Friends of Mineralogy- Pennsylvania Chapter

Fall Symposium, November 11 & 12, 2023

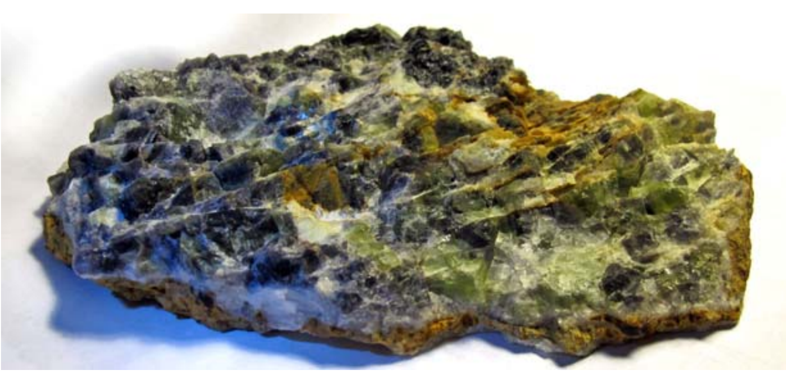
Pennsylvania Mineralogy and Geology

Presented Online and In Person at
Heritage Hall, University of Pittsburgh - Johnstown, Pennsylvania

Symposium field trip site: New Paris Quarry, Bedford County, Pennsylvania.

View through the quarry looking westerly, down at 45° angle, showing the final shot pile left by New Enterprise with the intention of improving safety. It covered the main fluorite vein and most of the quarry wall.

W. Stephens photo using DJI Mavic 3 Enterprise drone, Nov. 4, 2023.



Green and purple fluorite, ~ 6", probably collected in the 1970s.
D. Glick specimen & photo, ex-Pen Ambler, ex-Ed Carper.

Fluorite crystals from an old collection, each ~ 0.2".
W. Stephens specimen and photo.

Friends of Mineralogy

Dedicated to the advancement of serious interest in minerals and related activities

We are collectors, professionals, and curators who share a love of mineral specimens and the desire to promote understanding and appreciation of mineralogy.

FM's objectives are to promote, support, protect and expand the collection of mineral specimens and to further the recognition of the scientific, economic and aesthetic value of minerals and collecting mineral specimens.

National FM newsletters, links to other chapters, and much more can be found on their web site: **www.friendsofmineralogy.org**

Friends of Mineralogy - Pennsylvania Chapter

provides:

- the benefits of membership in the national organization
- an annual Symposium in November
- field trips
- quarterly illustrated Newsletter
- an extensive WWW site with news, downloadable books, and more
- **NEW!** Membership in EFMLS with its many benefits

Membership application forms are available on our web site

Please explore the FM-PA web site at

www.rasloto.com/FM/

Symposium Zoom information

The Zoom link is being sent via e-mail. The session opens at 8:00 a.m.

Please join promptly so that the Symposium can begin at 8:30 a.m.

Start by muting your microphone to avoid extraneous noises in the symposium.

Please submit questions via Chat (move cursor near bottom of screen to make line of icons appear).

Professional Geologists: Professional Development Hours

Certificate for 6 PDHs for full lecture attendance available on request.

Pennsylvania Mineralogy and Geology

Friends of Mineralogy - Pennsylvania Chapter Fall Symposium
November 11 & 12, 2023 University of Pittsburgh - Johnstown

SCHEDULE of EVENTS

		page
Friday, November 10: informal MEET & GREET, Sleep Inn, 6:00 p.m.		
Saturday, November 12: SHOW 8:00 - 6:00, free admission, Heritage Hall A		
Saturday, November 12: SYMPOSIUM, Heritage Hall B, University of Pittsburgh-Johnstown		
8:00 to 8:30 a.m. EST	Registration in Heritage Hall lobby	
8:30 to 8:40 a.m.	**Opening Remarks**	
8:40 to 9:25 a.m.	**William Kochanov, PG, Pa. Geological Survey, retired** **Gypsum Occurrence in the Lower Pennsylvanian Vanport Limestone, Lawrence County, Pennsylvania**	4
9:25 to 10:10 a.m.	**Andrew A. Sicree, PhD, Penn State Univ. & Harrisburg Area Community College** **Minerals from Centre County: From the bottom of the quarry to the top of the Sky**	6
10:10 to 10:20 a.m.	**FM-Pa Members: Chapter Membership Meeting** **<u>ALSO</u>**	
10:10 to 10:50 a.m.	BREAK- Check out the silent auction and visit the show.	
10:50 to 11:35 a.m.	**Robert J. Altamura, PG, PhD, Great Falls College – Montana State University** **A Model for the Cause of Iridescence in Plagioclase Feldspar and the Effect of Superimposed Polysynthetic Twinning**	8
11:35 a.m.-1:25 p.m.	LUNCH BREAK - lunch by advance order, or UP-J cafeteria or local restaurants <u>Silent auction continues until 1:25</u> - Room open during lunch	
1:25 p.m.	Silent Auction ends	
1:30 to 1:55 p.m.	**Bill Stephens, PG, Stephens Environmental, and Stephen R. Lindberg, University of Pittsburgh - Johnstown** **Geology & Mineralogy of the New Paris Quarry with Emphasis on Structural and Stratigraphic Relationships as Assessed Using Modern Mapping Techniques, Part 1**	10
1:55 to 2:40 p.m.	**Chris Howard, Aleya Shreckengost, and Ryan Kerrigan, PhD, University of Pittsburgh - Johnstown** **The Geochemistry and Petrology of the Bald Hill Bentonites in Southwestern Pennsylvania**	15
2:40 to 3:00 p.m.	**Aleya Shreckengost, University of Pittsburgh - Johnstown** **Examining Mineral Fluid Inclusions to Assess the Economic Potential of Allegheny Hydrothermal Systems**	16
3:00 to 3:30 p.m.	BREAK	
3:30 to 3:50 p.m.	**Christopher Coughenour, PhD, and Stephen Lindberg, University of Pittsburgh - Johnstown** **Insights from phosphatic conodont fossils recovered from a Silurian-inland sea at the New Paris quarry, Bedford County, Pennsylvania**	17
3:50 to 4:30 p.m.	**Bill Stephens, PG, Stephens Environmental, and Stephen R. Lindberg, University of Pittsburgh - Johnstown** **Geology & Mineralogy of the New Paris Quarry with Emphasis on Structural and Stratigraphic Relationships as Assessed Using Modern Mapping Techniques, Part 2**	**See p. 10**
4:30 to 4:50 p.m.	**Field Trip & Safety Instructions**	
4:50 to 5:00 p.m.	Distribution of Professional Development Hours certificates to PGs	
6:30 p.m.	Rock Giveaway at Krebs Hall	
Sunday, November 12: FIELD TRIP to collect and learn at New Paris Quarry see maps on pages		**19-20**
9:30 a.m. to 3:00 p.m.	**For Symposium Registrants Only.** Depart from Sleep Inn 9:30 a.m.	

Gypsum Occurrence in the Lower Pennsylvanian Vanport Limestone, Lawrence County, Pennsylvania

Bill Kochanov, PG
Pennsylvania Geological Survey, retired

The Vanport Limestone of western Pennsylvania is commonly noted for its diverse fossil assemblages, particularly large-diameter crinoid columnals. During preliminary assessment of stops for the 2005 Field Conference of Pennsylvania Geologists, an occurrence of gypsum was documented in an exposure of the Vanport limestone (Kochanov and Bragonier, 2005).

The Vanport is variable in thickness, maximizing to approximately thirty feet. The exposure at the Gateway Commerce Center (now Wampum Underground), the Vanport can be differentiated into upper and lower sections; the upper section being more planar bedded, whereas the lower appears as more nodular bedded. The base of the Vanport is underlain by the thin Scrubgrass Coal and shale. The Vanport is capped by a thin, sideritic layer identified as the "Buhrstone iron ore." This in turn is overlain by the Lower Kittanning series of siltstone, shale, and coal (Figure 1).

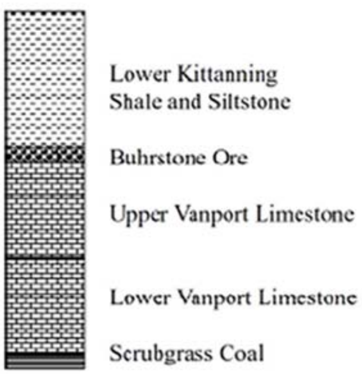


Figure 1. Generalized stratigraphic column showing the section at Wampum.

At first, the material was thought to have been calcite, but its failure to react with hydrochloric acid prompted further analysis. SEM analysis by the Pennsylvania Geological Survey confirmed that the crystalline material was gypsum. On site, gypsum occurs within the lower half of the Vanport where it is thinly sandwiched between bedding layers and within fractures (Figure 2). The gypsum displays well in sunlight as a sparkling drusy coating on the limestone (Figure 3). Within the major bedding parting between the upper and lower Vanport section, the gypsum was found loose as small nodules resembling hollowed geodes Figure 4).

To form gypsum (Ca_2SO_4), there needs to be a source of calcium and sulfate ions. In the limestone dissolution process, water interacts with carbon dioxide to form carbonic acid (H_2CO_3). This weak acid is the primary agent in the dissolution of carbonate bedrock, and in the long term, helps to develop a karstic landscape. When the carbonic acid comes in contact with limestone (the Vanport in this instance), calcium and the carbonate ions are disassociated, resulting in free calcium and the carbonate ions joining with water to form bicarbonate

Figure 2. Fracture-filled gypsum (left); gypsum "exuding" out from bedding partings (right).

Figure 3. Encrusting crystalline gypsum on limestone surface, closeup right.

ions. The Lower Kittanning suite of coal-bearing rocks accounts for the source of the sulfates via the oxidation of pyrite. For a more detailed discussion of this reaction series, see White (1988).

Figure 4. Gypsum “geodes” (left), SEM photograph (300X) of gypsum (right)

In general:

Water plus carbon dioxide making carbonic acid

$$H_2O + CO_2 \rightarrow H_2CO_3$$

Calcite (limestone) dissolved by carbonic acid providing calcium and bicarbonate ions

$$CaCO_3 + H_2CO_3 \rightarrow Ca^{2+} + 2HCO_3^-$$

Secondly, sulfate ions must be generated. The sulfur within the pyrite must be oxidized and then sent on a search for the calcium ions freed from the limestone dissolution process to make gypsum. In this series of reactions, pyrite is oxidized to release dissolved Fe^{2+} (ferrous), SO_4^{2-} (sulfate) and H^+ ions.

$$FeS_2 + 7/2\ O_2 + H_2O \rightarrow Fe^{3+} + 2\ SO_4^{2-} + 2H^+$$

When the acidic water comes into contact with the limestone, the acid becomes neutralized, with the sulfate ions being unaffected. Evaporation of solution containing Ca^{2+} and SO_4^{2-} causes them to combine to form gypsum (White, 1988).

$$Ca^{2+} + SO_4^{2-} + 2H_2O \rightarrow CaSO_4 + 2\ H_2O$$

The iron in the pyrite can undergo further oxidation and change the ferrous iron (Fe2+) to ferric iron (Fe3+), which in turn can be precipitated as iron hydroxide $Fe(OH)_2$. This precipitation of iron as a hydroxide is usually in the amorphous form called limonite (White, 1988). This phase of the reaction series may have had a bearing on the development of the Buhrstone iron ore and accounted for the “ferriferous” nature of the Vanport in general.

The occurrence of gypsum at this locality provides the impetus for the individual to investigate the Vanport in other localities throughout western Pennsylvania as well as offering the collector an opportunity to add a unique specimen to their collection.

References and suggested Readings

Kochanov, W.E. and Bragonier, W., 2005, Stop 7. The Vanport limestone at Wampum: in Fleeger, G.M. and Harper, J.A., eds.,Type Sections and stereotype sections: Glacial and bedrock geology in Beaver, Lawrence, Mercer, and Crawford Counties, Guidebook for the 70th Annual Field Conference of Pennsylvania Geologists, p. 101-114.

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White, W.B., 1988, Geomorphology and Hydrology of Karst Terrains: Oxford University Press, New York, 464 p.

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Biography

William (Bill) Kochanov (ko-chan’-off) is a former Senior Geologist with the Pennsylvania Geological Survey. Although most noted for authoring the series of county reports specifically designed to characterize sinkholes and karst within Pennsylvania, he had also been the lead investigator for bedrock mapping projects in the Northern Anthracite Field, the Endless Mountain region, and within the Chester Valley of southeastern Pennsylvania.

Minerals from Centre County: From the bottom of the quarry to the top of the Sky

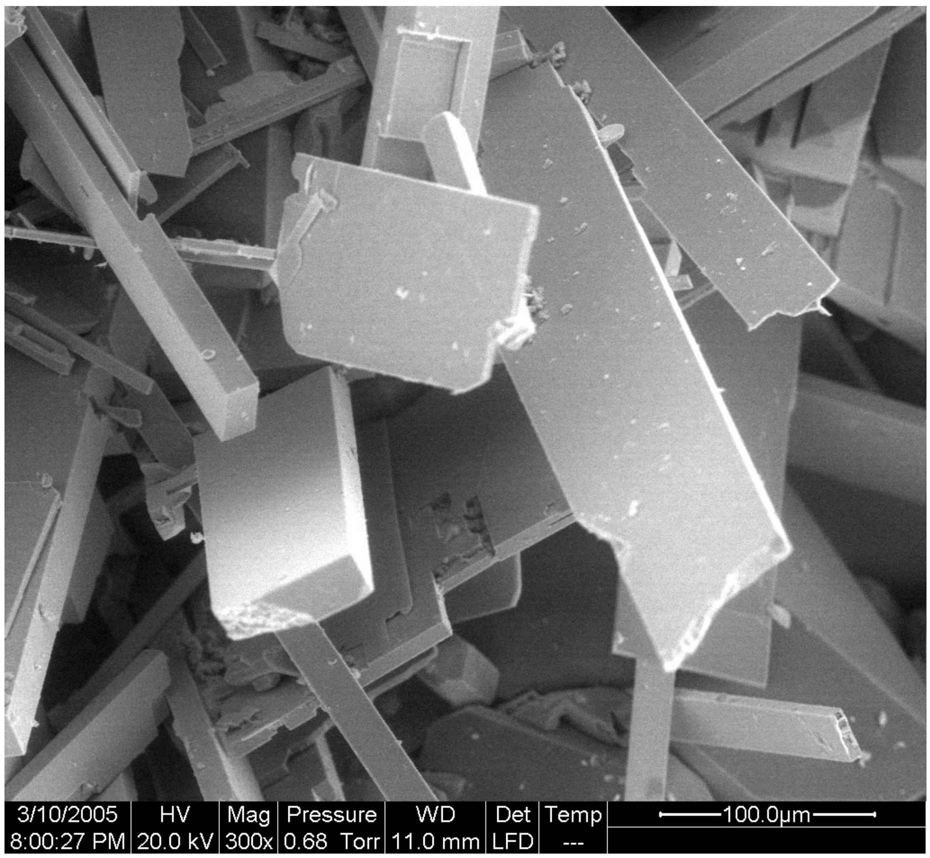
Andrew A. Sicree, PhD
Penn State University and Harrisburg Area Community College

Centre County, PA, is the source for some of the finest strontianites and the world's most unusual pyrites. College Township is the site of Oak Hall Quarry, an aggregate quarry located in Middle Ordovician carbonate rocks. Cross-cuttting veins in these limestones host small crystals of calcite, dolomite, fluorite, barite, pyrite, and quartz (locally called "Lemont Diamonds"). The limestones of the Ordovician Loysburg Formation contain several beds that have plentiful vugs (more or less rounded open spaces, up to about 20 cm in diameter). These vugs may have originally been filled with gypsum - some gypsum fillings have been found - but most of the vugs are found to be filled with calcite crystals and/or partially filled with strontianite. In partially-filled vugs, strontianite occurs as white, acicular radiating sprays of needle-like or chisel-like crystals up to 5 cm in length.

A drastically-different mineralogy occurs at the "Skytop" roadcut in Patton Township. Located in Silurian sandstones, construction of the I-99 roadcut through the Skytop ridge moved about 2 million tons of rock (much of which contained acid-producing pyrite and resulted in a multi-million dollar cleanup effort). The roadcut exposed cross-cutting veins containing small crystals of quartz, pyrite, sphalerite and galena. In some locations, the pyrite crystals were wildly-varying in morphology. Appearing to the eye to be fine "whiskers," studied under the ESEM, these pyrites were discovered to have a wide variety of shapes, including spear-like, lath-like, and stick-like crystals, as well as hopper-structures, and cubic and modified cubic crystals.

Quartz, clear crystal “Lemont diamond”, approx. 0.5", on pink dolomite. Oak Hall Quarry, Centre County, Pennsylvania. *J. Passaneau photo.*

Strontianite spray of radiating crystals, approx. 2", Oak Hall Quarry, Centre County, Pennsylvania.
J. Passaneau photo.



Pyrite showing various crystal shapes. I-99 “Skytop” roadcut, Centre County, Pennsylvania. *ESEM photograph by A. Sicree.*

Dr. Andrew Sicree earned his PhD in Geochemistry and Mineralogy from Penn State; he lives in Boalsburg near the Oak Hall quarry. He is involved in teaching to all ages of those interested in minerals and science, and currently teaches at Penn State University and Harrisburg Area Community College.

A Model for the Cause of Iridescence in Plagioclase Feldspar and the Effect of Superimposed Polysynthetic Twinning

Robert J. Altamura, PG, PhD
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Working on a relatively large plagioclase cabochon with impressive iridescence, I was inspired to review various aspects of plagioclase. Plagioclase feldspar is referred to as a solid solution series, meaning, a compositional variation ranging between end member minerals that share a similar chemical formula, but with substitution of elements in one or more atomic sites. Substitution can most easily occur when an element in the mineral formula can be replaced by another element of similar atomic diameter and electrical charge. In the case of plagioclase, there is a range of chemical compositions from $NaAlSi_3O_8$ (albite end member) to $CaAl_2Si_2O_8$ (anorthite end member) depending on the proportion of sodium and calcium in the crystal structure. Plagioclase is divided into six minerals based on compositional range of sodium versus calcium: albite, oligoclase, andesine, labradorite, bytownite, and anorthite.

All plagioclase is triclinic, has a Mohs scale of hardness of approximately 6, and a specific gravity ranging from 2.62 to 2.76. Plagioclase is a major component of the most common plutonic igneous rock and the most common volcanic rock on our planet. In Pennsylvania, plagioclase is a crucial component of the granites of the Proto North American terrane and the diabases of the Gettysburg terrane.

The color of plagioclase can vary depending on sodium/calcium content and can range from white to yellow to bluish to gray in color. The optical phenomenon of iridescence in labradorite (~50-70% Ca in the formula) and peristerite (~0-25% Ca) (fig. 1) is believed to be due to immiscibility of plagioclase subspecies that occurs during the solid state as temperatures cool to less than 1,200ºC depending on exact pressure (Klein and Philpotts, 2013; Bowen, 1913; Weill et al., 1980). This talk will provide a phase equilibria model using an integration of plagioclase chemical composition and temperature at fixed pressure.

Figure 1: Photographs of cabochons (~1.25" except d, ~ 1.75") illustrating iridescence and polysynthetic twinning in peristerite and labradorite. a. Oval cabochon carved from peristerite ("moonstone") plagioclase showing iridescence. b. Tear-drop cabochon carved from peristerite illustrating polysynthetic twin lamellae. c. Heart cabochon carved from labradorite variety of plagioclase showing iridescence (schiller effect). d. Oval cabochon carved from labradorite clearly showing iridescence overprinted by polysynthetic twin lamellae. *D. Glick photos, 2023.*

Mineral grains occur over a wide range of sizes. These grains are individual crystals that generally are interlocked with neighbor grains. They are considered mineral grains and not crystals, because they lack well-developed crystal faces, because of their close intergrowth with adjacent grains. Well-formed crystals of considerable size are relatively rare in nature because they mainly occur in coarse-grained assemblages found in pegmatites or quartz veins. Rarer are well-formed twinned crystals or twins. Primary or growth twins are the result of atoms attaching on the outside of a growing crystal in such a way that the original pattern of the crystal structure is interrupted but in a regular way.

Secondary twinning is a process that causes twinning intergrowth after crystal growth is completed. Secondary twinning can result from mechanical deformation and also from the displacive transformation of one polymorph into another.

Classification of twinning (see figure 2 for mineral example line drawings):
- Contact twins: have a definite compositional surface separating the two individuals.
- Penetration Twins: comprise interpenetrating individuals having an irregular composition surface.
- Multiple or repeated twins: 3 or more crystals twinned. A polysynthetic twin results if the composition surfaces are parallel (see figures 1c and 1d for plagioclase cabochon photographs).

Examples of plagioclase illustrating both peristerite range intergrowth and labradorite range (Bøggild) intergrowth immiscibility (iridescence) overprinted by later polysynthetic twinning (fig. 1d) will be discussed.

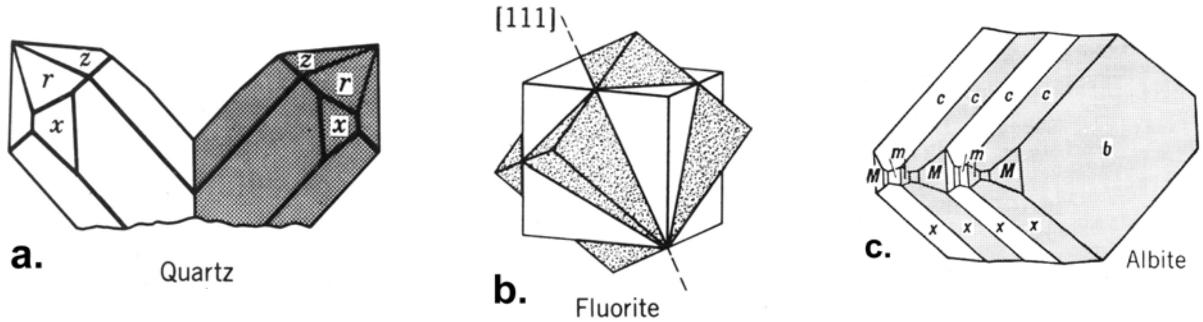

Figure 2: Line drawings showing examples of a contact twin, a penetration twin, and polysynthetic twins. (modified from Klein and Hurlbut,1993). (a) Right- and left-handed contact twinned quartz crystals (twinned along a contact plane). (b) Two penetrating cubes of fluorite (twinned along a axis). c. Polysynthetically twinned plagioclase (twinned by mirror planes).

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Bowen, N.L., 1913, The melting phenomena of the plagioclase feldspar, American Journal of Science, Vol 34, pages 577-599.

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Weill, et al., 1980, The igneous system $CaMgSi_2O_6$-$CaAl_2Si_2O_8$-$NaAlSi_3O_8$: variations on a classic theme by Bowen, in Physics of Magmatic Processes, editor - R.B. Hargraves, Princeton University Press, Princeton NJ, pages 49-92.

Robert Altamura, a Ph.D. graduate of the College of Earth & Mineral Sciences at Penn State, arrived in central Pennsylvania from Middletown, Connecticut, as a graduate of Wesleyan University and as a freelance consultant to the Connecticut Geological Survey as well as several New England mining companies. He has been a professor at several universities in the northeast and in California. He is a licensed professional geologist and has authored approximately 100 publications. He is semi-retired and currently teaches online geology for Great Falls College of Montana State University and for OLLI at Penn State. He has been studying the geology of Pennsylvania for more than 30 years. His recent publications and current research focus involve active tectonics in New England and offshore.

Geology & Mineralogy of the New Paris Quarry with Emphasis on Structural and Stratigraphic Relationships as Assessed Using Modern Mapping Techniques

Bill Stephens, PG, President:
Stephens Environmental Consulting, Inc.
Eastern Federation of Mineralogical and Lapidary Societies, Inc.
Friends of Mineralogy Pennsylvania Chapter

Steve Lindberg, Adjunct Instructor
University of Pittsburgh, Johnstown Campus
Energy and Earth Resources Department

The New Paris Quarry is an important albeit small quarry located in western Bedford County, Pennsylvania, formerly owned and operated by the New Enterprise Stone and Lime Co. and originally opened by J.S. Taylor in 1929. According to Miller (1934), the New Paris quarry was one of seven local quarries that were mining the "Helderberg" Limestones that were burned in stone kilns and open heaps to make lime. The New Paris quarry was recently sold to the adjacent landowner who has graciously allowed UPJ to conduct investigations and instructional events at the quarry as an educational site.

The New Paris quarry is a unique geological location. The New Paris limestone quarry exposes an exceptional series of upper Silurian and lower Devonian limestone units. The Silurian-Devonian boundary as well as bentonite beds and formation contacts are exposed in the quarry. The quarry provides a wealth of stratigraphic and depositional sequences that enable a reconstruction of the paleo-environment of the region during the middle Paleozoic Era. Abundant fossils that include brachiopods, corals, bryozoans, trilobites, and stromatoporoids offer a clear picture of invertebrate life that flourished within the shallow seas.

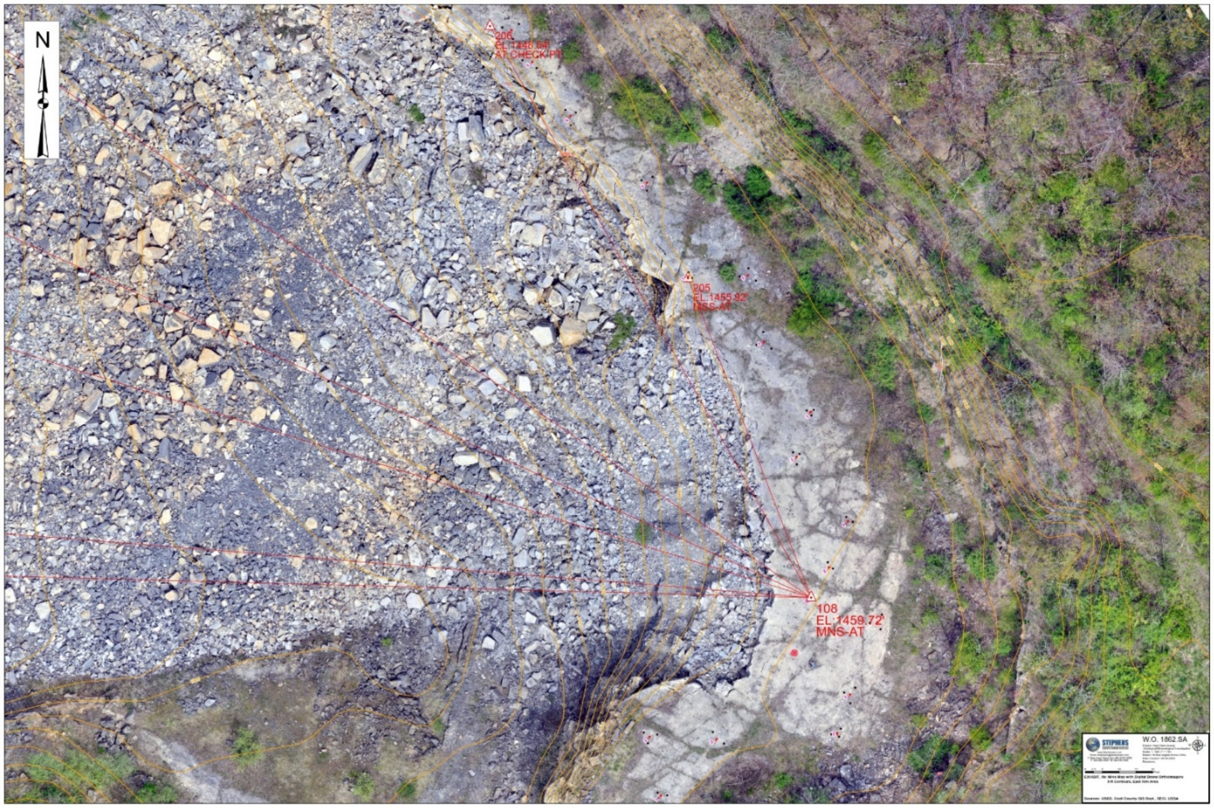
The New Paris quarry is located on the gently westward dipping flank of Chestnut Ridge, in the eastern portion of the Allegheny Front within the climb-out zone between the Appalachian Valley and Ridge and Appalachian Plateau Provinces. Within the quarry, beds strike generally NNE and dips vary from approximately 8º west northwesterly in the western part of the quarry to as little as 2-3º in the eastern part of the quarry based on recent mapping. Two prominent joint sets, near vertical, antithetical and nearly 90º to each other cut bedding at near 90º.

Modern mapping techniques have been employed to develop a more accurate picture of stratigraphic and structural relationships in the quarry. These techniques include low-altitude drone mapping with surveyed ground control, strike and dip measurements using a robotic total station (direct and remote reflectorless observations) as well as bedding observations. From these techniques, accurate spatial information, structural, and stratigraphic information were obtained and used to prepare an accurate composite stratigraphic section and to measure several veins.

Evidence of low temperature hydrothermal activity is substantiated by the presence of mineralized veins that contain calcite and fluorite, fluorite crystals being of most interest to collectors. The structural analysis demonstrates the fluorite-bearing calcite veins are restricted to only one parallel joint/fracture set, though these veins are observed to follow subsidiary fractures to intercept adjacent parallel joints. Unfortunately, the main fluorite producing calcite vein is currently covered by the final shot pile left by New Enterprise as a safety precaution. Examples of crystalized fluorite can be found in many older collections and subhedral to euhedral crystals embedded in calcite can still be found in veins attached to the shot boulders and in the wall, though free-standing euhedral crystals are likely rare.

Hi Resolution Digital Ortho mosaic prepared from over 700 individual nadir camera shots taken as a mapping mission using a Mavic 2 Pro drone. The cameras were processed in DroneDeploy with a dozen survey quality ground control points. 5 Feet contours exported from Drone Deploy show current topography at the quarry on the flight date 04-30-2022. The red lines indicate intervisibility between Network GPS and conventionally surveyed GCPs.

Continued on p. 12



Enlarged view of the north and part of the east middle bench showing GCP/ Traverse point information and strike and dip locations taken by conventional survey methods as opposed to a Brunton Compass. The bright white boulders show upward facing calcite veins.


View looking westerly from the middle bench showing shot pile left prior to property transfer from New Enterprise Stone and Lime Co. Very white surfaces on large blocks are likely calcite veins possibly with fluorite.

View looking westerly showing preferential orientation of calcite veins nearly perpendicular to very gently diping bedding and also to near vertical joints devoid of calcite. The thicker calcite veins tend to contain collectible fluorite.

Biography: Bill Stephens, PG

Bill Stephens is a licensed Professional Geologist (DE, GA, NC, PA, SC, UT, VA), current President of FM-PA Chapter, President of the Eastern Federation of Mineralogical and Lapidary Societies, Inc. (EFMLS) and President of Stephens Environmental Consulting, Inc., a full-service environmental consulting, engineering, and surveying company serving in the Mid-Atlantic Region since 1995. Bill is also the current EFMLS Region IV RVP, and a past VP of Programs for the Delaware Mineralogical Society. Bill started collecting about age 11, after being inspired by a National Geographic article on gems of the Eastern Appalachians. Family and later college buddy collecting trips focused on collecting mainly in North Carolina, with incidental trips to southeastern PA locations including Phoenixville, French Creek and Cornwall. More recently Bill has developed a passion for "machine digs", including Diamond Hill and Hogg Mines machine digs, from which real knowledge of these deposits can be obtained. Bill has done extensive mapping at Mohawk Valley Mineral Mining in Sprakers, NY and “Area 52” in Canajoharie, both newly opened private Herkimer Diamond Mines. Bill has mapped the now regionally famous Wavellite occurrence at the National Limestone Quarry at Mount Pleasant Mills, Snyder County PA. Bill uses his resources, including geological knowledge, GIS skills and drones to develop programs designed to inspire others and help provide them more tools to be more successful in their collecting adventures.

Biography: Steve Lindberg, Adjunct Instructor, UPJ

Steve Lindberg is an adjunct instructor of geoscience in the *Energy and Earth Resources Department* and began teaching at the University of Pittsburgh at Johnstown during the spring, 1997 semester. During the 2022-2023 fall and spring semesters Steve taught Physical Geology, Prehistoric Life, Earthquakes and Volcanoes, Meteorology, and Geologic Field Methods. After retiring from public education in 2012, Steve was able to increase his course load at Pitt-Johnstown and spend more time pursuing his interests in geology, especially invertebrate paleontology and the regional geology of western Pennsylvania. Steve has been a member of the *National Association of Geoscience Teachers (NAGT)* since 1992; the same year he was awarded the eastern section's *Outstanding Earth Science Teacher for Pennsylvania* by the National Association of Geoscience Teachers. Steve has twice served as president for the associations eastern section and is currently the section president for 2023-2024. He organized the eastern section May 2023 meeting held in Ithaca, New York and served as field trip leader for the three day conference. Steve will once again lead the spring, 2024 NAGT conference being held in Berkeley Springs, West Virginia. He is a member of the *Geological Society of America* and attends the northeastern section meetings on a regular basis. Steve served as a field trip leader and speaker during the 2022 *Field Conference of Pennsylvania Geologists* field trips; and will do so again for the 2024 conference in Gettysburg, Pennsylvania. In November of 2023, the Pennsylvania Chapter of the *Friends of Mineralogy* will hold their annual symposium here at Pitt-Johnstown; Steve is assisting in the organization of the weekend event. As a geologist and geoscience educator, Steve maintains a strong commitment to bring geoscience education to both students and others. Steve routinely arranges field trips for Pennsylvania rock and mineral clubs to the New Paris Limestone Quarry in Bedford County, which serves as a geoscience educational site. Some of his more recent geologic excursions include assisting EER department chair Dr. Ryan Kerrigan on spring break field trips to Iceland (2016), Scotland (2018), and a March 2022 trip to Hawaii.

The Geochemistry and Petrology of the Bald Hill Bentonites in Southwestern Pennsylvania

Chris Howard, Aleya Shreckengost, and Ryan J. Kerrigan

Department of Energy and Earth Resources, University of Pittsburgh at Johnstown, 450 Schoolhouse Road, Johnstown, PA 15904

The early Devonian (middle Lochkovian) Bald Hill Bentonites (BHBs) of central Appalachia have been examined through field, geochemical, and petrographic analyses to determine their tectonomagmatic setting. To the best of our knowledge, minimal trace element geochemistry exists on these K-bentonites; obtaining trace element geochemistry allowed for the testing of petrogenetic models/hypotheses to determine the type-eruptive source of the bentonites. Field work was undertaken at the New Paris Limestone Quarry in southwestern Pennsylvania, where three BHB units (BHB-B, BHB-B', and BHB-C; *respectively, oldest-to-youngest*) outcropped in mined sections of the Helderberg group. The BHB-B unit was observed to be ~1 ft thick and consists of basal calcite nodules, a stratified section, and an upper arkosic layer. A previously unidentified BHB unit (BHB-B') is situated between other known BHB units (BHB-B and BHB-C) and has been examined during this study. Both BHB-B' and BHB-C were observed to be ~3 in thick and consisted of only a stratified section. Representative samples were collected and submitted for bulk whole rock geochemical analyses for major, minor, and trace elements as well as thin-section production. Geochemical results were examined on multi-element variation (spider) diagrams, petrologic rock description plots, and petrogenetic discrimination diagrams. Major element data exhibit a shift in composition from felsic to mafic as the bentonite units get younger (from trachyandesite-andesite to foiditic), suggesting that progressive eruptions became increasingly more silica undersaturated. Rare Earth Element (REE) geochemistry plotted with respect to chondrite reveals a slight HREE enrichment, creating an overall broad U-shaped trend which could be attributed to secondary hydrothermal alteration. Trace element data plotted on petrogenetic discrimination diagrams supports that the magma composition likely originated from a volcanic island arc with some data plotting in the collisional source field. The timing and geochemistry support an association with early Acadian volcanic island arcs colliding with the eastern margin of North America and could provide insight on the tectonomagmatic dynamics of this orogenic event.


Near the Fagradalsfjall volcano, Iceland

I am a senior at the University of Pittsburgh at Johnstown majoring in Earth and Energy Resources with a double minor in Geography and certification in Geographic Information Systems. I'm interested in Geochemistry, Geomorphology, and Structural Geology. For the past two years I have spent my time working at the Pennsylvania Geological Survey, and this upcoming summer I plan on attending Indiana State University's Field Camp. I plan to graduate in the Spring of 2025 and continue my education in a graduate program.

Examining Mineral Fluid Inclusions to Assess the Economic Potential of Allegheny Hydrothermal Systems

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Hydrothermal veins exposed at the New Paris Limestone Quarry (Bedford County, PA) host the minerals calcite and fluorite which will provide valuable information about low-temperature hydrothermal systems present throughout the Allegheny region. Hydrothermal activity at this location is comparable to other instances of low-temperature hydrothermal alteration observed in Blair and Centre counties responsible for economic deposits of lead-zinc minerals. Hydrothermal minerals often trap and preserve fluid inclusions that can be examined to understand the nature of the hydrothermal alteration processes that deposited them. Fluid inclusions found in samples from the New Paris Quarry will be analyzed via fluid inclusion homogenization, in which samples will be heated and cooled under microscopic observation. Data from these analyses will offer definitive information on the origins of New Paris mineral veins, in addition to providing insight into the hydrothermal systems that alter the region and their potential for economic mineral deposition throughout the Alleghenies.

Ms. Aleya Shreckengost is a senior at the University of Pittsburgh at Johnstown majoring in Energy and Earth resources. Over the course of her curriculum, she has developed interests in mineralogy and geochemistry and hopes to achieve her Master of Science in Geochemistry. Aleya would like to pursue a career in renewable energy research and hopes that her ongoing projects will help expand her knowledge of geothermal processes. Aleya is thrilled to be involved in multiple research projects and will be presenting her results at the Geological Society of America's national conference in 2024.

Insights from phosphatic conodont fossils recovered from a Silurian-Devonian inland sea at the New Paris quarry, Bedford County, Pennsylvania

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The New Paris limestone quarry in Bedford County, PA provides one of the best exposures of the Silurian-Devonian boundary interval (~417 Ma) in the northeast. Sediments exposed in the quarry walls and floor were deposited in a large inland seaway over a span of several million years The quarry, now decommissioned, harvested limestones used in steel smelting, erosion control, and other endeavors. The site is well-known in the geologic community for its mineral (calcite and fluorite) and fossil collecting opportunities. It offers valuable access to what is an understudied interval in Pennsylvania with imprecise dates for limestones and volcanic ash-derived bentonites in the region.

Fossil conodonts are important index fossils that are widely used in biostratigraphy to establish precise dates in ancient marine deposits. The body of the conodont animal is very rarely recovered (to date, only several specimens from two genera), but indicates relation to jawless lampreys and hagfishes. Conodont "elements" are microscopic teeth-like structures that are commonly preserved. Elements are composed of hydroxylapatite ($Ca_5(PO_4)_3(OH)$), which changes color in response to burial depth temperatures. Conodonts were often cosmopolitan, evolved quickly and were often relatively short-lived (at species level). Conodonts can represent small intervals of time that can be correlated to other limestones around North America.

In this study, 1 kg limestone samples from five intervals at New Paris were collected and sent for processing of conodonts. Sampling spanned the quarry floor to the second highwall (~15 vertical meters) and four lithologic units. Conodonts were recovered in four samples. Color alteration indicated burial temperatures of 150º-300º C. The quarry floor (upper Jersey Shore Member) reveals no conodonts belonging to known Devonian sequences and dates to the Pridoli Epoch in the latest Silurian. The overlying LaVale Member sample was barren. The Corriganville Member samples taken around the bentonites ("B" and "C") all revealed a lower to middle Lockhovian affinity at the base of the Devonian system. Individual species compositions were similar in the near-bentonite samples, but will be explored further for correlations to possible data from similar beds in New York and Virginia.

Dr. Chris Coughenour is a graduate of Drexel University with a B.S. in Physics (Pennoni Honors College) and a Ph.D. in Environmental Science with an emphasis on the stratigraphy and hydrologic controls on sedimentation in tidally-influenced streams (primarily in Cook Inlet, Alaska). Analyzing ancient cyclic tidal deposits to calculate long- term changes in the Moon's orbital distance and period has also been a recurring theme in his research. Fun fact: The Moon is receding from Earth at 3.8 cm/year (data from lunar ranging facilitated by the Apollo 11 mission).

Following completion of graduate studies, Dr. Coughenour served as a faculty member at The Evergreen State College in Olympia, WA for three years. He found his way to Pitt-Johnstown in 2013 and served as EER Department Chair from 2014-2020.

Sedimentology, surface hydrology, and stratigraphy are continued interests at UPJ, with emphasis now on Johnstown-area sites and geoscience education. In September, the culmination of a 5-year project studying the Little Conemaugh watershed was published with colleague/alum Neil Coleman and alum Anthony Taylor (who was a student researcher). Somehow, this was the first peer-reviewed study of this historic flood-prone basin. Aside from quantifying discharge recurrence, a long-term goal of the project is to highlight aging infrastructure and the continued peril that flooding poses to the region. The work also represents a continuation of 1889 flood research begun by the late Dr. Uldis Kaktins.

Dr. Coughenour is also pursuing a student-driven project on the petrology of the Loyalhanna Limestone, a UPJ tradition! Is it marine or is it aeolian? Several students and alums have logged significant time collecting samples and performing literature reviews in preparation for grain size analysis from different regional localities, some with strong indicators of marine deposition (such as large brachiopods). This is a work in progress. Detailed clast size data in context can allow calculation of physical constraints on the transporting medium (air vs water), while analogs from modern systems in the literature can also help address the question.

Dr. Coughenour is the 2022-23 awardee of the Division of Natural Sciences Edward A. Vizzini Educator of the year. Dr. Coughenour lives in Somerset County with his wife and two children. He loves long walks on the beach (or anywhere there's interesting sediment), playing music, spending time with family and friends, and renovating an old house.