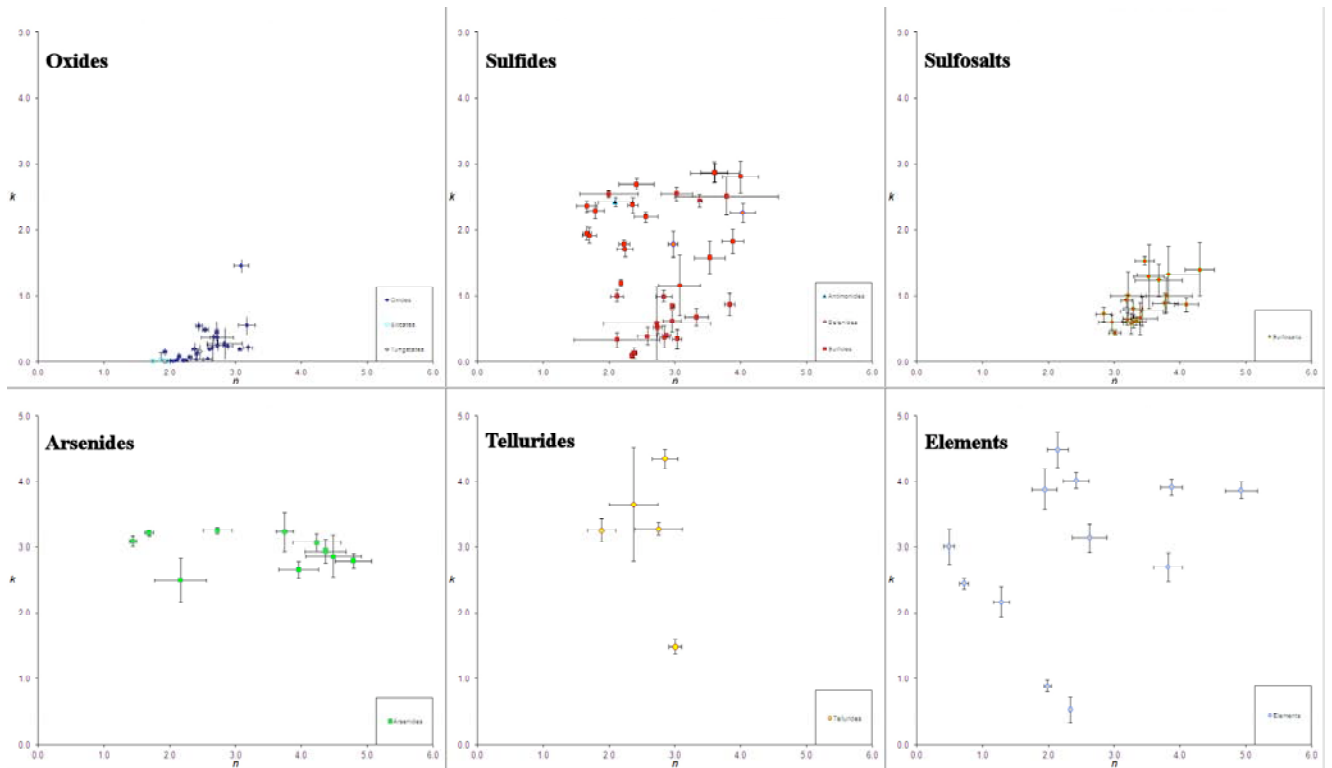


Figure 1. Plots of the nk -feature space for various anionic groups.

DEPOSITION JAPAN LAW QUARTZ Y-TWINS: MORPHOLOGY AND QUESTIONS CONCERNING THE ORIGINS OF JAPAN LAW QUARTZ TWINNING. **R. L. Morgan**, 2711 Mechanics Avenue, Savannah, GA 31404.

V-shaped, Japan-law quartz twins are composed of two crystals whose c-axes diverge at an 84.33° angle from a common origin. On each side of the twin there is a pair of parallel prism faces across the twin boundary that reflect light at the same angle. V-twin habits and morphology have been described thoroughly and are generally considered to have become twins at or near a common origin.

Rarer Japan-law twins come from the development of a smaller (secondary) crystal on an already established, larger (primary) crystal making a y-shape. Specimens for this study came from the Black Pine Mine in Montana and from the Mundo Nuevo Mine in Peru and are of Tessin habit (tapered). They have the same Japan-law angle of divergence and the same pairs of parallel prism faces.

These are twins by deposition and have one or more of the following traits:

- The y-tail is large and long.

- The tail terminates at an attachment point beyond the twin boundary.
- The primary crystal is wider on both sides of the secondary crystal.
- The top of the y has the supplementary, oblique 95.67° angle rather than the acute, 84.33° , Japan-law notch angle. (The twin is extending in the alternate direction.)

Some newly formed secondary crystals are located entirely on just one prism face of the primary. They typically are skewed being somewhat tabular at an angle across the primary's prism face. The primary's host face shows stimulated growth on the acute-angle side of the secondary crystal as do the two acute angle notch faces of the secondary (similar exaggerated notch growth as found on v-twins).

In cases where the secondary crystal extended beyond the ridge made by the two notch faces of the primary, then:

- Noticeable exaggerated growth developed on the two notch prism faces of the primary crystal (the same as notch effect growth on v-twins.)
- This growth emanated from the point of contact with the two-prism face ridge of the secondary crystal.
- The primary's two notch prism faces step down along each side of the secondary crystal to a slower growth area toward the tail.
- The secondary crystal is tabular with notch filling effect like found in v-twins.

In cases where the secondary's growth reached the outer prism face of the primary crystal:

- The outer prism faces of both became co-planer like most v-twins.
- The two prism faces of the secondary crystal in the oblique notch mainly abut only a wider single prism face of the primary crystal. (A similar feature to v twins when one crystal grew beyond the other.)

These deposition twins raise several questions:

- What conditions foster these deposition twins? (Perhaps those likely to result in Tessin habit crystals?)
- What is the structure of the original contact point and/or the original contact plane of such twins? (The secondary would have an unlikely $\{10\ 10\ 1\}$ face to attach directly to a prism face on the primary.)
- What accounts for the patterns of skewed and exaggerated growth? (Are there certain points of contact at the twin boundary that tend to produce dislocations and more rapid spiral growth?)



Middle: Two deposition twins on one prism face of a larger crystal (with angled growth pattern).
Top: A deposition twin straddling two prism faces of the larger crystal

OBDUCTION OF AN OPHIOLITE COMPLEX - (*UPPER MANTLE AND OCEANIC CRUST*) ON THE CONTINENTAL CRUST OF THE GREAT NORTHERN PENINSULA, NEWFOUNDLAND. C. C. Reynard, 110 College Ave. Poughkeepsie, NY 12603.

At present the island of Newfoundland's Great Northern Peninsula is bordered by the Atlantic Ocean and the Gulf of St. Lawrence. However, during the Ordovician Period, the island was part of the Laurentian landmass located below the equator under a warm shallow continental sea.

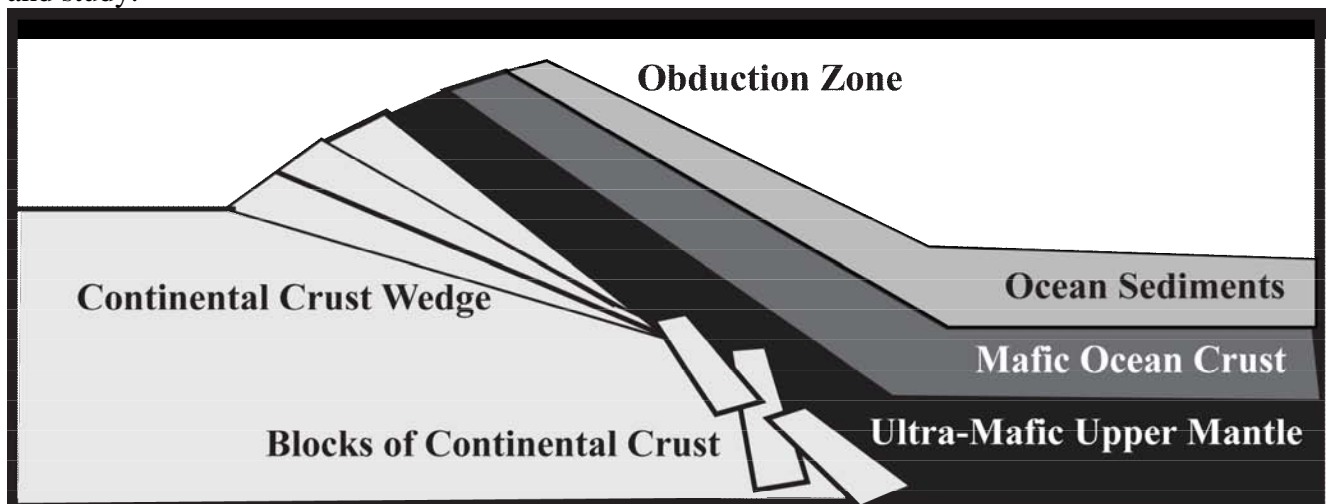
This sea was part of the Iapetus Ocean (Atlantic). The Iapetus Ocean existed for more than 100 million years until plate reorganization resulted in the closing of the great sea. For 100 million years the Iapetus Ocean grew smaller as the Laurentian Plate was engaged in a slow collision with a number of island arcs and the microcontinent of Baltica. During the Ordovician, a slice of the oceanic lithosphere and upper mantle, an ophiolite complex, was obducted or thrust over the Great Northern Peninsula's continental crust. The closing of the Iapetus began the reunification of the landmasses creating the new super-continent – Pangea. Newfoundland would end up near the center of this new landmass. Three hundred million years later rifting and plate movement would put the island in its present location.

Today on the Great Northern Peninsula an exposure of rocks from Earth's mantle, occurs in the area known as the Tablelands in Gros Morne Park. The Tablelands is a huge flat topped massif of yellow-ochre ultramafic igneous hartzburgite, a variety of peridotite consisting mostly of the two minerals, olivine and low-calcium (Ca) pyroxene enstatite. The hartzburgite stands out in contrast to the surrounding gray hills of folded limestone, shale, metamorphic and mafic rock. Weathering has changed the surface of the original dark green peridotite/hartzburgite to a yellow-ochre limonite. In some locations olivine is weathered to iddingsite, (a combination of clay minerals, iron oxides and ferrihydrites) that form in the presence of water. There is evidence of fractures through which hot

fluids have percolated and metasomatized the peridotite into serpentine group minerals. Peridotite is nutrient poor so very few spots of greenery exist, making the Tablelands a stark landscape.

Where the former lithosphere/ mantle boundary is exposed, in sharp contrast, is a dark brown chert mélangé with limestone clasts. At Gros Morne the transition zone between the ocean crust and the upper mantle is complete enough to include the exposure of the Moho Discontinuity at Trout River Pond, the exact site where the Earth's lithosphere met the mantle. The complete obducted oceanic crust can be found at the Bay of Islands near Corner Brook. This sequence of deep sea sediments, pillow lavas, sheeted dikes, gabbros and ultra-mafic mantle peridotite is the most complete sequence known. Exposures of the upper oceanic crust are represented by basalt and gabbro.

The large exposure of mantle material at the Tablelands is so rare on our planet that the site, named for the mountain Gros Morne, was designated as a World Heritage Site and International Geologic Site in 1987. Gros Morne Park protects these rare rocks and their minerals for all to see and study.



Interpretation of Obduction Zone and Art Work by C.C. Reynard - 2012

Gros Morne Ophiolite Obduction.

AN UNUSUALLY COARSELY CRYSTALLINE CALCITE FROM THE YUCATÁN PENINSULA, MEXICO. **Jared Mingos**, Mark P.S. Krekeler, Miami University, 501 East High Street, Oxford, OH 45056. Dave Aldridge Department of Geological Sciences, University of Alabama, 202 Beville Building, Tuscaloosa, AL, 35407.

Although extensive sedimentology research has been conducted on the Yucatan, detailed mineralogical studies of calcite, among other macroscale minerals, from the region are lacking. This is largely due to a paucity of occurrences of large crystalline material of interest. Field work in the summer of 2011 in the Yucatán led to a find of an unusual chocolate to caramel colored brown calcite believed to be formed from hydrothermal processes which are unusual for the region. The calcite specimens were found in a limestone quarry that allowed the underlying karst features to be exposed. The stratigraphy of the quarry is simple and consists of carbonates with a pronounced paleosol horizon at 4 meters below present surface. The calcite occurs in a pocket within a limestone approximately 9 meters from the surface of the surrounding area. Calcite samples obtained consist of two textures. The dominant texture is large intergrown rhombohedral crystals that are commonly 3 to 5 centimeters in maximum length. This texture comprises 95% of the deposit. In open pockets,

smaller euhedral crystals with a complex trigonal “dogtooth” texture are common with crystals being approximately 1 to 2 centimeters in maximum length. The country rock contact is porous and grades quickly into unaltered limestone bedrock. This is the first such calcite occurrence observed in the Yucatán by our research group from visits to approximately 40 quarries over the past 10 years.

Powder X-ray diffraction data confirms the specimen material as calcite. Scanning electron microscopy has identified two common inclusion impurities - oxide/oxyhydroxide clay aggregates and elemental bismuth. The origin of clay aggregates is ambiguous and may be soil derived or may be precipitated from fluids. Bismuth occurs as subhedral elemental particles and appears to be concentrated on cleavage planes with textures consistent with in situ mineralization and not a detrital origin. Aqueous geochemistry in the Yucatán region is known to be diverse and the deposit may reflect some combination of karstification followed, or commensurate with, mineralization derived from low temperature sedimentary brine interactions.

Results of this study indicate that coarsely crystalline calcite does occur sparingly in the Yucatán Peninsula. Although the quarry was being actively mined for road aggregate in 2011 and is very likely depleted of material, the origin of the calcite is ambiguous and warrants further geochemical investigations of existing samples. Although occurrences are rare, this find opens the possibility for some level of professional collection of calcite to occur in other regions.

FLUORAPATITE FROM A REMARKABLE OCCURRENCE OF GRAPHITE AND ASSOCIATED MINERALS, KARO PIT, BLOCK D, MERELANI HILLS, TANZANIA.

J. M. Long¹, J. F. Rakovan², J. Jaszczak³, D. Trinchillo⁴, A. J. Sommer⁵. ^{1,2}Department of Geology & Environmental Earth Science, Miami University Oxford, Ohio, USA; ³Department of Physics and the A. E. Seaman Mineral Museum, Michigan Technological University, Houghton, Michigan, USA; ⁴Fine Minerals International, Edison, New Jersey, USA; ⁵Department of Chemistry & Biochemistry, Miami University Oxford, Ohio, USA.

The Merelani Hills deposit is best known as the exclusive locality for the purple-blue gem variety of zoisite known as Tanzanite. However, this deposit has produced many stunning specimens of other minerals, with their own intriguing properties (Wilson et al. 2009). In December 2007 a magnificent pocket was discovered in the Karo Pit, Block D of the Merelani Hills that contained the following mineral assemblage: axinite-(Mg), chabazite, diopside, graphite (3 generations), fluorapatite, gypsum, laumontite, mesolite, pyrite, siderite, tremolite and zoisite (var. tanzanite). Spectacular graphite crystals form the matrix to specimens of many of these species. The small number of apatites from this find exhibit noteworthy paragenesis, chemistry, inclusions and extraordinary optical properties.

Fluorapatite $\text{Ca}_5(\text{PO}_4)_3\text{F}$ is found in transparent (gemmy), elongate to equant crystals with pyramidal and pinacoid terminations. The color of each specimen ranges from gray to light blue to green to dark blue depending on various factors. They display dichroism in unpolarized light, color change in different light sources and pleochroism in polarized light. In unpolarized light the crystals are yellow-green when viewed down [001], the c-axis, and blue-green when viewed perpendicular to [001]. The type of incident light can also cause color change. The apatites are more blue under incandescent light and more green under halogen light (Figure 1). Pleochroism in the samples is particularly striking when viewed

perpendicular to [001] in polarized light. With the polarization oriented parallel to the c-axis the crystal is dark blue and when the polarization direction of the light is oriented parallel to the a-axis the color is yellow-grey (Figure 2).

Energy dispersive spectroscopy (EDS) was utilized to determine the major element chemistry of the apatite and X-ray diffraction data were used to refine the crystal structure and halogen composition. Both indicate near end-member fluorapatite. Polarized optical absorption spectra show distinct variation with polarization direction and indicate that the color is possibly due to the presence of Mn or V as well as minor contributions from rare earth elements. The apatites also exhibit interesting primary 2-3 phase fluid inclusions, in which clusters of euhedral graphite crystals are present, possibly as daughter crystals. Raman spectroscopy provided confirmation that the fluid inclusion daughter crystals are graphite. Secondary fluid inclusions and hollow tubes, suspected to be etch channels, that are parallel to [001] and run the entire length of the crystal are present in the sample pictured in figure 2.

Literature Cited:

Wilson, W.E., Saul, J.M., Pardieu, V., & Hughes, R.W. (2009) Famous mineral localities: The Merelani Tanzanite Mines, Lelatema Mountains, Arusha Region, Tanzania. *Mineralogical Record* 40:346-408.



Figure 1. Apatite color change due to incident light. A) Blue in incandescent light, B) green in halogen light.

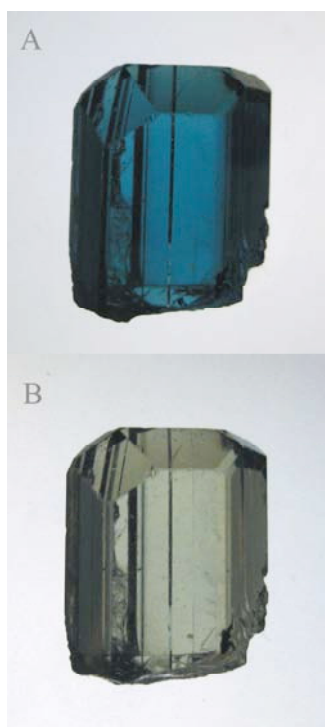


Figure 2. Apatite backlit with plane polarized light to show pleochroism between A and B. A) Viewed along [210] with $E||[001]$. B) Viewed along [210] with polarization plane rotated 90° to its position in A, $E||[100]$.

MINERALS OF THE TANZANITE-PREHNITE ASSOCIATION FROM MERELANI HILLS, TANZANIA. **J. Simonoff**¹, **M.A. Wise**². ¹6 Ali Drive, Middletown, MD 21769; ²Dept. of Mineral Sciences, Smithsonian Institution, Washington, DC 20013.

Blue prehnite was recently discovered as blocky, prismatic crystals on tanzanite from Merelani Hills, Tanzania. Recent work on specimens containing the tanzanite-prehnite association has revealed the presence of several minerals not previously reported from the tanzanite locality.

The blue prehnite is typically color zoned with a pale blue core and occasionally translucent white rims. Semi-quantitative EDS analysis did not show any significant differences in major element chemistry (Ca, Al, Si) between the blue and white prehnite. A second generation of prehnite, which occurs as clear platy crystals up to 4 mm long and is also closely associated with tanzanite, was identified by X-ray diffraction (XRD).

The suite of minerals associated with prehnite includes titanite, graphite, diopside, apatite, calcite, chabazite, laumontite and stilbite. Also recognized for the first time are rhodochrosite, fluorite, molybdenite and an unidentified rare-earth mineral. Pale brownish crusts found on the surfaces of blue prehnite and tanzanite was determined by backscattered electron imaging and XRD to be a mixture of calcite and rhodochrosite. The calcite crystals (up to about 200 μm across) are rhombohedrons with rounded edges and pitted, cracked faces. In contrast, rhodochrosite tends to form smaller crystals (less than 100 μm across) with generally sharper and more pristine crystal faces. Semi-quantitative EDS analyses indicate that all of the calcite had significant manganese substituting for calcium, whereas substantial calcium replaces manganese in the rhodochrosite.

Fluorite forms cuboctahedral (dominantly octahedral) crystals that are almost completely

colorless aside from purple coloring on the cube faces. The fluorite was found primarily on platy prehnite. Filiform molybdenite was identified by XRD and is often partially enclosed by chabazite. Several small (<50 μm) zircon crystals were found included in prehnite or titanite and rarely in diopside. In some cases, crystals of a so-far unidentified rare-earth mineral, enriched in uranium and thorium, were found on zircon. The largest of these was only about 10 μm across.

The paragenetic sequence of the tanzanite-prehnite association shows that the mineralizing solutions were largely Ca-enriched over a significant portion of the crystallization history of the tanzanite deposit. Prior to the formation of prehnite and tanzanite, the solutions first produced grains of zircon and a rare U-Th mineral, followed by the contemporaneous growth of graphite and titanite, then apatite and diopside. Carbonates, sulfides, zeolite minerals and fluorite are paragenetically later than the prehnite and tanzanite and do not appear to be indicative of crystallization from the breakdown of primary mineral phases.



Figure 1. Blue prehnite, tanzanite and pyrite. Specimen width 7.5 cm.

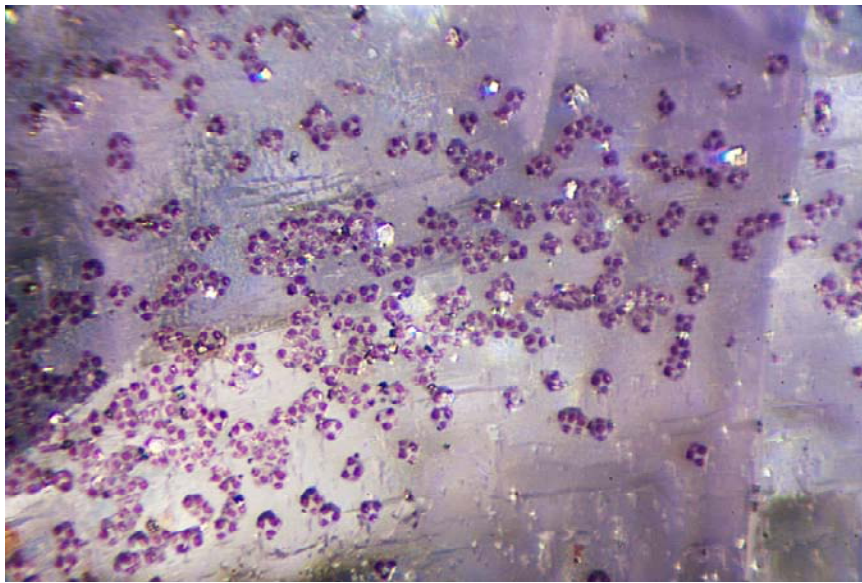


Figure 2. Purple fluorite on tanzanite. FOV 1.8 mm.

PRELIMINARY ELECTRON MICROSCOPY INVESTIGATION OF NATURALLY OCCURRING CRYPTOMELANE FROM XIANGTAN, CHINA. **H.A. Barrett, and M.P.S. Krekeler**, Miami University, 501 East High Street, Oxford, OH 45056.

Cryptomelane, a Mn-oxide belonging to the hollandite group, occurs in low temperature geologic environments. The idealized empirical chemical formula is $K(Mn^{4+}, Mn^{2+})_8O_{16}$. However, Mn^{3+} cations are known or are likely to occur in some samples. The mineral is reported to have monoclinic $I2/m$ and tetragonal $I4/m$ polymorphs. In summary the crystal structure consists of four rows of double manganese octahedra (2×2) that create a tunnel that has sites for K^+ cations, which may be more generally referred to as A sites. These K^+ cations can exchange for molecular water and other cations. Cryptomelane is of great interest because of its cation exchange capacity and catalytic properties in synthetic form. There are comparatively few electron microscopy studies of natural cryptomelanes and thus there is a poor understanding of the variability of cryptomelane textures.

The Xiangtan manganese deposit in China has large amounts of cryptomelane and is a source of Mn, but may also be an industrial mineral source of cryptomelane. A large sample of this material was obtained to investigate variation in texture. Hand sample material is black in color and massive, with no discernable features. When cut and polished, it has a metallic luster and is a grey color. Field emission scanning electron microscopy (FESEM) investigation under variable pressure conditions using N_2 as the compensating gas indicates a botryoidal texture of round spheres that range 1-5 μm in diameter, as well as a dendritic “Christmas tree” textures (representative images below). The acicular fibers of the dendritic texture are approximately 1-3 μm in length and tens of nanometers wide. A dendritic texture is indicative that Mn-rich waters flowed through fractures and openings to precipitate in cavities and pores. Observed textures illustrate complexities of the phases present.

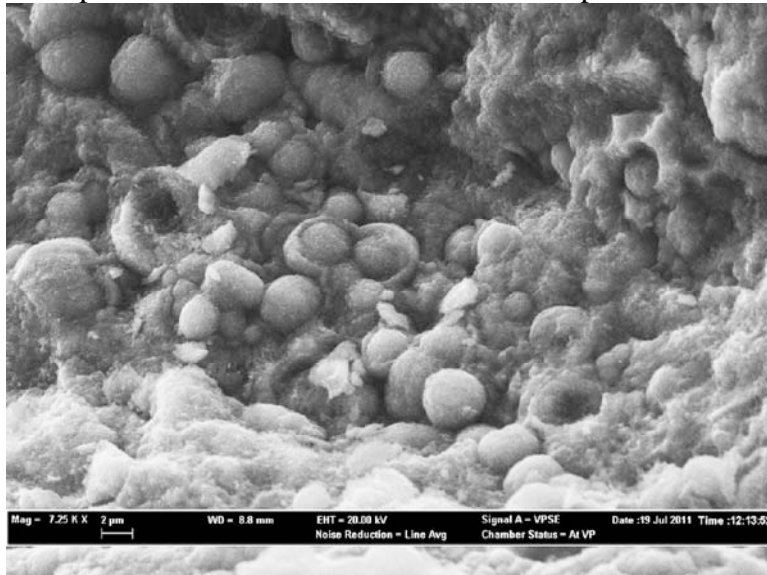


Figure 1. FESEM image of botryoidal cryptomelane from Xiangtan, China.

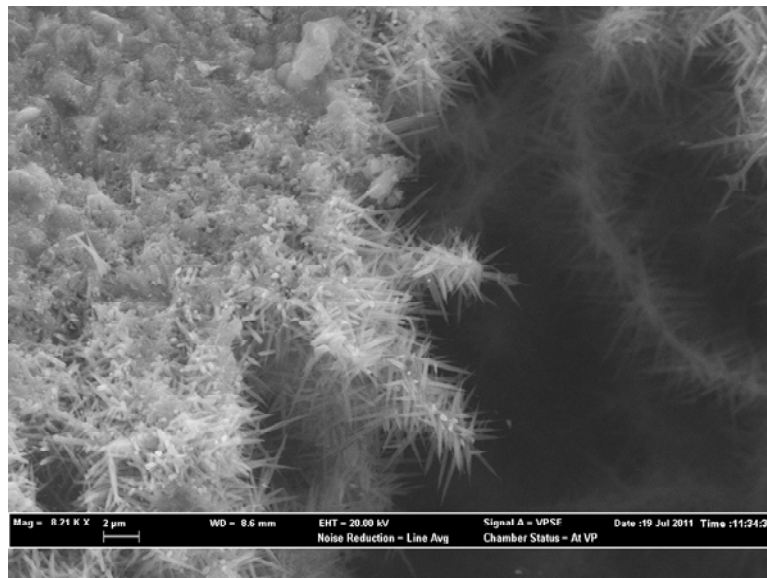


Figure 2. FESEM image of dendritic “Christmas tree” texture of Chinese cryptomelane.

IN SEARCH OF WHY CHARLES UPHAM SHEPARD'S MINERALS DID NOT SURVIVE THE TEST OF TIME. by **V. King**, P.O. Box 90888, Rochester, NY 14609.

Charles Shepard [1804-1886] was in a mineralogical family. He was James Dana's and Benjamin Silliman, Jr.'s brother-in-law and was Charles Jackson's cousin. Shepard named 73 minerals, of which 10 are valid: amesite (1876), danburite (1839), microlite (1835), monetite (1882), nitrocalcite (1835), nitromagnesite (1835), schorlomite (1846), tinalconite (1878), warwickite (1838). Chalcodite (1851) is the ferric analog of stilpnomelane and awaits redefinition. The microlite controversy has been examined (King and Teixeira, 2010). Much of the microlite controversy involved quantitative analyses of elements that were poorly defined, particularly tantalum. The problem with eumanite (1851) was possibly the same as that for microlite, chemical analyses involving tantalum and niobium could be confused with titanium. A study of Shepard's “lederite” revealed the transition between early mineralogy and “modern” mineralogy (King and Chinellato, 2012). In the lederite controversy, Shepard discovered a new crystal habit of titanite, which also had a peculiar “cleavage” in addition to the “normal” cleavage. A half century later, *parting* was described by Gerhard vom Rath. The controversy probably kept Shepard from re-visiting the lederite “cleavage” anomaly, otherwise he may have described parting, years before vom Rath. Early mineralogy used the same methods as biology: careful examination and accurate description of physical attributes. Eventually, chemical analysis made it possible to distinguish minerals that otherwise resembled each other. Abraham Werner stressed physical properties as the means of identifying minerals, but by 1814, Jöns Berzelius began to identify and classify minerals by their chemical compositions, although his initial scheme was unpopular. Friedrich Mohs was one of the last European mineralogists to base mineral identification principally on physical properties and his hardness scale was his greatest achievement. Shepard was a disciple of Mohs' methods. Many of Shepard's species were almost immediately discredited, particularly by Dana and other Yale faculty members. Shepard eventually increased his use of chemical analysis in naming minerals, but he did not discuss in his articles which minerals might have a similarity to his new species, but they sometimes could be identified as existing species based on Shepard's own chemical analyses. Shepard's philosophy of a “natural arrangement” of mineralogy implied that many minerals were indistinguishable by chemical analysis. In many instances, even the common minerals had few good

chemical analyses. The important insights of what controls a mineral's chemical formula were still far in the future. An examination of the failed species proposed by Shepard reveals his continued adherence to Werner's and Mohs' principles. Because of Shepard's (1832-1835) *natural arrangement*, boltonite (1835) was not in the same volume as peridot! Serpentine and williamsite (1848) were placed within the same group, but the distinction between the two was based on color. Some species seemed to have a unique crystallographic shape or an unusual aggregate: edwardsite (1837), eremite (1837), or houghite (1851). Cymatolite (1867) and monite (1882) were proposed based on their unique textures. Calcimangite (1865) was a black calcite, while goshenite (1844) was described as a pink beryl! Aquacreptite (1868) was named because it would jump and pop when intensely heated.

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NATIVE BRASS and Other Wonderful Things from Japanese Volcanoes

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“Native Brass” has been reported very sparingly from several localities in China and Russia, on the Moon, and relatively more abundantly as inclusions, along with native copper and native zinc, in anorthite feldspar crystals from the Izu islands, an active volcanic chain in the Pacific Ocean south of Tokyo, Japan. This also happens to be the classic locality for anorthite, numerous specimens from here having reached the Western world in the late 19th century, and they are among the closest to end-member composition (An_{96-97}) of any in the world. This presentation will focus on field collecting opportunities for anorthite and brass on an active volcano in the Izu islands, with peripheral social comments on the idiosyncracies of Japanese mineral collectors and collecting culture, whose highly active mineral collecting community is little known to the outside world.

Systematic species collectors are curious about the validity of “brass” as a mineral species, and its status is a bit complicated, so here is a summary of what is currently known, for future reference.

The term “brass” is used for numerous different alloys of copper and zinc, having a long history as industrial products, with different compositions exhibiting different physical properties, and with some of them also including minor Sn, Pb, Mn, etc. But there is no continuous solid-solution series between copper and zinc because their structures are different, copper being isometric and zinc hexagonal. So “brass” in Nature could theoretically refer in the mineralogical sense to a zinc-rich variety of native copper, or copper-rich variety of native zinc, or a structurally independent species, or to intimate mixtures of different phases. Although industrial brasses have of course been very well studied, most finds of native brasses have been studied only compositionally, not structurally, but we can draw some possible conclusions by comparing them with their synthetic analogues, which have been grouped into the following compositional fields, listed here according to increasing percentage of zinc (compositional boundaries only approximate, and phases that are only stable at high temperature are not discussed here):

α -Brass: Cu-Zn completely miscible < 35% Zn. Isometric, face-centered cubic, hexoctahedral. α -Brass is subdivided into numerous varieties with different colors and machining properties, including “Tombac” ~ 15% Zn; “Prince Rupert’s metal” ~ 25% Zn; etc.

β -Brass: 45<50% Zn. Isometric, body-centered cubic, CsCl structure. Formula often written CuZn, but composition slightly variable.

γ -Brass: 55<70% Zn. Isometric, hextetrahedral, sphalerite structure.

ϵ -Brass: 78<88% Zn. Hexagonal, magnesium structure. Formula sometimes written CuZn₄, but composition slightly variable.

Native Zinc *sensu stricto* is 99<100% Zn, as it can hardly accept any Cu at room temperature, although previously reported native zincs do contain traces of Sn, Pb and Cd, but not Cu. Hexagonal.

Previously reported natural brass occurrences, likewise in order of increasing zinc content:

Cu_8Zn - 11.0 % Zn ($\text{Cu}_{8.01}\text{Zn}_{0.99}$), collected by the Luna-24 probe

UM 1980-02-E:CuZn – 18% Zn ($\text{Cu}_{4.45}\text{Zn}$).

UM 2003-03-E:AgAuCuZn – 20% Zn. Formula $(\text{Cu,Au,Ag})_4\text{Zn}$. No structural data.

Native Brass (traditional usage) and UM 1980-01-E:CuZn – 25% Zn. Formula Cu_3Zn . Isometric. Unfortunately, the term “native brass” has been used inconsistently, often meaning just any native Cu-Zn alloy, sometimes this one specific composition. So other formulae can be found in the literature too, including Cu_2Zn and CuZn. Published without approval of the IMA. Numerous localities, mostly in Russia; one chinese locality reported in 1989.

Tongxinite – 33% Zn. Formula Cu_2Zn . Isometric. Published without approval of the IMA. Eight localities in China.

Zinccopperite – 36% Zn. Formula Cu_7Zn_4 ? Another term like “native brass” that has been used (by Chinese researchers) inconsistently, sometimes for this specific composition (one locality in China), sometimes generically for any Cu-Zn alloy; published without approval of the IMA. No structural data.

Zhanghengite (an approved species - IMA 1985-049) – 50% Zn. Formula CuZn. Isometric. One locality (chinese meteorite). = β -Brass

Danbaite (an approved species - IMA 1981-041) – 67% Zn. Formula CuZn_2 . Isometric. One locality in China. = γ -Brass

In the absence of structural data to the contrary, we can assume that Cu_8Zn , UM 1980-02-E:CuZn, UM 1980-01-E:CuZn, ordinary “native brass”, and tongxinite are probably all varieties of α -brass or, mineralogically, “zinc-rich varieties of native copper”. β -Brass and γ -Brass already have IMA-approved species status as, respectively, the minerals zhanghengite and danbaite. “Zinccopperite” is more problematic – possibly α -brass, or perhaps 2-phase mixtures of α -brass and β -brass.

So how do the metal inclusions in Izu islands’ anorthites compare with these previously reported brasses? Both pure native copper and pure native zinc are present (although not together), as well as intermediate compositions (“brass”). These intermediate Cu-Zn alloys are not of random compositions but rather very closely grouped around only three compositions with 13% Zn, 25% Zn, and 40% Zn, perhaps indicating some structural control favoring alloys of these compositions? The first two most likely correspond to α -Brass (i.e. zinc-rich native copper). The latter composition, with 40% Zn - Cu_3Zn_2 , is by far the most abundant of all the metal inclusions, although it falls outside of the composition fields for any of the stable Cu-Zn phases, and it does not correspond to any of the previously reported native brasses! (It does appear to have been found once in lunar regolith (*Pavel Kartashov, pers. comm.*)). But it does correspond to the artificial alloy “Muntz metal”, an intimate 2-phase mixture of α -brass and β -brass (zhanghengite).

N. Nishida, M. Kimata and Y. Arakawa (1994) Native Zinc, Copper, and Brass in the Red-Clouded Anorthite Megacryst as Probes of the Arc-Magmatic Process. *Naturwissenschaften* 81:498-502.

Minerals from a Natural Shale Fire

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Will Shewfelt, Ernest Carlson

A talus slope adjacent to a river-cut cliff in Devonian shale in north-central Ohio caught fire by spontaneous combustion sometime in September of 2009, and burned until March 2011. Temperatures in the core of the fire exceeded 400°C.

A suite of at least 13 minerals, typically associated with volcanic fumaroles (most of them highly unusual for Ohio, where volcanoes are currently scarce) were collected from the vents of this fire. These include sulfur, gypsum, anhydrite, salammoniac, tschermigite, mascagnite, letovicite, voltaite and/or other members of the voltaite group; and tentatively identified metavoltine, alunogen, and pyracmonite. At least three additional potentially new species are included in the assemblage.

This talk will present the geologic setting of these minerals, consider the issue of whether they should be considered minerals or not, describe and document the observed minerals at the current state of their investigation, and analyze the highly varied and beautiful forms of salammoniac observed at this location in terms of the relationship between crystal form and “crystallization pressure”.

Come see the results of a unique version of hot times in rural northern Ohio!



Frost-like salammoniac dendrites and other crystals found under a large slab of shale at the surface of the shale fire on January 30, 2011. Field of view about 5 inches wide.

Historic Oriented Crystal Preparations by the Firm of Steeg and Reuter, with Notes on a Few American Makers

Daniel Kile

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Introduction

The rapid expansion of our knowledge of mineralogy throughout the 1800s is largely attributable to the development of equipment designed to analyze the behavior of light transmitted through them. Accordingly, the development of specialized instruments utilizing polarized light, such as staurosopes, polariscopes, and petrographic microscopes, greatly facilitated these studies.

Concurrent advances in mineralogy and scientific apparatus also required the manufacture of suitable material for study. Rock thin sections were the most common preparations examined, but the understanding of the diagnostic optical properties of individual minerals required the study of single crystals. Thus, a need arose for preparations of carefully oriented crystal sections used for teaching and research. There were a number of firms that mastered the techniques of crystal orientation, grinding, polishing, and mounting, but among them only a few stand out as being exceptional in their craft. Among these, the firm of Steeg & Reuter, Bad Homburg, Germany, is unquestionably among the most noteworthy regarding the variety of crystals and difficulty of preparation.

Brief History of the Steeg & Reuter Firm

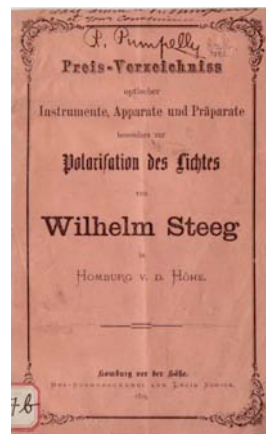
Wilhelm Steeg (1819–1903) learned his trade as an apprentice to Ivan Werlein in Paris. By 1854 he had founded his own firm in Homburg vor der Höhe, Germany. His first catalog, issued in 1867, consisted of 36 pages. The early mounts were fabricated of square cork frames (of varying thicknesses to accommodate different sizes of mineral samples) ca. 3.5 cm across; a crystal section was cemented to a circular glass positioned inside a round opening within the cork frame. Thicker mineral sections were uncovered, while thinner or more fragile plates were laminated between glass. Lastly, a paper label with the company logo (signed "Wilh. Steeg in Homburg v.d.H.") was affixed to the exterior of the mount. Many such preparations, however, were often shipped without any trade label, whereupon the purchaser could affix a secondary label that was often handwritten in an artistic script or calligraphy.



Wilhelm Steeg, 1819-1903



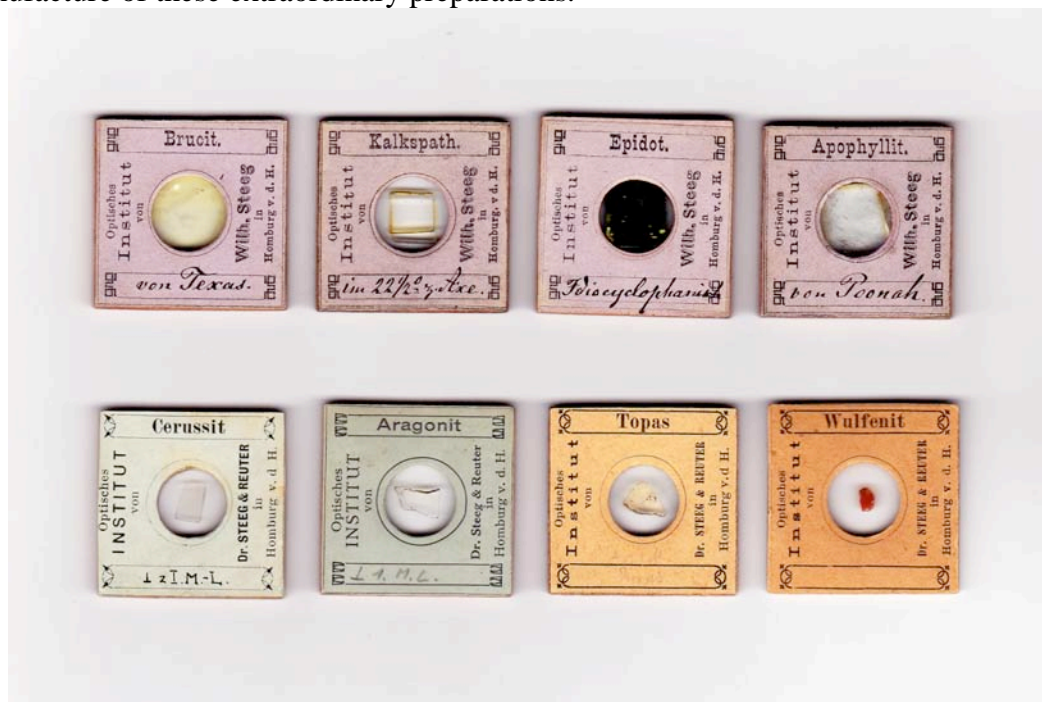
Peter Reuter, 1852-1898



W. Steeg catalog, 1873

By 1866 Peter Reuter (1852–1898) had joined the firm as an apprentice, and by 1877 he was a full partner. In this year Steeg was also awarded an honorary Ph.D., and the trade label for the firm was changed to "Dr. Steeg & Reuter in Homburg v.d.H.". Thus, cork mounts signed "Wilh. Steeg" predate 1877. August Reuter (1875–1965), the eldest son of Peter, became a partner of the firm in

1900. Under his stewardship, the firm expanded considerably, and by ca. 1914 the company had produced their largest catalog, composed of 166 pages and offering more than 500 oriented crystal mounts, in addition to a wide variety of calcite prisms, mica and gypsum waveplates, spheres, lenses, and various equipment for polarized light, including, for a short time, petrographic microscopes upon the acquisition of the Voigt and Hochgesang firm in 1905. By the early to mid-20th century, the firm had also provided their oriented crystals on regular glass mounts, ca. 28 x 48 mm (i.e., the Giessener format). The firm declined after the death of August Reuter in 1965, and presently there is no manufacture of these extraordinary preparations.



A selection of cork-mounted mineral sections by Wilhelm Steeg (top), and by Dr. Steeg & Reuter (bottom). The W. Steeg preparations predate 1877.

An Overview of Some Mineralogical Preparations

Although a number of other European firms fabricated their own oriented mounts (e.g., W. Ladd, and Newton and Co., in London), their production was limited to the simpler preparations; the variety and excellent workmanship of difficult material by Steeg & Reuter became world renowned, and their oriented mounts found their way into the archives of universities and private researchers worldwide. Many of the crystals were prepared in very thick plates, accentuating the study optical properties in relation to crystal symmetry and orientation, which would not otherwise be clearly evident in thinner preparations.

Crystals for these oriented sections were sought from worldwide sources. The materials were carefully selected for their optical properties, then meticulously oriented and ground and polished to exacting standards using specialized goniometer apparatus. Among the oriented crystallized minerals provided by this firm, numerous synthetic organic and inorganic crystals



A selection of mounts unquestionably manufactured by Steeg & Reuter, and signed by the retailer, J.G. Hofmann, Paris.

(such as santonin and potassium dichromate) were manufactured and sold. Such preparations, though not minerals *per se*, nonetheless provided a wide range of optical properties to further reinforce and augment the concepts of optical principles gleaned from natural minerals. Included in the artificially grown crystals were the various platinocyanide compounds, e.g., Ba-, Mg-, Sr-, and K-platinocyanide); these were very difficult to synthesize, but many of them produced spectacular conoscopic dispersion effects in oriented sections.



A selection of rotating mounts; these were intended to demonstrate pleochroism while turning the brass handle.

The expense of these preparations was determined by availability of suitable material, and the difficulty of preparation. Cinnabar, for example, was very difficult to polish, and in earlier days satisfactory material was exceedingly rare; its price reflected this, being offered for as much as 200

Marks in the early 1900s – a very substantial sum for that era. To place that figure in perspective, a high-end petrographic microscope in the same catalog listed for 400 Marks. In comparison, preparations of the more common materials cost on the order of 2 – 15 Marks. Sapphire and ruby were other expensive mounts, being offered for as much as 100 Marks. Most of the crystals were mounted as oriented plates within the cork frames, intended to illustrate optical phenomena such as birefringence, extinction angle, uniaxial/biaxial character, optic angle, pleochroism, dispersion, optical activity, anomalous interference colors, etc. Some minerals noted for pleochroism were mounted on a rotating brass peg within the cork frame, whereby the mineral could be rotated to demonstrate pleochroic effects quite dramatically. Other specialized preparations included twinned crystals and plates of crossed crystal sections to illustrate unusual interference patterns.



*Interference figures photographed in monochromatic sodium light:
Left, biaxial figure; center, twinned crystal; right, Airy's spiral.
From Hans Hauswaldt's "Interferenze-Erscheinungen", 1902; this was
the first of a remarkable 3-volume series, published from 1902 – 1908.*

In addition, special preparations with a higher level of artistic merit were fabricated. Among the most spectacular were the carved gypsum pictures. The interference colors (as per Newton's scale) vary in relation to the thickness of the material. Accordingly, master craftsmen carved cleavage slices of gypsum to varying depths to give a colorful pattern portraying scenes, birds, butterflies, etc. The interference colors would dramatically change to complimentary colors when crossed polarized light was switched to parallel polarized light. This work was done until the 1960s, when tulips or butterfly motifs were carved on glass slides and provided with Leitz Prado polarizing projectors. These preparations, while artistic, were also excellent pedagogical tools in the classroom, whereby a student, having seen the unique and colorful motifs can then delve into an understanding of the optical principles of retardation, thickness, and birefringence that govern the interference colors creating the picture.

Mica was another medium used to create spectacular mounts. Using different thicknesses of mica sheets [which fortuitously has a perfect (001) cleavage], and varying the thickness and orientation of multiple overlays, impressive symmetrical patterns were created, including sectorial geometrical figures, concentric circles, radial aggregates, checkerboards, etc., all based on fundamental optical principals which again were reinforced for the student. Exacting techniques and expertise were required to cleave the mica to a precise thickness, in addition to the delicate work of cutting, orienting, and overlaying the sheets.

Still other mica preparations were intended to convey more esoteric optical features. The Nörrenberg set, for example, was prepared with overlays ranging from 2 to 24 sheets, each cut to precise thickness and oriented at 90° to one other. The final mount in the set created a pseudo-

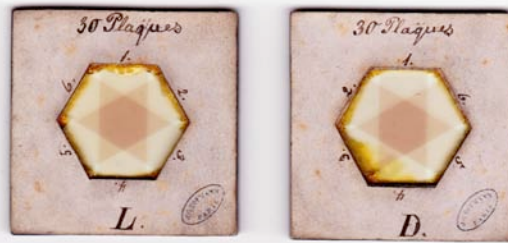
uniaxial interference figure, thereby demonstrating formation of an apparently uniaxial $3T$ mica (such as biotite) via the polytype stacking sequence, in contrast with a normal biaxial $2M_1$ muscovite. The Reusch set of micas was composed of overlain lamellae oriented at 60° to one another, and demonstrated optical activity that is observed in the interference figure, such as noted for quartz or cinnabar.



A set of Nörrenberg crossed mica plates to demonstrate the formation of a pseudo-uniaxial character in 3-T micas.

Lastly, mica-gypsum combinations were prepared of carefully oriented and interleaved cleavage sections to produce spectacular and colorful interference figures. The orientation and stacking sequence of lamellae were varied to give different interference figure patterns. While not of particular value for demonstrating optical principles, the figures were nonetheless quite impressive.

With all of the layered preparations discussed above, orientation of the cleavage lamellae to an *exact* angle and thickness for each slice had to be *perfectly* executed, else wise the interference figure would be asymmetrical. The author can personally attest to this, having attempted fabricating a Nörrenberg plate composed of only 4 layers. Many of the techniques for preparation of these and other mounts described above are recounted in Lewis Wright's book "Light: A Course of Experimental Optics", published in 1892.



A set of right-and left-handed Reusch plates, also known as "Artificial Quartz", used to demonstrate creation of optical activity using overlain sheets of mica.

Some American Manufacturers

In addition to the venerable Steeg & Reuter enterprise, several American manufacturers provided a range of oriented crystals mounted on glass slides. The W.H. Tomlinson Company was unique in that it offered an extensive selection of these mounts. The firm was established by 1905 in Philadelphia, Pennsylvania, and by 1912 had relocated in Swarthmore, Pennsylvania. Initial offerings were limited to thin sections of common rock types and ores, and by 1915 the inventory of prepared slides expanded to include oriented crystal sections. These were initially offered as crystals that were oriented along crystallographic faces (e.g., parallel pinacoid, brachy pinacoid, etc.), but by 1922 crystals oriented along optic directions (e.g., optic axis, acute bisectrix) were listed. These preparations were cut as thin sections, intended to replicate the appearance of an interference figure as it would appear in a standard rock thin section, in contrast to many of the mounts made by the firm of Steeg & Reuter, whose preparations were generally quite thick in order to accentuate optical properties not easily evidenced in thin section. Tomlinson was active in the academic world as well, having authored a number of papers for scientific journals on the techniques for the manufacture of thin sections.

Due to declining health, Harold Tomlinson sold his business and inventory to Dick and Donna Organist, Newark, Delaware, in 1958. Both of the Organist's had a geological background, and previously had apprenticed with Tomlinson, learning his techniques of thin section and oriented crystal preparation. Donna described Tomlinson as a person of "a great deal of knowledge, patience and good humor". They continued this enterprise, offering, in addition to custom thin section preparation, an extensive list of oriented minerals in the same fashion as their predecessor. Their active business came to a close ca. 2006.



A selection of oriented mounts by W.H. Tomlinson and R. von Huene



R. von Huene

Rudolph von Huene was another notable American maker, perhaps not as well known as Tomlinson. Originally from Germany, he was affiliated with the California Institute of Technology (CalTech) in Pasadena, California, and like Tomlinson, wrote various papers in scientific journals regarding thin section preparation. Some of his preparations featured sections of multiple crystal orientations on a single slide, e.g., hornblende, plagioclase, calcite, and augite. But von Huene is probably most recognized for his preparations that were marketed for many decades through Ward's Natural Science, Rochester, New York. There were four slides in all, quite distinctive with printed paper labels bearing his name and mounted beneath balsam: anhydrite showing Bxa and Bxo figures; relief illustrated with five mounted grains; 2V with six mounted grains; and six minerals showing different interference figures mounted on a single slide. Presumably the Ward's inventory sold over the past decade was derived from earlier-acquired preparations, and now most of von Huene's mounts are shown as out-of-stock in their catalog.

With the closing of the businesses of Steeg & Reuter, Tomlinson, Organist, and von Huene, it does not seem likely that another preparator will be forthcoming to provide oriented crystal sections, partly on account of the loss of the specialized skills involved, and partly also due to the regrettable waning of interest in optical mineralogy. Unfortunately, the skill and techniques for the manufacture of these extraordinary preparations have become a lost art.

A Brief Description of Selected Oriented Steeg & Reuter Crystal Preparations

Crystals were usually oriented and mounted to illustrate a specific optical property. Accordingly, a broad spectrum of uniaxial and biaxial materials was fabricated to illustrate fundamental properties of extinction, pleochroism, optic angle, optic sign, birefringence (and retardation), dispersion, twinning, optical activity, and anomalous interference colors.

A selection of representative mounts prepared by Steeg & Reuter, and the optical properties they illustrate, are described below, with brief comments as appropriate.

Extinction:

Kyanite

Maximum extinction angle = 30°

Optical Activity, Optic Axis:

Quartz

Seen with Airy's spirals in Brazil-law twinned crystals; also produced artificially with crossed plates of left and right-handed sections

Cinnabar

Optical activity 25x that of quartz; by far the most expensive mount made by the firm

Pleochroism:

Cordierite (Dichroite)
Cr-NH₄-Oxalate
Idocrase
Epidote

Also supplied in a rotating mount
Spectacular red–purple dichroism
Also supplied in a rotating mount
Both in rotating and flat mounts

Uniaxial Crystals, Optic Axis:

Brucite
Apophyllite
Strychnine sulfate
Apatite
Idocrase

Uniaxial positive
Uniaxial positive (also anomalous colors)
Uniaxial negative
Uniaxial negative, low birefringence
Uniaxial negative (anomalous biaxial)

Biaxial Crystals, Acute Bisectrix (Bxa):

Aragonite
Barite
Sugar
Topaz

$2V = 18^\circ$, high birefringence
 $2V \sim 40^\circ$
 $2V \sim 48^\circ$
 $2V \sim 55^\circ$

Optic Axis Dispersion:

Cerussite
Titanite
Muscovite
Santonin

Strong $r > v$, high birefringence
Strong $r > v$; one of the more expensive mounts
Distinct $r > v$
Strong $r < v$

Crossed Axial Dispersion:

Brookite

Extreme crossed axial dispersion, showing a change in optic plane orientation from red to blue light

Horizontal/Inclined Dispersion

High sanidine
Low Sanidine

Mg-Pt-CN compounds

Inclined dispersion, low birefringence
Horizontal dispersion, inclined dispersion, low birefringence
Extreme dispersion, horizontal and inclined

Retardation/Birefringence:

Gypsum
Twinned diopside

Geometric mica preparations
Carved gypsum pictures

Preparations of uneven thickness
Optic axis figure showing high and low birefringence for twins of different thickness
Spectacular geometric patterns of oriented lamellae
Scenic motifs among the most spectacular of the Steeg & Reuter preparations

Crossed Crystal Plates:

Nörrenberg set

Reusch Set

Oriented at 90° to show pseudo-uniaxiality of 3T polytype stacking
Oriented at 60° to show optical activity, i.e., "artificial quartz"

Mica–Gypsum Combinations

Crossed plates interposed to show spectacular interference figure patterns

Anomalous Interference Colors, Optic Axis:

Apophyllite

Interference figures without normal sequence of Michel-Lévy colors; black & white only

Brucite

Interference figures without normal sequence of Michel-Lévy colors; black & white only

Acknowledgements

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DR. ANDREW FERNANDO HOLMES (1797-1860):
AN EARLY CANADIAN MINERAL COLLECTOR AND HIS COLLECTION

Peter Tarassoff

Born in Cadiz, Spain, to English parents, Holmes received his early education in Montreal and his medical degree at the University of Edinburgh. He was one of the first members of the medical staff of the Montreal General Hospital founded in 1820, and of the teaching staff of the associated Montreal Medical Institution which in 1829 became the Faculty of Medicine of McGill University. He was named the first Dean of Medicine at McGill in 1844. Like many physicians of his day, Holmes was a keen amateur naturalist. His first interest appears to have been botany, and between 1820 and 1825 he assembled a herbarium of over 500 native plants of the Island of Montreal. He was a founding member in 1827 of the Natural History Society of Montreal and later served as its president. One of the society's objectives was the establishment of a natural history museum, and Holmes played a prominent role in developing the museum's mineralogical collection. About 1826, and probably earlier, Holmes had begun to build his own mineral collection. His mineral collecting appears to have peaked by 1834.

In 1856, Holmes offered his herbarium and mineral collection to McGill University. They were duly purchased for \$600, which was then a large sum. The mineral collection catalog, in Holmes' handwriting, survives in the Redpath Museum. It is more than a catalog. With its annotations, lists documenting the source and acquisition date of mineral specimens, and even some letters, it provides a unique insight into Holmes the mineral collector, and the mineral collecting scene in North America in the early 19th century.

For a Canadian collection of its time, the Holmes collection of about 2,200 mineral specimens (and 400 rocks) was notably diverse in species and localities. Canadian specimens, numbering about 600, are representative of what could then be found in Quebec and Ontario, particularly in the Grenville Province and Saint Lawrence Lowlands. Some of the American localities represented in the collection are Monroe, Haddam and Trumbull, Connecticut; Franklin, New Jersey; Warwick, Lockport and Gouverneur, New York; Southampton and Chesterfield, Massachusetts; Acworth, New Hampshire; and Paris, Maine. Scottish localities include Leadhills, Strontian and the Kilpatrick Hills. Classic English localities in Durham, Cumbria and Cornwall are well represented. Among classic European localities are Bourg d'Oisans and Chessy, France; Schemnitz (Banská Štiavnica) and Libethen (L'ubietová), Slovakia; Arendal and Langesundsfjord, Norway; Ytterby, Sweden; Mount Vesuvius, Italy; and Beresovsk, Russia. There is even a specimen (sulphur) from the Sandwich Islands (Hawaii). By today's standards, the quality of the specimens in the Holmes collection is unremarkable. Nevertheless, they reflect what was available at the time. Some of the specimens are now rare examples from extinct localities.

Most of the minerals from Canadian localities were evidently collected by Holmes himself. In the 1820s and 1830s the only mines in Quebec and Ontario exploited a few deposits of bog iron ore and magnetite. Holmes' field collecting would have focused on outcrops, quarries producing limestone for building stone and the manufacture of lime and cement, and civil engineering works such as the Lachine Canal in Montreal (constructed in 1821-1825) and the Rideau Canal between Kingston and Ottawa, Ontario (1826-1832). Surface exposures of calcite vein-dykes in the Grenville Province would have been especially productive of mineral specimens. Shepard (1840) recorded: "A second locality of the mineral [*lederite* = titanite] was made known by Dr. A. F. Holmes of Montreal about eight years ago, who obtained it in considerable abundance from Grenville [village in Quebec for which Grenville Province was named], in Canada."

Like mineral collectors today, Holmes networked with collectors, mineralogists and institutions, exchanging specimens. Among them were the New York physicians William Horton

(1796-1844), Martyn Paine (1794-1877) and John Honeywood Steel (1780-1838); West Point Professor of Chemistry, Mineralogy and Geology, John Torrey (1796-1873); U.S. Army Major Joseph Delafield (1790-1875); Vermont Academy of Medicine Professor of Botany and Chemistry, Lewis Caleb Beck (1798-1853) (later, Professor of Chemistry at Rutgers University and New York state mineralogist); University of Vermont Professor of Mathematics and Natural Philosophy, George Wyllys Benedict (1796-1871); Yale University Lecturer in Natural History, Charles Upham Shepard (1804-1886) (later, Professor of Chemistry at Amherst College and Connecticut state mineralogist). To these American connections we can add Baron Alois J.X. von Lederer (1773-1842), Austrian Consul-General to the United States, who was stationed in New York. Holmes' European contacts included the prominent Berlin mineral collector and banker Friedrich Tamnau (1802-1879). Holmes developed a special relationship with both Shepard and the famous Scottish physician and mineralogist Thomas Thomson (1773-1852), Professor of Chemistry at the University of Glasgow.

The only Canadian collector named by Holmes is Montreal physician, and co-founder of the Natural History Society of Montreal, Benjamin Berthelet (1796-1847). There is no mention of James Wilson (abt.1800-1881), physician, fellow graduate of the University of Edinburgh, and mineral collector living in Perth, Ontario. Like Holmes, Wilson was also in touch with Thomson. It's unlikely that Holmes and Wilson would not have known each other.

Holmes records mineral exchanges with three institutions: the Literary and Historical Society of Quebec (founded in 1824), the Belfast (Ireland) Natural History and Philosophical Society (founded in 1821), and rather surprisingly given his personal involvement, the Natural History Society of Montreal. Holmes seems to have purchased minerals to a limited extent. The only dealer named by Holmes is Alexander Rose (1781-1860), a prominent mineralogist and mineral dealer in Edinburgh, and this in connection with an exchange with a Scottish mineral collector.

In his 1836 *Outlines of Mineralogy, Geology and Mineral Analysis*, Thomson described several new species from material that had been sent to him by Holmes. These included the now discredited *baryto-sulphate of strontian* (~ barian celestine; from Drummond Island, Lake Erie, and Kingston, Ontario), *huronite* (~ impure anorthite; from "neighborhood of Lake Huron"), *neuroлите* (~ pyrophyllite (?); from Stanstead, Quebec), *raphilite* (~ tremolite; from Bathurst Township, Ontario), and *retinalite* (~ *serpentine*; from Grenville, Quebec). Only one of the minerals from Holmes described by Thomson as a new species, the plagioclase feldspar bytownite (from Bytown (Ottawa), Ontario), is still considered valid. In a separate 1836 publication, Thomson named a mica, from Warwick, Orange County, New York, *holmite* (also *holmesite*), after Holmes. It was subsequently shown to be the same as the earlier named *seybertite*, now clintonite. But the true nature of another mineral escaped Holmes' attention. Sometime in the 1830s he collected a mineral from "the foundation of McGill College" which he labeled tremolite. It was in fact a new species, dawsonite, later collected "near McGill College" by renowned Canadian geologist and McGill University Principal Sir William Dawson, and named after him in 1875.

When McGill University's Redpath Museum first opened in 1882, the Holmes collection featured prominently in the mineral displays. With the installation of the outstanding Walter F. Ferrier (1865-1950) mineral collection in 1913-14, the Holmes collection was relegated to storage. Many Holmes specimens have been lost over the years or are now unidentifiable. Only about four hundred are currently accessioned in the museum's mineral database. But what remains of the Holmes collection, and especially its unique catalog, are of great historic value.

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Preliminary Analyses of Some Minerals from New York State

Steven C. Chamberlain

The information presented here has not been published before. These preliminary identifications of mineral specimens from New York State are based on semi-quantitative analysis with a Scanning Electron Microscope (SEM). The analyses were performed by Dr. David Bailey with me in the co-pilot seat, using the SEM at Hamilton College. I thank Dave for his continuing support and assistance; however, the identifications given here, right or wrong, are solely my responsibility.

These identifications should be considered preliminary because x-ray corroboration of the identifications is largely absent. On the other hand, physical characteristics such as hardness, cleavage, and crystal morphology factor in significantly to most of these identifications. I believe most of the identifications are correct, or at least close enough to guide future researchers toward a more exact identification.

The main motivation for pursuing this work was to refine the data in the catalog of the Steven C. Chamberlain Collection at the New York State Museum. This piece in the Program Notes provides some wider dissemination of the data in the event the results are never formally published otherwise.

Madison County

- Mineralized vugs in the Lockport Dolostone occurrence at Bridgeport on the south shore of Oneida Lake (43°09'44"N, 75°55'37"W).

- White crystals of an unidentified sulfate - Barite

St. Lawrence County

- Road cut on first curve in Kents Corners Road southeast of the intersection with US Rt 11, Dekalb Junction (44°28'14"N, 75°19'11"W).

- White plates and rosettes - Pyrophyllite

- Brown tourmaline - Dravite

- Black xls with red highlights - Rutile

- Hill overlooking Leonard Brook, Bower Powers Farm, Pierrepont (44°33'31"N, 75°01'12"W).

- Black amphibole - Tremolite

- Zinc Corporation of America #3 Mine, Balmat (44°16'00"N, 75°24'10"W).

- Acicular sulfate xls - Ba-rich Celestine

- Fluorapatite Locality on Dave Downing Farm, Pierces Corners (44°27'54"N, 75°29'36"W).

- Blue tourmaline xls - Dravite

- Road Cut in Rock Island Road north of Gouverneur (44°23'29"N, 75°27'14"W).

- White platy sulfate crystals - Barite

- Veins west of Grass Lake and east of Burns Road, northeast of Redwood (44°20'11"N,

75°44'02"W).

--Scapolite - Meionite about $\text{Me}_{84}\text{Ma}_{16}$

•Danburite Locality, Russell (44°22'10"N, 75°11'14"W).

--Scapolite - Marialite about $\text{Ma}_{63}\text{Me}_{37}$

--Apatite - Fluorapatite

--Amphibole - Tremolite

--Limonitic masses - Goethite, Sulfur, Gypsum, all in crystals

•Church Property, south of Russell (44°22'35"N, 75°11'13"W).

--Scapolite - Marialite about $\text{Ma}_{69}\text{Me}_{31}$

•Road Cut in old Rt. 58 at Bishop Road, Black Lake (44°24'43"N, 75°32'54"W).

--Scapolite - Meionite about $\text{Me}_{86}\text{Ma}_{14}$

--Black coating on scapolite - Allanite-(Ce)

•Hurlbut Farm, north of Gouverneur (44°29'04"N, 75°26'48"W).

--White secondary amphibole - Tremolite

•East bank of Oswegatchie River just south of bridge, MacMaster Farm, Dekalb (44°29'57"N, 75°20'43"W).

--Green to pale brown tourmaline - Dravite

•Hill overlooking Hall Farmhouse, Morrison Road, north of Gouverneur (44°26'11"N, 75°28'39"W).

--Amber-colored tourmaline - Fluor-dravite

•Finlay Farm, Irish Settlement Road, northeast of Pierrepont (44°32'56"N, 74°59'42"W).

--Green and black amphibole - Tremolite

--Blue-gray, metallic equant crystals - Molybdenite

--Scapolite - Meionite about $\text{Me}_{64}\text{Ma}_{36}$

--Plagioclase with blue Schiller - Albite (Peristerite)

•Prehnite Road Cut on Russell-Hermon Road (44°26'34"N, 75°10'45"W).

--White rhombohedral zeolite - Chabazite-Ca (x-rayed)

•Chiarenzelli Prospect, near Seven Springs Ski Lift, Parishville (44°34'58"N, 74°51'22"W).

--White feldspar - Albite

--Green feldspar - Albite

--Tourmaline - Dravite

--Large embedded pyroxen crystals - Diopside

--Dark green amphibole - Tremolite

•Exposures south of Selleck Road, West Pierrepont (44°29'30"N, 75°02'21"W).

--Colorless zeolite - Heulandite-Ca (x-rayed)

--Lavender Scapolite - Marialite, about $\text{Ma}_{90}\text{Me}_{10}$

--Altered lavender scapolite - Ba-rich Microcline and Mg-rich Muscovite

--Brown mica - iron-rich Phlogopite, some with much fluorine possibly Fluorophlogopite

- White feldspar replacing scapolite - Albite
- Tan feldspar replacing scapolite - Microcline
- Brown massive and microcrystals - Titanite
- Plagioclase crystals - Albite
- Feldspar crystals - Microcline
- Green tourmaline - Fluor-uvite but with less iron than more common dark brown fluor-uvite
- Colorless, pale green, dark green, and black amphibole - Tremolite with increasing amounts of iron as an impurity

•Exposures south of North Russell (44°28'07"N, 75°07'03"W).

- Green pyroxene - Diopside
- Green amphibole - Tremolite
- White feldspar - Microcline

39th RMS Exhibits

Barbara Sky – **Pyrite Miniatures**

Bob Morgan – **Pyrite Twins - Same Law, Different Habits**

Bob Whitmore – **Interesting Minerals**

Bruce Gaber – **Five-Element Arrangements**

Chris Stefano – **Mineral Specimens from the Collection of the University of Michigan's Department of Earth and Environmental Sciences**

Chris Stefano – **Selected Rare and Unusual Specimens from the Collection of Christopher J. Stefano**

David Joyce – **Minerals from the Cobalt Mining Camp**

Don Lapham – **New Calcites from Pennsylvania**

Terry Huizing – **Hematites**

Jim Mann – **Maine Mineral and Gem Museum**

John Ebner – **Micromounts, Past & Present**

Jonathan Levinger – **Francon Quarry**

New York State Museum – **NYS Minerals**

Paul & Janet Clifford – **World-Wide Apatites**

Paula Piilonen – **Interesting Minerals**

Smithsonian Institution – **Wonderful! Recent Acquisitions**

Specimens from the RMS Technical Session

Tom Mortimer – **New Hampshire Minerals**

Val Collins – **New Acquisitions**

Wendy Melanson – **Museum at Bancroft**

William Severance – **Arizona Classics**

William Severance – **Russian Malachite from the William Vaux Collection**

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