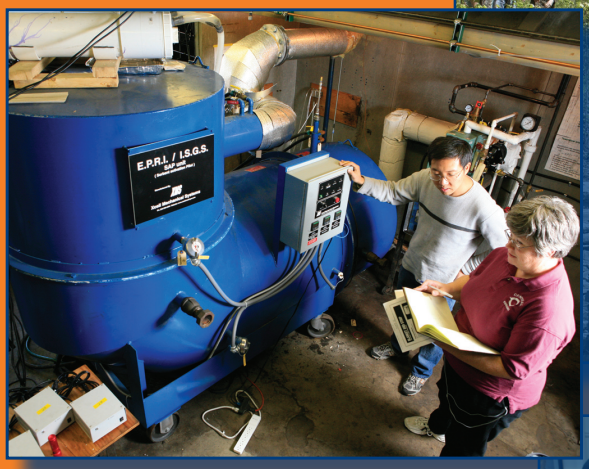
Traditions in Transition

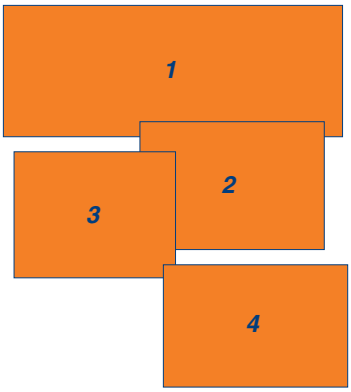


Annual Report 2008

ILLINOIS
UNIVERSITY OF ILLINOIS AT URBANA-CHAMPAIGN

Institute of Natural Resource Sustainability
ILLINOIS STATE GEOLOGICAL SURVEY

Cover photography: *(1) Mahomet aquifer drill site north of Ludlow. Photograph from Al Wehrmann, Illinois State Water Survey. (2) Horseshoe Lake field trip participants at Orchard Creek, Rock Springs Hollow Section, examining exposures of Upper Ordovician age Girardeau Limestone. Photograph by Michael Knapp. (3) Xu Chen and Kathy Henry at the ISGS Applied Research Lab with the transportable bench sorbent activation process (SAP) unit, a patented technology developed at the ISGS. Photograph by Joel Dexter. (4) Bob Vaiden's Build Illinois exhibit is a major draw at the 2008 ISGS Open House. Photograph by Joel Dexter.*



Acknowledgments

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Traditions in Transition

Annual Report 2008

Institute of Natural Resource Sustainability
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Traditions in Transition

Just three years into its second century, the Illinois State Geological Survey (ISGS) has been swept up in a major change in the administrative structure of taxpayer-supported science done in public service to Illinois. After having been part of state government for 103 years, the ISGS and the other Illinois scientific surveys (Illinois Natural History Survey, Illinois State Water Survey, and the Waste Management and Research Center) were merged with the University of Illinois at Urbana-Champaign on July 1, 2008. At 5:30 p.m. on June 30, Governor Blagojevich signed legislation authorizing the transfer effective at midnight that same night. Thus, the Surveys left their home of the past 13 years, the Illinois Department of Natural Resources, and began a major transition.

Four months have passed, and, at this juncture, it is clear that the change is the most significant since the Illinois scientific surveys were organized under a single Board of Natural Resources and Conservation (BNRC) in 1917. Without changing physical location, the Surveys have become divisions of a newly formed University of Illinois Institute of Natural Resource Sustainability (INRS). Former ISGS Chief Bill Shilts is the Institute's founding Executive Director, and he reports to Interim Vice Chancellor for Research, Ravi Iyer. We all report to the University Board of Trustees. Thus placed appropriately within the University structure and having the strong support of senior University leadership, the Surveys are poised to continue our work, to grow, to thrive, and to enhance the University mission.

Merger of the Surveys with the University of Illinois has happened at a time when transitions are under way globally, politically, and economically. Crises are raising questions about our collective future. From local to global scales, uncertainty about the future of water and energy supplies, the pace and impacts of climate change, the availability and suitability of land and mineral resources to meet societal needs, the maintenance and expansion of our infrastructure, and the health of the world economy and ecosystems has reached new levels of urgency. So it is particularly important now that the Surveys carry our knowledge, expertise, databases, and mission through our administrative transition intact and ready to be applied to important aspects of these global changes. It is up to us in the Geological Survey to help Illinois, and thereby the world, define and attain a sustainable future for our natural environment, resource and raw material needs, and energy and water supplies, while contributing to a healthy economy.

The move of the Surveys to the University is much more than administrative window dressing. The Surveys' locations, staffing, budgets, and responsibilities remain largely the same. Historic legislative mandates regarding the nature and mainly Illinois focus of our research and service are embedded in Survey tradition and were restated in the new authorizing legislation. Yet we have readily adapted to University governance, policies, and outlook, and those offer us options. We now feel closer to our University colleagues and they to us. Faculty and students approach us with the enthusiasm of a newly found friend. New and expanded research collaborations are under discussion, and some are beginning. We are rapidly shedding our image as an "allied agency" and becoming an integral element of the University community in perception and in reality.

Having entered into the university community of scholars and researchers, the Surveys will have opportunities for greater involvement in education. Student participation in Survey research, always an advantage of our campus location, will increase. There will be opportunities to increase our role in teaching. New opportunities to examine research questions and apply our knowledge in regional, national, or global contexts will be explored. Broader opportunities to attract external funding will open via avenues available to University entities.

Governance provided formerly by the Board of Natural Resources and Conservation (BNRC) has been replaced by the University Board of Trustees. The Institute will bring together a new advisory body, the Illinois Board of Natural Resource Sustainability (IBNRS). Plans are to retain the members of the former BNRC and to add state agency and University participants.

For its part, the University of Illinois took on a huge task in transferring nearly 600 Survey staff members into the University human resource and payroll systems. Despite the University's size, absorption of that many additional staff members was characterized as "a large chunk to swallow." The complex mechanics of the merger were wedged into a very short time span, but they went well. And, more than just smoothing the transfer, University staff members received us into the University community with positive, helpful, friendly, and collegial attitudes everywhere.

Throughout the transition, the Geological Survey staff has performed commendably, sustaining all of our research and service programs, many of which are highlighted in this document. In Decatur, Illinois, we continued to develop the world-watched test of CO_2 sequestration technology in collaboration with Archer Daniels Midland (ADM), the U.S. Department of Energy, the Illinois Department of Commerce and Economic Opportunity, and many others. Related efforts under way at several sites injected CO_2 into coal beds and into partially depleted oil reservoirs. Detailed geologic mapping in priority areas, largely in populous areas of northeastern and southwestern Illinois, is proceeding. Our staff members are publishing geologic maps at an unprecedented rate. Our support of the Illinois Department of Transportation's infrastructure expansion and upkeep is ongoing. Culmination of major efforts in support of Illinois' bid for FutureGen in December 2007 appeared to have been successful in bringing that commercial-scale, zero-emissions, coal-fired, power station with sequestration to Mattoon—until the project was delayed indefinitely by the federal government. Perhaps the final chapter of that story has not been written. State budget challenges threatened a significant program of applied research in support of water supply planning just as the Surveys entered the University. It has been gratifying that county and local governments and institutions stepped up on short notice to directly support the project with their funds. As of this date, the project continues in large part because of that support, for which we are grateful.

So it is that I can report here that the Geological Survey's transition into the University of Illinois is one that has honored our traditions, kept our mandates intact, and retained our name—Illinois State Geological Survey—a significant point of pride for us. We retained our staff, facilities, responsibilities, strong sense of purpose, and most of our budget. Thus, the traditions of ISGS research and service for the benefit of the people of Illinois, discharged ably for the past 103 years, have not only survived the transition but also have remained our highest and most urgent objectives. At the same time, we gained flexibility that we will use to explore opportunities, to expand our traditional role, to develop new research, and to venture into new areas.

We are still in transition in the sense the Survey has always been in transition, changing as we ask ourselves basic questions. How can we expand our service to Illinois? How can we increase our collabo-

rations with faculty, students, and other researchers and Surveys? What new research capabilities and applied programs should be developed to meet coming needs? How can the ISGS and the INRS in partnership with our Survey and University colleagues make major contributions in the application of the geological sciences to the benefit of Illinois and beyond? These are large questions that our new situation allows us to pursue with renewed enthusiasm.

–E. Donald McKay III
Interim Director

Awards and Honors

ISGS Honors Awarded

Eleven individuals and one company were honored at the 2007 Illinois State Geological Survey awards program, held December 7, 2007. The awards were presented by ISGS Chief Bill Shilts in recognition of the outstanding contributions of these individuals and companies for the benefit of the people of Illinois. The awards and their recipients are listed here.

Outstanding Cooperator

Gallagher Drilling Company was honored in appreciation of its engineering, geological, and field logistical support as lead operator in the CO_2 Injection into Coal Demonstration Project.

ISGS Coal Section Head David Morse accepts Outstanding Cooperator Award for the Gallagher Drilling Company.

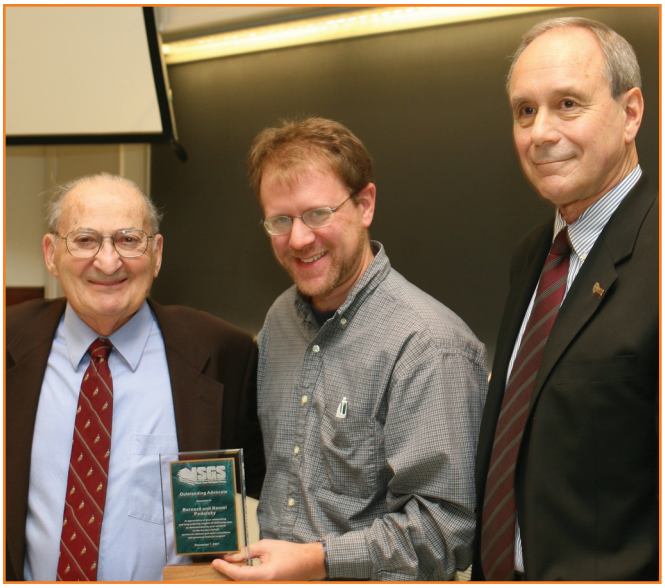
David L. Gross, the first recipient of the Outstanding Alumni Contributions Award, in the company of Scott Elrick and Chief Bill Shilts.

Outstanding Alumni Contributions

David L. Gross was named the first recipient of this new award in appreciation of his post-retirement dedication to the ISGS through his contributions to the Centennial celebration, service on the Board of Natural Resources and Conservation, advocacy with elected officials, and generous financial contributions.

Outstanding Advocate

Bernard and Naomi Podolsky were recognized in appreciation of their outstanding and long-enduring support of ISGS programs, as demonstrated by their contacts on the Survey's behalf, service on national and state committees, and generous financial support.



Bernard Podolsky receives the Outstanding Advocate Award from Scott Elrick and Chief Bill Shilts.

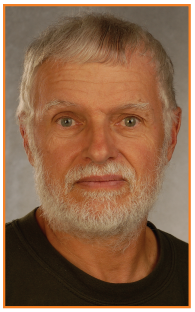
Distinguished Achievement Award

Debra A. Griest

Debra A. Griest was recognized for her outstanding leadership and counsel in finance and human resources, especially during difficult financial times.

Lifetime Achievement Award

W. John Nelson was honored for his nearly thirty-five years of outstanding research on bedrock, coal, and structural geology.



W. John Nelson

Outstanding Contribution to Survey Health and Safety

Richard A. Cahill

Richard A. Cahill was honored for his contributions to the ISGS Safety Committee, especially his chemical inventory and disposal efforts.

Brent E. Lemke and Alison B. Lecouris hold the Special Achievement by a Team Awards they received from Chief Bill Shilts. Daniel O. Nelson, the third member of the team, was not present for the photograph.

Special Achievement by a Team

The NAD83 Conversion Team, **Daniel O. Nelson, Alison B. Lecouris,** and **Brent E. Lemke,** were recognized for their outstanding contributions in converting ISGS data from the Lambert projection to the North American Datum of 1983.

Outstanding New Staff Member

Two new staff members were honored this year. **Yongqi Lu** was recognized for his outstanding contributions to the ISGS through the development of innovative technologies for air pollutant control, such as mercury and CO_2 emissions, from coal-fired power plants.

Yongqi Lu

Jason F. Thomason

Jason F. Thomason was honored for his outstanding contributions to three-dimensional mapping of the glacial lithostratigraphy for the Great Lakes Geological Mapping Coalition in northeastern Illinois.

Staff Recognition

Map Posters Reach Wide Audience

At the request of ESRI co-founder and president J. Dangermond, Illinois State Geological Survey geologist **Barbara J. Stiff** provided a digital copy of a poster showing the use of ESRI products. The poster was originally presented at the 2005 Geological Society of America workshop, Three-dimensional Geological Mapping for Groundwater Applications, during the 2005 ESRI International Users Conference. Stiff was contacted because one of her two award-winning posters (ESRI best poster award) was on display at the ESRI Redlands headquarters. Several of Stiff's posters and maps have been submitted to the Library of Congress as part of the ESRI archive, including the poster featuring the stacked sequence of Illinois maps that became part of ISGS Illinois Map 10.

Barbara J. Stiff

Master's Degree Earned

Congratulations are extended to **Geoffrey E. Pociask** of the Illinois State Geological Survey Wetlands Geology Section on the completion of his master of science degree in geography from the University of Illinois at Urbana-Champaign. Pociask's thesis is titled "An Evaluation of Bendway Weirs: Effects on Stream Channel Migration and Cross-sectional Geometry."

Geoffrey E. Pociask

Completing Terms in Professional Associations

Beverly L. Herzog completed her two-year term as Chair of the Association of Ground Water Scientists and Engineers (AGWSE) and Vice President of the National Ground Water Association (NGWA) at the Ground Water Expo in Orlando, Florida, on December 6, 2007. NGWA has more than 14,000 members, most from North America, and AGWSE is its largest division, with more than 9,000 members. In addition to the AGWSE and NGWA boards, Herzog served on the board of the National Ground Water Research and Education Foundation and more than 15 committees or work groups, several of which she chaired. Past Chair AGWSE Vicki Kretsinger noted that ". . . Bev has been instrumental in the step-by-step approaches taken to build relationships that are leading to more specific requests for financial support to accomplish nationwide monitoring and groundwater resources evaluation goals. We have continued to persuade congressional staff members of the importance of groundwater . . . . The AGWSE Board greatly appreciates her tireless efforts and continued contributions as a Board member, then Secretary, and Chair."

Beverly L. Herzog receives a plaque from Vicki Kretsinger, Past Chair of the Association of Ground Water Scientists and Engineers (AGWSE). Herzog was recognized for her service to the National Ground Water Association (NGWA) and the AGWSE.

In the News

Several ISGS research project areas made headlines this past year, including stories about water supply, the April 2008 earthquake in southern Illinois, carbon capture and sequestration, karst terrane in Jo Daviess County's dairyland, and earth science education. *Discover Magazine* called the discovery of the fossilized rain forest near Danville one of the top 100 science stories of 2007. An important recent story was the administrative move of the ISGS and its three sister agencies from the Illinois Department of Natural Resources to the Institute of Natural Resource Sustainability at the University of Illinois at Urbana-Champaign.

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Sequestration Potential of Mt. Simon Sandstone

Illinois is eminently qualified for the development of clean coal technologies. The state's vast coal resources and an excellent potential sequestration resource, the Mt. Simon Sandstone, make the unique combination of clean-coal energy production and sequestration a viable opportunity for the future of coal energy in Illinois.

The sequestration potential of the Mt. Simon Sandstone continues to be studied through a $66.7 million contract from the **U.S. Department of Energy–National Energy Technology Laboratory (USDOE-NETL)** supplemented by co-funding from **Archer Daniels Midland Company** (ADM), **Schlumberger Carbon Services,** and other corporate and State resources.

ADM, Decatur, Illinois.

The **Midwest Geological Sequestration Consortium** (MGSC), ISGS, and ADM are working together on the Illinois Basin–Decatur carbon sequestration project, which will involve the capture and storage of carbon dioxide (CO_2) from ADM's ethanol plant in Decatur, Illinois. The project is designed to confirm the ability of the Mt. Simon Sandstone, a major regional saline reservoir in Illinois, to accept and store 1 million metric tonnes of CO_2 over a period of three years. Carbon dioxide from ADM's ethanol plant will be injected into a well drilled to depths exceeding 7,500 feet into the Mt. Simon Sandstone, where the compressed, liquid-like CO_2 will be stored in the pores of the rock formation, which is presently saturated with water that is several times saltier than sea water. The safety and effectiveness of the storage will be monitored by the MGSC through an extensive monitoring, mitigation, and verification (MMV) program.

The technical qualifications of the Decatur, Illinois, site include one of the best saline reservoirs for carbon sequestration in the Midwest, possibly even in the nation. The Mt. Simon Sandstone is a thick reservoir, has a good primary shale seal, and is overlain by two additional shale units that can act as backup seals. Scientists are confident in the site and are preparing to conduct a three-dimensional seismic survey to image the Mt. Simon reservoir to (1) understand the reservoir's structural configuration and (2) correlate its properties to data from an injection well to better understand the surrounding rock that will contain the carbon dioxide plume. This information will (3) serve as a baseline for future surveys defining the location of the CO_2 in detail. Such a survey is an essential step to ensure the safety and integrity of any specific geological carbon sequestration site and also to understand the regional configuration of the Mt. Simon.

This knowledge would benefit future biofuels and clean coal projects located in central Illinois as well. The Mt. Simon Sandstone is a major Illinois resource supporting development of integrated coal gasification and sequestration. The Illinois Basin contains abundant coal resources suitable for gasification, and the more that is understood about the Mt. Simon, the more assurance there will be that the need for carbon sequestration can be effectively addressed as those coal resources are being developed.

The ISGS has been a leader in geological carbon sequestration research since 2001 and has been researching Illinois Basin geology since the Survey's formal inception in 1905. The ISGS' extensive expertise in sequestration, Basin geology, environmental geology, reservoir geology, oil and gas, and coal geology positioned the Survey to win the USDOE-NETL contract and supported the State of Illinois' **Department of Commerce and Economic Opportunity** (DCEO) bid for FutureGen.

The Survey contribution to the FutureGen competition included more than 40 scientists and staff members who provided geological assessment, GIS data, public outreach, general information, and overall technical support for four of the project sites. The ISGS helped screen the 28 original preliminary sites to select the four sites proposed by Illinois, two of which were selected as semi-finalists (Mattoon and Tuscola). ISGS scientists modeled the projected carbon dioxide plume in the subsurface and conducted two-dimensional seismic surveys with interpretation for the selected sites. On December 17, 2007, the FutureGen Alliance selected Mattoon, Illinois, as the preferred site for the project. Although the project has been temporarily delayed, the ISGS continues to provide technical support for the preferred selected site at Mattoon, Illinois, including evaluation of new geophysical data.

Installing Wells for Groundwater Monitoring and Modeling

Significant progress was made at all three active carbon sequestration sites during 2008 as part of the **Midwest Geological Sequestration Consortium Project, Phase II.** At the coal bed site, the third coal monitor well and the carbon dioxide (CO_2) injection well in the Wabash County project were drilled, cored, logged, and cased. Springfield Coal core samples from the new monitor well were placed in desorption canisters to evaluate differences in methane gas content based on coal maceral type. Springfield Coal core from the injection well was preserved for use in a display. In June, the wells were perforated, coal permeability was measured with water

ISGS drilling and well installation at the ADM site for the monitoring, mitigation, and verification portion of the deep saline reservoir pilot program.

injection pressure transient tests, and all four wells were logged with Schlumberger's cased hole resistivity tool. The CO_2 injection began in late June with 8- to 24-hour pulses, followed by no injection for similar time periods, as pressure changes in all four wells were continuously monitored. More sustained injection/fall-off pulses followed. Water and gas samples were collected to monitor generated methane and then CO_2 buildup. Similar samples collected from the four groundwater monitoring wells showed no leaked methane or CO_2. As of late fall 2008, 70 tons of CO_2 have been injected.

Nine groundwater monitoring wells were installed at the **Archer Daniels Midland** plant, Decatur, Illinois. These wells are being used in the monitoring, mitigation, and verification (MMV) program for the deep saline reservoir pilot that is part of the Phase III CO_2 geologic sequestration program funded by the **U.S. Department of Energy–National Energy Technology Laboratory.** The monitoring wells provide groundwater quality data needed for compliance with the **Illinois Environmental Protection Agency** Underground Injection Control permit that will be issued to Archer Daniels Midland.

ISGS geochemists continue to model the groundwater and brine water quality data collected from the enhanced oil recovery huff-n-puff pilot located in the Loudon oil field near St. Elmo, Illinois, the third CO_2 sequestration site. The chemical composition of the brine samples has continued to become more acidic since the termination of CO_2 injection. The concentrations of iron, manganese, and potassium initially increased in brine samples collected from the CO_2 injection well and are now decreasing. The possible effect of sorption/desorption reactions on the fluid composition are being modeled. The effects of sorption reactions can play an important role in determining fluid composition and, because of the relatively rapid kinetics, are likely to be one of the first aspects of fluid chemistry affected by the introduction of CO_2. Sorption onto hematite, possibly available in the subsurface as a cement or grain coating, can be used to explain the decrease in sulfur and the increase in manganese concentration after the introduction of CO_2. The change in concentrations is a reflection of the decrease in pH caused by the dissolution of CO_2 in formation water. As the pH decreases, the type of ion that is preferentially sorbed on the hematite surface changes. There is also some dissolution of iron, but the predicted values need to increase more for the model to match the field data.

Sequestration Field Efforts Continue

Jennifer Lewicki from **Lawrence Berkeley National Laboratory** and Ivan Krapac from the ISGS installed an Eddy Covariance Tower at the Illinois Basin–Decatur site mid-August 2008. The tower contains a complete weather station to monitor vertical and horizontal wind speed and direction, temperature, relative humidity, solar and photosynthetic radiation, rain, and atmospheric carbon dioxide (CO_2) concentrations. Data collected from these instruments will allow monitoring of the CO_2 atmospheric flux downwind of the CO_2 injection well. This information will be used to monitor for potential CO_2 seepage at the site and is one of many techniques being used in the monitoring, mitigation, and verification (MMV) program. The MMV program will deploy various monitoring techniques to determine the location of the CO_2 plume in the injection reservoir. The monitoring is to determine whether there are impacts from injection activities on human health and the environment and to develop mitigation plans should unexpected results occur during the project.

ISGS geochemists Bracken Wimmer and Abbas Iranmanesh continue to collect groundwater and gas samples from the enhanced coal bed methane (ECBM) and oil recovery (EOR) pilot projects. These samples are used to monitor groundwater quality to determine whether CO_2 injection operations are affecting shallow groundwater quality. To date, the water quality data indicate that project activities have not had an impact on local water quality. Monitoring gas concentrations in project wells will determine the performance of the coal seam with respect to CO_2 injection.

Bedrock geologists Hannes Leetaru and John McBride (Brigham Young University) and Marcia L. Couëslan (Schlumberger Carbon Services) worked on developing geophysical parameters for acquiring new seismic reflection data at the Illinois Basin–Decatur site.

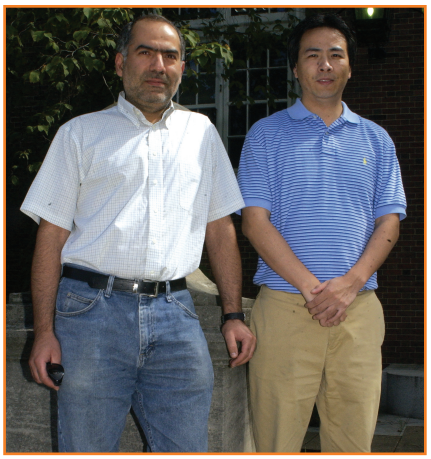
Capturing Carbon from Coal-Fired Power Plants

The **U.S. Department of Energy** (U.S. DOE) has selected the ISGS to develop a technology to capture carbon dioxide (CO_2) from coal-fired power plants. In the United States, coal-fired power plants emitted about 1.96 billion metric tonnes of CO_2 in 2005. In the Illinois Basin, 126 power plants emitted about 273 million metric tonnes of CO_2 in 2005, of which 98% was contributed by the coal-fired plants. Yongqi Lu, principal investigator and ISGS chemical engineer, will lead the 3-year, $700,000 U.S. DOE project.

Calgon Carbon Corporation (CCC) has also committed an additional $100,000 for in-kind contributions in support of this project. The ISGS team of Yongqi Lu and Massoud Rostam-Abadi will collaborate with the CCC and Professor Mark Rood, **Department of Civil and Environmental Engineering at the University of Illinois at Urbana-Champaign,** to advance an integrated vacuum carbonate absorption process (IVCAP) for post-combustion CO_2 capture. The development of the IVCAP was initiated in 2004 by ISGS chemical engineers Yongqi Lu, Scott Chen, and Massoud Rostam-Abadi with support from the **Midwest Geological Sequestration Consortium** (MGSC). A U.S. patent application describing the process is pending.

The U.S. DOE award will allow the ISGS to advance the IVCAP to an industrial-scale technology for potential pilot-scale or full-scale testing at a utility site after the conclusion of the three-year project. The team has proposed performing an experimental study (1) to test the proof-of-concept of the IVCAP process, (2) to identify an effective catalyst/additive for accelerating the CO_2 absorption rate and reducing the stripping heat, (3) to evaluate a modified IVCAP for combined SO_2 and CO_2 removal, and (4) to analyze the technological and economic performance of the process for industrial applications.

Energy Technology Critical to Water Issues



From left: ISGS chemical engineers Seyed Dastgheib and Yongqi Lu will lead a project to develop technologies to conserve water used in energy production.

The **U.S. Department of Energy** (U.S. DOE) selected the ISGS to develop technologies to reuse produced water from CO_2 enhanced oil recovery, coal-bed methane recovery, and mine pool water by coal-based power plants. The three-year $830,000 DOE award and a $230,000 grant from the **Illinois Department of Commerce and Economic Opportunity (DCEO), Office of Coal Development and Marketing,** will allow the ISGS an opportunity to address the critical water issues facing the energy sector. ISGS chemical engineers Seyed Dastgheib and Yongqi Lu (co-principal investigators) will lead the project. Participants of this project are ISGS

principal scientist Massoud Rostam-Abadi, three professors from the **University of Illinois at Urbana-Champaign** (Mark Shannon, Mechanical Engineering Sciences; Richard Masel, Chemical and Biomolecular Engineering; Charles Werth, Civil and Environmental Engineering), **Midwest Geological Sequestration Consortium, BPI Energy Inc.,** and **White County Coal, LLC.**

Coal power plants are the second largest user of fresh water in the United States. In Illinois, the thermoelectric power sector accounts for about 84% of the estimated 14 billion gallons per day of fresh-water withdrawals and one-third of the state's total 1 billion gallons per day of fresh-water consumption. Illinois electric power generation capacity is projected to expand 30% by 2030, increasing water consumption by 55 to 160%. The U.S. DOE and DCEO awards will be used to evaluate the feasibility of reusing the three types of nontraditional water sources for cooling or process water for coal-based power plants in the Illinois Basin. Tasks will include evaluating the quantity and quality of the produced water, investigating and developing suitable treatment technologies, and conducting detailed economic and benefits analyses. The research will provide critical information for the use of these nontraditional water sources for power plant makeup water, which would allow for increased use of nontraditional waters in the Illinois Basin and nationally.

Sorbent Activation Process for Mercury Control

Illinois State Geological Survey (ISGS) chemical engineers worked with engineers from **Apogee Scientific, Inc., Electric Power Research Institute (EPRI),** and **Maxwell Engineering and Consulting** to design a full-scale sorbent activation process (SAP) unit to be fabricated by **Heat Transfer Specialists,** Pekin, Illinois. SAP is a state-of-the-art, patented technology developed at the ISGS. This one-of-a-kind technology is expected to reduce the cost of mercury control removal from coal power plants by more than 50%. The SAP unit will be used for on-site production of activated carbon from Illinois coal at **Ameren's** Meredosia power plant during September through December 2008. The engineering design data were obtained from the Applied Research Laboratory at the ISGS using a bench-scale SAP unit.

The ISGS engineering team has designed, fabricated, and is currently testing a transportable SAP unit to demonstrate the technology at several utility sites.

Xu Chen and Kathy Henry at the ISGS Applied Research Lab with the transportable bench sorbent activation process (SAP) unit, a patented technology developed at the ISGS.

This patented technology is a result of an Illinois mandate to cut mercury emissions from coal-burning power plants by 90% by mid-July 2009. The SAP process will help reduce the operating cost of activated carbon (AC) injection processes for mercury control. The technology involves the on-site production of AC from the same coal as that burned by the utility. The SAP unit can produce 1 to 4 pounds of AC per hour and can be attached to a sorbent test device, which will allow the performance of the AC products to be tested in the slipstream of an actual flue gas.

The SAP unit is the result of more than five years of research and development efforts supported by EPRI. In October 2007, Illinois Clean Coal Institute (ICCI) awarded ISGS a grant to evaluate the performance of the SAP at a utility site burning Illinois coal. EPRI and ISGS are seeking support from industry to test the SAP at several other utility sites during 2008 and 2009. ISGS engineers are currently performing optimization tests with the SAP unit at the ISGS Applied Research Laboratory.

New Class of Carbon-Based Adsorbents Developed

ISGS chemical engineers, along with faculty and students from the **University of Illinois at Urbana-Champaign, Department of Chemistry and Environmental Engineering,** have developed a process for synthesizing a new class of carbon-based materials. The energy and environmental applications of these carbon products are currently being investigated. An invention disclosure describing the process, products, and potential uses of these novel carbons has been prepared for submission to the **Office of Technology Management at the University of Illinois** and to the **Electric Power Research Institute.**

Waste Gypsum Conversion Process Information Provided

Illinois State Geological Survey scientists have seen an increase in the number of requests for information about an ISGS process for producing value-added products from waste synthetic gypsum. The ISGS conversion process produces two value-added products, fertilizer and high-quality calcium carbonate, from waste gypsum. The requests come from electric and related companies in the United States and abroad that generate large quantities of waste gypsum during their routine operation. The companies are seeking to use the process to produce value-added products that can be used for wet flue gas desulfurization. The ISGS research and development project that developed the conversion process occurred during 1996 to 1999 with support from the **Illinois Clean Coal Institute** and the **U.S. Department of Energy.**

Limestone Information Requests

Zak Lasemi of the ISGS Industrial Minerals and Resource Economics Section has responded to a number of requests regarding high-calcium limestone resources in Illinois. Lasemi, Massoud Rostam-Abadi, and Yongqi Lu also met with representatives from a major lime company to discuss

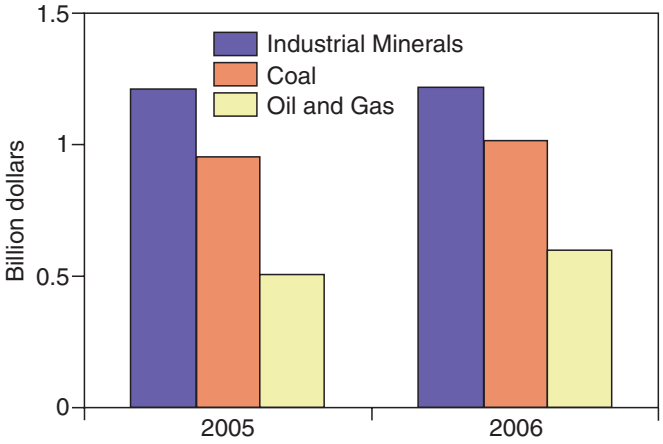
Zak Lasemi and Rod Norby examine limestone at Tuscola Quarry.

high-calcium limestone resources and the reactivities of various limestones. High-calcium limestone is sought for use in desulfurization in existing and potential coal-burning power plants. Limestone also may be used to capture a significant amount of mercury during the scrubbing process. As a result, there has been a great deal of interest in obtaining geological information about high-calcium limestone resources in central Illinois.

Although Pennsylvanian age limestones are mined in a number of quarries in central Illinois, the limestone beds are relatively thin, and production barely meets the demand for road construction limestone. Agricultural limestone also is produced in these quarries as by-product fines during the crushing of limestone. Although this limestone could be suitable for desulfurization, the quarries can barely meet increasing demands for agricultural limestone by the farming industry in central Illinois. Exploration of the availability of high-quality limestone in the south and southwestern parts of the state is extensive. As part of ongoing ISGS projects, maps are being developed to show the distribution of high-calcium limestone resources in Illinois. Another project, currently funded by the **Illinois Clean Coal Institute,** is investigating the suitability of limestone fines (agricultural lime) from quarries as a source of sorbent for desulfurization in coal-fired power plants.

Annual Review of Illinois Industrial Minerals

Illinois State Geological Survey (ISGS) geologists have completed the annual review of Illinois industrial minerals for the **Society of Mining Engineers'** *Mining Engineering* magazine and the **U. S. Geological Survey's** (USGS) *Minerals Yearbook*. Two extended abstracts were also published in the abstract volume of the 44th Forum on the Geology of Industrial Minerals.



The value of Illinois fuel and nonfuel minerals, 2005–2006.

Of the industrial minerals mined or manufactured in Illinois, those that have the highest value include crushed stone, cement, sand and gravel, and industrial sand. Crushed stone and sand and gravel aggregate materials combined continue to account for more than 60% of the value of Illinois' nonfuel industrial minerals. Dolomite, mined from the Silurian and Ordovician carbonates in northern Illinois, accounted for most of the total stone production.

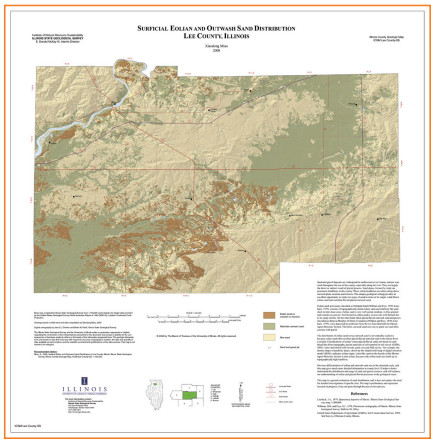
In terms of value, industrial minerals continue to be Illinois' leading mineral resource commodities, totaling $1.22 billion. According to the USGS mineral industry profile, Illinois ranked 16th among the 50 states in total value of nonfuel mineral production. By value, crushed stone was the state's leading industrial mineral, accounting for about 47% ($573 million) of the total, followed by portland cement, 25% ($308 million); construction sand and gravel, about 14% ($176 million); and industrial sand, about 8% ($102 million). Lime, fuller's earth (absorbent clay), tripoli (microcrystalline silica), and other nonfuel minerals, in decreasing order, accounted for most of the remaining 5% ($63 million). Economic analysis indicates that, because of their large impact on construction and transportation infrastructure, every dollar's worth of industrial minerals consumed in Illinois contributes $550 directly and indirectly to Illinois' gross state product.

Road maintenance and improvement are major sources of demand for the state's crushed stone, sand and gravel aggregate, and cement. According to the **Illinois Department of Transportation,** Illinois has the third-largest network of state and local roads and the sixth-largest interstate highway system in the country. The state also has more than 26,000 bridges, 8,227 of which are in the state highway system, which is heavily used. A significant number of bridges need repair or replacement, as do many stretches of the interstate highway system and many state and secondary highways and roads. Large amounts of construction aggregates are required to keep interstate highways in top condition, maintain major highways, and improve congested urban and rural highways.

Illinois is experiencing a dramatic increase in demand for high-calcium limestone, mainly in response to environmental regulations set by state and federal governments that made it necessary for coal-fired power plants to be equipped with limestone-based scrubber systems to reduce sulfur dioxide (SO_2) and mercury emissions. Stringent pollution control requirements have accelerated installation of limestone-based flue gas desulfurization (FGD) systems in coal-fired power plants. This trend toward increasing numbers of FGD units is expected to continue. Because of the importance of high-calcium limestone as a scrubbing agent, it is essential to address issues associated with the transport, availability, and suitability of high-calcium limestone resources for use in FGD power plants. Nearby sources of suitable limestone raw material must be found to feed existing and new scrubber installations and to aid in the selection of proper resources for desulfurization systems in the future. The ISGS is continuing to map and characterize Illinois high-calcium limestone resources that are suitable for controlling SO_2 and mercury emission in coal-fired power plants.

Map of Lee County Sand Distribution Nearing Completion

A map showing the surficial eolian and outwash sand distribution of Lee County has been completed and is near release. Sand and gravel deposits are found in southwestern Lee County (part of the Green River Lowland) and are also in the northeastern part of the county. Sand in Lee County has two major origins: (1) windblown eolian sand and (2) water-lain glacial and fluvial outwash sand.



Sand distribution map of Lee County, Illinois.

Eolian sand, previously classified as the Parkland Sand, consists of topographically distinct dune sand and relatively flat sand sheets in interdune areas. Eolian sand is very well sorted and medium to fine grained, containing no gravels. Soil formed in eolian sand is exces-

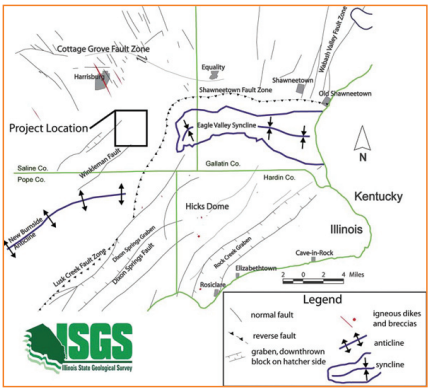
sively well drained due to the sand's texture. In contrast, thick glacial and fluvial outwash sand and gravel classified as Batavia Member of Henry Formation was deposited by meltwater from the ice front that built the Bloomington Morainic System in Lee County. Outwash sand can vary in grain size and often coexists with gravel.

The geologic significance of the Lee County map is that it shows the distribution of eolian sand in relation to outwash sand. The sands are not mutually exclusive at some localities because eolian sand is generally above glacial and fluvial outwash sand in the Green River Lowland. Classifications of eolian versus glacial and fluvial sands are based on data from topography, parent materials of soil reported in the **U.S. Department of Agriculture Soil Survey,** water and related well records, and grain size. Previous differentiation of eolian and outwash sand has been at the statewide scale, and the new county map will provide much more detailed information. The map improves the understanding of the distribution and use of this sand and gravel resource and the eolian and the glacial and fluvial processes.

Completion of this new map will complete the mapping of the sand distribution of the entire Green River Lowland (Bureau, Henry, Lee, Rock Island, and Whiteside Counties). A similar map of Bureau County has been completed, and the surficial geology of Henry, Rock Island, and Whiteside Counties has been mapped by Richard Anderson, Augustana College. Collective information from these mapping projects will provide a clear picture of sand distribution in the Green River Lowland.

Assessment of a Geophysical Coal Exploration Method Completed

The final technical report for the assessment of a geophysical coal exploration method was submitted to the **Illinois Clean Coal Institute.** The report contains data pertaining to coal thickness, depth to coals, chemical analyses of coal, geophysical models, and stratigraphic correlations in Saline County, approximately 5 miles southeast of Harrisburg, Illinois.



Coal mine locations in the study area, approximately 5 miles southeast of Harrisburg, Illinois, in Saline County.

The focus of the project described in the report was to accurately and cost effectively predict the geology of a coal field. More geologic data generally yield a better geological model of the coal field, and advances in geophysical methods may provide tools to supplement the traditional methods of coal exploration.

In this study, two seismic methods, multi-channel analysis of surface waves (MASW) and shear wave (SH-wave) analysis, were evaluated to determine their usefulness as coal exploration tools. It was determined that the MASW method was useful to model the relief of the bedrock surface. Because the geophone spacing was 5 feet, the mapping of the unconsolidated material thickness was much more accurate than results using a typical coal exploration program. The method was not useful in modeling below the bedrock surface due to its poor vertical resolution and limited depth of penetration.

The project results also showed that the SH-wave survey was able to accurately model bedrock down to 150 to 200 feet below the surface. Amplitude change, or the tuning effect, was useful to image the existing thin (less than 5 feet) coal layers. The method also allowed prediction of locations of igneous dikes, which intrude through the coal seams in this region. Two-dimensional geologic models constructed with this method were very useful in visualizing complex fault zones.

Illinois Coal Bed Methane Cores Donation

BPI Energy, the major developer of coal bed methane in Illinois, donated cores, logs, and data from their exploration efforts to the ISGS. The cores, from approximately 12 wells from various areas of southern Illinois, are being described by Coal Section members. Several cores are continuous for several hundreds of feet and provide valuable documentation of the variations of Pennsylvanian stratigraphy, particularly coals, in the Illinois Basin.

Abandoned Mine Maps Delivered to IDOT

Mapping of abandoned mines has been completed for 13 quadrangles in Jackson, Williamson, Franklin, Hamilton, and White Counties. The 7.5-minute maps for those quadrangles, accompanied by directories containing detailed information on the mine histories and sources of information, have been delivered in both paper and digital formats to the **Illinois Department of Transportation,** the project sponsor, and have been released to the public.

One of the 2008 abandoned mine maps produced by the Coal Section of the ISGS: Coal Mines in Illinois, De Soto Quadrangle, Jackson, Williamson & Franklin Counties, Illinois, Herrin Coal.

The new maps are for the Carbondale, De Soto, Gorham, Oraville, Pomona, Christopher, Sesser, Ewing, Norris City, McLeansboro, Thackeray, Macedonia, and Enfield Quadrangles. The maps and directories will help government planners, developers, and private citizens to identify areas that have been undermined.

Combustion By-Product Research Receives Additional Funding

Illinois State Geological Survey researchers have received additional funding from **Duke Energy** to conduct scale-up production test runs for the **U.S. Department of Energy** coal combustion by-product research project. The scientists also received support from **Tampa Electric Inc.** and **ConocoPhillips** to conduct coal combustion by-product utilization research. An invention disclosure related to manufacturing autoclaved aerated concrete (AAC) utilizing fly ash has been filed with the **University of Illinois at Urbana-Champaign.** Additionally, two papers, one related to power plant slag utilization and the other related to AAC production utilizing fly ash, have been presented to the 23rd International Conference on Solid Waste Technology and Management, which was held in Philadelphia, Pennsylvania, March 29 to April 2, 2008.

Commercial-Scale Tests of Fly-Ash Blocks

Researchers at the ISGS have successfully completed commercial-scale production of autoclaved aerated concrete (AAC) blocks using Class C fly ash from the Baldwin power plant. The compressive strength testing of the final blocks was conducted at a laboratory of the **University of Illinois at Urbana-Champaign.** The AAC blocks produced with Class C fly ash without additives met commercial quality standards. Further testing to evaluate the effect of silica sand additive on compressive strength of AAC blocks is in progress.

Commercial-scale, autoclaved aerated concrete blocks made using Class C fly ash from the Baldwin power plant.

Fired Bricks Containing Spent Equilibrium-Catalyst

Illinois State Geological Survey scientists completed bench-scale production test runs making fired bricks containing spent equilibrium-catalyst (e-cat) solid waste material. The fluid catalytic cracking process in an oil refinery uses a metal catalyst coated on silica-alumina clay or zeolite (catalyst support material). The catalyst can convert heavy hydrocarbons to light hydrocarbons, but a small fraction of the catalyst is continually replaced with a fresh catalyst to maintain activity. In North America, more than 400 tons of this spent e-cat are generated daily, most of which is disposed of in municipal landfills and on-site facilities. **MCAT Services LLC,** an Illinois-based processing plant, is currently recovering metals from the spent e-cat received from oil refineries. The residue from their recovery process was used in a brick-making evaluation at the ISGS. Successful bench-scale results have been completed, and the next step is to conduct testing at a larger scale.

Land and Water Resource Mapping

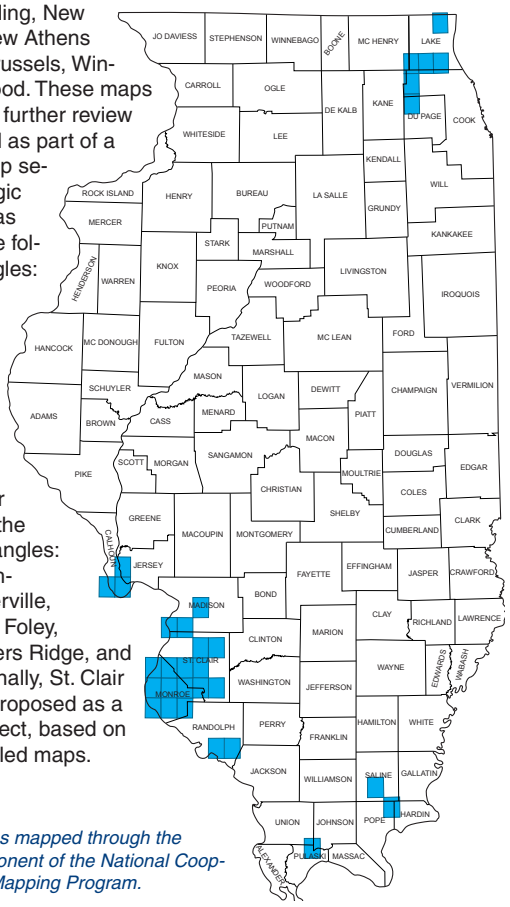
STATEMAP Products Completed

Each year the Illinois State Geological Survey (ISGS) participates in the STATEMAP component of the **National Cooperative Geologic Mapping Program** (http://ncgmp.usgs.gov/), which provides federal funds for detailed two-dimensional geologic mapping to state geologic surveys. The **U.S. Geological Survey** (USGS) administers the program, and funds are distributed to state geological surveys on a competitive basis. The program also includes a federal component, FEDMAP, and an educational component, EDMAP. The ISGS encourages universities to participate in the EDMAP component and welcomes their cooperation with ongoing ISGS mapping projects.

Overall, the ISGS ranks ninth among state surveys in federal dollars received under this program, having received more than $2.45 million for geologic mapping in the state's high-priority areas since the program's inception in 1993.

The high-priority areas include the metropolitan Chicago area, where there is great demand for groundwater resources; southern Illinois, where mapping has focused on identifying economic mineral resources such as coal, high calcium carbonate, and other minerals; and the St. Louis Metropolitan East area, in order to meet the societal needs of the greater St. Louis region. Prioritization of the map areas for the STATEMAP program involves dialogue with the **Illinois Geologic Mapping Advisory Committee,** which includes representation from local, state, and federal government, private industry, and higher education.

The ISGS recently completed and delivered to the USGS seven new geologic maps of the following 7.5-minute quadrangles at a scale of 1:24,000: Wheeling, New Athens East, New Athens West, Herod, Brussels, Winfield, and Nutwood. These maps will now receive further review and be released as part of a formal ISGS map series. New geologic field mapping has just begun in the following quadrangles: Zion, Aurora South, Paderborn, Redbud, Altenburg, Gorham, and Shetlerville. A new proposal will be submitted in November 2008 to map in the following quadrangles: Waukegan, Highland Park, Naperville, Yorkville, Plano, Foley, Hamburg, Karbers Ridge, and Oregon. Additionally, St. Clair County will be proposed as a compilation project, based on completed detailed maps.



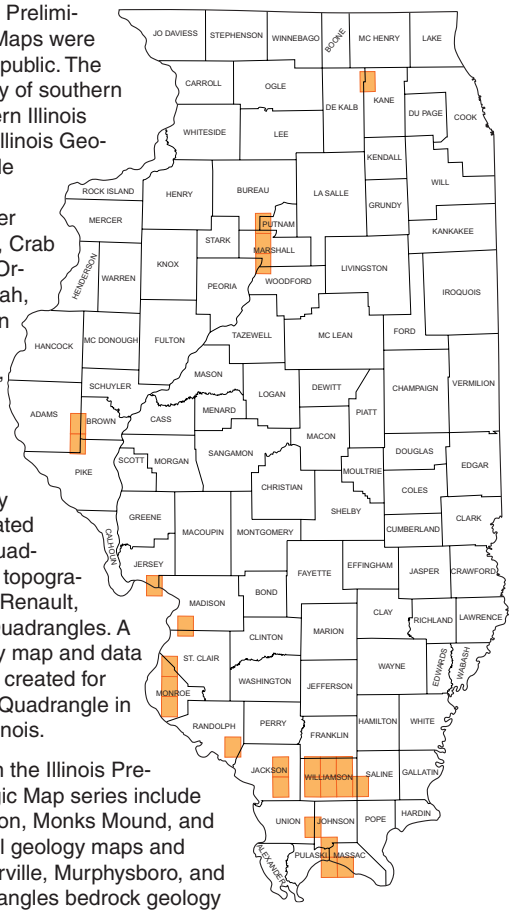
Illinois quadrangles mapped through the STATEMAP component of the National Cooperative Geologic Mapping Program.

The STATEMAP mapping team includes Joe Devera, Brett Denny, Mary Seid, Mike Barnhardt, Andy Stumpf, Drew Philips, Dave Grimley, Brandon Curry, and Steve Brown.

2008 Quadrangle Map Releases

During this reporting period, 21 Illinois Geologic Quadrangle maps and nine Illinois Preliminary Geologic Maps were released to the public. The bedrock geology of southern and southwestern Illinois dominated the Illinois Geologic Quadrangle map releases: Bandana, Carrier Mills, Columbia, Crab Orchard, Crab Orchard Lake, Elsah, Herrin, Johnston City, Joppa, Karnak, Marion, Mt. Pleasant, Pittsburg, Renault, Waterloo, and Welge. Sinkhole density maps were created also for three quadrangles in karst topography: Columbia, Renault, and Waterloo Quadrangles. A surficial geology map and data point map were created for the Hampshire Quadrangle in northeastern Illinois.

New releases in the Illinois Preliminary Geologic Map series include Chillicothe, Lacon, Monks Mound, and Putnam surficial geology maps and Fishhook, Kellerville, Murphysboro, and Pomona Quadrangles bedrock geology maps.



2008 quadrangle map releases.

Mapping the Lake Calumet Region, South Chicago

The Illinois State Geological Survey has initiated a project to map the three-dimensional (3-D) geology of the Lake Calumet Quadrangle in south Chicago. This urban geology project will be part of the **Great Lakes Geologic Mapping Coalition** (GLGMC) mapping effort in northeastern Illinois. Mapping will (1) delineate deposits that lie between the land surface and the uppermost bedrock, (2) determine the nature of the shallow Silurian bedrock, including its thickness and degree of fracturing, (3) evaluate the deeper bedrock units, and (4) ascertain the exchange of groundwater between glacial aquifers and the underlying bedrock aquifer. The most important aspect of this project will be the 3-D mapping of all materials in the study area to determine their engineering properties and their potential for transmitting contaminants.

Beginning in the late 1800s, the Lake Calumet region was transformed from an area of sand dunes and low-lying marshes to one

of heavy industry, residential development, and numerous dumping grounds for industrial and municipal waste. In 1893, for example, the Army Corps of Engineers reported that a milling company located at the mouth of the Calumet River deposited so much slag and dredge that the area around it grew at a rate of four acres per year.

Land degradation continued into the 1980s as steel mills closed, creating numerous brownfields, and there were further plans to continue filling in most of the lake to provide land for private developers. About that time, though, environmental groups began to promote conservation and cleanup. The most significant strides began in 1996 with attempts to establish Calumet Ecological Park. In 2001, a new Calumet initiative was announced that advocated the restoration and enhancement of open spaces while revitalizing economic opportunities.

The current land use of the quadrangle is public parks, ecological restoration areas, industrial holdings, waste disposal and contaminated sites, infrastructure development, and residential and commercial establishments, all on top of filled and natural land. Once the ISGS has mapped the geology in a detailed 3-D view, contaminated problem areas will be delineated, engineering properties of fill and natural materials will be identified to assist in construction designs and hazard avoidance, and large-scale groundwater flow models will be developed, which may assist in pump-and-treat decontamination processes. This information could lead to the implementation by decision makers of cost-effective plans with future lower liabilities for economic development, environmental protection, and remediation and redevelopment.

The mapping of the Lake Calumet Quadrangle will first involve the careful review and compilation of existing geologic maps and other data for the study area, including subsurface data from thousands of existing water-well logs on file at the ISGS and from engineering borings for foundations, highways, bridges, utilities, and remediation activities. Then exploratory drilling and geophysical activities will be conducted to better understand the depth, thickness, distribution, character, and continuity of subsurface natural and fill deposits. All data (including old maps) will be put into electronic formats and entered into the ISGS Geographic Information Systems (GIS) database, and 3-D views of the geology will be constructed. Proposed maps will show the (1) distribution, elevation, and thickness of the various glacial, postglacial, and artificial fill deposits in the study area; (2) topography of the bedrock surface; and (3) bedrock lithology. Once these maps are completed, interpretive maps for aquifer sensitivity and engineering conditions and other maps can be developed.

The mapping of the Lake Calumet Quadrangle will be a multi-year effort with partial funding by the GLGMC, but most funding will come from State of Illinois appropriations to the ISGS. Additional federal and state dollars would enhance data collection and significantly reduce the time required to complete the mapping effort.

Geology Department Contribution Enhances Outcrop Studies

A Leica reflectorless total station with integrated scanner and robotic surveyor and accompanying advanced GPS receivers are graciously being made available to the ISGS by professor Jim Best of the **University of Illinois Geology Department.** Chris Stohr at the ISGS will process ISGS information and familiarize the Geology Department staff with the use of this advanced technology.

The ISGS is using the equipment for detailed documentation and analysis of outcrops for preparing three-dimensional maps of facies, lithologic contacts, and textural changes.

Using this equipment, Chris Stohr, Steve Brown, and Don Keefer already have photographed glacial deposits exposed at the Wedron Silica facility in LaSalle County, Illinois. The borrowed instruments should improve the information obtained in this three-dimensional geologic mapping project. Additionally, the equipment benefits the students who are being trained in the use of these state-of-the-art instruments for geologic investigations.

New Field Work Adds to the Knowledge of the Mahomet Aquifer

The Mahomet aquifer and the shallower aquifers in the Glasford Formation that overlie it are the focus of a continuing field investigation. As part of the project, six observation wells have been installed at four sites. Two of wells are in the Mahomet aquifer; the other four wells are in Glasford Formation sand and gravel aquifers. Continuous core was collected at two of the sites, and drill cuttings were collected from the drilling fluid at other sites. The deepest boreholes at four of the sites were logged using gamma-ray logging. As of the end of 2007, a total of 17 additional observation wells have been installed in the Mahomet aquifer and the overlying aquifers in the Glasford Formation. Additionally, resistivity data have been collected along a quarter-mile line at the **River Bend Champaign County Forest Preserve** in Mahomet.

Mahomet aquifer drill site north of Ludlow. Photograph from Al Wehrmann, Illinois State Water Survey.

Preliminary analysis of the results showed the presence of three units within a depth of 150 feet. The units seem to correlate with alluvial sand and silt, glacial outwash, and till. The units were seen in the core that was collected at a site along the **Mahomet Forest Preserve transect.** Resistivity data were also collected along two transects at **Lodge Park in the Piatt County Forest Preserve,** north of Monticello, to identify a suitable site for installing observation wells to measure hydraulic head in Illinoian age (Glasford) sediments and the pre-Illinois Mahomet aquifer. Seismic data were collected along a transect over the Pesotum Bedrock Valley. Analysis of these data better characterized the sediments infilling the valley and the bedrock surface along the seismic profile. Two observation wells were installed at a site near the center of the seismic transect. The borehole sediment description and the downhole gamma log data helped the scientists interpret data from the seismic profile.

Although the Pesotum Bedrock Valley is filled predominantly with fine-grained sediment, the additional data suggest a more complex geology. Many different sediment types, representing several glacial episodes and at least one preglacial episode, were recovered from the borehole. The geologists grouped these materials into three

general units to aid in the interpretation of the seismic data. Unit 1 includes glacial till and several sand and gravel layers. Unit 2 includes mainly hard glacial till of uniform texture. Unit 3 consists of layers of gravel, sand, and silt and clay that directly overlie weathered bedrock. Aquifer materials in the lower part of Unit 3 are at about the same elevation as the Mahomet aquifer. The geologic and hydrogeologic relationships between the Pesotum Bedrock Valley and the Mahomet aquifer will be further explored.

Geophysics for Community Water Development

The ISGS, along with **Heneghan & Associates,** Jerseyville, and **Kohnen Concrete Products** (drilling contractor), Germantown, drilled test holes and geophysically logged four locations based on the results of an electrical earth resistivity (EER) survey performed during summer 2007. The survey was a follow-up study from a 1960 ISGS EER survey completed by staff member Merlin Buehle that located the existing wells and well field for the Village of Kane. The surveys identified a coarse-grained, alluvial (riverine) sand and gravel channel paralleling the existing floodplain and river. However, low data density from the 1960 EER study limited exploratory drilling to a north-south line from the existing wells.

The 2007 study developed an EER grid that covered a 60-acre parcel to further delineate the channel deposit identified by the 1960 survey. The four locations selected for test drilling were based on the 1960 results. The two surveys had very similar results except for a line immediately north of the existing wells, which differed sharply. The exact explanation for the difference has not been determined, but the presence of drainage tile might be a possibility.

The most recent test drilling and logging indicated that the alluvial aquifer was indeed limited and contained rather well-defined boundaries, which corroborated the results of the two earlier surveys. Gamma and resistivity logs were strongly correlated with the surface data, and, considered with the test drilling, confirmed the presence of a bedrock channel and the coarser-grained material. The bottom 5 feet of unconsolidated material was a dense till rather than coarse sand and gravel. Overall, the sand and gravel at the favorable locations was twice as thick as at the unfavorable locations. The EER surveys showed the bottom elevation of the alluvial deposit was higher, and the texture was finer, at the less favorable locations.

Since the initial EER study, the land containing the wells has been sold, and the new owner has expressed less interest in developing new community wells on the property. The engineering firm and community are working with the landowner to reconsider allowing the community to expand its well field. This landowner attitude has become much more prevalent during the past five years than previously when farmers and landowners were much more willing to give up a few acres for wells. Competition for resources, ethanol production, and the price of corn and soybeans have forced small communities such as Kane to consider buying larger tracts of land.

ISGS Geophysics Supports Delaware Mapping

For the past five years, the Geophysics Section of the ISGS has been developing a new method for rapidly collecting seismic reflection data using the land streamer. Similar in concept to geophone streamers towed behind boats for normal ocean surveys, this streamer is towed behind a car on land. Although the technique was developed for mapping along country roads in Illinois, the technique is applicable in many other areas as well. During spring 2008, ISGS staff member Steve Sargent took the land streamer east to assist the **Delaware Geological Survey** and **University of Delaware** in their investigation of the regional Cretaceous aquifer. Although the sediments were much thicker than those previously imaged in Illinois, the land streamer system worked well and helped the scientists visualize sediments several hundred meters deep. Delaware Geological Survey scientists were pleased with the level of detail the land streamer revealed.

ISGS crew gathers data with their land streamer to assist the Delaware Geological Survey and University of Delaware.

ISGS Sediment Laboratory Reopens

The Sediment Laboratory of the Illinois State Geological Survey reopened officially during fall 2007 after 5 years of being closed. Hue-Hwa Hwang, the Sediment Laboratory director, has been working on rebuilding the lab that in the past had offered a substantial amount of technical service to both the scientific and engineering communities. Particle size analysis of sediment samples is now available to ISGS staff and to the public. The laboratory has completed hundreds of particle size analyses of samples since November 2007. Most of the samples are of glacial and postglacial sediments drilled as part of geologic mapping funded by the **National Cooperative Geologic Mapping Program (STATEMAP)** and the **Central Great Lakes Geologic Mapping Coalition.** Internal laboratory standards help the ISGS staff optimize the quality of analysis. The standard deviation for sand, silt, and clay fractions of ISGS internal reference standards is better than 1%, which is an excellent achievement for the hydrometer method used for particle size analysis. Laboratory staff will continue to work toward improving the service capability and quality of the ISGS Sediment Laboratory in order to meet the needs of both ISGS programs and public demand.

ISGS Sediment Laboratory reopens for sample analyses.

Sources and Fate of Nitrate in the Illinois River

The Illinois River is a main tributary of the upper Mississippi River and has one of the largest nitrogen fluxes in the Mississippi River basin. The Illinois River watershed drains about 44% of Illinois, which is dominated by row crop agriculture. Using chemical and isotopic analyses, geologists at the ISGS investigated the sources and fate of nitrate (NO_3^-) in the Illinois River from Chicago to the Mississippi River. The major nitrate sources were assumed to be treated wastewater, primarily from the Chicago area, and synthetic fertilizer from

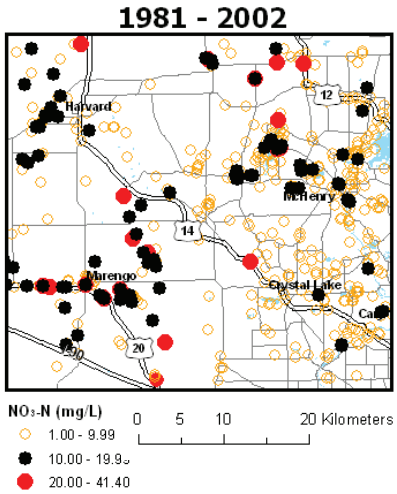
the agriculturally dominated land between Chicago and the Mississippi. Samples were collected on a seasonal basis from 14 sites along the Illinois River and from selected tributaries. Samples were also collected from treated wastewater plants, tile drains, and precipitation.

Filtering water samples for isotopes of nitrates.

The total nitrogen (N) concentrations in the river were as high as 11.7 mg/L near the Chicago area and generally decreased with distance from Chicago, as discharge from groundwater, tributaries, and tile drains added to the river. Nitrate concentrations decreased most during the summer, when flow rates were low, field tiles were usually dry, and tributaries showed little to no nitrate concentration.

The isotopic composition of the nitrate in the Illinois River varied by season and river flow rate, reflecting different dominant source inputs and denitrification trends. During winter and early spring, when flow rates were high, the isotopic composition was dominated by nitrate from fertilizer nitrogen and soil nitrogen sources. During late summer and early fall, when flow rates were low, the isotopic composition indicated that the dominant nitrate input was from treated wastewater. Most of the data suggested that denitrification predominantly occurred in the groundwater prior to discharge into the Illinois River. However, during low flow conditions, a positive shift in the isotopic composition between the upper and lower portions of the river was observed, reflecting denitrification or fractionation due to significant biota uptake in the broad shallow reaches of Peoria Lake, a man-made lake in the central part of river system. This finding is significant because in-stream denitrification has typically not been observed in larger river systems.

McHenry County Groundwater Quality and Land Use



Historical records of nitrate concentrations for McHenry County during 1981 to 2002.

During the past few decades, McHenry County has transitioned in many areas from agricultural land use into urban use with fast-growing housing demands. Croplands still dominate rural areas. The majority of the county's water resources comes from shallow sand and gravel aquifers, which are vulnerable to surface-contamination sources. To evaluate the effect of changing land use on groundwater quality, approximately 38,000 groundwater quality records from McHenry County were retrieved from the data archives of the **Illinois State Water Survey** and the **McHenry County Health Department.** Geographic Information Systems (GIS) software was used to analyze this large data set. In addition, 30 groundwater samples were collected from private wells (both drilled and dug) for chemical and isotopic analyses. These data were used to identify the distribution and sources of elevated nitrate concentrations and to evaluate the effect of changing land use on shallow groundwater quality.

Historical groundwater data revealed that total dissolved solids, chloride, and nitrate concentrations in groundwater have increased since the mid-1960s, indicating deterioration of groundwater quality during the previous century's last decades. The timing of these changes coincides with rapid population growth in McHenry County and the use of road salt. Spatial analysis revealed that the highest concentrations in all three categories were found in shallow wells less than 100 feet deep, strongly suggesting that the contaminant sources were from the ground surface.

Chemical and isotopic data from the groundwater samples indicate that the type of land use controlled the type and concentrations of ions present. For example, groundwater samples from urban areas had higher sodium and chloride concentrations, which was attributed to the application of road salt. Samples from facilities in rural areas and near livestock facilities had higher nitrate and total nitrogen concentrations, which was attributed to the application of fertilizer on croplands. Based on isotopic results, the predominant sources of nitrate in shallow groundwater samples collected from both rural and urban areas were fertilizer and soil organic matter due to the widespread fertilization of croplands surrounding isolated urban areas in McHenry County.

Overall, the results of this investigation revealed that (1) groundwater quality in McHenry County has deteriorated significantly since the mid-1960s due to the increasing application of road salt and fertilizer and that (2) land use in an area such as McHenry County, where sand and gravel dominate the near-surface geology, can rapidly and adversely affect the local groundwater quality. The study results were published as ISGS Open File Series 2007-6.

Lake Michigan Water Level Nears Record Low

Ice along the Lake Michigan shoreline during January 2008 when water level was near the record low.

The water level of Lake Michigan has been declining slowly over the past several months. The gradual decline is more than would be expected from seasonal fluctuations. On several days in early January 2008, wind conditions displaced enough lake water to temporarily bring lake level below its 1995 January record low. The lake remains within inches of setting a new record low. Water level is now more than two feet below the long-term average and about five feet below the record high of January 1987.

Water levels were a key issue in a presentation given by ISGS coastal geologist Mike Chrzastowski at the **Chicago Cultural Center**

on January 10, 2008. The presentation focused on the history of building parkland along the Chicago north lakefront and the need to know how low water will impact private property along the northernmost two miles of the Chicago lakefront.

The talk was sponsored by **Chicago Friends of the Parks,** as part of its Last Four Miles project. The project will address how lakefront parkland could be constructed along the last four miles of Chicago lakefront without public access. The planning is a prelude to the 2009 centennial celebration of the publication of *Plan of Chicago.* The most recent efforts have focused on planning for the future of the Rogers Park neighborhood, which has shoreline at the far northern limit of the Chicago lakefront.

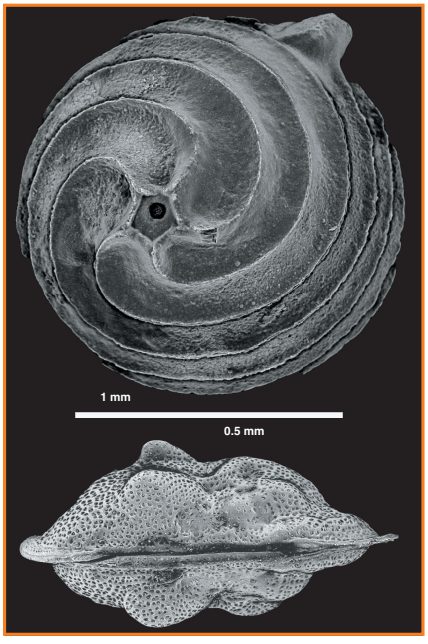
From Watershed to the Global Ocean

The Illinois State Geological Survey organized and conducted a scientific session, "Groundwater Inputs to the Ocean, From the Watershed to the Global Ocean," at a recent scientific meeting sponsored by the **American Geophysical Union, American Society of Limnology and Oceanography, The Oceanography Society,** and the **Estuarine Research Federation.** The meeting was held March 2 to 7, 2008, in Orlando, Florida. A main goal of the ISGS session was to build a consortium of scientists to discuss and prepare a research program to study groundwater and surface water interactions and to recognize the importance of groundwater to the Great Lakes Region. The pilot project of this program is titled, *A Study of the Subsurface Water Role in the Water Resources of Lake Michigan: Ecological Policy, Assessment, and Prediction.*

Understanding Past Ecology at Illinois Site

A recently completed study took place at **Pratt's Wayne Woods Forest Preserve** at a site near Brewster Creek in northwestern DuPage County. The study determined that deposition of loess, the windblown silt that is the parent material of Illinois' rich soils, ceased at that location about 14,670 years ago. The study also documented paleoecological and environmental changes during the transition from the last glacial period.

Quaternary geologists studied an 8-m-long core obtained from near the deepest part of a wetland kettle basin. The basin acted as an archive of the fossils and sediment that were deposited during the transition from the last glacial to interglacial period (about 17,000 to 10,500 calibrated years ago). Radiocarbon dating indicated that the sediment succession (from bottom to top) of silt, marl, and peat corresponds with the major climatic events interpreted from Greenland ice cores. The rate of sediment accumulation varied and was slowest at the base of the major rock units.



Scanning electron micrographs of a carapace of the ostracode Limnocythere verrucosa.

Additional kettle basin cores showed that the zones of slow sediment accumulation grade shoreward to unconformities that are in places marked by deposits of fine sand and, occasionally, fossil remains, such as a recently discovered mastodon.

The pollen record at Brewster Creek differs from that at other sites in the region, which indicates that vegetation varied significantly between sites under the same climatic regime. During the waning parts of the last glaciation, the dominant plant types included spruce, fir, and black ash. Other species, including pine, birch, oak, and elm, became important later during the transition. Spruce pollen persisted until about 10,800 years ago at Brewster Creek, which is about 1,000 years longer than at other sites in the area, such as Nelson Lake in Kane County. Evidence from fossil ostracodes and diatoms, both microscopic lake dwelling organisms, indicates that Brewster Creek initially was a lake with water enriched in sulfate and bicarbonate ions. At the beginning of the transition to the last interglacial period, the lake was depleted in sulfate ions (probably because of bacterial activity) and stayed that way for the remainder of the record. The evidence for the change in water chemistry coincides with a change in lithology from smectite-bearing silt to marl.

Climatic reconstructions based on ostracodes indicate that temperatures were similar to that of west-central Minnesota (mean annual temperature about 5°C) through the transition and increased to about 8°C at the beginning of the last interglaciation. Average rainfall increased from about 650 to 700 mm/yr to 850 to 950 mm/yr. Present conditions include an average annual temperature of 9°C and an average annual precipitation of 950 mm.

These research results are now published in the ISGS Circular 571, *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,* by B.B. Curry, E.C. Grimm, J.E. Slate, B.C. Hansen, and M.E. Konen.

Unraveling a Half-Century Mystery

In 1957, Arthur Andrew, a local resident of Adams County, Illinois, noticed a large "elephant tooth" poking from a bluff several miles southeast of Lima near the former bed of Lima Lake. As the *Quincy Herald-Whig* described on Sunday, April 20, 2008, "Andrew took the tooth home, and the mystery began sprouting. For 51 years, residents of the Lima Lake area have been hearing about the local mastodon tooth and wondering how old it might be." The director of the **North American Archaeological Institute** in Quincy, Steve Tieken, received permission from the tooth's current owner to date the giant creature using the radiocarbon dating method.

Hong Wang, director of the Radiocarbon Dating Laboratory at the ISGS, took on this project. Together with Stanley Ambrose, anthropology professor, Wang used a pencil-size drill with a diamond bit to grind a half-inch piece of tooth enamel from a corner of the tooth into fine powder. Of the typical chemical compounds in teeth that can be used in the age-dating process, the scientists selected bio-apatite. Bio-apatite is made up of calcium phosphate crystals that, during the growth of the tooth, trap carbon dioxide within the tooth structure (carbonate). Wang combined the tooth enamel sample with an extremely weak acid (0.1 *M* acetic acid) for over 20 hours

Radiocarbon dating method proves useful in determining the age of this mammoth tooth fossil.

to prepare it for analysis. Afterward, the remaining sample material was mixed with a stronger acid to release the carbon in the bio-apatite. This released carbon was used to date the mastodon tooth.

The analytical results dated the sample at 10,775 ± 35 radiocarbon years before present. Surprisingly, this mastodon specimen is the youngest ever dated, suggesting it could represent the "last mastodon standing" on the North America continent.

On June 1, 2008, the *Quincy Herald-Whig* reported this result. Now Lima Lake residents wonder what caused the demise of the furry mastodon. Steve Tieken is currently examining clues such as scratch marks on a vertebrate found next to the mastodon tooth that suggest human butchering of the carcass. ISGS scientists have offered to analyze this bone specimen to confirm the age of the mastodon and verify whether it is the youngest known mastodon found in North America.

Searching for Buried Steamboats

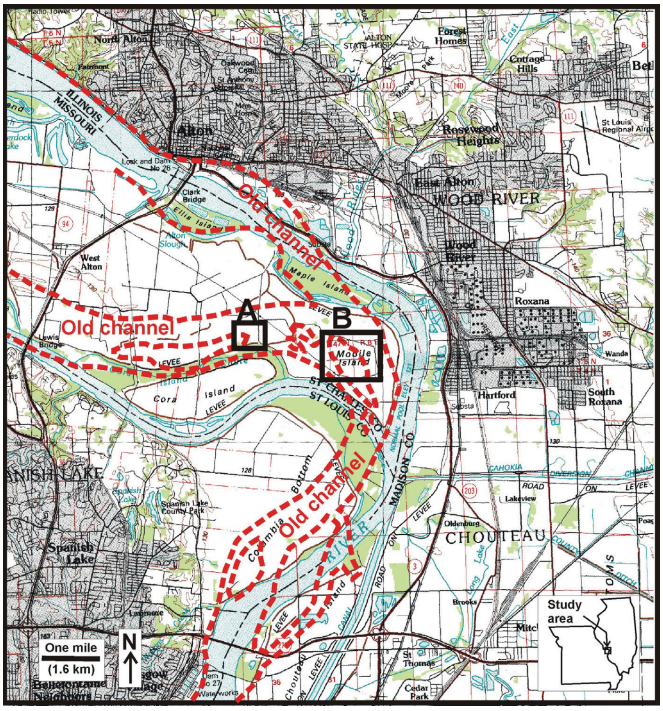
On the evening of April 25,1840, the *Bedford,* a relatively small side-wheel steamboat, was descending the Missouri River near its mouth, bound for St Louis, when she struck a snag and sank in less than five minutes in deep water. Over the ensuing decades, the Missouri River channel has shifted to the south so much that the site of the *Bedford's* wreck is now beneath dry land. During June 2007, under the auspices of the **U.S. Army Corps of Engineers,** St. Louis District, ISGS geophysicist Tim Larson conducted a magnetometer survey looking for the *Bedford* and two other wrecks. The iron boilers and engines from the old steamboats should produce a large magnetic anomaly even if the wrecks lie 30 to 40 feet below ground.

After a week of trekking through corn fields, sloughs, and cottonwood saplings with a magnetometer and GPS unit mounted on his back, the geologist located a telltale anomaly not far from the reported location of the *Bedford* wreck. Unfortunately, the other wreck sites could not be located. The large magnetic anomaly was found in a swale on the "back side" of what once was Mobile Island. This swale could have been a short cut channel near the mouth of the Missouri River, and the magnetic anomaly is consistent with 8 to 12 tons of iron buried at a depth of 35 to 40 feet. The site is located within **Missouri Department of Natural Resources (DNR) Confluence Point State Park.** Archeologists from the Missouri DNR are developing a plan to collect drill core from the site to determine whether the *Bedford* has finally been found.

Assisting Archeological Dig at Urbana's Founder's Park

Illinois State Geological Survey Quaternary geologists Steve Brown and Mike Barnhardt and geophysicist Tim Larson assisted **University of Illinois** archeologists and town officials by identifying and describing the sediments and buried structures at three sites adjacent to Boneyard Creek in downtown Urbana. The locations are thought to be near the site of a cabin built by one of Urbana's founding fathers. The site is to become the location for a new city park, Founder's Park, in celebration of the Urbana's 175th anniversary.

Sediment from six boreholes (two hand-bucket augers and four PowerProbe) ranging from 7.5 feet to 24 feet in depth was described. Sediment was identified as artificial fill of variable texture (generally from 7 to 10 feet below the land surface) overlying black, organic, and clay-rich silt (about 7 to 12 feet below the land surface) atop sand and gravel deposits. The fill is the result of many decades of construction and changing land use, and brick, sand, and gravel have been incorporated into the fill. Also present are small pieces of slag, coal, and fine sand that may be the evidence of past industrial activities near



Location of study area at the confluence of the Missouri and Mississippi Rivers. Areas A and B are the locations of the two magnetic surveys at Cora Island Chute and the Mobile Island Areas. Note how the present river channels differ from those mapped by the Public Land Surveys of 1815–1817.

the site. The organic rich silt probably represents the land surface of the Boneyard Creek floodplain at the time of modern settlement. The sand and gravel appear to represent natural deposition by the creek, possibly in a point bar location. The core and sediment samples were examined, identified, and interpreted by the Survey geologists. Based on examination and interpretation of the samples, the geologists prepared two cross sections and a brief interpretative document for the archeologists.

Additionally, two of the sites were surveyed in a grid pattern using a ground-penetrating radar unit to help identify buried contacts and buried structures that may be related to both human activity and natural landscape processes. This survey provided real time views of the subsurface and suggested areas for additional investigation. The processed radar data indicated the presence of disturbed ground at one site that possibly is related to past human activity.

ISGS scientists drill boreholes at the site of Urbana's Founder's Park in search of evidence of early settlers.

Radar images at the other site suggested the locations of old building foundations. Two descriptive posters of the radar work were prepared for the archeologists. Based on the preliminary drilling and geophysical work at the site, the archeologists decided to excavate in one area.

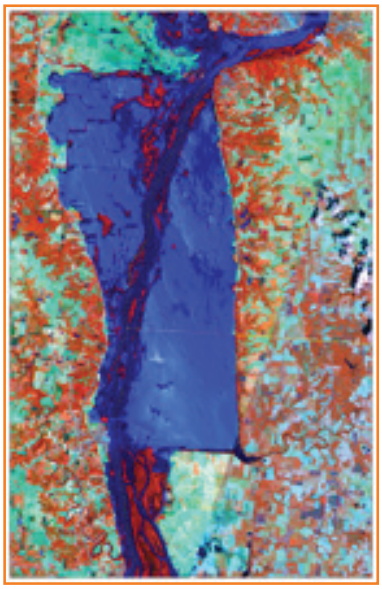
Data Preservation and Use

Bridge Consultants Use ISGS Core Information

When a new Mississippi River bridge project was scaled back, revised design plans required the relocation of the pylons for the four-lane, cable-stayed bridge. The alteration will require new, expensive borings, but pertinent information about the site is contained in the original bedrock cores from the original borings. Consultants asked to examine those cores, which are stored in ISGS facilities, to see what rock types, fractures, bedding, and other details are revealed. Core examination will give them some idea of what they can expect to find from the new boreholes in the Mississippi River.

The ISGS obtained the core and jar samples from the **Illinois Department of Transportation (IDOT) District 8** and from **Hanson Engineers, Springfield, Illinois,** when IDOT ran out of storage space in 2004. All parties recognized the value of the samples. The IDOT transfer was for temporary storage at the ISGS for 10 years. **Ve'Niecy Pearman Green, Materials Section at District 8** in Collinsville provided copies of the borehole logs for use in conjunction with the examination of the physical core.

Providing Flood Imagery



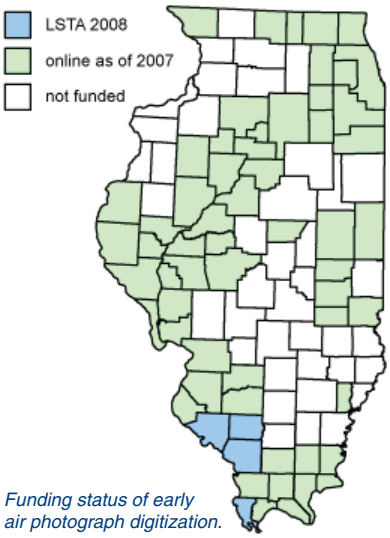
Color infrared image collected along the Mississippi River between Warsaw, Illinois, and La Grange, Iowa, by the French Spot satellite.

Scientists from the Illinois State Geological Survey, the **Illinois State Water Survey,** the **Illinois Natural History Survey,** and geography faculty from **Illinois State University** are collaborating to process and interpret satellite imagery collected over Illinois during June and early July 2008. Illinois, Indiana, Iowa, Missouri, and Wisconsin experienced significant flooding during this period. As a result of this natural disaster, on June 10, 2008, the **U.S. Geological Survey** (USGS) activated the International Charter.

The International Charter aims at providing a unified system of space data acquisition and delivery to those affected by natural or man-made disasters through authorized users. Each member agency has committed resources to support the provisions of the Charter and thus is helping to mitigate the effects of disasters on human life and property (http://www.disasterscharter.org/).

Through cooperative relationships established between the U.S. Geological Survey, the **National Geospatial Agency,** the **Department of Defense,** the **Department of Homeland Security,** and other federal and international agencies, a variety of imaging satellites have been acquiring daily both medium- and high-resolution imagery over flood-impacted areas of these five states. In Illinois, this image collection has been primarily focused over the Mississippi River floodplain from Rock Island County to the confluence of the Mississippi and Ohio Rivers in Alexander County.

Early Aerial Photos Available on ISGS Web Site



Funding status of early air photograph digitization.

During the past decade, the Illinois State Geological Survey (ISGS) has been engaged in an ongoing project to digitize the earliest aerial photographs of Illinois and to place them in a digital archive for online distribution through the Illinois Natural Resources Geospatial Data Clearinghouse (Illinois Clearinghouse). Funding from the **2008 Library Services and Technology Act (LSTA) grant** allowed the ISGS Library to digitize 953 photographs from four additional counties (Alexander, Jackson, Perry, and Randolph) and add them to the Illinois Clearinghouse. Through the ongoing collaborative efforts of the ISGS Library and the **Illinois State Library,** 62 of 102 Illinois counties are now Internet accessible.

As the ISGS and Illinois State Library worked toward completing the Illinois Historical Aerial Photography (ILHAP) project, more history about the aerial photograph collection was discovered. For instance, although the first aerial picture of Illinois was considered complete in 1939, further research revealed that two additional years were actually needed to get a "good" picture of the entire state. During the first four years of the original aerial photography, several new and improved aerial photographic techniques were established and standardized, leading to retakes of several thousand photographs in 1940 and 1941 over counties that were originally completed in 1936 and 1937. Well over 50,000 photographs were taken between 1936 and 1941, but only about 33,000 photographic prints from that period remain.

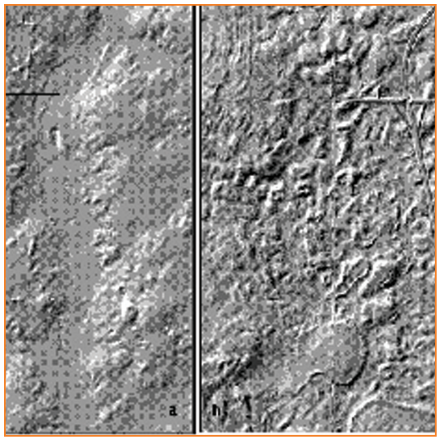
The original photographic prints were placed into controlled collections used by various government agencies and learning institutions. The **U.S. Department of Agriculture (USDA)** retained the immense collection of original cellulose nitrate film negatives until the 1960s when it transferred the collection to the **National Archives and Records Administration** (NARA) for safekeeping. Nitrate negatives, however, are unstable unless stored in climate-controlled areas. After a fire at a NARA storage facility in 1978, NARA decided it no longer wanted to store nitrate-based film and began a program to copy the original large-format nitrate film onto much safer, small-format acetate film.

Unfortunately, the original negatives that were destroyed were the early Illinois aerial photographs. Many of the resulting small-format duplicate negatives are of poor quality and produce unusable photographic prints. Thus, the existing contact prints made directly from the original negatives are the only reliable high-quality images that Illinois has as a record of its first statewide aerial picture, and these are deteriorating.

In March 2001, the ILHAP project was initiated at the ISGS to digitally capture these existing original prints using exacting standards and make those digitized images Internet accessible to an expanded audience. Today there is an overwhelming interest by the public to

view these aerial time capsules, yet securing funding to complete this archive has been, and will continue to be, a challenge. The hope is to complete the statewide archive so that once again the first picture of Illinois will be available for all to see.

Illinois Height Modernization Program Begins



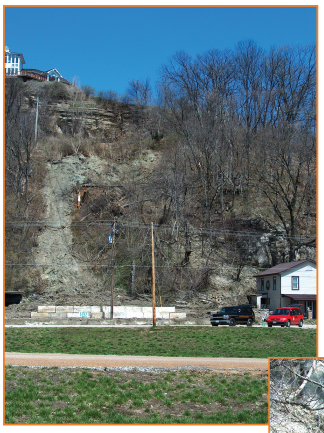
Quality comparison of current and high-resolution Digital Elevation Models (DEMs).

Every engineering project and many land-use planning efforts require accurate height measurement, which, in turn, requires a datum-consistent vertical and horizontal statewide network of survey benchmarks and a statewide high-resolution digital elevation model (DEM) of the Earth's surface. Unfortunately, Illinois currently falls far short of both goals and is ranked in the bottom ten states in the quality of its elevation data.

The **National Geodetic Survey** (NGS), part of the **National Oceanic and Atmospheric Administration,** provides funding to states through the Height Modernization Program to improve the quality of elevation data using global positioning satellite (GPS) technology in conjunction with traditional leveling, gravity, and modern remote sensing. Thanks to a budget initiative through **Representative Timothy Johnson's office,** Illinois joined this program in July 2008.

The long-term goal of the Illinois Height Modernization Program is to establish (1) a datum-consistent vertical and horizontal statewide network of survey benchmarks, and (2) a statewide high-resolution digital elevation model (DEM) of the Earth's surface based upon the updated network of survey benchmarks. During the first year of this multi-year project, the program will plan the long-term work, establish an infrastructure for data distribution, begin to recover existing benchmarks and establish new benchmarks, search out and begin to acquire existing DEM data sets from county or other governmental units, and initiate project outreach. The plan for future years, if funded, is to continue to establish benchmarks and to partner with other units of government to acquire new DEM data.

Grafton Landslide Investigated



Photographs of the landslide at Grafton, Illinois.

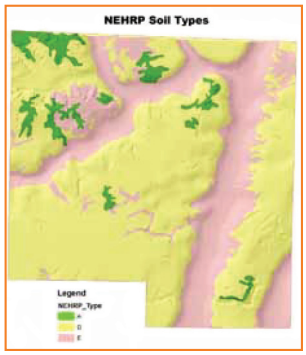
An earth slump landslide occurred within materials on a bench of limestone bedrock in Grafton. An ISGS engineering geologist, Bob Bauer, responded to an urgent request to evaluate the setting for the **Illinois Emergency Management Agency** (IEMA). The mayor of Grafton had closed State Route 100 until the threat of potential landslides onto the road was assessed. Material from high on the slope flowed down the slope, as did the thin soil on the bedrock face below the bench, and part of the lower part of the slide pressed up against the back of a house. The geologist supplied the city engineering firm and IEMA with information regarding the setting, borehole information, and diagrams and provided a list of possible mitigation issues to investigate.

The engineering geologist also provided pictures, locations, and descriptions of Illinois landslides to the **U.S. Geological Survey Landslide Center** after its staff saw press coverage of the Grafton landslide. Among the described images was a rock fall event along the Mississippi River north of Savanna and historic pictures of rock slumps in the same area in the 1920s. Also, pictures of landslides that damaged houses west of Peoria, Illinois, were provided.

While mapping in Calhoun County, Illinois, for the STATEMAP program, two ISGS geologists visited a landslide located on a property just below Tara Point Inn in Grafton. A scarp had developed in the Hannibal Shale, which is about 50 to 60 feet thick in this area and overlies Silurian age dolomite. The Hannibal Shale can turn into a greenish claystone and become very unstable. A perched groundwater table, due to a large amount of rainfall and a small pond, contributed to the slide. Jointing of the carbonate rocks above the Hannibal Shale yielded a great deal of water, which further exaggerated the slump.

Earthquake Preparedness Information for Winnebago County

During fall 2007, engineering geologists at the ISGS produced a report and several maps for consultants to Winnebago County to use for their county hazard mitigation plan. Using existing maps of the layers and thickness of materials resting on bedrock, the geologists produced a map that indicated how much these materials will amplify earthquake ground motions. The customized map was specifically designed to be used in a computer loss estimation program to provide estimates for damage to buildings and infrastructure from earthquakes. The report outlined the techniques that were used to generate the map.



National Earthquake Hazard Response Program (NEHRP) soil types superimposed over the bedrock elevation map for Winnebago County.

Imaging Process Enhances Seismic Hazards Assessment

ISGS Geophysics Section staff gather geophysical data.

The ISGS Geophysics Section continues to broaden applications for near-surface geophysics, including seismic reflection, ground-penetrating radar, and electrical, magnetic, and other geophysical methods for stratigraphic imaging. New improvements in data acquisition, processing, interpretation, and modeling have led to larger surveys with higher temporal and spatial resolution.

The new techniques for processing and visualization of large amounts of data have enabled more sophisticated stratigraphic interpretation. For example, the seismic group acquires an average of 35 miles of seismic data along secondary roads in Illinois every year using the multi-channel land streamers they built. The acquired data are processed and interpreted in conjunction with complementary information from shallow drill holes, samples, and an understanding of materials to provide the best possible image of the upper 150 m of the shallow subsurface.

The quality and efficiency of seismic data acquisition were recently enhanced by the adoption of an advanced self-oriented downhole geophone and new downhole seismic analysis software. The acquisition and processing of downhole seismic data are now almost three times faster than before. The measured downhole seismic data (seismic P-wave and S-wave velocity vs. depth) will be used initially to calibrate the seismic reflection data. ISGS staff also intend to integrate the data acquired from each surveyed site to describe the velocity structure of the major glacial units at the location. This new characterization of the glacial sediments will provide key information for seismic hazards assessment studies.

April 18, 2008, Mt. Carmel, Illinois: Magnitude 5.2 Earthquake and Aftershocks

At 4:37 a.m. on April 18, 2008, Illinois experienced a 5.2 magnitude earthquake that was felt in 18 states. The quake epicenter was located about six miles northwest of Mt. Carmel, Illinois, in the Wabash Valley Seismic Zone. This area was the location of previous magnitude 5 earthquakes in 1968 and 1987. The 1968 magnitude 5.3 earthquake was the largest recorded in the central United States since 1895.

On the day of the quake, ISGS staff provided information to the **Governor's Office, Illinois Emergency Management Agency** (IEMA), and the public through approximately 20 press interviews

and continuous updates to the ISGS Web site. ISGS staff coordinated deployment of portable recording seismographs near the main shock epicenter by representatives of the **Center for Earthquake Research and Information, University of Memphis,** and by **Indiana University.** The damage in towns within about 30 miles of the earthquake was documented. Over two dozen aftershocks of magnitude 1.0 or greater were recorded, and ISGS staff continue to monitor these events and communicate information to the public.

1904 Berry School, Mt. Carmel, Illinois, showing the collapsed chimney and missing bricks that resulted from the April Illinois earthquake.

The ISGS had a staff member at the **State Emergency Operations Center** in Springfield who helped write several press releases for the Governor's office and IEMA. Text was also provided for IEMA and **Department of Homeland Security** Web sites. Additionally, ISGS staff, the IEMA director, and a representative from the **Department of Insurance** participated in the State's press conference. Historical earthquake information about the area of the earthquake and expectations for aftershocks were also communicated to the representatives in the State Emergency Operations Center.

Damage in Illinois was recorded by two ISGS geologists on the day of the main shock. The geologists documented the nonstructural damage to chimneys, parapets, grave markers, and television antennas in many towns in roughly a 30-mile radius of the epicenter. They documented one building where brick walls fell inward, causing the apartment building to be condemned.

Earthquake Preparedness Planning Continues

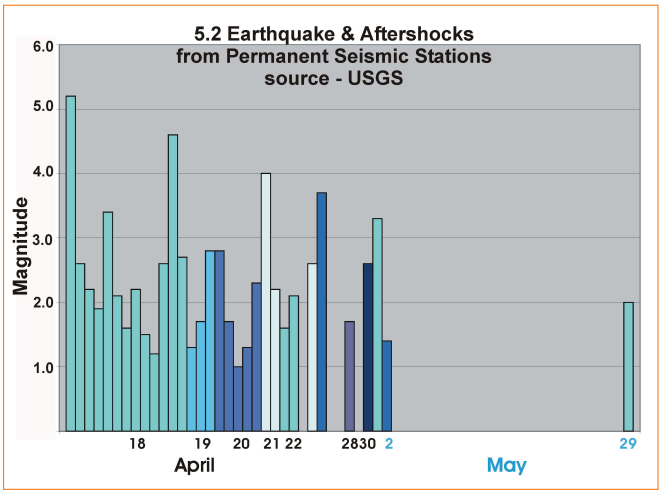
After the April 2008 earthquake and as part of its ongoing planning efforts, the ISGS participated in the meeting of the **Federal Emergency Management Agency** (FEMA) New Madrid Catastrophic Planning project in Champaign, Illinois. This meeting of the **Mid-America Earthquake Center, FEMA, George Washington University, Central United States Earthquake Consortium** (CUSEC), **CUSEC State Geologists,** and **U.S. Geological Survey** reviewed the progress and direction of a New Madrid earthquake scenario impact on eight states. The eight states involved are Illinois, Indiana, Kentucky, Tennessee, Missouri, Arkansas, Mississippi, and Alabama. ISGS engineering geologist Bob Bauer serves as the CUSEC state geologists' representative for the FEMA planning. Since January, the ISGS has been working with representatives from the eight states in the area to produce two maps for each state showing how the soils overlying bedrock would behave during an earthquake. Maps showing soil classified by its susceptibility to amplification and liquefaction were completed and formatted for use in an earthquake loss estimation computer program. The estimation for this project will show impacts in each of the four FEMA regions in the area and will also be used in a few years as the basis for a New Madrid earthquake exercise for the eight-state region.

ISGS engineering geologist Bob Bauer made two hour-long presentations at the New Madrid Fault Region Earthquake Preparedness Conference, sponsored by the **University of Illinois Extension Office** and held in Metropolis, Illinois, on May 6, 2008. The presentations covered the history and impact of earthquakes in the central United States. Handouts to the 150 meeting participants included links to various online publications related to preparedness and mitigation for homeowners and facilities. Additionally, the staff member was interviewed by two television stations in Paducah, Kentucky, about preparedness and about the April 18, 2008, Illinois earthquake.

A presentation also was made to the **Illinois Community College Board** in Godfrey, Illinois, on the history and impacts of earthquakes in the central United States. Information was distributed on evaluating potential earthquake impacts on college campuses and mitigation techniques.

Post-Earthquake Information Management System

Robert Bauer was an invited participant in a workshop on July 22–23, 2008, in Chicago for the **University of Illinois Civil Engineering Department** project to create a Post-Earthquake Information Management System. The workshop included experts from across the country who are involved in post-earthquake response and recovery. Bauer is involved with the **Central U.S. Earthquake Consortium** State Geologists in setting up post-earthquake technical clearinghouses in each state following a large earthquake. The July workshop will result in a scoping document on how to move forward on such a project to produce the information system. One of the suggestions was to use such a system in the clearinghouses or headquarters during the proposed 2011 New Madrid earthquake exercise in the central United States.



April 18, 2008, earthquake and aftershock graph.

Wetlands and Environmental Assessments

Tollway Runoff Monitoring Project Begins

Wetland scientists at the Illinois State Geological Survey began a 3-year project monitoring water quality for the **Illinois State Toll Highway Authority.** The project goal is to determine the effectiveness of bioswales that are now under construction along a section of I-294, which is being widened.

Charles Knight, ISGS scientist in the Wetlands Section, collects discharge data from a roadside ditch at the future site of a bioswale along I-294 in Des Plaines, Illinois.

Bioswales, or vegetated wetland drainageways, are intended to lessen the impact of contaminants from tollway runoff on groundwater quality. The bioswales are intended to increase runoff contact time with wetland vegetation and soils, which transform nutrients and remove suspended sediment and certain other pollutants.

The first phase of this project involves the emplacement of automated samplers, flow meters, and water-quality data loggers at three stations along the tollway. The information provided by these instruments will help the scientists to monitor runoff prior to construction of the bioswales and to establish the baseline loads of target contaminants leaving the roadway onto adjacent lands owned by the **Forest Preserve District of Cook County** or directly into the Des Plaines River. Later phases will measure the effectiveness of the bioswales after construction and compare the quality of runoff discharged by the bioswales to the present load.

Preliminary Site Assessments

The Environmental Site Assessments Section of the ISGS conducts 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. Site assessments are conducted in all nine IDOT districts and can range in scope from work at intersections to major bridge and highway projects. Potential hazards identified by ISGS work can then be avoided, remediated, or mitigated, depending on IDOT project needs. During the period covered by this annual report, the section completed 107 site assessments for IDOT.

Interstate 355 Extension Opens

Illinois State Geological Survey staff members played a large role in the environmental studies for the I-355 tollway south extension from I-55 to I-80, which opened on November 11, 2007. Beginning in 1989, various proposed alignments were evaluated for their potential

Site assessment equipment during the environmental studies along the I-355 extension route from I-55 to I-20.

for hazardous waste, and the results of those studies were used in alignment selection. The studies continued through 2002, when specific parcels to be acquired were assessed for potential environmental hazards in a cooperative agreement between the **Illinois Department of Transportation** and the **Illinois State Toll Highway Authority.**

Significant delays in construction were caused by the presence of the Hines emerald dragonfly, a federally endangered insect that inhabits seeps along the tollway route in the lower Des Plaines River valley. Scientists at the ISGS were involved in several phases of habitat planning for the tollway. Involvement began in the early 1990s with a study on the impacts on dragonfly habitat from the potential reduction of seep discharge caused by the loss of infiltration from new impermeable roadway surfaces. Routing and design alterations were suggested at that time. The ISGS is currently working to help mitigate the tollway's impacts on the dragonflies by studying the hydrology and geochemistry of the current dragonfly habitats to help design new dragonfly habitat restoration areas.

ISGS Provides Environmental Work for Mississippi River Bridge

On Monday, December 17, 2007, the McKinley Bridge, which connects Venice, Illinois, to St. Louis, Missouri, reopened to traffic. Built in 1910 for rail lines, the bridge was closed in 2001 for major reconstruction. ISGS Environmental Site Assessments staff conducted environmental studies for the **Illinois Department of Transportation** prior to the rehabilitation of the bridge, which included evaluation of potential excavation sites for the presence of hazardous waste. Formerly a toll bridge, the bridge has reopened as a toll-free bridge and now has lanes devoted to bicycle and pedestrian traffic.

McKinley Bridge connecting Venice, Illinois, to St. Louis, Missouri.

Public Outreach

2008 ISGS Open House Attracts Large Crowd

More than 1,500 visitors enjoyed 34 exhibits, demonstrations, and hands-on activities presented by Illinois State Geological Survey scientists and others at the 2008 ISGS Open House held on Friday, March 7, and Saturday, March 8. More than 450 students, teachers, and chaperones had advance reservations for Friday. These class field trips were only a portion of the visitors who gathered during the most heavily attended Friday morning in ISGS Open House history. The kids loved the exhibits, the teachers were interested and entertained, and the exhibitors were excited to share their professional expertise with visitors.

Bill Dey demonstrates how groundwater moves through the subsurface.

In addition to more than 100 ISGS staff participants, exhibitors included representatives from the **Illinois Department of Commerce and Economic Opportunity,** the **Illinois Clean Coal Institute,** the **Illinois Natural History Survey Mobile Science Center,** and the **University of Illinois Geology Department.** Invited guests in attendance included State Senators Michael Frerichs and Dale Righter, State Representative Naomi Jakobsson, representatives from the offices of Senator Barack Obama and Senator Dick Durbin, and University of Illinois Chancellor Richard Herman.

At 8:00 a.m. on Saturday, with the wind chill factor hovering near zero, almost 200 runners and walkers braved the cold and lined up for the first ISGS Earth, Wind, and Fire 5K Run and 2.5K Walk. This was an amazing level of participation for a first-time event. Andy Derks of Charleston finished the run in first place with a time of 15:50. Elane Jones of Savoy won first place for the walkers. Illinois Senator Dale Righter was the Overall Male Masters winner.

Bob Vaiden's Build Illinois exhibit is a major draw at the 2008 ISGS Open House.

Festival of Maps Chicago

A portion of the ISGS exhibit at the Richard J. Daley Civic Center, downtown Chicago, as part of the citywide Festival of Maps Chicago. The exhibit ran from November 5 through December 5, 2008.

"Geological Maps: Understanding the Complicated World Beneath Our Feet" was the title of the ISGS exhibition that began November 5, 2007, and continued through December 5, 2007, at the Richard J. Daley Civic Center, 50 West Washington, Chicago, Illinois. The ISGS was one of 30 institutions participating in the citywide Festival of Maps Chicago, which ran from November 3, 2007 into 2008. The Festival was a "citywide celebration of humanity's greatest discoveries and the maps that record our boldest explorations" that aimed to inspire and educate the public.

Several ISGS scientists worked with ISGS editors and designers to produce the broad range of map materials for the exhibit. Included in the 30-panel display, and of special interest to Chicago residents, were the historic and current aerial images of the Chicago Loop area, a recent geologic map of Chicagoland, and information and images of Lake Michigan shoreline mapping, the meteorite impact area that touches O'Hare, and the Chicago flood. Also included was a visual history of statewide geological maps from the 1800s to the present. Other maps pertained to global climate change; energy, mineral, and water resources; potential engineering and earthquake hazards; and areas susceptible to groundwater contamination.

The maps on display represented only a tiny fraction of the detailed information that is available from the Illinois State Geological Survey for use by Illinois citizens. The exhibit was intended to raise awareness, especially in the Chicago metropolitan area, of the existence and scope of this information and its critical importance as the foundation for informed resource decision making.

The ISGS was the only downstate agency represented in the Festival. Some of the most well-known other participants were **Adler Planetarium, The Art Institute of Chicago, Brookfield Zoo, Chicago**

Botanic Garden, Chicago History Museum, The Field Museum, Illinois State Museum Chicago Gallery, Museum of Science and Industry, Newberry Library, and **University of Chicago.**

After the festival, 26 of the ISGS exhibit panels were installed on the first floor of the Natural Resources Building on the University of Illinois Urbana-Champaign campus to inform visitors to the ISGS headquarters of the scope of the ISGS mapping program.

ISGS Public Field Trips

Approximately 100 people attended each of the ISGS Geological Science Field Trips offered during fall 2007 and spring 2008. The fall 2007 trip, offered in September and again in October, highlighted the geology and natural resources of **Pere Marquette State Park** and the surrounding areas in Jersey and Madison Counties. The participants on this trip learned much about the history of the limestone industry and its importance to the development of the area at stops visiting active and abandoned limestone quarries, historic Grafton, and Piasa Park. Piasa Park also offered the opportunity for the visitors to learn about the history of the Piasa Bird image. The group had a chance to view displays about the historical and cultural significance and the ecological, transportation, and commercial importance of the Mississippi, Missouri, and Illinois Rivers at the National Great Rivers Museum and the Melvin Price Locks and Dam south of Alton. Along the trip route, participants had the opportunity to collect fossils, including *Gravicalymene celebra,* one of the most famous trilobites in the Midwest, and mineral specimens, including geodes. Evidence of ancient faulting and folding of rocks and the relationship between geology and biodiversity were seen and discussed along the Goat Cliff Trail at Pere Marquette State Park.

Participants on the Pere Marquette field trip listen to the legend of the Piasa Bird, as they view its image on the limestone bluffs at Piasa Park, Alton, Illinois.

Horseshoe Lake field trip participants at Orchard Creek, Rock Springs Hollow Section, examining exposures of Upper Ordovician age Girardeau Limestone.

The spring field trip, held in April and again in May 2008, was to the **Horseshoe Lake State Conservation Area** within Alexander County. The trip stops focused on river processes and the many faults and fractures in the area. Participants viewed the landscape changes that followed the Santa Fe Levee breach during the Great Flood of 1993. At Horseshoe Lake, they learned that this oxbow lake was formed approximately 6,000 years ago when the Mississippi River changed course, cutting off a large meander. Participants then stopped to see an excellent view of the ancient Ohio River valley and had an opportunity to discuss the geological history and changing course of the Ohio River. They also were able to see a number of faults and fractures and examine a rare exposure of a graben (a downthrown block of bedrock bounded by two faults) within the quarry highwall. Quarry stops also provided opportunities to collect agates and loess kindchen (unusually shaped calcareous concretions that form in loess deposits) and to learn about the limestone, novaculite, and tripoli industries. As expected, given the number of faults seen on the trip route, among the questions answered by the ISGS geologists were several concerning southern Illinois' 5.2-magnitude April 2008 earthquake and its relationship to the New Madrid Seismic Zone.

Geologic Mapping Effort Contributes to Local Community Education

Geologists and hydrogeologists working on the **Great Lakes Geologic Mapping Coalition** project are mapping the surficial geology of Lake County, Illinois. The goal of the project is to map, in three dimensions, the geology from land surface to top of bedrock. To accomplish this, an extensive program of drilling is being used to acquire continuous high-quality core samples of the sediment. At each borehole location where significant deposits of sand and gravel are encountered, a groundwater observation well is installed to monitor long-term water levels in the aquifer. Several dozen wells are now emplaced throughout the county. One such observation well was installed at the Deer Park village hall site near a historic barn that has been restored to serve as a facility for village hall meetings and community events and as a museum and education center.

Following discussions with Mike Barnhardt, the ISGS project leader, staff from the education center invited the ISGS to provide material for a display at the site. In response, several ISGS staff members prepared a multi-panel poster for permanent display that illustrates the glacial history, sediments, and hydrogeology at county scale and also of the local Vehe Farm

ISGS exhibit at Vehe Farm, illustrating the glacial history, sediments, and hydrogeology of the area.

area. Specific parts of the display discuss the depositional history of the geologic materials as interpreted from the sediment sequence encountered in the borehole. Also discussed is the installation of the observation well and how it will be used to better understand the behavior of the aquifers in the area. An aerial photographic history of the Vehe Farm area from 1939 to present is shown. The local and regional geology and hydrogeology are discussed in separate panels, which include graphics illustrating groundwater flow, the hydrologic cycle, types of aquifers, and terminology commonly used in discussions concerning groundwater.

The exhibit is intended to provide a basic understanding of geological issues for the layperson. Additionally, two types of drill bits used during the borehole drilling are displayed on a shelf especially constructed for our exhibit. Samples of the sediment encountered during the drilling are shown as well. Samples of the modern soil, diamicton, sand, silt, and bedrock—cut from the original core—are on display, and their core position is described. A 4-minute video of the drilling, sediment retrieval, and well installation is available for play in a kiosk in the visitor welcome area. This video was recorded during the drilling in late 2006 by the ISGS staff photographer. Additional materials suitable for community teachers are being prepared. Already, local schools have expressed interest in water sampling from the well and information about groundwater resources and glacial history.

Field Trip on Geology and Earthquakes in Southwestern Illinois

ISGS staff and Missouri scientists conducted a field trip for about 50 participants concerning geology and earthquake effects in southwestern Illinois during October 2007. Attendees represented the insurance industry, city government, regional and Scott Air Force Base emergency managers, risk managers, hospital administrators, and the National Guard.

Field trip participants tour a cave in southwest Illinois to see firsthand the impact of past earthquake events.

The trip participants viewed seismic retrofit of bridges crossing the Mississippi River and approach bridges to this crossing, learned the geologic history of the American Bottoms, heard historical accounts of damage from past earthquakes, toured a cave that had been impacted by previous earthquakes, and viewed a feature in the soil produced by a past earthquake near Edwardsville, Illinois. The ISGS produced a 90-page field guidebook for the trip.

Professional Meetings

Conference on Illinois River System Management

The **11th Biennial Governor's Conference on Management of the Illinois River System** attracted more than 400 participants, a record number, from federal, state, and local agencies and the general public. The ISGS, one of the conference sponsors, was active in several aspects. The ISGS staff participated in a technology workshop on mapping applications and data available from the ISGS. Staff also organized a topical session, presenting two talks, one on the geologic and cultural history of the Illinois River and a second on the monitoring efforts of a floodplain restoration project at the mouth of the La Grange River. The ISGS also sponsored a general information booth.

University Efforts in Hydrologic Advancement

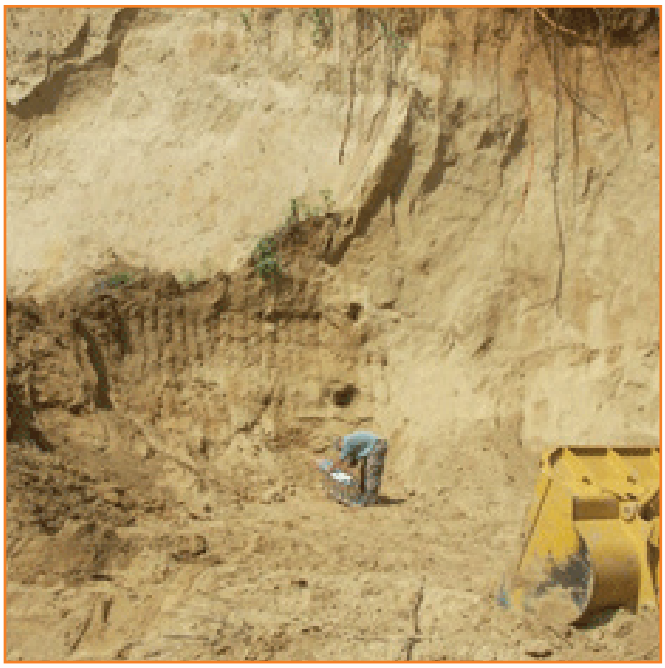
Three staff members attended the **Consortium of Universities for the Advancement of Hydrologic Sciences, Inc.** (CUAHSI) regional meeting in Deerfield, Illinois, on October 12, 2007. The consortium is seeking collaborators for the Geophysics Module of its Hydrologic Measurement Facility (HMF-Geophysics), based on experience from a pilot project funded by the **National Science Foundation.** The objective of HMF-Geophysics is to enable hydrologists to better use near-surface geophysical techniques as an integral part of their research. The primary role of HMF-Geophysics collaborators will be to perform short-term feasibility studies to assess the applicability of various geophysical techniques for hydrologic problems. Additional services include consulting with hydrologists on possible approaches; education of the hydrologic community about near-surface geophysics through presentations at professional meetings, development of educational materials, and organization of workshops; and identification and engagement of geophysicists at other institutions who are interested in collaborating with hydrologists on projects.

At the meeting, the ISGS staff met with CUAHSI Executive Director Rick Hooper to discuss opportunities for the ISGS Geophysics Section to collaborate with CUAHSI institutions in solving hydrologic problems related to groundwater-surface water interactions and shallow groundwater contamination. The extensive ISGS expertise in shallow geophysical methods to map and characterize aquifers should be of value to CUAHSI field projects, and the project will provide opportunities for ISGS scientists to collaborate with other top U.S. geophysicists and hydrologists on problems involving the characterization of shallow geology. The collaboration should also provide opportunities for developing new methods and in-house expertise that can be directly applied to other ISGS projects.

ISGS Researchers Active at North-Central GSA

Four ISGS geologists co-led two field trips for the **North-Central Geological Society of America (GSA) meeting** in Evansville, Indiana. Thirty people from Maryland, Ohio, Pennsylvania, Nebraska, Missouri, Iowa, Indiana, and Kentucky attended the first trip, which covered the Illinois-Kentucky Fluorite District in southern Illinois and northwestern Kentucky. One of the trip highlights was the stop at the Hastie Mining Company quarry, the only place in Illinois where fluorite is currently mined as a by-product of the limestone quarry operation.

The second field trip, which focused on conodont locations, was organized by the Pander Society, a group of conodont enthusiasts organized in 1967. Conodonts are of great value in biostratigraphy, particularly in Silurian through Pennsylvanian age rocks. Conodonts undergo successive color changes with temperature of burial and can be used as an index to evaluate hydrocarbon-bearing rock. The field trip visited four sites in southwestern Indiana where conodonts are known to occur in Pennsylvanian rocks. These sites were an outcrop of the Lead Creek Limestone, a surface coal mine showing Middle Pennsylvanian coal-bearing rocks, a box cut serving as the portal to an underground mine where Middle Pennsylvanian rocks are exposed, and the type outcrop of the West Franklin Limestone. The field trip was co-led by a retiree from the Indiana Geological Survey and a coal geologist who works as a consultant for Marshall Miller Co. in Evansville. For this trip, an ISGS geologist led the stop that discussed aspects of Pennsylvanian stratigraphy, sedimentation, and conodonts in southwestern Indiana.



Thick Peoria Silt loess near Owensboro, Kentucky, is being studied to correlate the paleosols with similar loess-paleosol sequences in southern Illinois. This loess was deposited between 25,000 and 11,000 years ago.

Contributions to American Geophysical Union Focus Groups

The ISGS Geophysics Section is involved in state, national, and international programs related to geologic risks and natural and human-induced geologic hazards. The impacts of such hazards continue to increase around the world. The growth of human societies and their escalating complexity and a changing climate will cause the risk associated with geohazards to be even greater in the

From left to right: Yevgeniy Kontar, Illinois State Geological Survey; Ramesh Singh, Indian Institute of Technology; and Frank Rack, ANDRILL, University of Nebraska-Lincoln, are among those scientists meeting on the topic of geologic risks and natural and human-induced geologic hazards.

future. The ISGS Geophysics Section is contributing to the understanding of these issues in several ways. One response includes the Geophysics Section's participation in the new **International Natural and Human-Induced Environmental Hazards and Disasters Research Program,** which would focus on environmental hazards related to geophysical trigger events. This program is supported by the **American Geophysical Union (AGU) Near Surface Geophysics Focus Group,** which was formed two years ago and now has approximately 2,000 members. Many members in the focus group had an interest in applying geophysical methods to assess natural hazards. In response, a new AGU focus group, the Natural Hazards Focus Group, was organized during fall 2007.

Staff in the ISGS Geophysics Section significantly contributed to the activities of both AGU focus groups by conducting oral and poster presentation sessions and by organizing and convening sessions on the impact of natural and human-induced hazards that addressed topics from around the world.

Hosting the 54th Friends of the Pleistocene Field Conference

The Illinois State Geological Survey hosted about 115 geologists for the **54th Friends of the Pleistocene Field Conference,** The Deglacial History of Northeastern Illinois. The conference was based in DeKalb, Illinois. The field trip led by Brandon Curry included stops that featured topics ranging from Paleozoic cave fills containing fossils of the earliest conifers; beds of sand and gravel folded and faulted by overriding glacial stresses about 18,000 years ago; and the Aurora mastodons at Phillips Park, including three remarkably well preserved skulls and toothed jaws that have recently been radiocarbon dated.

Attendees examine glacial deposits at one of the field trip stops at the ISGS-hosted Friends of the Pleistocene field trip.

The trip included discussions of multiple deglacial floods that affected the geomorphology and sediments of the Illinois River valley. The group looked at evidence of the oldest known torrent of 19,000 year ago—a large, linear gap across the Marseilles Moraine located between the towns of Oswego and Yorkville. The gap is underlain by 30 feet of lake sediment containing fossils of tundra plants, which provided material for the radiocarbon dating of the event. Also featured was a stop at a DeKalb mound. Thought to be the deposit of an ice-walled lake, this landform and other DeKalb mounds located throughout northeastern Illinois have yielded fossil tundra plants that have been radiocarbon dated. The results are providing new details and new insight into the deglacial history of northeastern Illinois. For example, stable isotopic ratios ($^{18}O/^{16}O$) indicate that the lakes were filled with water other than glacial meltwater.

Wedron Quarry was also visited to allow field trip participants to examine the type section of the Wedron Group, the unit that comprises tills and related deposits of the last glaciation. Featured at this stop was a discussion of the glacial stresses that resulted in evidence of strain during sedimentation. An introduction to the geology of northeastern Illinois and discussion of the geology of the field trip stops were published as ISGS Open File Series 2008-1.

Addressing Geologic Hazards through International Ocean Drilling Program Workshop

The Illinois State Geological Survey contributes to the **International Ocean Drilling Geo Hazard Program** (IODP) by developing the **Coastal Zone Geo Hazard Geophysical Observation System** based on offshore drilling platforms. As was dramatically shown by the Sumatra earthquake and associated tsunami of late 2004, the oceans are the source of some of the most severe geologic hazards.

The workshop, which convened in Portland, Oregon, August 26 to 30, 2007, was designed to establish the current state of community knowledge and activity in the area of submarine geologic hazards and to address a series of focused questions. In particular, investigations of geologic hazards through scientific ocean drilling still face many obstacles. The understanding of the necessary conditions and triggers for catastrophic geologic events (e.g., landslides, earthquakes, and tsunamis) is incomplete, and instruments for making in situ or remote measurements of the geotechnical and other material properties of the rocks and sediments involved are limited.

Key goals of the workshop were to define outstanding research questions that can be addressed through scientific ocean drilling, establish scientific priorities, identify potential drilling targets, evaluate existing technologies and scientific approaches, and formulate strategies to overcome anticipated scientific and engineering challenges. The workshop enhanced international collaborations and stimulated teams of proponents who are expected to develop competitive IODP proposals addressing oceanic geologic hazards.

Petroleum Technology Transfer Council Workshops

The **Petroleum Technology Transfer Council (PTTC)** held two workshops co-sponsored by the **Midwest Region PTTC** and the **Illinois Geological Society** on February 18 and March 5, 2008. The February workshop was held in Mt. Vernon, Illinois, with 65 attendees. Jon Olson, an American Association of Petroleum Geologists (AAPG) 2008 Distinguished Lecturer and Professor of Petroleum Engineering, University of Texas at Austin, presented information on modern fractured reservoir theory and fractured reservoir characterization methods and provided examples of applications that can be helpful in dealing with the challenges in a wide array of Illinois Basin reservoirs.

The second PTTC workshop highlighted findings from a three-year **U.S. Department of Energy**-funded contract. The workshop focused on lower Paleozoic reservoirs in the Illinois Basin. The March workshop was conducted in Evansville, Indiana, as a pre-convention workshop of the annual **Illinois Oil and Gas Association** Meeting. There were 118 attendees who heard 11 presentations by ISGS staff, including presentations about five newly completed reservoir studies.

Active Projects

Office of the Director

Economic Costs and Benefits of the ISGS Geologic Mapping Program. S. Wald.

Height Modernization (Year 1). B. Herzog, S. Beaverson, D. Luman, C. Stohr, L. Young, S. Wald.

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

Geophysics

Application of Waterborne Geophysics in Illinois: Perspectives and Challenges. Y. Kontar.

Bedrock Geophysical Borehole Database. C. Blakley.

Characterization of Bedrock Hydrogeology for Northeastern Illinois Water Supply Planning. C. Blakley, D. Keefer, D. Larson, J. Thomason.

Digitization of Historic Electrical Earth Resistivity Survey Reports and Files. T. Larson, T. Young.

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