ISGS
GEONEWS
Spring 1988

Can Illinois deliver clean coal to market?

Survey scientists say yes.

Clean-air legislation of the 1970s made coal desulfurization critical in the 1980s—especially in Illinois with more than 170 billion tons of high-sulfur coal in the ground. The laws target coal-burning utilities, which make up 90 percent of the market for Illinois coal.

"In recent years, the Survey has given top priority to research aimed at removing enough sulfur from coal to give utilities a 'compliance' coal — one that meets standards," says Subhash Bhagwat, mineral economist at the Illinois State Geological Survey (ISGS). "But it takes 15 to 30 years from the time we find something in the lab till it becomes reality in the market."

To shorten that time, the ISGS set to work early in the 1980s in two major areas of research: physical and chemical desulfurization. Now the results are coming in.

Physical coal cleaning

In the Applied Research Laboratory, Richard B. Read and other engineers are working on aggregate flotation — an improved flotation method that removes 90 percent of the pyritic sulfur and up to 90 percent of the ash from selected Illinois Basin coals.

The success of aggregate flotation partly depends on surfactants, which are special reagents developed by Cal Meyers, professor of chemistry at Southern Illinois University.

"We mix finely ground coal with water, then add the surfactants and alcohol. Coal particles are basically floated by bubbles, forming a black froth that we skim off. It makes a good product," says Read. "Right now, we're testing the process on a pilot scale."

Aggregate flotation may get a boost from biochemical experiments in J. Bruno Risatti's lab.

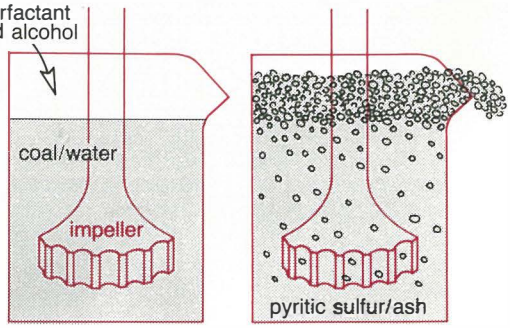
"We've found that some bacteria produce chemicals that suppress the mineral pyrite when they're used during physical coal cleaning. One compound suppresses up to 65 percent of the pyrite." Risatti explains that this should make it easier to separate sulfur-containing pyrite from coal. "Next we'll try to isolate the compound and determine its structure so we can choose similar compounds that are readily available or synthesize one to add to froth flotation."

In another project run by Michael Stephenson, coal is "deep cleaned" by thermal methods. Heating coal up to 650°C with no access to air leaves a product "low in volatile matter, but fairly well depleted in sulfur," says Stephenson. "We can approach a compliance fuel in this way."

Chemical coal cleaning

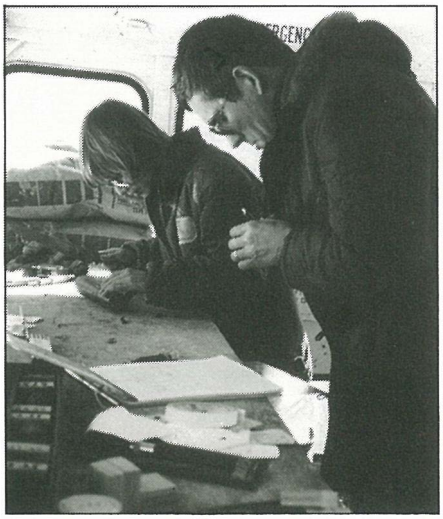
Organic sulfur resists removal by physical methods. In the late 1970s, Richard H. Shiley of the ISGS and C. C. Hinckley and G. V. Smith, both of Southern Illinois University, began investigating another approach. They developed a process that strips coal of 90 percent of its total sulfur — organic and inorganic. By reacting carbon monoxide and ethanol with iron sulfides in coal, they trigger another chemical reaction that removes all but about 0.2 percent of the organic sulfur. A small continuous-feed reactor, designed to demonstrate the first two steps of the process, should be in operation by late 1989.

Richard Read sums up the Survey's role: "We're part of what the state is trying to do — help its industry."



"We mix finely ground coal with water, then add the surfactants and alcohol. Coal particles are basically floated by bubbles, forming a black froth that we skim off."

ISGS investigates future site of world's most powerful x-ray source



At work in the mobile lab, Brian Trask, ISGS, and Cynthia Bonczkiewicz of the STS staff examine and describe drilling samples—a daily routine.

Since last July, ISGS geologists under Myrna M. Killey's direction have been analyzing the geology of the future site at Argonne National Laboratory for the world's most powerful source of x-rays, called the Advanced Photon Source (APS). The APS will be used by researchers from academia, industry, and government laboratories in medicine, semiconductor technology, petroleum refining, plastics, and other fields. At any one time, 300 scientists will be able to use the APS. Argonne hopes to begin construction for the facility as early as next year.

An important part of the Argonne facility is the positron storage ring. Positrons, which are positively charged electrons, will be accelerated in a circular path at nearly the speed of light. When this path is bent by magnets, x-rays will be emitted. The circumference of the ring will be about 3,500 feet. The foundation for the ring must be extremely stable. The effective operation of the ring will depend on its being isolated from vibration.

Argonne officials asked the Geological Survey for assistance in investigating the site because of its extensive experience in

siting similar structures. They approached John Kempton, Senior Geologist (who heads the ISGS geologic team involved in siting the Superconducting Super Collider in Illinois), for his ideas on the project. Kempton, Paul DuMontelle, and Robert Bauer met with Argonne personnel to discuss the project.

"There were two basic tasks," Killey says. "We had to determine which geologic and hydrological parameters were most critical for building a stable foundation for the synchrotron. We also had to test the soils to see how they would transmit vibration so the foundation could be designed to minimize it." The ISGS team worked closely with Pieter Braam, consulting geologist for Argonne, on setting up a drilling and testing program to characterize the site. STS Consultants was chosen by Argonne to assist with drilling, sampling, and engineering analysis of soil materials.

ISGS scientists compiled regional geologic and geotechnical data from various sources—Survey files, well logs, maps, unpublished field records, bridge-foundation boring logs, and various documents on file at Argonne National Laboratory. "We performed the regional studies to make sure we wouldn't have any surprises in the geology when we focussed on the site itself," says Brian Trask, who is working with Killey in overseeing the project. Analysis of the regional data paved the way for the field studies, which began last fall.

Before the drilling phase was begun, ISGS scientists directed by Paul Heigold spent a couple of months performing seismic refraction and electrical earth resistivity surveys at the site. The team included Vickie Poole, Edward Smith, Terrie Adams, Brian Trask, and Myrna Killey. According to Heigold, surface geophysical methods are the most economic and efficient way to characterize the sediments down to and including the bedrock surface.

In December, STS Consultants moved a drill rig onto the Argonne site; they drilled four holes into bedrock outside the area where the ring will be sited and 23 shallow holes on the ring site. STS took continuous core on five shallow holes and Shelby tube samples at various intervals from the remaining holes. ISGS also took core samples for analysis and testing. Inter-Survey Geotechnical Lab, staffed by Michael Miller, Rebecca Roeper, and James Ploetz, determined particle size. Wen-June Su and Robert Mitchell are conducting tests on the physical properties of foundation soil samples. Ross Brower assisted with the hydrogeological studies. The team is currently completing laboratory analysis and geologic and geotechnical evaluation of the samples and is beginning work on the final report.

Philip Reed and Walter Morse conducted down-hole geophysical logging. "What we've done and are continuing to do is make graphs of the earth materials—sort of like a cardiogram," says Reed. "We'll use the graphs to correlate stratigraphy and material type."

Although the Argonne project has progressed smoothly, the field work has not always been easy. The area is dotted with archaeological sites. "The archaeological considerations are really high," Heigold says. "Our earth resistivity studies are fairly benign. But with the seismic refraction, we use dynamite for an energy source, so we have to watch carefully for the archaeological digs." The mild winter also posed a few problems. "Almost every other week, Argonne had to pull us out of the mud," Killey says.

At present, samples taken in the field are being analyzed at ISGS and STS laboratories for moisture content, density, grain size, and Atterberg limits. Compaction and consolidation testing will also be conducted to find out how the material acts after a load is placed on it.

Survey scientists are working with Argonne National Laboratory in compiling the results of the laboratory analyses. An architectural/engineering firm will use the study findings when it begins work on the foundation design for the Advanced Photon Source. The Survey's field investigation should be completed by June 1.—*js*

Brian Trask and Myrna Killey load core boxes into the Survey's new carry-all in preparation for the final round of drilling and sampling at the Argonne Lab site.

Dr. Paul R. Seaber, who returned last October to the starting place of his professional career, became the new Acting Head of the Ground-

DOE funds ISGS oil and gas research

The Geological Survey of the Illinois Department of Energy and Natural Resources has been selected by the Department of Energy (DOE) to conduct research on improved oil recovery. The target is nearly 1.5 billion barrels of by-passed oil that remains trapped in existing Illinois reservoirs by natural subsurface conditions. The projected four-year study will involve matching federal and state funds. Illinois is one of six states participating in the program.

The project is part of DOE's initiative to enhance domestic oil production and reduce the nation's reliance on foreign petroleum. It will also benefit the southern Illinois oil and gas industry.

The state and federal governments have each appropriated $250,000 in FY88 to start up the research effort. The $500,000 will finance the data-gathering and planning phase of the project, which involves screening the Survey's oil and gas database, integrating geological and engineering information, establishing a preliminary reservoir classification scheme, and assessing one or two reservoirs for improved and enhanced recovery potential.

"We want to describe the reservoirs so that we can gain a better understanding of where they are, why they act as they do, and what we can do to increase the amount of oil that is recovered from them," explains Donald F. Oltz, head of the Survey's Oil and Gas Section, which is conducting the state-DOE project.

The study will also determine ways to minimize formation damage and stimulate producing wells in Illinois. Two workshops are planned to share the new technology with the oil industry, particularly the independent producers, who, given the low price of oil, are unable to support or carry out research and development.—*al*

ater Section in January. More than 27 years go Seaber studied groundwater as a doctoral udent under George Maxey, a professor of eology at the University of Illinois at Urbana-hampaign and Head of the Groundwater ection of the ISGS.

Seaber joined the ISGS following a 3-month emi-retirement and a 30-year career with the .S. Geological Survey. He likes his new job. 've been revitalized," says he. "When you pend 30 years with one agency you begin to ok forward to retirement and vacations — ut semi-retirement made me realize that I anted to continue to be active in the field iat I love." He views his new post as a emi-teaching position in which to "pass on ome of my past experience to the young, ilented professionals in the section."

Under Seaber's direction, the Groundwater ection will concentrate on computerizing the xtensive database of well records and well gs, implementing the groundwater assess-ient and protection act, promoting the urvey's groundwater research in scientific journals and meetings, and improving service to the public.

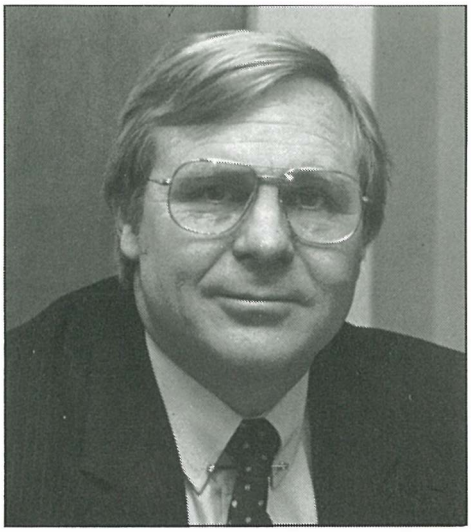
The Groundwater Section averages nearly 30 requests a week from homeowners, farmers, industries, and municipalities seeking solutions to their water availability problems and advice on landfill sitings. "They want to know where to drill new wells, how deep they should be, and how much water they can expect to produce," he explains.

Seaber's experience is wide ranging. Under the auspices of USGS, he worked on groundwater sources, ground-surface water relationships, water quality, mine drainage, and groundwater economics in two river basins in Pennsylvania. In Florida he concentrated on water resource and water quality studies. He was loaned to the U.S. Agency for International Development as technical advisor for hydrology projects in Pakistan, Senegal, and India for several years. He retired from the USGS in 1986 to work for the Sultanate of Oman as Director, Water Resources Data Department.—*al*

Griffin heads Group

Dr. Robert A. Griffin is the new Principal Scientist and Head of the Chemistry and Minerals Engineering Group. He began his new position in January after nearly two years as Head of the Groundwater Section, preceded by eight years as Head of the Geochemistry Section. Griffin joined the Illinois State Geological Survey in 1973.

Griffin has reorganized some sections and units and has officially recognized and identified the major laboratories providing services within ISGS and to the other Surveys.



He has also set up a quality assurance and control program and is working with his staff to improve analytical chemistry service to the Survey. Coal desulfurization and other coal cleaning research, and research and service programs in geochemistry, analytical chemistry, and clay minerals will also proceed "as vigorously as possible," according to Griffin.

Griffin has authored or co-authored nearly 90 articles. His major research interests have been solution chemistry, physical-chemical interactions of pollutants with earth materials, and evaluation of waste management practices to protect groundwater resources.

Griffin's educational credentials include bachelor of science and master's degrees in soil science from the University of California in 1966 and 1968, and a doctorate in soil chemistry from Utah State University in 1973.

Inaccurate maps tell lies. "Lines represent real surfaces," said Mitch Reynolds, map expert from the U.S. Geological Survey, as he conducted an intensive, three-day course on geologic map review this March at the ISGS. During one exercise, geologists and cartographers from the Illinois and Indiana Geological Surveys and the University of Illinois were instructed to cut up a cross section, then realign the layers of faulted rock to check their consistency and uniformity. Nothing matched.

Reynolds had made his point about the value and difficulty of a map reviewer's job. "Be kind, but direct," he said. "Your own reputation is at stake."

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Illinois State Geological Survey Publications

The Hornsby District of low-sulfur Herrin Coal in central Illinois (Christian, Macoupin, Montgomery, and Sangamon Counties), 1987, by W. John Nelson, with contributions by Philip J. DeMaris and Robert A. Bauer (Circular 540, 40 p., 1 plate, $3.75).

An estimated 1.17 billion tons of low-sulfur coal underlies the "Hornsby District." Although the Hornsby deposit is thick, only moderately deep, and close to markets, it has scarcely been touched by mining — mostly because of fear of unstable roof conditions. The low-sulfur coal, containing an average 1.5 to 2.0 percent sulfur, is overlain by 20 feet of Energy Shale, a nonmarine shale that shielded the Herrin peat from sulfur-bearing marine water. This low-sulfur coal also contains about 1.5 percent less ash and 2 percent more moisture than does adjacent high-sulfur coal. Outside the area of Energy Shale the Herrin Coal is overlain by marine strata and contains more than 3 percent sulfur.

Study findings suggest that the Hornsby shale will require more artificial support than is normal for roof strata in Illinois and that efforts should be made to protect the shale from changes in humidity. Evidence of in situ horizontal compressive stress indicates that moderate roof-control problems may exist in any mine with Energy Shale roof.

Illinois mineral industry in 1985 and review of preliminary mineral production data for 1986, 1987, by Irma F. Samson (Illinois Mineral Notes 99, 44 p., $1.25).

This publication summarizes the output and value of minerals mined, processed, and manufactured into products in Illinois.

Order information

Publications and maps may be purchased by mail from the Survey offices at 615 East Peabody Drive, Champaign, IL 61820. Orders are shipped via 4th Class mail unless otherwise requested. Please allow 2 to 4 weeks for delivery; add $3.00 to these rates for first class mail/United Parcel Service. Prepayment required.

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Structural geology of southeastern Illinois and vicinity, 1987, by W. John Nelson and Donald K. Lumm (Circular 538, 70 p., 2 plates, $3.75).

The aim of this investigation of the nature, extent, age, origin, and history of faulting in southeastern Illinois and adjacent parts of southwestern Indiana and western Kentucky was to help assess the seismic risk for southern Illinois. Specific goals were to determine whether the Fluorspar Area Fault Complex connects with the Wabash Valley Fault System and whether the Shawneetown Fault Zone joins the Cottage Grove Fault System. Attention was focused on southeastern Saline and south-central Gallatin Counties, where all these fault zones converge.

Inventory of Lake Michigan research projects 1984-87, compiled by Nancy P. Holm (Environmental Geology Notes 121, 423 p., $5.00).

This publication includes descriptions of more than 320 projects, covering research in biology, chemistry, geology, physical limnology, atmospheric sciences, socioeconomics, and management. Indexes are included for subject (keyword), area of lake studied, and principal investigators. The inventory should be useful for Great Lakes researchers, environmental managers, and agencies requiring information on specific research projects.

Stratigraphic correlations of the Seelyville, Dekoven, and Davis Coals of Illinois, Indiana, and western Kentucky, 1987, by R. J. Jacobson (Circular 539, 27 p., 2 plates, $3.75).

These three coals were previously considered to be separate seams of regional extent in the Illinois Basin Coal Field, but subsurface studies reveal that the Dekoven and Davis Coals are actually splits of the Seelyville Coal. This study involved the construction of seven linked cross sections (based on extensive drill hole data from an average one well per mile) along a 170-mile northeasterly trending transect in eastern Illinois, western Indiana, and western Kentucky.

Petroleum industry in Illinois, 1985 — oil and gas developments and waterflood operations, 1987, by Bryan Huff (Illinois Petroleum 128, 14 p, $1.25).

This annual report contains information about Illinois oil and gas production and secondary recovery operations; it consists primarily of data in tabular form.

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