Revealing the Past, Discovering the Future



Illinois State Geological Survey Annual Report 2005



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Revealing the Past, Discovering the Future

Annual Report 2005

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ILLINOIS STATE GEOLOGICAL SURVEY

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Contents

From the Chief	3
The Year in Summary	8
Active Projects	14
Centenial Celebration	22
Centennial Lecture Series	24
Centennial Celebration Donors	27
Century of Achievement	28
History of the Geologic Map	28
ISGS Publications	34

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From the Chief

As you may know, from May 2005 to May 2006, the Illinois State Geological Survey is celebrating the centennial of its legislative reincarnation in modern form (the original Illinois Geological Survey functioned from 1851 to 1875). T.C. Chamberlain, professor at the University of Chicago and arguably one of the greatest geologists of all time, urged then-governor Charles Dineen to re-institute the Survey, which he did through legislation enacted and signed in May 1905.

During the past century, the ISGS has established an enviable reputation for providing objective earth science information to public, private, and state institutions in Illinois; these institutions, companies, and citizens have come to depend on us for information critical to their economic development and environmental security. I don't think anything I have written or seen written about us can better illustrate that dependence and appreciation than the following lead paragraphs from a memo circulated to the residents of the Village of Lake Barrington. Our Wetlands Geology Section is providing advice to help guide Lake Barrington city planners in making decisions. I received this copy recently (November 2005) from the Village president and city planner who were addressing their constituents in regard to a housing development near a fen and nature preserve:

We are pleased to update you on several items related to the . . . subdivision and the issues related to the . . . Nature Preserve.

1. Illinois State Geological Survey (ISGS) Study Participation.

<u>ISGS Expertise to Assist Lake Barrington.</u> The Village is extremely pleased to announce that the ISGS has confirmed that it will work with . . . Lake Barrington's environmental and engineering experts in assessing the scientific and technical issues associated with the proposed . . . development [their italics], including the design of a groundwater flow study and the corresponding placement of the testing piezometers associated with the study.

<u>ISGS Viewed as Subject Matter Expert for Key Governmental, Non-Governmental Stakeholders</u>. The participation of the ISGS is particularly important because a number of the stakeholder agencies involved in the consultation process, including the Illinois Nature Preserves Commission (INPC), the Lake County Forest Preserve District (LCFPD), and Citizens for Conservation (CFC), have indicated that <u>they view the ISGS as being the lead agency for them in providing</u> <u>technical</u>, scientific, environmental and engineering analysis on the issues involved in the proposed development.



I underlined the last sentence and view this unsolicited statement as capturing the essence of our value to the citizens of Illinois. Similar statements could have been and have been made about virtually every aspect of the Survey's program, and it is the Survey's intent to continue this tradition of providing solid, credible, and objective science as it serves the ISGS in its second century.

During this special year in our history, we have taken the opportunity to sponsor a number of products and high-profile events to reaffirm, in both our staffs' and our citizens' minds, the value that this institution brings to the state through its research and service programs in earth science. Among those events and products are the first-ever comprehensive book, the *Geology of Illinois*, to be published next summer, the recompiling and publishing of the new *Bedrock Geology of Illinois* map, printed through a gift to the Centennial fund from the **Illinois Association of Aggregate Producers**, the sponsoring of several special field trips, hosting and sponsoring the 97th annual meeting of the Association of American State Geologists (AASG), hosting the 51st Friends of the Pleistocene annual field trip, hosting the 50th Midwest Ground Water Association's annual conference, and sponsoring a series of eleven public lectures by high-profile scientists and authors, ranging from Apollo 17 astronaut Harrison (Jack) Schmitt to author Simon Winchester. The events listed herein have already taken place, and the first two of our Centennial Public Lecture Series speakers, astronaut Schmitt and science author Kevin Krajick, have led the Series with well-attended lectures that have attracted considerable media attention. Our Centennial Committee also is planning a Survey Open House for the public during spring 2006 that will feature exhibits, demonstrations, and hands-on activities.

Our Centennial activities are making more Illinoisans than ever before aware of our presence and of the programs we carry out on their behalf. A good indication of the Survey's health and of the high regard in which it and its programs are held is the fact that nearly all of our Centennial events and products have been supported by funds donated to us by employees, past and present, friends of the Survey, and many of our major clients throughout the state. To date, we have received more than \$135,000 in donations, not counting the "in-kind" support we have received for our field trips and meetings.

I think you will see in the past year's publications and activities the fruition of our major research thrusts in energy and geological mapping. Among the manifestations of our changing directions and priorities are the large number of geologic maps released this year and the award of a significant, \$14 million grant from the **U.S. Department of Energy.** This grant will allow us to pursue a second phase of testing aimed at providing for geologic disposal of carbon dioxide from various industrial processes, the most important being power plant emissions. I firmly believe that, to make Illinois' Saudi-Arabia-size energy resource available for economic growth in the state and for energy security in the nation, we must team up with our colleagues in academia, state government, and the private sector to develop strategies for using coal in a more environmentally benign and effective way. The commercialization of our coal washing technology by **Dynamic Separations, Inc.,** a new company formed in Champaign by a group of venture capitalists, is a further measure of our commitment to seeking novel ways to support the coal economy of the Illinois Basin.

We have been able to accomplish much over the past year, despite the constraints placed on us by the state government's poor economic situation and our non-competitive salary structure. Our demographics are such that, at the time of writing this, we face the prospect of replacing 28 members of our staff over the next two years, a daunting challenge in these times of contraction of state funding. Most of the positions we must fill are being vacated by experienced scientists who are retiring and taking a wealth of specialized expertise and an extensive "corporate memory" with them. I have adopted a policy of allowing those scientists who choose to do so to stay on to continue to contribute to our research on a voluntary basis, an option that many have chosen to accept. Nevertheless, as we fill these positions, the character of the Survey will inevitably change in concert with shifts in research emphasis to better serve a changing society. Programs in three-dimensional geological mapping and Geographical Information Systems, shallow geophysics, bedrock and glacial geology, low-temperature geochemistry, and coal research will be strengthened while we maintain strong capabilities in other areas of research that are already strong, especially those related to minerals, energy, and water.

When I report to you next year, I hope that we will have been able to recruit to fill our research staffing gaps effectively and that the diversity and accessibility of our products and services will continue to increase.

I should also point out that the ratio of state-appropriated funding to funding generated by grants and contracts (G&C) has evolved from a ratio of approximately 60:40 when I arrived here a little more than 10 years ago to about 49:51 at the present time. I feel that to maintain our cutting-edge and proactive research program, based in Illinois and focused on Illinois problems, we must maintain and supplement our appropriated funds while continuing to make our G&C funding grow. I am firmly committed to vigorously pursuing increased G&C funding, particularly from federal sources, but I am concerned that if we allow our state-appropriated funding to slip to the point where we are simply responding to contract demands, as has happened with other state geological surveys, our core research program, which should allow us to anticipate Illinoisans' earth science needs, could shrink to the point where we could no longer be as capable of anticipating those needs and could not easily provide matching funds for federal grants.

Thus, it is important to me to strive to preserve an appropriate funding-source formula and an appropriate placement in state government that will allow us to continue to serve the citizens of Illinois as effectively as we have during the past century.

Toward this end, my fellow chiefs and I are continuing discussions with the Illinois Department of Natural Resources (IDNR) and with the University of Illinois about the formation of an Institute for Natural Resources (or Sustainable Development) that would embody the reality of our fundamental research and service missions for the citizens of Illinois. An Institute also would resolve the fundamental differences and strengthen the commonalities between the Surveys' missions and those of IDNR and the University. If located within the University, we certainly would bring considerable strength to President White's strategic vision, which includes major efforts in sustainability and energy research. One of the principal advantages of being wholly located within the University, in common with the 20 or so other state geological surveys that are so located, is that we could better adjust our salary structures to allow us to compete more effectively with this and other universities for top-level scientific and technical staff. On the other hand, maintaining one foot in state government and one in the University, as is the case now, though administratively unwieldy, does permit certain operational advantages. I will continue to work hard, with my colleagues in the other Surveys and Waste Management and Research Center, to make the four-survey Institute a reality and will work with our supporters, administrators, and elected officials to preserve the uniquely valuable services we provide for the state.

The Future

In 1955, ISGS Chief, John Frye, delivered an anniversary speech commemorating the Survey's first 50 years of achievement. John had only been in office a year or two, and he projected the Survey's strong energy programs, which dominated its research agenda at the time, into the future, with a sense of continuing the programs that had made the ISGS a prominent institution. A few years after making that speech, however, John must have realized that the needs of Illinois society were changing and broadening, and he launched the ISGS into new fields, particularly the field he is credited with conceiving, environmental geology. I point this out because today we are similarly involved in the process of reflecting



on our past achievements and adapting ourselves to meet evolving societal and research needs. With the large number of empty positions we have to fill because of our retirement demographic, we will be enhancing our most important programs and in some cases striking out in new directions. This is a critical time for the Survey, and the decisions we make now about the makeup of our scientific, technical, and support staffs will impact the Survey and the state long after our tenures here have passed, just as the decisions made in the early Leighton years and the Frye years have shaped the Survey long after their day.

Our Short Term Future—The Next Ten Years

Over the next ten years, several important issues must be addressed if we are to maintain our national prominence and our relevance to Illinois citizens. I have already mentioned the hiring decisions that must be made, but other issues are on the horizon that will radically impact our mission:

- 1. Funding models are changing. Both the University and the Surveys are facing steadily decreasing appropriations of general revenue funds to support their functions. In the case of the University, contract and grant, tuition, and donated funds will surpass state appropriations in a few years; the ISGS has already passed that point with over 50% (60 to 75% for our sister agencies) of our revenues coming from grants and contracts. The University is responding to this funding challenge by increasing tuition and encouraging out-of-state registrations (which are not options for us), by ramping up fund-raising activities (which we have undertaken the first steps with our Centennial fund drives), by encouraging increasing contract and grant funding (as we do), and by looking at ways to generate revenue directly or indirectly by commercializing inventions by faculty and staff (as we have done with the creation of Dynamic Separations, Inc.). Both the Survey and the University also are increasing lobbying efforts in Washington to make Congress aware of the significant return on federal dollars that is directed to our institutions. *Regardless of our placement in state government, we will face the same decreasing direct state general revenue support faced by the University and other state agencies in Illinois and across the nation.*
- 2. We must examine and resolve our dilemma of being a state agency with a research and service mission. Although salary disparities between state agencies and universities have not been a huge obstacle in the past, in the last decade they have increased to the point that we are hard-pressed to attract the caliber of scientific and technical staff that we presently enjoy and that has sustained us through these past 100 years. We do not compete with state governments for employees, but, as always, with industry and universities; our research "business" is more compatible with that of those latter entities. Our present situation, given these realities, is not sustainable, and we must strive to change the nature of our placement in state government, or we will have to consider changing our mission to a strictly service function that could just as easily be offered by the private sector. Neither my fellow chiefs nor I think that it is in the best interests of the state to change our mission. Thus, we are pursuing the establishment of an Institute that will serve as a vehicle to provide the latitude to establish an appropriate salary structure and research base to continue our traditional and valued services to the governments, businesses, and citizens of Illinois. Whether that Institute ends up within IDNR or elsewhere in state government, within the University of Illinois, or in some combination of those possibilities, all parties concerned agree that some form of Institute is in the scientific surveys' future, if we are to thrive.
- 3. With the appointment of Dr. White as the President of the University of Illinois, the University has embarked on a campus-wide strategic planning process in which the Surveys and Center, which collectively generate more than 7% of the University's contract and grant research funding, have been

invited to play important roles. This indicates that our relationship with the University has become more of a partnership than ever and that discussions of the Institute concept have generated a better understanding of the Surveys' potential and actual roles on campus. It is particularly noteworthy that President White has chosen disciplines related to sustainability (of resources) and energy as two of four or five areas where he feels the University can excel nationally and internationally, and where it can also best serve the immediate needs of the state. Because the Illinois-focused missions of the ISGS and other scientific surveys are relevant to sustainability, particularly of ecosystems and water resources, and to energy issues, *it is obvious that we will have a major role to play in refining and reshaping the University's mission, particularly its responsibilities as a Land-Grant institution.*

Our Next Century

It is always interesting to me to read about the ideas of futurists who envisioned my world from their vantage points in the distant past, so I will take a stab at what I believe (and hope) the ISGS will have accomplished by its bicentennial celebration in 2105.

By 2105, we will have produced accurate geological maps of the upper 1,000 feet (perhaps 330 meters by that time) of the State of Illinois at a scale of 1:25,000 or better; these maps will exist in cyberspace, will be easily queried or manipulated, and will be able to be used seamlessly with similar maps in our neighboring states. The geophysical and other subsurface imaging technologies that we develop to make the three-dimensional geological maps and the scientific understanding of our geologic past that is necessary to interpret them will have made a significant contribution to earth science far beyond our state boundaries, as has happened during the past 100 years.

At least partially as a result of the next century of ISGS research, I expect that, in 2105, Illinois companies will be using our coal and petroleum resources in new and more efficient ways to derive a variety of fuels, and, more importantly, those resources will be used as the organic base for a range of synthetic, non-fuel products, from medicines to carbon-based plastics and fibers. Fusion and safe nuclear power may obviate the need for coal, gas, or oil as fuel sources, but the Survey will continue to supply input critical to siting and protecting our energy-producing facilities. By whatever processes energy is created over the next century, the Survey will have been instrumental in developing the important environmental strategies that will be necessary to minimize and make benign the solid, gaseous, and liquid wastes associated with its production.

In 2105, the Survey will still provide critical environmental and planning guidance for our expanding metropolitan areas, which may cover much of the state by 2105 if there is not a new paradigm for urban expansion that involves increasing population densities in our traditional urban locations and settings.

Finally, in keeping with our traditional earth science roles among the world's geological surveys, I expect the ISGS to continue to lead in the integration of earth science research and service with societal demands.

Few of us are likely to be alive to see how the ISGS fares at the end of the next century, but I can assure you that the work we do today, the innovations we conceive, and the impacts we make on our citizens will materially affect our successors, just as those who crafted the Survey and its mission 100 years ago have directly impacted our professional lives. We can only hope that our successors will regard us with the same

William W. Shilts, Chief



The Year in Summary

ISGS Centennial

The ISGS kicked off a year-long celebration of its centennial in May. The ISGS hosted the 51st annual Midwest Friends of the Pleistocene meeting and a two-day field trip through central Illinois. The trip and its guidebook, *Quaternary Deposits and History of the Ancient Mississippi River Valley in North-Central Illinois*, were dedicated to 149 ISGS scientists and affiliates who have contributed to the understanding of the Quaternary geology of Illinois by publishing their findings in ISGS reports and maps since the re-establishment of the ISGS. ISGS achievements were on exhibit in May at the State Capitol during the Governor-declared Illinois State Geological Survey Week. In June, ISGS hosted the annual meeting of the American Association of State Geologists.

June also saw the release of two **Illinois Department of Natural Resources**sponsored publications for the general public.



Chicagoland: Shaped by Ice and Water explains how glacial processes formed the landscape of the Chicago area. The first volume of a new Illinois State Parks series, *Time Talks: The Geology of Starved Rock and Matthiessen State Parks*, brings the parks' geology trailside so visitors to the area will understand better how to read the geology they see around them. Four public field trips



Eagle Cliff, Starved Rock State Park, shows the massive erosion of the Illinois River valley over the past 15,000 years.

to the Starved Rock and Matthiessen State Parks, two in fall 2005 and two in fall 2006, were planned to coincide with and complement the publication's release. The second publication is the map poster *Chicagoland: Shaped by Ice and Water*, which provides a visual perspective of the area not available from the ground and explains how geologic processes laid the foundation for the development and continued prosperity of the state's largest city.

In addition to the public field trips that the ISGS conducts annually, the Survey is conducting several small field trips during its year-long centennial period. The first took place on October 15 and 16. On this special

two-day field trip, three ISGS geologists led participants to several locations in southern Illinois: Ferne Clyffe State Park, Tunnel Hill, Bell Smith Springs Natural Landmark and Scenic Area, and Mill Stone Bluff on the first day and the Garden of the Gods Recreation Area, an abandoned fluorspar mine, Rim Rock Recreation Area, the faulted Horseshoe Upheaval, and Old Stone Face on the second day. The second trip explored the Silurian reefs of Thornton Quarry in northeastern Illinois and the equipment Material Services Inc. uses to mine the stone from this immense quarry. A portion of the



Shale in outcrop at Tunnel Hill, southern Illinois.

quarry has been designated as a reservoir to capture, store, and release for treatment sewer overflow from Chicago flooding events.

Throughout the 2005–2006 school year, the ISGS will bring in distinguished speakers, beginning in October with Harrison Schmitt (the only geologist to walk on the moon) and ending in April with Simon Winchester (author of several best-selling books including *Krakatoa—The Day the World Exploded: 27* August 1883 and *The Map that Changed the World*). More information about the centennial speakers is given later in this publication.

Geologic Mapping and Stratigraphic Framework Studies

ISGS is continuing to develop three-dimensional maps and models of Quaternary sediments and bedrock. During FY 2005, ISGS geologic mapping projects were active in 80 different quadrangles in various stages of activity. Most were in the rapidly urbanizing areas around St. Louis Metro East and in the northern and western suburbs of Chicago. A suite



Geologic cross section from the map *Surficial Geology* of the Bethalto *Quadrangle, Madison County.*

of 1:48,000-scale compilation maps of the surficial geology, drift thickness, bedrock topography, and soil parent materials are nearing completion for the middle part of the Illinois River valley north of Peoria. The mapped area includes five 1:24,000-scale quadrangles and four partial quadrangles. Considerable geologic insight was gained from the ISGS mapping along this reach of the Illinois River valley, where ancient courses of the Mississippi River were delineated and traced. For the other quadrangles studied during FY 05, geologists and technicians are compiling 43 surficial geology maps, 45 bedrock geology maps, 7 drift thickness maps, 7 bedrock topography maps, 2 aquifer sensitivity maps, and 2 sinkhole density maps. Of the 80 quadrangles active during the year, 47 have been or are presently supported by grants from the National Cooperative Geologic Mapping Program (STATEMAP), 2 were partially supported through the funding from the Central Great Lakes Geologic Mapping Coalition, and 8 were partially supported through a contract with the **Illinois Department of Transportation**.

Eight STATEMAP maps were completed in August 2004. These maps are posted on the ISGS Web site. Results from the field and laboratory studies and computer modeling undertaken through this new detailed mapping have shed light on a number of research questions related to the glacial (Quaternary) or preglacial (Paleozoic) history of the state. Research concerning the origin of various mapped units and associated landforms is increasing the understanding of the state's overall geologic framework and will lead to even more accurate maps in the future. Ten STATEMAP quadrangles were mapped and delivered in August 2005, and 9 quadrangles and a compilation map of surficial geology for Madison County will be delivered in August 2006.

Energy Resources and Environmental Engineering

The Midwest Geological Sequestration Consortium (MGSC), led by the ISGS, has been selected by the **U.S. Department of Energy** for a Phase II Regional Carbon Sequestration Partnership to determine the ability, safety, and capacity of geological reservoirs to store carbon dioxide (CO_2) in the subsurface of the Illinois Basin. The Phase II partnership is a consortium of Illinois, Indiana, and Kentucky geological surveys, joined by industry, government, and business associations. Members of the partnership will assess



Hannes Leetaru, John McBride, and Robert Finley examine draft maps and models related to the **U.S. Department** of Energyfunded project to sequester carbon underground. all aspects of geological CO_2 storage in the Illinois Basin. During Phase I, existing data have indicated that the Basin's geology is favorable for CO_2 storage, or sequestration. In some localities, two or more potential CO_2 sinks are vertically stacked, making storage there more economical. ISGS geologists will continue their investigations into the methods and economics of CO_2 capture at facilities such as coal-fired power plants and will examine the costs of transporting large quantities of CO_2 via pipeline. The geologists are particularly focused on the properties of the rock units that control injectability of CO_2 , the total capacity for storage near major

 $\rm CO_2$ sources, the safety of injection and storage processes, and the security of the overlying rock units that act as seals for the reservoirs.

With support from the **Illinois Clean Coal Institute** (ICCI) and industrial partners **Freeman Energy** and **Dynamic Separations, Inc.** (DSI), the ISGS is testing the operation of one of its new mineral processing technologies at the full industrial scale. A small-scale model of the motorless-rotorless cell was demonstrated by DSI at the quadrennial mining exposition in Las Vegas, Nevada, where the

device and the company generated strong interest from mining companies in many fields. With 40,000 people in attendance at the exposition, the DSI exhibit booth was nearly always filled with mining company representatives interested in the possibilities offered by the technology for their particular mineral processing problems.

ISGS engineers have completed Phase I of an Electric Power Research Institute (EPRI)supported project to gain a better understanding of how various properties of the unburned carbon in fly ash can impact the extent of capture and oxidation of mercury released from coal during combustion in



Latif Khan explains the workings of his motorlessrotorless cell to a member of the press at the mining exposition in Las Vegas, Nevada.

utility boilers. The research was suggested by the observation that mercury emissions from different power plants that burn the same coal can vary widely. The results from this research program will help to make the connections between fuel properties, combustion conditions, and mercury emissions from coal-fired power plants. The ultimate goal of the study is to develop technical know-how that could help coal-fired power plants maximize in-flight capture and oxidation of mercury by manipulating the characteristics of the unburned carbon particles in their fly ash.



Mineral Resources

The ISGS completed a survey of the suitability of limestone and dolomite resources in the southern half of the state for use in scrubbing sulfur from the exhaust gases of coal-fired power plants. Studies of the physical and chemical characteristics of the rocks showed that coarse-grained, high-calcium limestones generally are best suited for use in wet scrubber systems, whereas dolomites, apparently because of their greater magnesium carbonate content, work best at the higher temperatures of fluidized bed boilers. Our geologists found that the sulfur-scrubbing capacity of quarried carbonate rocks vary from one bed to another, and, in some instances, a quarry may need to

Zakaria Lasemi and Rod Norby examine the quality of surface aggregates.

mine and sell the stone from a particular bed to serve the needs of a nearby power plant. The report's release has generated questions from both the United States and United Kingdom, and several companies have requested copies of the full report. The ISGS has expanded the study to the sulfur-scrubbing capacity of the carbonate rocks in the northern half of the state. The primary goal of this project, which is funded by **Illinois Clean Coal Institute**, is the completion of a comprehensive database and a set of maps on the quality and distribution of scrubber stone resources in Illinois.

The **U. S. Geological Survey** (USGS) has released the 2003 data on nonfuel mineral production for Illinois. The information was gathered by the ISGS and submitted to the USGS under a Memorandum of Understanding. The estimated value of nonfuel mineral production for Illinois was \$911 million in 2003, which was down about 1% from that of 2002. Nevertheless, Illinois remained sixteenth in rank among the 50 states in the total value of its nonfuel raw mineral production and accounted for about 2.5% of the U.S. total. Industrial minerals accounted for all of Illinois' nonfuel mineral production in 2003. Crushed stone remained the state's leading nonfuel mineral commodity, followed by portland cement, construction sand and gravel, industrial sand, lime, fuller's earth, and tripoli.



Ordovician-age dolomite, Savannah Blacktop Quarry, Carroll County.

Groundwater Geology and Geochemistry

ISGS hydrogeologists are actively engaged in the ISGS quadrangle mapping program, re-interpreting the geologic information into aquifer maps because groundwater resource identification is one of the primary objectives of the mapping program. In addition, the ISGS is conducting two countywide groundwater studies in northeastern Illinois in cooperation with the **Illinois State Water Survey** (ISWS). The projects in **Kane and Kendall Counties** both will produce a series of aquifer maps and 3-D models that will be the basis for groundwater flow modeling for the counties. The geologic model is nearly complete for Kane County, while work is just beginning in Kendall County.

A multidisciplinary team of researchers from the ISGS, Illinois State Water Survey, and several University of Illinois departments investigated the fate and transport of nitrogen in a small watershed in response to national concerns about the emergence of the hypoxic zone in the Gulf of Mexico and the charge that Illinois is a major source of the nitrogen in the Mississippi River that is thought to cause the hypoxic zone to form. The geologists and other scientists examined the mass balances of nitrogen inputs and removals in

a tile-drained agricultural watershed. The ISGS-led research team monitored the groundwater factor. Results from the study demonstrate the significant effect of precipitation on the fate and transport of nitrogen in the watershed and indicate that the shallow subsurface can be a significant nitrogen sink. Results from several other factors in the mass balance equation for the watershed are still being calculated.

The elevated concentrations of sodium (Na^+) and chloride (Cl^-) in natural waters that are common in Illinois and elsewhere can serve as indicators of, or may themselves constitute, a water quality problem. ISGS geochemists characterized many of the most prevalent natural and



From left: Walt Kelly and Keith Hackley collecting samples on the Illinois River.

anthropogenic sources of Na^+ and Cl^- in surface and ground waters, primarily in Illinois, and explored techniques that could be used to identify the sources. A total of 128 samples—including precipitation,

surface water, and groundwater—were collected and analyzed. Seven potential sources of Na⁺ and Cl⁻ in surface water and groundwater were considered for the study: agricultural chemicals, septic effluent, animal waste, municipal landfill leachate, seawater, basin brines, and road deicing compounds. Results suggest that relatively simple graphical techniques may provide a greatly improved method for identifying the sources of Na⁺ and Cl⁻ contamination in groundwater and surface water.

Engineering and Environmental Geology

An ISGS engineering geologist served on the organizing committee for the National Earthquake Conference, held in September 2005 in St. Louis, and helped to organize a technical session to show how a computer loss estimation program can be used by federal, state, and local officials and industry to estimate possible damage levels from earthquakes. Also discussed was the need for accurate data on the behavior of earth materials to plug into the program to obtain more realistic loss estimates. Case studies showed how the computer program has been used by cities, states, and private industry for decision making. The conference's main goal was to present information and tools that state and local officials and industrial planners could take home with them and put to use to mitigate some level of earthquake damage. The ISGS-organized conference field trip gave participants an overview of the history of earthquakes in the central United States and the greater St. Louis metropolitan area.



A portion of a computerized map showing hazard potential for earthquake damage.



Lake Michigan shoreline and Chicago skyline.

Illinois is preparing its application to join the federal Coastal Zone Management Program, the last of 35 eligible coastal states and territories to do so. ISGS experts are playing an important role in the planning and implementation of Illinois' program. Managing the coastal zone requires a strong focus on geological processes, and the ISGS has a 40-year history of research, service, and outreach along the Illinois coast. The **Illinois Department of Natural Resources** (IDNR) **Office of Water Resources** is the lead agency for the development team that also includes representatives from the **IDNR Director's office**, the **Governor's office**, and the ISGS. The Survey's specific responsibilities in the program include identifying critical coastal erosion areas, determining needs for beach and lake-bottom mapping, and defining short- and long-term needs for managing the limited sand resources.

Through its contract with the **Illinois Department of Transportation**, the ISGS recently completed the first of many preliminary environmental site assessments for the Chicago Region Environmental and Transportation Efficiency Project. CREATE involves more than 40 separate projects to relocate railroad lines and reduce the number of at-grade railroad-railroad and railroad-street crossings in the Chicago area in order to improve the flow of both railroad and automobile traffic through Chicago. The main purpose is to increase rail traffic efficiency through this part of the nation, which has historically been a bottleneck for rail transport.



Railroad site assessment as part of the CREATE project in the Chicago area.

Databases and Collections

Anyone with Internet access can search and download information from the huge database of water-well drilling records collected and maintained by the ISGS. Two on-line utilities, both accessed through a link on the main ISGS Web page, provide access to the computerized water-well information. The first method uses a set of database tables and is driven by a form that users fill out to query the master database, which contains more than 400,000 water-well logs and thousands of other borings. The second method allows users to select wells of interest from the database via a map display interface. The interactive map allows people to "point and click" on a location on a map of the state, zoom in, and define a rectangle to specify a more detailed area, find all the known non-oil wells in that area, and select subsets of the well data to be tabulated and presented to the user. By selecting individual well locations, users can view information about the location and ownership of water wells, coal test borings, engineering test wells, and other non-oil borings in the database. In addition, users can also view information such as the total depth of the well, the driller's log descriptions of subsurface units (e.g., sand, gravel, and limestone), and the depths to the top and bottom of each unit. The Illinois water-well Web page displays well locations for the entire state and useful geographic references including highways, county and township boundaries, lakes, and municipalities, orthophotographic images, and statewide maps of the major aquifers.

The Illinois Historical Aerial Photography (ILHAP) project, a multi-year effort coordinated by a team of Survey scientists, has archived and made available the earliest historical aerial photography for 45 counties. The approximately 34,000 aerial photographs that cover the entire state were first acquired from 1936 through 1941. Only a few collections of these earliest aerial photographs remain in existence, and most are now incomplete. The original negatives for the photographs were destroyed by the U.S. National Archives in 1980 because of the deterioration and dangerous instability of the nitrocellulose film. Thus, there is no longer any way to restore or reprint the collection. On-line access to the archive began in late 2003, and, since that time, users in Illinois and throughout the world have accessed and downloaded more than 1 million individual files. The photographs are being used by government agencies, surveyors, planners, consulting scientists, engineers, and others to determine past land uses, examine the effects of restoration efforts on natural areas, assess historical changes in stream dynamics, and a variety of other applications. The images are available at http://www.isgs.uiuc.edu/nsdihome/webdocs/ilhap/.

Education and Outreach

The ISGS completed a three-year program, funded primarily by the **Illinois Board of Higher Education** (IBHE), to sponsor student and faculty research projects at the Geology and Geography

Department of **Illinois State University** (ISU). Through the program, more than 50 undergraduate and graduate students were taught to use cutting-edge geophysical techniques. Students participated in field work and data analysis and presented their research results at professional meetings. By using an innovative approach to data acquisition called a "landstreamer," designed specifically for this project, the ISGS team was able to reduce the number of workers required while increasing the data acquisition rate. IBHE funds were also used to establish specialized computer labs running identical software at the ISGS and ISU so that the students could participate in the data interpretation. State-of-the-art seismic processing software was made available to the project by **Seismic Micro-Technology**. Research topics included mapping the geology and hydrology of the Mahomet aquifer in Piatt County and western Champaign County and mapping the geology of the glacial deposits in parts of La Salle County. The high-resolution seismic images of the Mahomet aquifer revealed the presence of subglacial landforms, called tunnel valleys, that provided insights into the processes that formed the sand



Recording landstreamer data on site.

and gravel deposits. The project resulted in five master's theses and numerous presentations by students at professional meetings.

Active Projects

Office of the Chief

Height Modernization, B. Herzog, D. Luman, C. Stohr, R. Krumm.

Host of the 2005 Annual Meeting of the American Association of State Geologists, J. Goodwin, D. Gross, T. Kemmis, M. Chrzastowski, M. Chambers, R. Strawbridge, W. Shilts, J. Dexter, C. Briedis, P. Carrillo, J. Hannah, M. Knapp, C. Nimz.

Midwest Ground Water Conference Host, B. Herzog, D. Keefer, M. Mushrush, B. Renfrew, S. Denhart.

Three-dimensional Mapping

Assessment of ASTER-based DEM and Shuttle SRTM Data as Input to a Large-Scale Geologic Mapping Program Situated in Midwestern Continental Glacial Terrain, D. Luman.

Digital Archive of 1936–1941 Historical Aerial Photography for the State of Illinois, D. Luman, D. Lund, C. Stohr, S. Beaverson.

Evaluation of Land Cover Change Models for the State of Illinois, D. Luman.

Friends of the Pleistocene Field Excursion, R. Berg, D. McKay, A. Hansel, A. Stumpf, T. Kemmis, M. Mushrush, D. Sieving, J. Dexter.

Illinois Historical Aerial Photography Digital Archive—Southern Eleven Counties. D. Luman, D. Lund, S. Beaverson.

Three-dimensional Geological Mapping along the Middle Illinois River Valley, R. Berg, D. McKay, A. Stumpf, D. Keefer, L. Smith.

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

Vincennes Mapping Project, M. Barnhardt, D. Luman, J. McLeod, R. Bauer, W.-J. Su, J. Carrell.

Geophysics Support

Geophysical Characterization of Crystal Lake Basin and Margins, T. Larson, S. Sargent.

Geophysics Database and Web Site, T. Young, C. Blakley, T. Larson, D. Nelson, A. Lecouris, D. Garner.

Geophysics Mapping, T. Larson, S. Sargent.

Hard-Rock Dike Detection in Southern Illinois Using Seismic Reflection Surveys, T. Larson, S. Sargent, B. Denny.

Seismic Reflection Survey in the Ohio River, T. Larson, S. Sargent, J. McBride (Brigham Young University).

Energy and Earth Resources Center

An Assessment of Geological Carbon Sequestration Options in the Illinois Basin, R. Finley, S. Frailey,
H. Leetaru, M. Rostam-Abadi, R. Bauer, S. Bhagwat, S. Chen, I. Demir, K. Hackley, D. Keefer,
E. Mehnert, D. Morse, J. Risatti, B. Seyler, R. Knepp, S. Beaverson, C. Korose, R. Krumm, D. Nelson,
D. Garner, B. Renfrew, P. Cookus, D. Lund.

Coal

Cleat and Other Fracture Development in Illinois Coals, I. Demir, D. Morse, T. Moore.

Contributions to National Coal Resources Data System, S. Elrick, A. Louchios, R. Jacobson.

History of Coal Mining in Illinois: A Pictorial Review, C. Chenoweth, T. Moore, J. Nelson.

Improved ISGS Coal Quality Database, I. Demir.

Maintenance of Coal Resource and Mine Data (Office of Mines and Minerals), T. Moore, A. Louchios, S. Elrick, C. Korose, R. Jacobson.

7.5-Minute Quadrangle Mined-Out Area Studies, C. Chenoweth, J. Obrad, A. Myers.

Suitability of Illinois Coals for Different Industrial Uses, I. Demir.

Energy and Environmental Engineering

A Feasibility Study of Carbon Sequestration Utilizing Ammonium Bicarbonate in Fly Ash Amended Soils, J. Chou, M. Chou, J. Stucki.

Commercial Production of Fired Bricks with Illinois Coal Fly Ash and Bottom Ash, M. Chou, J. Chou, T. Moore, V. Patel, J. Stucki (UIUC), Ameren, Streator Brick Co.

Demonstration of ISGS Washer Retrofit at Galatia Mine Coal Processing Plant, L. Khan, W. Roy.

Demonstration Study of High Sulfur Coal Combustion in Oxygen-enriched Flue Gas, M. Rostam-Abadi, S. Chen, Y. Lu, K. Henry, Air Liquide, McDermott Technologies.

Expanding Market for Activated Carbon from Corn-to-Ethanol By-products, M. Rostam-Abadi, M. Rood, C. Werth.

Innovative Building Material from Illinois Coal Combustion By-product, J. Chou, M. Chou.

Laboratory and Field Testing and Upgrade of a Larger ISGS Filter Press, L. Khan, W. Roy, K. Bendix, P. Littrell, C. Manrique.

Manufacturing Fired Bricks with Class F Fly Ash from Illinois Basin Coals, M. Chou, J. Chou, V. Patel, S. Bhagwat, J. Nelson, J. Stucki (UIUC), N. Shaffer (Indiana Geological Survey), industry partners.

Pathway to Commercialization of the Motorless-Rotorless Cell, L. Khan, W. Roy, K. Bendix, S. Kaineg, P. Littrell.

Studies of Advanced Mercury Sorbents and Technologies, M. Rostam-Abadi, S. Chen, M. Rood (UIUC), R. Chang (EPRI), URS Corporation, ADA Corporation, K. Henry.

Geochemistry

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

Chemical and Mineralogical Properties of Illinois Soils, G. Dreher, L. Follmer.

Determining Lead Exposure Sources in Northwestern Illinois, J. Risatti, Z. Lasemi, E. Mehnert, R. Finley, W. Shilts.

Investigating the Role of a 1,600-acre Floodplain Site in Trapping Suspended Sediment from the Illinois and La Moine Rivers, K. Carr, R. Cahill, A. Phillips.



Organic Compounds in Sediments from the Grand Calumet River—Lake Michigan to Lake George, G. Salmon, R. Cahill, M. Unger (Indiana University, Sanitation District of Hammond).

Potential Soil Cleanup Objectives for Nitrogen-containing Fertilizers: A Field Study, W. Roy, I. Krapac.

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

Unified Geochemistry Database Development-Implementation, G. Salmon.

Unified Geochemistry Database Development—Planning, J. Steele, G. Salmon, J. Risatti, S. Denhart, B. Stiff, H. Wang, A. Lecouris.

Industrial Minerals and Resource Economics

A Research Report on the Role of Aggregates in the Illinois Economy, S. Bhagwat.

Aggregate Resource Mapping in the St. Louis Metro East Region of Illinois: Cahokia and Columbia Quadrangles, Z. Lasemi, R. Norby.

American Association of State Geologists U.S. Silica Field Trip and Guidebook, T. Kemmis, K. Keith, J. Dexter, P. Carrillo, C. Nimz, Z. Lasemi, A. Stumpf.

Compilation of Illinois Gravel Mineralogy, T. Kemmis.

Economics of Underground Mining of Limestone, S. Bhagwat, Z. Lasemi, M. Dunn (CONCO Western Mining Co.).

Fox River Valley Reconnaissance, T. Kemmis, J. Dexter, C. Stohr.

Geology of the Bedrock Aggregate Industry of Northeastern Illinois, D. Mikulic.

Green River Lowland Reconnaissance, T. Kemmis, A. Bettis (University of Iowa), E. Hajic (University of New Mexico).

Illinois River Valley Reconnaissance, T. Kemmis, E. Hajic (University of New Mexico), C. Stohr, J. Dexter, R. Nelson (Illinois State University).

Inventory of Illinois Limestone Resources for FGD and FBC Desulfurization Units, Phase II, Z. Lasemi, G. Salmon, S. Bhagwat, G. Dreher, H. Leetaru, D. Mikulic, M. Rostam-Abadi, L. Smith, D. Byers.

Subsurface Silurian Lithostratigraphy of Northeastern Illinois, D. Mikulic.

The Economics of Global Warming, S. Bhagwat.

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

Silurian Geology of West-Central Illinois, D. Mikulic, R. Norby, J. Kluessendorf (University of Wisconsin), T. Butcher (University of Portsmouth).

Bedrock Geology

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

Geologic Map of the Cypress Quadrangle, J. Aud, J. Devera, J. Nelson.

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

Geologic Mapping for Natural Resources and Complex Structure of the Ava, Willisville, Oraville, Raddle, and Rockwood 7.5-minute Quadrangles, J. Devera, B. Denny, J. Nelson, R. Jacobson, J. McLeod, J. Aud, J. Hutmacher, T. Young.

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

7.5-minute Surficial Geologic Map of the Ames Quadrangle, J. Devera, G. Shofner.

STATEMAP: Southern Illinois Project, J. Devera, J. Nelson, R. Jacobson, J. McLeod, B. Denny, J. Aud, J. Hutmacher, J. Domier.

Sedimentology Laboratory

Illinois Clay/Shale Resource Database, K. Keith, L. Smith, A. Lecouris.

Sedimentology Laboratory, K. Keith.

Oil and Gas

Annual Report of Oil Field Statistics, B. Huff, R. Lipking, A. Lecouris.

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

Development of Color-Coded Pay Zone Maps and New Structure Maps, J. Crockett, S. Gustison.

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

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

Geographic Information Systems Approach for Play Portfolios in the Illinois Basin, B. Seyler, B. Huff, J. Crockett, J. Cokinos, S. Gustison, S. Beaverson.

Illinois Coalbed Methane (IDCEO), D. Morse, I. Demir, T. Moore, B. Wimmer.

Impediments for Siting a Coal-powered Plant, S. Gustison, P. Johanek.

Mid-Continent Interactive Digital Carbon Atlas and Relational Database Now Called NATCARB, B. Seyler, C. Korose, P. Johanek.

Mt. Simon Gas Storage Characterization (U.S. Department of Energy). D. Morse, H. Leetaru, J. Hannah, C. Nimz.

Oil and Gas Data Update and Drilling Report in GIS Format, B. Huff, S. Gustison, J. Cokinos.

Petroleum Technology Transfer Council (U.S. Department of Energy FY05), D. Morse, S. Gustison, B. Huff, J. Crockett, B. Seyler, J. Grube.

Geologic Mapping and Hydrogeology Center

Engineering and Coastal Geology

American Association of State Geologists Full-Day Chicagoland Geology Excursion, M. Chrzastowski, S. Greenberg, D. Adomaitis.



CUSEC State Geologists Mapping Efforts in Midwest and U.S.Geological Survey Urban Hazard Mapping Areas, R. Bauer, W.-J. Su.

Illinois Coastal Program—Planning and Development, M. Chrzastowski.

Methodology for Seismic Microzonation Using IS, Database, and Shake2000, W.-J. Su, R. Bauer.

Revision and Update of Mine Subsidence in Illinois: Facts for Homeowners, R. Bauer, C. Nimz.

Geospatial Analysis and Modeling

ArcIMS Application for ISGS Staff to Access and Export All ISGS Well Data (IDNR G2005050), S. Beaverson, D. Lund, B. Stiff, R. Krumm, C. Nimz.

Computer Applications Programming, LEGAL Replacement or Rewrite, D. Nelson, A. Lecouris.

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

GIS Database Development, D. Nelson, J. Domier.

History of the Geologic Map of Illinois-ISGS Centennial Display, C. Abert, C. Nimz, P. Carrillo.

ISGS Web-based Centennial Photo Album, D. Thurston, R. White, S. Denhart, J. Dexter.

Hydrogeology

A Statewide Monitoring Network to Evaluate Pesticide Contamination of Groundwater in Illinois— Installation, Sampling, and Data Analysis, E. Mehnert, consultants, W. Dey, D. Keefer, H. Wehrmann (ISWS), S.Wilson (ISWS), C. Ray (University of Hawaii).

Build Illinois Video Production, R. Vaiden, J. Dexter, D. Byers, S. Greenberg.

Development of a Statewide Database of Hydraulic Conductivity Values from Quaternary Units in Illinois, J. Sieving.

Development of Three-dimensional Visualization Application, D. Keefer, F. Dorothy (ISGS intern).

Estimation of Groundwater Recharge in Northeastern Illinois, E. Mehnert, T. Kemmis, P. Kesich (Fermi).

Evaluation of Analytical Element Groundwater Flow Modeling to Improve Geologic Mapping/Year 2, E. Mehnert, W. Dey, Y.F. Lin (ISWS), G. Roadcap (ISWS).

Geologic Mapping of the Aurora South 7.5-minute Quadrangle, J. Sieving.

Hydrogeologic Characterization and Analysis for Lake County, D. Keefer, J. Sieving, D. Larson, M. Barnhardt, T. Young.

Hydrogeologic Mapping for Kendall County, D. Keefer, D. Larson, E. Smith, R. Vaiden, J. Sieving, M. Mushrush, B. Curry, J. Devera, T. Kemmis, T. Larson, T. Young, C. Blakley, D. Mikulic.

Hydrogeology Display, R. Rice, D. Larson, J. Dexter.

Illinois River Basin Hydrologic Observatory: Proposal Development, D. Keefer, E. Mehnert, A. Phillips, R. Cahill.

Mass Flux of Nutrients (Nitrogen and Phosphorus) in Shallow Groundwater/Year 6, E. Mehnert.

Redesign of Hydrogeology Web Site, D. Keefer, M. Mushrush, R. Rice, D. Larson, E. Smith, C. Nimz, S. Denhart.

Regional Groundwater Assessment: Metro East Region, E. Smith, R. Vaiden, M. Mushrush.

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

Isotope Geochemistry

Dating of Cave Sediments and Speleothems, S. Panno, B. Curry, K. Hackley, C. Lundstrom (UIUC), P. Carrillo.

Determination of the Dominant Sources of Nitrate in Wells and Springs of the Sinkhole Plain Using Nitrogen and Oxygen Isotopes, K. Hackley, P. Carrillo, C. Nimz.

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

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

Indicators of the Origin of Sodium and Chloride in Natural Waters, S. Panno, K. Hackley.

Investigation of the Age of Recharge of Groundwater to Mahomet Valley Aquifer Using Geochemical Techniques, K. Hackley, S. Panno, P. Carrillo.

Mass Flux of Nutrients (Nitrogen and Phosphorus) in Shallow Groundwater—Assessment of Denitrification in Shallow Groundwater by Isotopic Methods, H. Hwang, T. Johnson, W. Beaumont (University of Southern California).

Sinkhole Density, Bedrock Topography, Water Table, and Drift and Loess-Thickness Maps of the Columbia, Waterloo, and Renault Quadrangles, S. Panno, P. Weibel, B. Stiff, editor, graphic designer.

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

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

The Hydrochemistry of Illinois, S. Panno, K. Hackley.

The Use of Probability Graphs to Estimate Background Concentrations of Nitrate in Groundwater, S. Panno, W. Kelly, K. Hackley.

Radiocarbon Dating

Calcified Rootlets and the Significance of Terrestrial Carbon Cycles in Response to Climate Change in Illinois During the Last Glaciation, H. Wang, S. Greenberg.

Loess Stratigraphy of the Last Five to Six Glacial-Interglacial Cycles in Southern Illinois, H. Wang, S. Greenberg, K. Whitlock.

Quaternary Geology

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

Delineation of Hydric Soils by Magnetic Susceptibility, D. Grimley, J. Dawson (UIUC), J. Wang (UIUC), D. Liebert (Urbana Park District).



Dunlap Mapping, P. Weibel.

Geologic Mapping in Illinois: Surficial Geology of the Germantown Hills Quadrangle, A. Stumpf, L. Smith.

Geologic Maps for the Marengo South Quadrangle, McHenry, De Kalb, and Kane Counties, B. Curry, J. Domier.

Geologic Maps of the Big Rock Quadrangle, Kane, Kendall, and De Kalb Counties, B. Curry, S. Wildman, J. Aud, A. Tovey, J. Domier, J. Carrell.

Glacial/Quaternary Geology Web Site, A. Hansel, M. Mushrush, D. Byers.

Illinois River Basin Restoration Project: Watershed and Pool Assessments, A. Phillips, L. Smith, G. Pociask, B. White (ISWS), L. Keefer (ISWS).

Incorporating Electronic Logs of Wells and Borings Obtained by Quaternary Section into ISGS Database, C. Stohr, A. Lecouris.

Klumpen: Meso-Scale Features of Soils, L. Follmer, J. Dexter.

Mapping and Characterization of Till Units at Fermilab, Batavia, Illinois, B. Curry, D. Keefer.

Mapping Geochemical Trends of Surficial Materials in Illinois, A. Dixon-Warren, A. Hansel.

Oakhill Mapping, P. Weibel.

Quaternary Database Development, B. Stiff, A. Lecouris.

Spring Bay Mapping, P. Weibel, A. Stumpf.

STATEMAP: Geologic Mapping in Illinois: Surficial Geology of the Lake Zurich Quadrangle, A. Stumpf, J. Domier.

STATEMAP: Surficial Geologic Mapping of the Lebanon and Mascoutah Quadrangles and Madison County Compilation Project, D. Grimley, A. Phillips, J. Duncan, J. Aud, J. Hutmacher.

STATEMAP: Geologic Mapping of the Libertyville Quadrangle, M. Barnhardt, B. Stiff, drill crew, J. Carrell, J. McLeod, J. Domier.

STATEMAP: Surficial Geology Mapping in the New Douglas, Grantfork, and Highland Quadrangles, D. Grimley, A. Phillips, J. Carrell.

Surficial and Engineering Geology of the Collinsville 7.5-minute Quadrangle, A. Phillips.

Surficial Geologic Mapping in Madison and St. Clair Counties, A. Phillips, J. Carrell.

Surficial Geology and Bedrock Topography of the Bethalto 7.5-minute Quadrangle, D. Grimley, J. Domier, C. Nimz.

Surficial Geology and Bedrock Topography of the Hampshire Quadrangle, B. Curry, J. Carrell, J. Domier, A. Tovey.

Surficial Geology of the Kellerville and Fishhook 7.5-minute Quadrangles, M. Barnhardt, M. Killey, J. McLeod.

Surficial Geology of the Wood River and Monks Mound 7.5-minute Quadrangles, D. Grimley, J. Carrell.

Summary of Illinois River Basin Landforms and Topographic Regions, A. Phillips, L. Smith, T. Kemmis.

Three-dimensional Geologic Mapping for the Central Great Lakes Geologic Mapping Coalition, M. Barnhardt, R. Berg, A. Hansel, A. Stumpf, C. Stohr, D. Luman, B. Stiff, V. Amacher, D. Larson, T. Kemmis, R. Bauer, W.-J. Su, T. Larson, J. Carrell, J. McLeod, J. Domier.

Williamson County Quaternary Mapping, L. Follmer, J. Nelson, S. Indorante (USDA-NRCS), M. McCauley (USDA-NRCS), J. Domier.

Geoscience Information Center

Geology of State Park Series—Illinois Beach State Park, M. Dufour, S. Greenberg, M. Chrzastowski, J. Hines, R. Vaiden, C. Nimz, D. Byers, J. Dexter, C. Briedis.

Geology of State Park Series—Starved Rock and Matthiessen State Parks, M. Dufour, S. Greenberg, M. Chrzastowski, J. Hines, R. Vaiden, C. Nimz, D. Byers, J. Dexter, C. Briedis.

2004–2005 Geological Science Field Trips, W. Frankie, R. Jacobson, M. Knapp, C. Nimz, S. Cromwell.

Information Technology Services

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

Transportation and Environment Center

Environmental Site Assessments

Field Guide to the History and Features of Burnham Park, Chicago, Cook County, B. Trask, C. Briedis, C. Nimz, J. Bachrach, J. Dexter.

LA 450 Class Preparation and Presentation, P. Bannon-Nilles, B. Trask, G. Kientop, D. Adomaitis.

Preliminary Environmental Site Assessment Program for the Illinois Department of Transportation, A. Erdmann, D. Adomaitis, P. Bannon-Nilles, C. Beccue, J. Bodamer, L. Bray, R. Bryant, S. Chakravorty, M. Collier, E. Collins, C. Decker, S. Ellis, J. Geiger, M. Hart, G. Kientop, A. Leininger, D. Schmidt, M. Spaeth, B. Trask, and M. Yacucci.

Wetlands Geology

Providing Hydrogeologic Assistance to the Illinois Department of Transportation Regarding Wetlands and Other Issues, J. Miner, C. Fucciolo, S. Benton, K. Carr, K. Weaver, B. Robinson, G. Pociask, E. Plankell, G. Shofner, R. Cahill, D. Larson, J. Bodamer.

Providing Hydrogeologic Assistance to the Illinois Nature Preserves Commission and Illinois Department of Natural Resources, J. Miner, R. Locke.



Centennial Celebration

Kick Off: ISGS Week

In honor of the Survey's centennial, Governor Rod R. Blagojevich proclaimed May 12–18, 2005, as Illinois State Geological Survey Week. Representative Naomi Jakobsson introduced Chief Bill Shilts to her House colleagues on Tuesday, May 17. On that same day, the ISGS presented several displays in the State Capitol building to highlight the Survey's century of achievements and current research activities. Eight ISGS staff members were present to greet legislators, legislative staff, and visitors to the capitol and explain the displays and ISGS programs.



Representative Naomi Jakobsson (left) visited the Survey in May 2005 to read the Governor's proclamation congratulating the ISGS on its centennial. Chief Bill Shilts holds a copy of the proclamation.

The exhibits included an outline of Survey geological contributions since 1905, the history of statewide geologic mapping in Illinois, geologic mapping for groundwater development in northeastern Illinois, carbon sequestration, discovery of oil reservoirs in the Silurian rocks under Stephen A. Forbes State Park, and demonstrations of the IL-OIL and IL-WATER ArcIMS portions of the ISGS Web site.



Left: ISGS staff prepare for the exhibits at the State Capitol in Springfield. Bev Seyler, Ardith Hansel, and Mike Barnhardt stand ready to discuss Survey mapping efforts. Center: Bev Seyler, Steve Gustison, Bev Herzog, Hannes Leetaru, and Curt Abert in front of the history of mapping exhibit. Right: Bev Herzog and Jon Goodwin listen as Steve Gustison demonstrates how to use the IL-OIL data on the ISGS Web site.



"To you and all your staff at the Illinois State Geological Survey I extend my most heartfelt thanks for your efforts in organizing and managing a superb 97th Annual Meeting of the AASG!... The creativity of your field trip leaders and organizers took what some skeptics thought would be a fairly dry topic—urban geology—and turned it into a very engaging and rewarding experience. We all took away some lessons in urban geology as well as how to run successful field trips. Thanks."

–Robert G. Marvinney, President AASG Maine Geological Survey Augusta, Maine

ISGS Hosts Midwest Glacial Geologists

The ISGS also hosted the 51st Annual Midwest Friends of the Pleistocene field trip on May 13–15, 2005. Field trip participants made 11 stops in the Illinois River valley area between Chillicothe and Henry. They examined the river and glacial sediments and buried soils that record the past 500,000 years of history of the ancient Mississippi River, which once flowed through north-central Illinois, following along the approximate course of the modern Middle Illinois River.

The trip was attended by 130 geologists, professors, and students from across the United States and Canada. The field trip guidebook, *Quaternary Deposits and History of the Ancient Mississippi River Valley in North-central Illinois*, is published as ISGS Open File Series 2005-7.



Geologists, professors, and students examine river and glacial sediments along the Illinois River valley during the field trip of the 51st Annual Midwest Friends of the Pleistocene meeting, hosted by ISGS.

State Geologists Meet in Illinois



Former Chief Morris Leighton and current Chief Bill Shilts on the AASG Field Trip to Illinois Beach State Park.

The 97th Annual Meeting of the Association of American State Geologists (AASG) was hosted by ISGS staff from June 11–15, 2005. Meeting participants included 34 active state geologists, 9 honorary

and retired state geologists, deputy state geologists from 13 states, and representatives of 6 federal agencies and 8 nongovernmental agencies or foundations. The officials gather annually to discuss problems of mutual concern, coordinate research and service programs with officials of sponsoring federal

agencies, and conduct Association business. About 100 people, including spouses and other guests, attended the meeting. Meeting highlights included the initial meeting welcome by Illinois Department of Natural Resources Director Joel Brunsvold on behalf of Governor Rod Blagojevich and the



Mike Chrzastowski, coastal geologist, explains the relationships between geology, human engineering efforts, the Lake Michigan coastline, and the City of Chicago. Jon Goodwin, meeting coordinator, stands behind.

Department; a tour of U.S. Silica Company's mine and plant at Ottawa, Illinois,



State geologists examine the sidewall at U.S. Silica in Ottawa during the AASG meeting.

followed by dinner at Starved Rock State Park lodge; and a field trip of the Lake Michigan shoreline from Illinois Beach State Park to downtown Chicago.

"Well, the 97th Annual Meeting is history and you can take a breather. . . . Thanks for doing what was needed to make the meeting run so well. . . . [We] enjoyed the setting so much that we are talking about returning in the near future to see more of the sights in the Loop."

> –Larry D. Fellows Director and State Geologist Arizona Geological Survey Tucson, Arizona

Centennial Lecture Series

Global Change—Revealing the Past, Discovering the Future

As part of the Centennial Celebration, several internationally recognized scientists and science writers have been invited to Urbana-Champaign to make public presentations and interact with students on the University of Illinois campus. The lecture series is being supported entirely by **private donations to the ISGS Centennial Celebration Fund**.



October 13–14, 2005: Dr. Harrison "Jack" Schmitt Apollo 17 was not only the last lunar landing mission, it was the first and only time a geologist. Dr. Harrison "Jack"



From left: Harrison Schmidt, Apollo 17 astronaut, narrating his public lecture. Student questions at Wiley Elementary School in Urbana.

Schmitt, walked on the surface of the moon. "A Trip to the Moon and Beyond" was the title of the free public lecture Schmitt gave to an enthusiastic audience of approximately 600 people at Lincoln Hall, University of Illinois at Urbana-Champaign (UIUC) campus, on Thursday, October 13, 2005. He was the first speaker in the ISGS Centennial Lecture Series. ISGS staff, Centennial fund donors, and special guests were invited to a reception for Schmitt at the Levis Faculty Center on Wednesday evening. Thursday morning, Schmitt talked to fourth and fifth graders from Wiley and Thomas Paine Elementary Schools in Urbana. Schmitt also presented two other lectures during his

visit, "Martian Evolution: Lessons from the Moon," primarily to ISGS staff on Thursday afternoon and "Full Moon, Old Earth" to the UIUC Geology Department and others on Friday morning. All five events were well attended, and Schmitt's visit received excellent coverage by local media. **Fox Development Corporation** provided major funding for this lecture.

November 3–4, 2005: Kevin Krajick Science writer Kevin Krajick is the author of the book *Barren Lands: An Epic Search for Diamonds in the North American Arctic* and numerous articles on climate change and other topics of natural science. He has won numerous journalism awards including the

American Geophysical Union's Walter Sullivan Award for Excellence in Science Journalism in 1998. Krajick's articles have appeared in *National Geographic, The New Yorker, Newsweek, The New York Times, Los Angeles Times, Science, Discover, Audubon, Smithsonian, and Natural History.* Krajic addressed approximately 180 people on Thursday afternoon, November 3, 2005, during a free public lecture titled "The Secret Search for Diamonds in North America," at Beckman Institute Auditorium, UIUC. The lecture explored the history of diamond prospecting and the large 1994 diamond discovery in Canada's Barren Lands. Friday morning, Krajick spoke to UIUC journalism students and ISGS staff at Gregory Hall, UIUC, about "The Art and Science of Science Journalism: The Case of the African Killer Lakes," the journalist's From top: Science writer Kevin

story and geological reasons behind the poisonous gas eruptions from deep lakes From top: Science writer Kevin Krajick talks to University of Illinois journalism students. Barkstall Elementary School students line up to ask Krajick questions about diamond prospecting.



in volcanic craters in Cameroon. These eruptions snuffed out the lives of hundreds of people and animals in Cameroon. Later that day, Krajick and a short talk about diamond prospecting was eagerly received by fourth and fifth graders at Barkstall Elementary School in Champaign.

February 8–9, 2006: Dr. P. Patrick Leahy and Dr. Scott Tinker The public presentation by these two speakers is currently scheduled for February 9, 2006, at Beckman Institute Auditorium. Leahy is Acting Director, U.S. Geological Survey (USGS). Previously, Leahy was Associate Director for Geology, USGS, where he was responsible for federal earth science programs, including worldwide earthquake hazards monitoring and research, geologic mapping of land and sea floor resources, volcano and landslide hazards, assessments of energy and mineral resources, and all USGS international activities. Leahy will speak on the role of the USGS in addressing societal needs. Dr. Scott W. Tinker, Director of the Texas Bureau of Economic Geology, has been asked to speak on the evolving role of state geological surveys in addressing societal needs. The two scientists also will present separate lectures drawn from their current work. (Details TBA.)

February 23–25, 2006 (date tentative): Dr. Paul F. Hoffman and Dr. Richard Alley Dr. Hoffman, the Sturgis Hooper Professor of Geology at Harvard University, has published scientific evidence for the controversial "early snowball earth" hypothesis. This hypothesis proposed that the Earth was completely blanketed by ice some 700 million years ago and this event actually triggered the "Cambrian explosion," the sudden appearance of complex animals with hard shells. Hoffman is the principal figure in a recent best-selling book, *Snowball Earth*, by Gabrielle Walker, which traces the history and controversies of the theory. Hoffman is a noted expert on the geology of the Precambrian, with numerous articles in scientific journals. Alley, Evan Pugh Professor of Geosciences at Pennsylvania State University, has found evidence in Greenland ice cores for sudden climatic changes during the last 150,000 years. He has published several thoughtful scientific articles on the natural and human impacts of global climate change. His recent book, *The Two-Mile Time Machine: Ice Cores, Abrupt Climate Change, and Our Future*, presents "the first popular account of the wildly fluctuating climate that characterized much of human prehistory—long deep freezes alternating briefly with mild conditions—and explains that modern humans have experienced an unusually temperate climate that could come to an end in a matter of a few years." Alley heads the National Academy of Sciences panel on abrupt climate change. (Details TBA.)

March 15–17, 2006: Dr. James Franklin and Steve Blasco Dr. Franklin, retired Chief Scientist of the Geological Survey of Canada, was one of the first geologists to use a deep submersible to study "black smokers" on the mid-ocean ridges. Franklin is an expert on gold deposits. Steve Blasco is a marine engineering geophysicist at the Geological Survey of Canada's Bedford Institute of Oceanography, Dartmouth, Nova Scotia. In 1991, Blasco was chief scientist on a joint Canadian, United States, and Russian scientific/commercial expedition to film the S.S. Titanic wreck site using state-of-the-art Russian MIR submersibles and Canadian large format IMAX filming technologies. (Details TBA.)

April 3–7, 2006: Dr. Robert G. Skinner and Dr. Robert J. Finley Dr. Skinner is Director of the Oxford (University) Institute for Energy Studies, was trained in geology and climate studies, and is a former director of the Policy and Planning Directorate of the International Energy Agency in Paris. He is an internationally recognized expert on energy and the environment. Dr. Robert J. Finley, Head of the Energy and Earth Resources Center, Illinois State Geological Survey, is leading the Midwest Geological Sequestration Consortium in a major U.S. Department of Energy-funded study to determine the capability, safety, and capacity of subsurface geological reservoirs in the Illinois Basin to permanently store CO² captured from industrial sources such as coal-fired power plants. Results from this study could help to bring the planned FutureGen emission-free, coal-fired power plant demonstration project to Illinois. Dr. Finley is an expert on Illinois' position in the global energy marketplace. (Details TBA.)

April 25–27, 2006: Simon Winchester Writer Simon Winchester is a regular contributor to magazines and newspapers including Condé Nast *Traveler* and *National Geographic*. He is the author of





more than 16 books, including works on travel writing, history, and an acclaimed biography, *The Surgeon* of Crowthorne (1998). The Map That Changed the World (2001) is the story of William Smith, the nineteenth-century English engineer who, in 1816, created the first modern geologic map. Winchester's Krakatoa—The Day the World Exploded: 27 August 1883 (2003), explores the drama surrounding the nineteenth-century eruption of this volcano in Java. His other books include The Meaning of Everything: The Story of the Oxford English Dictionary (2003), short listed for the 2003 British Book Awards History Book of the Year, and The Professor and the Madman, which presents the intriguing story of the Corresponding editors of the Oxford English Dictionary. His most recent book, A Crack in the Edge of the World: America and the Great California Earthquake of 1906 (2005), will be the subject of his public lecture. A book-signing event at a local bookstore is being arranged.

CENTENNIAL CELEBRATION DONORS

The Illinois State Geological Survey gratefully acknowledges the generosity of the following individuals and corporations who have made contributions or agreed to provide in-kind services to support the activities of the ISGS Centennial Celebration. In addition to the centennial activities described in this report, the donors are sponsoring two major geological products. The Illinois Association of Aggregate Producers has sponsored the entire printing costs for the 2005 statewide *Bedrock Geology of Illinois* map. This map is the first printed update of the state's geology since 1967. The second project is the benchmark volume, *Geology of Illinois*, now in the editing and drafting stages. This volume describes the many aspects of Illinois geology and is intended to appeal to interested members of the general public who want to better understand the scope of the state's geology and its importance. An overview of the Survey's history helps to illustrate the scope and significance of Survey contributions. (List as of November 10, 2005.)

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Century of Achievement

Since 1905, members of the Illinois State Geological Survey, one of the nation's premier state geological surveys, have studied, inventoried, and reported on the state's geological environment and its energy and mineral resources for the benefit of Illinois' citizens and industries. The ISGS also has provided a wide range of critical services that have helped to provide both a healthy economy and a healthful environment for the people of the state.

ISGS geologists and engineers have pioneered new technologies and developed innovative concepts that have had significant impacts on the basic science of geology and on the application of geology in solving real-world problems.

Geological Mapping

Gathering information about the foundations of modern Society

- Pioneered the use of three-dimensional mapping techniques to portray the successions of geological materials
- Used rigorous peer-reviewed economic analysis to demonstrate that every dollar invested in geological mapping returns \$25 in benefits to the economy

Groundwater Geology

Helping ensure safe, sustainable water supplies

- Mapping regional groundwater aquifers
- Mapping aquifer recharge and contamination potential
- Pioneered geophysical methods to locate groundwater
- Devised ways to construct landfill liners and covers to reduce leakage









Land-Use Planning

Sharing geological information with planners

- Mapping the distribution and properties of Illinois' diverse geological materials
- Prepared more than twenty geology-for-planning reports
- Providing preliminary screening of IDOT construction sites for hazards
- Providing geological information needed to protect and enhance wetland habitats affected by road construction



VCAIN

Environmental Protection

Using geology to help ensure healthy ecosystems

- Established the discipline of environmental geology in 1963, now practiced worldwide
- Researching the fate and transport of chemical contaminants, including livestock wastes
- Determining groundwater quality for various geological units
- Evaluating groundwater remediation methods
- Studying the sequestration of carbon dioxide in geological reservoirs (developing "cradle-tograve" strategies for management of carbon to reduce greenhouse gas emissions)







Coal

Improving opportunities to use Illinois' Saudi Arabia-size coal resources

- Developing patented technologies to recover more of the fine coal currently discarded
- Measuring the methane content of Illinois' coals to estimate usable reserves
- Leading research in cooperation with industry on new emission-free methods to use Illinois coals
- Mapping the thickness, depth, and properties of resources that affect their availability for mining
- Characterizing the chemistry and heat contents of Illinois coals
- Pioneered the use of pollen fossils in coal to correlate coal beds, a technique now used worldwide



Oil and Gas Aiding industry exploration and development

- Identifying and mapping the distribution and structure of oil-producing geological units
- Characterizing the properties of oil reservoirs
- Developing and recommending improved methods for increasing oil recovery from Illinois fields
- Developing better ways to manage Illinois' numerous underground gas storage reservoirs (Illinois' capacity for underground gas storage dwarfs all other states; daily gas deliverability from storage ranks fourth, behind Michigan, California, and Texas)
- Transferring geological information to oil and gas companies through workshops



Construction Materials

Assisting Illinois aggregate producers

- Mapping the distribution and thickness of potential aggregate resources
- Characterizing geological units to aid in exploration and intelligent
 development
- Assessing the functional properties of bedrock and gravel materials for use as construction aggregate



Engineering Geology

Assisting construction and hazard prevention projects

- Developed the first engineering geology research program
- Determining engineering properties of Illinois soils, sediments, and rock units, especially in terms of their ability to amplify earthquake shaking intensity
- Pioneered in studies of causes and effects of mine subsidence on overlying materials and structures
- Studied landslide potential and mitigation methods
- Conducted research used to plan tunnel development



Materials Technology

Developing important new technologies, some of them patented

- Determining how to make better bricks that incorporate waste coal fly ash and bottom ash
- Determine how to use fly ash to make autoclaved, aerated concrete, an energy-efficient building material widely used in Europe but new to North American markets
- In partnership with industry, conduct research on use of coal fly ash to help capture mercury from power plant flue gases
- Motorless, roterless cell for recovering presently wasted coal fines

History of the Geologic Map

1843 Geologic Map Coal Measures Conglomerate of Coal Measures

Carboniferous Limestone Old Red Sandstone Helderberg Limestones (?) Niagra Group

1846 Geologic Map

Coal Formation
 Ohio Valley, Calcareous
 Ohio Valley, Lower Siliceous
 Pentramital Limestone
 not mapped

1906

A copy of the 1906 Geologic Map of Illinois by Stuart Weller is kept on file in the ISGS map library. The map is in fairly poor condition, and a small portion of western Illinois is missing. The map is sealed between thick acetate sheets (for "protection"), which has resulted in much discoloration of the original. The acetate sheets also caused rollers on the scanner to slip, causing distortion in the scanning process. Fortunately, the county boundaries and the latitude and longitude lines were drawn fairly accurately, and georeferencing the map was fairly simple. 2,118 borings were used.

Also in 1906: Theodore Roosevelt is President; San Francisco earthquake (estimated magnitude of 7.8) destroys much of the city; Richard Oldham proposes that the Earth has a molten interior. The population of Illinois in the 1900 census is 4,821,550.

1843

James Hall's 1843 geologic map of Illinois provided unique digitizing challenges. This map existed as an attached plate in a large 160-year-old volume borrowed from the Southern Illinois University library. Removing the plate from the volume for scanning was not an option. A local imaging company was able to photograph the plate and scan the film at a resolution high enough for reasonable replication. Georeferencing the map was also a challenge. Illinois county boundaries were included as part of the base map; however, the county boundaries in 1843 were significantly different from 2004 boundaries. Also, the original projection (if a projection was used) was unknown. Three georeferencing attempts were required to approximate modern boundaries. Note the shape of the county lines shown on the 1843 map and compare them to the 2005 map. The original scale of the map was approximately 1:1,900,800.

Also in 1843: John Tyler is President; Wagner writes *The Flying Dutchman*; the first major wagon train sets out on the Oregon Trail from Elm Grove, MO; Charles Dickens' *A Christmas Carol* is published; Francis Scott Key dies. The population of Illinois in the 1840 census is 476,202

1846

The 1846 geologic map of Illinois by David Dale Owen also provided challenges. This map was an attached plate in a 160-year-old volume in a noncirculating university collection. A high-resolution digital photograph was used to create the map image, and negotiations are in progress to have the university scan the map at a higher resolution. Latitude and longitude lines were included as part of the base map information; however, the location of the lines was inaccurate. Compare the latitude and longitude lines shown on this map with the lines on the 2005 map. The shape of the state outline is also drawn quite inaccurately. Several georeferencing attempts were made to register the image, but the results are very inaccurate. The original map was produced at an unknown and very small scale (approximately 1:5,000,000). 4 borings were used.

Also in 1846: James K. Polk is President; the Mexican-American war starts; Neptune is discovered; Iowa is admitted to the Union.



1917

A few copies of the 1917 *Geologic Map of Illinois* are archived in the ISGS map library. The map condition is generally good. The technical challenge in scanning and digitizing this map was the map's physical size, which caused the file size of the scanned image to be immense. This map was published at a scale of 1:500,000. 19,111 borings were used.

Also in 1917: Woodrow Wilson is President; World War I; Russian Revolution. The population of Illinois in the 1910 census is 5,639,571.

1917 Geologic Map

Quaternary Cretaceous-Tertiary Pennsylvanian Upper Mississippian Lower Mississippian Bevonian Silurian Ord, Richmond Ord, Galena-Platteville Ord, St. Peter Ord, Prairie du Chien

1945

Several copies of the 1943 *Geologic Map of Illinois*, compiled by J. Marvin Weller and others, are archived in the ISGS map library. Nearly all of the copies are in very good condition. Size again provided a technical challenge in scanning and digitizing of this map. The map width was 36.5 inches, and the maximum width of the ISGS color scanner is 36 inches. The ISGS map librarians allowed one map to be slightly trimmed in order to accommodate the scanner width. The file size of the resulting scanned image was quite large. This map was published at a scale of 1:500,000. 60,985 borings were used.

Also in 1945: Franklin D. Roosevelt dies and Harry S. Truman becomes President; World War II ends; Mohandas (Mahatma) Gandhi goes on hunger strike; Broadway production of *Oklahoma!* The population of Illinois in the 1940 census is 7,887,260.



Tertiary undifferentiated Cretaceous Pennsylvanian Mattoon Bond Modesto Carbondale Spoon Abbott Caseyville Mississippian Upper Chesterian Lower Chesterian Upper Valmeyeran Middle Valmeyeran Lower Valmeye Devonian Upper Middle Lower Silurian undifferentiated Ordovician Galena-Platteville

1967 Geologic Map

1967

Ancell
Prairie du Chien
Cambrian

undifferentiated

— contact
 — fault

1945 Geologic Map

Quaternary undifferentiated Tertiary undifferentiated Cretaceous undifferentiated Pennsylvanian upper Mcleansboro Group Iower Mcleansboro Group Carbondale group Tradewater group Caseyville group Mississippian upper Chester group middle and lower Chester group
 Ste. Genevieve to Warsaw limestones Keokuk to Fern Glen formations Kinderhook group Devonian Dutch Creek and younger formations formations below Dutch Creek Silurian undifferentiated dolomite and limestone Ordovician Maquoketa shale middle Ordovician limestones St. Peter sandstone Prairie du Chien group Cambrian undifferentiated contact fault

intrusive dike

The 1967 Geologic Map of Illinois was originally digitized by ESRI in 1984 as part of the creation of an Integrated Terrain Unit (ITU) map for the Illinois Department of Energy and Natural Resources. The ITU data contained maps of natural features, including Quaternary (or surficial) geology, a stackunit (or three-dimensional) map of surficial geology to a depth of 50 feet, natural divisions, glacial boundaries, soil associations, Soil Conservation Service land resource areas, ecoregions, and potential natural vegetation. The large amounts of data were very useful to begin GIS analysis. An unfortunate consequence of the ITU process, however, was generalization of the original maps. In 1995, the geologic map was re-digitized without generalization by ISGS as part of a statewide screening effort. The original scale of the map is 1:500,000. 163,585 borings were used.

Also in 1967: Lyndon B. Johnson is President; Vietnam War; USSR, USA, and UK sign treaty to ban nuclear weapons from space; Beatles release Sgt. Pepper's Lonely Hearts Club Band. The population of Illinois in the 1960 census is 10,082,208.

6

History of the Geologic Map





2005 Geologic Map

Tertiary undifferentiated **Tertiary and Cretaceous** undifferentiated Cretaceous undifferentiated Baylis Formation Permian ultramafic intrusions Pennsylvanian Mattoon Formation Bond Formation Shelburn-Patoka Formations Carbondale Formation Tradewater Formation Caseyville Formation Mississippian Upper Pope (Kincaid to Tar Springs Formations) Lower Pope (Glen Dean Formation to Aux Vases Sandstone) Ste. Genevieve Limestone St. Louis Limestone Warsaw Formation and Salem Limestones (western Illinois) Ullin and Salem Limestones (southern Illinois) Borden Siltstone; includes Chouteau Limestone in east-central Illinois Meppen Limestone, Fern Glen Formation, and Burlington-Keokuk Limestone Springville Shale and Fort Payne Formation Glen Park Fm., Hannibal Shale, Chouteau Ls., McCraney Ls., Prospect Hill Siltstone, Starr Cave Ls. **Mississippian and Devonian** New Albany Shale Group Devonian Muscatatuck Group Tamms Group Silurian undifferentiated limestone and dolomite Ordovician Maguoketa Formation or Group Galena Group Kimmswick Limestone and Decorah Fm. (southern and western Illinois) Platteville Group Ancell Group Prairie du Chien Group Cambrian undifferentiated Paleozoic undifferentiated, found within Des Plaines Impact Structure

2005

The 2005 *Bedrock Geology of Illinois*, by Dennis R. Kolata and others, was produced in response to demand for a printed statewide geologic map. The 1967 map was out of print, and a large amount of new, detailed mapping information had been gathered and digitally recorded since the 1967 map. ArcGIS (8.X) and Arc/Info (7.X) software were used to assemble the map. Coverage and shape file data of various scales, projections, and coordinate systems and various levels of documentation were assembled into a geologic database. The lack of robust editing tools and topology in early versions of ArcGIS resulted in much difficulty (and headaches). ArcEdit was used for most of the editing of map polygons and lines. The power and ease of use of new software functions (such as layer transparency) can result in unique views of the data, such as that shown here. The map shown here combines the new geologic map layer with a shaded-relief depiction of the consolidated bedrock surface, which is buried by as much as 400 feet of glacial material. The scale of the soon to be published geologic map is 1:500,000 and is shown here at ~1:900,000. 437,290 borings were used.

Also in 2005: George W. Bush is President; Iraqi war; relief to Asia pours in after December 2004 earthquake (9.3 on Richter scale) and tsunami kill 290,000 in Asia and Africa; ISGS Centennial. The population of Illinois in the 2000 census is 12,419,293.

ISGS Publications

(Released to the public July 1, 2004, to June 30, 2005)

ISGS Series

ANNUAL REPORT

Illinois Geology: Information and Innovation. Illinois State Geological Survey Annual Report. 2004. 54 p.

CIRCULARS

Circular 565 Geomorphic History of the Rock River, South-Central Wisconsin, Northwestern Illinois. R. Anderson. 2005. 34 p. (CD-ROM)

Circular 568 The Benoist (Yankeetown) Sandstone Play in the Illinois Basin. H.E. Leetaru, K.K. Mize, and J.S. Cokinos. 2005. 46 p. (CD-ROM)

COAL MINE MAPS

Directory of Coal Mines in Illinois, 7.5-minute Quadrangle Series. Coal City Quadrangle, Grundy County, Illinois J.M. Obrad and C. Chenoweth. 2004. 39 p. Accompanies Coal Mines in Illinois—Coal City Quadrangle, Grundy County, Illinois. 1:24,000.

Directory of Coal Mines in Illinois, 7.5-minute Quadrangle Series. Colchester Quadrangle, McDonough County, Illinois A.R. Myers and C. Chenoweth. 2004. 110 p. Accompanies Coal Mines in Illinois—Colchester Quadrangle, McDonough County, Illinois. 1:24,000.

Directory of Coal Mines in Illinois, 7.5-minute Quadrangle Series. Galatia Quadrangle, Saline County, Illinois J.M. Obrad and M.H. Bargh. 2005. 25 p. Accompanies Coal Mines in Illinois—Galatia Quadrangle, Saline County, Illinois. 1:24,000.

Directory of Coal Mines in Illinois, 7.5-minute Quadrangle Series. Gardner Quadrangle, Grundy County, Illinois A.R. Myers and J.M. Obrad. 2005. 27 p. Accompanies Coal Mines in Illinois—Gardner Quadrangle, Grundy County, Illinois. 1:24,000.

Directory of Coal Mines in Illinois, 7.5-minute Quadrangle Series. Harco Quadrangle, Williamson and Saline Counties, Illinois A.R. Myers and J.M. Obrad. 2005. 29 p. Accompanies Coal Mines in Illinois—Harco Quadrangle, Williamson and Saline Counties, Illinois. 1:24,000.

Directory of Coal Mines in Illinois, 7.5-minute Quadrangle Series. Karbers Ridge Quadrangle, Gallatin and Hardin Counties, Illinois J.M. Obrad. 2005. 24 p. Accompanies Coal Mines in Illinois—Karbers Ridge Quadrangle, Gallatin and Hardin Counties, Illinois. 1:24,000.

Directory of Coal Mines in Illinois, 7.5-minute Quadrangle Series. Minooka Quadrangle, Grundy County, Illinois A.R. Myers and J.M. Obrad. 2005. 12 p. Accompanies Coal Mines in Illinois—Minooka Quadrangle, Grundy County, Illinois. 1:24,000.

Directory of Coal Mines in Illinois, 7.5-minute Quadrangle Series. Morris Quadrangle, Grundy County, Illinois J.M. Obrad. 2004. 48 p. Accompanies Coal Mines in Illinois—Morris Quadrangle, Grundy County, Illinois. 1:24,000.

Directory of Coal Mines in Illinois, 7.5-minute Quadrangle Series. New Haven SW Quadrangle, Gallatin County, Illinois A.R. Myers. 2005. 11 p. Accompanies Coal Mines in Illinois—New Haven SW Quadrangle, Gallatin County, Illinois. 1:24,000.

Directory of Coal Mines in Illinois, 7.5-minute Quadrangle Series. Pittsburg Quadrangle, Williamson and Franklin Counties, Illinois A.R. Myers and J.M. Obrad. 2005. 26 p. Accompanies Coal Mines in Illinois—Pittsburg Quadrangle, Williamson and Franklin Counties, Illinois. 1:24,000.

Directory of Coal Mines in Illinois, 7.5-minute Quadrangle Series. Ridgway Quadrangle, Gallatin and Saline Counties, Illinois A.R. Myers and C. Chenoweth. 2005. 13 p. Accompanies Coal Mines in Illinois—Ridgway Quadrangle, Gallatin and Saline Counties, Illinois. 1:24,000.

Directory of Coal Mines in Illinois, 7.5-minute Quadrangle Series. Wilmington Quadrangle, Grundy and Will Counties, Illinois J.M. Obrad and C. Chenoweth. 2005. 56 p. Accompanies Coal Mines in Illinois—Wilmington Quadrangle, Grundy and Will Counties, Illinois. 1:24,000.

GEOSCIENCE EDUCATION SERIES

GES 19 Guide to the Illinois Caverns State Natural Area. S.V. Panno, S.E. Greenberg, C.P. Weibel, and P.K. Gillespie. 2004. 106 p.

Geoscience Education Map Brochure A Self-guided Tour of Illinois Caverns. S.V. Panno, C.P. Weibel, S.E. Greenberg, and B.J. Stiff. 2005. Two sides.

GES 20 How to Read Illinois Topographic Maps. 2005. 28 p. URL: http://www.isgs.uiuc.edu/servs/pubs/pdf-pubs/topo_map_guide_sm.pdf)

GEOLOGICAL SCIENCE FIELD TRIP GUIDEBOOK SERIES

2004B Guide to the Geology of the Ferne Clyffe State Park and Surrounding Area, Johnson and Pope Counties. W.T. Frankie. 2004. 51 p.

2005A Guide to the Geology of the Kickapoo State Park and Surrounding Area, Vermilion County, Illinois. W.T. Frankie. 2005. 36 p.

ISGS GUIDEBOOK SERIES

GB 34 Stratigraphy and Biostratigraphy of the Mississippian Subsystem (Carboniferous System) in Its Type Region, the Mississippi River Valley of Illinois, Missouri, and Iowa. P.H. Heckel, P.L. Brenckle, H.R. Lane, E.C. Rankey, B.J. Witzke, B.J. Bunker, J.M. Masters, and Z. Lasemi. 2005. 118 p.

POSTER

Chicagoland: Shaped by Ice and Water M.J. Chrzastowski. 2005. 24 × 36 inches.

STATE PARK SERIES

Time Talks: The Geology of Starved Rock and Matthiessen State Parks Illinois State Park Geology series. 2005. Full color. 48 p.





IGQ Crystal Lake-BT Bedrock Topography of Crystal Lake Quadrangle, McHenry and Kane Counties, Illinois. B.B. Curry. 2005. 1:24,000. URL: http://www.isgs.uiuc.edu/online-maps/igq/crystal_lake_7_5.htm

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