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Pennsylvania Geology

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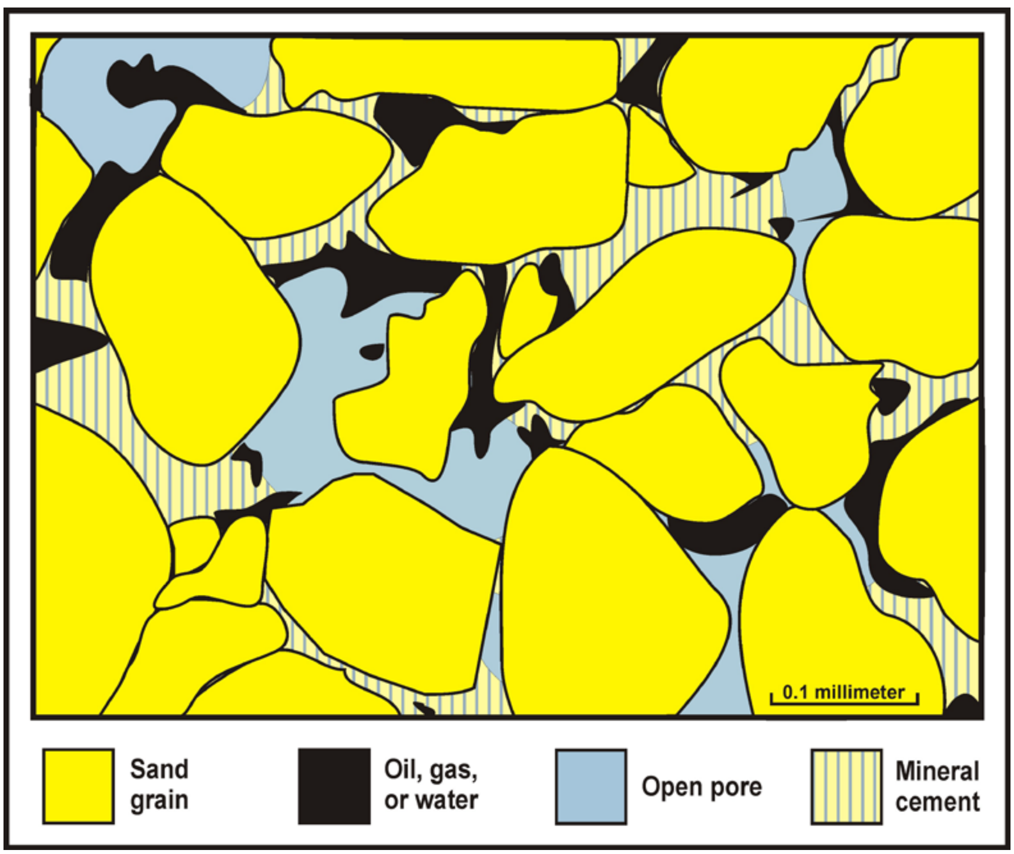


Editorial

Nothing

Jay Parrish, State Geologist
Pennsylvania Geological Survey

What is the value of nothing?

In this issue George Love has an article on pore space. This has become an important issue in Pennsylvania. At the Survey we have conducted an intensive study in support of a carbon sequestration analysis. The real issue is finding enough pore space to store supercritical carbon dioxide and owners of that pore space.

At the same time the Marcellus shale is lacking pore space, so it must be hydraulically fractured (fracked) to provide conduits for the gas to flow to a horizontal drill hole. Fracking requires chemical laden water which in some cases must be disposed of in pore space.

For generations geologists have looked for what fills the pore space. Now they look for the pore space alone as a valued commodity.

It all comes down to pore space.

Nothing.

google images

Buddy, Can You Spare a Hole?

George Love, Assistant Director and Chief of Data Distribution Section
Pennsylvania Geological Survey

Each of us has heard the warnings regarding global warming. Climatologists have advised us to reduce our carbon footprint by reducing our carbon dioxide (CO_2) emissions. No doubt you have heard the admonitions - Lower your energy consumption! Recycle that plastic! Bike to work! In response to a growing concern within Pennsylvania, the Legislature passed Act 129 in October of 2008. The goal of the Act is to take affirmative action to reduce Pennsylvania's carbon footprint. The Act required that the Department of Conservation and Natural Resources' Bureau of Topographic and Geologic Survey (Survey) conduct a sitting assessment, a risk assessment, and a cost study directed at developing a state network for CO_2 capture, transmission and storage. (Carbon dioxide is a greenhouse gas that is believed to be at least partially responsible for global warming.) For the Survey, the sitting assessment required a review of geologic literature, boring logs, and seismic data pertaining to Pennsylvania's geology. The huge tonnages of CO_2 that must be sequestered will require significant storage capacity. Potentially available storage sites - let's call them holes - and the value of those holes are discussed in this article.

Carbon Sequestration

The basic concepts of carbon sequestration, generally known as CCS (carbon capture and sequestration), are quite simple: capture CO_2 at an emitter's plant, compress the gas into a supercritical liquid (a fluid in the temperature and pressure range where the density of the gas and liquid phases are equal and it can move through solids like a gas and dissolve materials like a liquid), transport it to a storage site, and place it into the available storage holes.

Holes at Large

Holes have long been recognized as valuable resources. Our predecessors recognized the comfort of living in a dry, warm cave, safe from foul weather and marauding predators. Apparently, they felt that such places might also be secure sites in which to record and store memorabilia, for example, the cave art of Lascaux, France. Long-term utilization of earthly openings -- the concept is hardly new.

On the surface where things are visible to the casual observer, holes such as quarries, strip mines, and open cuts have been utilized as dumps for household trash, decaying farm animals, old cars and who knows what else. (Future archeologists will wonder at the variety of "stuff" the ancient societies had available to them, and they will shake their heads at our low regard for our planet.) However, in some cases they will marvel at the creative uses for surface holes. Governmental entities have used quarries to store water in bad times and good. In central Florida, unreclaimed phosphate strip mines have been developed as upscale residential communities because the overburden piles are covered by volunteer trees (those planted by Mother Nature) and the mine cuts are now fish-filled lakes. In the hilly terrains of western Pennsylvania, shopping malls, restaurants, and industrial sites have sprung to life on the floors of old surface coal open cuts. More grandly, some groups have used surface mines and quarries to host golf courses. Figure 1 is a spectacular example of the Black Diamond Golf Course in Lecanto, Florida.

Figure 1. The green in the foreground is Hole #14, a 515-yard par 5 dogleg left curving around an old limestone quarry that is now the site of a golf course in Florida. Middle ground shows the par 4, 359-yard Hole #15. The background shows the par 4, 435-yard Hole #16 atop the quarry highwall.

Another example is a new hotel under construction in a 300-foot-deep (100 meters) abandoned andesite quarry in China. Figure 2 is the artist's rendering.

Figure 2. Hotel near Shanghai, in the Songjiang District of China. The hotel features underwater public areas, 380 guest rooms and conference facilities for up to 1,000 people. Two underwater levels will house a restaurant and guestrooms facing a 10-meter deep aquarium.

Clearly, surface openings have uses and therefore value. The value of a surface opening is a function of the location (proximity to the people who will use it), its size (how much can it hold?), its containment characteristics (will the stored material leak or otherwise escape?), and its rock characteristics (long-term stability to perform.) During the early days of mining, exhausted surface mine openings were a blight on the landscape. After the passage of the Surface Mine Control and Reclamation Act in 1977 and subsequent regulations, mine openings became liabilities. Today, reclamation is mandatory so few surface openings are available to be filled with CO_2.

Underground, caves and mine openings have a wide range of uses as well. Entrepreneurs have developed tourist attractions at most of the known large natural caves; Indian Echo Caverns in Dauphin County and Penn's Cave in Centre County are two Pennsylvania examples. Some coal mines, such as the No. 9 Coal Mine (anthracite coal) near Lansford, PA and the Tour Ed Mine (bituminous coal) near Tarentum, PA, are living a second life as mining museums and tourist rides. Other mine openings have been developed for a variety of non-tourist applications. Within the United States, examples include hothouses to grow seedlings (Kellogg Mine, Idaho; Butte Mine, Montana); construction facilities for sail boats (Pixley Mine, Missouri); cold storage rooms for frozen turkeys and expensive office space and sensitive-equipment manufacturing facilities (Kansas City area, Missouri); dry storage for documents, cars, boats, and other valuables (Wampum area, Pennsylvania); and oil in salt caverns (the Strategic Petroleum Reserve in Texas and Louisiana). During the Cold War, the U.S. Government stored thousands of 5-gallon tins containing high-energy biscuits in the Mary Mine near Tonopah, Nevada, for use in the event of a nuclear attack. U.S. mine openings have been used for less interesting materials as well – waste disposal such as power plant flyash, calcium sulfite/sulfate from fluegas desulfurization systems, and in the not-too-distant past, raw sewerage. Overseas, the uses range from hospitals for the care of lung patients in Russia, to cheese aging in Italy, to storage of compressed air in Finland. For more interesting examples regarding the use of underground openings, see the web page for the International Tunneling and Underground Space Association at www.ita-aites.org.

Clearly, underground openings have uses and therefore value. The value of a subsurface opening is a function of the location (proximity to the people who will use it), its size (how much can it hold?), its containment characteristics (will the stored material leak or otherwise escape?), and its rock characteristics (long-term stability to perform.) Sound familiar?

Holes Galore

Pennsylvania is replete with holes, but are all of them useable for CO_2 sequestration? Alas, they are not! All the Pennsylvanian openings that might be otherwise unused, including the underground mines, are too near the surface to provide adequate pressure and containment to sequester CO_2. Hence the value of these openings for CO_2 sequestration is **$0.00**. All is not lost, however. Pennsylvania has other holes that may be suitable.

Holes at Small

At the close of 2007, U.S. Energy Information Administration (EIA, 2008) reported there were, in the U.S., 326 depleted gas storage fields with a working capacity of 3500 Bcf (billion cubic feet). These are deep geologic horizons that are capable of receiving, storing, and then releasing natural gas in a controlled manner as needed. The concept is not a great deal different from a sponge—the reservoir accepts the natural gas with minimal resistance to the injection; hosts the gas with minimal distortion to the reservoir; has minimal leakage; and readily releases the natural gas when the pressure regime is altered. The gas is "housed" in open pores (see Figure 3) and fractures. This allows communication within the reservoir but not outside its boundaries. Pennsylvania is home to approximately 50 natural-gas storage facilities utilizing depleted or depleting natural-gas fields.

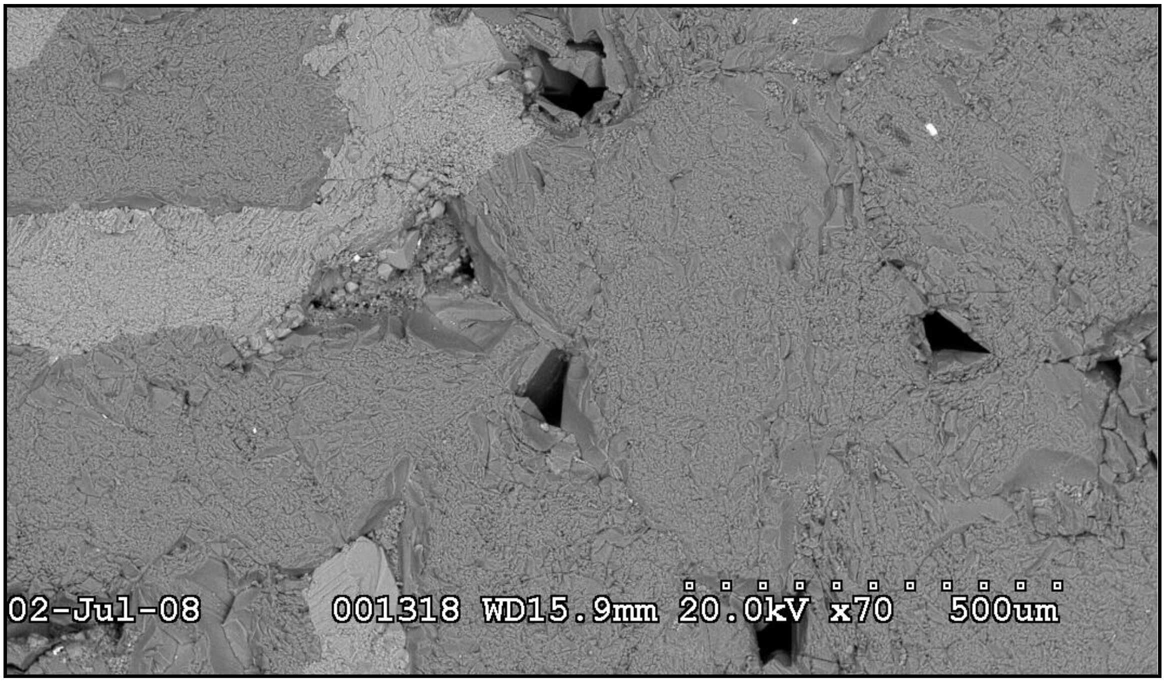


Figure 3. SEM photomicrograph showing reduced intergranular porosity in the in the Lower Devonian Oriskany Sandstone. The sample is from beyond western Pennsylvania (sometimes referred to as "Ohio.") The dark areas are the pores where one might "store" CO2. The larger pores are between 50 um and 75 um in the X, Y and Z dimensions. The dark gray is quartz (grains and authigenic cement) and the light gray is calcite cement. The sample was provided by Christopher Laughrey recently of the Survey; the image was captured by John Barnes of the Survey using equipment at the Survey's Middletown laboratory.

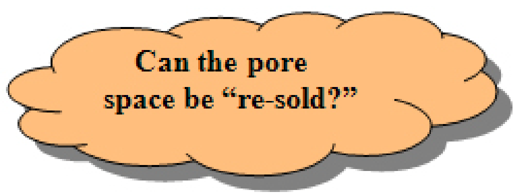
Storage of natural gas (a commodity of value) in small, interconnected openings is a proven technology. Storage of carbon dioxide in a similar manner seems a logical extension of this application. For this reason, the Survey's work has focused on the physical attributes of these small, interconnected openings. As a science-based organization, we looked at the macroscopic and microscopic nature of the rocks, made preliminary assessments of the regional and local structures, prepared projections of the volume of CO_2 that could be stored, and estimated the square miles of surface area required to contain the lateral extent of the injected CO_2.

Mineral Rights and $mall Hole$

So, this preamble tells us small holes can meet the physical requirements for containment of CO_2. We geologists can pat ourselves on the back because we have properly assessed, and are continuing to assess, the applicability of small holes to sequester CO_2. However, we have not addressed one of the most significant questions related to small holes, openings that we cannot readily see, will likely never touch, cannot be "removed" in the sense of a mineral, but which we want to fill and abandon for all eternity. And that question is "How much for that hole in your yard?" By what mechanism must the Commonwealth determine the fair market value of all the small holes it must acquire to mitigate its contribution to global warming? Are there any guidelines for us to use?

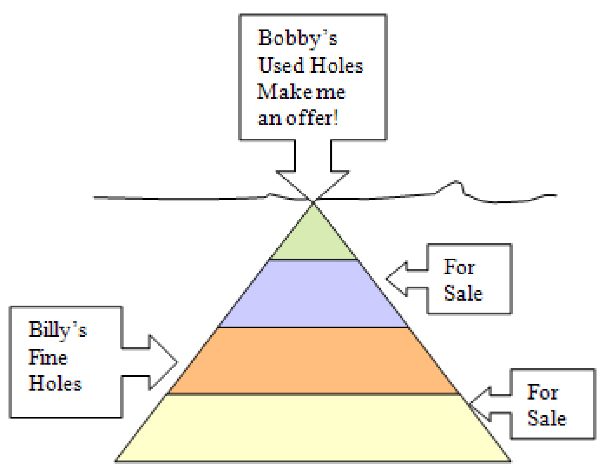
Pennsylvania's history of mining, and oil and gas exploitation, has forced development of laws that describe and protect ownership rights. Geologists who have been involved with the extractive industries have long been familiar with the property rights of mineral ownership. Broadly speaking, extractive "mineral" property rights apply to things that can be removed from on or under the land. Examples with which we are all familiar include limestone, sand, building stone, clay, precious metals, coal, crude oil, and natural gas. It is not that difficult to comprehend a mineral right when the discussion revolves around something tangible and extractable. Change that discussion to an empty space that is not removable, and the arguments become more difficult to quantify. (Please note a great deal of liberty is being taken with the term "mineral." It is being used in the mining and extractive industry sense, not the mineralogical, sense.)

Mineral rights can be bought and sold, much like the ground surface beneath one's home. These mineral rights are considered to be severed (separated), when sold, from the ownership of the surface estate. In Pennsylvania, rights related to "land" fall into several categories (estates), two of which are of interest to the average land owner: (1) the surface estate; and (2) the mineral estate. Each of these estates is viewed as being separate and distinct; that means each may be owned by a different party. An entity that owns property "in fee" owns the surface and all the underlying values. Therefore, that entity, let's use the word "person," may convey oil and gas rights, coal rights, salt rights, limestone rights, gold rights, and so forth, to another person or many persons. If the minerals can be conveyed, why can't the spaces between the minerals? Maybe the average landowner has the ability to convey the rights to stationary holes.



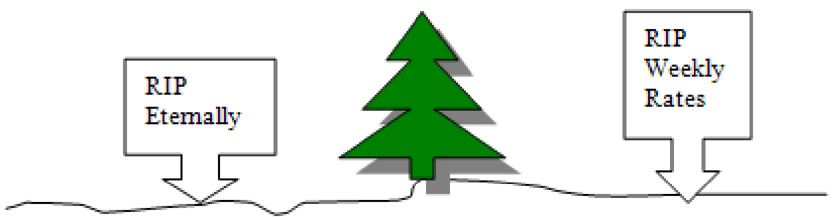
In the case of a mineral (gas for example) that previously occupied the hole, if the gas is sold and removed, does the surface owner retain ownership of the pore space? Can the pore space be "re-sold"? If the surface owner has sold or leased the right to store natural gas on the property, has the surface owner also sold the right to store CO_2? "The right to natural gas storage is retained by the surface owner unless it is severed through a lease or conveyance. Pennsylvania courts have indicated that the surface owner maintains the right to natural gas storage unless the oil and gas lease explicitly conveys the right to store gas to another party." (DCNR, December 2009, Section 3, p. 5.) Now we are back to definitions. Does "gas storage" imply CO_2 storage if the lease specifically conveys storage rights? Does "storage" have an implied time frame? Remember that natural gas is a commodity of value only when withdrawn and used as a fuel.

With regard to storage of gas, presumably when used as fuel, "In instances where the right to store gas was previously conveyed, it may be necessary to acquire the right to store CO_2 from both the surface owner and the gas storage owner. On the other hand, the need to acquire the right to store CO_2 from the gas storage owner may only be necessary in instances where the CO_2 will be stored in an already depleted oil or gas reservoir intended to operate as a natural gas storage facility." (DCNR, December 2009, Section 3, p. 5-6.)



If the surface owner wants to sell the pore space above or below the gas horizon, the gas rights owner may have no say in the matter. By the same token, if the gas rights have been severed, and the owner of those rights wants to sell the pores within the producing zone to a CCS company, the surface owner may have no recourse.

Sale of mineral rights results in two or more parties with legal claims to parts of the same "address," whether it is on the surface or at some depth beneath the surface. Most of the public feels that the tax-paying surface owner holds the supreme rights. Interestingly, the Commonwealth's courts do not necessarily subscribe to that belief, "Pennsylvania courts have recognized the mineral owner's right to protection from unreasonable encroachment or damage and have held that the surface owner's interest in the surface estate is generally subject to the mineral estate." (DCNR, December 2009, Section 3, p. 3-4.) My right to mine gold beneath your surface may be compromised by Bobby Joe's right to store CO_2. Who's rights are paramount?



How about the concept of storage versus disposal? Storage suggests removal in the future while disposal could mean long-term, as in perpetuity. How does one value the eternal use of property? A cemetery might be an example, especially since both might be viewed as eternal "resting places."

How about the situation where the injected CO_2 migrates onto an adjacent property? Would that be considered a trespass? The unauthorized use of pore space is not in the lexicon of the average person. On the surface, pollution moving across property lines is easy to identify; at 5,000 feet down, how would you know and who should pay for monitoring?

Conclusions, Sort Of

The practice of geology has long been recognized as a science with plenty of room for speculation, rumination and hallucination. This article is intended to demonstrate that the geologic aspects of CCS are not restricted to the nature of the rocks themselves. The debates within other disciplines cannot and should not divorce themselves from the basic nature of our science. While we may not be lawyers or climatologists, our science has trained us to have a broader perspective, to bring seemingly unrelated bits of data to the table, to incorporate thinking that links various disciplines together. Pennsylvania may, or may not, be on the cutting edge of CCS, but we geologists can provide information for the politicians to ponder as they are faced with difficult and expensive decisions. Our efforts can provide part of the scientific backdrop for the public to consider as it listens to the debate.

And, of course, we can provide rational opinions regarding "How much is that hole in your yard?!"

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The Black Diamond Golf Course. Additional photographs may be viewed at www.blackdiamondranch.com/.

The Songjiang Hotel, http://www.greenroofs.com/projects/pview.php?id=529

The Great Dillsburg Earthquake Swarm: Cooperative Geology

Helen Delano, Geologist
Pennsylvania Geological Survey

Sometimes we get to see a different perspective on what the term "geologic community" means. On October 5, 2008, at about 6:30 in the evening, a magnitude 2.0 earthquake rattled a portion of northern York County. It was picked up on seismographs in eastern Pennsylvania and Maryland in the regional networks linked to the Lamont-Doherty Earth Observatory (LDEO) of Columbia University and the U.S. Geological Survey. This was the beginning of a series of events and cooperative investigative efforts that are continuing more than a year later. To date, at least 28 quakes have registered on the regional seismic network with magnitudes from about 1 to 2.9. Well over 800 microearthquakes have been reported by local observers. A report was released in November detailing some of the study results. It provides more in-depth and detailed information than this brief article, and is available on the Survey's web site as Open-File Report 09-01.1

Officials of Carroll Township, Dillsburg Borough, the York County Emergency Management Agency and local residents were understandably concerned by the early quakes, especially when residents reported feeling additional smaller events – beginning perhaps as far back as August 2008. Reports included felt tremors, booming sounds and sometimes a smell of sulfur.

Jeri Jones (Jones Geological Services) and William and Jason Krieger (York College of Pennsylvania) collected felt reports from local residents. From the reports, they produced isoseismal maps of Modified Mercalli intensities, which gave more precise locations of the center of activity than the seismograph records from tens of miles away.

On October 19, 2008 at least a dozen quakes were recorded by the regional network instruments – the largest a magnitude 2.1. These and four more quakes in the next few days led researchers from LDEO, assisted by Jeri Jones and Charles Scharnberger (Millersville University) to set up a local array of seismographs. These portable instruments are designed to detect the short period signals from smaller events. Because they are set up near the active area, they can be used to locate the sources of the earthquakes more precisely than can be done from the regional, permanent network. The work done collecting felt reports was useful in determining good locations for the instruments, both for proximity and for cooperative homeowners in seismically quiet areas (with low traffic activity and other types of noise).

Three portable seismometers were placed on October 24, 2008. The network was later expanded to four and some locations adjusted. Forty-nine small earthquakes were recorded before the array was taken down in early December.

Felt reports continued through the winter and spring, and at a Carroll Township Board of Supervisors meeting in May, Charles and Jeri presented an update and discussed the benefits of another local network. One of the local residents, Mr. Perry Bates, volunteered to underwrite the costs of setting up a new array of four seismographs borrowed from the PASSCAL (Program for Array Seismic Studies of the Continental Lithosphere) program of the Incorporated Research Institutions for Seismology (IRIS). Once again Jeri and Charles selected locations – trying to find sites that would have little traffic noise and would surround the area of most of the epicenters.

The Pennsylvania Geological Survey offered staff time to support the effort, and Professor Andy Nyblade and his graduate students at Penn State University arranged for the equipment to be borrowed and shipped from Socorro, New Mexico. Several of us made a trip to State College to learn how to install the portable seismographs and program the data recorders.

We installed the four instruments, (Figures 1 and 2) in late May and changed out the data cards (electronic media, similar to those used in digital cameras) about once a week through the summer of 2009. The equipment at each station consisted of a 3-channel geophone, a GPS antenna, a power supply and battery and a Data Acquisition System (DAS) that controls all and stores the data. The GPS antenna provides the precise time signal to keep all the instruments synchronized, as well as giving the precise location of each station. The three channels of the geophones measure displacement in east-west, north-south and vertical directions.

Figures 1 and 2: Above left: installation of a three-channel geophone at one of the IRIS stations. Below, right: one of the IRIS seismograph installations. The geophone is buried, the GPS antenna is visible in the upper right of the photo. The power supply and back-up battery are in the lower plastic box, the DAS and extra cable are in the upper box, protected from rain and other disturbances .

Data processing fell to Charles Scharnberger, while Jeri Jones continued collecting felt reports, which exceeded 800 by November of 2009. The seismograph data show some events that were not reported by any observers, so we know that the reported number of events is low. Exact numbers will never be known, but almost certainly exceeded 1000 events by November of 2009. Epicenters of some of the events recorded by the two arrays are shown on the map in Figure 3.

Other swarms of microearthquakes are known, including some in similar geologic settings. One of these, in Moodus CT, is well known and has had several recurrences since pre-colonial times (Ebel, 1989). It seems however that the Dillsburg swarm is the longest-lasting one on record, continuing for more than 13 months, while others ended after 6 to 8 months.

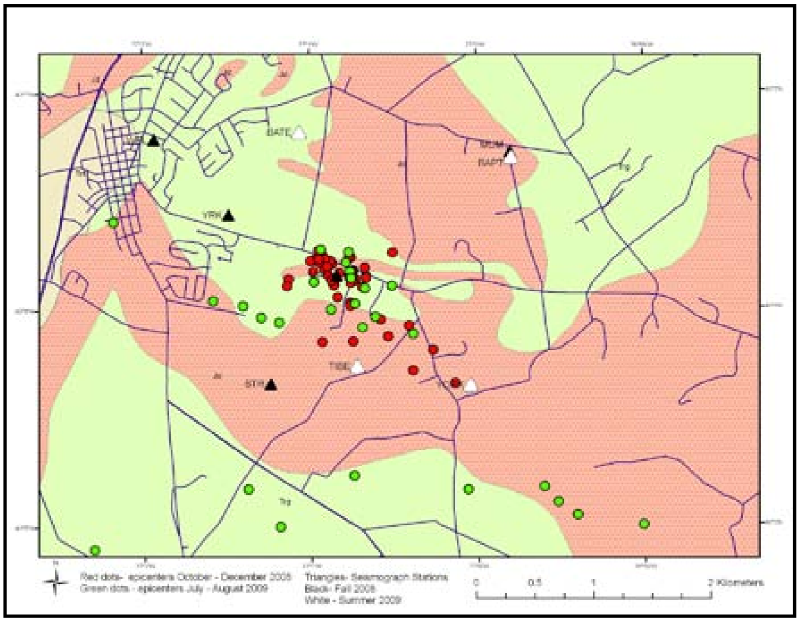

Figure 3. Map showing locations of epicenters located with the local seismograph arrays. Red dots are locations from the LDEO array in fall of 2008, green dots from the IRIS array in summer 2009. Background colors are geologic units. Green is the Triassic Gettysburg Formation, red-orange the Jurassic Diabase. Triangles are the locations of the seismometers- black for LDEO array, white for the IRIS array.

The geology of the area east of Dillsburg is fairly well known, thanks to the existence of significant Cornwall-type iron ore deposits. (Gray, 1999). These were mined from 1828 until about 1915, and the mines were documented in contemporaneous geological reports of the USGS and the second Pennsylvania Geologic Survey. During World War II, the U.S. Bureau of Mines and the U.S. Geological Survey investigated a number of potential sites for domestic supplies of strategic mineral resources, including Dillsburg. The diamond drill hole data and descriptions of the rock were published in 1950 (Hotz) so we have good data on the upper few hundred feet of the subsurface.

The obvious conjunction of the earthquake locations with some of the old mines led to initial speculations that the first quakes might have been mine collapse, but information on hypocenter depths showing that they were from 0.5 to about 3 kilometers deep, well below the maximum depth of the mines. (Figure 4) The long continuation of activity also argues against mine collapse as an explanation.

Although deeper than the mines, these are still remarkably shallow earthquakes. The sounds that are reported to accompany many of the quakes indicate the shallow hypocenters. Vibrations of a wide range of frequencies are produced when rocks break, but in most earthquakes, frequencies that humans can hear are damped out during movement through kilometers of rock. The short travel distances of the Dillsburg quake waves allow some audible vibrations to reach the surface as booming or “explosive” sounds.

Once the locations of the epicenters and hypocenters of the earthquakes were known, the geologic map information showed us that the earthquakes are occurring at or near the lower contact of a large diabase sheet within the surrounding sedimentary rocks of the Gettysburg Formation. The difference in strength between the two rock types is the likely factor controlling the location of the quakes. Northern York County, with the rest of the North American plate, is experiencing stress from movement of tectonic plates, and this stress is concentrated at places where rigid rocks abut more yielding materials.

A cause for the timing of this swarm is elusive. There have been suggestions that increased rainfall may be associated with both the beginning of the series and with some of the individual events, but the present data are not conclusive. We are continuing to look at the distribution of events, and gather information on felt events.

What does the future hold for Dillsburg? We see no reason to expect larger quakes to occur. Other similar swarms have ended without any larger events. The Dillsburg events will probably stop, but they have already continued longer than most, so we are still waiting. A few felt reports and instrumentally located epicenters of very small tremors outside the immediate Carroll Township area suggest that there may be some more widespread activity. We are continuing to investigate these, along with the other information.

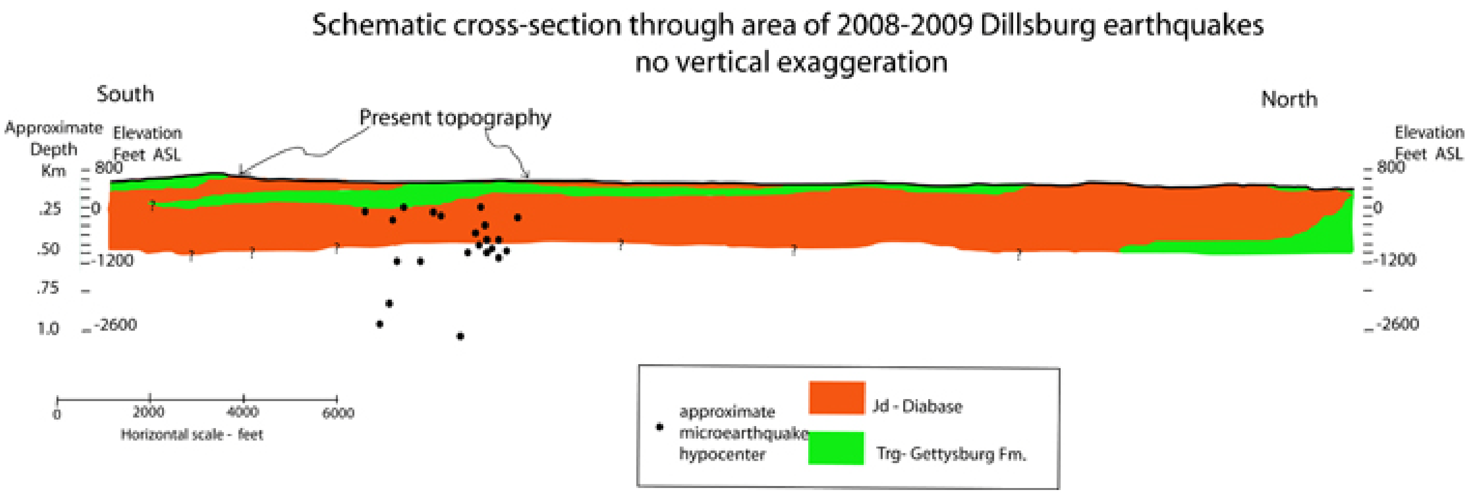

Figure 4. Schematic geologic cross section through the Dillsburg earthquake area. The iron mineralization (and the old mines) is in the sedimentary Gettysburg Formation rocks between the two diabase layers. One group of mine openings is just above the cluster of hypocenters.

As with most mid-continent seismic activity, we are learning about the Dillsburg earthquake swarm, but do not have many, let alone all of the answers. It is clear that we would know much less without the cooperation and collaboration of many people – most of whom have volunteered their time and talents.

Acknowledgement and credit for what has been learned about the Dillsburg earthquake swarm are shared among a lot of folks. More than 40 local residents reported effects. Jeri Jones, William Krieger and Jason Krieger interviewed residents and cataloged felt reports. Won-Young Kim, Mitchell Gold, John Armbruster and John Contino from LDEO carried out the initial study with the local array. IRIS and Penn State University provided instruments and technical support training for the second array, the data from which was processed and interpreted by Charles Scharnberger. Perry Bates of Dillsburg provided financial support to ship and install instruments. Homeowners allowed installation on their property and tolerated visiting data collectors for months at a time. Pennsylvania Survey staff and interns who helped with installation and monitoring include George Love, Tom Whitfield, Anne Lutz, Jessica Burguess, Audrey Wronski and Helen Delano. Dennis Low and others at the U S. Geological Survey provided valuable information, particularly about hydrogeology. The Dillsburg Area Authority made water well records available. Local government and community organizations from Carroll Township, Dillsburg and Franklintown Boroughs are among those who helped in many ways.

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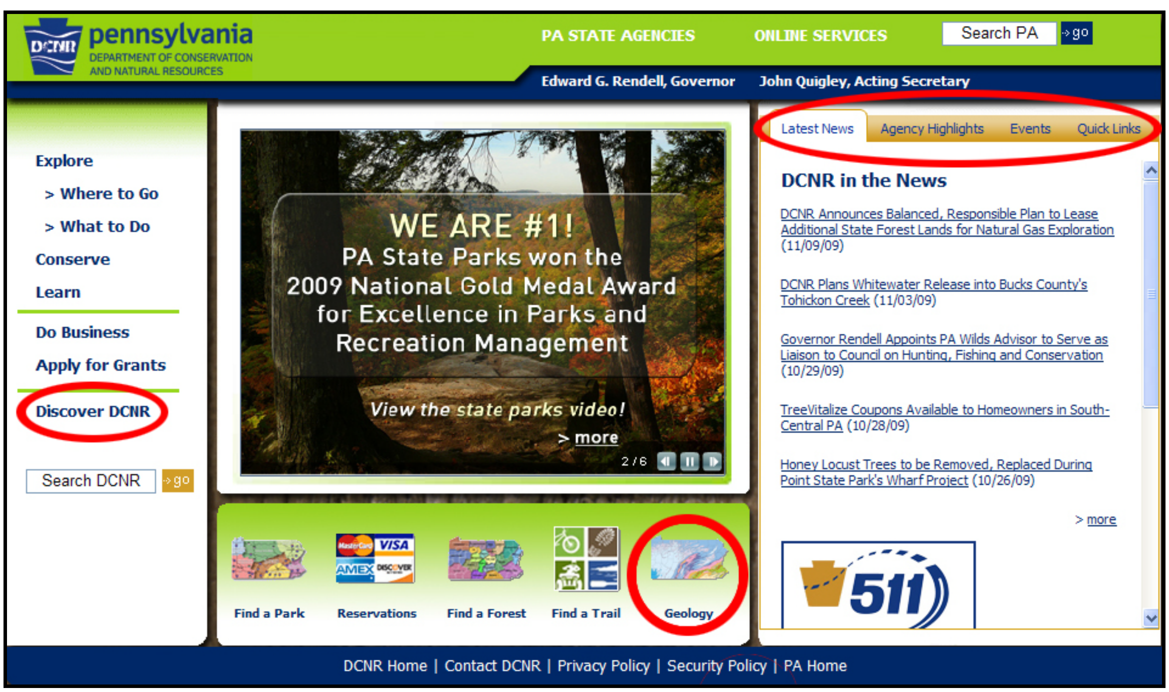
DCNR Website Redesign

Sandip Patel, IT Generalist Admin
Pennsylvania Geological Survey

Our DCNR website homepage has been redesigned with a fresh new look and with a new navigation structure. It's been many months in the making and has taken a great deal of time from many people. As you can see below, the web team has changed the graphics, the layout of the home page and the navigation bars. At present, only DCNR's home page been changed - in the near future all the remaining parts of the website will be changed. So, this is the time to get familiar with how the information and contents have been structured, and where on the page you can find the information or data you are looking for.

There is more than one way you can get to the same information from the homepage. For example, if you are looking for maps, as shown below, click on 'Geology' at the bottom of the center graphic and then click on 'Digital Maps, Data and GIS' on left navigation bar. You can find the publications in the same manner. Another way you could get to maps is by clicking 'Discover DCNR' on the left navigation bar, then on the next page click on the link under 'Maps' to access the 'Maps, Data and GIS'. You can access GIS data by clicking the 'GIS data' link under the 'GIS' tab. While you are at this page (Discover DCNR), you could also explore other parts of the department's website to learn more about DCNR. For publications, click on 'Discover DCNR' on the left navigation bar and on the next page, click on 'Publications'. On this page, click on the link to the Topographic and Geologic Survey, left navigation bar, then select the publications on the webpage.



If possible, please spend some time on new redesigned website and explore the left navigation bar or click on different tabs on the right of the center graphic to learn more about DCNR's latest news, highlights, events and quick links to most visited section of the DCNR's website.

New Version of WebDriller Goes Online

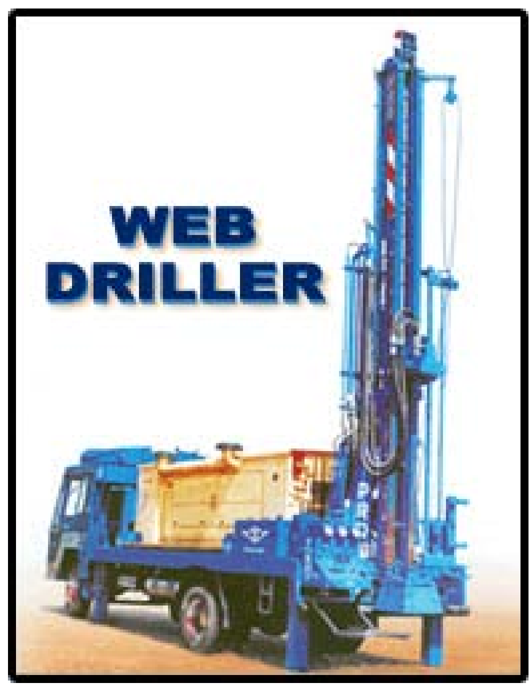
Gary Fleeger, Geologist
Pennsylvania Geological Survey

On June 1, the Survey introduced a completely new version of WebDriller, the web-based system that water well drillers use to submit their well records. Coinciding with that release was the requirement that all water wells be completed via WebDriller, rather than the paper records that many drillers continued to submit.

The main benefit of the universal use of WebDriller is significantly decreased cost to the taxpayer. With the submission of paper records, manual data entry into PaGWIS by either Survey staff and/or a contractor was necessary. The cost was prohibitive, and our staff was unable to keep up with the 15,000 paper well records that we would receive each year. As a result, our backlog extended 20 years for some counties, requiring users to visit our Middletown office to view the records.

A secondary benefit is the automatic transfer of submitted data from WebDriller to PaGWIS, making the data available much more quickly. With paper records, the delay was a year at a minimum, and because of the funding and record volume problems, the delay could be as much as 20 years. At the moment, however, we are still experiencing a technical problem with the data transfer. The data are being archived but are not visible for review. This problem is being addressed, and we expect the issue will be resolved soon.

The new WebDriller collects the same data as the previous version. However, it has a number of improvements:



- An easier to use format.
- Many more data validation checks than the previous version. These data checks prevent errors in data entry, eliminating some of the erroneous data that often plagued the old system.
- Help files that are more readily accessible with each entry screen.
- The elimination of the 15-minute timing of the old system.
- Direct access to an on-line mapping system, where the user merely clicks on the well location to enter the latitude and longitude into the proper fields.

We hope that the mandatory use of the new WebDriller will result in much better availability of the water well record for homeowner and scientist alike.

Happy Birthday, Pennsylvania Geological Survey

Rick Keen, Librarian
Pennsylvania Geological Survey

The Pennsylvania Geological Survey celebrated its 90th birthday in June, 2009. The 4th Geologic Survey of Pennsylvania was established by an act of the legislature on 7 June, 1919, as a bureau within the Department of Internal Affairs. The legislation, creating the Survey, tasked the Survey to provide comprehensive reports on both the geology and geography of the state, to co-operate with state and federal agencies, to maintain a library, and to "put the results of the survey, with the results of previous surveys, into a form convenient for reference."

In September, 1919, an important first step in fleshing out the new bureau was taken when Governor Sproul appointed George H. Ashley to serve as the State Geologist. A former State Geologist of Tennessee, Ashley had also worked for the United States Geological Survey as the chief of its coal section. Sproul's selection of Ashley proved invaluable to the development of the Survey. Within months after his selection the fledgling bureau consisted of nine staff including four geologist.

Ashley recognized that continual research into coal, oil and gas resources were vital to the economic growth of the state. But he interpreted the legislation creating the 4th Pa Survey as an opportunity to create a permanent survey whose task was to provide timely geologic data; assisting the state to meet changing needs and requirements (Faill, PA Geology, v.18(1), 1987. Under Ashley's direction, the Survey assumed a more systematic but diversified approach to publishing geologic data. By 1946, when Ashley retired, the Survey had published 11 reports in the atlas series, 6 county reports, 27 mineral resources reports, 7 reports on ground water in the state, and 130 progress reports.

Ashley's interest in providing timely data is evident in a decision to publish reports in a rather unconventional format. Prior to the release of the progress reports series, Survey publications were printed by the state printing office. In an earlier article on the history of the 4th Pa Geological Survey, it was suggested that Ashley was frustrated by the amount of time required by the printing office to make reports available to the public. He decided to forgo formal publication of progress reports; instead, they were released to the public as mimeographed reports. The decision to use the mimeograph not only expedited the availability of reports but also reduced publication costs.

Ashley's influence on the Survey is still evident today. The Survey's primary function remains the same: to provide geologic data, in a convenient format, to aid in the decision making process. There continues to be a pressing need for geologic data to aid state agencies, planning commissions, and local communities make wise decisions concerning the use of the state's resources. Recent reports authored by Survey staff, while not ignoring the need for information effecting economic growth, have studied the water resources of the state, geologic hazards, and the potential of the state to geologically sequester harmful pollutants to minimize their impact on the environment.

The use of the mimeograph to publish progress reports only hinted at the potential of technology to assist in the distribution of data. Today, the Survey uses computer technology to aid geologist prepare reports and maps. While some publications are still printed, many more are now available in a digital format and the internet provides access to some of our out-of-print publications as well as many of our most recent publications, including PA Geology.

Faill, Rodger T. "The Fourth Geological Survey of Pennsylvania: the resource years," Pennsylvania Geology, v.18(1) February, pgs. 23-31.
with thanks to Dr. Parrish

Meet the Staff Part 8 - Data Distribution Section

(Previous Meet the Staff Parts: 1, 2, 3, 4, 5, 6, and 7)

The Survey's Data Distribution Section is responsible for managing publication and distribution of the information produced by the other divisions. This takes many forms, including our web site, traditional publications, newer digital publications, and outreach activities. The division also manages the Library and provides IT help desk support and network support for the Bureau. The staff is led by Division Chief George Love, and includes Helen Delano (Geologist), Richard Keen (Librarian), Sandip Patel (IT Supervisor), Kyle Imbrogno (IT Generalist) and Tyler Michael (IT Technician).

George Love and **Helen Delano** were profiled recently in Meet the Staff Part 3. **Kyle Imbrogno** is currently on extended military leave and will be profiled in a later issue.

Sandip Patel joined the PA Geological Survey in June 2005 as an IT Generalist in our Middletown office. In 2008 he was promoted to the IT Generalist Administrator position, where he supervises two IT Technicians and has overall responsibility for the day-to-day IT help desk support, system and network support of the Survey. His team is also responsible for the management, contracting and procurement of all IT projects within the Survey. He and his team are always testing and looking into new technology to make the data collection, manipulation and distribution aspects of the Survey's functions user friendly, easy to maintain, and efficient. In addition, as a part of the Data Distribution group within the Survey, he and his team are responsible for different aspect of data distribution internally and externally such as website support and maintenance, application support, and last but not least the PAIRIS/WIS system. . The PAIRIS/WIS system provides access to all oil and gas well related data to other state and federal agencies and more than 200 oil and gas industry clients from all over the US and Canada.

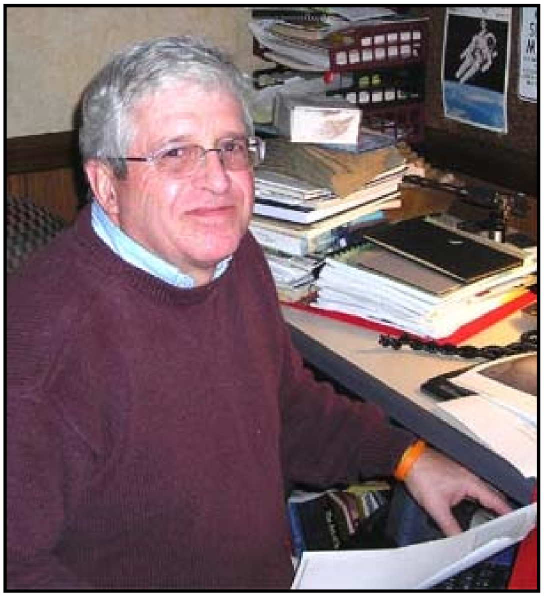
Sandip was educated in India. He holds a BS in Computer Science from University of Pune in Loni, India. Before joining the Survey, he worked as an independent IT consultant in various industries in the US and abroad. Working with the PA Geological Survey has given him exposure to the technology being used in the geologic world, how the IT applications and their utilization affect the geologic sciences. Interestingly, he has begun to realize how important geology and its data are to day-to-day life.

Sandip was born in Zambia in east Africa, and raised in India. He has been happily married for 10 years and has two children. His son will be seven years old on Christmas day and his daughter just turned two years old the weekend before Thanksgiving. Sandip spends most of his free time with his kids. He plays volley ball regularly and in the summertime he plays that odd and infinitely long game called Cricket. Before he came to the US, he followed football (Soccer). Now, he follows Football (as in the real version) because his son is asking him questions all the time about American Football. Sandip's seven year old son knows more than he about the different US Football teams, their schedules, and of course the "rules."

Tyler Michael is BTGS' newest staff member, having joined the Pennsylvania Geological Survey in September of 2008, as an Information Technology Technician. Tyler helps with the daily operation of the Survey's computer systems and frequently updates its website with new content. As geologists complete new open-file reports and other content, Tyler converts the reports to a web-friendly format and publishes them on the Survey's website. As he becomes more familiar with the technical jargon, he will aid in the translation of "geologic mumbo jumbo" into English!

Tyler completed his Associate Degree in Specialized Technology at the Thompson Institute of Harrisburg in 2004. He has over four years of service with the Commonwealth. Prior to joining the Survey, Tyler worked for the Department of Revenue, the Department of Public Welfare, and the Department of Health. He was part of the team that kept PA Emergency Management Agency (PEMA) connected to the world during emergency drills.

Tyler was recently married to his beautiful wife Debby, and has moved from Millersburg to the Harrisburg area. During his free time he enjoys long distance running and cycling. He ran his first marathon last year and participated in his first 100-mile (Century) bicycle ride this year. He is looking forward to tackling some sort of endurance race next year, not that 100 miles doesn't require endurance. Tyler enjoys working at the survey because he is learning things that he would have never learned or been exposed to if not for working with geologists. Some of what he has learned is of value!



Richard C. Keen (Rick) became the PA Geological Survey's Librarian in September 1992. His duties include acquisitioning print and non-print materials, cataloguing, interlibrary loan, cooperating with other libraries, assisting visitors, and maintaining an archival collection. In addition, he has recently been overseeing the daily library-related activities of several special projects, including the Survey's study of Carbon Sequestration, completing the program to scan aerial photographs for online accessibility, and providing information for a geologic data preservation program funded by the US Geological Survey.

The library is also expanding services while adapting to present day requirements for information. Efforts to provide staff with relevant and vital information, in a timely manner, have forced librarians to utilize electronic access from vendors as well as participating in AccessPA - an effort to facilitate sharing of resources among libraries throughout the Commonwealth.

Rick holds a B.A. from Bloomsburg University, Bloomsburg, PA, an M.SLS from Villanova University, Villanova, PA and an M.A. in history from West Chester University, in West Chester, PA. Prior to his position with the Survey, Rick worked at West Chester University's F. H. Green Library.

A former history major he has an intense interest in military history, Gettysburg in particular. Working with the staff of the Survey has fostered an interest in examining the importance of terrain in the battle of Gettysburg. He participated in the 2005 Annual Meeting of the NE Section of the GSA and co-authored a portion of the guidebook discussing the impact of topography on the 1st day. Last year Rick gave a presentation on the infamous charge on the 3rd day at Gettysburg as part of the annual field trip of Pennsylvania geologist.

Rick is married and has three grown children. Both he and his wife participated in the African Library Project last year. They sent more than 2,000 books to three libraries in Lesotho located within South Africa. This year they are in the midst of a drive to provide books to another library in Lesotho for orphans. His other interests (besides military history) include: hiking, biking, volleyball, photography, and reading.

Survey News

46th Industrial Minerals

The Survey will host the 46th International Forum on the Geology of Industrial Minerals in 2010. The abbreviated meeting will be held May 23 through May 25. The meeting and technical sessions will be held at the Survey's office in Middletown, PA. The website, www.46thindustrialminerals.org, will be operational in the near future. Registration forms, costs, requests for abstracts and details of the activities, as they evolve, will be posted.

Activities in the planning phase include:

Sunday, 23 May 2010

Day - The Geology of the Gettysburg Battlefield. This will be a repeat of the trip run by the 73rd Field Conference of PA Geologists. The afternoon will include a trip through the battlefield, guided by a park ranger. Cost to be determined.

Dinner on your own.

Evening – Reception at the Survey's office.

Monday, 24 May 2010

Proposed Technical Sessions

Session 1 (Mon. am)

General geology and mining history of PA

Current status of PA minerals industry

Session 2 (Mon. am)

Industrial Mineral Mining regulations in PA

Industrial Mineral Mining related reclamation and environmental issues in PA

Dinner on your own (but we will facilitate a group meal if requested)

Tuesday AM, 25 May 2010

Proposed Technical Session

Geology of Aggregates and Cement

Geology of Other Industrial Minerals

Brief Business Meeting

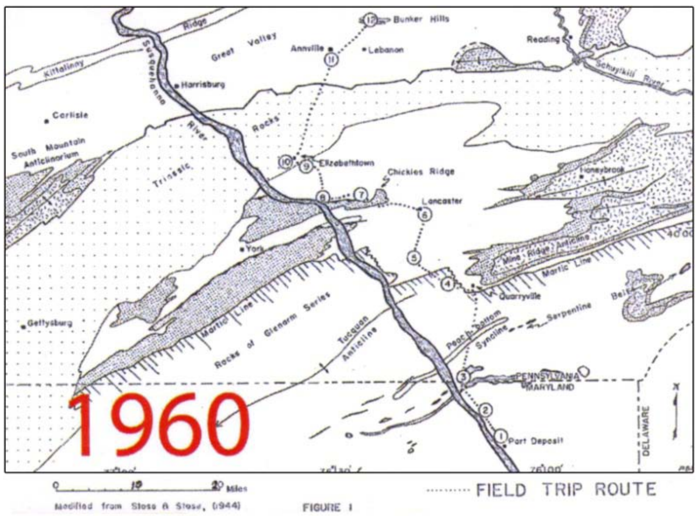
Tuesday PM

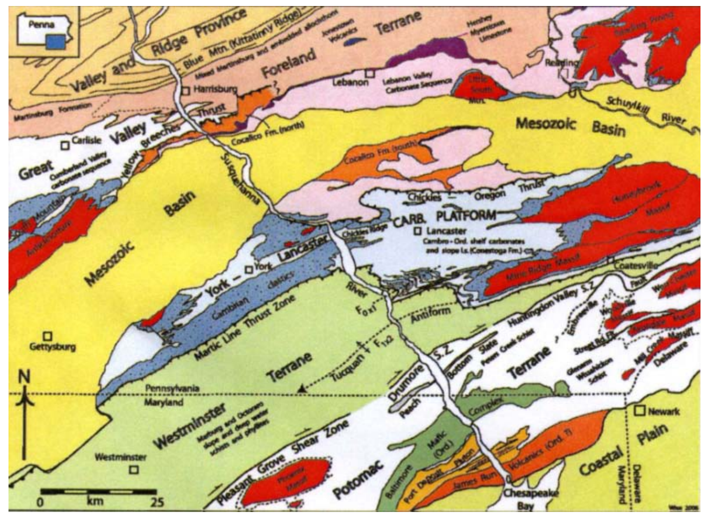
Field Trip TBD

This is an abbreviated schedule. The continuing economic slow-down has affected the industrial minerals industries in the area. This forum has historically drawn attendees from throughout the US and several foreign countries.

A Tectonic Cross Section (?) of the Pennsylvania Piedmont

50th Anniversary Update of the 1960 Trip
September 23, 2010 Afternoon Presentations
September 24 and 25, 2010 (Friday and Saturday) Field Trips





The 1960 trip of the Field Conference of Pennsylvania Geologists trip addressed "Some structural and tectonic problems of the Appalachian Piedmont along the Susquehanna River."

Now on the 75th anniversary of this organization and 50th anniversary of that trip, it is time to see what a host of geologists and other scientists enlightened by a half century's diligent work and several scientific revolutions have done toward solving some of those "problems" of 1960. Some have been largely solved, whereas new data (The survey collected new seismic reflection data in Lebanon and Lancaster Counties in September of 2009. These data will be available for review.) and greater sophistication have generated a far greater array for the next generation. This trip is designed to take a brief look backwards at what has been accomplished, to provide an update of our present understanding of Piedmont tectonics and geology, and perhaps to provide a new list of questions and problems for the next half century's geologists to puzzle over.

The trip will be headquartered in the Lancaster Area at the Marriott Lancaster at Penn Square. The afternoon of Thursday will be a roundtable discussion of the past work and new studies and findings. The first field trip day (Friday) will be devoted to the early Paleozoic platform, slope and deep water deposits and structures of central and southern Lancaster County. The second field trip day will be devoted to the foreland trough and its structural evolution northward into Dauphin and Lebanon Counties.

Mark your calendars to insure you do not miss this opportunity! More information is forthcoming. The Field Conference's website at http://www.fcopg.org will be updated as information becomes available.

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Recent Publications

Out-of-print report released online: **(November 2009)**

- G 7—Glacial deposits outside the Wisconsin terminal moraine in Pennsylvania

Miscellaneous Investigation open-file report: **(October 2009)**

- The 2008-2009 Earthquake Swarm Near Dillsburg, Pennsylvania

Out-of-print report released online: **(October 2009)**

- W 41—Ground-Water Resources of Lackawanna County, Pennsylvania

Out-of-print report released online: **(September 2009)**

- W 47—Geology and Groundwater Resources of Monroe County, Pennsylvania

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Contributed articles are welcome. Guidelines for manuscript preparation may be obtained at www.dcnr.state.pa.us/topogeo/pub/pageolmag/pageolguide.aspx or by contacting the editor at the address listed above. To subscribe send an email to RA-pageology@state.pa.us.