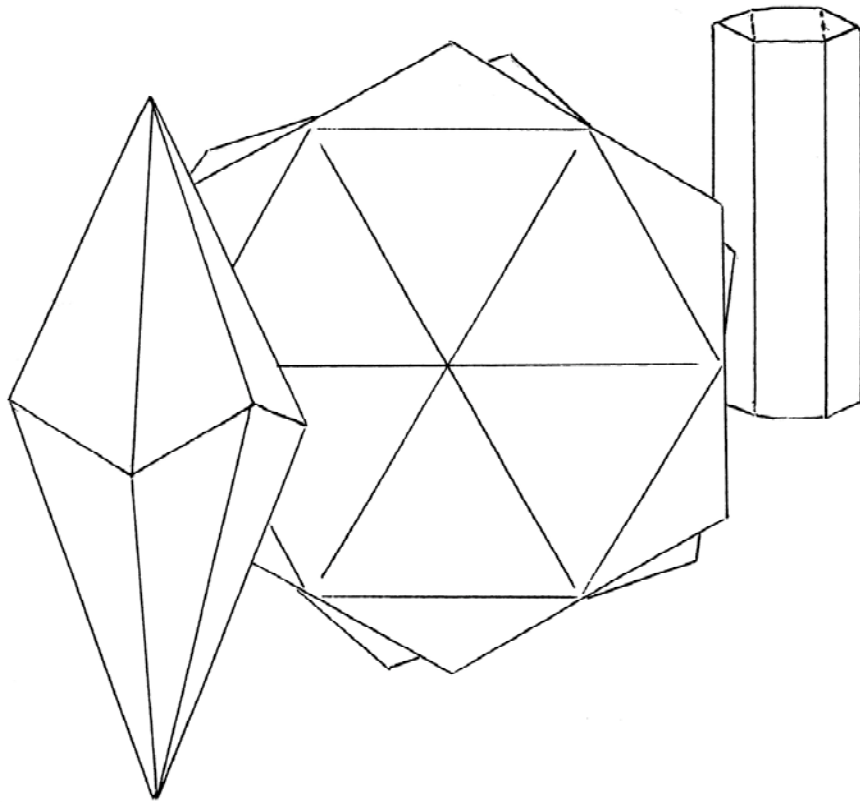


**The 41st
Rochester Mineralogical
Symposium**



April 24 - 27, 2014

S. Robinson, 2013

41st Rochester Mineralogical Symposium

Chairman & Emcee - Steve Chamberlain

Registrar - Helen Chamberlain

Treasurer - Dan Imel

Technical Session - Steve Chamberlain

Technical Session Moderator - Carl Francis

Program Notes, Publicity - Steve Chamberlain

Exhibits - Bruce Gaber

Program Notes Cover Art - Susan Robinson

Dealers - Helen Chamberlain

Facilities - Brian McGrath

Set-Up/Take-Down Crew - John Diaz, Fred Haynes, Brian McGrath, Bob Morgan, Mike Naven, Lee Tutt, Ken Wolff

What's New In Minerals – Jeff Scovil

Auction Solicitors General – Bruce Gaber, Gloria Staebler

Auctioneers – Bruce Gaber, Carl Miller

Auction Technical Support Wizards - Dan Sperber, Dan Imel

Auction Preparation and Support Team - George Robinson, Betty Fetter, Charlene Freundlich, Bill Freundlich, Alicia Imel, Lauren Imel, Dan Sperber, Phyllis Sperber, Laurie Steele-Sperber

Registration Desk - Betty Fetter, Susan Robinson, Elizabeth Von Bacho

Worthy Keeper of the Micromounters' Playroom - Quintin Wight

Technical and Web Site Support - Dan Imel, Paul Dudley

Video - Tom White

Security - Bell Security and Investigations

Symposium Committee - Helen Chamberlain, Steve Chamberlain, Betty Fetter, Bruce Gaber, Dan Imel, Bob Morgan, Brian McGrath

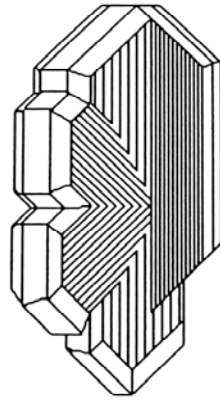


Table of Contents

Program	3
Abstracts of Contributed Papers	8
Sector Zoning in Diamonds from Zimbabwe by John Rakovan and others	29
20 Years After: A Brief Update on the Study of Telluride Minerals & Deposits by Bruce Geller	30
Mineralogical Miracles at Merelani by John Jaszczak	32
Herodsfoot Mine, Richard Talling and Bournonite by Roy Starkey	33
The Mount Antero Mineral Locality, Chaffee County, Colorado by Mark I. Jacobson	37
Minerals of the Cairngorms by Roy Starkey	40

Our warmest welcome to the 41st 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 for 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. Last year, everyone was pleased with our electronically printed Program Notes, with some color, so we are continuing to do so. As usual, everything is different, yet everything is the same.



An 11-cm stalactite of barite from the hanging wall of a newly discovered barite vein exposed in a road cut in Rock Island Road north of Gouverneur, St. Lawrence County, NY. This specimen was collected in 2013 by Donald M. Carlin, Jr. Steve Chamberlain photo.

PROGRAM

Thursday Evening, April 24, 2014

- PM 4:00-6:00 Cocktails and Snacks – Hospitality Suite, Room 400 (4th Floor)
- 6:00-7:45 Dinner – Baxter’s
- 8:00-9:15 **Grenville Grunge? Dispelling the Myth!** – *Michael Bainbridge*
Michael J. 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. Also a passionate advocate for the hobby, 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.
In 2006, Michael began regularly visiting the Haliburton Highlands (covering the western extent of the Canadian Grenville Geologic Province) from his home in Ottawa. In 2009, he settled full-time in Minden, one hour west of “Canada’s Mineral Capital,” Bancroft, Ontario. Since then he has also been working to help re-popularize hobby mineral collecting and general interest in geology through public outreach and tourism activities.
“Grenville” minerals have a bad rap. Granted, it’s not *entirely* undeserved, but there are plenty of unfair generalizations, which (for some bizarre reason) even local collectors seem to delight in perpetuating. With tongue firmly in cheek, *Grenville Grunge? Dispelling the Myth!* examines this self-deprecating tendency and seeks to mitigate the collateral damage of this unfortunate moniker by highlighting some of the finest (and yes, decidedly un-grungy) examples of Grenville minerals from collections such as the new Bancroft Mineral Museum and the speaker’s own field-collecting activities. We welcome him back to the speakers’ podium.
- 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 25, 2014

- AM 9:00 Announcements
- 9:15-10:15 **Mineralogical Miracles at Merelani** – *Dr. John Jaszczak*
Dr. John Jaszczak is a full professor of physics at Michigan Technological University and adjunct curator of the A. E. Seaman Mineral Museum. John earned a BS in physics from Case Western Reserve in 1983; an MS in physics from Ohio State in 1985; and a PhD in physics from Ohio State in 1989. He was a postdoctoral fellow at the Argonne National Laboratory for two years before joining the faculty of MTU. Besides pursuing funded research and teaching, John has been deeply involved in the development of special curricular programs for undergraduates at MTU. John’s role as a top-flight specimen mineralogist has included helping to curate one of the top collections in North America and publishing numerous articles on minerals and mineral occurrences. *Rocks & Minerals* has featured John’s work on Merelani. As most of you already know, John has a particular affinity for graphite, both as a collectible mineral and as the subject of advanced research. This morning’s talk will feature one of the finest specimen graphite occurrences in the world and just might have some minerals that are not black along for the ride. Please welcome Dr. John Jaszczak back to the speakers’ podium!
- 10:15 Coffee Break

10:30-11:30

Herodsfoot Mine, Richard Talling and Bournonite - Roy Starkey

Roy Starkey is a regular speaker on the British mineralogical / geological society circuit. He graduated from Sheffield University with a BSc(Hons) in Geology, and has pursued a career in manufacturing and operations management, gaining experience in a wide variety of engineering and technology product sectors, including ten years with Morgan Crucible manufacturing technical ceramics (crushed high-purity rocks!). He is now retired and seeks to devote more time to his mineralogical interests. He founded the British Micromount Society in 1981, and has held a variety of roles in the Russell Society, the UK's leading society for amateur and professional mineralogists, and is its immediate past-President.

Roy has published widely on British topographical mineralogy, including papers in the *Mineralogical Magazine*, *Scottish Journal of Geology*, *Proceedings of the Geologists' Association*, *Proceedings of the Bristol Naturalists Society*, the *Mineralogical Record*, and the *Journal of the Russell Society*. He recently completed a major article for the *Mineralogical Record* on Herodsfoot mine, Lanreath, Cornwall, which was published in 2012. Please welcome Roy Starkey to his debut at the RMS speakers' platform.

11:30-1:00 Lunch and Shopping Break

Friday Afternoon, April 25, 2014

- PM 1:00 Contributed Papers in Specimen Mineralogy - *Dr. Carl A. Francis* - Moderator
- 1:00 Steedeite, a new mineral from Mont Saint-Hilaire, QC by **M. M Haring** & A. M. McDonald.
- 1:15 Fluorapatite and other species from the Waisanen Quarry, Greenwood, Oxford County, Maine by **J. Nizamoff**, C. A. Francis, F. C. Perham, & R. A. Sprague.
- 1:30 Re-investigation of the Yedlin Locality, Topsham, Sagadahoc County, Maine, USA by **J. Nemetz** & V. King.
- 1:45 Base metal occurrences in the Taconic Mountains of New York by **M. Lupulescu**, M. Hawkins & D. G. Bailey.
- 2:00 A new collecting site at the Rose Road Locality, Pitcairn, St. Lawrence Co., NY by **S. C. Chamberlain**, M. R. Walter, D. G. Bailey, J. Chiarenzelli & G. W. Robinson.
- 2:15 Paragenesis of margarosanite at the Parker Shaft, Franklin, New Jersey, USA— A review by **V. King** & P. Chin.
- 2:30 Accessory mineralogy of an evolved Dickinson County, Michigan Pegmatite by **T. W. Buchholz**, A. U. Falster, & W. B. Simmons.
- 2:45 A new find of complex Na-Zr silicates in the Stettin Complex, Marathon Co., Wisconsin by **A. U. Falster**, T. W. Buchholz, W. B. Simmons, J. D. Guidry & C. M. Johnson.
- 3:00 Contact metamorphic minerals from the Alta Aureole, Central Wasatch Mountains, Utah by **S. L. Hanson**, A. U. Falster & W. B. Simmons.
- 3:15 Morphological evidence of authigenic gold deposition in lateritic placer deposits from the Guyana Shield of Venezuela by **J. Silverstein**, M. Krekeler & J. Rakovan.

- 3:30 Xenocrystic zircon and corundum (sapphire) from late Cenozoic alkaline basalts at Bo Loei, Ratanakiri province, Cambodia – evidence for multiple magmatic source affinities from trace elemental and isotopic ($\delta^{18}\text{O}$, U-Pb and Hf) compositions by **P. C. Piilonen**, E. A. Belousova, F. L. Sutherland, M. Danišik, J. A. Valley, G. Poirier, R. Rowe, S. Meffre, J. Thompson & K. Zaw.
- 3:45 Reichenstein-Grieserental quartz twins from King County, WA: Two distinct morphologies—two different laws by **B. Morgan**.
- 4:00 Apatite and monazite replacement reactions: Insights into pseudomorphism and the petrogenesis of the Llallagua Tin Deposit by **W. B. Betkowski**, J. Rakovan & D. Harlov.
- 4:15 The crystallization of cristobalite and feldspar in rhyolitic obsidian by **C. C. Reynard**.
- 4:30 Using single-crystal X-ray diffraction structure refinement as a means to determine apatite halogen chemistry by **J. T. Merrill**, S. R. Kelly, J. Rakovan, D. Harlov, K. M. Heffernan & J. M. Hughes.
- 4:45 End of Technical Session
- 4:45 Contributed Short Papers
- 4:45 Section zoning in diamonds from Zimbabwe by **J. A. Rakovan**, E. Gaillou, J. E. Post, J. A. Jaszczak, & J. H. Betts.
- 5:15 20 years after: A brief update on the study of telluride minerals & deposits by **B. A. Geller**.
- 5:45 Shopping Break

Friday Evening, April 25, 2014

- 6:30-8:00 Dinner – Baxter’s
- 8:15-9:15 **The Sulfur Mines of Sicily – Dr. Renato Pagano**
 In 1950, the honorary curator of the Museum of Natural History in Genoa first introduced Dr. Renato Pagano to mineral collecting as a Boy Scout. He has never looked back. He holds a doctorate in electrical engineering and had a distinguished career as an Italian industrialist. His passion for minerals has produced a collection of more than 13,000 specimens, with both systematic and aesthetic subcollections. His wife Adriana shares his passion for minerals and is his partner in collecting and curating. An excellent profile of Renato, Adriana, and their many collections appeared recently *Mineralogical Record* (42:41-52). Tonight Dr. Pagano will talk about a famous specimen producer, the sulfur mines of Sicily. We welcome Dr. Renato Pagano back to the speakers’ podium.
- 9:15-??? Continuation of “Shop’til You Drop”, spirits, and fellowship – 4th Floor

Saturday Morning, April 26, 2014

- AM 9:00-10:00 **What's New in Minerals and Localities, Part I – Jeffrey A. Scovil**
Each year Jeff Scovil shares his excellent photographs of minerals that have appeared on the market since the previous Symposium. Again this year, we welcome Jeff to the speakers' podium for What's New in Minerals and Localities.
- 10:00-11:00 **What's New in Minerals and Localities, Part II – Contributions from the audience.**
- 11:15-12:15 **Volodarsk Chamber Pegmatites - Dr. Peter Lyckberg**
Peter Lyckberg was born 1962 in Göteborg, Sweden, a district rich in pegmatite with various mineralisations which Peter started to study already as a child. At the age of 8 he found his first great pocket in a pegmatite and found plumbomicrolite, a mineral new to Sweden. In the coming years he found, explored many unknown mineral and gem carrying pegmatite and mineral deposits, first in Scandinavia, then on all continents. He studied gem rough from India, Sri Lanka, Brazil, Russia, California, Maine and African countries in early years (pre teen) and later worldwide material. He started his first subscription to a gemmological journal in 1972 (Lapidary Journal) followed shortly by many others. A major career as a collector, consultant, author, and lecturer followed. For the past 15 years he has been an inspector at the European Commission, General Directorate for Energy, and is an independent researcher in gem deposits. During the years he has been an advisor to institutions, companies, journals, museums, independent miners and collectors all over the world. In 1992 Peter was the first non Soviet scientist since the Russian revolution in 1917 to visit, photograph and study the classic Emerald-alexandrite deposits at Tokovaya-Izumrud near As best and the gem pegmatite and amethyst veins around Alabashka-Mursinka in the Urals, Russia and he worked with the Yakutsk Diamond mines in Siberia. He was the first non local to explore the high altitude mines in the Haramosh Mountains, Pakistan where aquamarine and topaz is mined. Peter was also the first and last non Soviet scientist to study the Volodarsk deposits, Ukraine in situ underground. This provides the topic for tonight's talk. Please welcome Peter Lyckberg to the RMS speakers' podium.
- 12:15-1:30 Lunch and Shopping Break

Saturday Afternoon, April 26, 2014

- PM 1:30-2:30 **The Mount Antero Mineral Locality – Mark I. Jacobson**
Mark Ivan Jacobson has had a life-long interest in pegmatites. In 2007 he co-authored the *Guidebook to the Pegmatites of Western Australia*. He wrote a comprehensive article on Mount Antero for *Mineralogical Record* in 1979. He is a frequent contributor to *Mineral News* and *Rocks & Minerals*. Recently he retired as a developmental geophysicist for Chevron for whom he was working in China in a joint venture with Petrochina. This afternoon Mark will talk about a classic American locality, exploited for specimens since 1885, but at such a high elevation that low oxygen, climate, and weather make it difficult to access. We welcome Mark I. Jacobson to the RMS speakers' podium.
- 2:30 Coffee Break
- 2:45-3:45 **The Branchville Pegmatite - Ted Johnson**
Ted Johnson worked for 30 years as a mechanical engineering specialist for a large New England utility. His expertise was analyzing and interpreting the vibrations that turbine-generators and other large machines make when they are operating. This information is used to help detect problems and develop maintenance programs. Although still in demand as a consultant, Ted, in retirement, has more time for mineralogy pursuits. His passion for collecting began about 50 years ago in Paterson, NJ. Ted's keen interests in nature in general, and geology and minerals in particular,

have led him to specialize in historic mining areas such as Cornwall, England; Laurion, Greece; and Broken Hill, Australia. A particular passion has long been New England minerals and pegmatite minerals from world-wide localities. He has operated Yankee Mineral and Gem Company since 1984 “to support these obsessions”. Several years ago, Ted talked about the Tilly Foster mine. Tonight he is talking about another classic eastern locality with extensive and complicated mineralogy, the Branchville Pegmatite. We welcome Ted back to the speakers’ podium.

Saturday Evening, April 26, 2014

- 5:15-6:30 SILENT AUCTION
- 7:00-8:30 Thirty-Eighth Annual Symposium Auction Dinner – Main Ballroom
- 8:30 THIRTY-EIGHTH ANNUAL SYMPOSIUM AUCTION

Sunday Morning, April 27, 2014

- AM 9:00-10:00 **Minerals of the Cairngorms – Roy Starkey**
Roy Starkey’s research interests are in the areas of British topographical mineralogy, the history of mineralogy, and the mineralogy of Scotland in particular. He is currently working on a book about the history of the minerals of the Cairngorms, and works as a part-time volunteer at the Lapworth Museum of Geology (University of Birmingham). We welcome him back to the speakers’ podium.
- 10:00-11:00 **Highlights of 50 Years of Mineral Collecting – Dr. Peter Lyckberg**
In 1973 at the young age of 11 Peter Lyckberg participated in the first field geologist courses at the University of Göteborg and within a few years visited and explored many of the Swedish mines in production for iron, silver, tungsten, zinc, lead, feldspar and also worked at the Swedish Geological Survey with bedrock mapping of Tjörn Island and the Göta Älv Valley as well as soil mapping of Stenungsön by the age of 15. At age 13 he also was consultant for the Swedish Geological Survey regarding 40 ancient deposits of silver, gold, Mn deposits in Dalsland and Värmland countries which he had spent summers locating in the deep forests. Here drilling, mining and publishing later took place based on his original exploration and information. In 1977 and 1981 he published his first reports on pegmatite deposits and had found giant topaz crystals to 80 kg, large beryl and schorl tourmaline crystals to 3 m long in Sweden. For some years he specialized in rare minerals and REE minerals. He built his own faceting machine and learned to facet self collected gems.
His civil engineering studies at the Chalmers University of Technology included research work during some years at the Yxsjöberg Scheelite-Cu deposit, and extensive studies of the Malmerget Magnetite deposit in northern Sweden where some unique pockets of gem quality golden calcite were discovered and documented.
His geological studies continued in various parts of the world including the gem deposits of California, Maine, Minas Gerais and NE Brazil, Namibia, Madagascar, Norway, Finland, Ukraine, Russia, Pakistan. In total around 2500 developed mines and quarries were visited and many more deposits yet to be developed. Peter has been an active lecturer since 1985 leading many field expeditions and he has been a long time member of the editorial board of several mineralogical journals including Mineralien Welt. His lectures have been conducted primarily in Swedish, Norwegian, English, German, French and Russian languages. This morning Peter will highlight some of his five decades of collecting. We welcome Peter back to the RMS speakers’ podium.
- 11:00 End of the Symposium

See you next year for the
42nd RMS:
April 23-26, 2015

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. Sixteen abstracts were submitted and accepted. Fifteen are scheduled for platform presentations on Friday afternoon. One will be a demonstration outside the time slot of the technical session. The accepted abstracts follow.

APATITE AND MONAZITE REPLACEMENT REACTIONS: INSIGHTS INTO PSEUDOMORPHISM AND THE PETROGENESIS OF THE LLALLAGUA TIN DEPOSIT.

W. B. Betkowski¹, J. Rakovan¹, and D. Harlov²: ¹Department of Geology and Environmental Earth Science, 114 Shideler Hall, Oxford, OH 45056; ²Helmholtz Zentrum Potsdam, Deutsches Geoforschungszentrum, Sektion 3.3, Telegrafenberg, D-14473 Potsdam, Germany.

Mineral replacement reactions are very common in the geological world. In fact this is the basis of the rock cycle. A specific class of replacement reactions occurs via fluid aided dissolution and precipitation. Within this class of reactions there are those where the formation of a new mineral is spatially and temporarily coupled with the dissolution of the preexisting mineral, and where the reaction process is limited to movement of a thin fluid-aided reaction front. The frequent result of this specific dissolution-precipitation mechanism is the formation of pseudomorphs (Putnis 2009). These can be heterostructural replacements (e.g. anglesite-galena) or isostructural (e.g. KCl-NaCl). Although in a strict sense they are not pseudomorphs, the product of such reactions can also be the replacement of a crystal by the same mineral with a slightly different (even at the trace element level) chemistry (e.g. apatite-apatite). However different in form - the driving force for mineral changes is always the same; re-equilibration with a new set of environmental conditions, i.e. lowering the total free energy of a system.

In order to test several hypotheses for well-established geochronologic inconsistencies from the Llallagua tin deposit, a series of monazite and apatite replacement experiments were conducted. Fluid-mineral experiments were run utilizing hydrothermal line autoclaves in a temperature range of 300°C to 600°C, under 1 Kbar pressure.

Experimental results were evaluated using scanning electron microscopy (SEM) and electron microprobe (EMPA) data from selected areas of the reaction products. Results are bringing new insights to already well described apatite and monazite replacement phenomena observed in copious field and experimental studies, especially under amphibolite-granulite facies conditions. During the 500°C and 600°C runs, with an alkali-bearing fluid ($\text{Na}_2\text{Si}_2\text{O}_7(\text{Aq})$), rim replacement textures with sharp, non-diffusive profiles were formed, suggesting that a dissolution-precipitation mechanism is responsible for apatite alteration (Fig.1). The same experiments have revealed extensive monazite alteration, often coupled with formation of a symplectite texture (Fig. 1).

At lower temperatures monazite was partially replaced but to a lesser extent. Furthermore, the monazite reaction kinetics changed as evidenced by the lack of symplectitic textures. Apatite grains also show dissolution-precipitation temperature constraints, being unreactive with surrounding alkali fluids at 300°C, and showing very limited reaction at 400°C.

Results indicate that selective replacement of monazite in a monazite and apatite assemblage can occur. This is consistent with the hypothesis that selective mineral replacement reactions are the source of the observed geochronologic discrepancies at Llallagua.

Literature Cited

Putnis, A. 2009. Mineral replacement reactions. *Reviews in Mineralogy & Geochemistry* **70**:87-124.

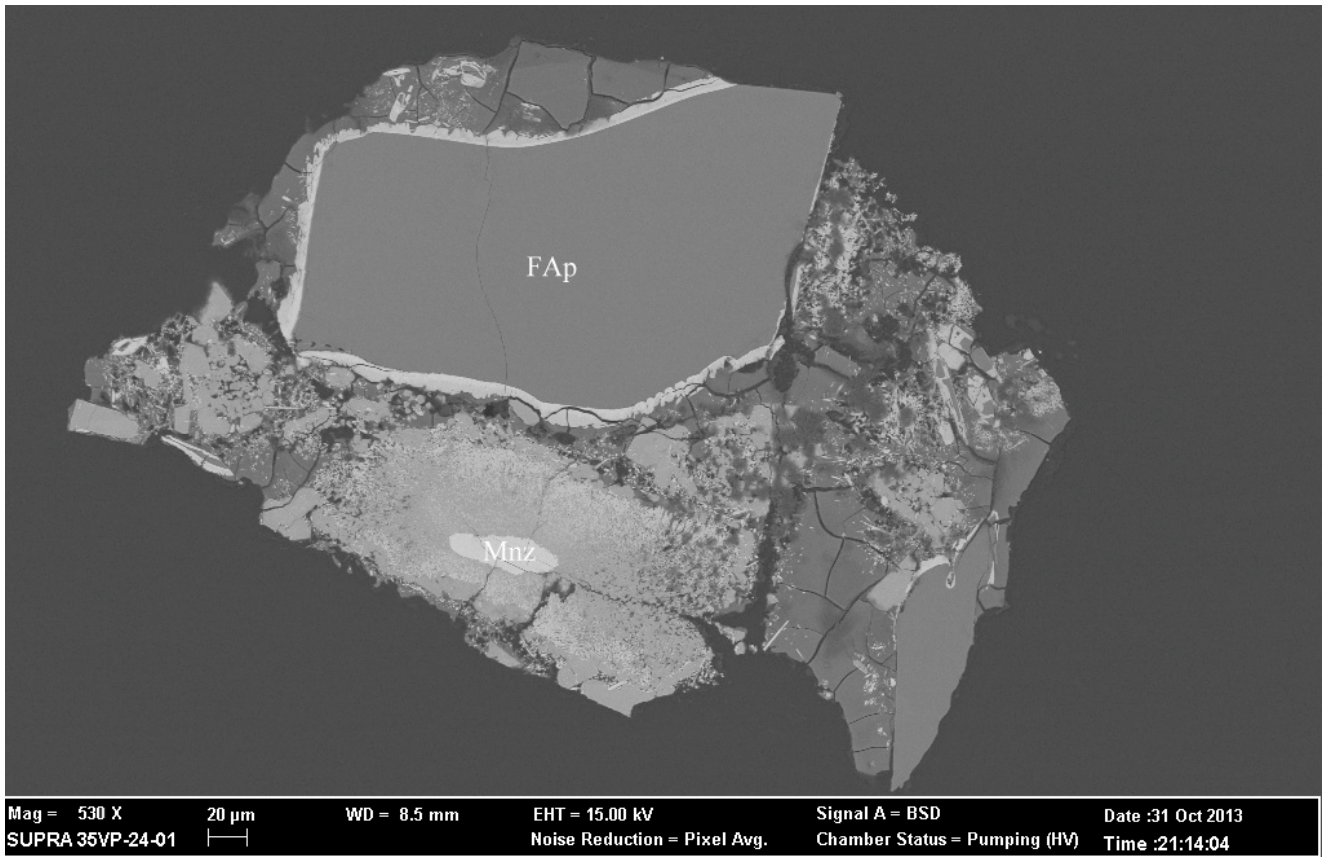


Figure 1. Back-scattered electron image of experimental apatite-monazite assemblage. Large apatite grains showing partial dissolution-precipitation reaction rim in a vicinity of significantly altered monazite with clearly developed symplectite corona. 13 days, T = 600°C, P = 1 Kbar.

ACCESSORY MINERALOGY OF AN EVOLVED DICKINSON COUNTY, MICHIGAN PEGMATITE

Buchholz, T. W.¹, A. U. Falster², W. B. Simmons². ¹1140 12th Street North, Wisconsin Rapids, Wisconsin 54494; ²Department of Earth and Environmental Sciences, University of New Orleans, New Orleans, Louisiana 70148.

James et al. (1961) documented approximately 90 known pegmatite occurrences in Central Dickinson County in the Upper Peninsula of Michigan. A small beryl-rich pegmatite was investigated to describe its mineralogy and determine its degree of geochemical evolution. The pegmatite is emplaced in Lower Proterozoic metamorphic rocks of the Peavy Node, which were deformed and metamorphosed during the Penokean Orogen (Atoh and Klasner, 1989), approximately 1880-1830 Ma (Schultz and Cannon, 2007). No radiometric dates exist but it is probable that the pegmatite is late- to post-Penokean in age. Local control for pegmatite emplacement appears to be related to the Felch Trough (a prominent E/W syncline).

The unnamed pegmatite is located in the SW $\frac{1}{4}$ SE $\frac{1}{4}$ section 30, T42N, R29W (Robinson and

Carlson, 2013). The dike is well zoned with a massive quartz core. The inner intermediate zone adjacent to the core contains common yellow-green beryl crystals, fluorapatite, and highly fractionated Nb-Ta species. Small miaroles are present but scarce. Minerals identified to date include Mn-rich almandine, gahnite, schorl, columbite-(Fe), tantalite-(Fe) or tapiolite-(Fe), U-rich pyrochlore, microlite and U-rich microlite, sparse uraninite as inclusions in U-rich microlite, hafnian zircon (1.8 to 6.5 wt.% HfO₂), beryl, bertrandite, fluorapatite, rare HREE-rich xenotime-(Y), sparse monazite-(Ce), rare grayite, calcite, pyrite, a smectite-group mineral replacing beryl, and hematite. Electron microprobe analysis of very rare light tan, highly elongated, thin bladed crystals partially overgrown by columbite-(Fe) suggests they are probably fersmite. Bertrandite was found as both tiny blocky crystals in thin, late fractures, and clear bladed crystals in small vugs in the intermediate zones near the core margin. The Be was likely derived from altering beryl.

Nb-Ta minerals range from columbite-(Fe) with up to 62 wt. % Nb₂O₅, through compositions corresponding to tantalite-(Fe). Outer zones of crystals of columbite-group minerals consist of tapiolite-(Fe) with up to 78.5 wt. % Ta₂O₅. Pyrochlore-group phases such as U-rich pyrochlore (up to 13.1 wt. % UO₂), and microlite to U-rich microlite (up to 11.1 wt. % UO₂) overgrow crystals of columbite-group minerals.

In the central portion of the intermediate zone very rare small grains of HREE-rich xenotime-(Y), monazite-(Ce) and one sample of bastnäsite-group minerals have been found. Phosphorus levels also appear to have been low, since the only P minerals noted are the aforementioned REE phosphates and fluorapatite. The latter is restricted to the inner intermediate zones adjacent to the core, where it is associated with beryl while the former, found in loose material below the outcrop, appear to have crystallized in central portions of the intermediate zones together with muscovite and almandine.

Although granitic and pegmatitic dikes (James *et al.*, 1961) are common in the area, there are no known exposures of larger granitic intrusions from which pegmatites may have been derived. However, Attoh and Klasner (1989) found shallow negative gravity anomalies in the Peavy metamorphic node and interpreted them as products of partial melting during Penokean metamorphism, and further determined that pressure and temperature conditions during metamorphism of the Peavy Node would have been conducive to partial melting of granitic and pelitic rocks at shallow depths.

Literature Cited

- Attoh, K., Klasner, J.S. 1989: Tectonic implications of metamorphism and gravity field in the Penokean orogeny of northern Michigan. *Tectonics*, V. 8, no. 4, p. 911-933.
- James, H.L., L.D. Clark, C.A. Lamey, F.J. Pettijohn. 1961: *Geology of Central Dickinson County, Michigan*, USGS Professional Paper 310, Washington, DC. 176 pages.
- Robinson, G.W., Carlson, S.M. 2013: *Mineralogy of Michigan Update*, Houghton, MI: A. E. Seaman Mineral Museum, Michigan Technological University.
- Schultz, K.J., Cannon, W.F. 2007: The Penokean Orogeny in the Lake Superior region. *Precambrian Research*, V. 157, No. 1-4, p. 4-25.

A NEW COLLECTING SITE AT THE ROSE ROAD LOCALITY, PITCAIRN, ST. LAWRENCE CO., NY.

S. C. Chamberlain¹, M. R. Walter², D. G. Bailey³, J. Chiarenzelli⁴, G. W. Robinson⁵. ¹Center for Mineralogy, 3140 CEC, New York State Museum, Albany, NY 12230; ²P.O. Box 137, 2982 State Rt. 11B, Nicholville, NY 12965; ³Geosciences Department, 198 College Hill Road, Hamilton College, Clinton, NY 13323; ⁴Brown Hall 145, St. Lawrence University, 23 Romoda Drive, Canton, NY 13617; ⁵9654 Highway 37, Ogdensburg, NY 13669.

In the spring of 2012, we discovered a new site of mineralization approximately 100 meters NE of the classic wollastonite/diopside locality off Rose Road, near Pitcairn, NY. The new locality is a small hill at (44°12' 05"N, 75°14' 03"W) just to the east of the access road and is informally referred to as the "purple diopside mound" (PDM). The mineral associations here are quite different from those at the nearby wollastonite skarn, and include the following minerals which were identified using a combination of sight identification, SEM/EDS, and X-ray diffraction.

Albite occurs as white crystals to 1 cm and as white masses in purple diopside.

Corundum occurs as deep purplish pink, anhedral masses (ruby) to 5 mm in massive meionite.

Diopside occurs as purple prisms to several centimeters and as fine-grained masses. It contains about 1 wt % FeO and 1 wt % TiO₂, which may account for its unusual color. The green diopside at the nearby wollastonite skarn contains 2.5 wt % FeO, the yellow needles that make up part of the altered wollastonite crystals contain about 5 wt % FeO, and the actinolite overgrowths on the green diopside contain more than 7.5 wt % FeO. None of these minerals, however, contains any titanium detectable by SEM/EDS.

Fluorapatite occurs as bright blue-green transparent prisms to 8 cm.

"Gieseckite" occurs as sharp euhedral pseudomorphs to several centimeters with graphite.

These have a complex internal replacement texture and variable composition. Some appear to be granular labradorite. The original mineral has not been identified.

Graphite occurs as hexagonal crystals and rosettes to several millimeters.

Marialite occurs as white outer zones on gray meionite crystals.

Meionite occurs as sharp prismatic crystals to 20 cm with transparent gray centers and sporadic white rims. The composition is estimated from SEM/EDS to be about Me₇₀Ma₃₀. Massive, yellow-gray meionite that fluoresces bright yellow in longwave UV light occurs in pegmatitic intergrowths with purple diopside and calcite.

Natrolite occurs as white, radial crystal aggregates to 0.5 cm by 5 cm and as masses of acicular crystals, probably formed by the decomposition (weathering) of scapolite.

Phlogopite occurs as honey brown transparent crystals, sometimes in masses of 20 cm or more and as pseudomorphs after meionite to 3 cm.

Prehnite occurs as brown, rounded, radial groups of crystals to 4 cm on a matrix of calcite, graphite, and pyrite. Like natrolite, prehnite probably formed by weathering of scapolite.

Pyrite occurs as modified cubes to 5 mm, as minute crystals, often altered to goethite, in "gieseckite", prehnite, and meionite, and as oriented parallel arrays of capillary crystals in meionite.

Spinel occurs as pink octahedral crystals to 1 mm with calcite and phlogopite.

Titanite occurs as tabular dark brown, almost black crystals to 5 cm and as minute crystals of complex morphology in albite.

Zircon occurs as minute, euhedral crystal inclusions in meionite.

The geology and origin of this unusual deposit is currently under investigation. The zircon age of the locality is 1170 Ma.



Left: Geiseckite and diopside, 2.5 cm with crystals to 1.5 cm. Michael Walter collection #00189. Right: Meionite, 16.5 cm with crystals to 11 cm. Michael Walter collection # 00177.

A NEW FIND OF COMPLEX Na-Zr SILICATES IN THE STETTIN COMPLEX, MARATHON CO., WISCONSIN.

A. U. Falster¹, Buchholz, T. W.², W. B. Simmons¹, J. D. Guidry¹, and C. M. Johnson¹. ¹Department of Earth and Environmental Sciences, University of New Orleans, New Orleans, Louisiana 70148; ²1140 12th Street North, Wisconsin Rapids, Wisconsin 54494.

The Stettin complex (SC) is a 1565 Ma (± 3.5) (Van Wyck, 1994) alkalic complex which is part of the Wausau complex exposed in Marathon Co., Wisconsin. The complex measures approximately 6 by 8 km and is concentrically zoned. The eastern and southern margin consists of a complex series of altered volcanic rocks and pendants and several enclave-rich syenites, including nepheline syenite (Myers et al., 1984). The outer zone of the SC is made up of a discontinuous ring of nepheline syenite and syenite characterized by tabular K-feldspar toward the interior (Myers et al., 1984). The intermediate zone consists of amphibole and pyroxene syenites. The core of the complex consists of pyroxene syenite and measures about 1.5 km across. The core is surrounded by a second ring of nepheline syenite (Myers et al., 1984). Most of the nepheline syenites of these two rings exhibit a miaskitic chemistry, zircon and titanite are the typical high field strength element-bearing minerals.

In a few areas in the outer ring of the nepheline syenite, a definite agpaitic mineral assemblage occurs consisting of the eudialyte-group species, catapleiite and baddeleyite. The eudialyte group minerals occur in raspberry-red masses up to 1 cm in the nepheline syenite and are confirmed by EMPA to be Mn-rich kentbrooksites. The eudialyte group minerals are associated with pale brown catapleiite and along altered zones of the eudialyte group minerals, baddeleyite has been identified and confirmed by EMPA. Baddeleyite occurs as a late replacement mineral that replaced kentbrooksites along fractures and along some parts of the rim of the masses. No zircon was found in these nepheline syenites. Several other species occurring intergrown or in close proximity to the masses of kentbrooksites and catapleiite still await more analytical efforts. It is remarkable that kentbrooksites occur in the SC and not eudialyte.

Literature Cited:

Myers, P. E., Sood, M. L., Berlin, L. A., Falster, A. U. (1984): The Wausau Syenite Complex. *Institute on Lake Superior Geology, 30th Annual Meeting, Field Trip # 3.* 58p.

Van Wyck, N. (1994) The Wolf River A-type magmatic event in Wisconsin: U/Pb and Sm/Nd constraints on

timing and petrogenesis. *Institute on Lake Superior Geology, 40th Annual Meeting, Part 1, Program and Abstracts*, p. 81-82.

AN APPARATUS FOR MOUNTING SUB-MILLIMETER SIZE MINERAL SPECIMENS (MICROMOUNTS).

E. Grundel, 2000 S. 2nd Street, Apt. #8, Arlington, VA 22204.

A homemade apparatus has been constructed that allows one to make micromounts of mineral specimens that are as small as 0.050 mm. Such tiny specimens are difficult to mount using conventional techniques and thus are not often seen in collections.

The critical components of the apparatus are a miniature vacuum pump, pipette tips, very fine fused silica capillaries, and a foot-operated on/off switch. The smallest capillaries are 0.10 (OD) x 0.050 (ID) mm; thus setting a lower limit on specimen size.

Specimens in the sub-millimeter size range are 1-2 orders of magnitude smaller than normal micromount specimens. Using this apparatus, these notes require new techniques at every step in the preparation of the micromount. Especially challenging in the initial phase of use is developing good motor skills: i.e. brain, eye, hand, and foot coordination. Single crystals and tufts of fibrous crystals are among the more difficult specimens that have been mounted.

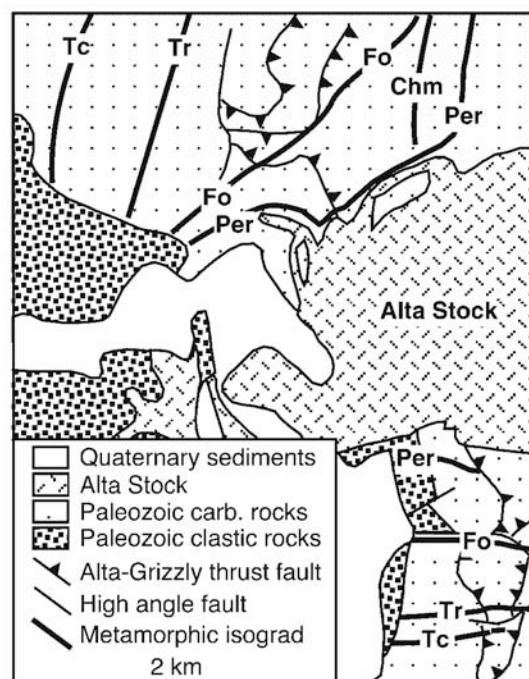
If adopted, this tool will enable mineral collectors to preserve specimens that, until now, have not been saved.

CONTACT METAMORPHIC MINERALS FROM THE ALTA AUREOLE, CENTRAL WASATCH MOUNTAINS, UTAH.

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 Alta Stock is one of a several early- to mid-Tertiary intrusive rocks in the central Wasatch Mountains, Utah. The Alta Granodiorite is, in part, intrusive into a series of Precambrian to Lower Paleozoic carbonate rocks. Pre-intrusive thrusting in these units placed the Cambrian Maxfield Formation above Upper Mississippian Deseret-Guardison formations. Emplacement and cooling of the Alta stock metamorphosed these carbonate rocks and formed a contact aureole that extends to approximately 2 km beyond intrusive contact (Cook and Bowman, 2000). The parent dolomitic carbonates are iron-poor, thus all of the index minerals have near end-member compositions and are white in color.

Four distinct mineral zones are present and, from the unaltered carbonate rocks toward the contact with the Alta Stock, include the talc, tremolite, forsterite and periclase zones. These zones represent



increased heating and progressive metamorphism toward the igneous contact. Additionally, a clinohumite zone is present between the forsterite and periclase zones along the northern margin of the stock, but was not included in this study. Dolomite and calcite are present in all zones. Samples from each zone were evaluated using a Scanning Electron Microscope to determine the minerals present and habit of each.

Talc Zone: This zone, the most distal metamorphic zone relative to the stock, experienced only low grade metamorphism. Talc $[(Mg_3(Si_4O_{10})(OH)_2)]$ and calcite formed by reaction of dolomite and quartz (chert nodules < 1 cm). Massive calcite and talc, both as crystals and microscopic masses, occur as overgrowths on chert nodules, thus represent a reaction boundary between unmetamorphosed dolomite and quartz.

Tremolite Zone: Closer to the stock, higher grade metamorphism is marked by the first appearance of tremolite $[Ca_2Mg_5(Si_8O_{22})(OH)_2]$. Chert nodules are notably absent from this zone as they have been replaced by intergrowths of tremolite and calcite. Tremolite occurs as acicular crystals that are in contact with tiny (< 30 micron) intergrowths of tabular to prismatic phlogopite crystals. Also, highly distorted, < 1 mm, pyrite crystals are associated with phlogopite.

Forsterite Zone: Forsterite $[Mg_2SiO_4]$ occurs as euhedral tabular crystals, generally < 1 cm in maximum dimension and are often enclosed in calcite. Accessory spinel $[MgAl_2O_4]$ is present as octahedrons less than 50 microns in size, with rare crystals reaching 100 microns. Minor phlogopite occurs as micron sized crystal clusters. In general, tremolite does not continue into this zone (Cook and Bowman, 2000) although a single occurrence of coexisting forsterite and tremolite was found.

Periclase Zone: This discontinuous zone, where present, is adjacent to the igneous contact and represents the highest grade of metamorphism present. Although the index mineral for this zone is periclase $[MgO]$, pervasive down-temperature fluid flow resulted in retrograde metamorphism that replaced periclase with pseudomorphs of brucite $[Mg(OH)_2]$ (Cook and Bowman, 2000). In samples analyzed, brucite was rare and occurred as lamellar and fibrous masses. Forsterite persists into this zone and was identified from several samples. Spinel was reported from this zone (Cook and Bowman, 2000) but was not found in this study. Fibrous masses of black ludwigite $[Mg_2Fe^{3+}(BO_3)_2]$ also occur in this zone, generally in thin bedding controlled layers and as disseminated grains in layers with abundant brucite.

Although the contact mineral assemblage lacks showy specimens, the near absence of iron as a chromophore has resulted in an unusual completely white mineral assemblage. Additionally, the presence of exolved magmatic fluids containing boron led to the formation of ludwigite near the intrusive contact, an uncommon mineral in contact metamorphic assemblages.

Literature Cited

COOK, S.J. & BOWMAN, J.R. (2000): Mineralogical Evidence for Fluid-Rock Interaction Accompanying Prograde Contact Metamorphism of Siliceous Dolomites: Alta Stock Aureole, Utah, USA. *J. Petrol.* **41**:739-757.

STEEDEITE, A NEW MINERAL FROM MONT SAINT-HILAIRE, QC.

M.M. Haring and A.M. McDonald, Department of Earth Sciences, Laurentian University, 935 Ramsey Lake Road, Sudbury, ON, P3E 2C6.

Steedeite, ideally $NaMn_2Si_3BO_9(OH)_2$, is a new borosilicate from Mont Saint-Hilaire, Québec, Canada, one of the world's most prolific localities for new minerals. The mineral was first discovered in the late 1980's by Col. Quintin Wight and is named for Mr. Anthony Hosford Steede in recognition of his contributions to understanding the mineralogy of Mont Saint-Hilaire. The mineral occurs in

vugs within sodalite syenite in slightly radiating bundles of acicular crystals (Avg. dimensions: 0.006 x 0.011 x 0.51 mm) (Figure 1). Minerals associated with steedeite include microcline, analcime, nepheline, aegirine, pyrrhotite, sodalite, eudialyte-group mineral, sérandite, thermonatrite, catapleiite, UK78, and UK80.

Steedeite crystallizes in the P-1(#2) with a 6.837(1), b 7.575(2), c 8.841(2) Å, α 99.91(3), β 102.19(3), γ 102.78(3)°, V 424.81(1) Å³, and $Z = 4$. The crystal structure of steedeite (formerly UK 79) was solved and refined to $R = 1.69\%$ for 2409 reflections ($F_o > 4\sigma F_o$). It contains one unique Na and B site, two Mn sites, and three Si sites. Each SiO_4 tetrahedron is linked to two adjacent SiO_4 tetrahedra through shared corners to form single silicate chains with a periodicity of three, or dreier chains. The chains are linked through shared corners to $BO_2(OH)_2$ tetrahedra, resulting in a loop-branched dreier chain (Liebau, 1978). These contain four-membered $BSi_3O_9(OH)_2$ rings. The loop-branched dreier chains are linked through shared corners to bands of edge sharing $MnO_5(OH)$ octahedra. The loop-branched silicate chains and $MnO_5(OH)$ bands form distinct tetrahedral (T) and octahedral (O) layers, respectively, resulting in a $T-O-T-O...$ stacking perpendicular $\{011\}$ (Figure 2). Linkages between borosilicate chains and bands of $MnO_5(OH)$ octahedra generate a series of channels along $\{010\}$ that contain Na.

The crystal structure of steedeite has similarities to those of UK78 ($NaMn_2Si_3BO_9(OH)_2 \cdot 2H_2O$), pectolite ($NaCa_2[Si_3O_8OH]$)–sérandite ($NaMn_2[Si_3O_8OH]$) series pyroxenoids, and scheuchzerite ($Na(Mn,Mg)_9[VSi_9O_{28}(OH)](OH)_3$). All four minerals are single chain silicates with a $T-O-T-O...$ stacking similar to steedeite. Of these minerals, steedeite and UK78 are the most similar as both minerals have identical borosilicate chains. In addition, steedeite and UK78 have similar chemical compositions however, UK78 contains additional H_2O groups. Pyroxenoids of the pectolite–sérandite series contain dreier silicate chains similar to steedeite however, these chains are unbranched. The silicate chains in scheuchzerite are more complex compared to those in steedeite, as they have a periodicity of seven and contain six-membered silicate rings.

Paragenetically, steedeite along with sérandite, UK78, UK80, and thermonatrite are late-stage phases which overgrow earlier-formed phases such as microcline, aegirine and analcime. The sequence of formation for steedeite, sérandite, UK78, and UK80 is unclear as none of these phases has been found together in the same vug. The hydrous structure of steedeite and its occurrence in vugs suggests that it precipitated from late-stage aqueous fluids. These fluids are inferred to have been highly alkaline (pH ~ 8 to 10) due to the presence of late-stage thermonatrite. Based on fluid-inclusion data as well as carbonate-carbonate and carbonate-silicate equilibria, the temperatures of late-stage fluids at Mont Saint-Hilaire are inferred to have been < 400 °C.

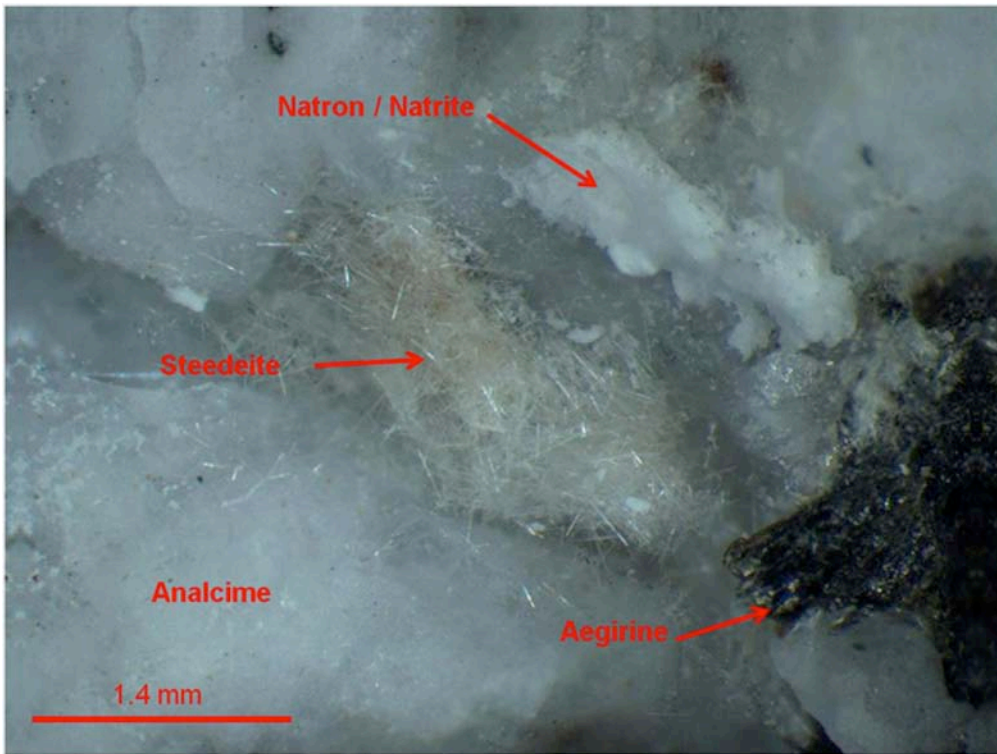
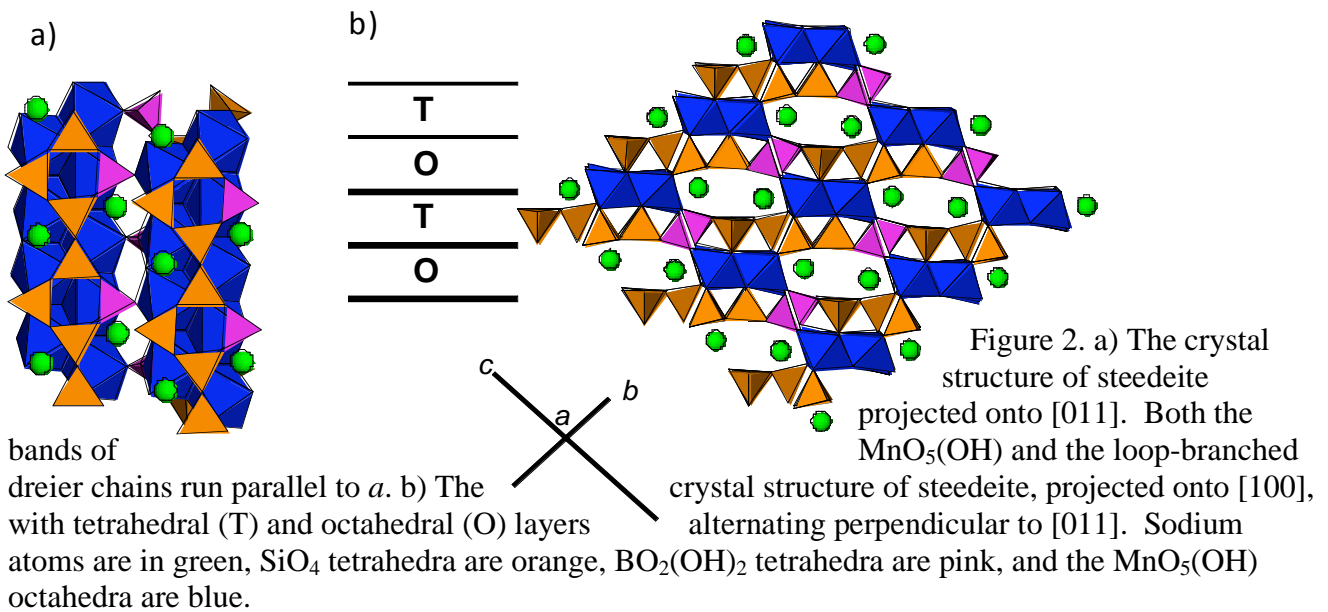


Figure 1. Loose aggregates of steedeite with natron, aegirine, and analcime (FOV: 1.0 mm).



USING SINGLE CRYSTAL X-RAY DIFFRACTION STRUCTURE REFINEMENT AS A MEANS TO DETERMINE APATITE HALOGEN CHEMISTRY.

J. T. Merrill¹, S. R. Kelly¹, J. Rakovan¹, D. Harlov², K.M. Heffernan³, and J.M. Hughes³. ¹Department of Geology and Environmental Earth Science, Miami University, 250 S. Patterson Avenue, Oxford, OH 45056; ²Chemistry and Physics of Earth Materials, Deutsches GeoForschungsZentrum, Potsdam, D-14473, Germany; ³Department of Geology, University of Vermont, Delehanty Hall, 180 Colchester Ave, Burlington, VT 05405.

Apatite forms many solid solutions. Some of the most important are among F, Cl and OH. Most geologic apatites are fluorine dominant (i.e. fluorapatite) while biological apatites, such as those in the bones and teeth of vertebrates, are thought to be OH dominant (i.e. hydroxylapatite). The solid solution among these constituents has recently gained increased attention due to the newly discovered uncertainty of the OH component in bone and the role of apatite in determining the water budget of the moon and Mars. Single crystal x-ray diffraction (XRD) is the most common method to determine the structure of minerals, and evaluation of chemical composition is usually done by other methods such as X-ray fluorescence. The evaluation of OH in apatite, however, cannot be done by standard X-ray fluorescence methods. However, because F, Cl and OH have different radii, they occupy slightly different positions in the structure and thus can be quantified using crystal structure refinements. The structure of twelve synthetic apatite samples with compositions along two solid solution joins, fluorapatite-hydroxylapatite and chlorapatite-hydroxylapatite, were determined from single crystal XRD data with special attention being paid to development of accurate halogen site occupancies. This is a distinctly different methodology than is used in comparison of powder XRD peak positions of an unknown sample to a set of standards with known chemistry.

The structures were refined to R_I values between 0.013 and 0.017. Once the refinement was complete the ratio of OH/(OH+F) or OH/(OH+Cl) was calculated, using the percentages of OH and F or Cl refined for each sample, and compared to that of the starting materials. The correlation of starting chemistry and resulting apatite composition was much closer in the F-OH series with a linear regression coefficient of $R^2=0.65$, while that for the Cl-OH series is $R^2=0.35$. The only structural sites that appeared along the anion column of all the F-OH samples were an F site at 0 0 .25 and an OH site at 0 0 .19. However, the sites in the Cl-OH samples were a bit more complex with the possibility of three different Cl sites. One at 0 0 0 and two that appear between 0 0 .058 and 0 0 .146. There were consistently two of the three possible Cl sites occupied but there was one sample in which all three Cl sites were occupied. Also in several of the Cl-OH samples splitting of the O3 site was observed. The end-goal of determining the halogen chemistry and structure of these samples is so that the complete series of compositions, mentioned above, can be used in pending thermodynamic studies using calorimetry.

PARAGENESIS OF MARGAROSANITE AT THE PARKER SHAFT, FRANKLIN, NEW JERSEY, USA – A REVIEW.

V. King¹ and Peter Chin². ¹P.O. Box 990888, Rochester, NY 14609; ²1031 Kuekue St, Honolulu, HI 96825.

Margarosanite, $Pb(Ca,Mn^{2+})_2(Si_3O_9)$, was discovered from the Parker Shaft in 1898 and named in 1916. The mineral's apparent scarcity is related to its deposition at moderately-high temperatures. Ito (1968) synthesized margarosanite at 350°C as well as other Pb-silicates, larsenite (550-900°C) and esperite (550-675°C). Hardystonite may be stable at 550 to 1000°C or more, but in Pb-rich fluids, it is not the only phase to crystallize below 800°C. Dunn (1985) suggested there were two lead silicate

assemblages. We studied the margarosanite-bearing assemblages, but there is obvious overlap. In the presence of Pb-rich fluids, larsenite and/or esperite may be stable without hardystonite. The implied paragenesis of interest is hardystonite □ larsenite □ esperite □ margarosanite. The association with additional Pb and Pb/Zn silicates (barysilite, clinohedrite, hancockite, nasonite, roebblingite) may be localized in development/replacement. For the purposes of this discussion, the mixture, caswellite (vesuvianite + grossular), and the varieties, cyprine and hancockite, provide useful names relating to the observed assemblages. Co-occurring minerals include: andradite, axinite-Mn, baryte, bustamite, caswellite (grossular + vesuvianite), franklinite, grossular, hodgkinsonite, native lead, feldspars (microcline – hyalophane - celsian), minehillite, pectolite, prehnite, vesuvianite (and cyprine), willemite, xonotlite, wollastonite, etc.)

Overlap in crystallization is the rule and the ranges we assign are based on observation. The origin of lead in the system will not be considered, except to say that numerous analyses of feldspars in the association do not contain appreciable lead, while hardystonite universally contains some lead Pb (up to 2% Pb) as mentioned by Palache (1935, p.95).

The early minerals (hardystonite, feldspars, wollastonite, andradite, franklinite, and rarely bustamite) formed at relatively high temperatures (Ito, 1968). Garnets are well-known to be stable across a wide temperature range if X_{H_2O} increases with falling T. The later minerals to form may have crystallized directly from a fluid or were replacements of the early minerals. During the medium temperature sequence, vugs were formed where some of the species crystallized directly rather than replacing an earlier mineral. Toward lower temperatures, hydrated species were stable and were part of the end alteration of the primary minerals, often as fine-grained masses, although vug formation occurred at low temperatures. Several species such as nasonite, ganomalite, and barite have been rarely observed in this assemblage and their placement is relatively less certain. The observed late formation of larsenite in hodgkinsonite vugs suggests that the stability field for larsenite is greater than implied by Ito (1968).

Observations of margarosanite specimens using ultraviolet light provides an efficient method of determining species, textures, and sequences. Paragenesis is influenced by a number of factors, not just temperature and pressure. Other important factors include Eh, X_{H_2O} , pH, f_o , etc., but the only purpose of this study was to review the observed parageneses of minerals associated with margarosanite. Interestingly, NIAST (2005) found that native Pb was stable over the entire range of natural pH, but only at low Eh.

Literature Cited

- Dunn, P. (1985) *The lead silicates from Franklin, New Jersey: Occurrence and composition*, Min. Mag. v 49, P. 721-727.
- Ito, J. (1968) *Synthesis of Some Lead Calcium Zinc Silicates*, Am. Min., 53:231-240.
- NAIAST (2005) Atlas of Eh-pH Diagrams, Geol. Surv, Jap. OF 419.
- Palache, C. (1935) *The Minerals of Franklin and Sterling Hill, Sussex County, New Jersey*, USGS PP180, pp. 135.

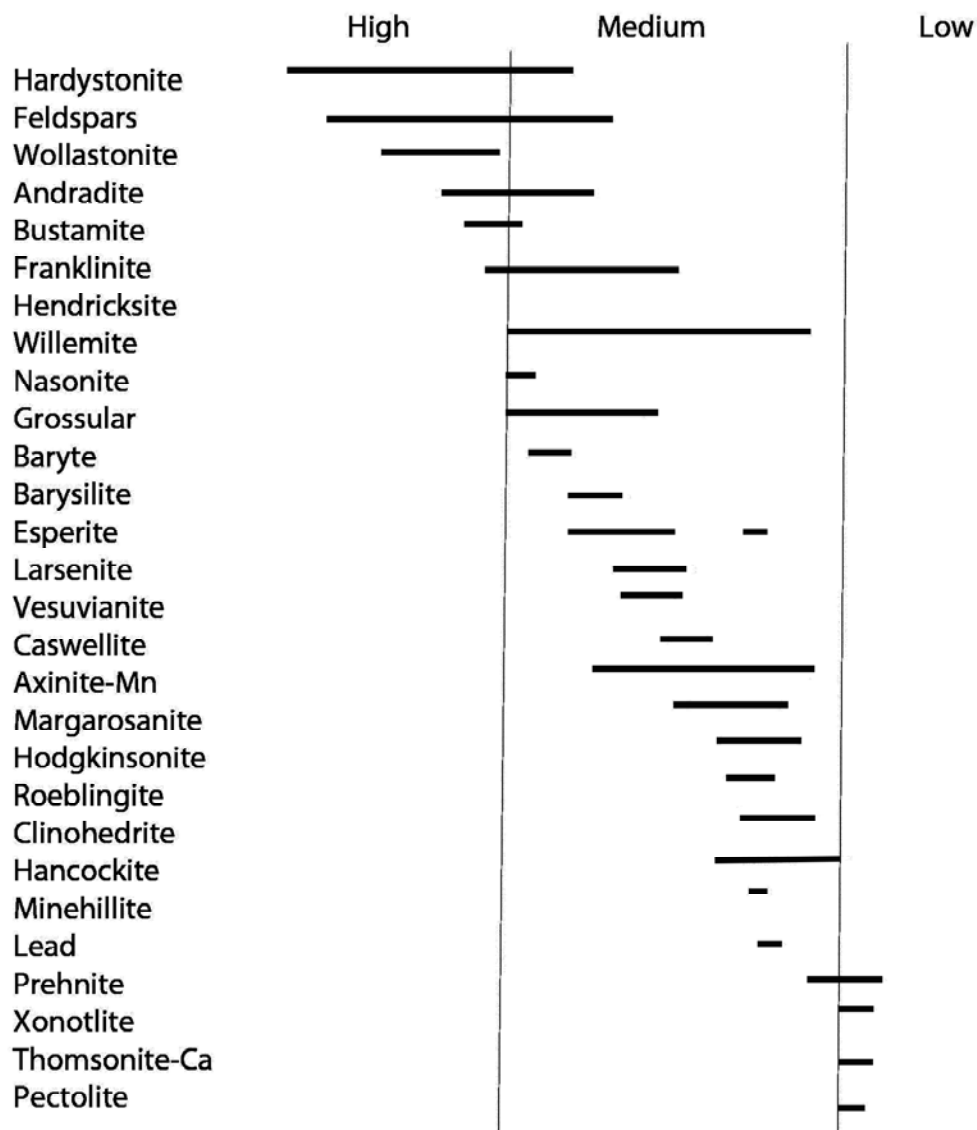


Figure 1. Paragenesis diagram

BASE METAL OCCURRENCES IN THE TACONIC MOUNTAINS OF NEW YORK.

M. Lupulescu¹, M. Hawkins¹, and D. G. Bailey². ¹New York State Museum, Research and Collections, 3140 CEC, Albany, NY 12230; ²Geosciences Department, 198 College Hill Road, Hamilton College, Clinton, NY 13323.

Base metal occurrences of lead-zinc and copper-lead-zinc form narrow veins and impregnations in the Ordovician dolostones and calc-schists at numerous locations in the central part of the Taconic region of New York. We studied samples from the more important locations at White Creek (Washington County), Flatbrook and Ancramdale (Columbia County), Shekomeko (Judge Bockee and Old Bryan Farm prospects), and Millerton in Dutchess County.

Our main goals were to determine the origin of these occurrences and their geological features within the range of the Appalachian base metal deposits. In order to accomplish these goals the authors performed field, mineralogical (transmitted and reflected light microscopy) and geochemical (trace element composition of the individual sulfides, sulfur and lead isotope composition) investigations on the occurrences mentioned above using historical samples from the New York State

Museum's Geology Collection for White Creek, Ancramdale (Emmons Collection), Flatbrook (Whitlock Collection) and new samples that were collected at Millerton and Shekomeko.

The mineralogical study revealed the following mineral species: galena, sphalerite, pyrite, tetrahedrite-tennantite, chalcopyrite, acanthite and native gold with smithsonite, hemimorphite, aurichalcite, malachite, azurite, and anglesite as secondary minerals usually exhibiting replacement textures.

Trace element composition of the sulfides showed high silver content, 257 to 766 parts per million (ppm), in tetrahedrite-tennantite. Sphalerite contains 4345 to 5452 ppm cadmium and 105 ppm indium. Pyrite contains 1844 ppm nickel, 311 ppm cobalt, and 122 ppm arsenic. Selenium displayed low and homogeneous content for all the analyzed sulfides (2 to 19 ppm). The lead composition of galena was less radiogenic ($^{206}\text{Pb}/^{204}\text{Pb}$ is 18.566-18.944) than in the Mississippi Valley type ores (J-type lead). The homogeneous lead isotopic character, the similarity between lead isotopic composition of these ores and Shawangunk Mountains base metal ores, led us to consider either a single source for the lead or fluids from multiple sources that were mixed before galena precipitated. We might consider a possible common origin for the galenas hosted by the two units. A similarity with the other Appalachian ores is also indicated. The sulfur isotopes displayed a narrow range for the individual mineral species ($\delta^{34}\text{S}$ is between 3.3 and -4.1). These values were close to those of the pyrite from the base of the Shawangunk Formation overlying the Taconic unconformity, but very different from the sulfur composition of the Shawangunk sulfides, implying a different origin. A progressive decrease of the $\delta^{34}\text{S}$ for the sequence pyrite-sphalerite-galena is possibly related to the normal trend during the equilibrium fractionation. The low $\delta^{34}\text{S}$ could represent the result of the bacterial reduction of sulfur derived from an underlying unit.

REICHENSTEIN-GRIESERTAL QUARTZ TWINS FROM KING COUNTY, WA: TWO DISTINCT MORPHOLOGIES – TWO DIFFERENT LAWS.

Bob Morgan, 2711 Mechanics Avenue, Savannah, GA, 31404

A number of specimens of Reichenstein-Griesertal (R-G) law twins have been found in four sites in King County, Washington. They are much more numerous than has been reported from any other place. For the first time there are enough to establish morphological features related to their growth as twins.

Noteworthy is their occurrence alongside Japan law twins. In every instance Japan law twins are either in the same pocket or in a nearby pocket. This is consistent with R-G twins from other localities.

Goldschmidt (1905) initiated the use of the hyphenated name. A Reichenstein specimen had a twin angle of $76^{\circ}34'$ and a Griesertal specimen had the complementary angle of $103^{\circ}26'$. He even suggested they might be considered representatives of two different laws. King County finds include specimens of both.

Most common are the twins with the $76^{\circ}34'$ angled twin notch. Over 40 have been found from at least four different places in King County. At Devil's Canyon they do not grow noticeably larger than surrounding single crystals. At Green Ridge they do stand out, similar to the way most Japan law twins stand out as larger than surrounding single crystals.

All exhibit some exaggerated growth in the twin notch. The two opposing prism faces in the center of the notch have grown thinner due to more rapid layer stacking, and the prism faces on either side are wider as a result. In a couple of specimens where handedness is indicated on both crystals, they are aligned with opposite handedness. This makes them mirror twins. A couple also show Dauphiné twinning as well.

Following Goldschmidt they are Reichenstein law twins, along with others that have been reported over the years from other localities.

There are at least seven from King County that have the main notch angle of $103^{\circ}26'$. So far these are unique. None others have been reported from other localities, except Goldschmidt's. Unlike the one Goldschmidt reported on from Griesertal, Switzerland, which had a smaller crystal nested on the pyramidal face of a larger crystal, these are relatively symmetrical 'v' twins.

Morphologically these seven are quite different from the Reichenstein twins. Instead of exaggerated growth in the notch where opposing prism faces meet, the exaggerated growth is outward to both sides of the notch. Stimulated growth is on the two sets of prism faces that meet on either side of the inner notch. These faces are noticeably thinner – having grown smaller through more rapid layer stacking. Instead of thinner inner notch prism faces like those found on Reichenstein twins the Griesertal's adjoining prism faces in the inner notch are disproportionately wide.

Although these two morphologically distinct patterns share complementary twin angles and perhaps share an original composition plane, this is not enough to combine them under the same twin law. Now that enough of the Griesertal twins with such differing growth patterns have been found, it is clear that two discernably different laws of quartz twinning can be identified.

What causes the more rapid development of growth layers on both types remains unexplored. Perhaps there is discouragement of growth layer development where the prism faces meet in the inner notch of the Griesertal law twins, similar to abnormally slower growth in the complementary wider notch on the back side of Japan law twins.

Sites in King County should produce even more specimens. Perhaps conditions of their origin and the dynamics of their growth will be studied and become better understood.

Literature Cited

Goldschmidt, V. (1905) Quarzzwilling nach $r=10$, Über die Zwillingsgesetze des Quarz. *Tscher. Min. Mitt.* 24: 157-179.



Reichenstein law twin from Green Ridge Claim, King County, WA. Rick Dillhoff collection. Photo by Jeff Scovil.



Grieserntal law twin, Mt Tenneriff, King County, WA. Collection of John Lindell. Photo by author.

RE-INVESTIGATION OF THE YEDLIN LOCALITY, TOPSHAM, SAGADAHOC COUNTY, MAINE, USA.

J. Nemetz¹ and V. King². ¹104 Ashley Drive, Brighton, New York 14620; ²P.O. Box 90888, Rochester, NY 14609.

The Yedlin Locality was described by Neal Yedlin, then of Richmond, Maine in 1942. Lane (1937) analyzed a “samarskite” from the locality. The “samarskite” was re-identified as ishikawaite, $U^{4+}Fe^{2+}Nb_2)_8$, by Hanson et al. (1995, 1999). Additional species were reported in King and Foord (1994, 2000): albite variety oligoclase, allanite-(Ce), almandine, annite, autunite, beryl, biotite, fergusonite-(Y), hematite, ishikawaite, magnetite, meta-autunite, microcline, monazite-(Ce), muscovite, nontronite, opal-AN, quartz, xenotime-(Y).

As part of the on-going interest in the Minerals Critical Areas Program (King, 1993), Standpipe Hill was re-investigated by the authors to determine the current status of various mineral localities.

The Yedlin Locality was initially located using dead reckoning and its position was measured by GPS, giving coordinates: 43° 55' 18" N, 69° 58' 44" W. The Yedlin locality is now in an area slated for housing construction unlike mineral localities such as the Standpipe Hill Quarry, which is located on town land near the water tower and unlikely to be changed in status. The Yedlin Locality, which has some international status for being an important ishkawaite locality, is likely to be obliterated during 2014 or 2015. The dark brown ishkawaite crystals are bladed to rod-like with pseudo-orthorhombic appearance. The surface may have a thin red brown film. The typical association is a crystal embedded in reddish brown microcline, which Yedlin (1942) noted was softer than normal immediately next to the ishkawaite (then thought to be samarskite). Ishkawaite may also be found in pinkish-red chalky oligoclase. Black to bronzy annite is frequently in contact with the ishkawaite. Associated minerals may include brownish red monazite-(Ce) crystals, which are occasionally fish-tail twinned. Rare associations include prismatic symmetrical very dark brown xenotime-(Y) crystals to 4x2x2 mm, anhedral masses of black niobian ilmenite and, rarely, orange red to dark red resinous grains to several mm of fergusonite-(Y).

The main discovery was that the Yedlin Locality really consists of three pits instead of one. All are located within 10 meters of one another, although the water-filled pit is most conspicuous. Digging in the shallow pits and dumps revealed that ishkawaite is present, thus the reputation that the locality is completely "picked over" is unfounded. Collectors are encouraged to visit the locality before it is gone.

Literature Cited

- Hanson, S. L., Simmons, W. B., and Falster, A. U. (1995) Ishkawaite, Polycrase, or "Samarskite" in Maine Pegmatites?, *Roch. Min. Symp., Prog. and Abs.*, v. 22, p. 14-15.
- Hanson, S. L., Simmons, W. B., Falster, A. U., Foord E. E., Litche F. E. (1999) Proposed Nomenclature for Samarskite Group Minerals: New Data on Ishkawaite and Calciosamarskite. *Mineralogical Magazine* **63**:27-36.
- King, V. T. (1993) Critical [Mineral] Areas Program. Preliminary Report to Eastern Federation of Mineralogical and Lapidary Societies, Rochester Academy of Science, Rochester, NY, pp. 42.
- Lane, A. C. (1937) Exhibit 7; Work at Harvard University, in Lane, A. C. and Marble, J. P., *Report of the Committee on the Measurement of Geologic Time*, Nat. Res. Council, Wash., DC, p. 59-61.
- Yedlin, Leo Neal (1942) Standpipe Hill, Topsham, Maine. *Rocks & Minerals* **17**:206-208.

FLUORAPATITE AND OTHER SPECIES FROM THE WAISANEN QUARRY, GREENWOOD, OXFORD COUNTY, MAINE.

J. Nizamoff¹, C.A. Francis², F.C. Perham³, and R.A. Sprague⁴. ¹Omya, Inc. 62 Main Street, Proctor, VT 05765; ²Maine Mineral & Gem Museum, Box 500, Bethel, ME 04217; ³1 Dunham Road, West Paris, ME 04289; ⁴10 Yates Street, Mechanic Falls, ME 04256

The Waisanen quarry is a significant Maine pegmatite locality, but its geology and mineralogy have not been studied in great detail. The Waisanen quarry was originally worked for feldspar by Cesare Trusiani from 1931-1935. Although a large pocket with pale purple fluorapatite was opened in 1935, the quarry lay idle and was little known to the mineral collecting community until 1963 when it was worked for feldspar and mineral specimens by Frank Perham (Perham 1964, Perham 1987). In 1963, Perham found a large pocket that contained lustrous smoky quartz scepters and mosaic overgrowths on gray to milky cores to 25 cm. Many of the quartz crystals within the pocket were coated on one side with twinned hydroxylherderite crystals to 4 cm whereas the reverse side exhibited

bertrandite crystals to 1 cm. Two other small pockets containing gemmy well-formed crystals of green elbaite were found nearby. Shortly after these finds mining ceased and the quarry lay dormant.

The Waisanen was reopened by Frank Perham and Barry Heath in 2009. The present work has produced fine smoky quartz crystals, etched pocket beryl (green, blue and pink), hydroxylherderite and a handful of fluorapatite specimens. In 2012 construction of an access road exposed a portion of the dump from the 1931-1935 (Trusiani) era. Collectors soon noticed that one horizon of the dump was rich in material that evidently came from a pocket. A large number of specimens were recovered (>1000) from the dump including hundreds of pale purple fluorapatite specimens. The fluorapatite crystals are typically tabular, pale purple with thin white overgrowths and can be up to 2.5 cm in size. The fluorapatite occurs with a dense druse of mm-sized quartz prisms and rare brown 1-2 mm oxidized pyrite cubes on etched cream-colored microcline and occasional muscovite books. Much of the microcline exhibits evidence of re-crystallization and in some cases late-stage albite appears as an overgrowth. Interestingly, no large quartz crystals were recovered from the dump workings. The observed mineral assemblage allowed us to make several inferences: 1) the majority of the specimens recovered likely came from the same pocket, 2) the pocket probably did not contain a large amount of open space, 3) the pocket likely resulted from the in-situ replacement of primary microcline. The large number of specimens recovered also allows us to surmise that the pocket must have been fairly substantial in terms of volume, perhaps in the range of two to three cubic meters. The vast majority of the fluorapatite specimens from the recent collecting activities appear nearly identical to those on a vintage specimen from the 1935 find that was part of the collection long displayed in Perham's Maine Mineral Store. The Maine Mineral & Gem Museum recently acquired this specimen as well as two other specimens similar in character that were labelled only 'Greenwood'. The 1935 find is hardly mentioned in the literature and as a result these fine fluorapatite specimens may have been misattributed to the nearby Harvard quarry. In addition to providing an opportunity to examine the pocket mineralogy of a historic fluorapatite find, the recent activity at the Waisanen quarry has allowed us to "set the record straight" regarding the provenance of several significant mineral specimens.

Literature Cited

Perham, F.C. 1964 Waisanen mine operations – Summer 1963. *Rocks & Minerals* **39**:341-347.

Perham, J.C. 1987 *Maine's Treasure Chest: Gems and Minerals of Oxford County*. Quicksilver Publications, West Paris, Maine, 269 p.



Figure 1. Fluorapatite with quartz and microcline from the Waisanen quarry, Greenwood, Oxford Co., ME.

XENOCRYSTIC ZIRCON AND CORUNDUM (SAPPHIRE) FROM LATE CENOZOIC ALKALINE BASALTS AT BO LOEI, RATANAKIRI PROVINCE, CAMBODIA – EVIDENCE FOR MULTIPLE MAGMATIC SOURCE AFFINITIES FROM TRACE ELEMENTAL AND ISOTOPIC ($\delta^{18}\text{O}$, U-Pb AND Hf) COMPOSITIONS.

Paula C. Piiilonen, Elena A. Belousova, F. Lin Sutherland, Martin Danišík, John A. Valley, Glenn Poirier, Ralph Rowe, Sebastien Meffre, Jay Thompson, Khin Zaw. Canadian Museum of Nature Box 3443, Sta 'D', Mineral Sci., Ottawa, Ontario K1P 6P4 CANADA.

Trace element (electron microprobe and laser ablation ICP-MS) and isotopic analyses (U-Pb, Lu-Hf and $\delta^{18}\text{O}$) along with age-dating methods [U-Pb and (U-Th)/He thermochronology] were used to characterize zircon and corundum (sapphire) xenocrysts from alluvial deposits associated with the Cenozoic alkaline basalts at Bo Loei, Ratanakiri province, Cambodia. Mining for gem zircon from *in situ* weathered, lateritic soils overlying alkaline basalts within the Ratanakiri province has been on-going for ~ 13 years, utilizing primitive, manual methods. The zircon xenocrysts (4 mm to 20 cm long; ave.: 1.5 x 1.5 x 1 cm) are highly prized for their bright blue colour when heat-treated in a reducing environment. Untreated zircon is colourless, yellow, red-orange or dark red in colour and are often colour-zoned, with darker zones enriched in U and Th. A bimodal morphological population

exists, with zircon alternatively dominated by the {100} prism and {101} bipyramid, or are “multiform”, dominated by the {121} pyramid with minor {001} and {110} prisms. Multiform zircons commonly display resorption features and hopper-type growth patterns, evidence for late-stage interaction with a corrosive melt or fluid. Corundum xenocrysts (average: 0.25 x 0.5 x 0.5 cm) are found in the same alluvial deposits as zircon. The subhedral to euhedral prisms range in colour from blue-green to dark blue to yellow-orange and contain inclusions of zircon and Nb-rich rutile. Zircon xenocrysts from Ratanakiri have U-Pb ages ranging from 0.88 to 1.56 Ma, with slightly younger (U-Th)/He ages of 0.86 to 1.02 Ma. The xenocrysts have chemistry typical of zircons derived from a mantle source with low HfO₂ (0.76 wt.%), Th (25 ppm), U (53 ppm) and ΣREE (149 ppm). The xenocrysts have mantle δ¹⁸O (4.88 – 5.01 ‰) and ¹⁷⁶Hf/¹⁷⁷Hf (0.282970) isotopic signatures, with εHf = 6.56, suggesting crystallization in a compositional range between DM (Depleted Mantle) and CHUR (Chondritic Uniform Reservoir) compositions. Zircon inclusions in corundum have a U-Pb age of 0.80 Ma, similar to that of the zircon xenocrysts, but have higher HfO₂ (2.60 wt.%), Th (2243 ppm), and U (1353 ppm), a chemical signature often associated with zircons derived from granitic or syenitic sources, likely within the lower crust. Xenocrystic corundum is characterized by high Ga values (up to 660 ppm), indicating that they are magmatic in origin. Although both the zircon and corundum xenocrysts have a magmatic origin and appear to have crystallized at approximately the same time before becoming entrained in erupting alkaline basalts, the chemical signatures of the xenocrystic zircon versus the zircon inclusions suggest two separate mantle sources for these gem stones.

THE CRYSTALLIZATION OF CRISTOBALITE & FELDSPAR IN RHYOLITIC OBSIDIAN.

C. C. Reynard. 110 College Avenue, Poughkeepsie, NY 12603.

This study will focus on the chemistry and crystallization process that creates spherulites. There is some variability as to the what minerals make up spherulites although the minerals cristobalite, high temperature quartz, and feldspar are always present. Mineralogists have identified the feldspar as: a cryptocrystalline perthite of sanidine/ albite, anorthoclase, or orthoclase. The accessory mineral fayalite Fe₂SiO₄ (an iron rich member of olivine group) is also found in these spherulites. This research encompasses the study of two sites in California: Cougar Butte, Cascade Range, Siskiyou County, California and a site in the Sierra Nevada Basin and Range Province, specifically Coso Hot Springs Deposit, China Lake, Coso Mountains, Inyo County, California.

At these sites, superb specimens of spherulites are found in the extruded volcanic glass, obsidian. These form during devitrification, a cooling process where the amorphous glass begins to crystallize at nucleation points. The environment for this devitrification is variable and depends on the thickness of the rhyolitic-obsidian flow, rate of heat loss or gain, abundance of centers for crystallization, and protection from surface weathering.

Cristobalite, SiO₂ is a polymorph of quartz that crystallizes at a high temperature. Some feldspars also crystallize at high temperatures. It is thought, as obsidian cools and is in a plastic state, the chemical constituents of cristobalite and feldspar diffuse slowly to favorable nucleation sites. Obsidian is not a pure glass as it contains inclusions of cryptocrystalline minerals such as illmenite and magnetite. These crystals can act as nucleation points.

Visual studies show that unbroken smooth spherulites form near perfect spheres in the obsidian. Broken spherulites studied under the microscope show the texture of mineral growth. In small, open 3/8 inch spherulites of gray-white crystals reveal a texture of radiating crystals

growing to from the center of the spherulite outward. In larger (> 1 inch) spherulites, multiple spherulites may merge with one another.. In empty hollows where spherulites were, a stitching pattern shows where multiple spherulites met. It has been suggested this pattern of crystals may have resulted from the presence of tridymite, another high temperature polymorph of quartz. In what is called snowflake obsidian, many cristobalite/feldspar spherulites have crystallized to give the rock the appearance of snowflake-like patterns.

Many of the spherulites fluoresce feldspar red under short-wave ultraviolet light. Some mega-spherulites (several meters across) are known, one such is in Colorado. These are unusual in that they may have formed from lava rather than through devitrification.

In addition to the cristobalite found in obsidian, mineralogists have found minute cristobalite spherulites in Libyan Desert glass. The process of change from amorphous glass to crystallization leaves mineralogists much more to learn.

The Western US and the West coast of Mexico provide the best specimens of spherulites in the world. The most well-known U.S. sites with spherulites in obsidian are California, New Mexico, Nevada, Utah, and Yellowstone Park (Wyoming/Montana). The type locality for cristobalite is Cerro San Cristobal, Mexico, where it was discovered in 1887.

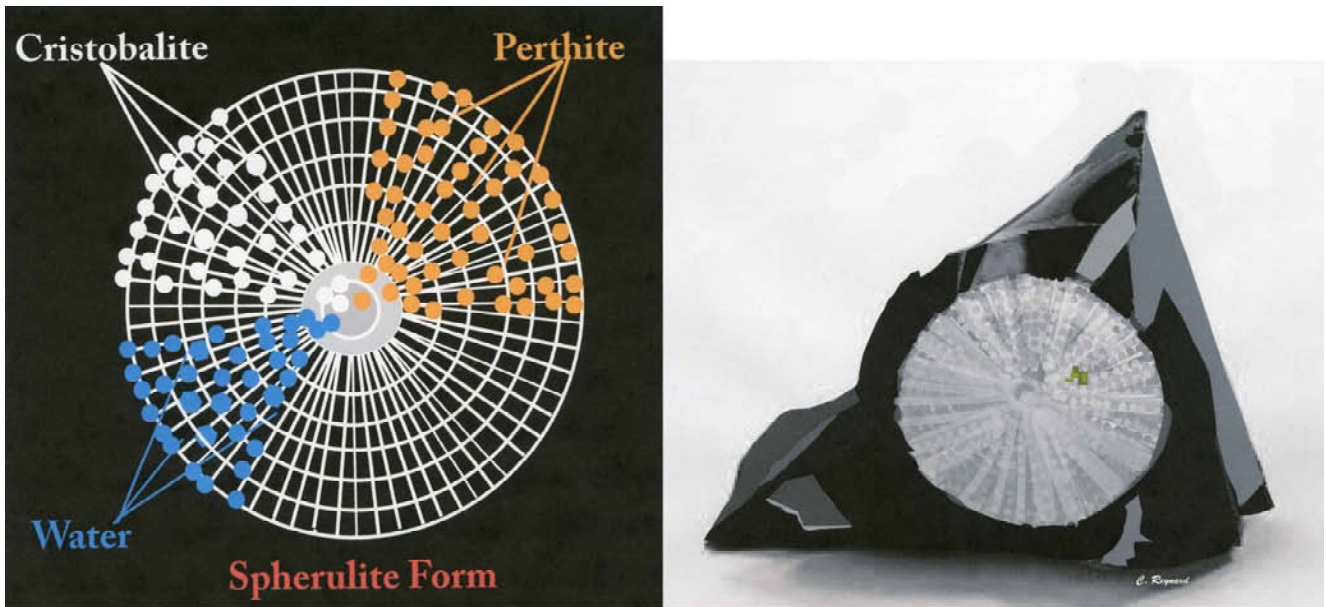
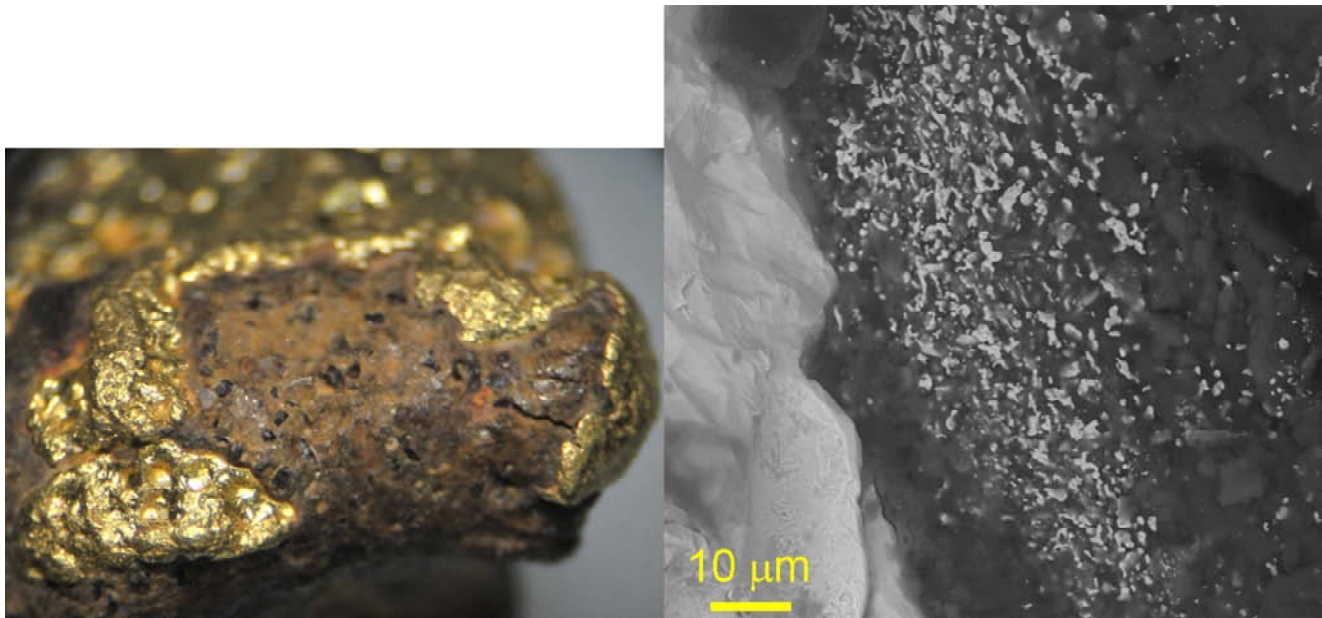


Figure 1. Two views of spherulites in obsidian.

MORPHOLOGIC EVIDENCE OF AUTHIGENIC GOLD DEPOSITION IN LATERITIC PLACER DEPOSITS FROM THE GUYANA SHIELD OF VENEZUELA.

J. Silverstein, M. Krekeler, J. Rakovan, Department of Geology and Environmental Earth Science, Miami University, 250 South Patterson, Ave., Oxford, Ohio 45056

Recent studies have shown that authigenic gold can crystallize during diagenetic processes in fluvial or soil environments. In near surface environments gold is relatively insoluble; however, organic ligands such as humic acids can complex with gold and increase its solubility. A gold sample consisting of a nugget embedded in a laterite matrix from the Guyana shield of Venezuela was investigated to determine if gold from this sample is authigenic or detrital. The nugget is mantled around the laterite matrix and has 1 mm impressions along the surface that is believed to be molds after preexisting detrital grains. Scanning electron microscopy (SEM) shows gold textures within the laterite matrix that are commonly seen in organic rich soils at near surface conditions and that suggest authigenic formation. SEM and energy dispersive spectroscopy (EDS) clearly show a growth halo of discrete micrometer to nanometer scale gold particles adjacent to the nugget. There is no evidence of scratches, dimples, or any other indicator of mechanical deformation that would be associated with physical transport of the nugget or the fine grained gold within the laterite. A spatial gap of particles between the nugget and the halo, combined with the intricate textures of gold particles in the halo suggest growth in place. Some nanoparticles show evidence of potential Oswald ripening where 1-3 micron sized particles are surrounding a 5 micron gold particle within the laterite. The exact mechanism of authigenesis is unclear; however, the results may have significant pragmatic implications. The occurrence of gold in lateritic placer deposits is common in Venezuela and Africa, and samples from a variety of regions should be investigated to determine if the textures observed in this study are common in these settings. Micrometer and nanometer scale gold may not be recovered in traditional placer mining methods used in laterite ores, thus many sites may have waste or processed ore that has recoverable gold. Future work will focus on determining the prevalence of this texture in Venezuelan samples and attempts to identify geochemical mechanisms for deposition.



Left: Gold nugget showing molds from preexisting detrital grains mantling the laterite matrix. Black quartz grains are seen within the laterite. *Right:* SEM image showing gold nugget (left) and distribution of nanoparticle gold within the diffusion halo (right).

SECTOR ZONING IN DIAMONDS FROM ZIMBABWE

J. Rakovan, Department of Geology and Environmental Earth Science, Miami University
Oxford, OH, 45056;

E. Gaillou, Mineral Sciences, Natural History Museum of Los Angeles County Museum, 900
Exposition Blvd., Los Angeles, CA 90007;

J. E. Post, Smithsonian Institution, Washington, DC 20013-7012;

J. A. Jaszczak, Department of Physics and the A. E. Seaman Mineral Museum, Michigan
Technological University, Houghton, MI 49931; and

J. H. Betts, 215 West 98 Street, No. 2F, New York, New York 10025.

Optically sector zoned diamonds (those in which the zoning patterns are visible to the unaided eye) are rare. These oddities, sometimes referred to as “star” or “asteriated” diamonds, have been known for centuries. For example Rondeau et al. (2004) describe several such specimens from the collection of the National Museum of Natural History of France, which were originally studied by the distinguished mineralogists René Just Haüy (1743-1822; the father of modern crystallography) and Alfred Des Cloizeaux (1817-1897). Recently, beautiful examples of sector zoned or “star” diamonds have appeared on the mineral and gem market, usually as oriented slices that nicely show the symmetric patterns of the sector zoning (see figure). Depending on the orientation of slices 2-fold, 3-fold or 4-fold patterns are visible. Several groups of scientists have been studying these diamonds and three recent papers detail their properties and the possible origin of chemical and defect zoning within them (Howell et al. 2013a; Howell et al. 2013b; Rakovan et al. 2014). Although somewhat uncertain, the origin of these diamonds is likely Zimbabwe.

The cube {100} sectors in these diamonds, determined in sections by electron backscattered diffraction (EBSD), exhibit numerous dark concentric bands, while the octahedral sectors are mostly transparent and colorless. Magnification in transmitted light indicates that the gray color associated with the cube sectors is due to a very dense accumulation of light-scattering inclusions. Raman spectroscopy with a 325-nm wavelength laser focused on the inclusions revealed the presence of the very intense diamond Raman peak at 1332 cm^{-1} and of a weak but discernible graphite peak at 1592 cm^{-1} . Howell et al. (2013a) have shown that these inclusions are actually defects known as disk-crack-like defects, the inside wall of which are coated with graphite. The cube sectors are also intensely cathodoluminescent, likely due to the substitution of nickel in the diamond structure. Fourier transform infrared spectroscopy (FTIR) shows that hydrogen and nitrogen are also sectorally segregated with much higher concentrations of nitrogen in the octahedral sectors and hydrogen in the cube sectors. Howell et al. (2013) also found significantly higher concentrations of H in the cubic sectors and they proposed that the H is somehow associated with the disk-crack-like defects. Optically visible sector zoning of defects, inclusions and substituent elements is a rare and fascinating phenomenon that is not only of interest to scientists but makes for interesting and beautiful specimens for the collector.

References

- Howell, D., W.L. Griffin, N.J. Pearson, W. Powell, P. Wieland, and S.Y. O'Reilly. 2013a. Trace element partitioning in mixed-habit diamonds *Chemical Geology* **355**:134-143.
- Howell, D., W.L. Griffin, S. Piazzolo, J.M. Say, R.A. Stern, T. Stachel, L. Nasdala, J.R. Rabeau, N.J. Pearson and S.Y. O'Reilly. 2013b. A spectroscopic and carbon-isotope study of mixed-habit diamonds; impurity characteristics and growth environment. *American Mineralogist* **98**:66-77.

Rakovan, J., E. Gaillou; J.E. Post; J.A. Jaszczak; and J.H. Betts. Optically sector zoned (star) diamonds from Zimbabwe. *Rocks & Minerals* **89**:(in press).

Rondeau, B., E. Fritsch, M. Guiraud, J.P. Chalain, and F. Notari. 2004. Three historical ‘asteriated’ hydrogen-rich diamonds: growth history and sector-dependent impurity incorporation. *Diamond and Related Materials* **13**:1658–1673.

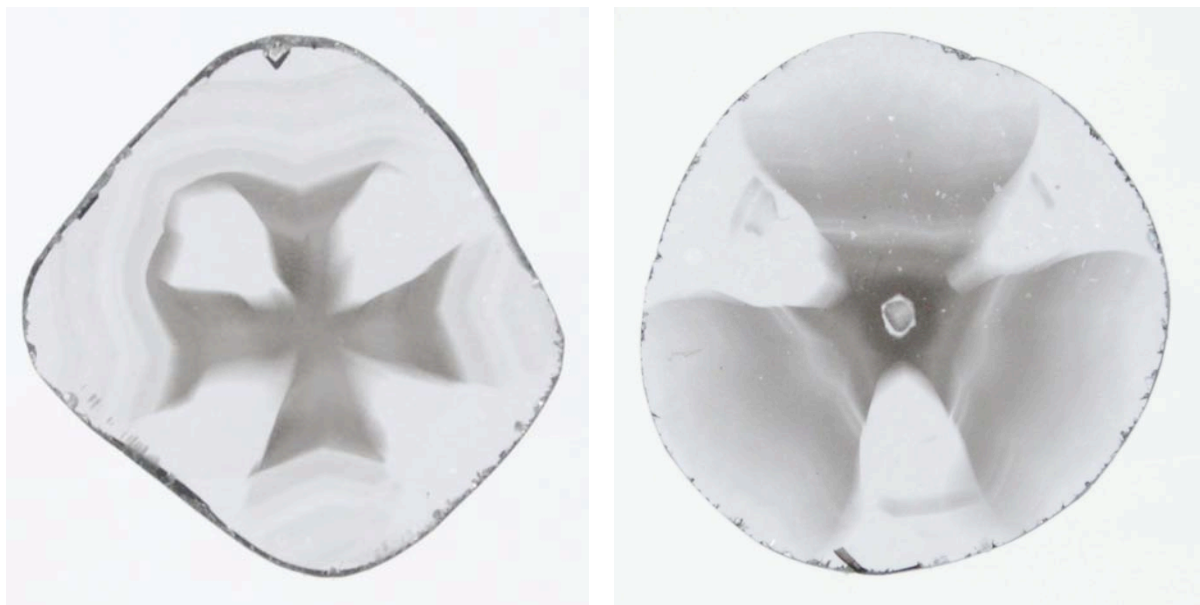


Figure. *Left*: a (100) section and *Right*: a (111) section from a “star” diamond crystal. The cube {100} sectors are dark, due to inclusions, while the octahedral sectors are mostly transparent and colorless. The specimens are approximately 5 mm in diameter. John Betts photos.

20 YEARS AFTER: A BRIEF UPDATE ON THE STUDY OF TELLURIDE MINERALS & DEPOSITS

B. A. Geller

Colorado School of Mines Geology Museum,
1310 Maple St.,
Golden, CO 80401

Much research has been conducted on telluride deposits (those containing the element Te), applying new tools and insights, in the twenty years since the completion of my doctoral studies (Geller, 1993). Te has become a more sought-after commodity, since its application in modern photovoltaic (PV) cells, thermoelectric devices (in military and medical applications), certain memory chips, and guided missiles (George, 2013a). Twenty years ago, Te was only employed in industrial applications, such as metal alloying, rubber vulcanization, and in glass/ceramic pigments, but continues to be used in these industries today (George, 2013b). It is likely that demand for Te will grow, as technology advances, catalyzing better understanding of telluride mineral distribution,

exploration for more Te deposits, and improved methods of Te extraction. All Te produced until recently, came as a by-product from processing sulfide ores. Only one deposit in China has recently been mined specifically for its Te.

Although Te remains one of the rarest elements on earth, the IMA has approved 85 unoxidized telluride minerals (those lacking O in their formulae). These are found in diverse geologic environments, generally in the trigonal crystal system. Despite similar chemical behavior with Se, only about 9% of worldwide Te deposits have any reported Se species (Ralph, 2014). Literature reported correlations of tellurides with V minerals are also over-exaggerated and run only at about 6% (Ibid). Nineteen elements have been found to bond with Te in nature, the most common being Bi, S, and Ag. There is no known natural Cd telluride phase. Ralph (2014) reports that the six most typically occurring tellurides on earth (referred to in this talk as ‘the big six’) in order of occurrence are: hessite, tetradymite, altaite, petzite, sylvanite, and calaverite, which strongly corroborates data presented in my dissertation, but not entirely in that order.

Tellurides have been reported on six continents. From data in Ralph (2014), many countries now report tellurides that did not in 1993. China has seen the largest increase in the number of telluride deposits. In 1993, the Boulder Telluride Belt (BTB) in Colorado had the largest diversity of telluride minerals in the geologic literature. Today, eight districts on four continents eclipse the BTB in this distinction (Figure 1).

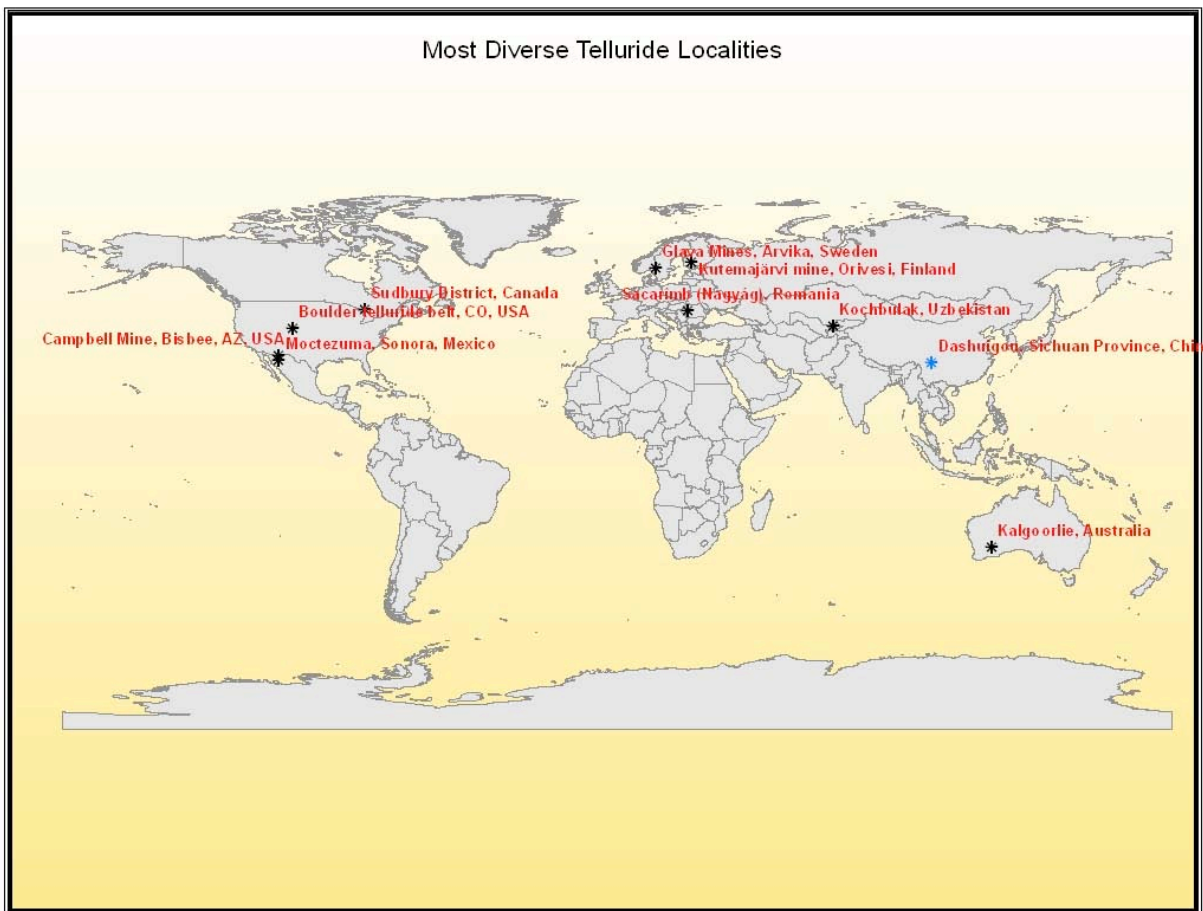


Figure 1. Worldwide telluride deposits with greatest telluride diversity, plus the world’s only primary telluride producing district in China.

The countries with the most telluride occurrences as reported by Ralph (2014) are: the United States, China, Canada, and Russia, which correlates well with their overall land size. Colorado had the

most telluride occurrences per square kilometer of any region in the U.S. in 1993 (Geller, 1993). Extrapolating from data presented by Ralph (2014), Colorado presently has the most telluride occurrences per square kilometer of any known region in the world, statistically.

In the future, more tellurides will be discovered, from more worldwide occurrences, from type localities and occurrences with extremely diverse telluride mineralogy, but they will remain rare, occur in trace amounts, and probably possess similarities to “typical” telluride chemistry (the predominance of Bi, S, Ag, Pb, Pd, Cu, Au, etc.). The ‘big six’ will continue to dominate world occurrences. This study corroborates the value of mineral databases in mineral research.

References

- Geller, Bruce Alan, 1993, Mineralogy and origin of telluride deposits in Boulder County, Colorado, Univ. of Colorado at Boulder Ph.D. dissertation, 731p.
- George, M.W., 2013a. “Mineral resource of the month, Tellurium.” *Earth Magazine*. March 2013, p.57.
- George, M.W., 2013b, “Tellurium,” *Mineral Commodity Summaries*, U.S. Geological Survey, January 2013, <http://minerals.usgs.gov/minerals/pubs/commodity/selenium/mcs-2013-tellu.pdf>.
- Ralph, J. (2014). Retrieved from <http://www.mindat.org/>

MINERALOGICAL MIRACLES AT MERELANI

John A. Jaszczak

Department of Physics and the A. E. Seaman Mineral Museum
Michigan Technological University

The Lelatema Mountains in northern Tanzania are host to one of the world’s richest flake graphite deposits, but it is the purple-blue gem variety of zoisite called Tanzanite that has brought renown to the region since the 1960s. Diopside, prehnite, gem green grossular (tsavorite), and axinite-Mg Merelani have also been prized by collectors in recent decades.

In December 2007 a pocket of exceptionally fine crystals of graphite was discovered at Karo Mine in Merlani’s Block D. Given graphite’s extreme softness and obvious lack of gem value, it seems almost miraculous that specimens of these graphite crystals, perhaps the finest in the world, were superbly preserved. Adding to their uniqueness and beauty, the graphite crystals are covered by a secondary overgrowth of graphite that contains rare stellate graphite dendrites. The pocket also produced superb gem-quality diopside, fluorapatite, and tremolite crystals.

More recently, world-class specimens of several sulfide minerals have recently become available on the market. Pyrite crystals of exceptional size and mirror-bright luster were the first to become available. In 2011 translucent wurtzite crystals of shocking size (to 10 cm) and red-orange color were discovered. The following year black octahedral crystals of alabandite were identified, the best of which are perhaps the world’s best for the species.

This illustrated lecture will review these seemingly miraculous mineralogical occurrences and reveal yet further surprises that have been uncovered.

Herodsfoot mine, Richard Talling and Bournonite – a 19th Century monopoly?

Roy Starkey

Superb bournonite specimens from Herodsfoot mine grace private and public collections across the world. Although not the type locality (Wheal Boys, also in Cornwall), a fine Herodsfoot bournonite is surely on many a collector's wish-list but few can afford the considerable financial outlay required to secure a presentable example. The supply of specimens from the mine was exhausted in the early 1870s and the story of how this relatively insignificant Cornish mine came to be at the pinnacle of collectors' desires is testament to the tenacity and resolve of one man, Cornish mineral dealer Richard Talling.

Bournonite was first described by the famous Cornish mineralogist Philip Rashleigh (1797, 1802) as an ore of antimony from Wheal Boys in the parish of St Endellion, Cornwall, where it was found associated with jamesonite, sphalerite, feldspar, quartz and arsenopyrite. A more complete description was provided by French crystallographer and mineralogist Jacques Louis de Bournon (1804). Robert Jameson subsequently named the mineral "bournonite" in honour of de Bournon in volume 2 of his *System of Mineralogy* (1805). De Bournon later coined the name "Endellion". It is however, Jameson's name bournonite that has persisted and is the accepted species name today.

Herodsfoot is a small hamlet situated in a steep, wooded valley about 3.5 miles SW of Liskeard. The community has its origins in the mining industry, and according to Stephens (1932) the lead-bearing lode, which runs for nearly a mile along the western side of the West Looe River valley near Herodsfoot has been "worked on and off for over 300 years".

The mine was reopened in 1844, and at that time the workings were found to be some 300 feet deep. Work continued, generally successfully, for 40 years with development resulting in the mine reaching a depth of 215 fathoms (1290 feet) and producing more than 19,000 Tons of lead ore and 600,0000 oz of silver ore, together with a little copper and wolfram.

The area is now a quiet agricultural district, with some of the former mine cottages having been turned into holiday homes, few original inhabitants remaining and any links to the mine's illustrious past fading with each passing year. The mine buildings themselves are very overgrown and in a poor state of repair, but efforts are being made to stabilise some of them, and to re-ignite local interest in the fascinating history of this famous Cornish mine.

The project which led to this talk resulted from an invitation to write an article for *The Mineralogical Record*, now published (Starkey, 2012).

Substantial amounts of mine spoil remain, largely obscured by vegetation, and all of the workings and dumps lie on private land. Permission for access must be sought in advance from the land owners by anyone interested in exploring the site in search of specimens.

Recent developments at the mine will also be reviewed and discussed.

THE MINING JOURNAL.

HERODSFOOT SILVER-LEAD MINE, LISKEARD, CORNWALL.

TO BE SOLD, as a going concern, BY PUBLIC AUCTION, at Webb's Hotel, Liskeard, on Thursday, the 23rd day of January, 1879, at Four o'clock in the afternoon, this VALUABLE MINE, which is in full working order, with all ample and excellent PLANT for its further development, comprising a first-class 60 inch cylinder PUMPING ENGINE, nearly new, with TWO BOILERS, and an extra spare one; 205 fathoms of PITWORK; a 40 feet WATER-WHEEL and CRUSHER; a 20 feet ditto, with double-acting WINDING-ENGINE and 16 heads of STAMPS, worked by a never failing stream of water, and all the necessary dressing machinery and appliances, together with the LEASES of an unexpired term of 21 years, from November 22, 1856, at 1-15th dues, now reduced during pleasure to 1-20th, and all the halvans on the mine.

The bottom level is now being driven through a good course of lead. The lead has for many years maintained a high price of over £20 per ton, and but for the present depression of price would now leave good profits.

With its efficient plant in working order, its great advantages of water power for winding and crushing, and the future prospects, the mine offers to mining capitalists an opportunity rarely submitted to them.

An inspection of the mine is invited, and every information will be given by the Parser, on application at the mine.

For Sale advert in the Mining Journal 4 January 1879

Selected references

de BOURNON, J. L. (1804) Description of a triple Sulphuret, of Lead, Antimony, and Copper from Cornwall. *Philosophical Transactions of the Royal Society, London*. 94, 30 -62.
JAMESON, R. (1805) *A System of Mineralogy*. Vol. II. Edinburgh.
RASHLEIGH, P. (1797, 1802) *Specimens of British Minerals Selected from the Cabinet of Philip Rashleigh, of Menabilly in the County of Cornwall*. London: 2 volumes, 56 p. and 33 plates, 24 p. and 21 plates.
STARKEY, R. E. (2012) The Herodsfoot mine, Lanreath, Cornwall, England. *The Mineralogical Record*. 43, 411-486.
STEPHENS, F. J. (1932) The mines around Liskeard-3. An expert's survey. *Cornish Times*. Friday Sept 2, 1932.



Herodsfoot Village and North Herodsfoot mine from All Saints Church. May 2010.
Roy Starkey photo.



Herodsfoot mine postcard, circa 1900.



Crusher House at North Herodsfoot mine. April 2011. Roy Starkey photo.



BGS RGSC M1085 Bournonite on quartz Herodsfoot mine 3x7x9cm xls to 4x1cm.

THE MOUNT ANTERO MINERAL LOCALITY, CHAFFEE COUNTY, COLORADO

Mark I. Jacobson

1714 S. Clarkson St.

Denver, CO 80210

The aquamarines from Mount Antero and Mount White were first introduced to the mineralogical community by "Nels" Nelson Daniel Wanemaker via a letter from Roselle T. Cross to George F. Kunz in 1885, although J. Alden Smith, Colorado State Geologist had been shown aquamarines from Mount Antero in 1882 [Smith (1883) in Jacobson (2011b)]. The discovery of aquamarine was soon followed by the recognition of phenakite, bertrandite, fluorite and topaz from the Mount Antero and Mount White areas. During the early years, from 1882 to 1893, Wanemaker sold specimens to many of the leading mineralogists and collectors in the USA. George L. English referred to Wanemaker as his Colorado collector in his mineral catalogs. George F. Kunz, Walter B. Smith, Roselle T. Cross, and Richard C. Hills also purchased specimens directly from Wanemaker.

These minerals were found in miarolitic pegmatites, injected pegmatites, hydrothermal veins, and greisens associated with the upper portions of the peraluminous Mount Antero granite, especially within its most leucocratic variant, Shannon's (1988) California granite.

Mount Antero and Mount White are the youngest parts of the Mt. Aetna caldera, a volcanic complex of Tertiary-aged intrusives and erosional remnants of surface volcanics that have been preserved due to the caldera formation. The Mt. Princeton quartz monzonite batholith (35.8- 34.4 mybp), with outer rind, isolated fragments of Mt. Pomeroy quartz monzonite, forms a subcircular outcrop 25 to 35 kilometers across. This batholith intruded into Proterozoic metamorphic and Paleozoic sedimentary rocks. After partial unroofing of this batholith, the surface feature collapsed along two major border faults, a northern NNE to SSW fault and a southern ENE to WSW fault. These fault traces are recognized by the Mt. Aetna quartz monzonite (34.6 mybp) that intruded into the fault planes at 34.13 bybp. Two units of surface volcanics, the Calico Mt. Andesite and younger Sewanee Peak volcanics (33.9 mybp) flowed across this erosional topography. At least two leucogranites, the Mount Antero (and its associated California granite), and Hoffman Park plutons intruded into these older rocks at 29.59 and 33.4 mybp respectively (Sharp 1976, Coolbaugh 1985, Shannon 1988, Toulmin and Hammarstrom 1990, McIntosh and Chapin 2004, Lipman 2007, Zimmerer 2011, Mills and Coleman 2013).

Beryl and molybdenite mineralization and miarolitic pegmatites are associated with or found within these leucogranites. These plutons are exposed at several locations -- Mt. Antero, Mt. White, around the California mine, the Browns Creek headwaters, the south flank of Mt. Shavano which is usually referred to as the North Fork intrusion and near Hoffman Park. Beryl and miarolitic pegmatites are known from the Brown Creek plug, California mine and the Mt. Antero granite exposures that surround Mount White and Mt. Antero. Only smoky quartz-microcline miarolitic pegmatites have been reported from the North Fork exposures. No miarolitic pegmatites or beryllium minerals have been reported from the Hoffman Park granite.

After Wanemaker had moved on to other mining ventures circa 1893, several other miners tried their hand mining on Mt. Antero with only James D. Endicott from Canon City documenting his success prior to 1928. Ed Over from 1928 to 1949, especially in association with Arthur Montgomery, contributed numerous specimens to leading museums and private collectors. With the rise in price of beryllium and its subsidy by the U. S. Federal government in 1952, John King of Salida, Colorado and Grady Cardwell of Texas both saw an opportunity on Mount Antero for mining beryl for beryllium

and producing aquamarine gemstones as a by-product. This led to the first dirt road up Mount Antero and Mount White in 1956 and the reopening in 1960 of the California molybdenum mine adit for evaluation.

By 1962, all the business entities on Mount Antero had gone bankrupt and the claims had lapsed. Mining the Mount Antero granite for disseminated beryl had been an economic failure. In May 1969, Grady Cardwell formed a new company, the North American Beryllium Corporation (NABC), and reclaimed the entire south knob of Mount Antero. NABC focused on trying to mine beryllium ore and not gemstones. NABC was not concerned with nor did it seriously interfere with hand digging for mineral specimens by others.

With the road open to collectors, numerous discoveries of gem pockets were made across Mount Antero and Mount White by many collectors from the 1970s through the 1990s. Collectors such as Chuck Barnes, Eldon Bright, Bill Chirnside, Bob and Doris Drisgill, Jim Grika, Pete McCrery, John Melby, “Rosy” Horace O’Donnell, Curtis Abbott, Cliff Nicholson, Andrew Taylor, Eldon Hunewell, George Fisher, George Robertson and many others made notable discoveries, only some of them from the south knob of Mount Antero.

The situation changed radically in 2001 when the Cardwell family decided to focus on mining aquamarine gemstones. Accordingly, under the active supervision of fourth generation Craig Cardwell, mineral collecting on the south knob of Mount Antero was restricted. In 2013, these claims were still legally valid. This forced a younger generation of collectors to move their collecting activities to areas that have not been prospected since 1956, when the first road up the mountain was opened.

Steve Brancato after 2001 recovered the finest matrix aquamarine specimens ever known, as well as topaz and smoky quartz. Jeff Self and associates recovered large quantities of smoky quartz and associated minerals. Bryan Lees’ sublease on the Cardwell claims resulted in the 2007 discovery of the finest helvite crystals known from the locality. The 2000-2012 prospecting activity has been more intensive and surprisingly more successful than ever before, proving the locality is far from barren. This activity has not been without cost and strife involving claim holders, casual collectors, environmental activists and US and state government employees.

The launching of the Weather Channel’s *Prospector* show in the first part of 2013, which was filmed during the summer of 2012, was a great success for the media company, “High Noon Entertainment.” The participants for this “let’s pretend reality” show greatly enjoyed the publicity, which during the filming in the summer of 2013 brought them new difficulties from the state and federal environmental regulators. For mineral collectors, the show created un-wanted attention, uncertainty and conflicts with “wannabe” treasure hunters. A mineral claiming frenzy was the result, blanketing the area with claims of unknown, uncertain and erroneous validity.

Further details of the locality history, geology and mineralogy can be found in Antero Aquamarines (Jacobson 1993). Other aspects of the locality history, can be found in later articles about some of the collectors such as Nelson D. Wanemaker (Jacobson 2005), James D. Endicott (Jacobson 2008a, 2008b), Roselle T. Cross (Jacobson 2011a), and Walter B. Smith (Jacobson 2013). The discoveries of the last decade by Steve Brancato and associates (Lees 2005), Jeff Self (Hutchinson 2008) and others have been reported in journals, mineral club newsletters and newspapers.

The locality remains an area of high collecting activity and a premier recreational area for hikers, campers, fisherman, hunters, 4 wheelers and ATV enthusiasts. Weekend traffic is considerable. Discoveries are still being made but require more hiking and creative prospecting.

References cited.

Coolbaugh, M. F. 1985. Geology and economic mineral potential of upper Browns Creek basin, Chaffee County, Colorado, M. S. thesis, University of Arizona, 243 p.

- Hutchinson, W. H. 2008. Morganite discovery from Mt. Antero in Chaffee County, Colorado. *Mineral News*, v. 24, no.7, p. 1, 4-6.
- Jacobson, M. I. 1993. *Antero Aquamarines: Minerals from the Mount Antero- White Mountain region, Chaffee County, Colorado*. L. R. Ream Publishing, Coeur d'Alene, Idaho. 126 p.
- _____. 2005. Colorado Pioneer Nelson "Nels" D. Wanemaker: prospector, Miner and Rancher. *Mineral News*, v. 21, no. 6, p. 6-8.
- _____. 2008a. Charles Alexander Beghtol - Colorado Gemologist. *Mineral News* v. 24, no. 3, p. 11-12.
- _____. 2008b. James D. Endicott: Colorado Gem Miner. *Mineral News*, v. 24, no. 6, p. 8-10.
- _____. 2011a. Roselle Theodore Cross: Enthusiastic Mineral Collector and Pioneer Congregational Pastor. *Mineral News*, v. 27, no. 4, p. 1-2, 9-11, 14-15.
- _____. 2011b. *Pioneer Colorado minerals – J. Alden Smith and his Minerals of Colorado: 1866 to 1882*. Batuan Biru Productions, Denver, CO. 165 p.
- _____. 2012. John C. H. Grabill and Nelson D. Wanemaker: Paths that crossed on Mount Antero. *Mineral News*, part 1. v. 28, no. 1, p. 1-2, 5-7; part 2, v. 28, no. 2, p. 1, 3-7.
- _____. 2013. Walter Brown Smith (1858-1939): Pioneer Colorado Mineralogist-Geologist. *Mineral News*, v. 29, no. 6, p. 1-2, 4,-8; v. 29, no. 7, p. 1-2, 5, 7-8, 11, 14-15; v. 29, no. 8, p. 1,3-4, 14-15.
- Lees, B. K. 2005. A spectacular new aquamarine find on Mount Antero, Chaffee County, Colorado. *Rocks & Minerals*, v. 80, no. 3, p. 198-199.
- Lipman, P. W. 2007. Incremental assembly and prolonged consolidation of Cordilleran magma chambers; Evidence from the Southern Rocky Mountain volcanic field. *Geosphere*, v. 3, no. 1, p. 42-70.
- McIntosh, W. C. and Chapin, C. E. 2004. Geochronology of the central Colorado volcanic field. *New Mexico Bureau of Geology & Mineral Resources, Bulletin* 160, p. 205-237.
- Mills, R. D. and Coleman, D. S. 2013. Temporal and Chemical connections between plutons and ignimbrites from the Mount Princeton magmatic center. *Contributions to Mineralogy and Petrology*, v. 165, no. 5, p. 961-980.
- Shannon, J. R. 1988. Geology of the Mount Aetna cauldron complex, Sawatch Range. Unpublished Ph.D. dissertation, Colorado School of Mines, 434 p.
- Sharp, W. N. 1976. Geologic map and details of the beryllium and molybdenite occurrences, Mount Antero, Colorado. U. S. Geological Survey, Misc. Field Studies map MF-810, 2 sheets, scale 1:24,000.
- Toulmin, P. and Hammarstrom, J. M. 1990. Geology of the Mount Aetna Volcanic Center, Chaffee and Gunnison Counties, Colorado. *U. S. Geological Survey Bulletin* 1864, 44 p.
- Zimmerer, M. J. 2011. The volcanic-plutonic relationship at three contrasting Rio Grande rift-faulted calderas. Unpublished Ph.D. dissertation, New Mexico Institute of Mining and Technology, Socorro, New Mexico, 284 p.

MINERALS OF THE CAIRNGORMS

Roy Starkey

The Cairngorms are the most extensive area of high mountain terrain in Britain and lie some 676 km (420 miles) north north west of London, and around 100 miles from either Glasgow or Edinburgh, both of which are served by modern airports. Good road links exist to Aviemore and around the periphery of the area. There are no public roads into the Cairngorms other than the so-called ski-road to Coire Cas on the north side of Cairn Gorm itself.

One in four of the UK's endangered species live here, in a landscape that offers the finest collection of glacial landforms outside arctic Canada. The Cairngorms National Park is the UK's largest, and most northerly National Park, and within this deeply dissected central plateau are to be found five out of six of Britain's highest mountains and the Queen's summer residence at Balmoral. The local population of over 17,000 people is swelled by 1.5 million visitors each year, and in 2012, the US magazine *National Geographic* named it as one of the world's 50 Last Great Places, calling it "*the destination of a lifetime*".

My interest in the area was sparked firstly by the writings of the late Matthew Forster Heddle (Heddle, 1901), and his early wanderings and notes thereof. The area has given its name to gem quality smoky quartz, but has also produced spectacular specimens of beryl and topaz. In days gone by "Cairngorm stones" were much sought after by the lapidary and jewellery trade, and hunting for crystals was both a popular pastime and a "cottage industry". Demand was such that the supply of authentic local material could not keep up, and inevitably, imported material began to be passed-off as Scottish. It is now very difficult, if not impossible, to be certain of the provenance of cut stones and those mounted in jewellery.

The social history of the area is fascinating, and contemporary accounts of the travails of the early crystal hunters and the hardships endured by them and their families, together with occasional success, bring the story to life. Following the purchase of Balmoral by Prince Albert and Queen Victoria, the area became firmly on the tourist route, and the various royal connections add further colour and interest to the rich local history.

The Chevalier de Johnstone, a soldier born in Edinburgh who took part in the Jacobite rebellion of 1745, and was an aide-de-camp of Prince Charles Edward Stewart, provides an account of his retreat from Culloden in April 1746, and a remarkable description of his overwhelming desire to acquire some specimens of cairngorm quartz rather than flee for his life (Winchester, 1871).

The Welsh travel writer and naturalist, Thomas Pennant, in his *Tour in Scotland 1769*, first published in 1771 (Pennant, 1776) also drew attention to "*the Carngorm in Strathspey...*" "*...remarkable for its height, and for the stones found upon it; I have seen these stones of blue, green, yellow, and amber colours; some so large as to make big snuff-boxes or small cups.*"

An illuminating account of a visit to the Farquharson's at Invercauld is provided by Sir John Stoddart, who was briefly editor of *The Times* from 1814-1816 (Stoddart, 1801), and this old collection was recently re-discovered by the author and has been curated and a public display opened at Braemar Castle in April 2013 (Starkey, 2013).

James Sowerby in his *British Mineralogy*, Volume 2, (Sowerby, 1806) notes that "*Cairn Gorum Crystals have been known for some years, and are said to have first caused the lapidaries to settle in Aberdeen, where they have been constantly employed in cutting them for seals, ring-stones, &c. They are perhaps of the oldest formation, and are found of various degrees of transparency, and sometimes are coloured yellow or brown. When of a deep colour they are esteemed as topazes and if clear and large are sold at a high price. The brown ones are also valued if clear; but when of a bad*

yellow, or muddy brown, the lapidaries have recourse to their art, and prove them to be rock crystals, by dissipating their colour, and giving them a transparent lustre.”

The talk will include a review of the history and occurrence of the various minerals together with first-hand accounts of explorations over the past thirty years, as a prelude to a forthcoming book on the subject.

The Cairngorms include areas designated as National Nature Reserves, Sites of Special Scientific Interest, Natura 2000 conservation sites (Special Protection Areas and Special Areas of Conservation), Geological Conservation Review sites and RAMSAR sites. Visitors are required to act responsibly and avoid damage to the environment at all times.

Selected references

HEDDLE, M. F. (1901) *The Mineralogy, of Scotland*. Douglas, Edinburgh. 2vols.

PENNANT, T. (1771) *A Tour in Scotland 1769*. John Monk, Chester.

SOWERBY, J. (1806) *British Mineralogy: Or Coloured Figures Intended to Elucidate the Mineralogy of Great Britain*, Vol.II.

STARKEY, R.E. (2013) The Farquharson of Invercauld Mineral Collection. *Braemar Buzzard*, Issue 28.

STODDART, J. (1801) *Local Scenery and Manners in Scotland during the years 1799- 1800, with a Vignette of St Bernard's Well, a Map, and 33 Plates*, 2 vols., London.

WINCHESTER, C. (1871) *Memoirs of the Chevalier de Johnstone* Vol.2., Translated from the original French M.S. of the Chevalier. D.Wyllie & Son, Aberdeen. 191pp.



Former Cairngorm quartz exhibit in Royal Scottish Museum. Roy Starkey photo.



Braemar Castle Farquharson Mineral Collection Exhibit April 2013. Roy Starkey photo.



Cairn Toul, Angel's Peak and Braeriach from flanks of Ben Macdui. Roy Starkey photo.

41st Rochester Mineralogical Symposium

Chairman & Emcee - Steve Chamberlain

Registrar - Helen Chamberlain

Treasurer - Dan Imel

Technical Session - Steve Chamberlain

Technical Session Moderator - Carl Francis

Program Notes, Publicity - Steve Chamberlain

Exhibits - Bruce Gaber

Program Notes Cover Art - Susan Robinson

Dealers - Helen Chamberlain

Facilities - Brian McGrath

Set-Up/Take-Down Crew - John Diaz, Fred Haynes, Brian McGrath, Bob Morgan, Mike Naven, Lee Tutt, Ken Wolff

What's New In Minerals – Jeff Scovil

Auction Solicitors General – Bruce Gaber, Gloria Staebler

Auctioneers – Bruce Gaber, Carl Miller

Auction Technical Support Wizards - Dan Sperber, Dan Imel

Auction Preparation and Support Team - George Robinson, Betty Fetter, Charlene Freundlich, Bill Freundlich, Alicia Imel, Lauren Imel, Dan Sperber, Phyllis Sperber, Laurie Steele-Sperber

Registration Desk - Betty Fetter, Susan Robinson, Elizabeth Von Bacho

Worthy Keeper of the Micromounters' Playroom - Quintin Wight

Technical and Web Site Support - Dan Imel, Paul Dudley

Video - Tom White

Security - Bell Security and Investigations

Symposium Committee - Helen Chamberlain, Steve Chamberlain, Betty Fetter, Bruce Gaber, Dan Imel, Bob Morgan, Brian McGrath

Cover Art by Susan Robinson

