Ohio Geology

A Quarterly Publication of the Division of Geological Survey *Summer 1998*

WORKING WITH THE DEPARTMENT OF REHABILITATION AND CORRECTION FOR THE PUBLIC GOOD

by Lawrence H. Wickstrom, James McDonald, and Thomas M. Berg

The Ohio Division of Geological Survey has released new, computer-plotted oil-and-gas-well location maps as well as digital data files of the corresponding well information. The project that created these new maps and data files is a remarkable state-government success story that we think all Ohioans ought to know about.

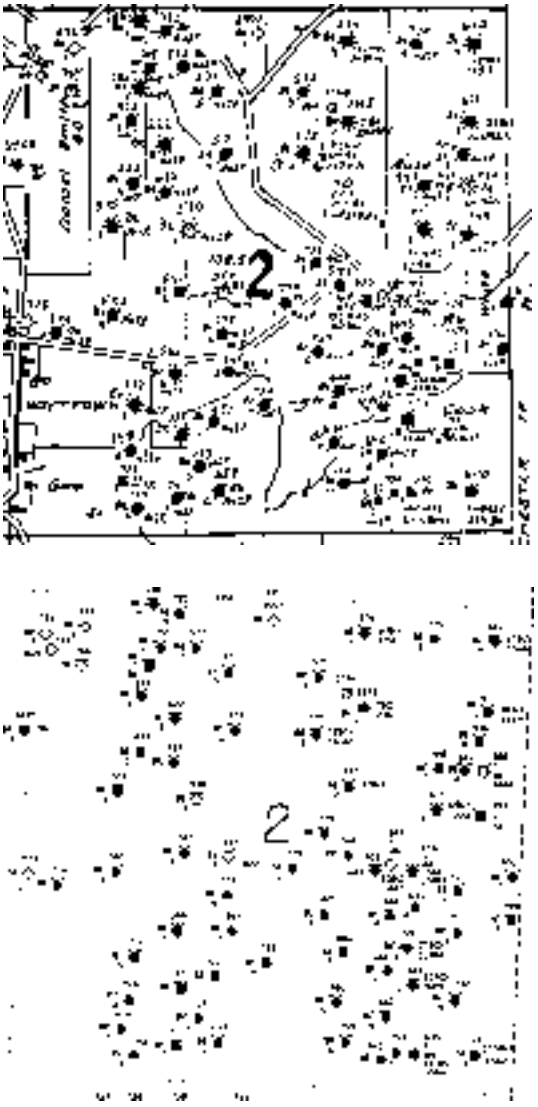
With the encouragement of Governor Voinovich, the Ohio Department of Rehabilitation and Correction (ODRC) has been working to provide prison inmates with opportunities to learn and develop skills that will give them an advantage when they return to the marketplace. Within ODRC, Ohio Penal Industries (OPI) has established CAD (computer-aided drafting) Services Shops and Digitizing Facilities at two correctional institutions. The Division of Geological Survey, OPI, a private-industry partner, and prison inmates carried out the oil-and-gas-well project at a considerable savings to Ohio taxpayers.

Oil and/or gas have been produced from at least 67 of Ohio's 88 counties. We estimate that more than 275,000 wells have been drilled in Ohio in search of oil and gas since 1860. The maps showing well locations and the information records from the wells represent the Survey's largest and most requested dataset. Increasingly, our customers and staff need this information in digital form for computer mapping and analysis of the data.

The primary maps on which most of these wells have been located for the last several decades are township bases at an original scale of 1 inch = 1,320 feet. We estimate that more than 200,000 wells were located on 1,176 maps. Since the establishment of ODNR's Division of Oil and Gas in 1965, an effort has been made to locate all permitted wells using the Ohio Coordinate System x, y coordinates. However, there are wide discrepancies between the coordinates submitted for some wells and their final permitted locations. Furthermore, many of the more than 100,000 wells drilled prior to 1965 have no location information other than the plotted points on our township base maps. The most efficient and consistent method to obtain coordinate locations for most of the wells drilled in Ohio was to digitize them directly from the township base maps.

The Survey had long recognized many problems with this map series. Many of the maps are so crowded with information that they are hard to read, and they have been through so many reproductions that the scale on many maps is no longer true. The Survey had been attempting to find funding to digitize oil-and-gas-well locations from the township maps since 1987. However, until recently the cost was prohibitive. Quotations from private industry ranged from $330,000 to $880,000. To perform the work in-house at the Survey would have required the purchase of several digitizing workstations, the space for the equipment and personnel, and funding to hire 5 to 10 workers. The Survey was unable to obtain these resources.

In 1995, the Ohio Survey initiated discussions with representatives of OPI, which had recently started a program to train inmates to digitize maps,



Left—A portion of the old township-based well-spot map for Bedford Township, Meigs County. Note the very cluttered, hard-to-read nature of the well information. Note also how much of the background information (lease names, roads, streams, even subdivision numbers) has been erased to make room for the well information. Below—The new digital well-spot map for Bedford Township, Meigs County. This maps is far more readable than the older well-spot map. Background information will be added in the near future.

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Thomas M. Berg, Division Chief and State Geologist

Ohio Geology

A quarterly publication of the

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Ohio Geology is a free publication. To become a subscriber please contact the Division of Geological Survey at the above address, phone numbers, or e-mail.

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From The State Geologist...

Thomas M. Berg

LONG-TERM, LAND-USE PLANNING AND VALUABLE MINERAL RESOURCES IN OHIO

Several of the articles in this issue of *Ohio Geology* focus on mineral resources and mineral industries in Ohio. The lead article about the Geological Survey's cooperative program with the Department of Rehabilitation and Correction shows how the Division has been able to provide the petroleum industry and Ohio citizens with a massive digital database on oil and gas wells in the state. As the rest of the world moves into the digital arena, this database will be of enormous value to those interested in Ohio's hydrocarbon resources. It will also be extremely useful to land-use planners who need to know the location of every oil or gas well in the state.

Doug Crowell's article on "Ohio's Mineral Industries & the Environment Teachers Workshop" illustrates how the Division of Geological Survey is working hard to raise public awareness of the crucial importance of finding a balance between using our abundant mineral resources and achieving environmental security. Mark Wolfe's "1997 summary of Ohio mineral production" drives home the tremendously important role that the fossil-fuel and mineral industries play in the state's economic development. Scott Brockman's article on Ohio's new map of its physiographic regions shows how geology and geomorphic processes are integral to how we classify our land and determine its future use.

One of the most important issues confronting Ohio today is farmlands preservation. The amount of land in our state dedicated to farming has been on a decline throughout most of the 20th century. Our cities continue to explode in size, and suburban sprawl has become a way of life for us. Very clearly, agriculture and related industries are at the top of the list in Ohio's economy. Farming and the food-processing industries contribute $56.2 billion to the state's economy each year. Long-range, land-use planning in Ohio must keep farmlands preservation as a top priority.

At the same time, I believe it is critical to identify and prioritize lands containing valuable mineral resources as the state moves toward long-range, strategic, land-use planning. For example, it is important to identify the location of high-quality sand and gravel deposits before golf courses or shopping centers cover them. We need to plan our land use sequentially and strategically so that such deposits can be extracted prior to other land uses. If we cover a prime sand and gravel deposit with a golf course, we need to understand that there is a price to pay: we will have to pay three to four times the cost for such material to be transported from a more distant location. Giving consideration to valuable mineral lands can easily put such lands in competition with prime farmlands, along with a host of other land uses. But giving consideration to location, quantity, and quality of valuable mineral resources in the land-use planning process at least allows for informed decisions that will affect many future generations of Ohioans.

Ohio's Mineral Industries & the Environment Teachers Workshop

What mineral resources are produced in Ohio? How does geology affect land use? Why is mining important to everyday life? These and many questions on Ohio mineral resources, mining, reclamation, and the environment were answered during the 12th annual Ohio's Mineral Industries & the Environment Workshop. This year's southern Ohio workshop was conducted July 27-31, 1998, by the Ohio Geological Survey and the University of Akron and was based at the Ohio Department of Natural Resources Fountain Square complex in Columbus. Grants from the Ohio Aggregates Association, the Ohio Mining and Reclamation Association, the Northern Ohio Geological Society, the Eastern Section of American Association of Petroleum Geologists, the Ohio Section of the American Institute of Professional Geologists, and the Ohio Chapter of Women in Mining paid for field-trip costs and educational materials. In addition, Shelly Materials, Inc., paid tuition, room costs , and a dinner/reception for the workshop participants.

First offered in 1987, these workshops familiarize teachers with Ohio geology, the importance of Ohio's fuel and nonfuel mineral industries, and how mining economic mineral resources can be compatible with environmental protection. Many Ohioans are unaware that coal, oil, gas, limestone, dolomite, sand, gravel, sandstone, conglomerate, clay, shale, gypsum, salt, and peat are produced in Ohio. Also, many do not know how these mineral resources are used daily, or how important these resources are to the economy of Ohio. Because of

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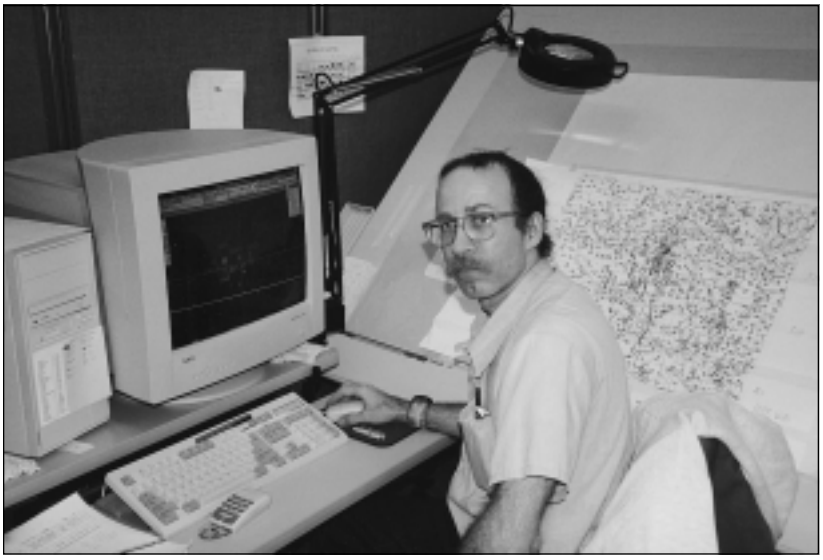
plans, and diagrams. OPI had a private-industry partner to perform project management, programming, and job-specific training. After meeting with the project manager from the partner firm of Lockwood, Jones and Beale, Inc. (LJB), we developed job specifications and requested a quotation for the oil-and-gas-well project. The quotation came to less than $100,000—less than one-third of the most inexpensive private-sector quote. ODNR's GIS Coordinator David Crecelius of the Office of Computers and Communications helped the Survey obtain funds for the project. Finally the path was clear to digitize the wells and create accurate, digital base maps upon which they could be plotted.

Training and digitization of a prototype county began in May 1996. Survey staff created digitization guidelines and specifications for OPI and met with LJB staff to work through the process and identify potential problems. A schedule was established, including delivery dates and return dates for all source maps and products. The state was divided into nine groups of counties, and one area was completed before moving on to the next. Working with ODNR's Division of Oil and Gas, we concentrated on western Ohio first—where there is very little current drilling activity—and then moved into eastern Ohio. This plan allowed the inmates to become familiar with the process and increase turn-around rates before working on counties having the greatest oil and gas activity.

Inmates at the Marion Correctional Institution (MCI) were involved in the initial training and prototype work. Because of the unique data type and the wide variability of our maps, Survey staff visited MCI twice to assist in training and answer questions. After the prototype-area problems were worked out, OPI decided to include the digitization shop from the Orient Correctional Institution (OCI) in the project to help meet the contract deadline. Survey staff also assisted in training the inmates at OCI. Because of other contractual obligations at MCI, OCI inmates completed the majority of the work.

While inmates were digitizing the well locations, Survey staff and student interns were busy creating a new series of digital base maps for the state. The work schedule for the base maps had to stay ahead of the OPI well digitizing. Numerous land-subdivision schemes have been used in Ohio. As most oil- and gas-well locations are surveyed from the subdivision boundaries, these land subdivisions had to be included on our maps. Nobody had ever digitized all of the irregular land subdivisions for the entire state. The end result is what we believe to be the most accurate, complete set of statewide digital, land-subdivision base maps.

We entered into this project with a little apprehension concerning the work to be performed by inmates, not knowing if they could produce a product of sufficiently high standards. We were pleasantly surprised by the degree of professionalism exhibited by the inmates toward their work and toward us. They displayed great concern over the quality of their product and really took ownership of the job, working out problems and finding better solutions on their own. This project turned out to be much more complicated than any of us realized at the beginning. The original township spot maps were in worse shape than we thought—far out of scale and difficult to read—and the data and symbols used were widely variable. The inmates rose above these problems to produce a high-quality set of digital maps and records.



An inmate at the Orient Correctional Institution working on digitizing one of the township well-spot maps.

In April 1997, when the contractor made the final product delivery, 210,837 well locations had been digitized and their attributes loaded into a corresponding database. The Survey has updated these files with wells permitted and drilled since the maps were digitized, and explanations have been added for the final map products. The new maps have superseded the old township maps for sale to the public, and the digital data files and digital base maps are available on CD-ROM and via the Survey's World Wide Web site. These new digital products will form the heart of the oil and gas segment of the Survey's planned integrated Geographic Information System.

We are proud to have worked with the inmates and prison officials, and take our hats off to them. We look forward to doing future digital projects in cooperation with OPI.

Petroleum Group Geology Supervisor Larry Wickstrom (right) and an inmate at the Orient Correctional Institution listen to a progress report on the digitizing project at OCI.

A new map of the physiographic regions of Ohio

A LITTLE BACKGROUND

In the early part of this century, high-quality topographic maps were available for the first time, and regional landform analysis, or physiography, was a vibrant and controversial area of scientific research. The big names in geology and geography were physiographers. For more than 50 years, William Morris Davis' familiar, though dated, concept of continuous erosional cycles, which pass through stages of youth, maturity, and old age, served as the unifying concept for the science. Physiographic maps led researchers to regions of similar geology and geologic history. Ohio, for example, was divided into regions that are so familiar they have appeared on the current fourth-grade proficiency tests, and include the Lake Plains, Till Plains, Glaciated Appalachian Plateaus, and Appalachian Plateaus. However, as geologic research became more process oriented, physiography faded, and the last update of the Ohio physiographic map appeared during the Great Depression.

Physiographic maps are in again; the Ohio, Indiana, and Pennsylvania geological surveys have each recently produced new physiographic or terrain maps. This time it's ecologists and land managers who want the maps for community and habitat studies. *The physiographic regions of Ohio*, a page-size full-color map, was compiled in part with funding from the U.S. Forest Service in cooperation with the Natural Resource Conservation Service and the U.S. Environmental Protection Agency. More detailed physiographic maps are a key component in developing large-area ecoregions maps, which these agencies plan to use in natural-resource management and research. (The Indiana-Ohio Ecoregion Map, published through the U.S. EPA, will be available in October 1998.) Unique physiographic regions are also unique ecoregions, but the former are much easier to map. In fact, the physiographic divisions of Ohio should seem natural to the observant traveler.

Even early travelers across the Ohio territory could easily identify unique areas such as the Black Swamp, Darby Plains, and Oak Openings. As settlement progressed, people noted broad regions where soils were more productive or less productive and where landslides or floods seemed more troublesome than elsewhere. The *Physiographic regions of Ohio* map puts boundaries on such regions and gives rhyme and reason to some puzzling geographic and ecological observations.

A FEW OF THE REGIONS

Ohio's 33 physiographic regions are an interplay between glacial geology, bedrock geology, topography, soils, and geologic history. For example, if you overlay Ohio's glacial map on the physiographic map, the origin and boundaries of some, but not all, regions become more obvious. For example, the Black Swamp occupied region 7, the Maumee Lake Plains. This infamous swamp was a tangle of trees and shrubs in ankle-deep water interspersed with well-drained oak-covered hillocks. These hillocks—Ice Age beach ridges, dunes, bars, and deltas of ancestral Lake Erie—are concentrated in region 7.2, the Maumee Sand Plains. The low, wet areas were clay flats of the deepest part of the lake basin and remain today as region 7.1, the Paulding Clay Basin, which has the distinction of being Ohio's flattest area; for dozens of square miles, the difference in elevation between the highest swell and the lowest swale is less than 5 feet.

Glacial geology offers insight into Ohio's highest region as well, the Bellefontaine Upland (region 3.3) in west-central Ohio. The high point of Ohio, Campbell Hill (1,549 feet above sea level), by rights should be a crag of bedrock that resisted the onslaught of glaciers. Instead, the glaciers piled more than 300 feet of debris over a mere bump of bedrock. More end moraines drape this area than any other.

Escarpments and divides produce striking changes in physiography. In eastern Ohio, the Flushing Divide separates Ohio's two major preglacial (Teays-age) drainage basins, which contrast in relief, dissection, and some surficial deposits. The north-flowing Teays system ceased to function once the earliest glaciers blocked water flow and caused a system of lakes to form, much like the TVA lakes on the Tennessee River. Teays-age valley bottoms and the lake deposits that fill them are still important features in the modern landscape of unglaciated Ohio and are shown as shaded areas on the physiographic map. East of the Flushing Divide, region 17.1, the Little Switzerland Plateau (the name was borrowed from the most rugged area in Monroe County along the Ohio River), is the only unglaciated region without remnant Teays-age features to soften the topography. The area's rugged topography and nearly impermeable soil and rock give rise to the most dangerous flash floods in the state.

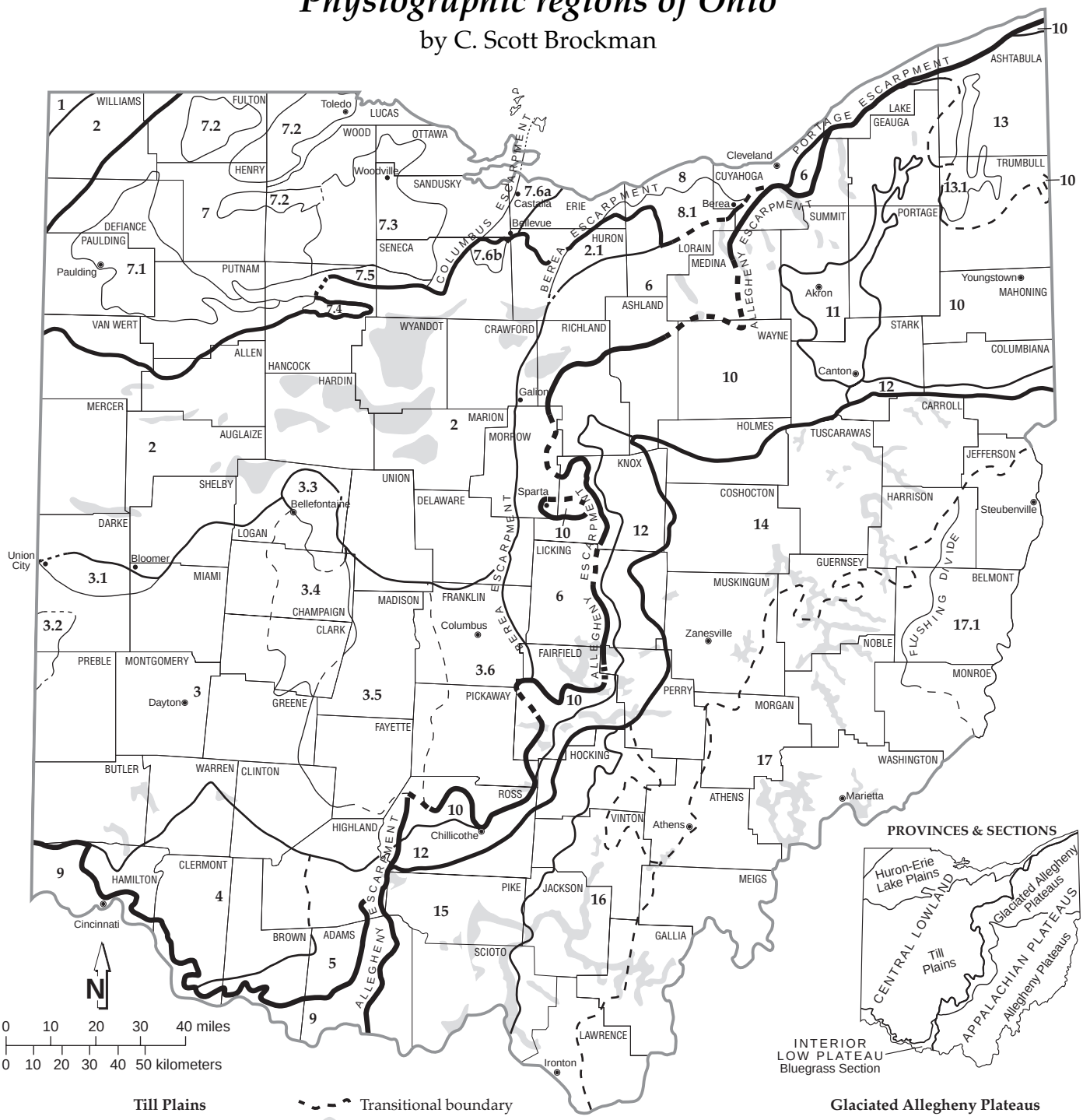
Ohio's largest region of surface-exposed bedrock, the Allegheny Plateaus (regions 14-17), is difficult to subdivide by geology alone. The most obvious bedrock control on physiography is in region 17, the Marietta Plateau, where fine-grained rocks of the Pennsylvanian-age Conemaugh Group produce rounded hills, areas of reddish soil, and relatively common landslides. Perhaps surprisingly, bedrock has more evident control in the glaciated part of the state. Large areas of the Berea Sandstone lie beneath thin drift on the Berea Headlands (regions 2.1 and 8.1). The Berea Sandstone is particularly resistant to glacial and shore erosion, which removed overlying softer rock units, leaving a relatively flat plain. The softer, more erodable units have been cut into the hilly Galion Glaciated Low Plateau (region 6); the contrast between these adjoining areas can be seen even from space.

Each physiographic region is unique in some way. The full-color page-size *Physiographic regions of Ohio* map includes a detailed chart on the reverse describing the characteristics, geology, and boundaries of each region. The map is available from the Ohio Division of Geological Survey, 4383 Fountain Square Drive, Columbus, OH 43224-1362. Single copies are free; there is a handling charge for multiple copies. Call the Survey's Geologic Records Center at 614-265-6576 for details.

—C. Scott Brockman

Physiographic regions of Ohio

by C. Scott Brockman



Till Plains

1. Steuben Till Plain

2. Central Ohio Clayey Till Plain
- 2.1. Berea Headlands of the Till Plain

3. Southern Ohio Loamy Till Plain
- 3.1. Union City-Bloomer Transitional Terrain
- 3.2. Whitewater Interlobate Plain
- 3.3. Bellefontaine Upland
- 3.4. Mad River Interlobate Plain
- 3.5. Darby Plain
- 3.6. Columbus Lowland

4. Illinoian Till Plain

5. Dissected Illinoian Till Plain

6. Galion Glaciated Low Plateau

Transitional boundary

Lake basin/deposits outside Huron-Erie Lake Plains

Huron-Erie Lake Plains

7. Maumee Lake Plains
- **7.1**. Paulding Clay Basin
- **7.2**. Maumee Sand Plains
- **7.3**. Woodville Lake-Plain Reefs
- **7.4**. Findlay Embayment
- **7.5**. Fostoria Lake-Plain Shoals
- **7.6a** and **7.6b**. Bellevue-Castalia Karst Plain

8. Erie Lake Plain
- 8.1. Berea Headlands of the Erie Lake Plain

Bluegrass Section

9. Outer Bluegrass Region

Glaciated Allegheny Plateaus

10. Killbuck-Glaciated Pittsburgh Plateau

11. Akron-Canton Interlobate Plateau

12. Illinoian Glaciated Allegheny Plateau

13. Grand River Low Plateau
- **13.1**. Grand River Finger-Lake Plain

Allegheny Plateaus

14. Muskingum-Pittsburgh Plateau

15. Shawnee-Mississippian Plateau

16. Ironton Plateau

17. Marietta Plateau
- **17.1**. Little Switzerland Plateau

Rocks, minerals, planets, and more: The Cleveland Museum of Natural History's Reinberger Hall of Earth and Planetary Exploration

In late 1997, The Cleveland Museum of Natural History opened a new hall devoted to the Earth and planetary sciences. The Reinberger Hall of Earth and Planetary Exploration, nicknamed "PLANET e," is the only large museum exhibit to integrate the disciplines of geology and astronomy. The hall also integrates real specimens with state-of-the-art interactive stations.

Many of the exhibit's walls are made of cast rock, so that visitors can feel that they are really next to basalt columns, inside a lava tube, and in a mine. Wherever possible, real mineral, rock, fossil, and meteorite specimens are in the open so that the visitor can touch them. These include basalt from Hawaii, 2-billion-year-old stromatolites from Minnesota and Labrador, and a 4.5-billion-year-old meteorite ("the oldest thing you'll ever touch").

Interactive stations allow the visitor to explore geological features of the earthlike planets, delve into various aspects of plate tectonics, and find out about the origin of many kinds of landforms. The Planetary Odyssey interactive station allows the visitor to "fly over" and "probe" the Moon, Mars, and other planets and moons. A time line in the hall begins on the ceiling with the Big Bang and cascades down upon a wall where a mural depicts various life forms during the past 600 million years. Fossil specimens in front of the time line are mounted so that they can be touched. A section on soils represents lunar regolith as well as Earth soils.

A young museum visitor watches the needle of seismograph in the earthquake display area. Photo by Dan Flocke.

In May 1998, the Wade Gallery of Gems & Jewels opened adjacent to PLANET e. The gallery features more than 1,500 rare and precious gemstones, jewelry, and lapidary work, a collection that is considered to be one of the top five institutionally owned collections in the United States. At the entrance to the Wade Gallery is an exhibit that allows the visitor to explore the world of microminerals using a microscope connected to a video screen. Visitors can select minerals and zoom in to see details of these minuscule, yet magnificent specimens.

PLANET e includes information on Ohio geology and on geological processes active in Ohio. Visitors can "experience" an earthquake by stepping onto a platform that periodically vibrates as a simulated television newscast reports on a "Cleveland earthquake." A nearby working seismograph records major earthquakes from around the world as they happen.

Ohio rocks are featured in a special area highlighting the state's Paleozoic rocks and glacial features. This area was designed to correct the common misconception that the landscape of Ohio, and the configuration of Lake Erie, have always been the way that they are seen today.

The exhibit pod includes real rock core, a faux rock wall coordinated with the core rock, touchable specimens of fossils and rocks, and an interactive station that allows visitors to discover just how different Ohio was in the geologic past. The initial screen of the interactive station includes a depiction of a core and a geologic map of Ohio. Visitors are prompted to explore Ohio's geologic past by selecting a segment of geologic time and an accompanying "rock video." When a selection is made, the relevant areas of rock are highlighted on the map and the appropriate "rock video" begins. The videos show rock outcrops, reconstructions of prehistoric environments, and light-hearted studio and field shots. The chorus of each song repeats the basic message that Ohio is not the way it used to be. Each individual song tells about a part of Ohio's geologic history and is done in a different style with catchy lyrics. The Silurian selection, for instance, is called "Silurian Surf" and emphasizes that there was a sea here during the Silurian.

Across from the exhibit on Ohio's Paleozoic rocks, a wall of simulated glacial ice towers over a segment of glacial grooves from Kelleys Island. Around the corner, an exhibit case features large crystals of Ohio minerals such as celestite and a large block of Ohio coal. An exhibit on caves includes faux cave walls and an interactive station.

The Reinberger Hall of Earth and Planetary Exploration was designed by a team of museum scientists, educators, and exhibits specialists with the help of many advisors, including educators, geologists, and astronomers. The hall was sponsored by a number of organizations and individuals, including the Reinberger Foundation and the National Science Foundation. The Ohio Division of Geological Survey was instrumental in this project. The core of Ohio rock is on loan from the Survey and a number of Ohio Survey staff members helped with the project, notably Sherry Weisgarber, Ron Rea, and Tom Berg.

—Joseph T. Hannibal
The Cleveland Museum of Natural History

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poor or unregulated mining practices prior to the mid-20th century, many people have a misconception that current mining practices leave land useless, unattractive, and environmentally harmful. These workshops show teachers that mining and reclamation can and do occur in an environmentally sound manner and that mined land can be restored to an attractive, valuable, and productive land use.

In two half-day classroom sessions, the 14 participants in the 1998 workshop heard presentations from experienced, well-informed professionals from research, industry, and state regulatory agencies. Three full days and two half-days of field trips gave teachers a first-hand look at mining, reclamation, and resource-processing operations of various mineral industries. The first half-day field trip was to the Olen Corporation Columbus Plant #3 in Franklin County, where the teachers viewed a state-of-the-art dredger and computer-managed sand and gravel operation. On the second day, teachers visited the Dundas mine of Waterloo Coal Co., Inc., in Vinton County, where thy saw surface mining of coal, clay, and limestone, including a blast, reclamation, and a coal-washing preparation plant. Afternoon activities included a tour of the Ohio Historical Society Buckeye Furnace State Memorial, a reconstructed charcoal-iron furnace that operated during the second half of the 19th century. Next, a sediment-choked stream valley, a low-pH stream, and an abandoned mine-gob site in Jackson County demonstrated the result of unregulated, underground mining practices and the need for environmentally sound reclamation procedures. Teachers then toured a manmade wetland constructed to mitigate acid mine drainage discharged from an abandoned underground mine at Carbondale, in Athens County. The last activity of the day was an inspection of a steel grating placed over an abandoned drift-mine opening near Kimberly, in Athens County. The grating prevents human entrance into the mine—mines are dangerous places—but allows bats access to the mine, which provides a cavelike environment for bat colonies.

On the third day, the teachers saw the brick plant, shale mine, and brick artwork of the Bowerston Shale Co. in Licking County. Next, the teachers toured the Glass Rock sandstone quarry and glass-sand processing plant of Oglebay Norton Industrial Sands, Inc. The last activity of the day was a tour of the Ohio Historical Society Flint Ridge State Memorial, where the teachers learned how Ohio's first industrial mineral was processed and used.

On the fourth day, the teachers toured the limestone-mining operation at the Columbus Plant of Martin Marietta Aggregates in Franklin County. The day ended with a trip to Caesar Creek State Park, in Warren County, where the teachers collected fossils. In spite of heavy rains, many excellent classroom samples of Ordovician-age fossils were collected. Also, sample collecting at each of the field-trip stops was a highlight for all the teachers.

The last half-day field trip was to a working oil and gas pump and storage tanks in Licking County, where Doug Core, a geologist and oil and gas consultant, spoke with the teachers about the mechanics of drilling for oil and gas along with the economics and environmental concerns of oil and gas production.

The intent of the workshops is to open the eyes of the teachers, and therefore their students, to the daily need for Ohio's mineral resources and the environmentally responsible way these resources are being extracted in Ohio. Although many people do not realize it, everyone relies on the science of geology and consumes mineral resources daily. Mining is a necessary human activity. The land being mined is reclaimed to be compatible with farming, livestock grazing, commercial and residential development, or recreation. The overwhelming interest and enthusiasm expressed by this group of teachers during the week, as well as comments from teachers of previous workshops, indicate that the effort and partnerships of all those involved have been successful. Including this year's 14 teachers, 250 elementary through high school teachers have earned 2 graduate or undergraduate credit hours from participating in the workshops since 1987. An estimated 86,000 students have benefited from practical information presented to teachers on various aspects of Ohio geology, mineral resources, mining, and reclamation.

The next southern Ohio Mineral Industries & The Environment Workshop will be July 26-30, 1999. In addition, a northern Ohio workshop will be offered July 12-16, 1999. Details regarding the 1999 workshops will be included in the winter 1999 issue of *Ohio Geology*. Teachers interested in attending one of these workshops can be placed on a notification list by contacting Dr. Roger Bain, Department of Geology, University of Akron, Akron, OH 43235; telephone: 330-972-7659; or by e-mail: rbain@uakron.edu.

—Douglas L. Crowell

Scot Parks, mine superintendent, Waterloo Coal Co., points to some unusual features in a highwall at Waterloo's Dundas mine in Vinton County during the 12th annual Ohio's Mineral Industries & the Environ-ment Teachers Workshop.

1997 summary of Ohio mineral production

In 1997, coal was produced by 54 companies at 142 mines in 22 counties. Production totaled 30,635,245 tons (8.2 percent increase from 1996); 17,479,237 tons were produced from 10 underground mines, and 13,156,008 tons were produced at 132 surface mines. The total value of coal sold was $743,430,982; average price per ton was $24.58. The five leading counties for 1997 coal production were Belmont, Meigs, Monroe, Vinton, and Harrison. Ohio is the 10th-largest coal-producing state in the nation[1] and the 3rd-largest coal-consuming state.

An estimated 779 new oil and gas wells were drilled in 37 Ohio counties in 1997. The top five counties in the number of new wells drilled in 1997

[1]National rankings for coal and industrial minerals were provided by the U.S. Geological Survey and the U.S. Department of Energy, Energy Information Administration. Information on Ohio oil and gas was provided by the Ohio Department of Natural Resources, Division of Oil and Gas; national ranking was provided by the Independent Petroleum Association.

were Wayne, Portage, Muskingum, Washington, and Stark. Ohio ranks 9th nationally in the number of wells drilled. The total reported crude oil production in Ohio in 1997 was 8,593,359 barrels (3.5 percent increase from 1996). The total value of the crude oil produced was $151,887,623; average price per barrel was $17.68. Ohio ranks 18th nationally in the volume of crude oil produced. Natural gas production in Ohio in 1997 was 117,408,373 thousand cubic feet (MCF) (2.5 percent decrease from 1996). The total value of the natural gas produced was $313,863,968; average price per MCF was $2.63. Ohio ranks 15th nationally in the volume of natural gas produced.

Limestone and dolomite were sold or produced by 78 companies at 125 operations in 51 counties in 1997. Production totaled 77,895,212 tons (12.2 percent increase from 1996). The total value of limestone and dolomite sold was $323,343,141; average price per ton was $4.15. The five leading counties for 1997 limestone and dolomite production were Franklin, Erie, Ottawa, Delaware, and Wyandot. Ohio ranks 2nd nationally in the production of lime and 6th in the production of crushed stone.

Sand and gravel were sold or produced by 233 companies at 301 operations in 64 counties plus Lake Erie in 1997. Production totaled 57,653,172 tons (10.7 percent increase from 1996). The total value of sand and gravel sold was $244,109,992; average price per ton was $4.23. The five leading counties for 1997 sand and gravel production were Hamilton, Franklin, Butler, Portage, and Stark. Ohio ranks 4th nationally in the production of construction sand and gravel and 9th in the production of industrial sand and gravel.

Sandstone and conglomerate were sold or produced by 19 companies at 28 operations in 19 counties in 1997. Production totaled 2,331,188 tons (14.3 percent increase from 1996). The total value of sandstone and conglomerate sold was $36,029,741; average price per ton was $14.46 for crushed stone and $63.84 for dimension (building) stone. The five leading counties for 1997 sandstone and conglomerate production were Geauga, Perry, Knox, Pike, and Lake. Ohio ranks 15th nationally in the production of dimension stone.

Clay was sold or produced by 42 companies at 52 operations in 24 counties in 1997. Clay production (including material for captive use) totaled 1,505,667 tons (24 percent decrease from 1996). The total value of clay sold was $8,064,617; average price per ton was $5.36. The five leading counties for 1997 clay production were Tuscarawas, Hamilton, Stark, Jackson, and Ottawa. Ohio ranks 4th nationally in the production of clay and shale.

Shale was sold or produced by 22 companies at 33 operations in 21 counties in 1997. Shale production (including material for captive use) totaled 3,561,826 tons (170 percent increase from 1996). The total value of shale sold was $4,693,780; average price per ton was $1.60. The five leading counties for 1997 shale production were Hamilton, Stark, Cuyahoga, Tuscarawas, and Marion.

Salt was produced by 3 companies at 5 operations in 5 counties in 1997. Two rock salt mines, one each in Cuyahoga and Lake Counties, and three brining operations, one each in Licking, Summit, and Wayne Counties, produced 3,561,826 tons of salt (29.3 percent decrease from 1996). The total value of salt sold was $47,304,935; average price per ton was $13.24 for rock salt and $15.06 for salt in brine and evaporated salt. Ohio ranks 3rd nationally in the production of salt.

Gypsum was produced by 1 company at 1 operation in Ottawa County in 1997. Gypsum production (all material was for captive use) totaled 264,154 tons (1.3 percent decrease from 1996). The total value of gypsum sold was $2,377,386; average price per ton was $9.00. Ohio ranks 14th nationally in the production of gypsum.

Peat production was reported by 4 companies at 4 operations in 3 counties (Champaign, Portage, and Williams). Peat sales (including material for captive use) totaled 17,546 tons (121.5 percent increase from 1996). The total value of peat sold was $80,974; average price per ton was $4.62. Ohio ranks 12th nationally in the production of peat.

The 1997 mineral statistics summarized here are preliminary. The *1997 Report on Ohio mineral industries* will provide complete statistics as well as directories of operators for each mineral commodity produced in Ohio (excluding oil and gas operators). Copies of the 1997 report will be available in late 1998 from the Division of Geological Survey. Cost per copy is $7.50 plus $2.00 mailing; orders to Ohio addresses must include 5.75 percent tax ($0.43). Credit-card (Visa or MasterCard) orders may be placed by calling 614-265-6576.

—Mark E. Wolfe

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