

Programs & Services  
of the

# Division of Geological Survey

The Ohio Department of Natural Resources (ODNR), Division of Geological Survey (commonly known as the Ohio Geological Survey) is Ohio's oldest natural resource agency, dating back to 1837. The Survey researches and maps Ohio's geology to support industry, commerce, environment, safety, and education, thereby ensuring Ohio's strong economic foundation. As Ohio's permanent archive and public access point for geologic data, the Survey supports:

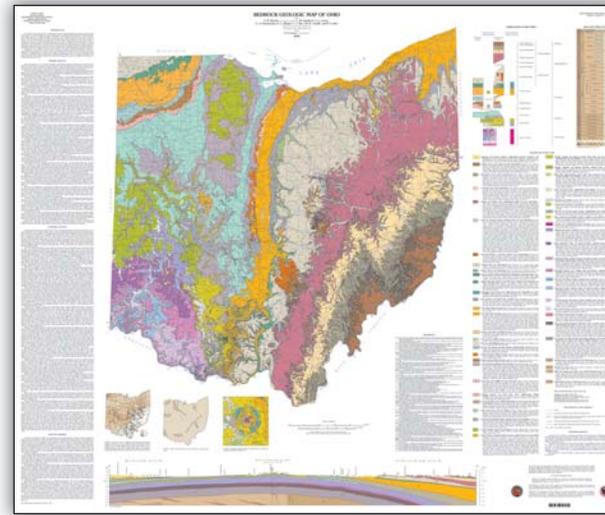
- ♦ Environmental protection.
- ♦ Proper land use development.
- ♦ Regulation of fossil fuel and mineral extraction.
- ♦ Groundwater development.
- ♦ Mitigation of geologic hazards.
- ♦ Mineral and petroleum exploration.
- ♦ Economic development.

## Bedrock and Glacial Geologic Maps— The Need for Basic Information

Geologic maps provide framework information needed to help us build highways, safeguard drinking water, prepare for disasters, protect wildlife, discover minerals, locate fuel sources, and much more. Consequently, such maps are useful to citizens at various levels, including geologists, hydrogeologists, engineers, mineral and fossil fuel producers, geotechnical consultants, land use planners, educators, government officials, and others interested in Ohio's Earth science.

In 2006 the Survey released the updated *Bedrock Geologic Map of Ohio*, culminating nearly 25 years of remapping the bedrock geology of Ohio. Nearly 3,850 individual maps were drafted by hand, converted to digital format, and compiled to create the new statewide geologic map.

Since 1997, the Survey's Geologic Mapping and Industrial Minerals Group has focused on 3-D mapping of Ohio's glacial deposits—unconsolidated deposits that cover about two-thirds of the state. The new mode of mapping reveals all glacial materials from the earth's surface to the top of the bedrock.



*Bedrock Geologic Map of Ohio*

The Survey has also developed a unique computer application to create custom, on-demand map products that feature data on locations of oil and gas wells, abandoned underground mines, earthquake epicenters, and more.

Ohio now has one of the most comprehensive, up-to-date sets of basic geologic maps in the nation. The Survey continually updates and improves geologic maps to efficiently convey extraordinary amounts of information vital to all Ohioans.

## Geologic map uses

The Survey distributes approximately 500 geologic quadrangle maps per year. However, as the Survey releases more digitally formatted maps, this number will significantly increase. Quadrangle maps have a variety of uses:

- ♦ **Groundwater exploration, development, and planning** - Water resource professionals use the Survey's geologic maps and data to create accurate groundwater potential and pollution potential maps.
- ♦ **Environmental consulting** - Professionals rely on geologic map products in mitigating polluted sites, reclaiming brownfield and toxic release sites for construction of new projects, and reusing once-abandoned land.
- ♦ **Exploration and development of minerals and fuels** - In 2008, Ohio's 141 coal-mining operations, 423 active industrial-mineral-mining operations, and 1,049 new oil and gas wells accounted for nearly \$3.3 billion of revenue and the employment of approximately 10,000 Ohioans.
- ♦ **Infrastructure** - Geologic maps are utilized on large-scale construction projects, such as roads, pipelines, dams, sewers, utilities, and railroads, to help predict conditions and cost, determine slope requirements, and develop mitigation plans for construction in geohazardous areas.
- ♦ **Understanding and preventing geologic hazards** - Geologic maps are invaluable for identifying, understanding, and mitigating Ohio's geohazards, including:

- Abandoned underground and surface mines.
- Karst (caves and sinkholes, common in limestone terrain).
- Landslides.
- Shore erosion.
- Radon (an odorless, radioactive gas known to cause cancer).
- Earthquakes.

- ♦ **Design and implementation of regulatory programs** - Federal, state, and local regulatory agencies use the Survey's maps to establish site specific requirements for permits.
- ♦ **Regional and local planning** - Geologic factors directly impact wise land use planning, zoning, and development of building codes.

## Economic Development

*So, what are geologic maps and data worth?*

As illustrated in the following paragraphs, the Survey historically has been, and continues to be, vital to the fuel and mineral extractive industries. But most people don't realize the importance of a geological survey to the everyday development of our society. Whether it is the building of a new sewer tunnel, the construction of a new highway, the development of a new shopping center, or the planning for



In 2008 over 26 million tons of coal were mined in 16 counties in eastern and southeastern Ohio.

new growth within the suburbs, the Survey's data and mapping products constantly are being used and save the citizens of Ohio many millions of dollars yearly. While the Survey does not get directly involved in many siting assessments (except for some very large, industrial manufacturing projects), our products are used by geotechnical and engineering companies that carry out the

planning. If each project had to recreate the Survey's maps and data from scratch, it would add tens- to hundreds-of-thousands of dollars to each project.

The government provides public goods and services, such as geologic maps and data produced by the Survey, to maximize the value of this information without diminishing the welfare of any single person, company, or industry in the process. By contrast, private investments are geared toward profit; privately financed, detailed geologic mapping benefits the company exclusively and is usually not made available to the public. These two opposing motives are fundamental to determining the value of public goods and services. As a public agency, the Survey delivers great value to Ohio citizens and industries; studies have shown geologic mapping returns over 23 times its cost to society.

## The Extractive Industries—Geology is Basic to Ohio's Energy and Infrastructure Future

As the state's primary source of geologic data and research for fuel and non-fuel mineral industries within the state (oil, gas, sand and gravel, limestone, salt, and coal companies), the Survey features:

- ♦ The primary repository of data and rock samples from Ohio's history of over 200 years of mining and nearly 150 years of oil and gas drilling.
- ♦ Data files containing records on over 260,000 oil and gas wells (location, drilling, completion, and production data).
- ♦ Thousands of well records and location maps, coal records, coal mine maps, and coal resource maps dis-



Several areas of Ohio experience frequent and costly landslides.

tributed annually to industry, landowners, and government agencies.

- ♦ Geologic maps and records that form the framework information used by sand-and-gravel, aggregate, and industrial minerals operators.

## Oil & gas

Since at least 1860, oil and natural gas production has occurred in at

least 66 of Ohio's 88 counties. Survey geoscientists support oil-and-gas exploration and production by mapping and characterizing both producing and potential oil and gas fields. Technical reports—released via print, the Survey's Web site, and technical presentations—are used by industry to find and manage geologic resources safely and efficiently.

## Coal

Coal-bearing rock formations are found in 40 Ohio counties, 32 of which have produced more than 3.7 billion tons of coal. The Survey has a long history of researching Ohio's coal-bearing strata and producing technical reports and publications to support resource development, safety, and to inform the citizenry of resource methods and history.

## Aggregates & Industrial Minerals

In 2008, over 100 million tons of both natural and man-made aggregate commodities were produced in 85 Ohio counties. The commodities include construction materials, such as aggregates (sand, gravel, slag, crushed limestone, dolomite, and sandstone), as well as salt, clay, shale, industrial sand, building stone, lime, cement, and recycled concrete. Such resources support a healthy economy and provide a large percentage of the raw materials required to build infrastructure, homes, schools, and businesses.

The Survey's bedrock and surficial mapping products provide the basic elements needed to identify economic deposits of these materials. Most aggregates produced in Ohio are used locally, usually within 50 miles of the production site, which helps to control trucking costs from mine

to usage point. The Survey identifies these reserves to allow proper land planning and zoning and protection of these sources. Using state-of-the-art computerized mapping applications, the Survey can produce resource maps for these commodities faster and in greater detail than ever to assist local planners and builders

### *Abandoned mine lands*

Since 1969, the Survey has actively mapped known locations of abandoned underground mines (AUMs) and subsidence issues related to underground mines. Over 4,700 AUMs, which once produced coal, clay, limestone, salt, iron ore, and other materials, exist within 43 Ohio counties.

Much of this mining took place before mining and reclamation laws existed. These mines underlie an area of over 800 square miles of the state. Additionally, over 625 square miles of Ohio land are affected by abandoned surface mines. The Survey is now working in concert with the ODNR Division of Mineral Resources Management, the state's mine regulatory agency, to research and create the most comprehensive inventory possible of all historic mine lands.

Abandoned mine lands can be a major geologic hazard in Ohio. Over time, underground mine structures deteriorate, allow roof rock and overlying strata to collapse into the mine void, and cause surface effects ranging from small pit openings to broad areas of surface sag. Mine subsidence commonly results in damage to building foundations, underground utilities, and roadways. Other potential problems from abandoned mine lands can include dangerous highwalls and impoundments, landslides associated with unstable mine spoil, mine openings, flooding, acid mine drainage, and mine gasses.

To reduce risks associated with abandoned mine lands, detailed knowledge of their location, extents, and geology is essential when developing plans for residential and commercial development, highway construction, mining,



The Ohio Geological Survey has created Ohio's most comprehensive collection of abandoned underground mine maps, available to the public via an interactive map application on our Web site. The map application receives tens-of-thousands of visits per year from government agencies, realtors, land owners, and non-governmental organizations.

2007, the Survey drilled the nation's first state-funded, deep carbon dioxide (CO<sub>2</sub>) sequestration test well in Tuscarawas County. Today, the Survey works with numerous utilities, ethanol producers, coal-to-liquids developers, oil and gas producers, and pipeline companies to develop geologic carbon sequestration options, including enhanced oil recovery techniques, and to prepare Ohio for future regulations.

### *Wind energy*

The Survey is working hand-in-hand with industry and the regulatory community to assist in safely siting large wind turbines. Whether the wind project is to be sited in Lake Erie or on a remote hilltop, understanding the geology underlying these large commercial turbines is basic to a safe and successful project.

### *Geothermal energy*

The Survey recently began a three-year study of the heat conductive properties of Ohio's geology. The results of this work will support the geothermal heating industry and may also lead to identifying large-scale

and drilling for water, oil, and natural gas.

### **Advanced Energy for Ohio**

#### *Geologic carbon sequestration*

Geologic carbon sequestration technologies are key to the removal of greenhouse gases from our atmosphere while allowing many types of advanced energy projects to move forward. The Survey has engaged in geologic carbon sequestration research since 2000 and has become a leader in this evolving field. The Survey coordinates geology studies for the eight-state Midwest Regional Carbon Sequestration Partnership (MRCSP), see <[www.mrcsp.org](http://www.mrcsp.org)>. And in

geothermal-energy production options within the state.

### **Support of Regulatory Programs**

Long before the regulation of coal mining (1874) and oil and gas drilling (1965), the Survey was gathering information, mapping mine and oil-and-gas reservoir locations, and providing the information to policy makers, industry, and the general public. The resulting archive formed the basis for regulations and provided new regulatory agencies a foundation on which to build programs. Today, the Survey remains the constant source of accurate mine, oil, and gas records; maps; and research.

Other important regulatory programs have relied on the Survey in the same manner, including hazardous



As of 2008, Ohio's oil-and-gas industry produces about 90 billion cubic feet of natural gas and five million barrels of oil annually from about 63,000 wells.

and industrial waste injection wells, solid waste landfills, groundwater, Lake Erie shore erosion, and abandoned underground mines.

The Survey also currently leads geologic carbon sequestration research for the state. New regulations soon will be developed that require large stationary sources of CO<sub>2</sub>, such as coal-burning power plants, ethanol plants, and fertilizer manufacturers, to capture and safely sequester this greenhouse gas. The Survey is working with regulatory agencies and industry to prepare Ohio for this new technology and regulation.

### Permanent Geologic Archive— Records and Rocks

Through the Geologic Records Center (GRC), Horace R. Collins Laboratory (HRCL), and the Internet, the Survey assists thousands of individuals and companies annually.

Industry representatives, scientists, policy-makers, educators, students, and the general public can access the Survey's records and publications at the GRC, located at the central ODNR campus in Columbus. The GRC houses and distributes technical reports, popular publications, geologic maps, resource maps (coal, industrial minerals, oil and gas), and various records dealing with specific sites and data throughout Ohio. The GRC also fields many questions from the public about Ohio's geology and offers free educational materials to teachers, including the popular rock and mineral kits. Since 1998, the Survey has distributed over 53,000 rock and mineral kits to Ohio's classrooms.

The HRCL is a multi-use facility which provides citizens, industry personnel, and researchers an environment conducive for studying the repository holdings of core samples, and records. The facility houses the Lake Erie Data Center and headquarters the Ohio Seismic Network (OhioSeis), a group of 25 volunteer, cooperative seismograph stations located at colleges, universities, and other Ohio institutions. The Survey manages network operations from the Ohio Earthquake Information Center at the HRCL, which also hosts a U.S. Geological Survey National Seismic Network station.

Increasingly Ohioans turn to the Survey's Web site to obtain information about Ohio's geology. In addition to Ohio geology information, the OhioSeis Web site, and numerous free publications downloads, visitors will find several interactive maps where they can query data to create and print their own custom maps or research locations of various mines, wells, earthquakes, or geologic formations.

The Ohio Geological Survey is proud to serve as a long-standing, well-respected, unbiased source of geologic data and knowledge for regulatory programs, agencies at all levels of government, private citizens and companies, and non-governmental organizations.

### Public Outreach

#### Geologic Records Center

- ♦ Technical reports
- ♦ Geologic maps
- ♦ Various data records
- ♦ Non-technical publications
- ♦ Resource maps
- ♦ USGS topographic maps

#### Horace R. Collins Laboratory

- ♦ Rock core samples
- ♦ Oil and gas well samples
- ♦ Laboratories and equipment
- ♦ Conference room/classroom
- ♦ Ohio Seismic Network
- ♦ Lake Erie Data Center
- ♦ Other geologic sample and data collections
- ♦ Public tours, displays, reports, and free publications

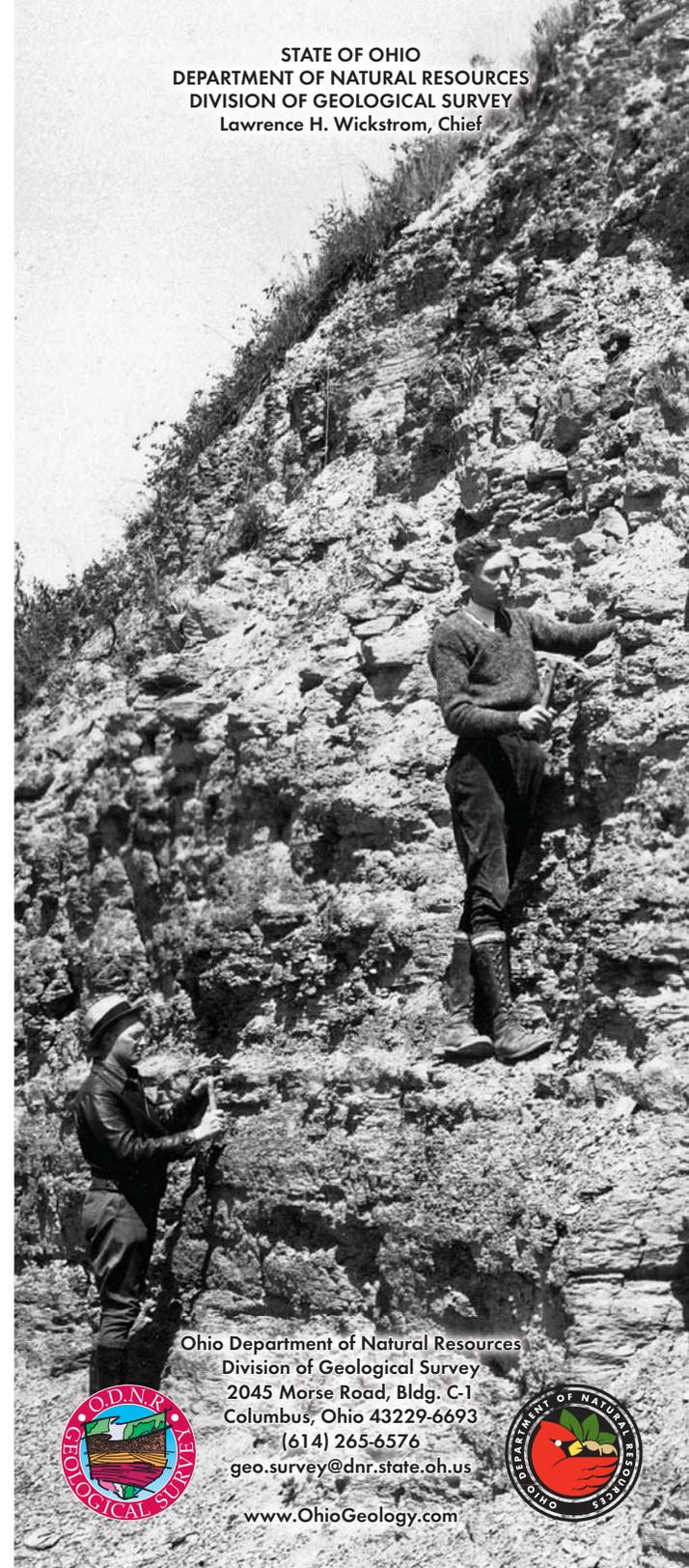


#### Internet

- ♦ Over 150,000 visitors/year
- ♦ Mine and well locations
- ♦ Publications for download
- ♦ Interactive map services
- ♦ Ohio geology information
- ♦ Educational resources

Equal opportunity employer M/F/H

STATE OF OHIO  
DEPARTMENT OF NATURAL RESOURCES  
DIVISION OF GEOLOGICAL SURVEY  
Lawrence H. Wickstrom, Chief



Ohio Department of Natural Resources  
Division of Geological Survey  
2045 Morse Road, Bldg. C-1  
Columbus, Ohio 43229-6693  
(614) 265-6576  
geo.survey@dnr.state.oh.us



www.OhioGeology.com