Geologic Information

Cornerstone of Land-Use Decisions

Illinois State Geological Survey Annual Report 2000

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Geologist Dave Grimley logging drill cores at the Survey building

To the People of Illinois

Illinois state and local decision-makers often face tough and conflicting public policy options over competing interests for land, water, mineral, and energy resources. Geologic information is indispensable in supporting the difficult decisions that promote economic growth and address the resource needs of a growing and shifting population while ensuring a high quality of life for future generations. In particular, geologic information is fundamental to wise land- and water-use policy, for resource development and protection, and for the identification and mitigation of potential and existing hazards.

Geologic information has always been important for one major resource issue that Illinois faces: the production and protection of our vital groundwater resources. In Illinois, as in the rest of the country and the world, water quality and supply are increasingly of serious concern. Around many industrialized sites in the state, groundwater can be at risk from improperly contained or discarded chemicals or from poor geologic siting of industrial or agricultural activities. In many agricultural areas in Illinois, groundwater quality in shallow aquifers may be degraded by the routine application of agricultural chemicals. Because contaminated ground-water can enter streams and rivers, surface-water quality also can be degraded in areas where geology is not favorable.

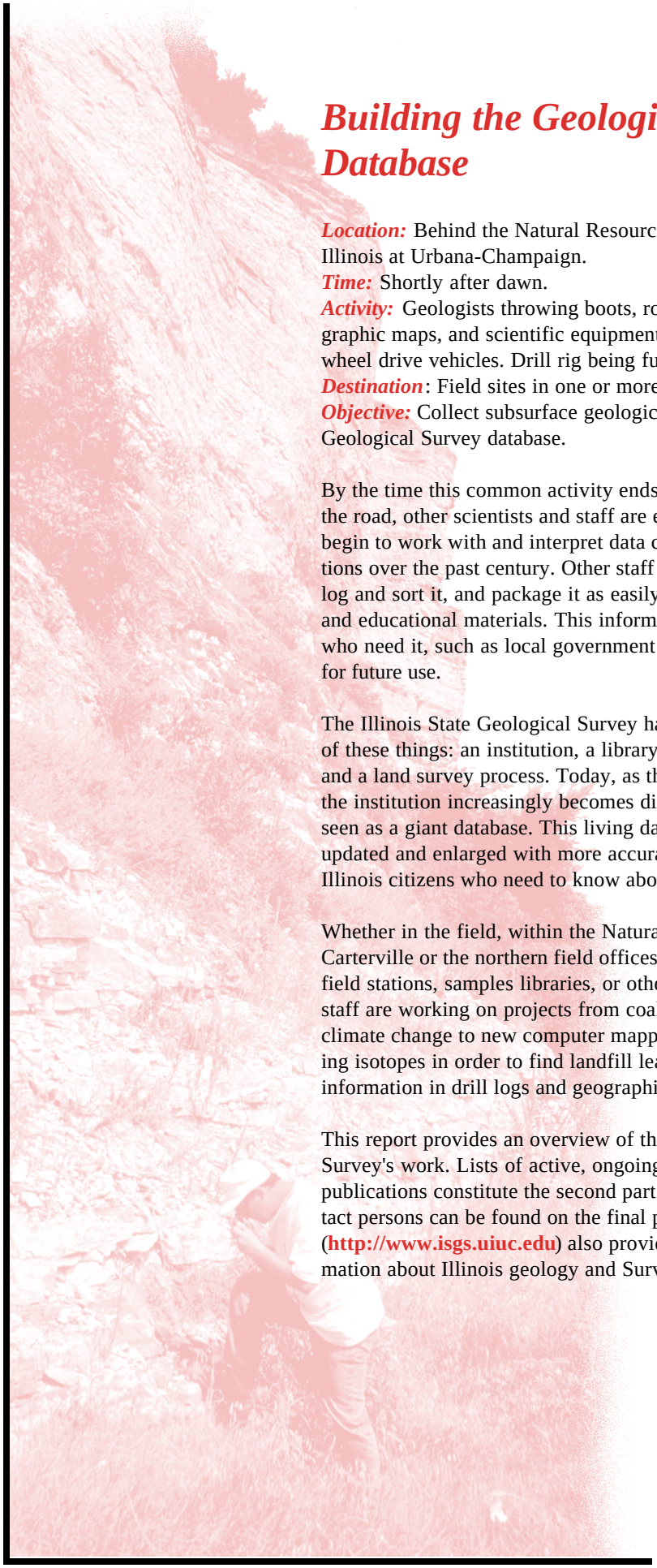
In addition to groundwater, Illinois has greater total potential coal resources (although not presently economically recoverable) than any other state in the country. We also have significant oil resources. Limestone and other construction materials are essential to the building and maintenance of our infrastructure and housing. All of these resources are of economic and environmental concern to the citizens of the state. Identifying and optimizing these resources are critical to the well-being of future generations.

For our society to best manage and protect our resources, increasingly greater precision is needed in the geologic information that we disseminate to the public. This need is the reason behind our programs to map the state's geology at a detailed scale and in three dimensions. This is part of our job at the Illinois State Geological Survey—to acquire, assemble, interpret, and then provide useful and understandable geologic information to the citizens of Illinois.

William W. Shilts

Bill Shilts, Chief
Illinois State Geological Survey

University of Illinois' Natural Resources Building, home to the Illinois State Geological Survey, photographed in the 1950s



Building the Geologic Information Database

Location: Behind the Natural Resources Building, University of Illinois at Urbana-Champaign.
Time: Shortly after dawn.
Activity: Geologists throwing boots, rock hammers, hard hats, topographic maps, and scientific equipment into various vans and four-wheel drive vehicles. Drill rig being fueled.
Destination: Field sites in one or more of the 102 Illinois counties.
Objective: Collect subsurface geologic data to supply the Illinois State Geological Survey database.

By the time this common activity ends and the vehicles move down the road, other scientists and staff are entering the Survey's offices to begin to work with and interpret data collected on previous expeditions over the past century. Other staff take this interpreted data, catalog and sort it, and package it as easily obtainable maps, publications, and educational materials. This information is then provided to those who need it, such as local government officials and planners, or stored for future use.

The Illinois State Geological Survey has been and continues to be all of these things: an institution, a library, an archive, an outreach effort, and a land survey process. Today, as the information contained within the institution increasingly becomes digital bits, the Survey can be seen as a giant database. This living database is constantly being updated and enlarged with more accurate and detailed information for Illinois citizens who need to know about the Earth's characteristics.

Whether in the field, within the Natural Resources Building, in Carterville or the northern field offices, at the Applied Laboratory, field stations, samples libraries, or other offices, ISGS scientists and staff are working on projects from coal to groundwater, from global climate change to new computer mapping technologies, from measuring isotopes in order to find landfill leaks to interpreting and arranging information in drill logs and geographic information system data sets.

This report provides an overview of the Illinois State Geological Survey's work. Lists of active, ongoing research projects and recent publications constitute the second part of this report, and a list of contact persons can be found on the final page. Our Web site (**http://www.isgs.uiuc.edu**) also provides access to a wealth of information about Illinois geology and Survey activities.

To get needed data to produce useful geological maps, ISGS scientists make frequent research trips to Illinois localities ranging from the middle of our largest cities to some of our most uninhabited areas.

Photos clockwise from upper left: Dave Grimley making field notes in the back of an ISGS vehicle, Dave Grimley and Rod Norby examining exposed glacial deposits in creek bed near Waterloo, Charles Dolan preparing to take soil samples in Chicago, and Russ Jacobson heading out into the field.

Anne Faber of the Geological Records Library is cataloging drilling records. Much of the information in the ISGS database is provided by water, oil, gas, and other private drillers around the state. The information they bring in is coded as to content and location. These records number in the hundreds of thousands and date back more than 100 years.

Some data are collected by direct observation. Here, Joe Devera is mapping St. Louis Limestone where it has been exposed in a streambed near Anna.

Chris Stohr uses a level to survey slopes of dredge spoil islands in Peoria Lake. The survey was used to estimate the slope stability of the islands. Other measurements were made using the global positioning system (GPS).

Illinois citizens make all kinds of changes on, above, and below the land surface. Tendrils of low-density suburban development stretch outward from city centers often unsupported by adequate geologic knowledge of the land, water, mineral, and other resources consumed, covered, and affected. Illinoisans handle potential contaminants at surface operations that, if spilled, can percolate downward. Refuse is buried beneath the land.

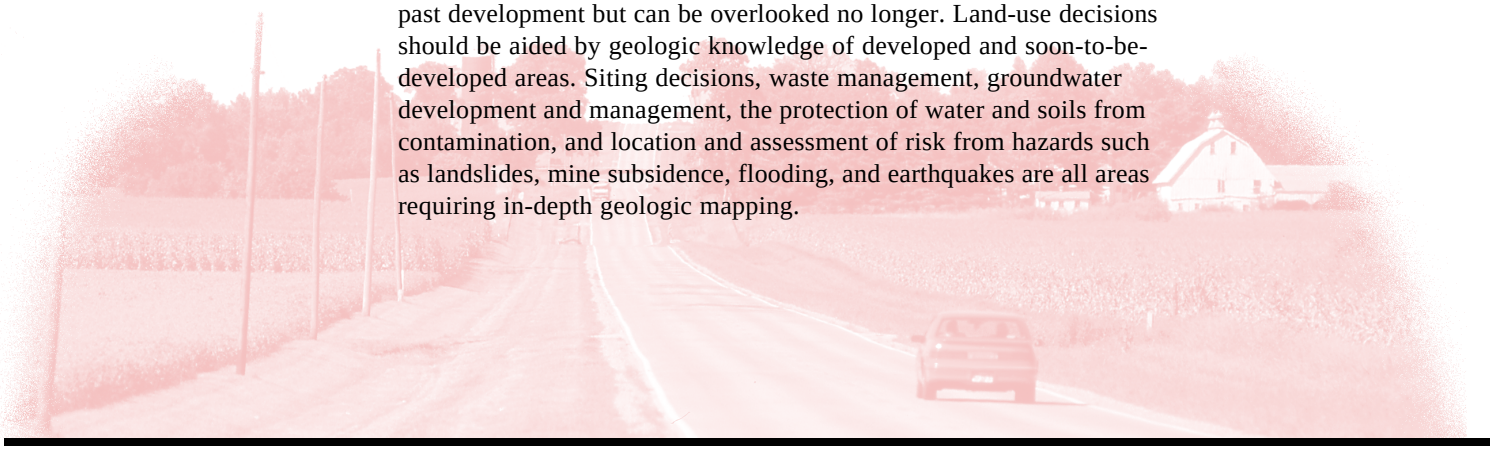
! With few natural surface barriers to development, suburban northeastern Illinois now has low-density suburban expansion that rivals that of Los Angeles. The result is environmental change, loss of farmland and natural open space, heavy use of local natural resources, development over construction resources, and high infrastructure costs.

! After building their homes, Peoria area subdivision homeowners were surprised to find out that high-quality water supplies were naturally limited in their new location. Limited or poor-quality water supplies also have restricted commercial development in other areas.

! The St. Louis Metro East area in Illinois is expanding over some of the most easily polluted karst terrain in the state. Septic system effluent, agricultural chemicals, and animal waste can seep directly into the underground rivers and caves in the limestone that underlies the region, and these caves can collapse under buildings and roads.

! The Illinois River, a commercial lifeblood as well as an important wildlife and recreation area, carries a huge sediment load that impedes navigation. Wetlands have been lost to land-use changes in the river's watershed. Flooding, such as the great flood of 1993, becomes more severe as runoff increases.

Detailed three-dimensional geologic mapping can provide the natural resource information needed for informed planning decisions, particularly in areas of the state, such as those just mentioned, where land-use issues are on the front burner. Illinoisans may now be exceeding the land's carrying capacity in some areas. In the absence of geologic map data, poorly informed land-use decisions may be made, resulting in significant economic and environmental costs. Many issues related to the protection and use of earth resources have been overlooked in past development but can be overlooked no longer. Land-use decisions should be aided by geologic knowledge of developed and soon-to-be-developed areas. Siting decisions, waste management, groundwater development and management, the protection of water and soils from contamination, and location and assessment of risk from hazards such as landslides, mine subsidence, flooding, and earthquakes are all areas requiring in-depth geologic mapping.



Large livestock facility in southern Illinois. These sites produce large amounts of animal waste that must be kept out of the groundwater.

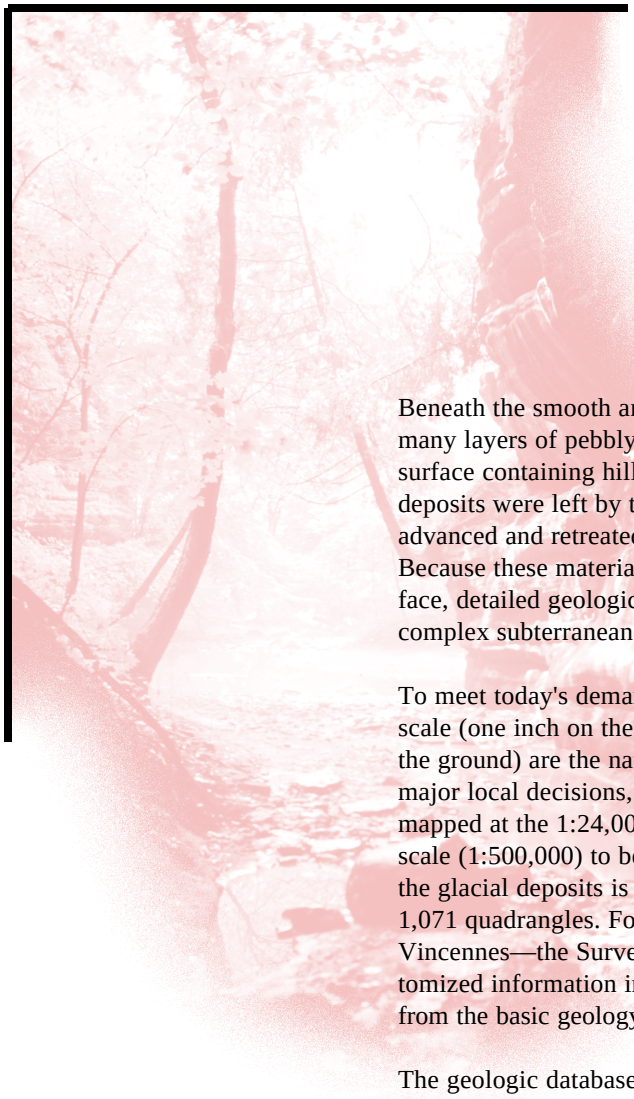
Suburban development on the northwestern fringe of the Chicago metropolitan area. This type of expansion removes land from other potential uses and places stress on existing resources.

Land use always has consequences. Potentially negative consequences can be better addressed through more detailed geologic information.

Waste landfill near Streator. Geologic information is essential for identifying underlying strata that will contain pollutants and protect the groundwater.

Children filling canteens with groundwater on a geology field trip.

The I-90 Skyway over the Calumet River mouth. Water is needed for many uses in Illinois, from drinking to industrial processing to transportation.

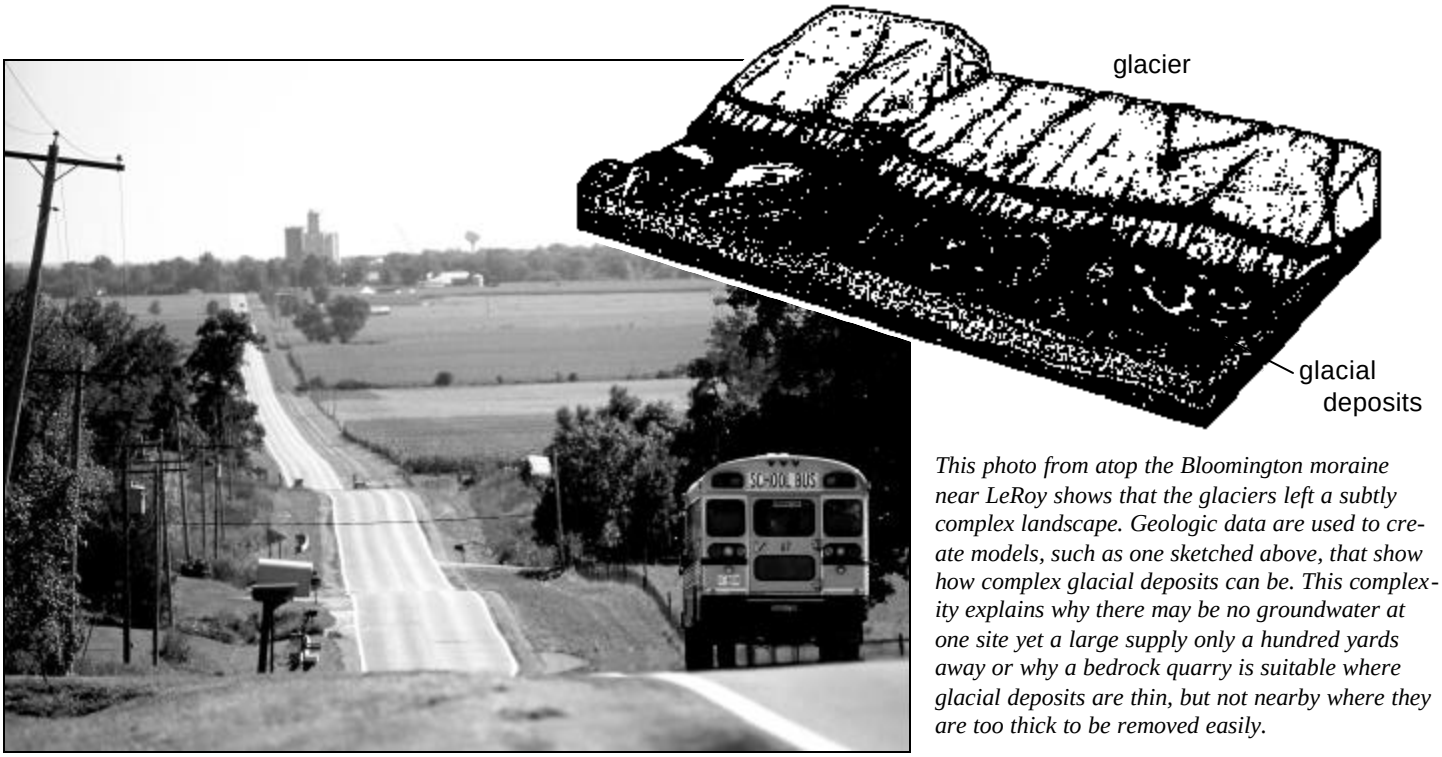


Beneath the smooth and subdued landscape covering much of Illinois, many layers of pebbly clay, silt, and sand and gravel mask a bedrock surface containing hills and deep valleys. These complex, varied deposits were left by the immense continental glaciers that repeatedly advanced and retreated across Illinois in the last 1½ million years. Because these materials lie largely out of sight beneath the land's surface, detailed geologic mapping is necessary to understand how the complex subterranean geology of a given location affects land use.

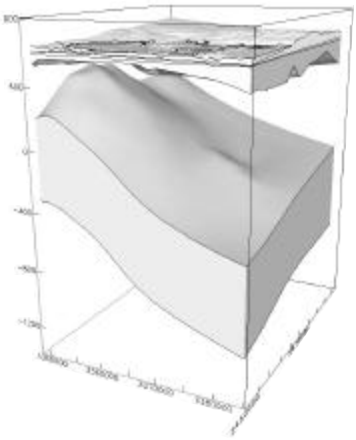
To meet today's demands for detailed information, maps at 1:24,000 scale (one inch on the map equals 24,000 inches—or 2,000 feet—on the ground) are the national standard. This scale is sufficient to make major local decisions, but less than 6 percent of Illinois has been mapped at the 1:24,000 scale. Most existing maps are at too general a scale (1:500,000) to be useful for local decisions. The 3-D geology of the glacial deposits is mapped in detail for only two of the state's 1,071 quadrangles. For those quadrangles—Villa Grove and Vincennes—the Survey intends to offer a complete array of customized information in the form of maps that are digitally derived from the basic geology.

The geologic databases behind our modern map products can be accessed directly or used to make other maps. For example, maps can be made that show thickness of surficial deposits, bedrock topography, aquifer location, susceptibility of aquifers to contamination, landslide or erosion potential, or how likely materials are to amplify earthquake ground motions. The benefits of these products to decision makers makes mapping a top Survey program.

In order to accelerate the mapping of Illinois by pooling resources and expertise, the Illinois Survey has formed a partnership with the U.S. Geological Survey and the Ohio, Indiana, and Michigan state surveys. This partnership, the Central Great Lakes Mapping Coalition, will improve the efficiency of the Illinois mapping effort and help set regional standards for describing, sampling, characterizing, and interpreting surficial materials. The Coalition's pilot program is underway in the Antioch Quadrangle in Lake County and will lay the groundwork for mapping high-priority areas of the state in a 14-year, intensive mapping program. Although limited federal funds have been made available to the Coalition, the ISGS and other Coalition members are actively seeking the greatly increased funding needed to make this high-priority geologic mapping a reality.

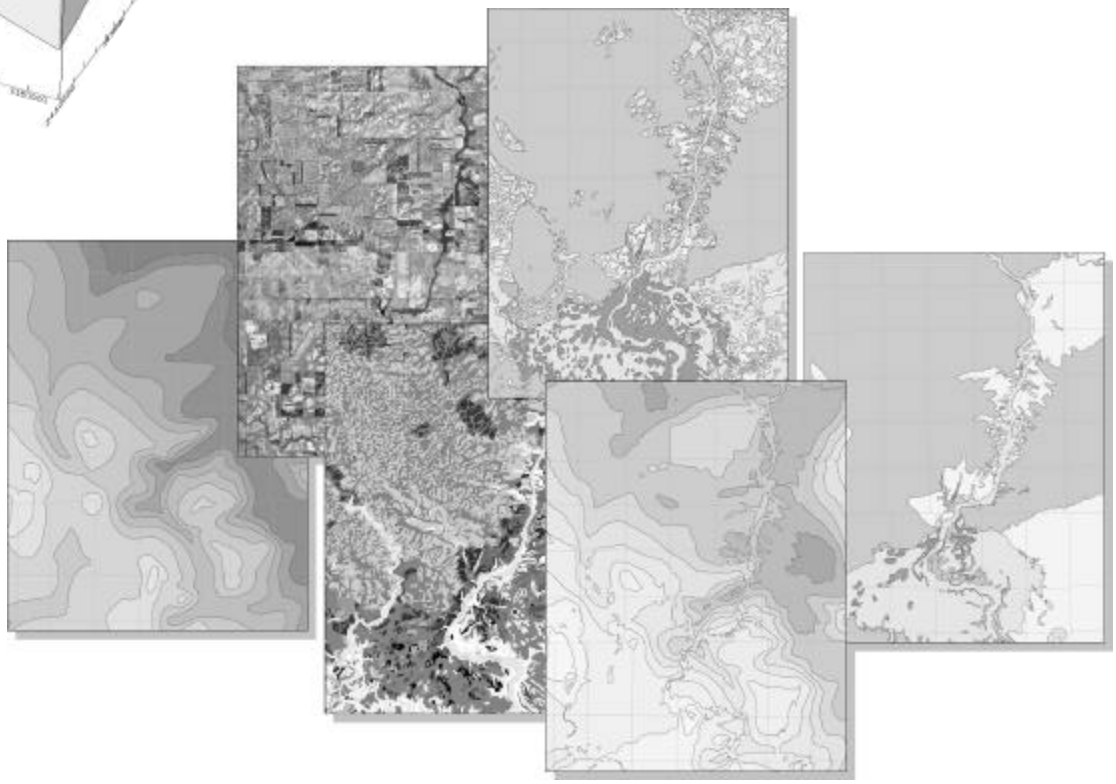


This photo from atop the Bloomington moraine near LeRoy shows that the glaciers left a subtly complex landscape. Geologic data are used to create models, such as one sketched above, that show how complex glacial deposits can be. This complexity explains why there may be no groundwater at one site yet a large supply only a hundred yards away or why a bedrock quarry is suitable where glacial deposits are thin, but not nearby where they are too thick to be removed easily.



The 3-D model at left shows one of many ways in which the digital information collected in these mapping projects can be displayed. Here, the thick Silurian age dolomite is shown beneath the glacial materials in the Villa Grove Quadrangle. Mississippian and Pennsylvanian age rocks, which are beneath the glacial materials and above dolomite, have been removed from the model. The location on the figure where the dolomite almost touches the glacial materials indicates where bedrock is quarried economically just east of Tuscola.

The illustration below shows, for a single quadrangle, some of the variety of map types that can be derived from the basic geologic maps. These are from the same area as the 3-D model and are, clockwise from top, aquifer sensitivity to nitrates, aquifer sensitivity to pesticides, drift thickness (thickness of glacial materials), agricultural soils, bedrock topography, and a digital orthophoto map.



Anticipating the goals of the Central Great Lakes Geologic Mapping Coalition, the Survey began its own long-term project in 1996 to map the surficial and bedrock geology of Illinois in three dimensions at 1:24,000 scale.

To do this, geologists gather information about geologic materials by examining historical drilling records, aerial photographs, surface units at the ground, electrical resistivity measurements, seismic records, and core samples. Other methods are being pioneered as part of the Coalition's pilot project research in Antioch and in neighboring states.

Archival and field data are collected in digital form or collected by hand and digitized. Then data are analyzed, verified, and entered into large databases. These databases can be used to obtain information directly or to produce highly detailed maps. Because each feature of the digitized maps is tied to extensive databases, geologists can use geographic information system (GIS) computer software to manipulate the data to produce customized maps. These maps are used by city and county planners, utilities, public health agencies, transportation departments, environmental protection agencies, builders and developers, agricultural agencies, mining companies, engineering firms and agencies, and the general public.

For instance, the Survey is gathering and interpreting the kind of 3-D geological information that planners need to assess the consequences of different growth scenarios and projected land uses on their area's resources. Detailed inventories and maps of regions' existing geologic resources present ways to monitor the consequences of decisions about land and water use.

Considering site geology in planning decisions ought to result in a better environment for all Illinois citizens:

- Increased protection of water supplies—both surface and groundwater.
- Increased identification of and preservation of access to underground resources: construction aggregates, minerals, and fossil fuels.
- Increased understanding, preservation, and restoration of wetlands and other natural areas.
- Increased ability for avoidance of and recovery from geologic hazards.
- Increased ability to restore brownfields and other environmentally damaged areas to productive use.
- Reduced toxins in lakes, rivers, and streams because of better waste containment.
- Reduced agricultural runoff and increased recharge rates for shallow groundwater aquifers.

Geologists use many tools and methods to collect field data. Drilling is the major way to obtain actual earth materials to study. In some cases, materials are obtained from beneath bodies of water, as the photo of the experimental USGS hoverprobe near Antioch indicates. Seismic and electrical resistivity surveys are other ways that geologists can gather information about materials that they can't directly see. Maps produced from aerial photographs, digital orthophotographs, and other data, including those compiled by communicating with satellites to pinpoint position, are used to identify and locate optimal spots for drilling and other data collection activities.

Above: ISGS geologists Mike Barnhardt, Ardith Hansel, Dick Berg, and Jim Risatti consult an orthophotographic map while in the field near Antioch. Right: Tonia Vaughn (center) helps a patron in the Geologic Records Library while Alan Metcalf (right) searches records. Far right: Geologists Hannes Leetaru and Andrew Stumpf analyze, photograph, and log drill cores.

Much of the labor involved in developing useful products is in logging, cataloging, and maintaining research samples libraries. When entering materials data into the database, geologists observe and list as many identifiable attributes of the material as possible. Methods include not only direct observation but also a variety of scientific tests that reveal the characteristics of a material. Old and new data are archived in a variety of forms in the Geological Records Library and in the ISGS Library as well as in the electronic databases and in samples libraries.

In Illinois, almost one-third of the water supply comes from buried or surface aquifers. Having access to adequate high-quality groundwater resources is a major issue, particularly in high-population and rapidly growing areas.

The Illinois State Geological Survey is currently addressing water issues in numerous ways:

! Obtaining three-dimensional, detailed geologic information about the thickness and areal extent of aquifers and the materials that confine them. Contamination potential varies according to specific geologic conditions.

! Understanding geologic materials helps geologists identify where water is likely to be found, often in subsurface sand and gravel materials of glacial origin. During the past year, Survey scientists provided water location assistance to individual homeowners and to counties and communities around the state, including Sterling, Metropolis, and Gifford.

! Studying the properties of various soils and geologic materials to understand how substances move through them, their filtering capacity, and other properties.

! Sampling lake and river sediments to determine whether they contain contaminants or can be used safely for land application.

! Using isotope analysis to pinpoint water contamination type, level, and sources.

! Working to understand and preserve watersheds and wetlands. Specific combinations of hydrogeologic and ecologic conditions are studied using teams of scientists from many disciplines.

! Studying industrial brownfields, landfills, and large agricultural facilities for contaminants and potential infiltration into water supplies.

! Encouraging safe siting of waste-disposal or waste-generating facilities away from aquifers and geologic hazards.

Such information can be used to answer questions such as these:

! Will there be sufficient groundwater supplies to sustain existing residential subdivisions as well as to allow for growth?

! Should residences rely on private wells and septic systems, or should public systems be provided?

! Are the geologic materials capable of supplying large, sustainable groundwater supplies needed for industry, manufacturing, and energy generation?

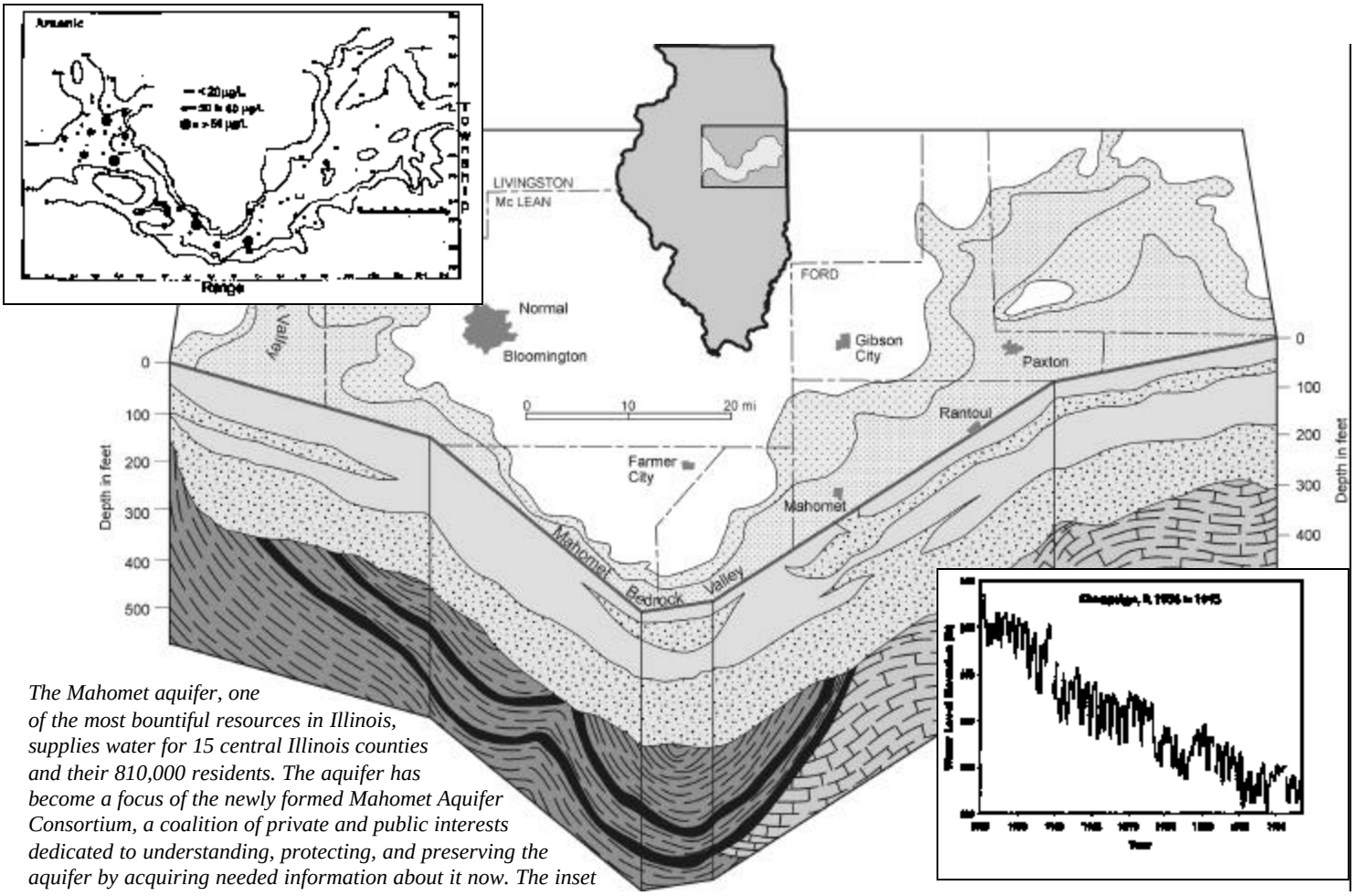
! Will a livestock/animal waste lagoon contaminate the local groundwater?

! Will heavy pumping of wells have an adverse effect on available groundwater resources?

! Do geologic conditions minimize the possibility of groundwater contamination from a municipal landfill?

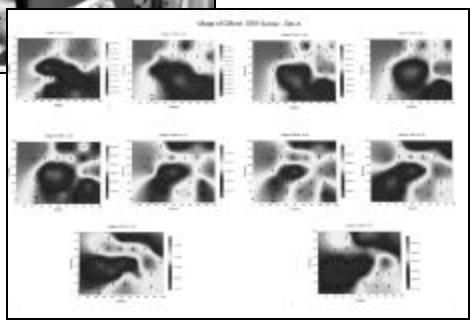
! Can wetlands be restored and maintained effectively?

! How will new construction or land uses affect water recharge areas?



The Mahomet aquifer, one of the most bountiful resources in Illinois, supplies water for 15 central Illinois counties and their 810,000 residents. The aquifer has become a focus of the newly formed Mahomet Aquifer Consortium, a coalition of private and public interests dedicated to understanding, protecting, and preserving the aquifer by acquiring needed information about it now. The inset map at top shows the occurrence of high arsenic concentrations in water pumped from the Mahomet aquifer. The steady decline in aquifer water levels at Champaign (graph at right) is due to pumpage, which has nearly tripled since the 1950s.

No resource is more important to Illinois than high-quality water. We have been fortunate to have plentiful supplies, but actions now are needed to make sure these supplies are protected and continue to be adequate over the long term.



Geologist Tim Young and geophysical assistant Shay Beanland interpret electrical earth resistivity (EER) contours at different depths. These data were part of an EER survey for Gifford's municipal water source.

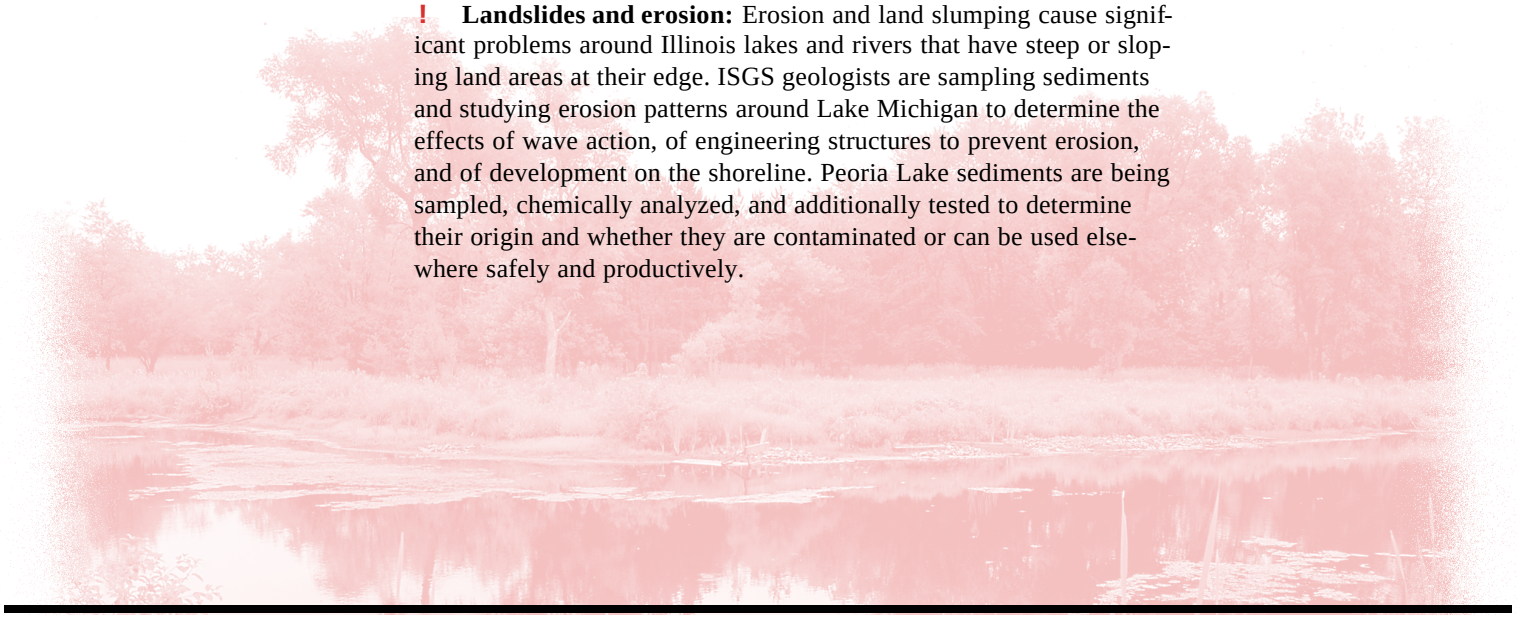
Electrical generation plants, such as this one at Clinton, use enormous amounts of water for cooling. Expansion of generating capacity, particularly of proposed new natural gas-fired cogeneration plants, will likely increase water use on the hottest days when water use is already high. Some existing plants do not recycle water.

The potential contamination of groundwater through improper disposal of industrial, agricultural, household, and medical wastes is just one of the major earth hazards now being addressed by ISGS scientists. Many other real and potential dangers are also currently being investigated:

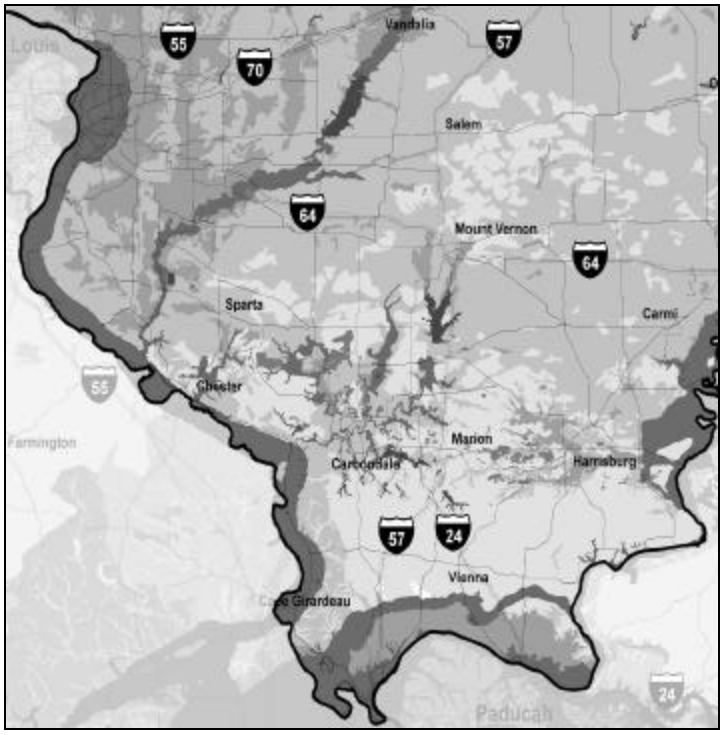
! **Earthquakes:** Although major earthquakes are not frequent in the Midwest, the potential exists for major damage to structures, particularly in the southern portion of the state. As participants in the Central U.S. Earthquake Consortium, ISGS geologists have been mapping the characteristics of near-surface materials to determine which combinations are likely to amplify ground motions or liquefy during an earthquake in the New Madrid Seismic Zone. ISGS geologists also are studying ancient faults elsewhere in the state and comparing recent earthquakes with historical records to determine whether earthquakes are occurring in new patterns, whether old faults are being reactivated, and whether these faults have the potential to cause an earthquake. These types of information are essential for good engineering decisions and emergency preparations.

! **Karst features:** Survey geochemists, hydrologists, and geophysicists are studying and characterizing karst terrain in the southern and western portions of Illinois. In karst topography, which is full of fractured rock, sinkholes, disappearing streams, springs, and caves, the subsurface can suddenly collapse as water dissolves subsurface rocks. Because karst can allow surface water to enter shallow aquifers without being filtered, geologists recommend avoiding dense development, uncontrolled waste dumping, and other practices that can pollute surface and groundwater. Field observations, sampling, and mapping efforts in the area provide the geologic information planners and municipal water companies need to ensure a safe drinking water supply.

! **Landslides and erosion:** Erosion and land slumping cause significant problems around Illinois lakes and rivers that have steep or sloping land areas at their edge. ISGS geologists are sampling sediments and studying erosion patterns around Lake Michigan to determine the effects of wave action, of engineering structures to prevent erosion, and of development on the shoreline. Peoria Lake sediments are being sampled, chemically analyzed, and additionally tested to determine their origin and whether they are contaminated or can be used elsewhere safely and productively.



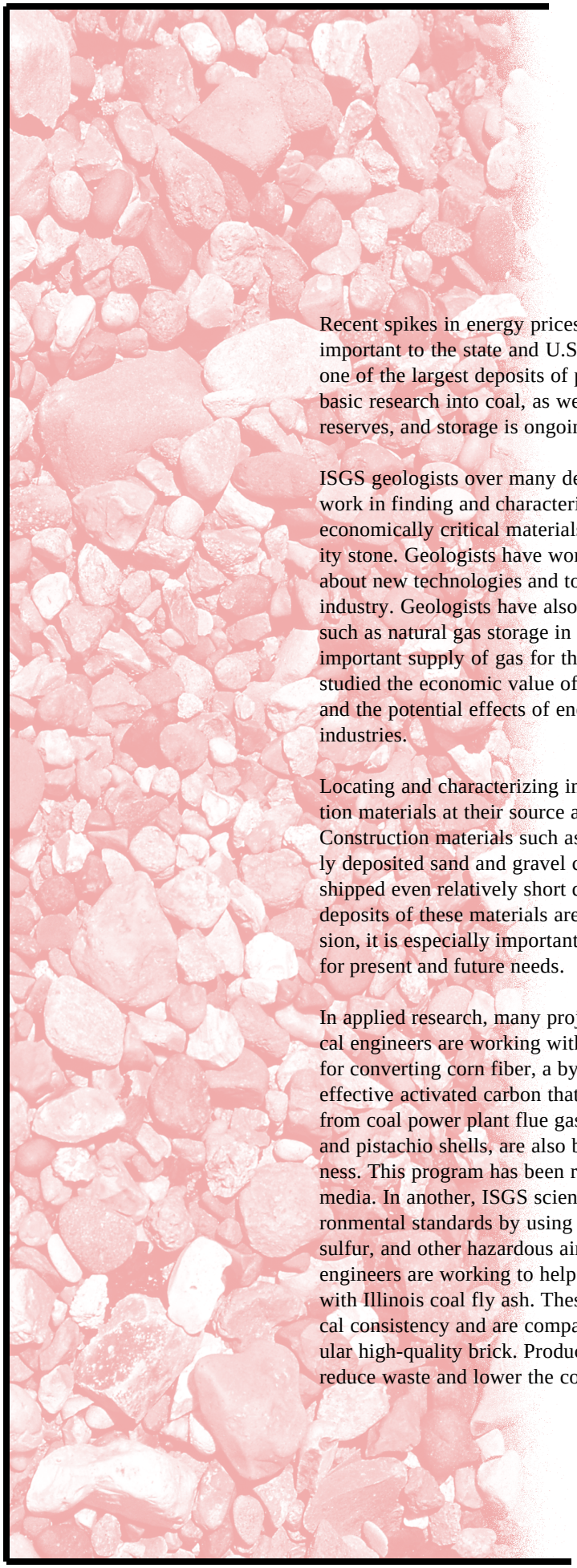
Erosion and the resultant siltation of eroded soils are a serious problem in the Illinois River Valley. Dredging is a solution to siltation, but sometimes there are high levels of contamination in dredged materials, which require special handling. The photo at left shows riprap installed at a highly eroded site in Cass County near the Illinois River Valley. Photos below show dredging of Lake Peoria. Fortunately, contamination levels have so far been found to be very low in this dredged material.



The map above shows glacial materials and their propensity to amplify seismic waves and even liquify during earthquakes. The dark gray along the rivers is the most vulnerable geologic setting.

Karst formations are sometimes described as being like Swiss cheese. Water dissolves limestone to create myriad pathways, caves, and sinkholes. Above, photographer Joel Dexter (foreground) accompanies ISGS geologists Sam Panno and Pius Weibel who are mapping water flows through karst caves in Monroe County in southwestern Illinois.

Jack Liu and Hue-Hwa Hwang of the renowned Isotope Geochemistry Laboratory perform stable isotopic analyses on the new high-speed, fully automated isotope ratio mass spectrometer. The fast, accurate analytical capabilities of the new instrument have allowed the ISGS to reduce the per sample cost of certain stable isotopic analyses by nearly 90%. Among other applications, these analyses are used to identify, measure, plot, and locate the source of pollution moving through the soil or groundwater.



Recent spikes in energy prices remind us that fossil fuels are still important to the state and U.S. economies. Fortunately, Illinois has one of the largest deposits of potential fuel (coal) in the country, and basic research into coal, as well as petroleum and gas technologies, reserves, and storage is ongoing.

ISGS geologists over many decades have worked and continue to work in finding and characterizing Illinois coal, gas and oil, and other economically critical materials such as sand and gravel and high-quality stone. Geologists have worked diligently to transfer knowledge about new technologies and to share well and mine information with industry. Geologists have also worked with industry in other areas, such as natural gas storage in sandstone reservoirs in Illinois, an important supply of gas for the heating season. ISGS economists have studied the economic value of minerals and construction aggregates and the potential effects of energy deregulation on the Illinois energy industries.

Locating and characterizing inventories of vital minerals and construction materials at their source are also part of the Survey's work. Construction materials such as dolomite and limestone rock or glacially deposited sand and gravel can become very expensive when shipped even relatively short distances. And because many of the large deposits of these materials are being encroached upon by urban expansion, it is especially important to identify and protect these resources for present and future needs.

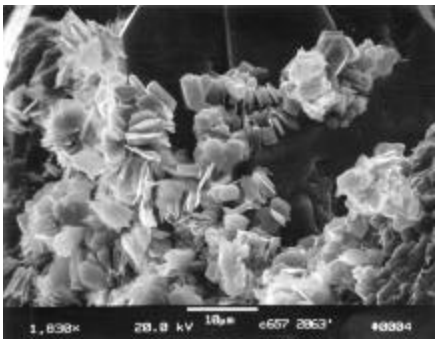
In applied research, many projects are underway. In one, ISGS chemical engineers are working with Illinois industry to develop a process for converting corn fiber, a by-product from making ethanol, into an effective activated carbon that is able to remove mercury emissions from coal power plant flue gases. Other materials, including old tires and pistachio shells, are also being converted and tested for effectiveness. This program has been reported by national and international media. In another, ISGS scientists are helping Illinois coal meet environmental standards by using new cleaning methods to reduce ash, sulfur, and other hazardous air pollutants. Also, ISGS chemists and engineers are working to help develop processes to manufacture bricks with Illinois coal fly ash. These bricks have excellent color and physical consistency and are comparable in strength and appearance to popular high-quality brick. Productive uses for fly ash could help to reduce waste and lower the cost of using Illinois coal in power plants.

Sand and gravel operation near Collinsville Illinois. Essential for construction, these materials are extracted mostly from glacial deposits. Finding easily mined sources close to points of use is an important factor in keeping building cost economical.

Petroleum refinery at Wood River, Illinois.

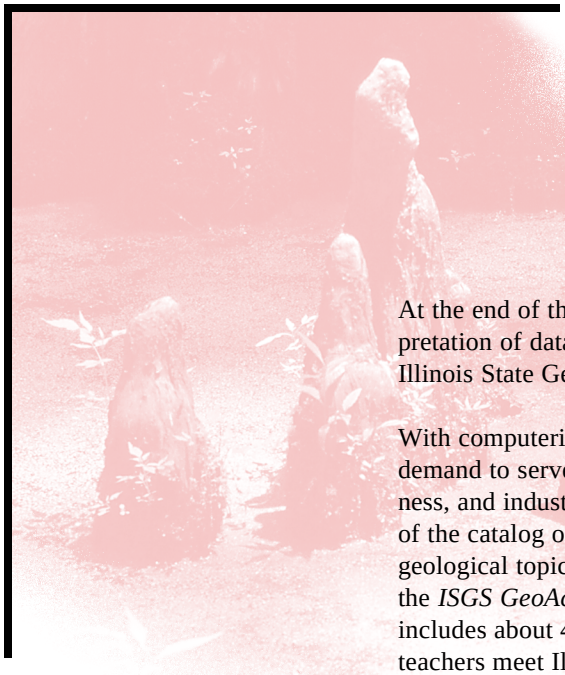
William Roy and Jimmie Cooper are shown behind the process optimization unit, constructed by ISGS researchers and staff. The unit can produce a high-surface area lime sorbent used to remove air pollutants from flue gases at coal-fired power plants.

Innovations in the areas of energy and chemical and environmental engineering are routine for ISGS engineers at the Applied Research Laboratory, which was just awarded its sixth patent. Scott Chen, Massoud Rostam-Abadi, and Tony Lizzio are shown feeding corn fiber waste after ethanol production into a rotary kiln to produce activated carbon. The team is converting a variety of waste by-products into activated carbon, which can remove mercury emissions from coal power plant flue gases.



This photograph taken from a recent ISGS study is a microscopic view of kaolinite and quartz crystals in a sandstone formation in southern Illinois. Understanding the porosity and structure of sandstones can help determine the potential of finding reservoirs of oil.

Coal-fired electric generation plant along shores of Lake Michigan in Lake County.



At the end of the long process that begins with the assembly and interpretation of data are the widely varied products and services that the Illinois State Geological Survey provides for the citizens of Illinois.

With computerization, a large variety of maps can be produced on demand to serve the exact needs of local governmental bodies, business, and industry. These map products, though, are still only one part of the catalog of publications available from the Survey on almost any geological topic relevant to Illinois. One recent set of publications is the *ISGS GeoActivities Series* for teachers. The 200-page compilation includes about 40 educational, hands-on activities that help K–12 teachers meet Illinois standards for teaching about geology. The activities were developed by ISGS staff, other professional geologists, and Illinois science teachers for use by the ISGS in teacher-training workshops and by K–12 teachers in their classrooms.

These and other products and publications are increasingly becoming available on the Internet for fast, efficient, and low cost transfer of information.

In addition, there are many other outreach and education activities at the Survey. In one short period this spring, ISGS scientists:

! provided technical information and photographs of Chicago beaches to the *St. Louis Post Dispatch* for a special travel section devoted to Chicago visitor attractions

! conducted a half-day geology workshop for 21 K–5 teachers at Dr. Howard Elementary School in Champaign

! presented two geology field trips for a total of about 250 people at Siloam Springs State Park

! attended the Near and Far Sciences in Illinois (NFSI) Teacher Showcase held in the Capitol Building in Springfield

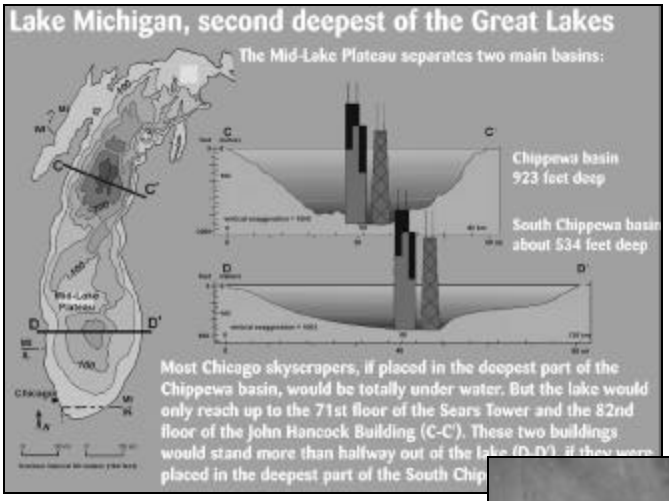
! provided information to a *Chicago Tribune* reporter about petroleum production in southern Illinois and the increase in exploration and drilling activity caused by the increase in oil prices over the last six months

! lectured on evidence for dinosaurs in Illinois at the Earth Day celebration held at the National Shrine of Our Lady of the Snows in Belleville

! proctored the Illinois Science Olympiad regional competition "Road Scholars" test. The "Road Scholars" section tested students' abilities to interpret and use topographic and highway maps

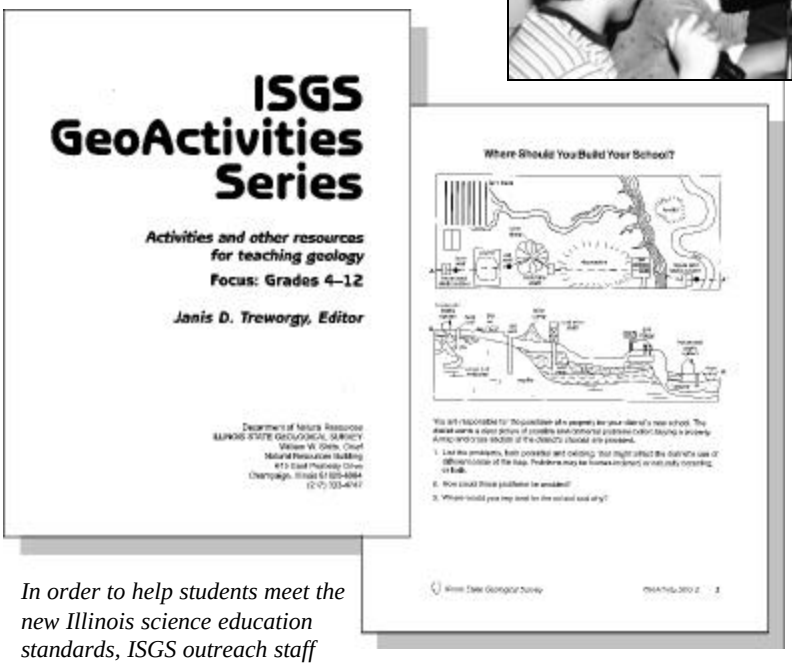
! gave 30-minute presentations on rocks, minerals, and fossils to southern Illinois school groups all day long for each of the four days of Stewardship Week at the UI Forest Resource Center, Simpson

Each year the Survey leads four field trips that allow the interested public to learn about and explore the state's most interesting geological features and the problems and opportunities associated with these features. Myrna Killey uses ISGS maps to explain to field trip participants what they will be seeing at this year's trip to Siloam Springs State Park in western Illinois. Part of the trip included looking for geodes in rocky stream beds.



Information on the Chicago lakeshore can be found on three new colorful and informative posters available from the Survey. The illustration is of just a small portion of one poster.

Every fall, during Earth Science Week, the Survey helps put on the highly popular Natural Resources Quiz Bowl for local elementary and secondary students. This year's event featured sixth, seventh, and eighth graders at Champaign's Jefferson Middle School.



In order to help students meet the new Illinois science education standards, ISGS outreach staff have developed a number of programs, including curriculum materials for elementary and secondary teachers.

The ISGS home page on the World Wide Web is an excellent portal to much of the information the Survey has available to the public. You can find the page at ***http://www.isgs.uiuc.edu/.***

"Development and protection of our state's resources, particularly water, are nearly impossible without detailed knowledge of the subsurface."

—William W. Shilts,
Chief, Illinois State Geological Survey

The Illinois State Geological Survey produces information. Like any product, information is assembled out of raw materials by people applying knowledge and then is shipped down the pipeline to market, in this case the public and private bodies, as well as individual citizens who need geologic information to make informed decisions. At the same time, the Survey exists as a public institution, financed by public investment and only partly through the sales of its products.

A difficult problem in economics is that it is very hard to set a value on public investments in information because many of its benefits are intangible and yet to be realized. In a related study, published as a special report this year, ISGS economists have tackled this challenge. The economists surveyed over 500 users of Kentucky's 1:24,000 maps; Kentucky is the only state so far to be mapped in its entirety at a scale of 1:24,000. The cost of Kentucky's maps was $90 million in 1999 dollars. In a rigorous economic analysis of the results, the ISGS economists determined that the benefits of producing and enabling access to the kind of information in geologic maps are enormous, at least 25 times and perhaps as much as 39 times the cost, in real dollar values. These benefits are only those that can be measured in real money and don't include the many more intangible benefits of scientific knowledge.

This finding is a strong endorsement of the Survey's goal of continuing to build the geologic information database and to provide timely and useful information as the foundation to make informed decisions about land, water, mineral, and energy use.

Active Projects, 1999–2000

Applied Geochemistry

Adsorption and Desorption of Eu, Sr, and Cr by Soil Components, W.R. Roy, P. Huggins (U of I student)

Anthropogenic Pb in Soils in the Chicago Area: Its Deposit History, Pathways, and Effects on Human Health, Y. Zhang

Bioremediation of Atrazine-Contaminated Fill Materials, S.-F.J. Chou, W.R. Roy

Chemical and Mineralogical Characteristics of Illinois Soils, G.B. Dreher, Y. Zhang, L.R. Follmer, R.E. Hughes, G.L. Salmon, J.D. Steele

Contaminant Transport Through a Field-scale Earthen Liner, I.G. Krapac, W.S. Dey, A. Valocchi (University of Illinois [U of I]), C. Werth (U of I), D. Daniel (U of I), B. Jellerichs (U of I student), J. Lee (U of I student)

Effect of Copper, Iron, and Aluminum on the Polymerization of Hexachlorocyclopentadiene (C-56), S.-F.J. Chou

Factors Affecting Pathogen Contamination of Non-community Water Wells, J.B. Risatti, R.C. Berg,

Graphite Furnace Method Development for Determination of Pb, Cd, As, and Se in Sediment and Soil Digests and Waters, J.D. Steele

Groundwater Quality near Livestock Waste Facilities That Utilize Deep Pit Systems, I.G. Krapac, W.S. Dey, W.R. Roy, B. Jellerichs (U of I student), J. Lee (U of I student)

Microbial Dechlorination of PCBs in Sediments from Waukegan Harbor, J.B. Risatti, G.L. Salmon

Monitoring Groundwater Quality near Livestock Waste Pits and Lagoons, I.G. Krapac, W.E Dey, T.H. Larson, C.A. Smyth (U of I), B. Jellerichs (U of I student), J. Lee (U of I student)

Nitrate Formation in Earth Materials in Mammoth Cave, Kentucky, I.G. Krapac, R. Olson (Division of Science and Research Management, Mammoth Cave National Park, KY)

Organic Compounds in Sediments from Near-shore Lake Michigan, G.L. Salmon

Organic Compounds in Sediments from the Grand Calumet River: Lake Michigan to Lake George, G.L. Salmon, N.T. Unger (Sanitary District, Hammond, IN)

Organic Contaminants in Air Samples Collected along Lake Michigan, G.L. Salmon

Participation in NASA Astrobiology Program, J.B. Risatti

Partitioning of Methane by Microbial Metabolism Pathways in Volo Bog, J.B. Risatti

Pesticide Storage and Release in Unsaturated Soil in Illinois, USA, W.R. Roy, I.G. Krapac, S.-F.J. Chou, F.W. Simmons (U of I), J. Lee (U of I student)

Sediment Geochemistry of Illinois Portion of Grand Calumet River, R.A. Cahill, G.L. Salmon

Sediment Geochemistry of Lake DePue, R.A. Cahill, G.L. Salmon

Sediment Geochemistry of Upper Peoria Lake, R.A. Cahill, G.L. Salmon, J.D. Steele

Transport of Agrichemicals in Alluvial Aquifers and Nitrate Attenuation by a Riparian Woodland: Effects of Flooding, J.B. Risatti, E. Mehnert

Chief's Office, Mapping

Central Great Lakes Geologic Mapping Coalition Technical Team, R.C. Berg

Geologic Mapping of 7.5-Minute Quadrangles: Antioch, R.C. Berg, A.K. Hansel, J.B. Risatti, C.J. Stohr

Geologic Mapping: Optimizing Environmental Protection and Resource Exploration, R.C. Berg

Geological Characterization of Watersheds for Ecosystem Partnerships, J.H. Goodwin, M.L. Barnhardt, R.A. Bauer, C.C. Goldsmith, V. Ipe, M.M. Killey, T.H. Larson, D.W. Luman, M.V. Miller, M.L. Sargent, R.J. Rice, L.R. Smith, R.C. Vaiden

Coal Section

Anomalously High Moisture Contents of Low-Sulfur Illinois Coals: Occurrence and Causes, H.H. Damberger, R.D. Harvey

Availability of Coal Resources for Future Mining in Illinois, C.G. Treworgy, C.A. Chenoweth, C.P. Korose, D. North

Behavior of Mineral Matter at Three Types of Power Plants Burning Illinois Coals, I. Demir

Coal Quality Patterns of Illinois Basin Coals, H.H. Damberger, I. Demir, R.D. Harvey

Geologic Mapping of 7.5-Minute Quadrangles: Kellerville and Fishhook, R.J. Jacobson, M.L. Barnhardt, J.E. Crockett, M.M. Killey, Z. Lasemi, D.W. Luman

McNairy Formation, Cretaceous–Tertiary Boundary, and the Search for Dinosaurs in Illinois and Missouri, R.J. Jacobson, J.M. Masters, J.A. Devera, G. Darrough (Missouri Ozark Dinosaur Project), M. Fix (University of Missouri, St. Louis), J. Utgaard (Southern Illinois University)

Mined-out Area Maps for Rock Island County, C.A. Chenoweth

Mined-out Area Maps for St. Clair County: Freeburg and Collinsville Quadrangles, C.A. Chenoweth, S.D. Elrick

Mined-out Area Maps for St. Clair County: French Village and O'Fallon Quadrangles, C.A. Chenoweth

Mineralogical and Chemical Composition of Inorganic Matter in Marketed Illinois Coal, I. Demir, R.E. Hughes

Occurrence and Origin of Coal Bed Methane and of Coal Mine Gas in Active and Abandoned Coal Mines of Illinois, H.H. Damberger, I. Demir, R.J. Finley

Update of "Coal Geology in Illinois" Article in Keystone Coal Industry Manual, H.H. Damberger

Coastal and Wetlands Geology

Compilation and Interpretation of Hydrologic and Geologic Data at State Nature Preserves and Natural Areas, J.J. Miner, W.S. Dey, M.M. Miller, R.C. Berg, R.A. Locke (Illinois State Water Survey [ISWS]), H.A. Wehrmann (ISWS)

Hydrogeologic Consultation, Review, and Monitoring of the Stern's Road Fox River Bridge Crossing Site, J.J. Miner

Wetland Investigations Program for the Illinois Department of Transportation, M.V. Miller, S.E. Benton, R.A. Cahill, K.W. Carr, C.S. Fucciolo, D.B. Ketterling, D.R. Larson, J.J. Miner, G.E. Pociask, B.J. Robinson, G.L. Salmon, J.D. Steele, B.A. Watson, K.D. Weaver

Energy and Environmental Engineering

Conversion of Corn By-products into High-value Activated Carbon, A.A. Lizzio, S. Desai (U of I), M.J. Rood (U of I)

Development and Demonstration of Integrated Carbon Recovery Systems for Processing of Fine Coal Wastes, Advanced Froth Washing System, L.A. Khan

Development of a Spiral Column to Clean Fine Coal, L.A. Khan

Development of Low-cost Mercury Sorbents, M. Rostam-Abadi, S.S. Chen, M.J. Rood (U of I), H.-C. Hsi (U of I), R. Chang (EPRI), C. Richardson (URS Radian), S. Sjostram (Apogee)

Effects of Chlorine in Coal on Furnace-wall Corrosion under Low NO_x Condition, M.-I.M. Chou, M. Luo

Engineering Development of FGD-Gypsum Conversion to Fertilizer and PCC (Phase IV), M.-I.M. Chou, M. Luo, S.-F.J. Chou, V.A. Patel

Illinois Basin Coal Sample Program, K.M. Henry

Low-cost Activated Carbon from a Corn-to-Ethanol By-product for Mercury Emissions Control, A.A. Lizzio, M. Rostam-Abadi. S.S. Chen, M.J. Rood (U of I), R. Chang (Electric Power Research Institute [EPRI], G.K. Welch (Williams Bio-Energy), P.L. Shane (Illinois Corn Marketing Board).

Proposal on Dust and Odor Problems Challenging the Animal Farming Industry, A.A. Lizzio, S.S. Chen

Scale-up of ISGS Froth Washer for Testing in a Commercial Plant, L.A. Khan

Recycling Waste Tire Rubber into Value-added Products for Air Quality Applications, M. Rostam-Abadi, M.J. Rood (U of I), C. Lehmann (U of I)

Engineering Geology

CUSEC State Geologists Mapping Efforts in the Midwest, R.A. Bauer, R.J. Nagy

Development of a Geophone/Geoprobe System for Downhole Shear-Wave Measurements, W.-J. Su, R.A. Bauer

Illinois Loess: Geology and Its Engineering Implications, W.-J. Su, L.R. Follmer

Investigation of Seismogenic Source in Southern Illinois from Paleoliquefaction and Seismic Reflection Data, W.-J.Su, J.H. McBride, L.R. Follmer

Seismic Microzonation of the Carbondale–Murphysboro Area in Southern Illinois, S.-J. Su, L.R. Follmer

Seismic-Wave Velocity Database in Southern Illinois for Microzonation Mapping, W.-J. Su, R.A. Bauer, L.R. Follmer

Environmental Site Assessments

Historical Land Uses at Illinois Beach State Park, A.L. Erdmann, R.A. Bauer, D.J. Adomaitis, P.L. Bannon-Nilles, K.W. Carr

IDOT Environmental Property Assessments, A.L. Erdmann, R.A. Bauer, D.J. Adomaitis, P.L. Bannon-Nilles, C.W. Beccue, R.E. Bowen, E.L. Bray, R.A. Bryant, N.I. Caldwell, S. Chakravorty, M.R. Collier, E. Collins, S.R. Ellis, D.A. Garner, J.W. Geiger, M.A. Hart, G.A. Kientop, A. Leininger, J.R. Ousley, D.R. Schmidt, J.C. Sieving, M.P. Spaeth, C.B. Trask, M.A. Yacucci

Metals Distribution and Transport in Groundwater Beneath the Diked Sediment Disposal Area: DePue Wildlife Management Area, Illinois, A.L. Erdmann, K.W. Carr, D.J. Adomaitis, H.A. Wehrmann (ISWS), T.R. Holm (ISWS), W.R. Kelly (ISWS)

Geospatial Analysis and Modeling

Geologic Assistance for Siting Solid Waste Disposal Facilities, Jo Daviess County (R.J. Krumm, C.S. McGarry)

Geologic Assistance for Siting Solid Waste Disposal Facilities, Lake County (M.H. Riggs)

Geologic Assistance for Siting Solid Waste Disposal Facilities, Lee County (R.J. Krumm, R.J. Nagy, M.H. Riggs)

Geologic Assistance for Siting Solid Waste Disposal Facilities, McLean County (M.H. Riggs)

Geologic Assistance for Siting Solid Waste Disposal Facilities, Stephenson County (R.J. Krumm, C.S. McGarry)

Map Illinois: The Illinois Natural Resources Geospatial Data Clearinghouse, M.H. Riggs, S.K. Beaverson

Plan for Processing, Archiving, and Distributing USGS DOQs for Illinois, R.J. Krumm, D.W. Luman

Groundwater Geology

American Bottoms Groundwater Resources Map, E.C. Smith

An Examination of Pesticide Occurrence in Shallow Dug and Bored Wells—Are High Detection Rates Related to On-field Applications?: Year 3, E. Mehnert, W.S. Dey, D.A. Keefer, H.A. Wehrmann (ISWS), S.D. Wilson (ISWS), J. (ISWS)

Aquifer Assessment: De Kalb County, T.H. Larson

Aquifer Assessment: Metro East, T.H. Larson, M.J. Mushrush, E. Smith, R.C. Vaiden

Bacterial Contamination of Karst Aquifers, S.V. Panno, C.P. Weibel

Columbia Landfill: Isotopic and Chemical Study, S.V. Panno, K.C. Hackley, C.P. Weibel

Educational Posters: Illinois Fossils and Illinois Cross Section, R.C. Vaiden, K.L. Benner

Geobits: Plate Tectonics and Build Illinois, R.C. Vaiden

Groundwater Basins of the Sinkhole Plain, S.V. Panno, C.P. Weibel, T. Aley (Ozark Underground Laboratory, Protem, MO)

Groundwater Geology of the Buried Mahomet Bedrock Valley Aquifer System, Focusing on De Witt and Piatt Counties, Illinois, D.R. Larson, B.L. Herzog, M.J. Mushrush

Healey Street Flood Impoundment Basin Test Hole and Piezometer, D.R. Larson, T.C. Young

Illinois Caverns Field Guide, S.V. Panno, S.E. Greenberg, C.P. Weibel

Installation of a Statewide Monitoring Well Network to Evaluate Pesticide Contamination of Groundwater in Illinois, E. Mehnert, D.A. Keefer, W.S. Dey, H.A. Wehrmann (ISWS), S.D. Wilson (ISWS)

Loss of Specific Capacity within a High-capacity Well in the NIWC Western Field, Phase 2: Determining the Responsible Chemical and Biological Mechanisms, E. Mehnert, K.C. Hackley, D.R. Larson, M.J. Mushrush, S.V. Panno, T.C. Young

Mahomet Valley Aquifer Consortium Study Proposal, E. Mehnert, D.R. Larson, T.H. Larson, H.E. Leetaru

Mechanism of Transport of Nutrients in Alluvial Aquifers during Normal and Flood Conditions, E. Mehnert

Method Development: Describing Unconsolidated Geologic Deposits for Improved Mapping and Hydrogeologic Modeling, D.A. Keefer, A.C. Phillips

Significance of Colloids in the Transport of Atrazine: A Preliminary Investigation, E. Mehnert, J.B. Risatti

Surface Geophysical Services to Municipalities and ISGS Projects

The Role of Flooding and Land Use Practices on Erosion Rates and Agrichemical Loading in the Southwestern Illinois Sinkhole Plain, S.V. Panno, K.C. Hackley

Water Quality Studies in the Big Ditch Watershed for C-FAR, E. Mehnert, H.-H. Hwang, W.R. Kelly (ISWS)

Industrial Minerals and Resource Economics

Aggregate Resources, Sequence Stratigraphy, and Depositional Facies of Mississippian Carbonates, Western Illinois, Z. Lasemi, R.D. Norby

AGI Paper on Clay Minerals and Educational Series, D.M. Moore

Analysis of Electricity Markets in the U.S.: Degree of Market Integration, V. Ipe

Benefits and Costs of Kentucky's Geologic Mapping Program, S.B. Bhagwat

Carbonate Textures in the Buckhorn Dolomite of Northwestern Illinois, D.M. Moore

Chlorite-Chlorite/Smectite-7 Angstrom/Chlorite-Corrensite Problem, D.M. Moore

Chlorite, Chlorite/Smectite, Vermiculite Problem, D.M. Moore

Clay Minerals Service and Maintenance, D.M. Moore, P.J. DeMaris, H.D. Glass

Coal and Fly Ash Studies, R.E. Hughes

Comparison of the Illinois and Neuquen Basins: Corrensite and Corrensite-like Mixed-clay Minerals as Stratigraphic Markers in the Quintuco Formation, Neuquen Basin, Argentina, D.M. Moore, D.G. Morse, D.R. Kolata, J.M. Vallés (Universidad Nacional del Comahue, Buenos Aires)

Correlation between Soil Texture and Crop Yield, D.M. Moore

Development of Coal Mining Software for USGS Coal Availability Programs, S.B. Bhagwat

Directory of Mineral Producers in Illinois, V. Ipe, J.M. Masters, L. Smith

Economics of Aggregate Industry in Illinois: Current Trends and Future Prospects for the Industry, V. Ipe

Economics of Underground Mining vs. Surface Mining of Limestone under Varying Geologic Conditions in Illinois, S.B. Bhagwat

Environmental Policies and Regulation: Trust Funds for Pollution Management, V. Ipe

Geoarchaeological Studies, R.E. Hughes

Geologic Mapping of 7.5-Minute Quadrangles: Villa Grove, Z. Lasemi, C.C. Abert, A.K. Hansel, D.W. Luman, R.D. Norby, C.P. Weibel

Illuvial Clay Fims = Transorted Clay, D.M. Moore

Industrial Minerals Service, R.E. Hughes, P.J. DeMaris, J.M. Masters, D.G. Mikulic, Z. Lasemi

Mapping the Bedrock Geology of Southeastern Wisconsin, D.G. Mikulic, T. Evans (Wisconsin Geological and Natural History Survey), R. Peters (Wisconsin Geological and Natural History Survey), K. Massie-French (Wisconsin Geological and Natural History Survey)

Mineralogical Characterization of Archaeological Materials Using a Portable Spectrometer, R.E. Hughes

Mineralogical Investigations, R.E. Hughes, P.J. DeMaris

Natural Gas Production and Distribution Statistics for Illinois, V. Ipe

Non-point Source Pollution Management: Economic Analysis of Ecological Approaches, V. Ipe

Pipestone Paper for American Scientist, D.M. Moore

Potential Impact of the "Illinois First" Initiative on Illinois' Aggregate Industries, S.B. Bhagwat

Sand and Gravel Resource Modeling: Vincennes Quadrangle, Carroll County, McHenry County, Southernmost Illinois, J.M. Masters

Silurian Geology and Aggregate Resources of West-Central Illinois, D.G. Mikulic, A. Butcher (University of Portsmouth)

Silurian Graptolite Project, D.G. Mikulic

Silurian Lithostratigraphy and Biostratigraphy of Illinois, D.G. Mikulic, R.D. Norby, J.K. Kluessendorf (U of I)

St. Peter Sandstone Diagenesis in the Illinois Basin, D.M. Moore

Stagnation in Sand and Gravel Production in Illinois: Its Causes and Implications, S.B. Bhagwat

Water Resources in Illinois: Supply, Demand, and Prices, V. Ipe

Isotope Geochemistry

Carbon and Oxygen Isotope Geochemistry of Calcite in Cleats of Coal Seams, C.L. Chou

Determination of Nitrate Sources in Sinkhole Plain of Southeastern Illinois, K.C. Hackley, S.V. Panno, H.H. Hwang

Geochemistry of Sulfur and Trace Elements in Coal, C.L. Chou

Groundwater Ages and Recharge Areas of the Mahomet Valley Aquifer, K.C. Hackley, S.V. Panno, J.D. Steele

High-resolution Climate Change Study in the Mississippi River Valley, H. Wang, L.R. Follmer

Method Development for ^{14}C-Age Model of Paleosol Stratigraphy, H. Wang, L.R. Follmer

Microbial Degradation and Diversity, S.M. Shiffer

Removal of Sulfur and Chlorine from Illinois Coal by Wet-grinding and Selective Flocculation, C.L. Chou

Saline Groundwater Study in Southwestern Illinois, H.H. Hwang

Source of CO_2 in Houses in Wood Dale, Illinois, K.C. Hackley

Trace Element Abundances and Geochemistry of Paleozoic Carbonate Rocks, C.L. Chou

Oil and Gas

Computerization of Oil and Gas Development Maps, A. Sanders, T. Davis

Cypress Sandstone Regional Study, J.P. Grube, T. Davis

Geneva Dolomite Research, B. Seyler, J.P. Grube

Geologic Characterization of Mt. Simon Sandstone Gas Storage Reservoir, D.G. Morse, T. Davis, B.G. Huff, A. Sanders, B. Seyler

Geologic Mapping of 7.5-Minute Quadrangles: Vincennes, D.G. Morse, M.L. Barnhardt, S.K. Beaverson, D.W. Luman, J.M. Masters, A.C. Phillips, C.G. Treworgy, W.-J. Su, C.P. Weibel

Hillsboro Gas Storage Field, B.G. Huff

Illinois Basin Source Rocks, D.G. Morse, M.D. Lewan (Denver Federal Center)

Operation of Midwest Regional Office of PTTC (US Department of Energy contract), D.G. Morse, T. Davis, B. Seyler, A. Sanders, E.M. Coleman, B.L. Renfrew

Tar Springs Reservoir and Area Geology, D.G. Morse

Quaternary Geology

A Critical and Statistical Evaluation of Characterization Methods for Sites Contaminated Through Multiple Discrete Spills, M.L. Barnhardt, D.A. Keefer

Access to Surface Exposures and Excavations of Outside Agencies and Firms for ISGS Geologists, C.J. Stohr

Acquisition of Cores, Samples, and Other Data Collected by State Agencies, Geotechnical Firms, and the Mining Industry, C.J. Stohr

Age and Environment of Petersburg Silt (Illinois Episode) and Older Lacustrine and Eolian Silts in Southwestern Illinois Related to Mapping Efforts on St. Louis Metro East Area, D.A. Grimley, A.C. Phillips

Clay Mineral Map and Data Compilation, M.M. Killey, H.D. Glass

Education Series Publication on Groundwater, M.M. Killey, D. Larson

Geologic Mapping of 7.5-Minute Quadrangles: Crystal Lake, Curry, C.J. Stohr, R.C. Vaiden

Geologic Mapping of 7.5-Minute Quadrangles: Dunlap, C.P. Weibel

Geologic Mapping of 7.5-Minute Quadrangles: Galesburg East and Appleton, M.L. Barnhardt

Geologic Mapping of 7.5-Minute Quadrangles: Geological and Landslide Potential Map for the Collinsville Quadrangle, A.C. Phillips

Geologic Mapping of 7.5-Minute Quadrangles: McHenry, B.B. Curry, C.J. Stohr, R.C. Vaiden

Geologic Mapping of 7.5-Minute Quadrangles: Oak Hill, C.P. Weibel, C.C. Abert

Geologic Mapping of 7.5-Minute Quadrangles: Peotone Airport, B.B. Curry, D.A. Grimley

Giant City State Park Geology, C.P. Weibel

Hydric Soils Delineation by Magnetic Susceptibility in Wetland Areas, D.A. Grimley

Hydrology, Surface Water Quality, and Paleohydrology of Nelson Lake, Kane County, Illinois, B.B. Curry, W.S. Dey, M.L. Sargent

Illinois Interagency Land Cover Program, D.W. Luman

Mapping of the Surficial Geology of Twelve Quadrangles in Southern Illinois, L.R. Follmer

McHenry County Geology for Planning, B.B. Curry

Paleohydrology/Paleoclimate Seed Grant Application to Purdue's PRIME Lab for Be-10 Assays, B.B. Curry

Pre-Illinoian Deposits of Western Illinois, M.M. Killey, H.D. Glass

Sampling and Geophysically Logging Commercially Drilled Holes, C.J. Stohr, T. Larson, T.C. Young

Sedimentologic and Stratigraphic Investigation of American Bottoms Using Geophysical Techniques and Borings, A.C. Phillips, T. Larson

Sedimentology and Ice Sheet Dynamics, A.K. Hansel

Springs of Illinois, C.P. Weibel

STATEMAP Quadrangle Mapping in Illinois (Beecher West and Steger), B.B. Curry

STATEMAP Quadrangle Mapping in Illinois (Chicago Metro West Area)(Elgin 7.5 Quad), B.B. Curry

STATEMAP Quadrangle Mapping in Illinois (Chicago Metro West Area)(Maple Park Quad), B.B. Curry, D.A. Grimley

Sedimentary and Coastal Processes

Application of Gravity and Magnetic Field Analysis Techniques to the Central U.S. Midcontinent Centered Around the Illinois Basin, J.H. McBride, D.R. D.R. Kolata, H.E. Leetaru

Conodont Genus Lochriea, R.D. Norby

Development of K–12 Geology Curriculum Materials, J.D. Treworgy, R.C. Vaiden, S.E. Greenberg

Fossils of Illinois: The Ordovician System, D.R. Kolata

General Processing and Interpretation of Seismic Data for Illinois Basin and Vicinity, J.H. McBride, D.R. Kolata

Geologic Framework of the Galena–Platteville Aquifer in Boone and Winnebago Counties, D.R. Kolata, C.S. McGarry

Geologic Mapping of 7.5-Minute Quadrangles: Cache, W.J. Nelson, J.M. Masters

Geologic Mapping of 7.5-Minute Quadrangles: Cahokia, J.A. Devera, M.L. Barnhardt, Z. Lasemi, R.J. Nagy, R.D. Norby, S.V. Panno, A.C. Phillips, M.L. Sargent, S.-J.Su

Geologic Mapping of 7.5-Minute Quadrangles: Cairo, W.J. Nelson, J.M. Masters

Geologic Mapping of 7.5-Minute Quadrangles: Cypress, J.A. Devera, W.J. Nelson

Geologic Mapping of 7.5-Minute Quadrangles: Metropolis, W.J. Nelson, J.M. Masters

Geologic Mapping of 7.5-Minute Quadrangles: Paducah Northeast, W.J. Nelson, F.B. Denny

Geologic Mapping of 7.5-Minute Quadrangles: Pulaski, W.J. Nelson, J.M. Masters

Investigation of the Structural Framework of the Middle to Upper Crust in the Wabash Valley Seismic Zone with High-quality Seismic Reflection Profiles, J.H. McBride, R.J. Krumm, L.R. Smith

Nature, Origin, and Regional Significance of Ordovician Unconformities in Eastern North America, D.R. Kolata

Neogene Grabens in Southernmost Illinois, W.J. Nelson, J.H. McBride

Ordovician and Silurian K-bentonites in North and South America and Europe, D.R. Kolata

Presenting Near and Far Sciences in Illinois Teacher Workshops, J.D. Treworgy, M.J. Chrzastowski, A.C. Phillips, R.C. Vaiden

Regional Study of Benoist Sandstone, H.E. Leetaru

Revision of the State of Illinois 1:500,000 Geologic Map, D.R. Kolata, W.J. Nelson

Seismic Reflection Investigation of Geologically Recent Faulting and Active Seismicity near Olmstead, Illinois, W.J. Nelson, J.H. McBride, J.M. Masters

Seismotectonic Studies of the Southern Illinois Basin Using Data from Existing Seismic Reflection Lines and a New PANDA Seismic Array Experiment, J.H. McBride

Sequence Stratigraphy of the Early Chesterian Series in the Illinois Basin, W.J. Nelson, J.D. Treworgy

STATEMAP Quadrangle Mapping in Illinois (Millstadt 7.5-Minute Quadrangle), J.A. Devera, C.C. Abert, M.L. Barnhardt, F.B. Denny

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