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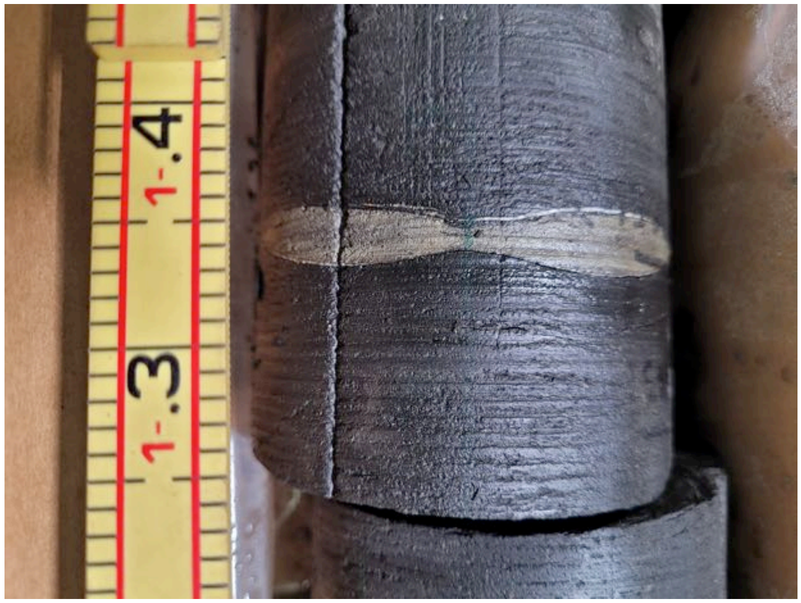

A barite nodule in the Union Springs Member of the Marcellus Formation from a depth of 7,456 feet in a core drilled in Allegheny County, Pa. (Scale in hundredths of a foot.) The core was obtained as part of the Eastern Gas Shale Project, and relevant data are still being obtained from it (see article on page 3).

EDITORIAL

It's All About People

Gale C. Blackmer, State Geologist
Pennsylvania Geological Survey

Scientists are not always the most gregarious of folks. I'm pretty sure that some of us became geologists because we can spend our days communing with rocks and not have to deal with humans. That said, the articles in this issue remind us of how closely people are involved in our work. Geology is a broad science that covers many aspects of the natural world, allowing or even requiring the development of narrower areas of specialization. It is often necessary to bring together teams of specialists to build a full analysis that moves a project forward, as described in the lead article about examination of a rock core from our Rock Sample Library. Similarly, state geological surveys like to build systems for describing, classifying, and naming the earth materials and geologic units in their own proprietary patch of the earth. However, when it comes time to stitch all those patches together into a "seamless" map of the nation, as the U.S. Geological Survey has been charged to do by Congress, we must work with our colleagues in neighboring states to understand and dissolve (as much as possible) the differences across state lines.

Of course, we can't overlook that rocks and water and soil don't care whether we study them. The ultimate purpose of our work is to benefit people. This is illustrated especially well by the work of the bureau's newest employees—outreach, water resources, natural hazards, and shepherding budgets. Our work has intrinsic scientific value, but its real fulfillment lies in the ways that it improves the lives of our fellow citizens.

Gale C. Blackmer

Group Effort Rock-Core Description—How a Legacy Core Can Help Inform Today's Research

Katherine Schmid
Pennsylvania Geological Survey

INTRODUCTION AND BACKGROUND

Rock cores provide a snapshot of the earth's subsurface. Storing these cores provides the opportunity for many different studies to be carried out on the rocks. Multiple studies may be performed to address different questions such as the depositional environment of the rock, economic resources that might be obtained from the rock, or how the rock will react to injected fluids. Core descriptions such as those in this paper provide a starting point to answering these questions. Additional studies may be repeated on a core as technology and methods improve.

As part of the **Midwest Regional Carbon Initiative** project (MRCI) (https://www.midwestccus.org/), I traveled from Pittsburgh to the Middletown office of the Pennsylvania Geological Survey to describe American Petroleum Institute core number 37–003–20980, otherwise known as EGSP4. The core is from a hole drilled in Allegheny County, Pa., at latitude 40.197236 and longitude –79.899999 (NAD83). The MRCI project, a continuation of the **Midwest Regional Carbon Sequestration Partnership**, is a geologic carbon sequestration project sponsored by the U.S. Department of Energy. Based on a region of more than 20 states, the goal of this project is to provide a foundation for carbon capture and storage technologies that can be commercially deployed throughout the United States. This project also includes monitoring technologies to ensure the safe sequestration of carbon dioxide.

The EGSP4 core was obtained during the **Eastern Gas Shale Project** (EGSP), which ran from the late 1970s through 1992. During this project, research teams studied Mississippian and Devonian organic-rich shales in the Appalachian and surrounding basins to describe the geologic, stratigraphic, and structural characteristics of these unconventional shale reservoirs to enhance production. For this project, five wells were drilled in Pennsylvania, and the cores are stored in the bureau's sample library (Harper, 2008). When the project was completed, the deeper organic-rich shales were not considered attractive production targets using the technology of the time (Harper, 2008).

However, when gas prices rose in the early 2000s, interest in these deep organic-rich shales returned. In the 2000s and 2010s, rock cores and cuttings stored in the Pennsylvania Geological Survey's core library were studied to learn about the potential for gas production from organic-rich shales and for the best ways to produce gas from the reservoir. To achieve these ends, researchers looked at attributes such as the organic carbon content, the thermal maturity, and the mineralogy of the rock (e.g., Schmid and Markowski, 2017; and Clark and Schmid, 2018). Although the EGSP4 core was collected more than 30 years ago, it was identified as an important datapoint for current projects such as MRCI and can inform shale's potential to store and trap carbon dioxide.

MRCI researchers are interested in this core because carbon dioxide preferentially adsorbs onto organic matter in rocks (Murugesu and others, 2023). Adsorption is a process in which a gas adheres to the surface of a solid and forms a condensed layer. For safe sequestration of carbon dioxide, it is important to consider not just the porosity and permeability of the host rock and the caprock, but the geochemical reactions of the carbon dioxide with the minerals in both formations. Rather than considering how the minerals in the rock will react to the fluids used while drilling and completing a well, for this project, we need to examine how they will react to carbon dioxide injected into the shale.

Due to MRCI's interest in carbon sequestration in the Devonian organic-rich shales, I was tasked with examining the core from the top of the Geneseo Shale member of the Genesee Formation at 7,060 ft to the bottom of the Onondaga Limestone at a depth of 7,500 ft (Figure 1). The Devonian black shales of the Hamilton Group (which includes the Moscow Shale through the Union Springs member of the Marcellus Formation) in the Appalachian basin were described by de Witte and others (1993). In descending order, this group includes the Moscow, Ludlowville, Skaneateles, and Marcellus Formations (using the terminology of Carter, 2019). These formations are divided by thin but extensive fossiliferous limestones including the Tichenor, Centerfield, and Stafford limestones (de Witte and others, 1993).

CORE DESCRIPTION METHODS

Thoroughly describing rock core requires geologists with various specializations such as paleontology and mineralogy. Traveling to the bureau's main office gave me access to geologists with these different specialties to assist with the core description process.

Detailed rock core description requires many steps. The steps performed in this process are shown in Table 1. Survey intern Cheyenne Woodward assisted me in describing the core.

Before a researcher examines a rock core, a good policy is to review past publications concerning the core. If no previous work has been done with the core, researchers are encouraged to review work done on nearby cores or regional geology. Next, a well-lit area is prepared in which to examine the rock core. Rock colors can be difficult to determine in poor lighting. Finally, the rock is sprayed with water to remove any debris that may have collected on the rock during storage or from the coring process.

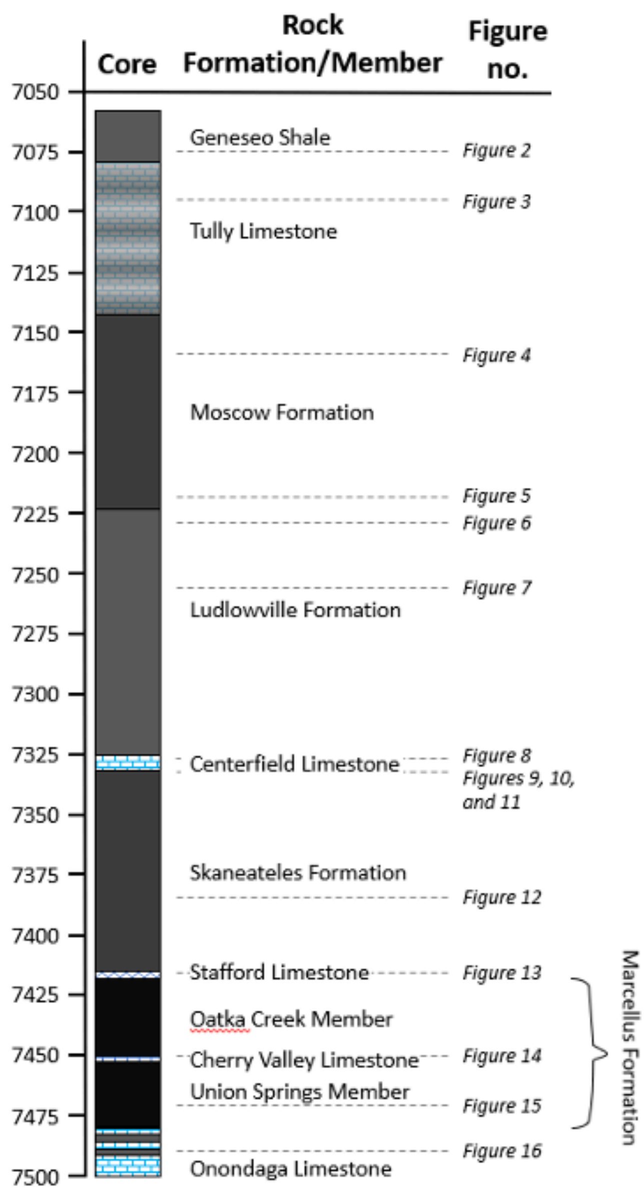

Figure 1. Section of Devonian core described from well 37–003–20980. The relative thicknesses of the formations are as observed in the core. The numbers to the left express the depth of the core in feet below ground surface. The shades of gray shown for the shales reflect the colors observed in this core.

Table 1. Core Description Steps

REVIEW CORE DESCRIPTION from previous work on it *(for example, Tamulonis and Carter, 2021)*

SET OUT CORE in depth order in a well-lit area

SPRAY CORE with water from a spray bottle to rinse off any dust and moisten the core. *Freshly obtained cores tend to have dust or drilling mud on them as a result of the drilling process.*

DETERMINE ROCK COLOR by comparing its color to color plates in the 2009 revision of the "Geological Rock-Color Chart—With Genuine Munsell Color Chips." *Bedrock color can be used to help distinguish formations, and color in shale has been shown to correlate to the organic content of the shale.*

I had been given a hard copy of this chart soon after I started working for the bureau. It can now be obtained online at https://commons.wikimedia.org/wiki/File:Rock-color-chart-2009_hg.jpg (accessed August 9, 2023), Creative Commons license https://wikidata.org/wiki/Special:EntityPage/Q18199165, creator: https://commons.wikimedia.org/wiki/user:Hgrobe

DRIP 10 PERCENT HYDROCHLORIC ACID on the core at any apparent facies change to see how calcareous the rock is; in other words, how much the rock reacts with the acid. *It is important to know how calcareous a rock is in order to predict potential chemical reactions with the rock.*

EXAMINE CORE for any distinguishing features such as fossils, fractures, or crystals. *This is done simultaneously with determining the color of the core and testing it with acid.*

FOSSILS	FRACTURES	MINERALS
Fossils can be used to identify the depositional environment of the rock, which can help determine its gas-production potential. Most of the fossils in this core formed through a process of replacement, in which dissolved minerals in the rock replaced the original material forming the original organism. Kristen Hand, Chris Oest, and Aaron Bierly aided with fossil identification.	Fractures are important to identify, because they can provide pathways for fluid to flow, or they can provide information on the stress field in the subsurface rock (National Research Council, 1996).	Crystals in sedimentary rocks generally reflect changes to the rock after deposition. Steve Shank assisted with mineral identification. In two places, minerals were identified using the bureau's handheld XRF device.

TAKE PHOTOGRAPHS of distinguishing features in the core. I was able to get good photographs with my cell phone. *John Neubaum, who runs the core laboratory in the bureau's main office in Middletown, has an excellent setup, which includes rollers to set core boxes on, bright lights, and a camera. Unfortunately, we were not able to get good detailed photographs of the core using that camera.*

For the first part of this description, Cheyenne Woodward and I compared the color of the moistened core to color plates in the 2009 revision of the *Geological Rock-Color Chart—With Genuine Munsell Color Chips,* a guide which I received soon after starting work for the bureau. Bedrock color can be used to help distinguish formations and/or minerals. For example, Clark and Schmid (2018) identified the top of the Bald Eagle Formation by noting the change of colors in the cuttings collected from a deep well in Tioga County. In shales, it has been shown that black coloration generally correlates with the organic richness of the shale (Harper, 2008). Data from Nuttall and others (2005) showed that black organic-rich shales can sequester significant amounts of carbon dioxide and that the absorptive capacity is proportional to the organic carbon content of the shale. In other words, darker shales are expected to absorb more carbon dioxide.

While we were recording the colors and depths of the color variations, Cheyenne and I applied 10 percent hydrochloric acid to the core at apparent facies changes to help identify the rock type. Calcareous rocks such as limestone react strongly with acid but can vary from very light to very dark in color, as they do in this core, so they can be difficult to distinguish without using acid. Less calcareous rocks will react less strongly to the acid and noncalcareous rocks will not react at all.

Cheyenne and I also examined the core for any distinguishing features such as fossils, fractures, or minerals. Photographs of some of these features (Figures 2 through 16) are included in the Figure Gallery at the end of this article (starting on page 10).

A fossil is defined as "any naturally formed record of animal or plant life found in rocks" (Hoskins and others, 1983, p. 1). Fossils give us information about the climate of the earth where and when the fossil was deposited. This information in turn can be used to help locate mineral resources such as oil, natural gas, or limestone (Hoskins and others, 1983). Fossils may be casts or molds, which only preserve the impression of one side of the plant or animal (for example, the impression of a shell). The plant or animal may also be preserved through a process known as replacement, in which the original components of the plant or animal are replaced by minerals such as quartz or pyrite, which are delivered into the rock by fluids. Preserved tracks or burrows are referred to as trace fossils (Figures 6, 9, and 10). As I am not a paleontologist, Chris Oest, Aaron Bierly, and Kristen Hand assisted me with identifying the fossils in this core.

A fracture is a break in a rock such as a joint, which does not have any visible offset, or a fault, which does have visible offset that allows fluids to flow through the rock. Some of these fluids may deposit minerals, such as calcite, which may eventually fill, or "heal," the fracture (Figure 5). The width of the calcite in this joint reveals the minimum amount the fracture was open while the calcite was being deposited (National Research Council, 1996). Alternatively, fractures may remain open and preserve evidence of movement along the break, such as slickensides (Figure 15). Fractures can also provide information about the stress field in the subsurface of the earth at the time the fracture formed (National Research Council, 1996).

Crystals in sedimentary rocks generally reflect changes to the rock after deposition of the sediments. For safe sequestration of carbon dioxide, it is important to consider the geochemical reactions of the carbon dioxide with the minerals in both the host rock and the overlying caprock. When injected into the subsurface, carbon dioxide will acidify existing brines in the subsurface; this triggers dissolution of some minerals. Montegrossi and others (2023) performed diffusive reaction experiments on shales and carbonate samples and observed reactions in carbonate minerals and pyrite defining a reaction front. Pyrite, also known as fool's gold, is a bright-yellow to brown metallic mineral that was observed at many depths in this core (Figures 2, 3, 4, 6, and 7). Steve Shank assisted with the mineral identification. In two places, minerals were identified using the bureau's handheld x-ray fluorescence (XRF) device.

Finally, I took photographs of these distinguishing features in the core (see Figure Gallery). These photographs help illustrate the features that I have described and make it possible for other scientists to see these features without traveling to the core library in Middletown. Photographs in this article are shown in depth order as encountered in the core (Figure 1).

CORE DESCRIPTION

The top of the Upper Devonian Geneseo Shale in the core is at 7,060 ft, and the base is at 7,077 ft. This shale is mostly a noncalcareous grayish-black to black thinly bedded mudstone with a few pyrite nodules at depths of 7,060.4, 7,074.18, and 7,074.35 ft. Figure 2 shows a pyrite nodule at 7,074.18 ft that is a little less than one one-hundredth of a foot thick. This mudstone is slightly calcareous in a couple of intervals at depths of 7,068.3 to 7,071.6 ft and 7,076.3 to 7076.8 ft; in other words, the rock fizzed a little with the hydrochloric acid.

The top of the Upper Devonian Tully Limestone in the core is at 7,077 ft and the base is at 7,135.4 ft. This bedrock reacted strongly to the hydrochloric acid. The limestone varies from medium light gray to dark gray, is medium to thickly bedded, and has pyrite and fossils scattered throughout. More pyrite was observed in the darker limestone layers. Figure 3 shows an irregularly shaped pyrite nodule in the Tully Limestone.

The top of the Middle Devonian Moscow Formation is at 7,135.4 ft and the base is at 7,221.4 ft. This shale is mostly a noncalcareous dark-gray to grayish-black moderately to thinly bedded mudstone with a thin calcite-healed fracture at 7,142.2 ft and pyrite nodules at 7,162.8, 7,163.1, and 7,189 ft (Figure 4 shows two of these nodules). Though a slightly calcareous interval was observed from 7,218.8 to 7,221.4 ft, no Tichenor Limestone was observed at the base of the Moscow Formation in this core.

The top of the Middle Devonian Ludlowville Formation is at 7,221.4 ft and the base is at 7,330.8 ft. This formation is mostly a noncalcareous dark-gray moderately to thinly bedded mudstone containing many interesting features. It has multiple calcite-healed fractures at 7,222.5 to 7,223 ft (Figure 5); pyrite-filled burrows at 7,227.55 ft (Figure 6); and a fossil (possibly a fragment of a gastropod) filled with pyrite and calcite at 7,256.25 ft (Figure 7).

The Centerfield Limestone defines the base of the Ludlowville Formation. The top of this limestone is at 7,325.4 ft and its base is at 7,330.8 ft. It is a medium-dark-gray to dark-gray limestone having numerous fossils, pyrite nodules, pyrite-replaced fossils, and pyritized burrows. The fossils at 7,325.1 and 7,325.4 to 7,326.18 ft (Figure 8) are probably solitary rugose coral fossils as identified by Kristen Hand, Chris Oest, and Aaron Bierly. In addition to these fossils, a burrow lined with pyrite was observed at a depth of 7,327 ft (Figure 9 and Figure 10). Chris Oest looked at this burrow and identified it as belonging to either the *Zoophycos* or *Nereites* ichnofacies, which can be used to help identify the depositional environment of the bedrock. These ichnofacies are found in the bathyal and abyssal zones of the continental shelf. Deeper in the Centerfield Limestone is a fossilized brachiopod that Aaron Bierly originally identified as belonging to the genus *Lingula*. It has since been reidentified as *Orbiculoidea* (Figure 11).

The top of the Skaneateles Formation is beneath the Centerfield Limestone at 7,330.8 ft, and the base is at 7,417.4 ft. It is a dark-gray to grayish-black thinly bedded shale that is mostly noncalcareous, but it does have some calcareous layers. One of these calcareous layers is mottled olive gray to medium dark gray and contains some fossil fragments at 7,382 ft (Figure 12). Numerous fractures partially healed by calcite were noted in this formation. Wavy beds and slickensides were observed between depths of 7,340.6 and 7,342.25 ft. The slickensides looked like S-shaped surfaces along the wavy bedding. Only one pyrite nodule was observed in this formation at 7,399.2 ft.

The Stafford Limestone is at the base of the Skaneateles Formation. Its top is at 7,416.5 ft and its base is at 7,417.4 ft. The contact angle between the deepest grayish-black to black shale of the

Skaneateles and the Stafford has a dip of about 20 degrees. The Stafford Limestone is a moderately bedded olive-gray limestone. Numerous rugose coral fossils occur in the top three inches of the limestone. The coral fossils are not in life position, as indicated by the variety of angles at which they occur in the core (Figure 13). Some pyrite was observed at the base of the limestone.

The top of the Marcellus Formation is the base of the Stafford Limestone. The Marcellus Formation has an upper shale known as the Oatka Creek Member and a lower shale known as the Union Springs Member. These two shale members are separated by the Cherry Valley Limestone in Allegheny County, Pa. (Carter, 2019). In this core, the first noncalcareous shale beneath the Stafford Limestone was identified as the top of the Oatka Creek Member at 7,417.4 ft. This mostly noncalcareous grayish-black shale continues to a depth of 7,452.2 ft. A couple of calcite-healed fractures were observed in this member. Soft-sediment deformation was observed in this shale from 7,446.6 to 7,447 ft. An olive-gray noncalcareous nodule of a mineral was observed at a depth of 7,426.9 ft. Steve Shank used a handheld X-ray fluorescence (XRF) device to identify a noncalcareous nodule of the same color deeper in this member at 7,449.4 ft and found it to be composed of barite (Figure 14).

The Cherry Valley Limestone is a thin bed of calcareous grayish-black thinly bedded mudstone that extends from 7,452.2 ft to 7,455 ft. To assist with his own field mapping, Aaron Bierly also examined the Cherry Valley Limestone in this core. He compared the thin limestone in the core to a large limestone boulder that he had seen in a quarry, and he determined that the boulder did not look like this horizon.

The Union Springs Member of the Marcellus Formation is a noncalcareous to calcareous grayish-black shale that starts at 7,455 ft. The contact between the organic-rich shale of the Union Springs Member and the Onondaga Limestone is transitional in this core. In this member, another barite nodule was observed and tested by Steve Shank with the handheld XRF at 7,456.35 ft (see photograph on cover). A pyrite nodule was observed at 7,458 ft. From 7,458.6 to 7,469 ft, the shale becomes calcareous and contains scattered pyrite. A deformed bed with slickensides was observed at 7,464 ft. An alternating light-gray and dark-gray laminated limestone was observed from 7,469 to 7,469.7 ft. From 7,469.7 to 7,482.9 ft the shale is calcareous to slightly calcareous and grayish black. In this section, several calcite-healed and partially healed fractures were observed, as were numerous pyrite nodules. Slickensides were observed at 7,470 ft (Figure 15), 7,476.2 to 7,476.5 ft, and 7,477.1 to 7,477.8 ft.

In the core, I identified the top of the Onondaga Limestone at 7,482.9 ft. However, Tamulonis and Carter (2021) identified the top of the Onondaga Limestone at 7,490 ft. The difference in these two interpretations could result from the contact being transitional, and it could also be related to the resolution of the instruments used in the geophysical logging of this well. In this core, the top of what I am calling the Onondaga Limestone is a very light-gray and dark-gray moderately bedded limestone with subvertical calcite-healed fractures throughout. This limestone extends from 7,482.9 to 7,484.7 ft. The core is a calcareous grayish-black mudstone from 7,484.7 to 7,485 ft and a noncalcareous grayish-black mudstone from 7,485 to 7,488.2 ft. From 7,488.2 to 7,488.7 ft, the core is a grayish-black fractured limestone with some slickensides. There is a layer that has some pyrite and possibly barite at 7,486.6 ft (Figure 16). The core is grayish-black shale from 7,488.7 to 7,490.2 ft that is noncalcareous over the first half foot and calcareous for the rest of the interval. From 7,491 to 7,492.7 ft (the interval identified as the top of the Onondaga Limestone by Tamulonis and Carter, 2021), the core is a grayish-black massive limestone. From 7,491 to 7,492.7 ft it is a calcareous dark-gray to grayish-black shale. The core from 7,492.7 ft to its base at 7,503 ft is a limestone that ranges from medium light gray to grayish black with bedding that ranges from thin to massive. Fossils were observed in the Onondaga Limestone at 7,500 ft. These alternating layers of black shale and limestone are depicted in Figure 1.

CONCLUSION

With Cheyenne Woodward's assistance, I described the alternating limestones and organic-rich Devonian shales in a deep rock core obtained during the EGSP project. This description was funded by the MRCI project with the goal of safe subsurface storage of carbon dioxide. The shades of gray in Figure 1 reflect the colors observed in the various shales. The darker shales tend to have a high organic-matter content that makes them better at adsorbing carbon dioxide. Most of these shales are separated by thin limestone layers. The organic-rich shales are mostly noncalcareous but do have some calcareous layers. These were important to note because of the chemical reaction between calcareous rocks and carbon dioxide. The mineral pyrite also reacts with carbon dioxide. Pyrite nodules were observed in most of these rock formations. Fractures were noted in the Moscow, Ludlowville, Skaneateles, Marcellus and Onondaga Formations. Numerous fossils were observed in the Centerfield and Stafford limestones. Some fossils were observed in the Tully Limestone, Ludlowville Formation, Skaneateles Formation, and Onondaga Limestone. Barite nodules were identified in the Marcellus Formation with the use of a handheld XRF.

Because the bureau stores historical rock cores and cuttings, I was afforded the opportunity to look at an "older" core. Data from this core may be used for modern projects and applications such as MRCI and the upcoming Central Appalachian Partnership for Carbon Sequestration project to help determine the potential of these formations as a carbon sequestration target or reservoir caprock. We can now see that the reactions between carbon dioxide and carbonate and pyrite must be taken into consideration in these scenarios. The open fractures noted in this core may indicate potential paths for fluids to flow; however, fractures observed in a rock core provide no evidence of the fracture's extent, so this information has limited use (National Research Council, 1996).

ACKNOWLEDGMENTS

I would like to thank John Neubaum for the use of the core laboratory; Cheyenne Woodward for her assistance; Aaron Bierly, Kristen Hand, and Chris Oest for their assistance with fossil identification; Steve Shank for his assistance with mineral identification; Robin Anthony for her assistance with writing this article; Michele Cooney for her review; and Gale Blackmer for her suggestions and kind comments.

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FIGURE GALLERY

Figure 2. Pyrite nodule in the Geneseo Shale at 7,074.18 ft. Scale in hundredths of a foot. (Back to text)

Figure 3. Pyrite nodule in the Tully Limestone at 7,094.1–7094.2 ft. (Back to text)

Figure 4. Pyrite nodules in the Moscow Formation at 7,162.8 and 7,163.1 ft. Scale in hundredths of a foot. (Back to text)

Figure 5. Calcite-filled fractures in the Ludlowville Formation at 7,223 ft. (Back to text)

Figure 6. Pyrite-filled burrows in the Ludlowville Formation at 7,227.55 ft. (Photograph by Cheyenne Woodward.) (Back to text)

Figure 7. Gastropod shell fragment in the Ludlowville Formation at 7,256.25 ft (about the size of the tip of a pinky nail). (Back to text)

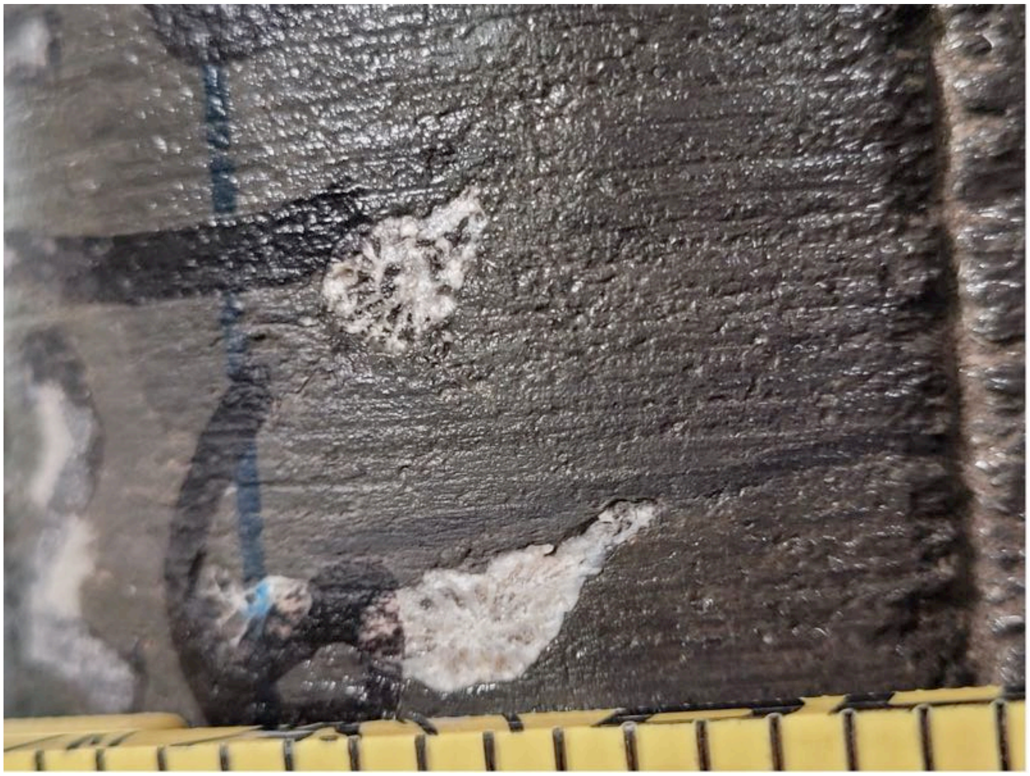

Figure 8. Rugose coral fossils in the Centerfield Limestone at 7,325.4 ft. Scale in hundredths of a foot. (Back to text)

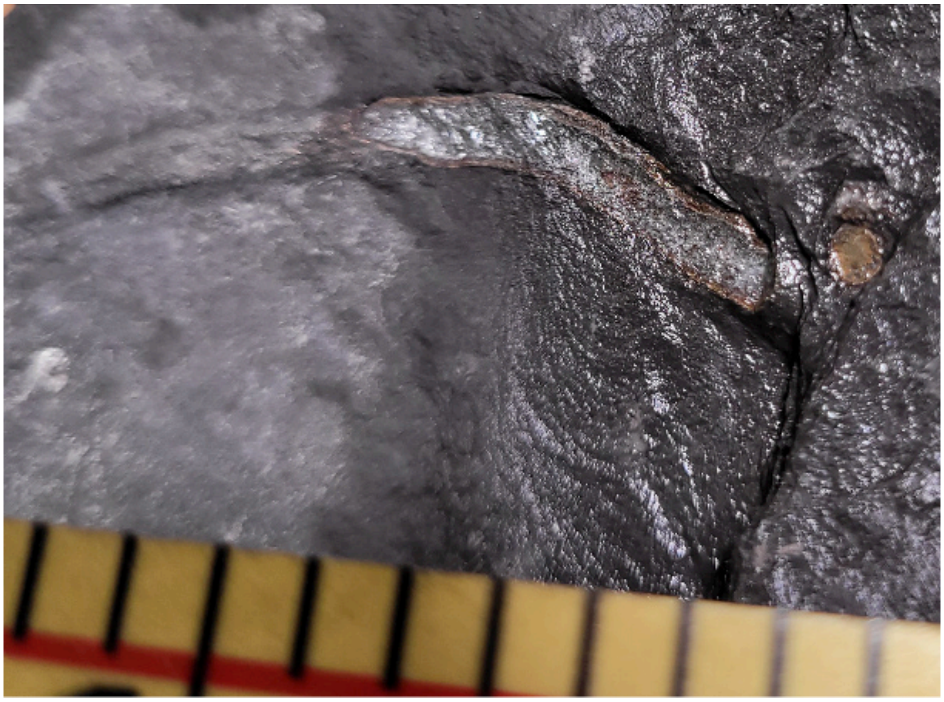

Figure 9. Burrow lined with pyrite in the Centerfield Limestone at 7,327 ft. Scale in hundredths of a foot. The burrow runs nearly horizontal in the core. (Back to text)

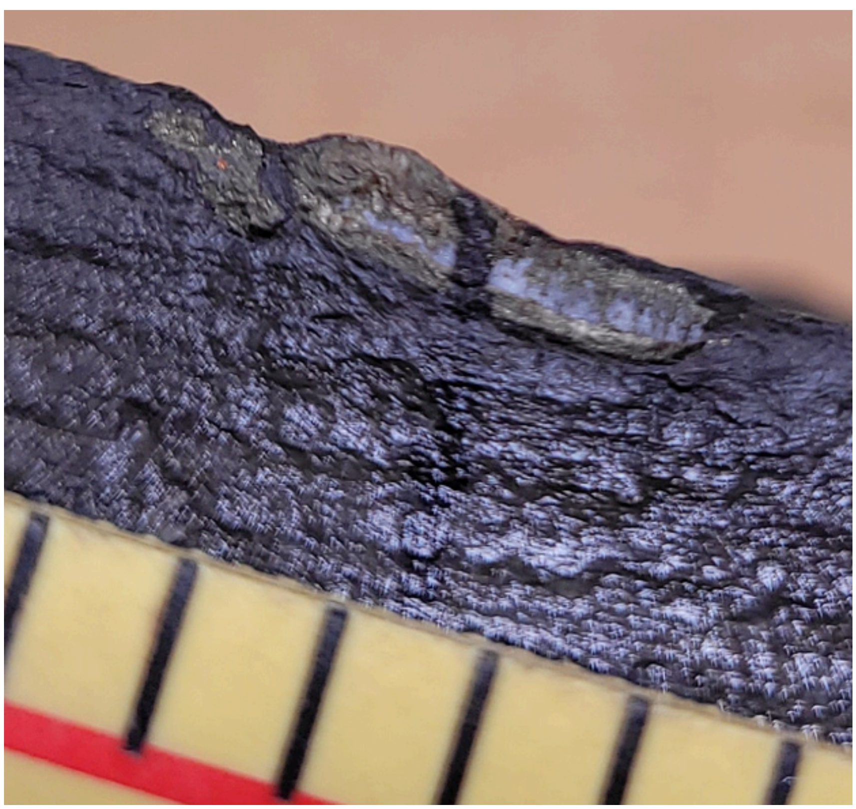

Figure 10. Pyrite-lined burrow in the Centerfield Limestone at 7,327 ft in cross-sectional view. Scale in hundredths of a foot. The black line through the center of the burrow is from a marker used on the rock sample. (Back to text)

Figure 11. Orbiculoidea *brachiopod fossil in the Centerfield Limestone at 7,327.8 ft. Scale in millimeters. (Back to text)*

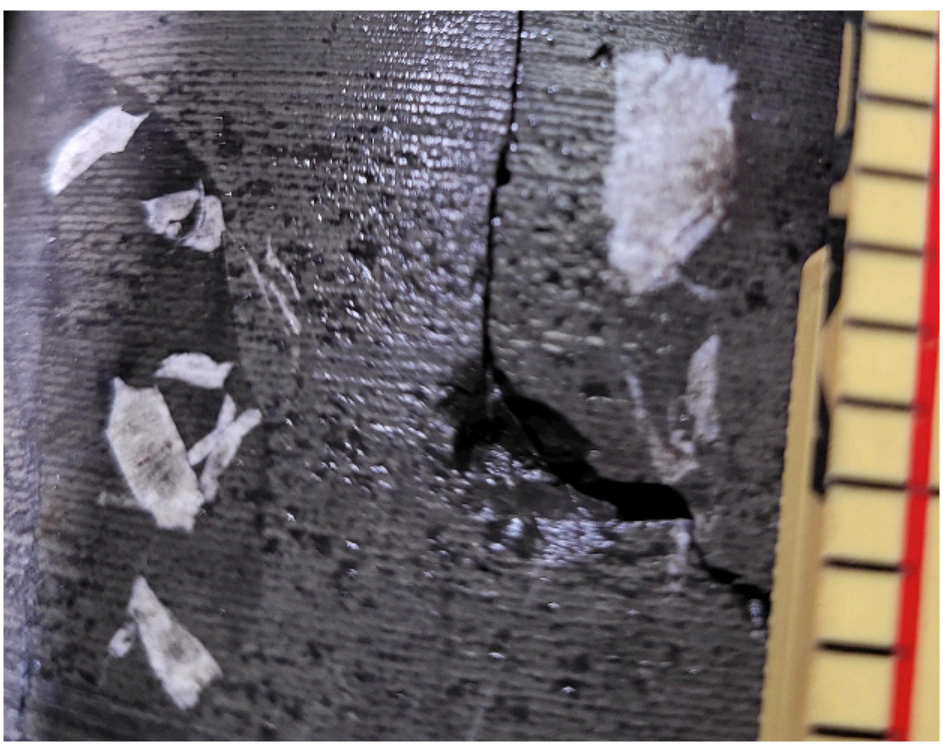

Figure 12. Fossils in the Skaneateles Formation at 7,382 ft. Scale in hundredths of a foot. (Back to text)

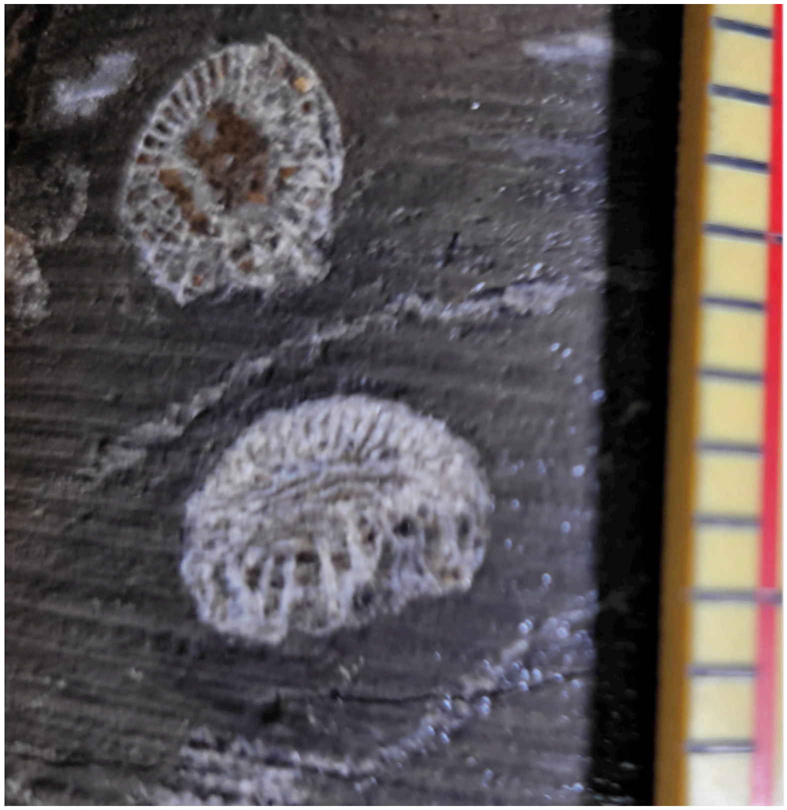

Figure 13. Rugose coral fossils in the Stafford Limestone at 7,416.5 ft. Scale in hundredths of a foot. (Back to text)

Figure 14. Barite nodule in the Marcellus Formation at 7,449.4ft. Scale in hundredths of a foot. (Back to text)

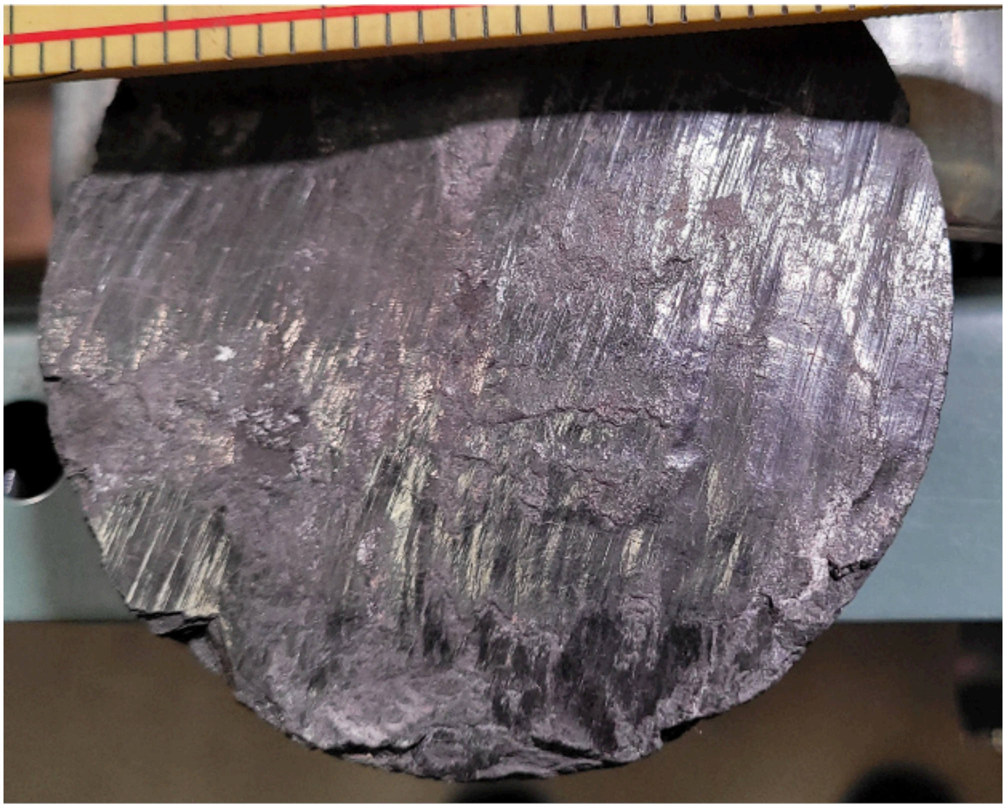

Figure 15. Slickenside in the Union Springs Member of the Marcellus Formation at 7,470 ft. Scale in hundredths of a foot. (Back to text)

Figure 16. Possible barite layer in the Onondaga Limestone with some pyrite at 7,486.6 ft. Scale in hundredths of a foot. (Back to text)

Summer Camp in the Devonian— The International Symposium on the Devonian System

Chris Oest
Pennsylvania Geological Survey

This year, for the first time in person in more than three years, the International Symposium on the Devonian System, co-sponsored by the Subcommission on Devonian Stratigraphy of the International Commission on Stratigraphy and the State University of New York College at Geneseo, was held in Geneseo, N.Y. The symposium featured pre-, intra-, and post-conference field trips to several classic Devonian outcrops in Ohio, New York, and Pennsylvania. Technical sessions accompanied field trips, and authors presented papers on topics including sedimentology, biostratigraphy, cyclostratigraphy, paleontology, and structural geology. All talks were Devonian-centric but not limited to discussions of strata in New York, let alone in North America. This event doubled as a primer to the recently released three-volume text *Devonian of New York*—a comprehensive resource documenting decades of research on Devonian strata in New York and their connection to other portions of the Appalachian basin and the world.[1]

Staff members Chris Oest and Aaron Bierly attended the meeting as representatives of the Pennsylvania Geological Survey. Below are four photographs of outcrops visited during the intra-conference field trip. Figures 1 and 2 show locations in northern Tioga County, Pa., where the exposed strata are Frasnian to Famennian in age (early late to latest Devonian). This is an important time interval in the Late Devonian, as a two-phased extinction event, called the Upper and Lower Kellwasser event, occurred during the latest Frasnian. Figures 3 and 4 show exposures of the Hamilton and Genesee Groups at Taughannock Falls State Park, northwest of Ithaca, N.Y. These strata are older than those observed in Tioga County and contain the Givetian-Frasnian boundary (late middle to early late Devonian). Together, strata in these photographs show rocks representing tens of millions of years of Earth's history.

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[1]Information about the recently released *Devonian of New York* is available at https://www.priweb.org/devonian-ny/.

Figure 1 (left). Outcrop of shale along State Route 287 northeast of the Hammond Reservoir in Tioga County, Pa. This shale is mapped within the Lock Haven Formation in Pennsylvania; however, Bush and others (2023) correlate this interval to the Pipe Creek Formation of New York. This interval is the physical manifestation of the first Frasnian extinction—the Lower Kellwasser event, a period that is marked globally by dark-gray to black shale deposition.

Figure 2 (right). Road cut exposing a shale interval in the upper Lock Haven Formation along U.S. Route 15/Interstate Route 99 in northern Tioga County, Pa. Field Conference of Pennsylvania Geologist attendees may recognize this location—see McLaurin (2013) and Oest (2013) for descriptions. This shale interval is correlated by Bush and others (2023) with the Dunkirk Formation of New York. The Dunkirk Formation postdates the second Frasnian extinction event—the Upper Kellwasser event—but does provide stratigraphic constraint to the location of this interval in Pennsylvania. The Upper Kellwasser event occurs within a thin black shale bed called the Point Gratiot bed, which is stratigraphically below the Dunkirk Formation. Since the Point Gratiot bed is not present at this outcrop in Pennsylvania, Bush and others (2023) concluded that the Upper Kellwasser event is manifested by the sandstones stratigraphically below the Dunkirk Formation in Tioga County.

Figure 3. The ledge that the falls are cascading over in this photograph is the Tully Formation. This outcrop is located in Taughannock Falls State Park, northwest of Ithaca, N.Y. The Tully Formation, consisting of wackestone, argillaceous limestone, and shale, is approximately 15 feet thick and unconformably overlies the Windom Shale Member of the Moscow Formation (Hamilton Group) at this location (Baird and others, 2023a).

Figure 4. Taughannock Falls as viewed from the observation platform in Taughannock Falls State Park. The falls are approximately 216 feet tall (see the pedestrian footbridge in the middle foreground for a sense of scale). The escarpment behind the falls exposes portions of the Genesee Group shales, siltstones, and sandstones. These strata record the Givetian-Frasnian boundary (late middle to early late Devonian), and this time boundary is located just above the top of the falls (Baird and others, 2023b).

STAFF NEWS

New Staff Members Welcomed

Stacey Daniels. Stacey joined the bureau in July (in the Middletown office) as the new Grant and Outreach Coordinator. She comes to the bureau with well-rounded experience inside and outside of the geology world. Stacey graduated with a B.A. in geosciences and classics from Franklin and Marshall College (F&M). Upon her graduation in 2009, Stacey interned for the Pennsylvania Geological Survey! Following her internship, she worked as a research specialist in the laboratory of the Department of Earth and Environmental Science at F&M, processing and testing soil samples for legacy sediment research. She also served as a teaching assistant for Landscape Geochemistry. Stacey then spent the largest chunk of her career so far working for start-up companies conducting global groundwater exploration. Stacey led project data collection and focused her research on the climate and stratigraphy of project areas while assisting with tectonic history and structural geology assessments, as well as geophysical surveys. She was in charge of all data management and conducted quality control on reports produced by the science team for stakeholders and clients.

Stacey has also explored many other professional avenues, from events coordinator and store manager for an independent bookstore, to serving as an elementary school substitute teacher. Stacey earned an M.S. in applied geosciences from the University of Pennsylvania (Penn) in May 2023. At Penn, Stacey focused on expanding her knowledge and experience in hydrogeology while exploring ways to use this knowledge for the benefit of society. Her capstone project built on her interest in geoscience education and hydrogeology by allowing her to propose and develop a hands-on field school for high school students, which was focused on telling the story of mill dams, legacy sediments, and stream restoration strategies for water-quality improvement in the Chesapeake Bay watershed. Stacey is looking forward to bringing her organizational skills, geology experience, and passion for teaching and learning to the bureau as the Grant and Outreach Coordinator. In her free time, Stacey loves to travel and explore the outdoors, and she plays ultimate frisbee competitively. Her favorite thing to do is to spend time snuggling or adventuring with her 4-year-old daughter, Theodora.

Stephanie Evans. Stephanie started at the Middletown office of the bureau in June 2023 as a Senior Geoscientist in the Groundwater and Environmental Geology Section. She spent the previous year with the Pennsylvania Department of Environmental Protection in the Bureau of Oil and Gas, Subsurface Section, working on plugging abandoned and orphaned oil and gas wells across Pennsylvania. Most of this time was spent preparing for the funding increase from the Infrastructure Investment and Jobs Act, which allows Pennsylvania to address the abandoned oil and gas wells problem. She spent 8 years prior to that working in the geotechnical engineering industry, first as field staff and then as a geologist. Her experience in the geotech field is varied. She has worked on numerous projects, including the upgrades to the I-95 corridor in Philadelphia and numerous small local bridges and culverts, and she has analyzed the slope stability for well pads, conducted karst surveys, overseen sinkhole remediations, and provided soil and rock information for several construction projects in central Pennsylvania.

Stephanie earned a B.S. degree from Lock Haven University of Pennsylvania in Applied Geology and is currently pursuing an M.E. in Geological Engineering and Geomechanics from the University of Arizona, with a focus area of geomechanics. When not at work or in class, she enjoys working with her dog Feldspar on various dog sports, reading with her cats, and mineral hunting and camping with friends and family.

AshleyPeifer. Ashley grew up in Lancaster County and graduated with an associate degree in General Studies (focusing on Business Administration) from Harrisburg Area Community College. She joined the bureau in July 2023. Ashley has been an Administrative Assistant for a year and a half and has been employed by the commonwealth for four years. She has a huge interest in rocks and likes to collect them, which makes the Pennsylvania Geological Survey the perfect agency for her. She loves to be outside hiking, kayaking (as shown in the photograph of her kayaking among the lily pads), or reading a book. She currently resides in Berks County along with her fiancée and two cats (Milo and Salem).

A Look Back in Time

Former Chair of the Geology Department at the University of Pittsburgh (1952–57) Chilton "Chip" Prouty (left) and former State Geologist (1953–61) Carlyle Gray (right) are seen here examining "Stones River" limestone in Cumberland County in 1953. Prouty conducted his fieldwork under the direction of the Survey and went on to publish his findings in the 1959 report, *The Annville, Myerstown and Hershey Formations of Pennsylvania* (General Geology Report 31). The photograph was taken by then staff geologist, Alan Geyer.

To see more photographs from the bureau's archives, please visit the library's Historical Photographs collection page.

—Jody Smale, Librarian

RECENT PUBLICATIONS

Maps (August 2023)

- Distribution of Sinkholes and Karst-Related Closed Depressions Within the Fannettsburg 7.5-Minute Quadrangle, Franklin, Fulton, and Huntingdon Counties, Pennsylvania (ZIP)
- Surficial Geologic Map of the Fannettsburg 7.5-Minute Quadrangle, Franklin, Fulton, and Huntingdon Counties, Pennsylvania (ZIP)
- Bedrock Geologic Map of the Fannettsburg 7.5-Minute Quadrangle, Franklin, Fulton, and Huntingdon Counties, Pennsylvania (ZIP)

Map (July 2023)

- Water Depth of Chapman Lake—Chapman State Park, Warren County, Pennsylvania (ZIP)

Calling All Authors

Articles pertaining to the geology of Pennsylvania are enthusiastically invited.

Pennsylvania Geology is a journal intended for a wide audience, primarily within Pennsylvania, but including many out-of-state readers interested in Pennsylvania's geology, topography, and associated earth science topics. Authors should keep this type of audience in mind when preparing articles.

Feature Articles: All feature articles should be timely, lively, interesting, and well illustrated. The length of a feature article is ideally 5 to 7 pages, including illustrations. Line drawings should be submitted as jpg files. Ensure that black and white drawings are not saved as color images.

Articles should be submitted as Microsoft Word files. Feature articles will be reviewed by at least one bureau staff member. It is the author's responsibility to obtain approval for use of any illustrations that are copyrighted, including those taken from the Internet.

Earth Science Teachers' Corner: Articles pertaining to available educational materials, classroom exercises, book reviews, and other geologic topics of interest to earth science educators should be 5 pages or less in length and should include illustrations where possible.

Announcements: Announcements of major meetings and conferences pertaining to the geology of Pennsylvania, significant awards received by Pennsylvania geologists, and other pertinent news items may be published in each issue. These announcements should be as brief as possible.

Photographs: Photographs should be submitted as separate files and not embedded in the text of the article. Please ensure that photographs as submitted are less than 10 inches wide in Photoshop or equivalent. Also ensure that black and white photographs are not saved as color images.

Submittal: Authors may send their article and illustrations as email attachments to RA-pageology@state.pa.us if the file sizes are less than 6 MB. For larger sizes, please submit the files on CD–ROM to the address given below. All submittals should include the author's name, mailing address, telephone number, email address, and the date of submittal.

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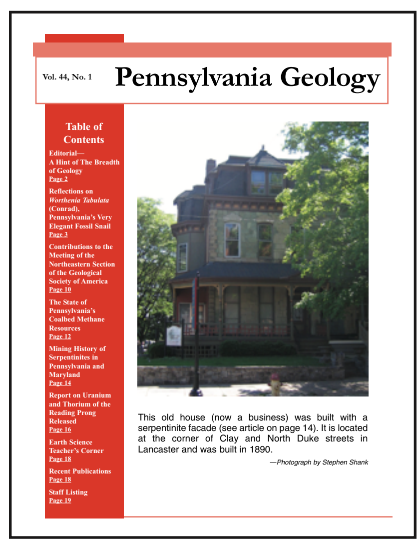
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This old house (now a business) was built with a serpentinite facade (see article on page 14). It is located at the corner of Clay and North Duke streets in Lancaster and was built in 1890.

—*Photograph by Stephen Shank*

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