# Illinois Geology: Science Serving Society

Illinois State Geological Survey
Annual Report 2007

## Acknowledgments

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ILLINOIS DEPARTMENT OF NATURAL RESOURCES

ISGS Illinois State Geological Survey

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Annual Report 2007

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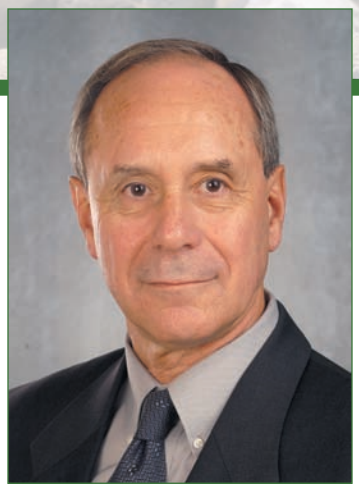
# To the People of Illinois



During the past year, ISGS activities have been newsworthy as never before, thanks largely to the growing public awareness of the critical role our energy and water resources play in the lives not only of our citizens, but also the lives of people well beyond the borders of Illinois. Local, state, national, and international news organizations have reported on ISGS' role in projects such as FutureGen, carbon sequestration, and the discovery of a 350-million-year-old rainforest floor, frozen in time in the ceiling of an Illinois coal mine. The level of press interest is unprecedented in my 13 years here, and I doubt that our research has ever been so widely reported.

There is a reason for this. With luck and with difficulty, we have assembled staff who have an envelope of expertise that is closely attuned to society's accelerating demand for earth science guidance and support. Thus, we have the right people, arguably one of the best teams in the country, to provide the technical underpinnings of innovative energy projects. Those projects include FutureGen and several similar private-sector projects in coal gasification or coal-to-liquid with sequestration of the resulting $CO_2$ emissions. We have hydrogeologists to help develop, with the **Illinois State Water Survey,** a series of plans that will ensure safe and adequate water supplies for our children. We have Quaternary scientists who are working with geological surveys all over the world to develop computer and data-gathering tools to make the modern three-dimensional (3-D) maps so necessary and in such demand for urban planning and resource development. We have engineers working on ways to reduce water use and eliminate pollutants resulting from energy production. We have scientists and technicians who work with the **Illinois Natural History Survey** and other agencies, primarily **Illinois Department of Transportation,** to preserve and restore wetlands while evaluating potential environmental hazards associated with highway or airport (O'Hare, Peotone) construction. In short, the $1.5 billion FutureGen project would not have been an option for Illinois without the impact of our energy team, and the demand for our 3-D geology maps to support planning decisions in the Chicagoland and St. Louis Metro East area could not have been fulfilled without the cutting-edge research of the mapping team.

There also is a clear message in the preceding words for the people of Illinois and their government. ISGS is able to be ready to tackle these challenges and fulfill these ever more critical needs because we are both an academic and a service agency that carries out "proactive" research; that is, our pool of scientific expertise and contact with other geological surveys, nationally and around the world, allows us to tailor our research to areas where our clients, the citizens and businesses of Illinois, have or will have the most need. By observing scientific and societal trends and carrying out research that is available in a timely way when crucial decisions have to be made by individuals or government, the Illinois State Geological Survey is able to stay at or ahead of the "cutting edge" of the types of research most pertinent to Illinoisans' needs.

For instance, our energy team started putting together research plans and multi-state partnerships before 2003 to compete for major funding for carbon sequestration research in anticipation of climate change drivers and based on confidential information we gathered about the pending FutureGen competition. Without our professional contacts and the prescient research program and the expertise we developed through it, Illinois would not be host to two of the four potential FutureGen sites.

The primary reason we have been so successful over the past 100 plus years in anticipating and fulfilling Illinois' needs is because we have enjoyed strong and stable core funding from the

State. This funding allows scientists who do not depend on contracts and grants to do research or develop externally funded programs that they know will have application months or years down the road or that will provide new products that our clients did not even envision until we made them aware of them. This is true of all the State Scientific Surveys; the stable-funded core provides the breakthroughs and the ability to have proven research in place to address societal issues before the non-earth science community knows those issues exist. I make this point for two reasons: first, there are many examples in this report of services we have rendered to our citizens as a direct result of having these proven research results in place; and, second, because there is a strong trend in state governments, here and elsewhere, to cut General Revenue funding for state agencies and put them on a "user pays" basis. If this should happen to the Illinois Surveys (and it has happened to geological surveys elsewhere with disastrous results), they will become, essentially, state-sponsored consulting firms with "billable hours" and little chance to do anticipatory research. That is, they will be responding to clients' issues after they become problems, not before, as ideally is the case now, and the Illinois Surveys will be increasingly forced to look for business outside the state, as is the case in two of the largest state geological surveys now.

In spite of these impediments, we have had a good year. I am personally committed to ensuring that next year and succeeding years will see the Survey continue to provide Illinois citizens the best and most sophisticated earth science support in the country, especially in this era of critical earth science questions—impacts of climate change, burgeoning urban populations, tidal shifts in energy strategies, increasing value and strife associated with water issues, and using our Saudi-sized coal energy reserves in economical and environmentally appropriate ways. We have the teams to address these and other issues now, and we have been able to attract new team members because of our reputation, not because of our salaries. It is my mission to preserve and defend that reputation for the benefit of the people of Illinois.

–William W. Shilts, Chief

# Mapping the Land Beneath Our Feet: A Field Demonstration of Data Collection Techniques

On August 15, 2007, the Bondville Road Station, a research facility maintained by the **University of Illinois Department of Electrical Engineering** and the **Illinois State Water Survey,** was the venue for a field demonstration given by the Illinois State Geological Survey (ISGS) to the **Board of Natural Resources and Conservation,** the **Mahomet Aquifer Consortium Board** and committee members, and other dignitaries. Forty-five guests attended.

*ISGS Chief, William Shilts, welcomes guests and explains the purpose of the field demonstration.*

The demonstration provided an opportunity for the Survey's guests to view many of the techniques and equipment used by Survey scientists to collect subsurface information. Chief William Shilts welcomed the guests and indicated that the purpose of the trip was to familiarize everyone with many of the field tools and techniques the Survey uses to reveal the subsurface geology. Donald Keefer, Director of the Geologic Mapping and Hydrogeology Center, presented an overview of ISGS mapping and hydrogeologic programs, including the Governor's Water Supply Initiative.

William Dey, Hydrogeology Section, spoke about studies of the Mahomet aquifer and reasons for being at the Bondville Road Station. The speakers emphasized the value to Illinois' citizens of the information gathered using the techniques and equipment being demonstrated and the reports, maps, and analyses that present the information.

Using core obtained from a nearby borehole, Andrew Stumpf, Quaternary Geology Section, described the ISGS drilling program and the high value of direct observations from continuous cores for characterizing sediment properties and interpreting environments of deposition and the geologic history of Illinois. Jack Aud, ISGS driller, and his crew demonstrated the drilling and core retrieval technique using the Survey's CME drill rig.

David Larson, Hydrogeology Section Head, used a cutaway model of an observation well to describe how such wells are constructed. The observation well provides a means to measure properties such as hydraulic head and hydraulic conductivity and to collect groundwater samples for analysis. Larson gave an overview of the significance and value of information that can be obtained from observation wells.

Timothy Young, Geophysics Section, exhibited some of the ISGS borehole geophysical logging tools and demonstrated their capabilities. He explained that certain physical and chemical properties, such as density and natural emission of gamma radiation, vary with different types of earth materials. He described how those properties are measured with different tools to determine the type of geologic materials that are present in a borehole.

Two surficial geophysical techniques, one old and the other new, were described by Timothy Larson, Geophysics Section. Use of the old technique, electrical earth resistivity (EER), dates from 1931.

*Tim Larson explains seismic reflection to attendees.*

The updated version of this technique, high-resolution electrical earth resistivity (HREER), is used at the ISGS primarily to distinguish sand and gravel from silt and clay. The results of an HREER survey can help geologists map the location and extent of aquifers. Larson then demonstrated how ground-penetrating radar uses radio waves to detect changes in earth materials or buried objects in the shallow subsurface.

Seismic reflection was another surficial geophysical technique highlighted at the field demonstration. Timothy Larson explained the process as Steve Sargent, Geophysics Section, assisted by students from the University of Illinois and **Illinois State University,** demonstrated the operation of the ISGS landstreamer, the equipment used to collect the seismic data. The landstreamer, developed and built by researchers and staff at the ISGS, allows for the rapid collection of high-resolution reflection data.

Robert Scott, Illinois State Water Survey, discussed the range of research projects being conducted at the Bondville Road Station by a variety of state, national, and international governmental agencies as well as various academic institutions. His presentation included a highlight of the Water Survey's long-term monitoring program, the Weather and Atmospheric Resources Monitoring (WARM), which is also on-site.

*Attendees at the ISGS field demonstration of data collection tools and techniques.*

# ISGS Awards

## 2006 Awards

Three friends of the ISGS and six staff members were honored at the 2006 Illinois State Geological Survey Awards Program, held December 8, 2006. The awards were presented in recognition of the outstanding contributions of these individuals for the benefit of the people of Illinois. Nominations are made by staff members, and a committee of staff selects the recipients.

**Edmund W. Murphy,** Past President of the Illinois Mine Subsidence Insurance Fund, received an Outstanding Cooperator Award in recognition of his long relationship with the ISGS in investigating and educating the public on mine subsidence damage. **Mark Rood,** Ph.D., also received an Outstanding Cooperator Award in recognition of his long-term dedication in working with the ISGS on many research and development programs in the field of energy and environmental engineering. **Senator Richard J. Winkel, Jr.,** was honored as an Outstanding Advocate in appreciation of his strong support of ISGS programs and his interest, advice, and diligence in ensuring adequate appropriations for geological research and information.

*Mark Rood*

***Senator Richard J. Winkel received the Outstanding Advocate Award from Chief Bill Shilts.***

*Alan Metcalf*

*Vicki Salzman*

***Chief Bill Shilts presents Robert J. Finley with the Distinguished Achievement Award.***

The Outstanding Contribution to Survey Health and Safety Award went to **Alan E. Metcalf** in recognition of his long-standing efforts in organizing ISGS blood drives. Outstanding New Staff Member Award went to **Vicki E. Salzman** in recognition of her outstanding contributions to the ISGS through her initiative, cheerfulness, and customer-oriented service of ISGS computers. The Distinguished Achievement Award was given to **Robert J. Finley,** Ph.D., in recognition of his outstanding leadership in energy research and policy, with a focus on "cradle-to-grave" carbon management. Lifetime Achievement Awards were given to **Leon R. Follmer,** Ph.D., in recognition of his more than thirty-five years of outstanding achievements and leadership in the field of paleopedology and **Ardith K. Hansel,** Ph.D., in recognition of her more than thirty years of outstanding achievements and leadership in the field of Quaternary geology. A new award, the Chief's Special Recognition Award, went to **Joel M. Dexter,** in recognition and appreciation of his outstanding work highlighting the Survey's activities through his beautiful photography of the people and places in Illinois.

***Chief Bill Shilts presents the Lifetime Achievement Award to Leon R. Follmer.***

*Ardith Hansel*

*Joel Dexter*

## Staff Recognition

*Myrna Killey*

In recognition of her exemplary record of distinguished service to the Institute and the profession, ISGS Emeritus Geologist **Myrna Killey** received the Honorary Membership Award from the **American Institute of Professional Geologists** (AIPG) at its annual meeting in Minneapolis on September 26, 2006. The AIPG award citation [slightly edited] noted that "Myrna M. Killey has contributed almost 40 continuous years of education, leadership, and service to the profession of geology.

In the 1970s, Myrna completed Ball State University's master's degree program in geology. [At] the Survey, she specialized in Quaternary geology and early Ice Age sediments in western Illinois. She led projects in applied studies such as the state's first landslide inventory, a major geotechnical site investigation at Argonne National Laboratory, and the geologic characterization of watersheds to serve citizens interested in restoring and maintaining watershed ecosystems in Illinois. Killey was also sought after for many Survey team projects, including investigation of a hazardous waste site in southwestern Illinois, siting studies for the Superconducting Super Collider in Illinois, the Great Flood of 1993, and most recently the inauguration of a series of publications on the geology of state parks in Illinois.

She also authored a popular publication for the Survey, *Illinois' Ice Age Legacy,* and is senior author on two other popular publications, *Illinois Groundwater: A Vital Geologic Resource,* and *Land-Use Decisions and Geology: Getting Past 'Out of Sight, Out of Mind.'*

Myrna also has a long record of service to the profession of geology. She became a Certified Professional Geologist with AIPG in 1982 and a Licensed Professional Geologist in Illinois in 1997. She was elected AIPG's Treasurer in 1993–1994 and Editor in 1999–2000, receiving two AIPG Presidential Certificates of Merit along the way. She was elected a Fellow of the Geological Society of America in 1995 and received, with other co-authors of *The Great Flood of 1993,* GSA's John C. Frye Memorial Award in Environmental Geology in 1997."

*Seyed Dastgheib*

**Seyed Dastgheib** of the Energy and Environmental Engineering Section was co-author of two papers (one oral and one poster) presented at the Carbon 2007 Conference in Seattle in late July 2007. The papers were based on Dastgheib's contributions to a research program while he was a visiting research engineer at the Universitat Rovira i Virgili, in Spain. The poster presentation won the **Walker Award for the best poster presentation by a graduate student.**

*Hannes Leetaru*

An ISGS presentation received the **Eastern Section of the American Association of Petroleum Geologists (AAPG) Division of Environmental Geosciences Best Paper Award** at the Eastern Section AAPG Meeting in Buffalo, New York, in October 2006. The presentation, authored by **H.E. Leetaru, J. Freiburg, J. Rupp,** and **J. McBride** and titled "Evaluation of Deep Saline Reservoirs and Entrapment for Carbon Sequestration Using Seismic Reflection Data," is abstracted in the 2006 Eastern Section of the American Association of Petroleum Geologists Annual Meeting Abstracts, October 8–10, Buffalo, New York, page 26.

*Jared Freiburg*

*David Morse*

ISGS scientists received both the **Best Paper and Best Poster Awards** from the **Energy Minerals Division at the American Association of Petroleum Geologists, Eastern Section** meeting in Buffalo, New York, in early October 2006. **David Morse, Ilham Demir, Tom Moore,** and **Scott Elrick** were presented with the Best Poster Award for their poster, "Coalbed Methane Research Drilling in Illinois: New Data." **Tom Moore, Ilham Demir,** and **David Morse** were presented with the Best Paper Award for their paper, "Illinois Basin Coalbed Gas: Is There a Play?".

*Scott Elrick*

*Tom Moore*

*Yevgeniy Kontar*

**Yevgeniy Kontar** has been elected **Bureau Member of the Geophysical Risk and Sustainability Commission** of the **International Union of Geodesy and Geophysics** (IUGG GeoRisk) for a four-year term that began on July 6, 2007. IUGG GeoRisk was established by the IUGG Bureau in August 2000 to study the interaction between hazards, their likelihood, and their wider social consequences as a result of the vulnerability of societies. There is a growing interest in and relevance to the interaction between science and society reflected in the economic, social, and public policy aspects of hazards. This distinction is expressed by the word "risk," which incorporates the concepts of hazards, their consequences, and their likelihood and covers a wider scope than does the word "hazard." Consideration of risk involves some consideration of the people who are at risk. IUGG GeoRisk is maintained by all eight IUGG Associations.

# ISGS in the News

## Chicago Tribune Story on Stearns Quarry Park

An article appeared in the *Chicago Tribune* on August 18, 2006, about the development of new parks in the City of Chicago. An ISGS geologist provided much of the information concerning the geology and history of one of the parks, the site of a former dolomite quarry in Bridgeport. The quarry, Stearns Quarry, opened in 1830 and was turned into a landfill in 1970. Now it is being converted into a park where visitors can see fossil-rich rocks on the former quarry walls. In addition, the former landfill will be converted to a sledding hill, and the park will include an athletic field and a walking path along terraced wetland paths.

## Three hundred-million-year-old Tropical Forest Captures the Public Eye

***Common in parts of the mine,* Neuropteris ovata *(above) often forms dense mats of leaves.***

Two geologists from the Coal Section of the Illinois State Geological Survey, in cooperation with geologists from the **Smithsonian Institution** in Washington, DC, **University of Bristol** in the United Kingdom, and **Peabody Energy** in Illinois, have published the discovery and description of a 300-million-year-old Pennsylvanian-age mire forest beneath the flat plains of east-central Illinois in the largest study of its kind.

The study investigated extensive, well-preserved plant fossils lying just above the Herrin Coal seam.

The fossils stretch over 2,500 football fields (1,000 hectares) in area and represent multiple niches of the forest environment, allowing the scientists to examine the subtle ecology of an ancient forest on an unprecedented scale. The research was able to demonstrate the emergence of ecological gradients at the landscape scale for these ancient forests and show the correctness of previously hypothesized theories about the structure of the Pennsylvanian-age mire forest.

***Scott Elrick studies a few thin stringers of coal above the main coal seam.***

Media attention stemming from this discovery has been international in scope and still continues. Articles were printed in major newspapers such as the ***St. Louis Post-Dispatch*** in the United States and internationally in ***Journal do Brasil.*** Internet stories were on all major science news sites, including **sciencenews.com, livescience.com, science.com, nationalgeographic.com,** and as far away as the official Iranian state-sponsored Internet news site. Interviews were given to area radio stations such as **WDAN AM** and to national stations **CNN radio news,** "Day to Day" on **National Public Radio,** and WDEL talk radio, which serves the East Coast. Television coverage included a morning appearance on **CBS affiliate WCIA Channel 3** news in east-central Illinois and a remote interview (voice only) with **Comcast Cable News** that broadcast to all of the East Coast. Interest exists for possible articles in a variety of general science magazines.

Additionally, the **Discovery Channel** plans to produce a television program on fossil plants in coal-bearing rocks, starring a scientist from the Smithsonian Institution and two ISGS geologists. This production was stimulated by the widespread publicity generated by their recent paper in ***Geology*** on the underground fossil forest in Vermilion County, Illinois.

ISGS staff met two agents from the Discovery Channel at the coal mines where filming is being proposed. The mines are **Five Star Mining Company's Prosperity Mine,** an underground mine near Princeton, Indiana, and **Vigo Coal Company's Friendsville Mine,** a surface mine near Mt. Carmel, Illinois.

The overall theme of the production is the ecological change that took place during the Pennsylvanian age. At the time of the Springfield Coal, as seen in the Prosperity Mine, the peat-forming forest was dominated by giant lycopod trees. Roughly 5 million years later, when the Upper Pennsylvanian coal beds being mined at Friendsville were formed, the giant lycopods had disappeared from North America, and tree ferns became dominant. The show will revolve around climate change and other factors that might have brought about this change in vegetation.

The Discovery Channel people visited the Survey, where staff members discussed using a long (800 to 1,000 feet) drill core from the ISGS Geological Samples Library to illustrate the occurrence of multiple coal beds in cyclical succession.

## Headline News

**Kane County Chronicle (Geneva), September 21, 2007:**
**County Holds Conference to Discuss Water Future**

**The News-Gazette (Champaign), August 31, 2007:**
**Antibiotics Find Way from Farms into Water Supplies**

**Science Daily (University of Illinois at Urbana-Champaign), August 22, 2007:**
**Team Tracks Antibiotic Resistance from Swine Farms to Groundwater**

**The News-Gazette (Champaign), August 16, 2007:**
**Researchers Study How to 'See' Under Ground**

**From Outdoor Illinois (Springfield), July 2007:**
**Underground Science**

**From National Geographic (Washington, DC), April 24, 2007:**
Giant Fossil Rain Forest Discovered in Illinois

**From Digital Silence (http://www.d-silence.com, April 24, 2007:**
Giant Fossil Rain Forest Discovered in Illinois

**From MSNBC (http//www.msnbc.msn.com/id/18279510), April 23, 2007:**
Fossilized Rainforest Found in Coal Mine

**From ABC News (http://www.abcnews.go.com/Technology/wireStory?id=3070478), April 23, 2007:**
Researchers Probe Fossilized Rain Forest

**From the Washington Post (Washington, DC), April 23, 2007:**
Researchers Probe Fossilized Rain Forest

**From Live Science (http://www.LiveScience.com/strangenews/070423 _ fossil _ forest.html), April 23, 2007:**
Ancient Rainforest Revealed in Coal Mine

**From Metro.co.uk, April 23, 2007:**
300 m-year-old Rainforest Found

**From the Journal Gazette Times-Courier (Mattoon and Charleston), April 21, 2007:**
Our View: Bill in Congress Would Benefit FutureGen Project

**From the MidWeek Local News (Sycamore), March 21, 2007:**
DeKalb City Water System Gets a Gold Star

**From the Beacon News (Paris), March 5, 2007:**
Coal Mine Operators Have Obligations to Surface Operators

**From Journal Gazette Times-Courier (Mattoon and Charleston), February 27, 2007:**
Experts Offer Insight into Coal Mining Methods

**From Engineer Live (http://www.engineerlive.com), October 22, 2006:**
Next Phase of Sequestration Project Begins with Carbon Dioxide Injection

**From the Illinois Government News Network (Springfield), October 17, 2006:**
Gov. Blagojevich Announces FutureGen for Illinois Task Force

**From the Times-Courier (Charleston), October 13, 2006:**
Geochemist: FutureGen Plan Hinges on Carbon Dioxide Sequestration

**From the University of Illinois, College of Liberal Arts and Sciences, College News, September 30, 2006:**
An Oasis of Art in the Egyptian Desert

**From The News-Gazette (Champaign), September 23, 2006:**
FutureGen Finalists Tour Facility

**From The News-Gazette (Champaign), September 5, 2006:**
Seismic Activity Played Role in FutureGen Picks

**From The Chief Engineer (Crestwood), September 5, 2006:**
Illinois, Texas Enter Next Stage in Efforts to Land FutureGen

**From the Chicago Tribune (Chicago), August 11, 2006:**
Kane Gets $1.4 Million to Check Water Issues

**From the Journal Gazette-Times-Courier (Mattoon and Charleston), August 8, 2006:**
Geology Key to Site Selection for Power Plant

**From the News-Gazette Online (http://www.newsgazette.com), August 4, 2006:**
Seismic Studies Next on Agenda for FutureGen Sites

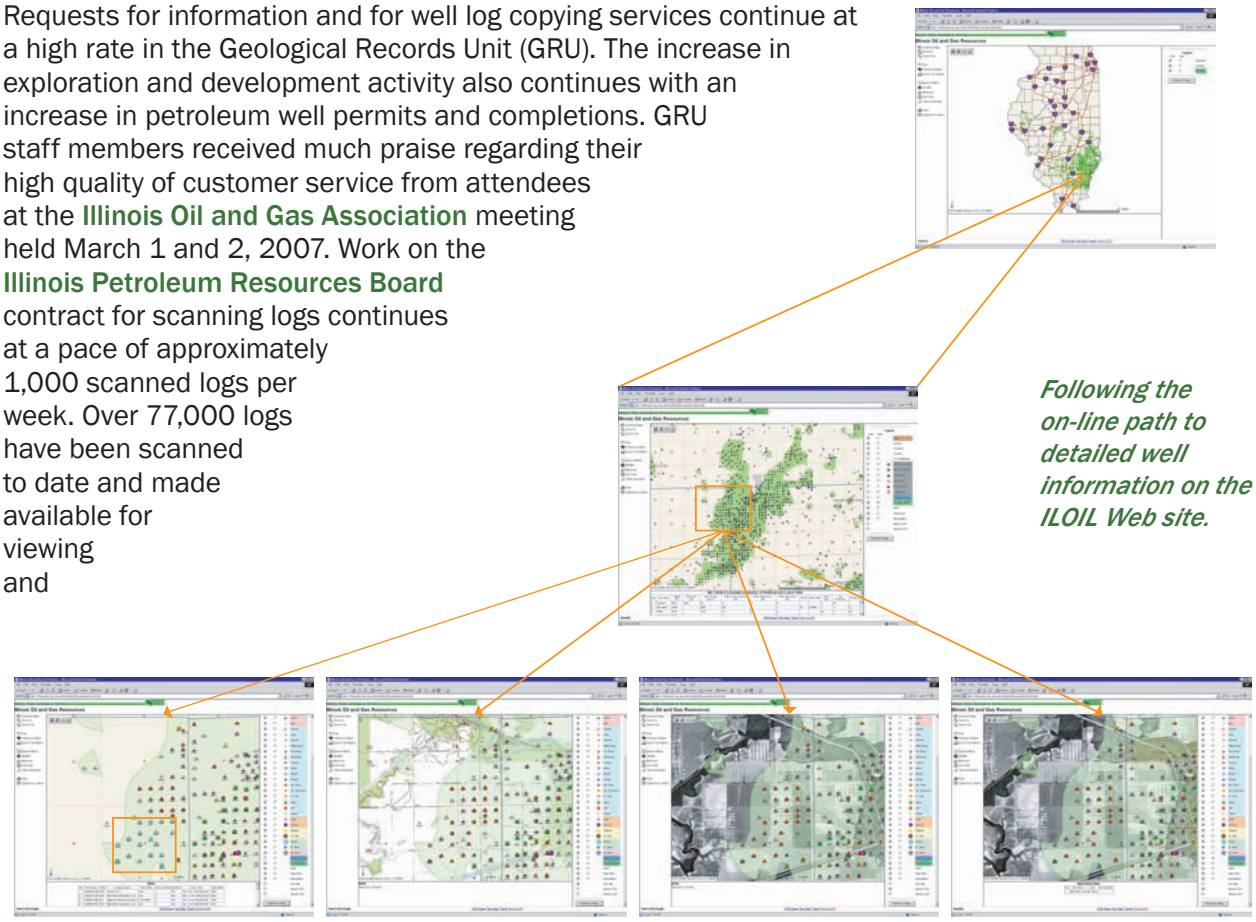
**From the Journal Gazette-Times-Courier (Mattoon and Charleston), August 1, 2006:**
FutureGen on Environment Study Fast-Track

**From the Journal Gazette-Times-Courier (Mattoon and Charleston), August 1, 2006:**
FutureGen Officials Discuss Finalists

# Data Delivery

## Oil and Gas Records in High Demand

Requests for information and for well log copying services continue at a high rate in the Geological Records Unit (GRU). The increase in exploration and development activity also continues with an increase in petroleum well permits and completions. GRU staff members received much praise regarding their high quality of customer service from attendees at the **Illinois Oil and Gas Association** meeting held March 1 and 2, 2007. Work on the **Illinois Petroleum Resources Board** contract for scanning logs continues at a pace of approximately 1,000 scanned logs per week. Over 77,000 logs have been scanned to date and made available for viewing and download from the ILOIL database hosted on the ISGS Web site (http://www.isgs.uiuc.edu/sections/oil-gas/launchims.shtml). This database is a very popular feature and is used over 200 times daily.



*Following the on-line path to detailed well information on the ILOIL Web site.*

## Illinois Clearinghouse: Celebrating Ten Years of Data Distribution

The Illinois Natural Resources Geospatial Data Clearinghouse (Illinois Clearinghouse) was first brought on-line in July 1997. The Illinois Clearinghouse serves as a gateway to Geographic Information Systems (GIS) and remote sensing data for Illinois and provides access to topographic maps, orthoimagery collections, historic aerial photography, infrastructure and natural resource data, and ArcIMS Interactive Map Services. The Illinois Clearinghouse is a formal National Spatial Data Infrastructure (NSDI) node (one of more than 300 worldwide) that is compliant with federal Geospatial One-Stop standards.

The Illinois Clearinghouse receives enthusiastic support from the Illinois GIS user community. Last year, 140,000 visitors accessed over 2 million Illinois Clearinghouse Web pages. During its 10-year history, customers of the Illinois Clearinghouse have enjoyed on-demand access to more than 27,800 data files and 18,300 aerial photos totaling over 35 terabytes of information free of charge. The

project to enable access to 2005 digital orthoimagery collections prompted requests from Google, Mapquest, Microsoft Earth, Navteq, the Nature Conservancy, the National Weather Service, and FutureGen partner agency representatives. A Web search for the key words "Illinois" and "GIS" offers the Illinois Clearinghouse as the first Web site returned by Google, Yahoo, AOL, and Ask.com. Additionally, GIS data downloads have become part of the curriculum for geography and GIS classes at several Illinois universities.

Together with the main Illinois State Geological Survey home page, ISGS mapping services that provide easy access to significant data holdings (such as oil and gas well data), and an e-commerce site that will be launched soon, the Illinois Clearinghouse represents one facet of the Survey's business presence on the Internet. The Illinois Clearinghouse continues to receive broad recognition from many people in Illinois, the Midwest, and the nation. To date, over $1.3 million has been dedicated to the expansion and upkeep of the Illinois Clearinghouse. Financial support to enable on-line access to Illinois data has been sustained through 40 separate grants, contracts, and student internships from Illinois state and county agencies, universities, and federal programs. Hosted by the ISGS, the Illinois Natural Resources Geospatial Data Clearinghouse can be found on-line at www.isgs.uiuc.edu/nsdihome.

## Distributing 2005 Orthoimagery

Compressed 2005 U.S. Geological Survey (USGS) orthoimagery has recently been made available on-line via the Illinois Natural Resources Geospatial Data Clearinghouse (Illinois Clearinghouse) at http://www.isgs.uiuc.edu/nsdihome. Orthophotography combines the image characteristics of an aerial photograph with the geometric qualities of a map. In a digital format, orthoimagery fulfills a fundamental role as a map base. The detailed 2005 data are useful to government, academia, and the private sector for many location-based disciplines.

For efficient management on-line, the orthophotography is split into two distinct collections. The first data collection covers the six-county Chicago urban area (CUA). This aerial imagery was collected on color film during the leaf-off period of spring 2005. Created in two projections, this data set comprises 8,892 data tiles. Uncompressed, the files require 630 gigabytes of disk space; the compressed files require 79 gigabytes.

The second data collection is the **National Aerial Photography Program (NAPP)** collection, which contains the remaining 96 Illinois counties. Aerial imagery was collected on black and white film during the leaf-off period of spring 2005. Created in two projections, this data collection comprises 7,885 Digital Orthophoto Quarter Quadrangle (DOQQ) files. Uncompressed data require 1.5 terabytes of disk space; compressed data take 153 gigabytes of space.

Illinois NAPP data files were made available on-line on October 4, 2006. More than 125,000 data files were downloaded in the first month. Chicago urban area files were made available on-line on April 27, 2006. During the first six months of availability, over 711,000 data files were downloaded from the Illinois Clearinghouse, an average of 3,783 files per day. The highest demand came in August 2006, which averaged 8,612 files downloaded per day. With this signature achievement, the ISGS provided over 8,600 in-demand products to customers within Illinois, the Midwest, and the United States daily.

Prior to the first data delivery, USGS and ISGS staff publicized the creation and imminent release of these data sets. The project team fielded many inquiries about the overall collection details and the date of initial release. Among inquiries from federal agencies and Illinois state, regional, and county agencies and municipalities were notable requests from other organizations including Google, Mapquest, Microsoft Earth, Navteq, the Nature Conservancy, the National Weather Service, and FutureGen partner agency representatives.

## Geological Sequestration Test in Illinois Coal: Field Site Selected and Work Begins

The **Midwest Geological Sequestration Consortium (MGSC),** led by the Illinois State Geological Survey, along with the **Indiana** and **Kentucky Geological Surveys** and industry partners, including **Gallagher Drilling Co., Inc.** in Evansville, Indiana, have begun preparations for carbon sequestration in coal seams and potential methane recovery in western Wabash County, Illinois. Teaming geological sequestration of carbon dioxide ($CO_2$), one of the most promising strategies for reducing greenhouse gas emissions, with coal bed methane recovery could provide additional resource recovery in the Illinois Basin. Initial work is primarily aimed at understanding the injectability of $CO_2$ and the response of the coal.

**Gallagher Drilling Co., Inc.** helped ISGS staff find a lease owner whose acreage was suitable for the field test site. ISGS geologists visited the selected site and staked locations for potential injection and monitoring wells. Well permits were received from the **Illinois Office of Mines and Minerals,** and site approval was obtained from the **U.S. Department of Energy.**

The ISGS drilled two of three planned coal-coring wells in July. The wells will allow the ISGS staff to analyze the coals and model $CO_2$ injection prior to the May 2008 $CO_2$ injection test. Depending on the results of pressure falloff tests and a pulse test, a third and possibly a fourth well will be drilled later this year. The target coal in this field test is the Springfield Coal seam at a depth of 942 feet. The seam is six to seven feet thick, and the extensive Pennsylvanian shales of the Carbondale Formation above the coal should provide an adequate seal. The field test is projected to inject 600 tons of $CO_2$ over a period of approximately 30 to 60 days, depending on the permeability of the coal, during which time the $CO_2$, as it is adsorbed by the coal, is expected to displace coal bed methane toward the two observation wells. The test will measure changes in injectivity (injection rate and pressure) as $CO_2$ is pumped into the well.

*Geologists remove core at drill site.*

The field test included the drilling of one injection well and two or three monitoring wells. The wells will be drilled in an L-shaped pattern parallel to the natural butt and face cleats (coal fractures) in the Springfield Coal. Geologists have cored multiple coals in the two wells drilled thus far. The core samples are being analyzed to determine their gas content, adsorption isotherms, and other coal parameters to be used for computer modeling of the sequestration process and the methane recovery potential. An extensive environmental monitoring, measuring, and validation (MMV) program will begin prior to injection of $CO_2$. Use of high-resolution infrared aerial digital imagery helped establish baseline land surface properties of the site. In the unlikely event of a leak, such imagery should allow detection of changes in the vegetation caused by interaction with $CO_2$. The MMV program also will include installation of groundwater and soil monitoring wells to measure the background levels of gas prior to $CO_2$ injection.

Gallagher Drilling Co., Inc. is the lease operator of the site and provides field, engineering and geologic support. Funding for this research is provided by the U.S. Department of Energy and the **Illinois Department of Commerce and Economic Opportunity, Office of Coal Development.**

## Patent Application Filed for a New Process for Carbon Dioxide Capture

An integrated carbon dioxide ($CO_2$) sequestration scheme includes three general steps: capture, transportation, and permanent storage. The vast majority of fossil fuel-fired power plants, which are the most likely point sources for $CO_2$ capture, generally produce diluted $CO_2$ gas streams. Capture of $CO_2$ from these sources is the most expensive step, at more than 70% of the total sequestration cost. Reducing capture cost would clearly have the most significant impact on the economic performance of a sequestration process.

Two chemical engineers at the Illinois State Geological Survey have recently developed a novel process for capturing $CO_2$ from coal-fired power plants. Preliminary economic analysis reveals that the $CO_2$ avoidance cost of this process will be around $33/tonne compared with $55/tonne for the conventional amine-based processes. The **Office of Technology Management at the University of Illinois at Urbana-Champaign** examined the invention disclosure submitted by the chemical engineers and concluded that the process contained sufficient intellectual property and merit for U.S. patent application. A patent application entitled "Integrated Vacuum Absorption Steam Cycle Gas Separation" was filed with the U.S. Patent and Trademark Office on May 8, 2007.

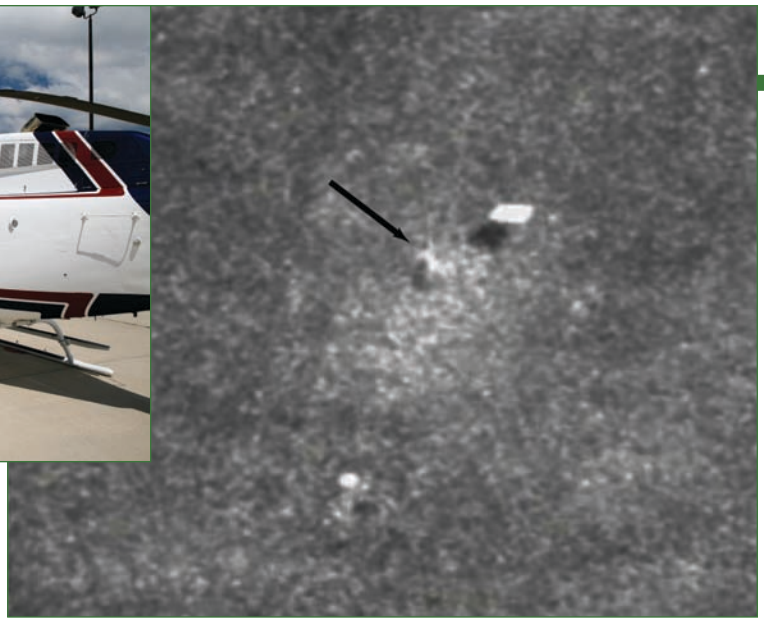
## Detection of Carbon Dioxide Emissions in a Field of Soybeans Using Airborne Thermal Infrared Imagery

The millions of tons of carbon dioxide ($CO_2$) gas that are expected to be recovered from coal gasification, such as the FutureGen power generating stations, are proposed to be injected underground into shallow and deep subsurface reservoirs. But will the greenhouse gas remain there? ISGS scientists are testing the use of remote sensing surveillance as a method to detect leaks occurring over a large area of the reservoir. A recently completed test was undertaken to determine whether $CO_2$—a colorless, odorless, common gas—could be detected leaking among row crops in agricultural, central Illinois.

Researchers at the **SoyFACE** facility, an internationally renowned climate-change research facility at the **University of Illinois at Urbana-Champaign (UI),** determined that when soybeans react to high concentrations of $CO_2$, stomata in the plant leaves constrict, causing water to be retained, thereby preventing transpiration and cooling. Consequently, the $CO_2$-affected plants become warmer than surrounding, unaffected plants.

On the image on page 16, the subtle, linear light-toned area between the round and square reference marks shows the

***ISGS scientists testing remote sensing surveillance of a $CO_2$ reservoir.***



*The Illinois Department of Transportation helicopter was used to obtain thermal infrared imagery from 750 feet above the ground.*

warm plants reacting to $CO_2$ gas released to simulate an underground leak. The arrow points to a corn plant among a mature soybean canopy at the UI South Farm.

Based on this phenomenon, a collaboration between geologists, agronomists, plant and crop scientists, and agricultural meteorologists from several UI departments and three state agencies devised an experiment, partly funded by the **UI Research Board,** to determine whether remote sensing could be used to detect the reaction of soybeans to high concentrations of $CO_2$.

To simulate a surface release leak from a 3,000-foot-deep underground reservoir, garden hoses were laid between soybean rows, and $CO_2$ was released from point sources (sprinklers) and cracks (pipes). Aerial thermal infrared (TIR) imagery was obtained using the **Illinois Department of Transportation** helicopter. Field measurements were guided by a special air-to-ground transmitter that permitted the ground crew to observe the TIR imagery as it was recorded, thereby greatly improving measurements, a real-time strategy not known to have been used previously.

Aerial TIR imagery showed that the $CO_2$-affected soybeans were noticeably warmer than surrounding unaffected beans. The heat plumes were detected both along the crop rows and following wind direction. The initial success of the experiment shows that significant gas leaks could be identified by remote sensing methods.

## Energy Use and $CO_2$ Emission Outlooks in the Illinois Basin

A study has been completed that developed a baseline scenario of mid-term energy use and carbon dioxide ($CO_2$) emissions in the Illinois Basin. The study forecasts the energy demand, electricity supply, and $CO_2$ emissions for the Illinois Basin from 2005 to 2030. The baseline scenario provides a basis for comparison and for further evaluation of impacts of $CO_2$ sequestration and other controls on future energy. The forecast for both primary and secondary energy consumption was performed for five major sectors (residential, commercial, industrial, transportation, and electricity) for Illinois, Indiana, and Kentucky. The study analyzed the predicted electricity generation, energy structure, and electricity efficiency, which are key factors impacting future $CO_2$ emissions. The results of this study indicated that during the 2005–2030 time period, the average annual growth rate of total energy

use in the Illinois Basin will increase 1.27%. Total electricity generation will increase 1.54% annually. Coal will continue to be the primary source for electricity generation in the Illinois Basin, increasing slightly from the present 72% to 76% of total electricity generation by 2030. According to the baseline scenario, the total annual $CO_2$ emissions in the Illinois Basin will increase from the current 700 million tons to 1,056 million tons by 2030. The electricity generation sector is projected to contribute 46.5 and 48.5% of the total $CO_2$ emissions during this period.

## Patent Pending on ISGS Filter Press

An ISGS engineer has developed a patent-pending filtration process for dewatering of coal fines. The process will potentially help coal mining operations recover cleaner fine coal with low-moisture content at a time when coal processing plants handle increasingly larger quantities of fine-grained materials generated either during mining, transportation, or processing. In an **Illinois Clean Coal Institute (ICCI)**-funded project, completed November 30, 2005, an ISGS team completed design and fabrication of an industrial-size filter press weighing about 10 tons. A number of successful shake-down tests were performed with the unit at the **Coal Research Park,** Carterville, Illinois, to evaluate the performance of the unit. The filter press was moved to Champaign for storage. A draft final report was submitted to ICCI. ISGS staff members are planning to submit a proposal to ICCI to perform a field demonstration of the filter press at a coal preparation plant during the program's next phase.

## Mercury Emission Control Research

Five mercury emission control-related research projects are currently in progress. In two recently funded **U.S. Department of Energy** projects, ISGS engineers are the key technical staff focusing on developing advanced mercury sorbents that have low impact on power plant operations and can be used for mercury capture from elevated acid flue gas streams. Project results will help scientists increase mercury removal efficiency in sorbent injection processes without impacting the operation of an electrostatic precipitator (ESP) or mercury removal from burning a high-sulfur coal flue gas.

In two projects funded by the **Illinois Clean Coal Institute,** ISGS chemical engineers are addressing (1) techno-economic analysis of multi-pollutant control for Illinois high-sulfur coal and (2) mercury life cycle assessment. Five site-specific, techno-economic studies are being performed to identify factors that influence the cost of installation of wet flue gas desulfurization (FGD) and selective catalytic reduction (SCR) systems for Illinois bituminous coal and FGD, SCR, and mercury control for Powder River Basin coal. Utilities can use the results of this study in making their mercury, $SO_2$, and $NO_x$ compliance decisions.

The goal of an ongoing study, supported by the **Electric Power Research Institute,** is to gain a better understanding of how various properties of the unburned carbon (UBC) in fly ash can impact the extent of capture and oxidation of mercury released from coal during combustion in utility boilers. Differences in the types of boilers and the operating practices of the power plants have been found to greatly affect the ability of the UBC particles in the fly ash to capture and oxidize the mercury in the flue gases. Data also have revealed that the particle size of unburned carbon, rather than the total amount of unburned carbon in fly ash, is a key parameter that can be used to estimate mercury capture. The ultimate goal of the study is to develop technical know-how that could help coal-fired power plants maximize in-flight capture and oxidation of mercury by manipulating the characteristics of the unburned carbon particles in their fly ash.

## Nanotechnology Applied to Power Plant Emissions

Since 1990, Survey staff members have been involved in developing and evaluating energy and environmental applications of carbon-based materials such as activated carbon and activated carbon fiber. In 2001, with a grant from the **Electric Power Research Institute (EPRI)** and collaboration with the **Department of Civil and Environmental Engineering at University of Illinois at Urbana-Champaign,** a new project was initiated to explore the energy and environmental applications of single-walled carbon nanotubes (SWNTs). Results from this research provided several major contributions to the understanding of these emerging carbon-based materials as adsorbents. The adsorptive characteristic of SWNTs is of interest because this material could potentially be used to store hydrogen in future hydrogen-fueled vehicles.

*Cleaned emissions from Abbott Power Plant, University of Illinois, Champaign.*

First, scientists demonstrated that the physical structure and adsorption properties of some as-produced SWNTs are not thermodynamically stable and change upon aging. Second, both by experiments and molecular simulations, the contributions of various sites of SWNTs were shown to be boundless for gas adsorption. Third, scientists identified the mechanism of adsorption of a mixture of water and several organic vapors on SWNTs. Fourth, the adsorptive properties of SWNTs were compared with those of activated carbon fibers for removal of environmentally relevant organic compounds from gas streams. Results from this research were published in several articles in highly referenced journals: three in ***Carbon,*** one in ***Langmuir***, and one in ***Journal of Physical Chemistry B.*** Results also were presented at more than 10 national and international conferences.

The activities of the Survey and University in this area have been well recognized in the international nanoscience community. An ISGS scientist presented an invited plenary lecture at the Carbon Conference in Oviedo, Spain, in 2005; was a keynote speaker and workshop presenter at the First International Nanotechnology Conference in Tehran, Iran, in 2007; and presented an invited paper, "Characterization of Adsorption Properties of Single-Walled Carbon Nanotubes for Gas Storage and Purification" at the University of Illinois Center of Nanoscale Science and Technology (CNST) Annual Nanotechnology Workshop, May 3–4, 2007.

## Potential Source of Limestone for Desulfurization Scrubbers Will Be Studied

The **Illinois Clean Coal Institute** has accepted the Illinois State Geological Survey proposal entitled "Limestone Fines—An Economically Viable Source of Sorbents for Desulfurization?" The project will characterize limestone fines in Illinois quarries, especially those located near existing and future coal-fired power plants, for potential use in flue gas desulfurization scrubbers. To be economically viable, the scrubbers need local, low-cost sources of high-quality limestone. An abundant but largely unused source of limestone for scrubbers may be the by-product fines produced by the stone-crushing equipment at all limestone quarries. Utilization of quarry fines as a scrubbing agent could provide two major cost savings: (1) because the material has already been crushed down to the appropriate size

needed for sulfur scrubbing, no additional energy cost is associated with grinding, and (2) because the fines are considered waste material, they are widely available at quarries at a low cost. Quarry fines have not been fully characterized to date, and their chemical, mineralogical, and physical properties and their reactivities with respect to sulfur oxide capture are not known. To determine the quality and suitability of these potentially effective and low-cost sources for scrubbing agents, ISGS scientists will analyze the fines from a representative selection of quarries, focusing on those near existing and potential coal-fired power plants. Results from this project will be useful in selecting the best product at an affordable cost for each power plant with specific sorbent needs.

## Limestone Information in Demand for Desulfurization

There has been a dramatic increase in the number of requests concerning the availability of high-purity limestone in Illinois for use in wet flue gas desulfurization in coal-fired power plants. The requests come from electric utilities, coal companies, and private consultants who are seeking information on the availability of limestone with 90% or better calcium carbonate content. Interest has been expressed in existing quarries and mines as well as potential reserves that could be worked for future extraction. Requests for information also come from other states, especially regions located along the Mississippi River, because barge transportation is relatively cheaper than transportation by truck or rail. There are a number of quarries and underground mines that extract high-calcium limestone in western and southern Illinois that are conveniently located along the Mississippi and Illinois Rivers, thus making transportation more economical. The availability of high-calcium limestone in the central and northern part of the state is limited, and the material has to be transported in from other areas.

## Addressing Critical Water Issues in Power and Energy Generation

Thermoelectric power plants are the second largest user of water in the United States, ranking only slightly behind agricultural irrigation. Power plants fueled by coal and natural gas account for about 52% and 17%, respectively, of the nation's electricity supply. The plants impose a high demand on the nation's water. The ISGS has initiated a new program to address critical water issues related to the power generation industry. The initial goal is to develop a research and development path that will lead to identification of potential research priorities related to water usage and consumption in power and energy generation plants. Water issues from coal mining and cleaning, to transportation, coal utilization in different power generation plants, and by-product utilization will be addressed. The project also aims to identify similar issues in plants powered by natural gas. Specific areas of interest are advanced cooling technology, water reuse and recovery technology, water treatment technology, and wastewater treatment technology. Ultimately, research areas will be identified that will lead to reduced power plant water usage and minimize potential water quality impacts in a cost-effective way.

## New Fly Ash Project Funded

A two-year project, "Manufacturing Fired Bricks with Class F Fly Ash from Illinois Basin Coals," funded by the **U.S. Department of Energy** and **Combustion By-products Recycling Consortium (U.S. DOE-CBRC),** is now completed, and a final report has been submitted. The project evaluated fly ash from **Cinergy PSI Cayuga** station to determine its viability as a material for fired brick making at a nearby brick plant. A summary of the project work was published by the U.S. DOE-CBRC ***Ashlines*** in the fall 2006 issue, volume 7, number 3. The U.S. DOE has recently granted an additional award to the ISGS researchers to further assist the brick industry and utilities in the commercial production of building products using fly ash and other coal combustion solid wastes.

## Concrete from Fly Ash Research Generates Outside Interest

After reviewing the Illinois State Geological Survey pamphlet, ***Energy-Efficient Concrete from Fly Ash,*** the president of an independent home construction firm in Massachusetts contacted the ISGS. The company president interviewed two ISGS researchers to discuss more details regarding the Survey's fly ash building block program. The president was impressed with the superior performance of the Survey's fly ash products and plans to prepare a report based on the interview for submission to the legislators of Massachusetts and to Senator Clinton of New York.

***Joe and Melissa Chou demonstrate insulating properties of blocks made using coal fly ash.***

## Manufacturing Autoclaved Aerated Concrete from Class C Fly Ash

A truckload (25 tons) of Class C fly ash generated by **Dynegy's** Baldwin power station in southern Illinois has been shipped to **OSA, Inc.** in Ringgold, Georgia. Test runs have been initiated for commercial-scale production of autoclaved aerated concrete (AAC). The scale-up results from a preliminary test were very promising. The tested formulation was very different from previous formulations used by the AAC industry, and, to our knowledge, this is the first time Class C fly ash has been used for AAC production. A patent application for this innovative process is under consideration. All forms of AAC use less cement in their manufacture than do regular cement blocks and wall products, but AAC made from Class C fly ash uses much less cement than AAC made with sand or Class F fly ash. This reduction is important because the cement production process is one of the larger contributors to $CO_2$ emissions. Using Class C fly ash in AAC can reduce greenhouse gas emissions and energy consumption during the manufacturing process. Additionally, heat insulation capabilities of AAC products are superior to traditional products, reducing the required energy in buildings constructed with AAC products. The use of AAC products may qualify for $CO_2$ reduction credits that can be traded in the marketplace under the proposed cap and trade regulations.

## Coal Bed Methane Exploration and Development

A coal geologist met with an energy company in Edwardsville to review its coal bed methane exploration and development program and to compare its coal data with ISGS data. The company has 87 producing wells in Saline County and a 10-well pilot project in Shelby County. The company has the largest lease holding for coal gas in Illinois and has been the only producer of coal bed seam gas in Illinois for the last two years. The company has been providing technical data, such as permeability values, which have greatly augmented ISGS studies.

## Discussions Further Development of Michigan Coal Gas

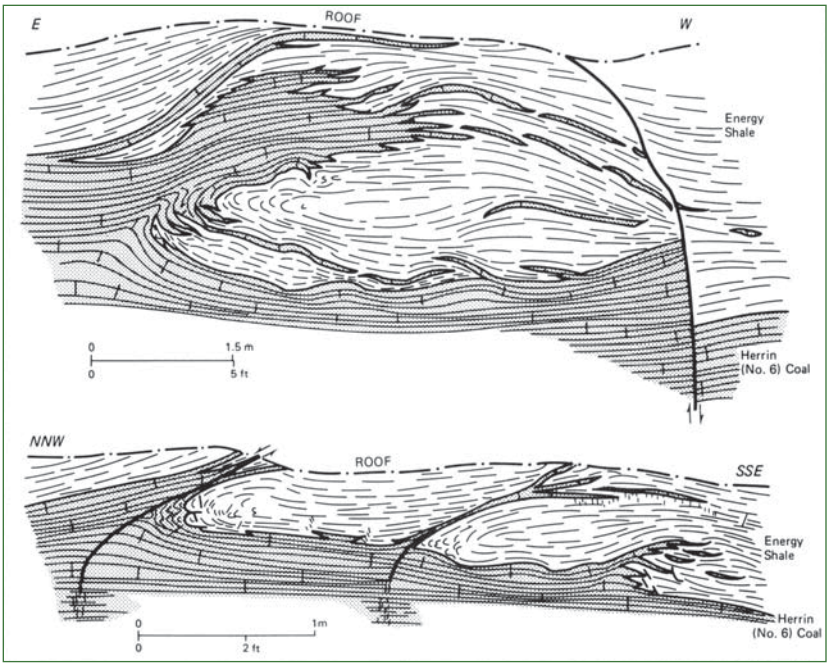
Two coal geologists met with representatives from a Michigan energy company to assist them in locating possible coal bed methane prospects near some of their holdings. The Michigan company, the only producer of coal mine methane in Illinois, has about 20 wells in production, primarily in

Franklin County. The geologists provided numerous maps, stratigraphic data, and reports to aid in evaluation and development. Custom maps also were created to assist the company in its search for new areas to drill.

## ISGS Staff Investigate Mine Roof Disturbance and Coal Rolls

Two ISGS coal geologists visited an underground coal mine in southern Illinois at the request of the mine operators to investigate an unusual and rather large roof disturbance. Preliminary investigations appear to point to a huge concretion, 15 feet or more wide and at least 7 feet tall. Samples of the possible concretion will be collected by a mine geologist at a later date. Additional follow-up visits will take place to determine whether this feature is persistent and repeats or is isolated.

The geologists also visited a surface mine in the Danville Coal in western Indiana at the request of the mine geologist to examine prominent coal "rolls." Based on this examination and on sedimentary structures in the overlying rocks, the geometry of the coal seam led to a preliminary interpretation of the coal "rolls" as deformation features resulting from differential sediment loading. Data from this mine will help geologists better understand similar features in Illinois. Additionally, an ISGS coal geologist created a series of custom coal maps showing coal mines, coal thicknesses, and potentially minable coal along the corridor of a proposed pipeline for a private company. These maps will help delineate areas to potentially avoid because of possible longwall mining.




***Coal rolls are most often stream channels developed in the top of the coal seam that push down on top of it or cut it out, making the coal "roll" up or down.***

## Abandoned Coal Mine Maps Delivered to Sponsors

The maps of abandoned mines in six 7.5-minute quadrangles (Streator North, Streator South, Long Point, Leonore, Cadwell, and Lovington) in La Salle, Livingston, and Moultrie Counties have been completed. These maps were funded by the **Illinois Mine Subsidence Insurance Fund.** Additionally, mapping of abandoned mines in 12 other quadrangles (La Salle, Marseilles, Ottawa, Starved Rock, Seneca, Tonica, Minonk, Pontiac Northwest, Blackstone, Flanagan North, La Rose, and Varna Quadrangles) in La Salle, Grundy, Livingston, Marshall, Woodford, and Putnam Counties has been completed for the project sponsor, the **Illinois Department of Transportation.**

All 18 of the maps are accompanied by directories containing detailed information on the mine histories and information sources used to make the maps. All maps and directories have been

delivered to project sponsors in both paper and digital formats and are available to the public. These maps and directories will help government planners, developers, and private citizens identify undermined areas.

## Large Software Donation Received

The ISGS has been awarded a three-year grant of software worth over 15 million dollars from **Landmark Graphics, a subsidiary of Halliburton Corporation.** This software will benefit the Oil and Gas, Coal, Industrial Minerals and Resource Economics, and Groundwater Sections. The software is necessary for the ISGS to complete the carbon sequestration research funded by the **U.S. Department of Energy.** The software will enable the ISGS to simulate the movement of carbon dioxide through subsurface formations and help ISGS scientists better understand the sequestration potential of different strata. In addition, the software will be used for subsurface mapping, reflection seismic interpretation, and teaching students about applications in petroleum geology.

## The Geologic Record of Droughts

The paper, "A 10,000 Year Record of Dune Activity, Dust Storms, and Severe Drought in the Central Great Plains," written by an ISGS geologist and geologists from the **University of Wisconsin** and **University of Nebraska,** was published in the February 2007 issue of ***Geology.*** This paper reported on results of optically stimulated luminescence dating on dune sand and loess deposits in the central Great Plains and gives new information on the timing and causal mechanism of severe droughts during Holocene times. Dune fields and loess deposits of the Great Plains of North America contain stratigraphic records of eolian activity that can be used to extend the short observational record of drought.

The paper presents a 10,000-year reconstruction of dune activity and dust production in the central Great Plains Region based on 95 optically stimulated luminescence ages. Clusters of ages define episodes of extensive high winds, which were interpreted as a response to frequent severe drought, at 1,000 to 700 years ago and 2,300 to 4,500 years ago (with peaks centered on 2,500 and 3,800 years ago). Sustained windy periods also occurred from 9,600 to 6,500 years ago. Parts of this record may be consistent with hypotheses linking Holocene drought to sea surface temperature anomalies in the Pacific or Atlantic Oceans or to the El Niño-Southern Oscillation phenomenon.

This paper has already received wider recognition. It was reported in the February 10, 2007, issue ("Why So Dry? Ocean Temperatures Alone Don't Explain Droughts") and the February 1, 2007, issue ("A Clearer Global Climate Forecast") of ***The Christian Science Monitor.***

## Oil Potential from Lower Paleozoic Rocks

Lower Paleozoic rocks of the Illinois Basin represent an important, yet under-explored target. Of the 4 billion barrels of oil produced from the Illinois Basin, only 7.5% has been from lower Paleozoic rocks.

The **U. S. Department of Energy (U.S. DOE)** has continued its funding of the Illinois Basin Consortium project to develop a digital play portfolio for the lower Paleozoic rocks that could improve exploration and development strategies in the Illinois Basin. The project is in its third and final year.

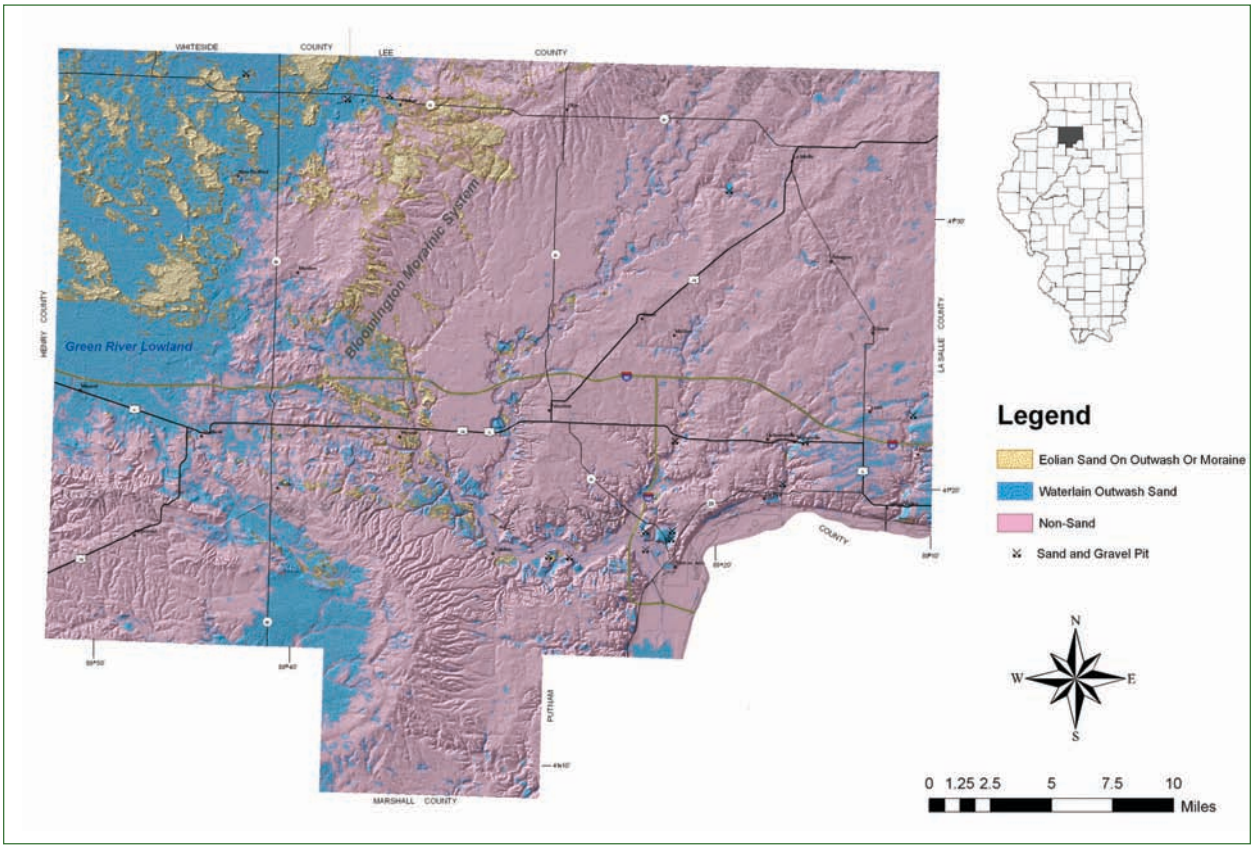
The work for this contract consists of mapping existing Devonian, Silurian, and Ordovician production in the Illinois Basin. A digital catalog of examples of lower Paleozoic reservoirs in the Illinois Basin is being developed as examples of prospective targets for exploration and development. A digital, interactive stratigraphic column of lower Paleozoic rocks in the Illinois Basin also is being developed. Construction of a digital cross section grid that illustrates both present-day structure and paleostructure to be used for structural evolution analysis is a major task. Analysis of Basin-wide

relationships of unconformities, paleogeographic maps, and isopach maps is planned to characterize established Devonian and older production. The potential for undiscovered older (deeper) Paleozoic plays will be analyzed and related to possible analogous Paleozoic plays in adjacent basins. Analysis of the existing seismic data grid will explore possible untapped play strategies related to re-mobilization of structures over geologic time, refine the role of offsetting of structures with depth, and examine the role of deeply seated faults and other structural features that may have influenced reef development.

Four papers, a poster, and a workshop associated with this project were presented at the American **Association of Petroleum Geologists Eastern Section** meeting in Buffalo.

## Preliminary Sand Map Completed for Bureau County

A preliminary map showing the distribution of wind-blown eolian sand and waterlain outwash sand in Bureau County has recently been completed. Sand and gravel deposits are widespread in northwestern Bureau County, the southern edge of the Green River Lowland, and are also found scattered throughout the rest of the county. They are largely the direct or indirect result of glacial processes. Sand dunes formed by wind are prominent landforms in this county. The eolian dunes generally lie above outwash plains, moraines, and terraces. This unique geological setting provides an excellent opportunity for geologists to study sand from two different origins: wind-blown eolian sand and waterlain fluvial/glacial outwash sand. Previous differentiation of eolian and outwash sand was at the statewide scale, and this map gives much more detailed information at the county level, helping geologists to better understand the distribution of sand and gravel resources and eolian and glacial/fluvial processes.




*Surficial eolian and outwash sand distribution of Bureau County.*

Classification of the sand origins was determined using combined data from topography, parent materials of soil reported in the county soil survey, water and related well records, grain size, and carbonate content. For example, the distinct shape of parabolic dunes, shown by the shaded relief map of the digital elevation model, can be used to classify the area as eolian. Lobe-like sand above the Bloomington Morainic System is clearly eolian, because only eolian sand can climb up on a topographically high moraine. Sediments that contain gravel and are calcareous likely are not eolian in origin.

# Mapping and Hydrogeology for Planning

## Water Resources Planning Efforts Progressing in Illinois

On January 9, 2006, **Governor Rod R. Blagojevich** issued Executive Order 2006-01, which called for the development of a comprehensive, statewide water-supply planning and management strategy. In response, a strategy development process was initiated for northeastern Illinois in November 2006 with the creation of a regional water-supply planning group facilitated by the **Chicago Metropolitan Agency for Planning (CMAP).** The 35 members represent nine stakeholder groups in northeastern Illinois. More information about the Regional Water-Supply Planning Group for northeastern Illinois is available from CMAP's Web site (http://www.chicagoareaplanning.org/watersupply/).

A regional water-supply planning committee for east-central Illinois was organized in February 2007, facilitated by the **Mahomet Aquifer Consortium (MAC).** The 12-member **Water Resources Planning Committee for East-Central Illinois** consists of representatives from 12 stakeholder groups in that area. More information about the committee is available from the MAC Web site (http://www.mahometaquiferconsortium.org/).

The Illinois State Geological Survey is compiling existing information about the hydrogeology of northeastern and east-central Illinois to make it available to the two planning groups. The data will be analyzed with respect to the information needed to address water-supply planning and management issues. These analyses will help identify what additional information is needed for the planning process.

## Investigation of the Mahomet Aquifer System Continues

*Mahomet aquifer monitoring well being drilled.*

The Mahomet aquifer and the shallower aquifers that overlie it constitute the Mahomet aquifer system, the principal groundwater resource of east-central Illinois. The ISGS recently completed test drilling at two sites west of Champaign. Both sites are located over the Mahomet aquifer. Using the wireline method, the initial borehole at each site was drilled through the entire thickness of unconsolidated sediment and a few feet into the underlying bedrock. The continuous core that was collected from the initial boreholes was described in the field by ISGS geologists and boxed for transport to the Quaternary laboratory for more detailed description and analysis. A natural gamma-ray geophysical log of the first borehole at each site was obtained. These geophysical logs complement the descriptive logs of the boreholes and greatly assist the decisions made regarding the number of observation wells to install at the site and depths of the screens.

Three observation wells were installed in separate boreholes at the first drill site. Two of the wells were installed in the Mahomet aquifer, one near the top of the aquifer and the other near the base of the aquifer. The third well was completed in a sand unit within the Glasford Formation. At the second drill site, two observation wells were installed in separate boreholes, one near the top of

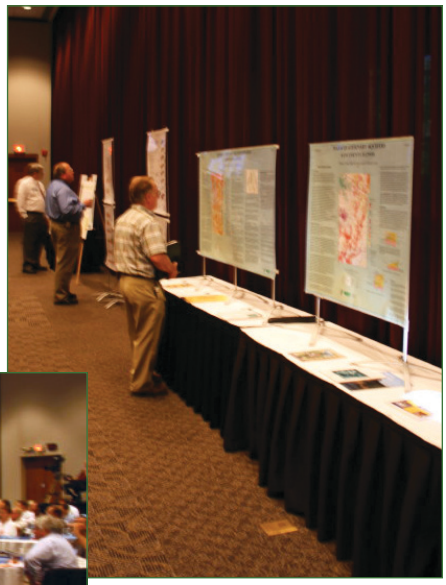
the Mahomet aquifer and the other near the aquifer's base. The observation wells were pumped to ensure good hydraulic connection to the adjacent aquifer. The water level in these wells will be measured periodically, and water samples will be collected for analysis. In support of the drilling at the second site, a seismic survey was conducted along a line from about three miles east of the drill site to nine miles west of it.

The data acquired will support ongoing geologic and hydrogeologic research of the Mahomet aquifer and shallower aquifers. These data will improve the understanding of the physical and hydraulic characteristics of the sediments within the Mahomet Bedrock Valley as well as groundwater availability and flow in the area. With continued development of east-central Illinois' groundwater resources, such understanding is integral to addressing water supply issues, as is currently being accomplished through the **Governor's Water-Supply Planning Initiative.**

## Kane County Workshop on Water Supply Sustainability and Map Delivery

About 250 people gathered at the Q Center in St. Charles on September 20, 2007, to participate in a workshop sponsored by the **Kane County Board**. The theme of the workshop was "Implementing a Sustainable Water Supply for Kane County's Future." An ISGS geologist gave two presentations at the workshop. The first covered the Quaternary deposits in Kane County, describing the shallow and local geologic setting and showing the major Quaternary aquifers in the County and the sensitivity of these aquifers to contamination. The second presentation pertained to the regional bedrock geology and described the geologic setting and structure of the Kane County region and the hydrogeologic framework of the bedrock geology. Scientists from the **Illinois State Water Survey** presented several other talks relating to the hydrology of the area.

The final suite of geologic maps developed for the Kane County project (Water Resource Investigation for Kane County, Illinois) was delivered to Kane County at the workshop. The maps show bedrock geology, aquifer sensitivity to contamination, major Quaternary aquifers, and geologic cross sections. The suite also includes a three-dimensional geologic model of Kane County. This suite of maps is the first in the new Illinois County Geologic Map series of ISGS. The maps can be viewed from the ISGS Web site (http://www.isgs.uiuc.edu/maps-data-pub/icgm/icgm.shtml).



***Kane County Workshop, September 20, 2007 (photographs by Randy Locke, Illinois State Water Survey).***

## Watershed Assessment for Ecosystem Restoration

An ISGS team is participating with the **Illinois State Water Survey (ISWS)** and the **Illinois Natural History Survey (INHS)** in assessments of Illinois River basin subwatersheds for ecosystem restoration opportunities. The assessments were requested by the **Illinois Department of Natural Resources (IDNR)** to support the Illinois River Basin Comprehensive Plan written by the **U.S. Army Corps of Engineers,** Rock Island District, in partnership with IDNR. The Illinois River basin drains nearly half of the state, contains or receives the wastewater from most of the population of the state, and is a nationally significant passageway for migratory birds. Despite significant ecological degradation over the past two centuries, the river was identified by the **National Research Council** as one of three large floodplain river systems in the lower 48 states with the potential to be restored to an approximation of its outstanding biological past.

*Geologists collecting samples from the Big Ditch watershed.*

The current focus of watershed assessment is on direct tributaries to the Peoria pool. The goal is to identify projects to reduce sediment loading to the Illinois River. The watershed assessments are intended to be rapid (about 1 year) and to lead to identification of critical restoration areas. The compendium of data will also constitute baseline information for the long-term monitoring of watershed conditions and project success. ISGS is providing a geological perspective by

- analyzing stream channel planform change by comparing historic and recent aerial photographs to identify styles and locations of channel change, to identify fundamental processes, and to make preliminary links between landscape change and channel change;
- mapping surficial geology to identify sediment sources, materials properties, and long-term geomorphic evolution of the watersheds;
- compiling comprehensive, interdisciplinary, existing data into watershed-focused databases. Each database is shared with ISWS and INHS partners and analyzed by ISGS for existing watershed conditions and changes in land cover and land use; and
- contributing to analysis of channel geomorphic measures and aerial (helicopter) video imagery obtained by ISWS.

The ISGS team is just starting a dendrochronologic analysis of gully formation in Partridge Creek. The analysis could be an important contribution to the interpretation of post-glacial landscape evolution in west-central Illinois. The age of trees and their growth history could provide information on geomorphic processes and variations of recent climate.

## Denitrification in the Shallow Groundwater of a Tile-Drained Agricultural Watershed

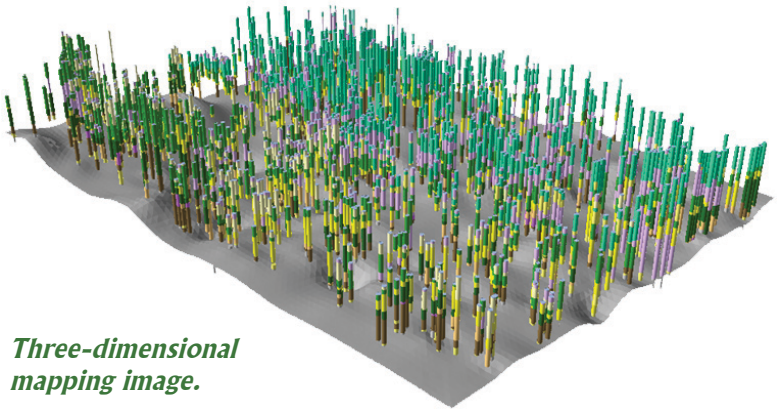
Non-point source pollution of surface water by nitrogen is considered a major cause of hypoxia in coastal waters. Because Corn Belt watersheds have been identified as major sources of nitrogen in the Mississippi River basin, the fate and transport of nitrogen from midwestern agricultural

watersheds need additional research. Over a 3-year period, nitrogen was monitored in the surface water and groundwater of a tile-drained Corn Belt watershed in central Illinois. Using geochemistry, isotope geochemistry, microbiology, and groundwater modeling techniques, researchers found that nitrogen was transported past the tile drains and into shallow groundwater.

Denitrification in shallow groundwater was estimated to be equivalent to 0.3 to 6.4% of the applied nitrogen or 9 to 27% of nitrogen exported via surface water. These estimates varied by water year and peaked during a year of normal precipitation after 2 years of below average precipitation. Analysis of data collected over 3 years of monitoring indicated that shallow groundwater in watersheds with fine-grained soils may be a significant nitrogen sink compared with the fate of nitrogen exported via surface water. These results were recently published in the ***Journal of Environmental Quality.***

## Three-dimensional Geologic Mapping Provides Information for New Municipal Water Wells in the Village of Barrington

Geologic mapping in northeastern Illinois, funded through the **Central Great Lakes Mapping Coalition, the STATEMAP component of the National Cooperative Geologic Mapping Program,** and the Illinois State Geological Survey, has been an ongoing priority of the ISGS. Geologic mapping teams have established cooperative relationships with community groups, government agencies, and municipal organizations in the region. These relationships have been valuable for the success of those mapping programs. Geologic mapping and associated research conducted by the ISGS has provided timely information for local communities that allows them to make informed decisions about planning, development, and water resources. Mutual cooperation with these organizations has provided the ISGS mapping teams with access to properties to collect geologic data by drilling boreholes and installing observation wells to monitor water levels. The wells are part of the groundwater monitoring system ISGS scientists are developing in northeastern Illinois.



***Three-dimensional mapping image.***

The Barrington area is a current focus of STATEMAP mapping efforts. The ISGS mapping teams have drilled at least seven stratigraphic borings and installed observation wells within a six-mile radius of the Barrington area. Representatives from Barrington were aware of the ongoing drilling and groundwater monitoring of glacial sediments in the area. With this knowledge, the Director of Public Works for the village contacted the ISGS seeking information about the geology and water resources at proposed locations for two new municipal water wells within village properties. The ISGS has begun preliminary discussions with village administrators and their contracted engineers to help them better understand the geologic framework and potential groundwater resources in the proposed water-well locations.

## Geologic Mapping Solves Wetland Restoration and Environmental Problems

Geologic research and mapping of the West Chicago Quadrangle in northwestern Cook and DuPage Counties has helped researchers, environmental hydrogeologists, and county agencies better understand topics as diverse as the paleoenvironment of an ancient mire that entombed a mastodon

about 13,000 years ago and finding the best places to install monitoring wells in an area with groundwater contaminated with low levels of volatile organic chemicals. The basic understanding of the area's geology will be captured on surficial geology and bedrock topography maps of the West Chicago Quadrangle, which are funded by the **STATEMAP component of the National Cooperative Geologic Mapping Program.**

To assess the geologic conditions, an ISGS geologist and a summer intern have been examining sediment cores, sample sets, natural gamma-ray logs, water-well and landfill boring records, and geotechnical reports. Their understanding of the geology has been enhanced by geophysical exploration that included the use of shallow electric earth resistivity, borehole geophysics, and seismic shear transects. The geologic mapping is providing an important context for two very different natural resource and natural history issues.

Contaminated groundwater in the West Chicago Quadrangle is a serious local environmental problem. The geology of the area plays an important role in determining the direction, speed, and changes in concentration of the contaminant along the groundwater's flowpath. The quadrangle is located in an area where there were at least two stillstands of the Lake Michigan Lobe of the glacier that advanced out of the Lake Michigan basin during the Wisconsin Glacial Episode. The fluctuations of the glacier created a complex succession of glacial, lake, and meltwater stream deposits as well as the formation of the West Chicago Moraine, a ridge composed primarily of fine-grained glacial sediment. The areas with the contaminated groundwater lie within a zone of relatively thin, fine-grained sediment and thick, permeable, sorted sediment.

The ISGS is working with the **Illinois Environmental Protection Agency** to better delineate the details of the geology in the areas affected by the groundwater pollution. ISGS geologic maps and cross sections will be important components to understanding the problem and suggesting potential solutions. Some of the interesting details of the area's paleoenvironment, learned from this study, are reported in ***The Late Glacial and Early Holocene Geology, Paleoecology, and Paleohydrology of the Brewster Creek Site, A Proposed Wetland Restoration Site, Pratt's Wayne Woods Forest Preserve and James "Pate" Philip State Park, Bartlett, Illinois,*** which is in the final stages of review.

In this study, an ISGS geologist collaborated with scientists from the **Illinois State Museum**, the **University of Minnesota**, **Northeastern University**, and **Northern Illinois University** to reconstruct conditions of a drained wetland prior to its reflooding and restoration. Since completion of the report, removal of drainage tiles has resulted in reflooding of the area and an immediate rebound by wetland plant species repopulating the area. During tile removal, three mastodon teeth were discovered, along with an in situ rib thought to be from the same animal. Collagen from one of the teeth dated at about 13,300 calibrated years before present. Among the many discoveries in the study, the most interesting


***Employees of the Forest Preserve District of DuPage County, Illinois State Museum, and Illinois State Geological Survey investigate the discovery site (photograph by Eric Grimm, Illinois State Museum).***

geological finding was that wind-blown silt ceased its rapid deposition at the onset of the last interglacial period about 14,500 calibrated years ago. This change is revealed in the change from deposition of sediment containing wind-blown clay minerals derived from the High Plains to marl containing little wind-blown sediment.

## Geophysical Logging Conducted for Chicago Flood Control Project

*Thornton Quarry, Hanson Material Service.*

The Illinois State Geological Survey provided borehole geophysical logging in support of the Transitional Flood Control Reservoir. The goal for this study for the **Metropolitan Water Reclamation District of Greater Chicago (MWRDGC)** is to identify fractures, bedding planes, and other features in order to implement a concrete curtain around the quarry. Part of the project requires pumping water into the holes in order to log the entire formation with acoustic imaging. The ISGS is currently coordinating with **Raimonde Drilling** and with the geologists and engineers with **Black & Veatch** and **Arcadis.** So far, five core holes have been logged, three of which were drilled at 15 degrees, and two of which are vertical. Three additional holes will be logged in the near future. Average depths are approximately 550 feet deep, and the holes are concentrated around the perimeter north lobe of Thornton Quarry. Logs that were recorded include gamma, 8-inch, 16-inch, 32-inch, 64-inch normal resistivity, spontaneous potential, single-point resistance, spinner/flowmeter, fluid temperature and resistivity, and acoustic televiewer.

## Isotopes and Halide Investigation Help Resolve Origin of Elevated Chloride Concentrations in Monitoring Wells of Illinois Landfill

Geochemists from the Illinois State Geological survey recently completed a study examining some geochemical characteristics of groundwater samples from a landfill in southern Illinois where monitoring wells contained elevated concentrations of chloride ions. In addition to the typical chemical analyses, oxygen and hydrogen isotope analyses and halide (chloride, bromide, and iodide) analyses were completed on 25 water samples (both up-gradient and down-gradient of the landfill) to help determine the origin of the elevated chloride concentrations observed in several monitoring wells.

The isotopic data showed that the two leachate samples collected from the landfill had a very different isotopic composition than local surface water and groundwater monitoring wells. Based on the isotopic results, no detectable leachate contamination was evident for any of the monitoring wells. However, this result did not explain the elevated chloride concentrations in many of the monitoring wells at the landfill. Landfill leachate typically contains thousands of milligrams per liter of chloride, making the chloride ion a more sensitive parameter of contamination than oxygen and hydrogen isotope analyses. Furthermore, in some areas, such as in this case, there are multiple sources of chloride, which could result in elevated levels of chloride in shallow groundwater wells.

Graphing techniques recently developed by the ISGS for distinguishing various sources of chloride in groundwater proved to be very helpful. The monitoring well samples that had elevated chloride

concentrations showed characteristics similar to other Illinois groundwater samples known to have been affected by brine and/or road salt contamination. In the present study, the halide and chemical data were used to generate mixing curves to further evaluate the range of concentrations observed in the data. Graphed data from the monitoring wells followed the curves generated between the brine (and road salt) end members and the up-gradient wells rather than along the curves calculated for the landfill leachate and up-gradient groundwater. Thus, the halide and isotopic data agreed, suggesting that the monitoring wells with elevated chloride concentrations were probably impacted by brine and/or road salt contamination rather than by leachate. The presence of old oil wells very near the landfill suggested that brine contamination in shallow monitoring wells in the area was possible, corroborating the isotope results.

## Origin and Evolution of Illinois' Longest Caves: An Integrated Approach to Interpreting the Geologic and Paleoclimatic Records

Geologists at the Illinois State Geological Survey are taking a multidisciplinary approach in their investigations of the origin and evolution of long, branchwork-type caves and their deposits in southwestern Illinois. Fogelpole Cave and Illinois Caverns are Illinois' longest caves. Both caves have active streams flowing through them. The caves also contain abundant fluvial sediments, flowstone, speleothems (stalagmites and stalactites), and breakdown, thus showing evidence of past climate change, large floods, and major earthquakes. By systematically mapping and dating these deposits, the geologists are beginning to see correlations among groups of deposits and their relationships to specific historic and prehistoric climatic and seismic events. From these results, the geologists are developing a conceptual model of the timing and mode of cave initiation, development, and deposition of sediments and speleothems within the caves and their relationship to paleoclimate conditions.

*A close-up view of a growing stalactite.*

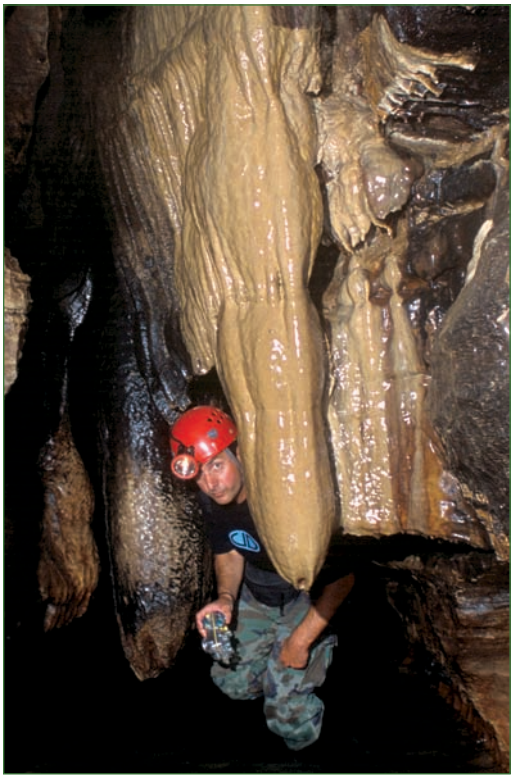
The results obtained to date suggest that the large caves in southwestern Illinois were initiated by glacial melting between 140,000 and 170,000 years ago (sometime near the end of the Illinois Glacial Episode and the beginning of the Sangamon Interglacial Episode). Cold, glacial meltwater probably began infiltrating into vertical fractures and flowing along horizontal bedding planes within the calcite-rich St. Louis Limestone. The present cave ceilings mark the top of the water table during that period. The continuous flow of water through these developing crevices and conduits resulted in additional dissolution of rock and downcutting of the caves that continue today (incision rates appear to have ranged from 0.032 to 0.048 cm/yr). Remnants of flowstone near the cave ceilings and stalagmites on benches recorded the time of exposure of these cave levels, as well as timing of wet and dry periods in Illinois. Side passages filled with fine-grained sediment are evidence of a major flood or series of floods that nearly filled the caves about 42,500 years ago. This event was also recorded in the stalagmites that have been sampled. Finally, many small, white stalagmites have been dated; these are thought to have been initiated at two distinct times, about 90 and 190 years ago, dates that correlate with two major earthquakes in the region, one that occurred in 1917 and another in 1811–1812, the latter being generated by the New Madrid Seismic Zone. These results indicate that caves contain a wealth of paleoclimatic and possibly seismic information that the ISGS geologists are only beginning to uncover.

## Southwestern Illinois Cave Deposits May Hold Evidence for Past New Madrid Seismic Zone Earthquakes

Predictions of seismic activity along the New Madrid Seismic Zone (NMSZ) require an accurate reconstruction of paleoseismic history. Considering the devastating effect of the 1811–1812 New Madrid earthquake on the central Midwest region, finding different types of evidence for establishing earthquake periodicity is very important. Ongoing research on cave deposits in southwestern Illinois by the Illinois State Geological Survey and the **University of Illinois Geology Department,** beginning in 2001, has shown that these underground deposits may be a unique and unexpected repository for such records. Geological features found in two southwestern Illinois caves, located within 250 km of the NMSZ and within 150 km of the epicenter of the 1811–1812 earthquakes, could be related to earthquake activity.

There are five types of features: (1) stalagmites with deviated growth axes; (2) hundreds of relatively small, actively growing, white stalagmites growing on older, similarly sized stalagmites (4,000 to 5,000 years ago), on older flowstone, and on breakdown in both caves; (3) fallen soda straw stalactites from an isolated area in one of the caves; (4) collapse features that may have been triggered by seismic waves moving through thick, saturated cave sediments; and (5) a previously unrecognized feature in speleothems that is just beginning to be investigated. Each type of evidence, including collapse features, could provide temporal evidence of a seismic event.

Scientists are still collecting, examining, and dating samples but have preliminary age results on the white stalagmites. Because of the similar morphology, appearance, and ages of the white speleothems, scientists propose that a single event initiated their growth. Two possible initiating events are (1) the rejuvenation of dormant speleothems resulting from the 1811–1812 NMSZ earthquake series and caused by reopening former flow paths to the caves and (2) agricultural activities on the surface that began in the area in the early 1840s. More data need to be analyzed before conclusions can be reached.



*Researcher investigating earthquake-related speleothem damage.*

## Geological and Pedological Controls on Grain Size and Sedimentation Rates for Peoria Loess Deposits in Illinois

A study of grain size distribution, sedimentation rate, and variations in matrix carbonate and color has helped identify the loess- and soil-forming processes in the Peoria Loess in southwestern Illinois. This analysis revealed that many of the weathering bands within the loess deposit contained finer-grained particles with a relatively higher sedimentation rate; other layers contained coarser-grained materials showing slower sedimentation rates. These results suggest that when the higher-sedimentation-rate layers were being deposited, vegetation was denser, and surface conditions wetter, in the loess deposit area. This situation would have

increased the dust-trapping efficiency and sedimentation rate. Conversely, during the intervals when the slower-sedimentation-rate layers were being deposited, the combination of strong surface winds, which would have transported coarser-grained particles from local dust sources, and sparse vegetation on a relatively dry surface probably reduced the dust-trapping efficiency on the loess deposits, resulting in this slower sedimentation rate. The study investigators concluded that the strong interactions between the loess- and soil-forming processes played an important role in grain size distribution and sedimentation rate in the Peoria Loess in southern Illinois during the last glacial period. The results of this study are published in ***The Importance of Both Geological and Pedological Processes in Control of Grain Size and Sedimentation Rates in Peoria Loess*** (Geoderma, volume 136, p. 388–400).

## Geologists Help State and Federal Agencies Determine Origin of Sediment at the Ottawa, Illinois, Superfund Site

Ottawa, Illinois, was previously the site for several facilities producing watch dials that glowed in the dark as a result of radioactive substances combined with the paint. The factories are gone now, but some manufacturing waste products remain, combined with other human-made and natural deposits and dumped at various localities in the Ottawa area. Consequently, a number of sites are under remediation. An Illinois State Geological Survey geologist met with geologists and engineers from the **Illinois Emergency Management Agency, U.S. Environmental Protection Agency,** and **Weston Solutions, Inc.** at one such Superfund remediation site in Ottawa to help them solve a geologic problem: the origin of the material. The contamination at this site is the result of fill material from numerous sources, including radium-bearing materials from the Radium Dial Co. or Luminous Processes, Inc. Excavations at site NPL-9A in downtown Ottawa revealed a black sandy, peaty layer that occurs between the underlying St. Peter Sandstone and the overlying definitive fill material. The black sandy material exhibits some radioactivity, but the overlying fill does not. The site geologists were unsure whether the material is a natural deposit or anthropogenic fill. Determination of the origin of the dark horizon will influence remediation decisions. If the material is a natural deposit or is composed of natural deposits, then its removal might not be necessary; being able to leave it in place would reduce remediation costs.

A sample was collected and brought to the ISGS for analysis. Initial analysis indicated that the material is composed mostly of quartz sand grains (approximately 80% by volume). These very fine- to medium-sized, frosted, subrounded grains are very similar to the underlying St. Peter Sandstone. The radioactivity of the sample is only slightly higher than that of background samples, suggesting that the material may be non-anthropogenic. Possible origins include post-St. Peter, pre-Pennsylvanian deposition, post- Pennsylvanian deposition, or even prehistoric deposition.

*A portion of the Ottawa Superfund site.*

# Wetlands Conservation

## Evaluating Impacts to Spring Bluff Nature Preserve

ISGS scientists are participating in a multi-agency study of the hydrology and geochemistry of the **Spring Bluff Nature Preserve,** which is owned and managed by the **Lake County Forest Preserve District.** The preserve, which is located along the shore of Lake Michigan at the Illinois-Wisconsin state line, contains a series of lakeshore dunes with intervening swales that contain wetlands that are often inhabited by threatened and endangered plant species. Development of the adjacent uplands is suspected to have altered the hydrology and geochemistry of surface-water inputs, thus changing the plant community to one dominated by nonnative or weedy species.

ISGS is measuring the hydrology and geochemistry of both altered and unaltered wetland communities on-site to identify any differences. Other agencies, including the **U.S. Geological Survey** and the **Lake County Public Health District,** are monitoring the geochemistry and volume of inputs to identify silt, chloride, and other constituents that are associated with altered plant communities in other studies. The year-long study, which began in summer 2007, will bring these data together to identify any changed conditions and their sources and to recommend restoration solutions. It is hoped that this initial study will expand to include other nearby high-quality habitats that are being degraded, including Illinois Beach State Park and Chiwaukee Prairie in Wisconsin.

## McHenry County Proposed Development near Detrana Fen

An ISGS wetlands scientist assisted the McHenry County Conservation District in installing several monitoring wells in Detrana Fen, where an adjacent development is being planned. Impacts to the quantity and quality of water are possible due to the development, which is to include residential wells, septic fields, and significant mass grading and installation of hardened surfaces.

## Plan for Braidwood Dunes Savanna

An ISGS wetlands scientist attended a meeting held at the **Forest Preserve District of Will County** regarding revision of the current remediation plan for tritium leaks at the Braidwood Dunes Savanna. Discussion centered around projected impacts to the preserve from pumping a nearby pond, which is expected to recover a plume of tritium-contaminated water. An alternative remediation strategy will be prepared by **Exelon.** Also in attendance were representatives from Exelon, **Forest Preserve of Will County, Nature Preserves Commission, Conestoga-Rovers and Associates,** and **Christopher B. Burke Engineering, Ltd.** A follow-up meeting will be held to present the new strategy.

## Hine's Emerald Dragonfly Habitat Conservation Efforts

A representative of the Wetlands Geology Section attended a meeting held in Romeoville concerning hydrologic studies related to the habitat conservation plans for the federally endangered Hine's Emerald Dragonfly. The purpose of the meeting was to identify common data sets that could be used in the multiple ongoing hydrogeologic studies in the area. Participants included the **U.S. Fish and Wildlife Service, Forest Preserve District of Will County, Will County Stormwater Management Planning Committee, the Village of Romeoville, the City of Crest Hill, Integrated Lakes Management Inc., Applied Ecological Services, STS Consultants, Graef Anhalt Schloemer & Associates,** and **Hanson Material Service.**

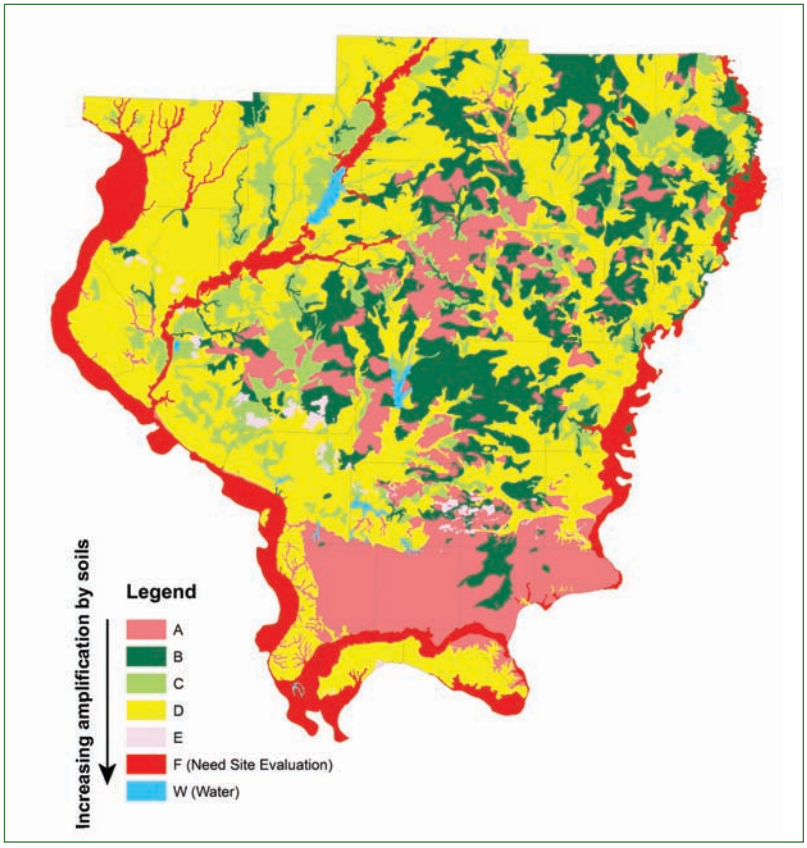
# Hazards Planning and Protection

## Preliminary Site Assessments Help Project Planning

For almost 20 years, the Environmental Site Assessments Section of the Illinois State Geological Survey has been engaged in conducting preliminary environmental site assessments for the **Illinois Department of Transportation (IDOT).** These assessments are designed to provide IDOT with environmental information early in project planning stages, so that state infrastructure projects can be completed on time and on budget. During the period covered by this annual report, 15 geologists and one student intern in the ISGS Environmental Site Assessments Section completed almost 100 site assessments for IDOT in 41 counties in Illinois. These projects were conducted in all nine IDOT districts and ranged in scope from work at intersections to major bridge and highway projects. Potential environmental hazards identified by ISGS work could then be avoided, remediated, or mitigated, depending on IDOT project needs.

## New Maps Show How Much Soils Will Amplify Earthquake Ground Motions

Engineering geologists at the Illinois State Geological Survey have completed a map for the southernmost 34 counties in Illinois. The new map shows soil classes, which indicate how much soils may amplify earthquake ground motions at a particular site. Such maps form the basis for damage estimates for those counties. The estimates will be developed for the **Illinois Emergency Management Agency** by the **Mid-America Earthquake Center** at the **University of Illinois at Urbana-Champaign.** The estimates will be used by state and local emergency managers to formulate various response plans, exercises, and possible mitigation efforts in those counties. This greatly revised map is based on much more detailed information about soil property changes with depth.




*Soil amplification map.*

## ISGS Assists in Production of Earthquake Preparedness Video

The ISGS annually assists several agencies in Illinois in various aspects of earthquake preparedness. Over the past 15 years, the Survey has helped produce earthquake exercises for the **Illinois Emergency Management Agency (IEMA),**

which includes participants from the **Illinois Department of Transportation,** state police, and county and city emergency managers. This work has led to a number of outreach products such as pamphlets and a video produced by the emergency managers with cooperation from the Survey. The ISGS was contacted by a trainer for the state police who asked for help in replacing an earthquake emergency response video that had been recently destroyed. The video was produced by IEMA in 1990 with production assistance by the ISGS. Fortunately, the ISGS had a broadcast-quality copy of the video, which was first reviewed for accuracy of content and then converted to DVD. Copies of the DVD were sent to the state police trainer and to IEMA. The ISGS is continuing work on earthquake preparedness in cooperation with other state surveys in the central United States through planning for post-earthquake responses.

## Deep Observation Borehole into the Earthquake Source

A representative from the Illinois State Geological Survey participated in the first meeting concerning a deep borehole observatory project for the New Madrid Seismic Zone. Held in Memphis, Tennessee, May 3-4, 2007, the meeting informed interested scientists, engineers, and institutions about the working group and provided a forum for discussing relevant issues. The workshop defined scientific targets and priorities and developed some strategies to best implement the work. The project is similar to the deep borehole project in southern California, which has drilled through the San Andreas fault and resulted in a new understanding of the fault environment.

During the New Madrid Seismic Zone project, instruments will be placed where the earthquakes take place, in the bedrock deep below the thick overlying sediments. Instruments in the bedrock, about a mile below the ground surface, will directly measure many parameters of the earthquakes, which are modified by the overlying sediments. Instruments installed within the seismic activity at depth could produce a better picture of the active faults that produce 100 to 200 small earthquakes each year. Monitoring instruments in the bedrock could provide a better understanding of the fault location and extent. Samples of the deep bedrock in the seismic zone and direct measurements of the physical properties of the thick overlying sediments will produce a better understanding of how the materials will behave in transmitting large earthquake ground motions to the surface, leading to better estimates of damage on the ground surface and better designs to mitigate damage.

## Publication Plan for Greater St. Louis Metropolitan Area Earthquake Scenario

A representative of the Illinois State Geological Survey is part of the executive committee for a proposed project to produce a document showing impacts from a major earthquake in the greater St. Louis metropolitan area. The first meeting for the project included participants from across the nation. It is hoped that the participants could produce the document for the 200th anniversary of the series of New Madrid earthquakes that rocked the central United States in 1811–1812. This scenario document is being produced with partial support from a national professional society, **Earthquake Engineering Research Institute (EERI).** The document will provide a sobering look at the impacts of a major earthquake on area infrastructure and infrastructure that passes through the New Madrid Seismic Zone to other areas of the nation. This document for public and public officials will show impacts such as those on buildings, electricity, water supplies, businesses, transportation systems of roads, railroads, river traffic, and pipelines. Direct and indirect costs will be estimated. Similar publications for Seattle and San Francisco have already been produced with partial support from EERI and other contributors.

## Earthquake Planning Assistance

Two Illinois State Geological Survey staff members provided an updated and revised section on earthquake history and impacts in Illinois for the State of Illinois (ISGS) 2007 Hazard Mitigation Plan, assembled by the **Illinois Emergency Management Agency.** This plan for the state is updated every three years and is required and approved by the **Federal Emergency Management Agency.** With this plan, the state qualifies for various funds for mitigation of hazards and response emergencies.

An ISGS engineering geologist was one of nine presenters on a two-day field trip starting in Memphis, Tennessee, and traveling through parts of Arkansas, Missouri, Illinois, Kentucky, and Tennessee to review the earthquake history of the New Madrid Seismic Zone and findings of researchers. The 30 participants represented insurance, pipelines, cable, telecommunications, business continuity and disaster recovery specialists, big box stores, federal reserve banks, and financial advisors. The ISGS presenter provided a 14-page paper for the field book, which covered the geologic setting, earthquake impacts, and local history of the southernmost area of Illinois and a 6-page section on resources for information.

## ISGS Expertise Aids Beach Building at Illinois Beach State Park

*Moving sand at Illinois Beach State Park (photograph by Greg Behm, Site Superintendent).*

Supplying sand for wave transport along the shore of Illinois Beach State Park is an important part of coastal stewardship by the **Illinois Department of Natural Resources (IDNR)** to counter erosional processes. A stockpile of sand is maintained at the north end of the state park to act as a feeder beach, which is eroded by northerly waves and "feeds" sand to the beaches to the south. In recent years, the sand stockpile had become a public relations issue because of concerns that the sand included asbestos-containing material (ACM). The ACM was primarily from asbestos-cement pipe (transite) used at a former housing development on what is now state park land. Sampling and testing by the IDNR, Illinois State Geological Survey, **University of Illinois at Chicago,** and the federal **Centers for Disease Control** all confirmed the minimal occurrence of the ACM and the lack of public health risk from this sand. However, to avoid future concerns, from March 12–23, 2007, the entire remaining stockpile of approximately 6,000 cubic yards of sand was excavated, trucked from the beach, and permanently disposed of at a landfill. Subsequently, from March 27 until April 6, 2007, a new supply of 26,000 cubic yards of sand from a Lake County sand pit was delivered to the park to build a new feeder beach under the guidance of the ISGS. This new feeder beach provides a sand supply that has no history associated with ACM.

# Reaching Out to the Public

## ISGS Fall Field Trip Attracts Large Crowd

Approximately 113 people attended the ISGS Geological Science Field Trip on October 21, 2006, to the Cave-In-Rock Area, in Hardin County in southeastern Illinois. Participants enjoyed fall color and a clear day as they traveled the scenic field trip route along the Ohio River within the eastern border of the Shawnee Hills. Uplift, folding, and faulting in the Pennsylvanian and Mississippian age bedrock could be seen along the route and in the steep cliffs along the river. The first stop was to the famous "river pirates" cavern where participants learned about the cave's geology and the legends and lore surrounding its history. Next came a short hike to nearby Tower Rock (500 feet above sea level), where Mississippian age Salem Limestone is overlain by St. Louis Limestone. Horn corals were seen in abundance here. A ferry ride across the Ohio River to Kentucky provided a unique water view of the cave and Tower Rock. Later stops at the American Fluorite Museum and the abandoned Annabel Lee Mine gave participants insight into the once thriving fluorite industry in Illinois and a chance to collect samples of Illinois' state mineral.

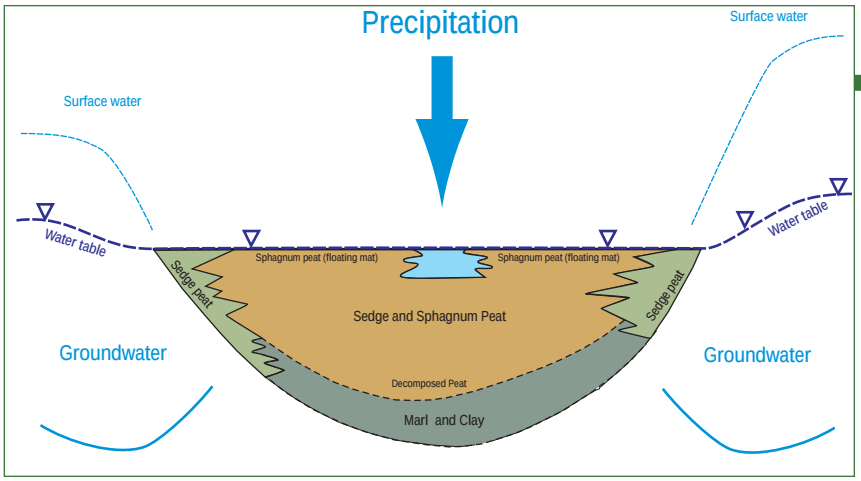
Participants also visited the Illinois Iron Furnace and learned about how pig iron was produced in the mid-1800s and its impact on the region's economics. It has generally been thought and reported in some literature that the iron ore used at the Illinois Iron Furnace was from the Liesegang banding that occurs in the Pennsylvanian age sandstones such as the Pounds or Battery Rock. While preparing for the upcoming geological science field trip, an ISGS geologist found references stating that the ore was limonite and that the limonite was mined near the Iron Furnace. During field work in the area, the geologist rediscovered the site of at least one of the old mining trenches and collected several examples of hematite with limonite staining. The old iron ore mining trench was along the Iron Furnace fault, a remarkable find since the mining and smelting of the ore at the Iron Furnace ended more than 150 years ago. The geologist also located the site of the area's second iron furnace, called Martha.

*Iron Furnace, Hardin County, Illinois.*

## Glacial and Wetland Features Highlights of ISGS Spring Field Trip

Participants on the spring 2007 ISGS Geological Science Field Trip explored the glacial and wetland features of McHenry and Lake Counties. At Moraine Hills, participants walked along the edge of Lake Defiance, one of the few glacial lakes in Illinois that has remained largely undeveloped, maintaining a near-natural condition. Three managed wetlands and several species of wildflowers and wetland plants were visible. At nearby Glacial Park, located between the Cary and Fox Lake end moraines, the geological features of interest were the undisturbed knob-and-kettle topography typical of glacial

moraines, kames, dissected outwash terraces, and kettles. The site provided exceptional examples of delta kames and biological richness. Another important aspect of the park is Nippersink Creek, one of Illinois' highest-quality streams. The creek is currently being dechannelized to restore the meanders that encourage aquatic life-forms, allow floodwaters to create temporary wetlands, and slow river velocity and erosion. The third stop was Volo Bog, where all stages of bog succession could be seen. The bog also is unique because it is the only "quaking" bog with open water in Illinois. At the final stop, participants learned about and collected samples from the glacial outwash fan deposits of Meyer Material Company Pit 26.




*Generalized hydrogeologic cross section through Volo Bog.*

## ISGS Celebrates Earth Science Week


Governor Rod R. Blagojevich proclaimed October 8–14, 2006, as Earth Science Week in Illinois. The Survey helped commemorate Earth Science Week for the public with its October Geoscience Field Trip to the Cave-In-Rock Area in southeastern Illinois. Additionally, ISGS distributed 40 American Geological Institute (AGI) toolkits to Champaign County middle schools for use by their science teachers. The packets contained an earth science calendar filled with activities and important geoscientific dates; fact sheets from the U.S. Geological Survey; a DVD on the national parks from the National Parks Service; illustrative materials from NASA; information about the new Smithsonian Institution interactive Web site for teachers; and posters from a variety of agencies. Information was included about the ISGS and its programs, upcoming ISGS geological science field trips, and the spring ISGS open house. Multiple packets were requested by Champaign (20), Urbana (6), Mahomet (5), and Fisher (2) schools; single packets were mailed to schools in Tolono, Heritage, Rantoul, St. Joseph, and Prairieview-Ogden (Thomasboro). The teachers and their schools were thrilled to receive these high-quality materials for use in their classrooms.

## Public Attends ISGS Open House

The Illinois State Geological Survey held its Second Annual Open House, March 9 and 10, 2007. An estimated 2,000 people came to the Natural Resources Building in Champaign to learn about the Survey's research and service activities. Staff members presented more than 30 exhibits and interactive activities, including digging for fossils at the "Kids' Fossil Dig," "Rocks, Minerals, Fossils, and Dinosaurs," "Fun with Liquids, Gases and Solids," The Wonders of Carbon Dioxide," and "Illinois from Space." Invited exhibitors included the Illinois Petroleum Resource Board's traveling exhibit van displaying information about the oil and gas industry in Illinois and "Cave Rave," a walk-in cave exhibit created by the graduate students of the University of Illinois Geology Department. Friday's visitors included more than 800 students and teachers from as far away as Charleston. Families


*Explaining glacial structure and movement (above) and how a magnetometer can be used to locate buried utility lines (right) at the 2007 ISGS Open House.*

were prominent attendees among the steady flow of Saturday's visitors. The ISGS Open House event was held concurrently with open houses hosted by the **University of Illinois' College of Agricultural Consumer and Environmental Sciences** and the **College of Engineering.**

## Illinois State Fair

A full set of 80 county coal mine maps, which are part of the Illinois State Geological Survey County Coal Map Series, were compiled, printed, and given to the **Office of Mines and Minerals** for display at the Illinois State Fair. These maps (1:100,000 scale) display known underground and surface mines and include the most up-to-date mined-out areas for active mines. The mines were a feature at the Office of Mines and Minerals booth where visitors could check their own property for the presence of mines.

Several ISGS staff members volunteered to work at the ISGS Exhibit and Kids' Fossil Dig at the Illinois State Fair in Springfield, August 10–19, 2007. The children had a lot of fun digging for an Illinois fossil, and the fossil display helped them identify their newly uncovered finds. Kids could then take their fossil home to start or build a collection. Adults and older children had the opportunity to browse the specially selected map products, posters, and publications available for viewing. Survey staff were on hand in the Discovery Park tent in Conservation World from 9:30 a.m. to 7:00 p.m. each day to talk with the public and answer questions.

## ISGS Scientists Provide Fossil Dig Materials to Argyle Lake State Park

ISGS staff provided fossils, posters, and literature to the natural resources coordinator for **Argyle Lake State Park,** near Macomb, Illinois. The materials will be used to construct a small-scale fossil dig at the park's visitor center. The visitor center features numerous hands-on displays, such as a track table, touch box, and animal pelts. The fossil dig materials provided by the Survey will give visitors to the park an additional opportunity for hands-on science learning.

## Geologic Mapping Efforts Contribute to Local Education about Glacial Geology and Groundwater Resources

As part of an ongoing geologic mapping effort in Lake County, three ISGS geologists and the ISGS drilling crew drilled a borehole and installed a water-level observation well at the Village of Deer Park, Vehe Farm Park. The geologic mapping has been funded by **Central Great Lakes Geologic Mapping Coalition (CGLGMC)** and the **STATEMAP component of the National Cooperative Geologic Mapping Program.** Subsurface exploration provides critical information for three-dimensional visualization of the glacial deposits and characterization of physical properties that affect groundwater flow. The observation well has been added to a regional network of wells ISGS geologists are monitoring on a quarterly basis to study long-term water levels in this part of northeastern Illinois.

*Installing a water-level observation well at Deer Park.*

In addition, the Survey is cooperating with the village administrators and the Vehe Farm Foundation to develop educational displays and exhibits about the glacial geology and history and their relationship to local ecology and groundwater resources. The park includes a restored historic barn that will be used as a village meeting space and education center. It is expected to have a high volume of visitors, including local earth science school field trips. The ISGS photographer videorecorded the complete sequence of drilling the borehole, retrieving and describing the core, completing the downhole geophysical logging, and installing the water level observation well. The video capture will contribute to the educational exhibits. Some of the sediment samples and solid core of the local bedrock will also be contributed to the exhibits.

## Several Energy Outreach Activities Completed

A professional development workshop for teachers was conducted in conjunction with the **Rock Island Regional Office of Education (ROE)** on June 14–15, 2007. The two-day workshop focused on Illinois Basin geology, energy resources, and carbon sequestration. Twenty-five teachers were in attendance, and each teacher received a set of sequestration posters. Further, the ROE science representative and ISGS staff discussed creating an upper-level professional development workshop for teachers on climate change and carbon sequestration for summer 2008.

A one-day workshop on Illinois Basin geology and geological sequestration for the **Professional Development Institute (PDI)** was presented in Decatur, Illinois, on June 26, 2007. Fifteen teachers attended the workshop and received sets of sequestration posters. PDI is a foundation dedicated to providing professional development opportunities for the **Decatur Public School System.** Further, the PDI representative and ISGS staff discussed the future creation of an advisory board to plan Phase III educational outreach and professional development programs for the Decatur Public Schools.

Four ISGS staff members assisted the **Illinois Department of Commerce and Economic Opportunity Office of Coal Development** at its 2007 Coal Education Conference, June 19–21, giving conference presentations and helping to lead tours of coal mines in southern Illinois. Approximately 100

teachers, from grade school through high school levels, attended the four-day conference to learn about coal and obtain continuing education credits by incorporating coal-based lessons into their teaching plans. ISGS staff presented talks to the teachers on coal formation, Illinois Basin stratigraphy and mapping, coal bed methane, and carbon sequestration and provided posters, maps, demonstrations, and other visual aids. Staff also helped lead tours and answer questions during visits to surface and underground coal mines and coal-fueled power plants in southern Illinois.

## Earthquake Awareness Week

As part of Missouri's Earthquake Awareness Week, an engineering geologist participated in booth displays at the **St. Louis Science Center** presenting posters and information to children about what to do during an earthquake. Also presented were pictures and information on damage in St. Louis from the largest earthquake in the central United States occurring during the last century. That earthquake occurred in southeastern Illinois, 110 miles east of St. Louis. The ISGS engineering geologist was also one of three speakers at the annual presentation to the public on the Greater St. Louis Urban Hazard Mapping Project. This project covers parts of both Missouri and Illinois. The **University of Missouri-Rolla, U.S. Geological Survey, Missouri Geological Survey,** and Illinois State Geological Survey are mapping the materials resting on top of the bedrock and measuring properties of these materials that indicate how they will amplify earthquake ground motions. The resulting maps can be used in earthquake loss estimation computer programs to estimate the amount of damage the area can expect from various magnitude earthquakes located in various areas in relation to the metropolitan area. This information can be used by federal and state emergency managers for preparation and running exercises, city and regional planners, and business contingency planners.

## Oceanography Debuts in Science Olympiad

The 2007 Science Olympiad Regional Competition for high school and middle school science students was held at Urbana Middle School on Saturday, February 3, 2007. The competition included a session on oceanography for which the ISGS coastal geologist was an event supervisor. Although all the participating students were from east-central Illinois, the national inclusion of an oceanography event in the 2007 Olympiad allowed these students to demonstrate their knowledge concerning tides, waves, and currents, ocean floor dynamics, and the chemistry of sea water. A total of eight Division B (middle school) and three Division C (high school) two-member teams participated in the oceanography competition.

## Coastal Geologist Explains History of Chicago River to Chicago High School Students

The **Friends of the Chicago River** hosted the 2007 Chicago River Student Congress on Saturday, February 3, 2007, at Amundsen High School in Chicago. This annual congress brings over 1,000 Chicago high school science students to this half-day event of workshops, displays, and presentations to learn about the science and management of the Chicago River. An Illinois State Geological Survey coastal geologist provided workshops on the geologic history of the Chicago River. The theme for this tenth annual Student Congress was "Fight for Your Right for Clean Water!"

*Chicago River, Chicago, Illinois.*

## Celebrating the 100th Anniversary of a Shoreline Vision

On June 6 and 7, 2007, the president and representatives of the Executive Board of the **American Shore and Beach Preservation Association (ASBPA)** were in Chicago to visit prospective hotel sites and field trip venues for the October 2008 Annual Meeting of ASBPA, which will be co-hosted by the Illinois State Geological Survey. This meeting will be held on the eve of the 100th anniversary year for the 1909 publication of the historic ***Plan of Chicago*** authored by architects and planners Daniel H. Burnham (1846–1912) and Edward H. Bennett (1874–1954). This historic publication, commonly known as the Burnham Plan, is largely responsible for the park-dominated Chicago lakefront that we know today. The Burnham Plan provided a vision for Chicago to build what is now considered a world-class urban shoreline. The 2008 meeting of the ASBPA will bring together in Chicago coastal managers, engineers, and geologists for the kick-off event for the commemoration of the 100th anniversary of Plan of Chicago. The meeting will include Chicago lakefront field trips hosted by the ISGS Engineering and Coastal Geology Section.

## Developing a Master Plan for the Evanston Lakefront

During winter 2006–2007, the **City of Evanston** completed the ***Evanston Lakefront Vision,*** a framework document outlining the community visions, goals, and objectives for the future of the Evanston shore along Lake Michigan. In July 2007, Evanston took the next step toward developing a master lakefront plan. An open house for stakeholders was held on July 27 at the Evanston Civic Center to refine further the concepts for this lakefront plan. An Illinois State Geological Survey coastal geologist participated in the open house, providing technical information related to erosion management and opportunities for park land construction along the Evanston shoreline. The next phase of this planning effort will be three public workshops to present and discuss alternative approaches for the master plan.

With the assistance of the Illinois State Geological Survey, an element of the existing Evanston lakeshore that is being discussed is a means to eliminate the functional but "aesthetically challenged" rubble-mound revetments that protect the park land of the Evanston lakeshore from wave attack. These structures have high crest elevations and block views to the lake from the lakeshore parks. Construction of submerged reefs, offshore breakwaters, and even offshore islands are being considered as means to retire the rubble-mound revetments that have served for well over a half century.

# Active Projects

## Office of the Chief

### *Three-dimensional Mapping Programs*

A Ground-penetrating Radar Assessment of Buried Infrastructure along the Beachfront at Illinois Beach State Park North Unit Phase I Scoping and Testing. T. Larson.

Friends of the Pleistocene Field Excursion and Guidebook. R. Berg, D. McKay, C. Nimz.

Geophysical Characterization of Crystal Lake Basin and Margins. T. Larson.

Hard-Rock Dike Detection in Southern Illinois Using Seismic Reflection Surveys. T. Larson.

Height Modernization. B. Herzog, D. Luman, C. Stohr, R. Krumm, S. Wald, A. Eller (IDOT).

Illinois from above and at the Ground Level: Images of the Great Depression and New Deal Era. D. Luman, J. Dexter, D. Lund, T. Bassett (UI Department of Geography).

Surficial Geological Mapping of the Henry Quadrangle, Marshall and Putnam Counties. R. Berg, D. McKay.

Three-dimensional Geological Mapping along the Middle Illinois River Valley. R. Berg, D. McKay, D. Keefer, J. Carrell, J. Domier, C. Nimz.

Three-dimensional Space Portrait of Illinois. D. Luman, C. Stohr, C. Nimz.

USGS State Assistance Grant for Facilitating Statewide GIS Coordination. D. Luman and S. Silch (USGS).

### *Geoscience Outreach*

2007–2008 Public Geological Science Field Trips. W. Frankie, R. Jacobson, A. Stumpf, D. Mikulic, M. Knapp, C. Nimz, S. Cromwell.

### *Publishing, Design, and Photography*

Chicago Festival of Maps Exhibit. C. Nimz, R. Berg, B. Herzog, C. Briedis, P. Carrillo, D. Luman, M. Barnhardt, M. Chrzastowski, R. Bauer.

ISGS Open House, 2008. C. Briedis, M. Knapp, P. Carrillo, C. Abert, R. Bauer, S. Denhart, B. Frahm, W. Frankie, K. Henry, J. Jach, D. Keefer, E. Plankell, W. Roy, J. Thomason, S. Wald, B. Vaiden, T. Vaughn, T. Young, C. Nimz.

Production of Geology of Illinois. C. Nimz, C. Briedis, D. Byers, P. Carrillo, J. Hines, M. Knapp, J. Dexter, D. Kolata, J. McBride, D. Mikulic, J. Devera, J. Nelson, D. McKay, B. Curry, K. Hackley, H. Wang, S. Panno, G. Dreher, W. Roy, B. Seyler, B. Huff, Z. Lasemi, D. Larson, B. Herzog, R. Berg, M. Barnhardt, W.-J. Su, M. Chrzastowski, R. Cahill, P. Weibel, R. Bauer, W. Shilts.

# Energy and Earth Resources Center

An Assessment of Geological Carbon Sequestration Options in the Illinois Basin, Phase II. R. Finley, S. Frailey, H. Leetaru, M. Rostam-Abadi, A. Anderson, R. Bauer, C. Blakley, D. Byers, S. Chen, J. Chou, J. Damico, D. Ekberg, D. Garner, J. Goodwin, J. Grube, S. Greenberg, K. Hackley, J. Hines, B. Huff, A. Iranmanesh, D. Keefer, R. Knepp, C. Korose, I. Krapac, T. Larson, D. Luman, E. Mehnert, D. Morse, W. Roy, G. Salmon, B. Seyler, C. Stohr, H. Wang, B. Wimmer, T. Young, A. Huber, S. Denhart, R. Krumm, A. Lecouris, D. Nelson, D. Thurston, A. Bernard, P. Cookus, B. Renfrew, J. Aud, M. Dodd, M. Thompson, S. Wildman, C. Wilson.

## *Bedrock Geology*

Assessment of a Geophysical Coal Exploration Method in a Faulted Terrane. B. Denny.

Geology of the Elsah, Grafton, and Alton 7.5-minute Quadrangles. B. Denny, J. Devera, D. Grimley, Z. Lasemi, E. Smith, J. Domier.

Illinois 2006 STATEMAP Geologic Mapping Proposal (Murphysboro, Pomona, and Cypress Quadrangles). J. Devera, B. Denny, J. Nelson, R. Jacobson, M. Seid, J. Aud.

Illinois 2007 STATEMAP Geologic Mapping/Bedrock Geology of Southern Illinois. J. Devera, M. Seid, B. Denny, J. Aud, J. Domier.

## *Coal*

Cleat and Other Fracture Developments in Illinois Coals. D. Morse, K. Hughes, R. Bauer.

Geologic Map of Cache and Cairo Quadrangles. J. Nelson.

Geologic Map of Millstadt Quadrangle (Revised). J. Nelson.

Geologic Mapping (Bedrock and Surficial) of Williamson County. J. Nelson.

History of Coal Mining in Illinois: A Pictorial Review. C. Chenoweth, C. Nimz, J. Hines, P. Carrillo.

Illinois Basin Coal Correlation Project. S. Elrick, D. Morse, A. Louchios, C. Korose, J. Obrad, C. Chenoweth.

Interactive Map Services for Coal Mined Areas and Resource Data. C. Korose, S. Elrick, A. Myers, A. Louchios, S. Beaverson, A. Lecouris.

Maintenance of Coal Resources and Mine Data, Office of Mines and Minerals. S. Elrick, A. Louchios, C. Korose, D. Morse.

Making Fired Bricks with Spent Equilibrium Catalyst: A Technical Feasibility Study. M. Chou, J. Chou, L. Chen, Y. Lai.

Management of Illinois Coal Resources Data FY2005 to FY2010: Contributions to National Coal Resources Data System (NCRDS). S. Elrick, A. Louchios.

Manufacturing Fired Bricks with Class F Fly Ash from Illinois Basin Coals. M. Chou, J. Chou, L. Chen, J. Stucki (UI).

Paleobotany of Roof Shales of Coal Seams in the Illinois Basin. J. Nelson, S. Elrick.

Preparation of 7.5-minute Quadrangle Maps and Directories of Mined Areas in the Taylorville, Kincaid, Stonington, Willeys, Pawnee, Edinburg, New City, Wenona, Humrick, and Thompsonville Quadrangles; La Salle, Marseilles, Ottawa, Starved Rock, Seneca, Tonica, Minonk and Pontiac Northwest Quadrangles, La Salle, Grundy, Marshall; 7.5-minute Quadrangle Coal Mined-Out Area Studies. C. Chenoweth, J. Obrad, A. Myers.

Production and Testing for Coal Bed Methane in Illinois. D. Morse, S. Elrick, A. Anderson, S. Frailey.

## Energy and Environmental Engineering

Design and Development of a New Flotation Machine. L. Khan.

Economic Evaluation of Illinois Coal and Western Powder River Basin Coal under Different Pollution Control Scenarios. S. Chen, Y. Lu, J. Loftus (UI), M. Rostam-Abadi.

Life Cycle Assessment of Mercury in Illinois Coals. V. Patel.

Studies of Mercury Sorbents. M. Rostam-Abadi, Y. Lu, X. Chen, S. Dastgheib.

System Analysis of Water Usage in Coal-Based Power Generation Plants. M. Rostam-Abadi, S. Dastgheib, Y. Lu, S. Chen.

## Geochemistry

Antibiotic Resistance Genes and Residues in Water and Soil in Close Proximity to Swine Production Facilities. I. Krapac, W. Dey, J. Chou, W. Roy, R. Mackie (UIUC), J. Chee-Sanford (USDA), Y. Lin (ISWS).

Feasibility Studies of IGCC Slag for Manufacturing Fired Bricks. J. Chou, M. Chou, L. Chen.

Field Testing of a Mobile ISGS Intelligent Filter Press. W. Roy, L. Khan.

Organic Compounds in Sediments from the Grand Calumet River, Lake Michigan to Lake George. G. Salmon, R. Cahill.

Sediment Quality and Sedimentation Rates in Backwater Lakes along the Illinois River. R. Cahill, G. Salmon.

Unified Geochemistry Database Development-Implementation. G. Salmon.

## Industrial Minerals and Resource Economics

Geology of the Bedrock Aggregate Industry of Northern Illinois. D. Mikulic.

Limestone Fines—An Economically Viable Source of Sorbents for Desulfurization? Z. Lasemi, D. Mikulic, M. Rostam-Abadi.

Mapping the Availability of Aggregate Resources of Ogle County. Z. Lasemi, D. Mikulic, X. Miao.

Sand and Gravel from Ridged Drift along the Kaskaskia River. X. Miao.

Sand Dunes in the Green River Lowland. X. Miao, D. McKay, H. Wang.

Silurian Geology of West-Central Illinois. D. Mikulic, R. Norby.

Subsurface Silurian Lithostratigraphy of Northeastern Illinois. D. Mikulic.

Web-based Directory of the Illinois Industrial Mineral Producers and Maps of Extraction Sites. Z. Lasemi, L. Smith, A. Lecouris, D. Mikulic, X. Miao.

### Oil and Gas

Annual Compilation and Report of Illinois Oilfield Statistics. B. Huff.

A Systems Approach to Identifying Exploration and Development Opportunities in the Illinois Basin: Digital Portfolios of Plays in Underexplored Lower Paleozoic Rocks/Statewide Contoured Structure Maps of Major Paleozoic Horizons in Illinois. B. Seyler, P. Johanek, J. Crockett, J. Grube, B. Huff.

Characterization and Regional Analysis of Cypress and Pennsylvanian Sandstone Reservoirs. B. Seyler, J. Grube, B. Huff.

Digital Archiving and Internet Access to Geological Records at the Illinois State Geological Survey on the ILOIL Web site. B. Seyler, B. Lemke, B. Huff.

Digital Portfolio of Plays in Underexplored Lower Paleozoic Rocks. B. Seyler, J. Crockett, B. Huff, J. Grube, Z. Lasemi, S. Frailey, S. Beaverson, H. Leetaru, D. Harris (Kentucky Geological Survey), B. Keith (Indiana Geological Survey), R. Krumm, A. Lecouris, P. Johanek, D. Ekberg, Z. Khorasgani.

Electronic Waterflood Data Collection. B. Huff, B. Seyler, P. Johanek, D. Nelson, S. Denhart.

Geographic Information Systems Approach for Play Portfolios in the Illinois Basin. B. Seyler, P. Johanek, S. Beaverson, C. Korose.

New Albany Shale Digital Data Access. J. Crockett, B. Huff, B. Seyler, D. Ekberg.

Petroleum Technology Transfer Council (PTTC). B. Seyler, D. Ekberg, B. Huff, J. Crockett, J. Grube, P. Johanek.

## Geologic Mapping and Hydrogeology Center

Northeastern Illinois Water Supply Planning Support. D. Keefer, D. Larson, S. Brown, B. Curry, J. Thomason, E. Mehnert, E. Smith, B. Vaiden, H. Wang.

### Engineering and Coastal Geology

CUSEC State Geologists Mapping Efforts in Midwest and USGS Urban Hazard Mapping Areas. R. Bauer, W.-J. Su.

Illinois Coastal Management Program/Planning and Development. M. Chrzastowski.

Methodology for Seismic Microzonation in the Metro-East St. Louis Area Using GIS, Database, and Shake2000. W.-J. Su, R. Bauer, K. Kukielka.

Statewide Seismic Risk and Vulnerability Study. R. Bauer, W.-J. Su.

### Geospatial Analysis and Modeling

Digital Bedrock Surface Map. C. Abert, P. Weibel.

Upgrade ArcSDE and ArcIMS Servers to ArcGIS Server 9.9. D. Nelson, S. Beaverson, D. Thurston, S. Denhart, A. Lecouris, C. Korose.

USGS-Funded Expansion of the Illinois NSDI Clearinghouse Node. S. Beaverson, R. Krumm, D. Nelson.

## Hydrogeology

Development and Presentation of a Workshop for Kane County, Illinois. W. Dey, C. Nimz, R. Vaiden, S. Greenberg, D. Byers, P. Carrillo.

Estimation of Groundwater Recharge in Northeastern Illinois/Year 4. E. Mehnert, T. Kemmis (EarthTech), D. Kelleher (EarthTech), P. Kesich (Fermi).

Evaluation of Analytical Element Groundwater Flow Modeling to Improve Geologic Mapping/Year 4. E. Mehnert, W. Dey, G. Roadcap (ISWS), J. Singh (ISWS), D. Song (USGS).

Groundwater Flow Models. R. Vaiden, S. Greenberg.

Hydrogeologic Assessment of Brine Discharge from Illinois Basin Aquifers to Shallow Groundwater or Surface Water/Year 2. E. Mehnert, S. Frailey, S. Panno.

Hydrogeologic Characterization and Analysis for Lake County. D. Larson.

Hydrogeologic Information Brochure. R. Rice, D. Larson, D. Byers, C. Nimz.

Hydrogeologic Mapping for Kendall County. E. Smith, D. Larson, R. Vaiden, B. Curry, J. Devera, T. Larson, A. Ismail, T. Young, C. Blakley, D. Mikulic.

Mapping Mahomet Aquifer below Champaign County. W. Dey, D. Larson, A. Stumpf, S. Brown, A. Phillips, A. Ismail, S. Sargent, T. Young, C. Blakley.

Redesign of Hydrogeology Section Web Site. D. Larson, R. Rice, S. Denhart.

Regional Groundwater Assessment: Metro East Region. E. Smith.

Water Resource Investigation for Kane County, Illinois. W. Dey, B. Curry, C. Abert, D. Keefer, A. Davis, J. Domier, D. Byers, C. Nimz, P. Carrillo, S. Meyer (ISWS), D. Walker (ISWS).

## Information Technology

GIS Database Development. D. Nelson, J. Domier, J. Carrell, S. Beaverson, S. Denhart.

Web Site Redesign and Reorganization. S. Denhart, C. Briedis, C. Nimz, J. Hines, P. Carrillo, R. White.

## Isotope Geochemistry

A Long Loess Record in Southern Illinois: Five Interglacial, Two Relatively Strong Interstadial Paleosols, and Five Loess Units. H. Wang, X. Miao, B. Curry.

Application of Nitrogen and Oxygen Isotopes of Nitrate to Identify the Sources and the Degree of Denitrification of Nitrate Levels in Illinois Groundwater. K. Hackley, E. Hwang, P. Carrillo, G. Roadcap (ISGS), T. Johnson (UI).

Calcified Rootlets and the Significance to Terrestrial Climate and Environment Changes in Illinois during the Last Glaciation. H. Wang.

Carbon Sequestration Educational Initiative: Supporting the Governor's Energy Plan and FutureGen by Making Sequestraiton Science Easy to Understand. S. Greenberg, D. Byers, M. Dodd.

Dating of Cave Sediments and Speleothems. S. Panno, B. Curry, K. Hackley, C. Lundstom (UI).

Determination of the Dominant Sources of Nitrate in Wells and Springs of the Sinkhole Plain Using Nitrogen and Oxygen Isotopes. K. Hackley, S. Panno, E. Hwang, W. Kelly (ISWS), P. Carrillo, M. Zulauf, C. Nimz, J. Hines.

Effects of Land Application of Untreated and Treated Swine Slurry on Crop Production and Subsurface Water Quality. K. Hackley, S. Panno, E. Hwang, W. Kelly (ISWS).

Effects of Urban Growth on Groundwater Quality in McHenry County Based on Chemical and Isotopic Assessment. E. Hwang, K. Hackley, S. Panno.

Hydrogeochemistry of Illinois. S. Panno, K. Hackley.

Improvement of Carbon-14 Dating Methods for Buried Charcoal and Bone Samples. H. Wang, S. Ambrose (UI).

Investigation of the Groundwater Evolution in the Mahomet Valley Aquifer Using Geochemical Techniques. K. Hackley, S. Panno, P. Carrillo.

Preparation of Laboratory Manual for Nitrate Isotope Analytical Procedure. E. Hwang.

Sinkhole Density, Bedrock Topography, Water Table, and Drift and Loess Thickness Maps of the Columbia, Waterloo, and Renault Quadrangles. S. Panno, B. Stiff, J. Domier, P. Carrillo, C. Nimz.

Sources of Nitrate in the Illinois River. S. Panno, K. Hackley, W. Kelly (ISWS), E. Hwang.

## *Quaternary Geology*

Clay Mineral Database. M. Killey, H. Glass.

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