One Hundred Fifteenth Annual Report of
the State Geologist

of the

Indiana Geological Survey
Department of Natural Resources

July 1, 1990, to June 30, 1991
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INTRODUCTORY STATEMENT

The Indiana Geological Survey, a Division of the Indiana Department of Natural Resources, is located on the campus of Indiana University, for which it is a Research Institute. A memorandum of understanding authorized and signed this past year defines this relationship. The management of the Survey, therefore, follows the policies and procedures of Indiana University. The upper level of the Survey is codirected by the Deputy Director of the Bureau of Reclamation for the Indiana Department of Natural Resources and the Vice President for Research and University Graduate School at Indiana University.

The Survey functions as a center for information, research, and education related to the mineral, energy, and ground-water resources and to the geologic hazards of Indiana. A major part of the information gathering system derives from the collection and archiving of rock cores, well cuttings and downhole geophysical logs. Information pertaining to the surface and subsurface geology of the state is disseminated as published reports and maps. The mission of the Survey is, therefore, to serve the citizens of Indiana by providing information and counsel that contribute to the wise use and management of mineral, energy, and ground-water resources; and to help promote the health, safety, and welfare of the citizens; and to help promote and encourage economic development of the State.

Norman C. Hester
Director and State Geologist
Indiana Geological Survey
STATE GEOLOGIST

Administrative Personnel

Norman C. Hester ......................................................... State Geologist and Director
Tammy J. Watson ......................................................... Secretary to the Director

Orientation and General Activities

The State Geologist serves as director of activities for the Geological Survey and as principal representative of the organization to industry, government, and the private sector.

Professional Activities

Organization and Committee Activity

The Director:

Serves as an active member of the:

1) Indiana Recycling and Energy Development Board
2) Certification of Indiana Geologists (Chairman)
3) Seismic Advisory Committee-Indiana State Emergency Management Agency
4) Earthquake Preparedness Legislative Study Committee
5) National Geologic Mapping Committee-American Association of State Geologists
6) Geoscience Education Committee-American Association of State Geologists
7) Coal Research Initiative for Indiana

Reports upon request to the:

1) Commission of the Department of Natural Resources
2) Director of the Department of Natural Resources
3) Vice President of Research and University Graduate School

Meets with:

1) The American Association of State Geologists and National Headquarter representatives of the United States Geological Survey (biannually)
2) The Regional United States Geological Survey representatives (annually)
3) Illinois Basin Consortium (biannually)

Met with various state and federal agencies to investigate and negotiate cooperative research agreements, contracts, and/or grants:

1) Department of Energy
2) United States Geological Survey, Geologic Division
3) Central United States Earthquake Consortium
4) Federal Environmental Protection Agency
Indiana Geological Survey at Indiana University

5) United States Geological Survey, Water Resources Division
6) Federal Office of Surface Mining
7) Indiana Department of Commerce
8) Indiana Department of Environmental Management
9) Indiana Department of Natural Resources
   a) Division of Water
   b) Division of Reclamation
   c) Division of Oil and Gas

Met with representatives of industry to solicit support and encourage the sharing of information with:

1) Indiana Independent Oil Producers Association
2) Amax Coal Company
3) Peabody Coal Company

Worked out cooperative research agreements with:

1) United States Geological Survey - Cooperative Geologic Mapping Program (south central Indiana)
2) United States Geological Survey - cooperative research to reduce earthquake hazards

University Instruction

1) Fall -- Indiana University, Geological Sciences Department Seminar on Pennsylvanian Sedimentary Environments for graduate students - four weekend field trips
2) Co-chair of the Department of Geological Sciences/Geological Survey Advisory Committee
3) Served on the Advisory or Thesis Committees for the following:
   Ph. D. candidates
   Lisa Rhoades
   Clayton D. Harris
   Jun Yuan
   John Hohman
   Cliff Ambers
   Masters candidates
   Franz Reisch

4) Chairman - Geological Society of America Medlin Scholarship Award
5) Directed the research of two high school students on the NSF sponsored Summer Science Institute

Miscellaneous

Public Lectures and Special Meetings:

1) July 3: *Earthquake Preparedness Study Committee, Indianapolis, Indiana.
2) Aug. 15: Earthquake Preparedness Study Committee, Evansville, Indiana.
5) Sept. 15: National Association of Geology Teachers, Morehead, Kentucky.
6) Sept. 17: *Earthquake Preparedness Study Committee, Televised presentations by Director, Survey Staff and Geology Department Faculty on Seismic Risk for Indiana, Bloomington, Indiana.
7) Sept. 25-26: Indiana Water Resources Research Center Workshop, Brown County State Park.
9) Sept. 28-29: Kentucky Geological Society Field Trip, Lake Cumberland, Kentucky.
13) Nov. 16: *TV Interview on Earthquake Risk for Indiana with Pat Ralston and Jerry Hauer, Terre Haute, Indiana.
14) Nov. 20: *Seismic Risk for Indiana presented to National Guard of Indiana, Kendall Armory, Indianapolis.
15) Nov. 27: *Televised presentation on Earthquake Hazard and Seismic Risk, Terre Haute, Indiana.
24) Apr. 1: Met with Peabody Coal upper management to discuss co-operative programs, St. Louis, Missouri.
31) June 5: Earthquake Hazard Field Trip with State Geologist of South Carolina classical areas to observe geologic features resulting from 1886 earthquake, Charleston, South Carolina.
32) June 14: Coal Research Initiative Committee, Indianapolis, Indiana.
33) June 16-30: NSF sponsored Summer Science Institute; directed research of two highschool students, Indiana University.

*indicates formal oral presentation.
MINERAL RESOURCES AND DATA MANAGEMENT BRANCH

COAL SECTION

Permanent Personnel

Donald D. Carr . Geologist and Head, Mineral Resources and Data Management Branch
Curtis H. Ault . Geologist and Head
Denver Harper . Geologist and Associate Head, Coal Section
Walter A. Hasenmueller Geologist and Associate Head, Data Management
Paul N. Irwin (OSM) . Geologist
Jimmy J. Johnson Systems Analyst/Programmer
Christopher Schubert Kohler (USGS, OSM) . Geologist
Licia A. Weber (OSM) . Geologist
Kathryn R. Shaffer Minerals Statistician/Office Assistant

Other Personnel

Adam Berkelhammer Research Assistant (July 1, 1990 to December 29, 1990)
Joe Callis Research Assistant (September 6, 1990 to June 30, 1991)
Christopher Carlson (DOR) Research Assistant (July 13, 1990 to August 18, 1990)
Lisa Chin Clerical & Database Assistant (August 27, 1990 to April 26, 1991)
Abdel-Azim M. Ebraheem (DOR) Research Assistant (July 1, 1990 to June 30, 1991)
Yvonne Huff (Coal Section/DOR) Research Assistant (July 1, 1990 to August 24, 1990)
Greg Olyphant (NOAA) Geologist (July 1, 1990 to August 3, 1990)
Larry Smith (DOR) Research Assistant (July 1, 1990 to May 10, 1990)
Michael Smith (DOR) Research Assistant (May 7, 1991 to June 30, 1991)
David Taylor Research Assistant (August 27, 1990 to October 25, 1990)
Kathy Thielen (OSM) Research Assistant (July 1, 1990 to June 30, 1991)
Chin-Iuag A. Wei Research Assistant (June 3, 1991, to June 30, 1991)
Marie Yager Research Assistant (September 17, 1990 to April 17, 1991)

Organization and General Activity

Research projects ranged from compilation of databases of county mineral production to a subsidence study of an abandoned coal mine at Cannelburg. Members of the Section published nine reports, maps, and abstracts and made five presentations at professional meetings. The coal-analysis file was completed and proofed and a publication including computer disks, the first publication in the Computer Databases Series, was submitted for review and approved for publication.

Members of the Section answered 376 requests for information, many of which were for maps showing abandoned mine outlines and areas of possible subsidence. The requests for information ranged from requests for mineral statistics to information on coal resources on properties of individuals. Data management included many requests for repair of PC equipment and help with programming for individual research by professionals of the Survey.
Completed Projects or Parts of Projects

1) Preparation of a Computer Database publication for the Coal Analysis Database
2) Computer database files for industrial minerals and petroleum expanded
3) Geographic Information System about abandoned mineland sites completed
4) Report on coal mining in Knox County completed
5) Report on coalbed methane in Indiana published
6) A report on geologic features associated with thick coal published
7) Vegetated trial plots installed at the Friar Tuck Project
8) Data compiled for monitoring of subsidence at Cannelburg

Research Projects

1) Coal Analysis File
   Editing of the 4.5 megabytes of computer files that comprise the coal Analysis Database was completed. A manuscript for a computer database publication describing this database was completed, reviewed, and awaits publication. Preparation of statistical summaries and figures for a report summarizing the character of Indiana coal was completed as was most of the text for this report.

2) Illinois Coal Sample Bank for the Center for Research on Sulfur in Coal (CRSC)
   The Indiana sample of Springfield Coal Member contained in this Sample Bank was used extensively for research by investigators funded by and working through the CRSC. Funds were being raised for the inclusion of two additional Indiana coal samples in the Bank.

3) History of Indiana mineral production
   Lotus computer files were updated through 1989 for each of the following major Indiana commodities: portland and masonry cement, fire clay and common clay and shale, coal, crushed limestone and dolomite, dimension limestone, natural gas, petroleum, and construction and industrial sand and gravel. The dimension limestone file was completed from 1940, and other files were completed from 1950. Background information on trends was compiled for some years for dimension limestone.

4) Database of county mineral production
   Information on the value of production was entered for each county and commodity produced by year from 1954-1989. Another database, which consists of separate commodity files and shows individual company production and value of production by year, pit, county of production, was completed from 1950 through 1988.

5) Indiana Coal Mine Information System - Phase IV
   Creation of a Geographic Information System (GIS) containing information about abandoned mineland sites was completed. Digitizing of the underground mine outlines documented by mine maps was nearly completed, and digitizing was begun for the surface mine outlines and the outlines of underground mines from secondary sources.

6) Coal mining in Knox County, Indiana
   This is a Survey project that will result in the latest in a series of published coal reports (following Vigo, Sullivan, and Gibson Counties). All reviews and revisions have been completed, and figures are now being drafted for Survey publication.

7) Coalbed methane
   A report about coalbed methane in Indiana was published as a Survey publication (see bibliography). This report provides an overview of coalbed methane as a hazard and as a resource and incorporates desorption data that have been collected by Survey personnel during a period of more than ten years.

8) Compilation of coalbed structure and thickness maps
   A report regarding underlying geologic features that are associated with deposits of thick coal in west-central Indiana was published in a scientific journal (see bibliography).
9) **Statistical analysis of coalbed data**

This proposal is to use publicly available data on thicknesses and elevations of Middle Pennsylvanian coalbeds to investigate statistical relationships between those coalbeds and underlying geological features. A draft of the proposal was submitted to outside reviewers for comments. Progress was made toward computerization of a needed database.

8) **Data Management**

The Data Management Committee was formed to coordinate and promote the development of data management at the Survey. The Committee includes representatives from all areas of research and service work carried out at the Survey. Coal Section staff members assigned to Data Management devoted a large amount of their time to handling numerous requests from other Survey staff members for assistance in selecting computer hardware and software, program applications, and other computing problems. In addition to these duties, Data Management personnel represented the Survey at professional meetings and coordination activities with other governmental agencies.

9) **Blackhawk Project**

This project, which had been funded by OSM-Division of Reclamation, formally ended on July 31, 1987. We have, however, continued monitoring water levels in several wells as a Survey project. A report about water-level changes in an abandoned underground mine at the site was published in a scientific journal (see bibliography).

10) **Friar Tuck Project**

This is a joint project of the Survey, the Division of Reclamation, Purdue University, and Indiana University. Vegetated trial plots were installed on an instrumented watershed, and plans were formulated for their expansion. A manuscript was prepared regarding the use of sodium as a tracer of water from abandoned mines in the Springfield Coal Member (see bibliography). The manuscript has completed Survey review and is currently being revised for outside publication.

11) **Cannelburg Project**

This project is funded by the Division of Reclamation and involves geotechnical and hydrologic monitoring studies related to recent subsidence events at Cannelburg, Indiana. Contract drillers were used to install wells and collection cores and underclay samples. A resistivity survey was conducted to detect the extent of underground workings. Maps, cross-sections, and graphs were produced that will be used in the final report.

12) **Data entry for the National Coal Resource Data system**

Coal resources were calculated and sent to the USGS for Warren, Fountain, and northern Vermillion Counties. Geophysical data for nine counties were coded, plotted, and entered into the NCRDS database. Training for the operation of the new UNIX operating systems was completed, and data were gathered for the purchases of Sun workstations.

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**Reports and Maps Published by the Geological Survey**


**Miscellaneous Publications**

Indiana Geological Survey at Indiana University


Irwin, P. N., 1990, Macros for repetitive mapmaking from ARC/INFO coverages (abs.): Abstracts, Indiana GIS Conference, p. 11.


Professional Activities

Papers and Posters Presented at Professional Meetings

Paul Irwin:

1) talked on PC-based applications of GIS for the Indiana Geological Survey at the Indiana GIS Forum in Indianapolis.

2) made a presentation about TIGER files to a SPEA Environmental Planning Course.

Denver Harper, Paul Irwin, and Licia Weber gave presentations on underground coal mine maps at a seminar of the Indiana Department of Insurance about the Coal Mine Subsidence Insurance Fund Seminar held at the Hulman Center in Terre Haute.

Other Lectures

Curtis Ault and Norman Hester made a presentation at Indianapolis to the Recycling and Energy Development Board concerning the need for funding for the addition of a second sample to the Illinois Coal Sample Bank.


Walt Hasenmueller gave a talk on IGS coal-quality data at a meeting of the Energy Development Board held at Department of Commerce in Indianapolis.

Organizational and Committee Activities

Curtis Ault served as a member of the Advisory Committee of the Illinois Sample Bank of the Center for Research on Sulfur in Coal.
Denver Harper served on the committee to select a new editor for the Survey.

Meetings Attended

Curtis Ault

1) attended a meeting of the Governor's Coal Forum at Indianapolis.
2) sat in for Norman Hester on the Recycling and Energy Development Board at Indianapolis and answered some questions on drilling methods.
3) attended a meeting of the Recycling and Energy Development Board at Indianapolis.
4) participated in an Advisory Committee meeting of the Illinois Basin Coal Sample Bank at Champaign, Illinois.
5) attended the Contractors Technical Meeting of the Center for Research on Sulfur in Coal at Urbana, Illinois.
6) attended the Coal Mine Reclamation Task Force meeting at Vincennes.

Paul Irwin

1) attended the Midwest/Great Lakes ARC/INFO user conference in Kansas City, Missouri.
2) attended conference of State of Indiana Geographic Information System.
3) participated in meetings of the Indiana University GIS Association held at Bloomington.
4) participated in meetings of the Indiana GIS Forum held in Indianapolis.
5) participated in Midwest/Great Lakes ARC/INFO users conference planning meeting held in Indianapolis.
6) attended the Coal Mine Reclamation Task Force meeting at Vincennes.
7) participated in the Indiana Department of Insurance, Coal Mine Subsidence Insurance Fund Seminar held at the Hulman Center in Terre Haute.
8) participated in the "Forum on Computing at State Geological Surveys" held in Lexington, KY.

Walt Hasenmueller

1) represented the IGS at the prescoping meeting for the draft environmental impact statement for the upper section (Bloomington to Newberry) of the proposed Indianapolis to Evansville Highway.
2) attended the Coal Mine Reclamation Task Force meeting at Vincennes.
3) participated in a roundtable discussion sponsored by Marshall Miller & Associates on geologic issues that affect coal mining in Evansville.

Denver Harper:

1) participated in a Coal Mine Subsidence Insurance Fund Seminar of the Department of Insurance, held at the Hulman Center in Terre Haute.
2) attended a meetings of the Indiana Board of Health concerning septic systems.
3) participated in a roundtable discussion on geologic issues that affect coal mining in Evansville sponsored by Marshall Miller & Associates.

Chris Kohler participated in the "Forum on Computing at State Geological Surveys" held in Lexington, KY.

Fieldtrips

Denver Harper conducted fieldtrips of the Friar Tuck site for Mike Long, visitors from TVA, participants in a slurry-reclamation workshop, and others.
Miscellaneous Activity

Curtis Ault met with Walter Hasenmueller, Carl Krause (ISGS), and Dick Harvey (ISGS) regarding the selection of one or more additional Indiana samples for the Illinois Basin Coal Sample Program.

Christopher Kohler

1) reviewed an electrostatic plot of the features associated with the Springfield Coal Member and prepared a list of references for the Indiana data included on that map.
2) reviewed a paper titled, "The Catalog of Well Samples at the IGS," by Sherry Cazee.
3) received a grade of A in G451 (Principles of Hydrogeology).
4) met with USGS, NCRDS personnel in Reston, Virginia to discuss the status of that project.
5) reviewed an abstract on lake level fluctuations in Lake Michigan by Todd Thompson.
6) installed a local-area network and continued advising the IGS staff on computer operations.
7) participated on the Springfield Coal Member project of the Illinois Basin Consortium.

Denver Harper:

1) and Ed Hartke assisted personnel from Midwest Gas Storage, Inc. inspect a property near Carbon, Indiana, for evidence of subsidence.
2) served on the committee to select a new Editor for the Survey.

Walter Hasenmueller

1) reviewed a proposal by Carl Rexroad and Lou Brown titled, "Conodont paleoecology and biostratigraphic zonation of the Desmoinesian Series (Pennsylvanian) in the southern part of the Illinois Basin."
2) reviewed a geologic-map manuscript by David Fishbaugh titled, "Geologic map of the Bellmore and Rockville Quadrangles, Montgomery, Parke, and Putnam Counties, Indiana."
3) reviewed a pamphlet prepared by Steve Brown titled "Earthquake hazards in southern Indiana."
4) January 31, completed a review of an abstract by John Comer titled "Paleoclimatic and eustatic controls on sedimentation in Late Devonian epeiric seas of western North America."
5) February 26, completed a review of an abstract by Carl B. Rexroad and Suzanne Lieurance titled "Conodont paleoecology of the Riverview Limestone Member of the Bond Formation (Pennsylvanian, Missourian) in Indiana."

Paul Irwin assisted with technical support at the introductory training session for ARC/INFO at the SPEA cluster.

Statistical Summary

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Other publications ................................................................................................. 9
Papers, maps, and abstracts reviewed .................................................................. 8
Field trips, educational ......................................................................................... 1
Attendance at professional meetings .................................................................... 21
Indiana Geological Survey at Indiana University

INDUSTRIAL MINERALS SECTION

Permanent Personnel

Donald D. Carr ........................................ Geologist and Branch Head, Mineral Resources & Data Management
Curtis H. Ault ............................................. Geologist and Head
Nelson R. Shaffer ........................................... Geologist
Todd A. Thompson ...................................... Geologist
Marilyn DeWees .......................................... Secretary

Other Personnel

Steve Baedke ............................................ Geological Assistant (June 6, 1991 to June 30, 1991)
Steve Bennett (NOAA) ..................................... Geological Assistant (July 1, 1990 to June 30, 1991)
Jeff Cutright .............................................. Geological Assistant (January 20, 1991 to June 30, 1991)
Insung Lee .................................................. Laboratory Assistant (July 1, 1990 to June 30, 1991)
Karl Leonard ............................................... Laboratory Assistant (July 1, 1990 to September 1, 1990)
David Manley .............................................. Laboratory Assistant (May 26, 1991 to June 30, 1991)
Kendall Miller .............................................. Laboratory Assistant April 28, 1991 to June 30, 1991
Greta Norris .............................................. Laboratory Assistant (August 19, 1990 to March 30, 1991)
Hien Nguyen ................................................ Laboratory Assistant (May 26, 1991 to June 30, 1991)
Linda Pride ................................................ Laboratory Assistant (September 2, 1990 to June 30, 1991)
Scott Thielen ............................................ Laboratory Assistant May 26, 1991 to June 30, 1991

Organization and General Activity

The activities of members of the Industrial Minerals Sections ranged from isotopic and heavy-metals research in shales to a study of causes and removal of stains from Indiana Limestone (Salem Limestone). A map of Monroe County showing the outcrop area of the Salem Limestone and part of the St. Louis Limestone was constructed and research was continued on ceramic resources; mineralogy, chemistry, and oil yield of black shale; structure on the Springfield Coal Member in Posey County; the three-dimensional facies of the Salem Limestone; and lake levels in the Lake Michigan basin.

Geologists of the Section published 19 abstracts, papers, maps, and directories, gave 15 papers and public lectures, and attended 56 professional meetings, fieldtrips, committee meetings, and other meetings. They answered 954 requests for information from government agencies, academia, and Indiana citizens ranging from information on mineral resources to professional requests for geologic data and assistance.

Completed Projects or Parts of Projects

1) Several professional papers and abstracts on metals and isotopes in shales
2) Three reports on the timing and physical limits of lake-level variation in the Lake Michigan basin.
3) Guidebook on the architectural elements of the Salem Limestone
4) Indiana certification of 116 geologists
5) Three reports on stain evaluation of Indiana Limestone
6) Physical properties of limestone for various types and sizes of anchors
7) Map of Monroe County showing outcrop area of the Salem Limestone and lower 50 feet of the St. Louis Limestone
8) Compilation and contouring of a map of Posey County showing structure on the Springfield Coal Member
Research Projects

1) Clay and Shale
Considerable industry interest in ceramic resources was evident this year. Numerous samples from mine exposures, cores, and outcrops of clay, underclay, and shale were collected. Geochemical and ceramic studies were continued, professional papers and abstracts were prepared, ceramic research for ar­chaeologic studies was continued, and presentations were made at professional meetings. Development of several new geochemical methods continued. An infrared study of kaolin was presented at an international conference. An interesting occurrence of well crystallized kaolinite in siderite nodules was found.

2) Black Shales
Samples of black shales continued to be collected and analyzed to determine mineralogy, chemistry, and oil yield. Several professional papers were prepared and presented detailing the results of the research. Isotope research was presented at national and international levels. An NSF proposal was prepared, and organic extractions were expanded. A paper appeared in *Economic Geology*. A pyrolysis gas chromatographic study yielded data on more than 100 samples. Leaching and weathering of shales was studied.

3) 'Silurian Reefs in Northern Indiana
A map of Indiana showing thickness of Silurian rocks and locations of reefs has been drafted and is approved for publication.

4) Exposures of Silurian Reefs in Indiana
A comprehensive and annotated list of Silurian reefs exposed in Indiana was compiled. Publication awaits final checking and critical review.

5) Sulfur Dioxide Absorption by Limestone
This project was revitalized and a new map compiled. Efforts were made to keep current with literature and answer requests for information. Compilation of limestone samples began and a large proposal was outlined.

6) Structure Map on the Springfield Coal Member in Posey County
All data have been compiled for this map, the map has been contoured, and faults have been delimited. The map awaits final data checking.

7) Directory of Crushed-stone Operators
This directory was compiled and copies were sent to operators and other interested persons.

8) Metal Deposits
Several new occurrences of ore minerals were recorded. An exciting multigeneration-banded ZnS material was discovered and analyzed, which generated industry interest. A cooperative effort with the USGS was started.

9) Meteorites
Collection of photographs of Indiana meteorites continued with the goal of accumulating a complete file of photographs for a report. Several talks were given, and a new fall near Nobelsville was investigated.

10) LLASH
The purpose of this project is to determine the timing and physical limits of lake level variation during the late Holocene in the Lake Michigan basin. This project was funded by the USGS and passed through the NOAA Illinois-Indiana Sea Grant Program. No new field work was completed in the last year, although three reports were written. One of those reports was published by the NOAA Illinois-Indiana Sea Grant Program, another will be published by SEPM, and the third report will be sent to a journal. Two additional reports are in the works that will be submitted to journals. This project will officially end in March of 1992 and will be superseded by the TAT-Lake project listed below.

11) Architectural Elements of the Salem Limestone
The purpose of this project is to understand the three dimensional distribution of facies and their characteristics within the Salem shoal building-stone deposits. Samples were collected in three quarries. Thin
sections were made and porosity/permeability measurements conducted on all of the samples by Marathon Petroleum Co. Mapping of the architectural elements will commence this winter.

A fieldtrip was led for the 20th Annual Meeting of the GLS-SEPM. Seventy-five participants were led through several Salem quarries after an evening of lectures. Guidebook 14, now in its second printing, was produced for this trip.

12) **TAT-Lake**
This purpose of this project is to continue the study of late Holocene lake level in the Lake Michigan basin that was begun on the LLASH project. This study continues the work started in northern Indiana but includes information from other sites within the basin. The project is funded by the USGS through their Coastal Wetlands Program and the US Fish and Wildlife Service through their Paleoclimate Study. Twenty-seven days of field work were spent in northern Indiana and Michigan with the collection of 48 vibracores and 24 peat cores. The cores are currently being processed.

13) **Bay of Fundy**
This project was sponsored by Indiana University to better understand the characteristics of tidalite deposits in the Illinois Basin. Nine vibracores and 8 push cores were collected along the banks of the Maccan River in Nova Scotia. The cores are currently being processed with comparison to lower Pennsylvanian and middle Mississippian tidalites.

14) **Certification of Geologists**
The panel that certifies geologists met and took the following action:

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<th>Date</th>
<th>Total considered</th>
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<tr>
<td>June 19, 1990</td>
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15) **Industrial Minerals and Rocks, 6th Edition (IMAR)**
Fourteen Associate Editors were selected to help in the preparation of the 95 chapters of the volume. Monthly newsletters were sent to the Associate Editors in an effort to keep them informed and coordinated. Authors for all chapters have been selected.

Revision began on the chapter on "Limestone and Dolomite," which appeared in the fourth and fifth editions of IMAR and will appear in the sixth edition when it is published.

16) **Stain Evaluation of Indiana Limestone**
A cooperative project with the Indiana Limestone Institute studied various types of staining on Indiana Limestone. Three reports were issued to the Institute.

17) **Anchor Testing of Indiana Limestone**
A cooperative project with the Indiana Limestone Institute investigated the physical properties of limestone for various types and sizes of anchors.

18) **Monroe County Map Showing Salem Limestone**
A "Map of Monroe County, Indiana, Showing the Outcrop Area of the Salem Limestone and of the Lower 50 Feet of the St. Louis Limestone" was compiled. The map was submitted for publication in the Miscellaneous Map series.

19) **Lawrence County Map Showing Salem Limestone**
Compilation began on a map for Lawrence County that will be similar to the one that was completed for Monroe County.
Reports and Maps Published by the Geological Survey


Miscellaneous Publications


Thompson, T. A., 1991, Lake-level behavior during the past 4,000 years in the southern part of the Lake Michigan Basin (abs.): Programs and Abstracts, International Association for Great Lakes Research, p. 72.


Thompson, T. A., Fraser, G. S., and Hester, N. C., 1991, Lake-level variation in southern Lake Michigan: Magnitude and timing of fluctuations over the past 4,000 years, Illinois-Indiana NOAA Sea Grant Special
Memorandum Reports

Curtis Ault prepared memorandum reports on crushed-stone quarries visited during the year.

Professional Activities

Papers and Posters Presented at Professional Meetings

Curtis Ault - lead discussions on jointing and hydrogeology for the Indiana Water Resources Association on fieldtrip stops at the Sellersburg Stone Co. Quarry and at the Ohio River.

Nelson Shaffer:
1) presented a paper on "Big calcite crystals in Indiana - What and how" at the North-Central GSA meeting at Toledo, Ohio.
2) gave a talk on hydrogeochemical exploration at the Indiana Water Resources Association meeting at Clarksville.

Todd Thompson
1) at the Conference on Quaternary Coastal Evolution at Wakula Springs, Florida, presented two papers, "Beach-ridge development and the altitude and age of past lake levels in southern Lake Michigan" and "Coastal evolution of the southern shore of Lake Michigan since Late Wisconsinan time."
2) presented a paper, "Lake-level behavior during the past 4,000 years in the southern part of the Lake Michigan Basin," at a Great Lakes Research Conference.
3) gave the opening lecture, "Lake-level behavior and the development of coastal wetlands in the Great Lakes: a sedimentologist's view," at the 7th Annual Society of Wetland Science Conference.

Organizational and Committee Activities

Curtis Ault
1) was appointed a member of the Indiana Research Work Group of the Indiana Department of Commerce.
2) served as a member of the Geologic Names Committee for the Survey.

Donald Carr:
1) served on a panel that certifies geologists (see Research Projects).
2) served on the Technical Committee of the Indiana Limestone Institute of America.
3) received the "Honorary Aggie Award" from the Indiana Mineral Aggregates Association.

Nelson Shaffer:
1) was elected President of the Indiana Chapter of the Friends of Mineralogy November 11.
2) presided as President and chaired meetings of the Friends of Mineralogy.
3) co-chaired a session on petrology and economic geology at the meeting of the North-Central Section of the GSA, at Toledo, Ohio.

Todd Thompson:
1) was the convener of the 20th Annual Field Conference of the GLS-SEPM at Bloomington.
2) had a discussion of his lake-level research and a photograph included in The HELM, v. 7, no. 2, p. 8. *The HELM* is the newsletter of the Illinois-Indiana Sea Grant Program.
3) had his last fall's SEPM field trip recognized in the Newsletter of the Great Lakes Section of SEPM, v. 20, n. 1, p. 1-2.
4) served as a member of the Geologic Names Committee for the Survey.

Public Lectures

Curtis Ault responded to questions on earthquakes and underground mines at a session of the Indiana Legislative committee on Earthquake Preparedness at Indianapolis.

Donald Carr:

1) gave a colloquium talk at Purdue University on the Salem Limestone.
2) talked on rocks at a 4th grade class at University Middle School.

Nelson Shaffer:

1) talked to Mrs. Robertson's 4th grade class at Bixford Elementary School about rocks and minerals.
2) discussed organic classification at an IGCP meeting of Project 254.
3) talked about large calcite crystals to Indiana Geologists at Indianapolis.
4) lectured on "Spheres and spores and metals and more" at the Univ. of Hawaii.
5) gave lectures on geochemical exploration, industrial minerals, and carbon isotope research to the IU Hydrology G451 class.
6) gave an invited lecture on literature searching by computer at IUPUI at Indianapolis.
7) lectured on clays for ceramics to an IU classical archaeology class.
8) talked on limestone at Harmony School Science Day.

Todd Thompson:

1) lectured on carbonate sedimentation in the Middle Mississippian of Indiana at an IU colloquium at the Department of Geology.
2) lectured on "Architectural elements and paleoecology of carbonate shoal and intershoal deposits in the Salem Limestone (Mississippian) in south-central Indiana."
3) lectured on transport of sediment under shoaling waves to an IU geology G591 class.
4) gave a lecture, "Establishing the altitude and age of late Holocene lake levels in southern Lake Michigan," at a Geosciences Colloquium at Northwestern Michigan University.

Meetings Attended

Curtis Ault:

1) participated a meeting with USGS personnel concerning a program on regional aquifers in northern Indiana and Ohio.
2) attended a state GIS meeting at Indianapolis.
3) participated in a Indiana Research Work Group of the Indiana Department of Commerce in Indianapolis.
4) attended Lake County Plan Commission for rezoning to permit a quarry near Lowell.
5) attended a meeting of the Indiana Recycling and Energy Development Board at Indianapolis.
6) attended a meeting in Indianapolis of the Legislative Advisory Committee on Earthquake Preparedness.
7) attended the fall meeting of the Indiana Academy of Science at North Manchester.
Indiana Geological Survey at Indiana University

Donald Carr

1) met with the CMRTF committee on several occasions to discuss technical transfer conferences
2) participated in a meetings of the C-18 Dimension Stone Committee of ASTM
3) participated in meetings of CMRTF.
4) participated in a meeting on aggregates at the Department of Civil Engineering, Purdue University.
5) attended the Fall Meeting of the Indiana Limestone Institute of America.
6) attended the Great Lakes Section-SEPM meeting in Bloomington.
7) attended a meeting of the Geological Society of America.
8) attended a meeting of limestone producers connected with ASTM Committee C-18 in Chicago.
9) participated in meetings of the Technical Committee of ILI
10) attended a meeting of Indiana Geologists.
11) attended a meeting of the Indiana-Kentucky Geological Society in Evansville.
12) attended the annual meeting of the Indiana Mineral Aggregates Association.
13) attended the SME Annual Meeting in Denver.
14) attended the AAPG meeting in Dallas, Texas.
15) attended the ILI spring meeting in Bloomington

Nelson Shaffer:

1) attended numerous mineral shows in the midwestern United States and elsewhere.
2) attended several orientation meetings on the proposed new highway from Evansville to Indianapolis.
3) participated in the annual meeting of the Geological Society of America at Dallas, Texas.
4) participated in numerous meetings of the Friends of Mineralogy.
5) attended a conference on biological desulfurization and solubilization of coal at Indiana State University at Terre Haute.
6) attended meetings of Indiana Geologists at Indianapolis.
8) participated in the North-Central GSA meeting at Toledo, Ohio.
9) participated in the Indiana Water Resources Association meeting at Clarksville.
10) attended a meeting of the Indiana State Museum Society at the Governor’s mansion.
11) attended the fall meeting of the Indiana Academy of Science

Todd Thompson:

1) met with representatives of USGS and US Fish and Wildlife Service at Ann Arbor, Michigan, concerning additional lake-level studies in Lake Michigan.
2) participated in a USGS meeting in St. Petersburg, Florida.
3) participated in a SEPM/IGCP meeting on Quaternary coastal evolution at Wakula Springs, Florida.
4) participated in the 7th Annual Society of Wetland Science Conference.
5) participated in a meeting of the 34th Annual International Association for Great Lakes Research Conference on Great Lakes Research.

Fieldtrips

Curtis Ault: was co-leader of the Scottsburg Lowland Fieldtrip of the Indiana Water Resources Association June 6 near Jeffersonville.

Donald Carr:

1) to the 4th grade class at University Middle School on a geology trip.
2) attended the fieldtrip of the Great Lakes Section-SEPM in Bloomington.

Nelson Shaffer led Raoul Libre, from Argentina, and Karen Keith on a trip to collect millerite.
Todd Thompson:

1) led a fieldtrip on architectural elements and paleoecology of carbonate shoal and intershoal deposits in the Salem Limestone in south-central Indiana.
2) led a fieldtrip for the Geology Division of the IDEM on the general geology of northwestern Indiana.

Miscellaneous Activity

Curtis Ault:

1) reviewed Todd Thompson's fieldguide manuscript on shoal deposits of the Salem Limestone. He also reviewed several manuscripts for the Geologic Names Committee.
2) was elected a Fellow of the Indiana Academy of Sciences at its fall meeting November 2.
3) attended an IU training course on communication styles.
4) reviewed "Beach-ridge development and the altitude and age of past lake levels in southern Lake Michigan" by Todd Thompson, "Comment on Angles of Repose that Exceed Modern Angles" by Gordon Fraser and Charles Sonett, "Catalog of well samples of the Indiana Geological Survey" by Sherry Cazee, a manuscript on a petrologic method for distinguishing eolian and marine grainstones by Bob Dodd and others, and several manuscripts and abstracts for the Geologic Names Committee.
5) was interviewed concerning the reefal deposit near Lowell, Lake County, by a reporter, Diane Spivak, for a newspaper in the Gary area.

Donald Carr attended IU classes on WordPerfect: Step 3, Focused Topics, Lotus 123, Windows orientation, and Campus Writing Program.

Nelson Shaffer:

1) submitted a nominee, Tom Dombrowski, who was selected as Outstanding Young Scientist for SME.
2) visited USGS laboratories in Denver and discussed metals-in-shale investigations with the researchers there.
3) reviewed a paper by Dean Alger and John Comer on the occurrence of oleananes and a paper by E. Van der Flier-Keller on potassium-group element in coal; a thesis, "Diagenesis and Isotope geochemistry of secondary silica in Columbia River Basalts, Pasco Basin, Washington State," by M. L. Spahn; a paper on organic shales for Joe Hatch of the USGS; a paper on sedimentology by E. H. Calson for Sedimentary Geology; an abstract by John Coner for an SEPM meeting; a paper on metals in black shales by a USGS author; and an abstract on kaolinite crystallinity for E. Koscardy and H. H. Murray.
4) attended an IU training course on selecting job applicants, a training course on "Getting to Yes," a course on "Stepping up to supervision," and a course on presentation skills.
5) was interviewed about scrubber limestone for a radio program.
6) contributed an article on limestone to Geo News

Todd Thompson:

1) reviewed a manuscript for Dan Sullivan on Indiana gas fields, three manuscripts for the Geologic Names Committee, a manuscript for Charly Zuppann on eolian facies in the Syc. Genevieve Limestone, "Prehistoric liquefaction features indicate strong Holocene earthquake shaking in the lower Wabash River Valley" by Ned Bleuer and others, "Discovery and preliminary investigations of the remains of an early Holocene forest on the floor of southern Lake Michigan" by M. J. Chrastoski and others, a manuscript by G. Fraser and N. Bleuer on large-scale ice advance sequences in northern Indiana, a report by J. Hill on gold, and a paper by G. Fraser and N. Bleuer on sedimentation in an interlobe overwash stream.
2) received a certificate of appreciation from the US Fish and Wildlife Service for his LLASH work.
3) met with Pete Seel, who was producing a PBS video on the limestone industry in Indiana. Todd took him to Dark Hollow and PMB Quarries.
6) edited a paper on sedimentation by G. Fraser for the Geologic Names Committee.

### Statistical Summary

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<td>Projects or major parts of projects completed</td>
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PETROLEUM SECTION

Permanent Personnel

John A. Rupp .................................................. Geologist and Head
Stanley J. Keller .............................................. Geologist
Charles W. Zuppann ......................................... Geologist
Vacant (Dan M. Sullivan retired, December 31, 1989) .......... Geologist
Jerry Burton .................................................. Geological Assistant
James Cazee ................................................ Geologist
Sherry Cazee ................................................ Geological Assistant
Melissa Clark ................................................ Secretary and Records Clerk

Other Personnel

Anne Burton ................................................ Clerical Assistant (June 16, 1990 - August 3, 1990)
Cheryl Cullen ............................................... Clerical Assistant (March 2, 1991 - June 22, 1991)
Jeff Cutright ................................................. Geological Assistant (January 5, 1991 - March 2, 1991)
Brian East .................................................... Laboratory Assistant (August 17, 1990 - August 31, 1990)
Polly Higgins ............................................... Clerical Assistant (February 16, 1991 - June 22, 1991)
Jane Hultburg ............................................... Laboratory Assistant (April 27, 1991 - June 8, 1991)
Sue Kairo .................................................... Geological Assistant (March 2, 1991 - May 11, 1991)
Raul Lira ..................................................... Geological Assistant (June 16, 1990 - September 15, 1990)
Henry Mang ................................................ Laboratory Assistant (August 19, 1990 - September 15, 1990)
Ryan Miller ................................................ Laboratory Assistant (August 19, 1990 - December 8, 1990)
Dean Pennington ........................................ Geological Assistant (March 31, 1991 - May 11, 1991)
Scott Shoda ................................................ Laboratory Assistant (September 16, 1990 - December 8, 1990)
Mark Taylor ................................................. Laboratory Assistant (September 16, 1990 - May 11, 1991)
Sean Watters ................................................. Clerical Assistant (February 16, 1991 - June 22, 1991)

Orientation and General Activities

The historical role of the Petroleum Section as a support to the geologic community involved in the exploration and development of hydrocarbons within the state continued to change. As the traditional role of resource definition and exploitation in the U.S. diminishes, the emphasis is shifting toward environmental concerns. Within the last year, an increasing number of inquiries have been made of the section pertaining to deep groundwater protection and development, deep well injection, and water input for secondary oil recovery. In addition to these environmental-subsurface data related subjects, projects involving alternative hydrocarbon development schemes are also increasing. Section personnel are fielding inquiries relating to horizontal drilling, fractured shale gas reservoirs, coal bed methane gas and compressed air storage.

Over the period of this report the price for Indiana crude ranged from $15.88/bbl (July 1990) to $34.69 (June 1991) and the average price was about $23.00/bbl an increase of approximately 25.1% from the prior year. The instability of the domestic oil price is reflected in the fact that there were price changes during the last half of 1990 and seven during the first half of 1991. This pattern of irregularity in crude price continues to exert an adverse effect on drilling activity and production.

During the year 394 permits of all types were issued in Indiana and this level of drilling activity resulted in 288 new completions representing a lessening decline of 10.6 percent from the prior year. Exploratory drilling during 1990 resulted in 21 successful completions, including 5 new-field discoveries, 12 new pools, and 4 extensions to existing fields.
A total of 159 well sites were checked in the section's ongoing program of validating well status, location, and elevation. A total of 25 personnel-days were involved in field work. The petroleum well file now exceeds 65,000 boreholes and is available to the public and industry through both reading room access and computer-readable diskettes.

There were 703 visitor days by 243 different visitors and a total of 1,468 conferences, most of which involved inquiries and requests pertaining to the well data file.

Both paper documents and geophysical logs are reproduced at cost. Turnover time on copying service is minimized through the use of part-time help to assist our regular clerical staff. A wide-bed Zeriox machine reproduces maps, many of which are used by other sections within the survey.

Currently, the section is composed of three geologists and a vacancy, supported by three full-time geological assistants and one secretarial staff person.

Projects

Annual ongoing projects

1) **Indiana Drilling Statistics.** Tabulation and classification of all completed test holes drilled in Indiana are compiled annually. These statistics compose a part of the completion summaries published by the American Association of Petroleum Geologists in an annual report on World Energy Developments. Basic well classification data are available on diskette from the American Association of Petroleum Geologists/CSD Data Center in Norman, Oklahoma. This program was discontinued this year.

2) **Indiana Oil Production.** Preparation of a report detailing the annual oil production by field published as the Survey's Mineral Economic Series was completed. This report has been published annually since 1954. Crude production for Indiana for 1990 was 3,000,092 barrels, which is a 9.3% decrease from 1989. The decline in overall production was 45% or about 2.8 million barrels, during the past 4 years.

3) **Indiana Oil Reserves.** The statistics on new drilling and oil production provide the data used in compiling an internal report on oil reserves and recovery through a format developed under a program previously conducted under the auspices of the American Petroleum Institute. The Department of Energy TORIS database is now being upgraded with this data.

4) **Review of Petroleum Exploration Map Series.** Maps in this series include all 92 counties in Indiana. These maps are revised or checked without revision every year to show status of drilling as of December 31, 1990. Three types: A (well locations and total depths of wells); B (well locations only); C (control on base of Beech Creek Limestone). 129 total maps were published for 1990. This process is now totally performed within the section without assistance from the Drafting Section. A new addition this year is the generation of the Allen County map in digital form.

5) **Indiana Estimates of the Undiscovered Potential Gas Reserves.** Estimates were submitted to the Potential Gas Committee as part of a nationwide effort to determine potential gas reserves of the United States, a number that is revised and published annually.

6) **Crane Naval Weapons Support Center Cores.** The section continues to acquire very valuable cores through the courtesy of Bill Murphy (United States Corps of Engineers) from an extensive coring project at the Weapons Center area in Martin County. These cores will provide data on the Pennsylvanian-Mississippian boundary in an area of sparse subsurface control. Additionally, core descriptions and gamma-ray logs are being integrated into the well records.

7) **Doe Run Company Northern Indiana Cores.** 28 deep cores drilled in 6 northwest Indiana counties during the late 1970's and 1980's were obtained for the Survey Core Library maintained by the Petroleum Section. These cores were cut for mineral evaluation and constitute valuable core data in an area of sparse
deep stratigraphic data. These cores and core data are now being integrated into the public access files.

8) Sample Cut. The Evansville Sample Cut is going out of business after preparing well cuttings for 30+ years in the Illinois Basin. The section has taken over this service and now is the only facility of its kind in the area.

Reports and Maps Published and Submitted for Publication


Reports Submitted for Outside Publication


Charly and Stan prepared nine reports for the Indiana-Kentucky Geological Society newsletter and "Guaranteed Geology" series.

Professional Activities

Poster Sessions and Talks

John Rupp:

1) Presented a description of horizontal logging techniques to the Energy Development Board.
Indiana Geological Survey at Indiana University

2) Presented a talk on the southern Ural Mountains, USSR, for the Survey colloquium.
3) Presented a talk at the Russian and East European Institute seminar on environmental questions in the USSR.

Stanley Keller:

4) Conducted a poster session for the Indiana-Kentucky Geological Society meeting in Evansville. The title of the poster was "Stratigraphy and oil fields in the Big Clifty and Hardinsburg Formations in Indiana," coauthored with John B. Droste.
5) Presented a talk to Indiana Geologists in Indianapolis titled, "The sub-Pennsylvanian unconformity - Its geology and elevation."

Charles Zuppann:

2) Presented "Shallow expression of buried Silurian reefs in Indiana, truth or fairy tale?" Lecture presented at "soft rock seminar," Indiana University Department of Geological Sciences.
3) John, Stan, and Charly presented 'Ten ideas for finding buried Silurian reefs in Indiana.' Poster paper presented at Indiana-Kentucky Geological Society meeting. Charly gave the same presentation at the annual meeting of the Illinois Oil and Gas Association.

Projects Initialized and Ongoing

Stanley Keller:

1) MES 37 'Petroleum Exploration, Development, and Production in Indiana during 1990.'
2) Incorporation of coal stratigraphic data in petroleum file system for 565 Sullivan County wells.
3) Working with the Corps of Engineers' records from Crane NWSC; approximately 50 new corehole records and descriptions are being integrated into the petroleum file.

John Rupp:

1) Geophysical characteristics of the basal sandstone/basement interface.
2) Subsurface Study of Lower Sandstone Group.
3) Subsurface bedrock aquifer salinity distribution.
4) Subsurface and surface geology of Pennsylvanian rocks on Crane NWSC.
5) Revision of Bulletin 42-N "Petroleum Industry in Indiana."

Charles Zuppann:

1) AAPG Studies in Geology volume: Mississippian Oolites of N. America, editor with Brian Keith, 19 papers.
3) Expand and modify petroleum database and other management systems of the Section.

Meetings attended

John Rupp:

1) Met with Don Oltz (Illinois State Geological Survey) to discuss funding (Department of Energy) for
reservoir study.  
2) Met with Charles Hardy and Wayne Fix (Indiana University Real Estate) to discuss oil leasing of Indiana University-owned Kentucky property.  
3) Met with United States Geological Survey personnel to discuss grants and collaborative basin studies.  
4) Met with Larry Kepler, Department of Commerce on horizontal drilling funding and logging.  
5) Met with Gary Cooper (Pioneer Drilling) and Gary Fricke (Division of Oil and Gas) to discuss spacing requirements on horizontal drilling.  
6) Met with organizing committee of the 1992 annual Geological Society of America meeting in Cincinnati, Ohio.  
7) Met with the Energy Development and Recycling Board to propose aspects of a formation evaluation program for a horizontal well drilling program.  
8) Met with Richard Hunt (Corps of Engineers) and Jeffrey Ciocco (United States Navy) to discuss environmental geology of NWSC.  
9) Met with Al Lao (IDEM) to discuss the drilling of a Class-I well at Michigan City.  
10) Met with Kathy Spicer (Indiana University Printing Services) to discuss production of Petroleum Section publications.  
11) Met with Dean Alger (IPL) and Jac Lentz (ANR) to discuss compressed air storage.  
12) Met with Neeraj Gupta (Ohio State University) to discuss hydrological modelling of Mount Simon Ss.  
14) Met with Jeff Ciocco (Northern Command) and Jim Hunsicker (Crane NWSC) to plan implementation of Crane study.  
15) Met with George Walker (Indiana University) to discuss current research.  
16) Met with Mike Long (Indiana Department of Natural Resources) to discuss current water-related research.  
17) Met with Paul Lira and Bob Winch (Indiana University Geosciences) to discuss chemical analyses of Mississippian rocks.  
18) Met with Jeremy Dunning (Indiana University Industrial Liaison) and John Comer (Indiana Geological Survey) to initiate proposal on formation water chemistry study.  
19) Met with Mark Longman (RPI) to discuss final report on the Illinois Basin.  
20) Attended the Kentucky Oil and Gas Association meeting in Owensboro, Kentucky.  
21) Met with the IBC planning committee in New Harmony.  
22) Met with representatives of Seismic Specialists, Inc. in Denver, Colorado.  
23) Met with Valery Sergeer (Moscow State University) to discuss environmental geology.  
24) Met with Vishnu Ranganathan (Indiana University Geosciences) to discuss digitizing the existing brine analyses.  
25) Met with representatives of Conoco to discuss the deep Illinois Basin.  
26) Met with Tim Ruble (Mobil Research) to discuss Cambrian source rocks.

Stanley Keller:

1) Met with the Indiana Geologists in Indianapolis.  
2) Attended three meetings of the Indiana-Kentucky Geological Society.

Charles Zuppman:

2) Met with Ward Collins, consultant, to modify portions of the petroleum database which he previously purchased.  
3) Met with Bob Dodd to review grant proposal for surface/subsurface study of the Ste. Genevieve Lime­stone at Orleans quarry and in southern Indiana.  
4) Attended three monthly meetings of the Indiana-Kentucky Geological Society.  
5) Attended the annual meeting of the Illinois Oil and Gas Association.
John, Charly, and Stan met with Midwest Gas Storage geologists on Carbon Field, Clay County.

John and Stan attended the Eastern Section American Association of Petroleum Geologists meeting in London, Ontario.

Field Trips

John Rupp:
1) Worked with Indiana University Real Estate on assessing status of oil activity on land in Daviess County, Kentucky.
2) Attended a trip with Charles Sonnett to observe Pennsylvanian siltstones.
3) Worked with United States Geological Survey RASA geologists and Citizens Gas personnel to sample 15 gas storage wells for water in Greene County.
4) Worked with Indiana Geological Survey technicians to gamma-ray log monitoring wells at Crane NWSC.

Stanley Keller:
1) Participated in a field trip to Monroe County Landfill.
2) Attended a meeting of the Indiana Gas Association which met in Monroe County with their Underground Gas Storage Committee.

Charles Zuppann:
1) Attended the Tri-State Field Conference in Iowa City, Iowa, to examine Mississippian rocks equivalent to the Harrodsburg-St. Louis-Ste. Genevieve rocks in Indiana.
2) Attended SEPM Great Lakes Section Field Conference to examine Salem rocks in the Bloomington-Bedford area of Indiana.

Stan and John examined cores at NWSC Crane with the Corps of Engineers drilling program.

Professional Activities

Industry Service

John Rupp:
1) Submitted a proposal to the United States Navy to work on cores and outcrops on NWSC Crane.
2) Began preparation of a proposal to the Department of Energy for fossil fuel research.
3) Began working with Kerry Hagerty (Geotrack International) to get fission track data for the midcontinent (in conjunction with CAC project).
4) Established new procedure for reproducing well records and logs targeted at more efficient service.
5) Successfully negotiated the use of 12 large regional seismic lines from three companies (Texaco, Midwest Gas Storage, Seismic Specialists, Inc.) for the use of two doctoral students addressing sequence stratigraphy questions in the Borden and Trenton in the Illinois Basin.
6) Continued to propose a formation evaluation program for the Pioneer Drilling Company horizontal well in Allen County, funded by the Department of Commerce REDB.
7) Continued to propose to the Division of Oil and Gas a study of the 10,000 ppm boundary determination in the state.
8) Successfully negotiated the use of large regional seismic lines from Arco for the use of two doctoral students addressing sequence stratigraphy questions in the Borden and Trenton in the Illinois Basin.
Indiana Geological Survey at Indiana University

Stanley Keller:

1) Reviewed the geology of and processed the core descriptions on 50 test holes which were drilled on NWSC Crane property in Martin County. We received the data from the United States Army Corps of Engineers.
3) Authored a stripper well survey for the Interstate Oil Compact Commission.

Charles Zuppann served as editor to American Association of Petroleum Geologists Studies in Geology volume on Mississippian oolites.

Professional Service:

John Rupp

1) Worked with Janis Treworgy, Steve Whitaker (United States Geological Survey) and Lloyd Furer, John Droste (Indiana Geological Survey, Indiana University Geosciences) to build a series of basinwide cross sections.
2) Reviewed maps for the Paducah CUSMAP project.
4) Completed an analysis for Petroleum Information on horizontal drilling.
5) Worked with Don Oltz (Illinois State Geological Survey) to update and further quantify reserves and reservoir data for inclusion in the Department of Energy TORIS database.
6) Provided information on the petroleum industry in the state for interviews with the Indianapolis Star and WIBC radio talk show.
7) Edited three manuscripts as critical reader for outside publication.
8) Reviewed a proposal to the Department of Energy.
9) Began working with Brian Tanner and Jeff Cutright (Indiana University Geophysics students) and Al Rudman to generate a series of reference synthetic seismograms.
10) Continued to work on the organizational committee for the national 1992 Geological Society of America meeting.

Stanley Keller

2) Sent slides (on loan) and publications on oil and gas to Jack McGriffin, Department of Natural Resources Reclamation Bureau, for use in a talk by McGriffin.

Charles Zuppann served as Vice President, program chairman, and newsletter editor for Indiana-Kentucky Geological Society.

John, Stan and Charly handled an increased number of public service requests due to the increase in the price of oil.

John and Stan composed a short paper on the subsurface reservoir distribution of the Salem Limestone.

Internal Service

John Rupp

1) Reviewed three papers for the Geologic Names Committee.
2) Received two reports from the section (MES 36 and Sample Catalog) for Survey publication.
3) Edited three abstracts and one paper for the use of geologic names.
4) Obtained a portion of a deep seismic line in the Illinois Basin for potential collaborative work with Ray Rene.
5) Reviewed one manuscript for the Geologic Names Committee.
6) Reviewed one abstract and two papers critically.

Stanley Keller:
1) Worked on integrating old Sullivan County well records into the master file.
2) Organized the Petroleum Section library with the help of Anne Burton.
3) Reviewed 72 unprocessed cores that were stored and sorted the good from the unusable. These have been integrated into the permanent core library.
4) Reviewed one abstract critically.
5) Compiled a procedure for Indiana Geological Survey core holes.

Charles Zuppann
1) Continued to work on changing the database format to handle records in a more workable fashion.
2) Edited 13 papers as Maps and Illustrations editor.
3) Worked with Sherry Cazee on designing format to permit printing of sample directory on laser printer.
4) Edited eight manuscripts and a set of maps as Maps and Illustrations Editor.
5) Prepared thin section photomicrographs and descriptions on Calprotrak well in Parke County.

Stan and Jim modified the Marion County Well Location Map to reflect new data from an old 1889 atlas which came to his knowledge.

John, Stan and Charly worked on integrating a large number of completions into the main file.

John, Stan and Charly served on a committee to review candidates for secretarial positions in the Petroleum Section.

Statistical Summary

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<td>Well cutting sets catalogued and filed</td>
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<td>Cores (wells)</td>
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<td>Strip logs made (wells)</td>
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<td>Feet of well cuttings represented on strips</td>
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<td>Wells field checked (current drilling only)</td>
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RESEARCH AND PROJECT DEVELOPMENT BRANCH
ENVIRONMENTAL GEOLOGY SECTION

Permanent Personnel

Edwin J. Hartke .................................................. Head
Ned K. Bleuer .................................................. Glacial Geologist
Steven E. Brown .................................................. Geologist
Thomas Chitwood ................................................. Laboratory Technician
Donald L. Eggert ................................................. Geologist
Anthony H. Fleming ........................................... Geologist
Nancy R. Hasenmueller ........................................ Geologist
Samuel S. Frushour ............................................. Geologic Technician

Other Personnel

Jason B. Bohnert ................................................. Field Assistant (May 26, 1991 to June 21, 1991)
Daniel Cassidy ................................................. Geological Assistant (January 6, 1991 to June 13, 1991)
Tim Eckert .................................................... Geological Assistant (May 14, 1991 to June 30, 1991)
Michael Furfaro ................................................ Geological Assistant (October 30, 1990 to June 30, 1991)
Kirsten M. Perman ................................................ Geological Assistant (May 6, 1991 to June 30, 1991)
Jill Richardson .................................................. Laboratory Assistant (August 30, 1990 to May 2, 1991)
Stephen Sabo .................................................. Geological Assistant (August 28, 1990 to April 10, 1991)
Larissa Samuelson ................................................. Geological Assistant (October 1, 1990 to April 26, 1991)
Teresa Wallbrown ................................................ Laboratory Assistant (September 17, 1990 to May 3, 1991)

Organization and General Activity

The Environmental Geology Section conducts basic geologic research for and with federal and other state and local agencies in order to promote sound development of the State's natural resources and define geologic hazards to growth. The study findings are applied by the above mentioned agencies, consultants, and citizens to protect and improve the quality of life in Indiana. In addition to these long-term research programs, the Section handles frequent requests for information and advice on geologic problems encountered by other agencies and citizens within the state.

The Section has increased its emphasis on outside funding for research projects. We submitted nine proposals, five of which were funded for a total of $202,000. Two proposals are still pending and two have been disapproved. These soft-money funded projects allow us to provide more service to more of the citizens of Indiana.

During the 1990 fiscal year Section members devoted much time to assist other state agencies and recorded 43 conferences, 176 man days in the field, 24 outside committee meetings, 290 incoming letters, and 221 outgoing letters. We also answered 243 environmental questionnaires, and authored 7 memorandum reports. Most of this activity was in response to outside requests for information from federal, state, and local agencies, consultants and citizens.

Members of the Section were involved in 12 formal research projects, two of which were completed and two initiated. The field and laboratory statistics for the data collection portion of these projects are: holes gamma logged, 291; feet gamma logged, 28,045; holes and total feet augured, 38 and 400; holes and total feet rotary drilled, 11 and 965; rock and soil samples described, 1242; and 673 samples processed through the soil laboratory.
Completed Projects or Parts of Projects

Completed Studies or Parts of Studies

Two major projects were completed during the past fiscal year:

1) The IDNR Division of Forestry sponsored study of airborne radon levels in Wyandotte Cave, and
2) The Office of Surface mining sponsored study of mine blast damage in and around McCutchanville, Indiana.

Research Projects

Continuing Studies

Work continues on the glacial/hydrostratigraphic studies in both Allen and Marion Counties. These studies will define ground-water contamination potential on the basis of the glacial stratigraphy. Both studies are partially funded by county agencies. Other studies in progress are: the identification of the coal resources of Vanderburg County, the thinning of the New Albany Shale over Silurian reefs, the environmental geology of Hamilton and Tipton Counties, the reclamation of the Friar Tuck abandoned coal mine, mine subsidence at Cannelburg, the revision of the unpublished hazardous waste disposal site suitability study, seismic risk in Indiana, the geology of the Kankakee, and a study of the gas resource potential of the New Albany Shale.

Miscellaneous Activities

Section members presented 17 talks before professional and general audiences.

Reports and Maps Published by the Geological Survey

Fraser, G., and Bleuer, N. K., Geologic framework of the aquifers in the Kankakee River Lowland: Indiana Geological Survey Occasional paper 60.

Outside Publications

Indiana Geological Survey at Indiana University


Reports Submitted

Bleuer, N. K, "Nature of glacial and other...interpreted through downhole gamma-ray logging: IGS Special paper__.
Bleuer, N. K, "Stratigraphy, chronology....Wisconsin glaciation....": IGS Special Paper__.
Hasenmueller, N. R., Clark, S., Frushour, S., and Komisarcik, K, ____, Radon survey of the Wyandotte Cave System in Crawford County, Indiana:

Miscellaneous Publications

Memorandum Reports


Professional Activities

Papers and Posters Presented at Professional Meetings

Nancy Hasenmueller prepared a poster session containing IGS publications and current research projects relating to environmental concerns. The exhibit was displayed at the Environmental Fair held at the Indiana University (IU) memorial Union in Bloomington on April 18.

Organizational and Committee Activities

Public Lectures

Don Eggert gave 12 talks to the public re the New Madrid earthquake threat to southern Indiana.
Nancy Hasenmueller presented information on careers in geology to Mrs. Rita Sander's second grade class at University Elementary School on November 14.

Meetings Attended

Nancy Hasenmueller presented a dry run of the paper on the GRI project to evaluate the gas potential of the New Albany Shale in the Illinois Basin at GRI headquarters in Chicago, Ill., on August 2, 1991. The paper was given at the GRI Professional Advisors’ Group Meeting in Traverse City, Mich., in September.

Fieldtrips

Fleming led field trips: for Board of Directors of Cordry - Sweetwater Lakes in Brown County to define cause of failing septic systems and county sanitarians and ISBH field staff on glacial geology and soils of SE Indiana.

Hasenmueller conducted a field trip to examine outcrops of the new Albany Shale in southern Indiana.

Brown led a field trip to describe a classic loess section in SE Indiana.

Miscellaneous Activity

Nancy Hasenmueller

1) Served as chairperson for the Geology, Geochemistry, and Resource Characterization Session at the 1990 Eastern Oil Shale Symposium in Lexington, Ky., on November 6-8, 1990.

2) Prepared an article on radon and the role of the Indiana Geological Survey (IGS) in radon research for the IU news series entitled “geoIndiana.”

Statistical Summary

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35
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THE GEOLOGY OF THE HUISCHEN FORMATION IN THE EASTERN MONTANA COAL BASIN

Abstract

The Huischen Formation is a prominent unit in the Mississippian sequence of the Eastern Montana Coal Basin. This formation is divided into three members, each with distinctive petrographic and mineralogical characteristics. The Lower Member is primarily composed of sandstone and siltstone with minor amounts of shale. The Middle Member consists predominantly of shale with minor sandstone and siltstone. The Upper Member is characterized by sandstone with interbedded shaly layers. The petrographic analysis reveals that the sandstone in the Huischen Formation is predominantly quartzose with minor amounts of feldspar and mica. The shale and siltstone units contain a variety of clastic minerals including quartz, feldspar, and mica. The Huischen Formation is important for its sedimentary history and is useful in understanding the tectonic evolution of the Eastern Montana Coal Basin.

Keywords: Huischen Formation, Eastern Montana Coal Basin, Mississippian, sedimentary petrography, tectonic evolution.
Indiana Geological Survey at Indiana University

1) West Fork White River Basin baseline water quality survey
2) Affirmative action plan
3) Effects of in situ gasification of New Albany shale on local ground water
4) Prevention of pad marks on Indiana limestone
5) Septic contamination of soil
6) Na content of leachate from bentonite
7) Cause of deterioration of limestone paving blocks
8) QA/QC and database of sulfur data for selected Paleozoic rocks
9) Method for analyzing ferrous iron
10) Networking of the Section's PCs

Research Projects

Funded

1) Research and reclamation feasibility studies at the Friar Tuck site, Sullivan and Greene Counties, Indiana. IDNR Division of Reclamation
2) Gas potential of New Albany Shale in the Illinois Basin. GRI; $220,911
3) Carbonate database development. IGS
4) Ground-water database development. IGS
5) Brine database development. IGS
6) Analysis of ground water in abandoned mine voids, Cannelburg, IN. IDNR Division of Reclamation
7) Na as a tracer for ground water derived from the Springfield coal. IDNR Division of Reclamation
8) Acid abatement at Friar Tuck using passive anoxic limestone drains. IDNR Division of Reclamation
9) Determination of leachable anions in shale. NSF (high school education program)

Rejected

1) Proposal to assess the levels of radon, methane, and trace elements in an aquifer system in northwestern Indiana. EPA: $78,716

Pending

1) Analysis of ground water, East fork White River Basin. IDNR Division of Water; $27,030
2) Tectonically fractured shale gas reservoirs; Developing a predictive mechano-chemical model for exploration and resource assessment. GRI; $500,842

Reports and Maps Published by the Geological Survey


Miscellaneous Publications

Journal Articles

Abstracts


Professional Activities

Papers and Posters Presented at Professional Meetings

John Comer - Potential for producing oil and gas from Woodford Shale (Devonian-Mississippian) in the southern Mid-Continent, USA. AAPG Annual Meeting, Dallas, TX

Tracy Branam - Inorganic ground-water chemistry at an experimental New Albany Shale (Devonian-Mississippian) in situ gasification site, Clark County, Indiana. Eastern Oil Shale Symposium, Lexington, KY and Indiana Water Resources Association, Clarksville, IN

Organizational and Committee Activities

John Comer - Member of IDNR Affirmative Action Advisory Committee

Peg Ennis - Member of search and screen committee for IGS editor

Public Lectures

John Comer - Climate and earthquakes. Arlington Heights Elementary School, 5th grades.

Meetings Attended

John Comer

1) AAPG Rocky Mountain Section, Denver, CO
2) AAPG Annual Meeting, Dallas, TX
3) Indiana Water Resources Association meeting, Clarksville, IN

Peg Ennis

1) Coal Mine and Reclamation Task Force, Vincennes, IN
2) Indiana Water Resources Association meeting, Clarksville, IN

Tracy Branam
1) Eastern Oil Shale Symposium, Lexington, KY
2) Coal Mine and Reclamation Task Force, Vincennes, IN
3) American Chemical Society meeting, Indianapolis, IN
4) Indiana Water Resources Association meeting, Clarksville, IN

**Statistical Summary**

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<td>Conferences with visitors and callers to the Survey</td>
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<td>Analytical techniques and software applications developed</td>
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<td>Seminars and short courses attended</td>
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<td>Samples analyzed</td>
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<td>Water</td>
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<td>QA/QC replicates, reruns, standards, dilutions</td>
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<td>Pyrolysis - GC</td>
<td>54</td>
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<tr>
<td>Individual determinations</td>
<td>21,172</td>
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In 1990 the Geophysics Section completed a three-summer program of reflection seismic shooting in Posey County, Indiana. This program was designed to image faults of the Wabash Valley fault system and deep structures and strata of the Illinois basin. Work was supported by industry (through the ARPEX Industrial Associates' Research Program in Exploration Seismology), academia (via student participation in a summer field course in Exploration Seismology at the University of Southern Indiana), and government (through a grant from the National Earthquake Hazards Reduction Program administered by the United States Geological Survey).

During summer 1990 roughly 1600 shot holes were drilled by the student seismic crew (including Rene) using truck-mounted augers loaned to ARPEX by a water well drilling company. This crew also laid 5 miles of seismic cable and planted sensors (geophones) at 11 foot, 8 inch-intervals along this line. Seismic explosives were simultaneously detonated in five, 10-foot holes for each shot. The resultant data were then recorded digitally using very sensitive and complex recording instruments donated by industry. These data were then taken to Houston, Texas and processed by Rene using computing facilities provided by a leading geophysical company as a donation to ARPEX.

In comparison to many or most minihole seismic surveys, rather large explosive charges, deep shot holes, smaller shot intervals, and many holes in each shot pattern were used. Also the lines were sited where favorable near-surface conditions facilitated deep penetration of seismic waves and clear imaging by the common-depth-point reflection seismic method. The processed seismic data imaged the underlying faults and structures clearly by reflections from layers at depths of approximately 3 miles. Results were most recently presented to the American Geophysical Union at a meeting in Baltimore, Maryland. The ARPEX seismic data are important to study of regional geology and may help stimulate or direct exploration for oil and gas much deeper than the shallow deposits presently exploited. Seismic determinations of structures and stratigraphy at depth may also be important to future development of deep waste disposal wells, coal mining, and underground gas storage in southwestern Indiana and may aid study of earthquake hazards related to deep crustal structures. As part of the ARPEX program Rene taught a 6-credit course in Exploration Seismology at the University of Southern Indiana.

In continuation of a study of seismic expression of reefs and drape of sedimentary strata over Silurian reefs in southwestern Indiana, a computer data base of formation tops was expanded and drape was modelled and analyzed with linear regression and crossplots of elevations of formation tops in oil and gas fields associated with known reef-induced structures in Indiana. The seismic data across fields in Clay and Sullivan Counties were originally donated by a Texas oil company in support of the ARPEX program. Seismic case histories and quantitative interpretation of drape by this study should significantly aid exploration for oil, gas, and gas storage structures in southwestern Indiana.

The Geophysics section also responded to numerous requests for information from the public, industry, academia, and governmental agencies concerning geophysical methods, earthquakes, etc.

Publications, Presentations, and Educational Courses

Rene, R. M., Hester, N. C., and Stanonis, F. L., 1990, Exploration Seismology (ETHS 627; 6 credit graduate course); A summer study program in Exploration Seismology (theory, acquisition processing and inter-


TECHNICAL SERVICES AND ADMINISTRATION BRANCH
The Publications and Education Section is part of the Technical Services and Administration Branch. The programs of the Public Relations and Educational Services Unit of the section are treated here. The section acts as a liaison between the Indiana Geological Survey and the private and business sectors, and coordinates the Survey's efforts to improve the organization's visibility throughout the state. Section services include the dissemination of general information about industrial minerals, information on Survey research and educational programs, and providing information on the general geology of Indiana. Recipients of this information include the public schools (middle school through high school), universities and colleges, the media, other divisions within the Department of Natural Resources, and the general public on a request basis.

Special-interest organizations, such as rock clubs, 4-H groups, and speleological societies, also seek information from this office. Included in section duties is the conception of displays that are used at fairs, rock shows, and geologic meetings. The publications efforts are included in the special section "Publications Sales."

Preparation of news releases, magazine articles, Geological Survey publications, field-trip guidebooks, and general-information memorandum reports is another function of this office. The published and open-file material varies in content from nontechnical/popular publications to the results of geologic research.

During fiscal 1990-91, section staff recorded 491 conferences, 14 field trips, and 231 items of correspondence with private individuals, the media, businesses, and educational institutions. Most of these items were answers to requests for information, including the identification of rock, mineral, and fossil specimens. Also, during the fiscal year 73 information packets were mailed, 25 special-service requests were met, 24 lectures delivered (mostly to schools), and 31 field days were logged in discharging office obligations.

Status of Projects

1) Slide file
   This is an ongoing project designed to provide detailed 35-mm color-slide coverage of a variety of geologic subjects. Specific subjects for which complete, or nearly complete, slide files already exist include: caves of Indiana, the coal industry, the gypsum industry, the petroleum industry, geophysical research, Quaternary geology, the lime industry, the dimension-stone industry, and a partial set on the physiography of Indiana. Subject matter within each of the separate files is constantly updated as new information, techniques, and equipment make such photography necessary.

2) Displays:
   The coal-mine display in the lobby of the Geological Survey was updated with the addition of new photographs.

A new display illustrating uses of limestone as aggregate raw material was begun with an estimated completion date of September, 1991.
Indiana Geological Survey at Indiana University

3) *Our Hoosier State Beneath Us*
   The last sets of the old newspaper series entitled "Our Hoosier State Beneath Us" were sent off to Indiana schools as part of a sales promotion begun by our Publications Sales office.

4) **STEPS**
   An Indiana University computer participation program entitled "Student and Teachers Electronic Productivity School" (STEPS) was initiated more than a year ago. During the past fiscal year, the Geological Survey participated in the program by offering a listing of publications, information on geologic hazards, and a geologic conference. The program allows participating high schools throughout Indiana to log onto IU mainframe computers from local computers via modem. The STEPS program is written with a help screen that simulates the homeroom and classroom elements of a typical high school. Our part of the STEPS program was called the Geology Conference and was part of the Math and Science Wing of the so-called electronic high school.

5) **geoIndiana**
   A new newspaper series, entitled *geoIndiana*, was initiated last Fall. The series was intended to provide information on a variety of geologic topics of general interest to the public. The Department of Geological Sciences (IU) also provides written material for the newspaper series on an alternating basis. *geoIndiana* is published monthly.

### Professional Activities

**Public Lectures**

"The Geology of Caves" to the Central Indiana Wilderness Club at Eagle Creek Park;
"The Geology of Indiana and why we have earthquakes" to campers at Shades State Park;
"The seismicity of Indiana" to the Martinsville Rotary Club
"Rocks of Indiana and why some of them produce oil and gas" to students at Highland Park School
"Seismicity of Indiana" to Environmental Health and Safety group, Evansville
"Earthquakes" to students at Harmony School, Bloomington
"Geology of southern Indiana: the foundation of forest soils" to U.S. Forest Service staff at the Central States Forest Workshop, Seymour.
"Earthquakes" to the Kewanis Club, Bloomington
"Seismicity of Indiana" to docents at Indiana State Museum
"Rock types and their origins" to preschoolers at Bloomington Developmental Learning Center
"The next New Madrid Event" as part of a talk show videotaped at Evansville
"Earthquakes and Indiana seismicity" to Bloomington Rotary Club
"Earthquakes and central Indiana" to citizens at Plainfield Library
"The Seismicity of Indiana" to large group at Hanover
"Earthquakes and the damage that they cause" to Exchange Club, Bloomington
"Earthquakes and preparedness" to citizens at Princeton High School
"Earthquake damage to buildings" to IU Art Museum staff
"Continental glaciation and its impact on Indiana" to rock club at Richmond
"Karst features and caves" to students at Edgewood Jr. High, Ellettsville
"Limestone quarrying and milling" to students at Edgewood Jr. High
"Origins of Indiana gold and diamonds" to Indiana-Kentucky Geological Society
"Detection of earthquakes" to students from Unionville Elementary School
"Origins of paleokarst at McCormick's Creek State Park" to students from Clay City school

Numerous building tours were provided, but are not listed here.

**Special Meetings Attended**
John Hill met with:

1) Kurt Wise to show him our facilities and to discuss ways of improving our education program in light of budgetary shortfalls.
2) Elizabeth Worden, Indiana College Placement and Careers Office, re possible joint ventures in education and our present programs.
3) Staff of U.S. Forest Service as part of Central States Forest Workshop.
4) Dianna Hines, IU News Bureau, re means of promoting the Geological Survey through cooperative effort with the news bureau.
5) Dave Rhinertson, Illinois State Geological Survey, re education programs of that agency and possible sources for grant funds to promote education projects of mutual interest to the Indiana and Illinois geological surveys.
6) Visitors attending the IU Science Career Fest; provided information on Survey research and potential careers in the geological sciences.
7) Lisa Townsend, College of Arts and Sciences, IU, re possible NSF funding for a summer workshop on earthscience education.
8) Marion Jackson, Indiana State Univ., re methods of illustrating and enhancing a publication on the natural areas of Indiana that Marion and numerous other authors are preparing for publication.

Field Trips

1) field trip to dimension-limestone quarry for students from Bloomington Elementary School
2) participated in Central States Forest Workshop by discussing origins of geologic features and soils in Seymour area.
3) w/ Curt Ault to Lonestar Stone Co. to review causes for catastrophic rupture on fracture lines.
4) field trip to dimension-stone quarry and mill for Edgewood Jr. High students
5) field trip on geology of the canyon at McCormick’s Creek State Park for local school group.
6) conduct tour of Wolf Cave for 100 students from Brentwood Elementary.
7) rock hunting trip for Boy Scouts at camp Bradford
8) tours of Wolf Cave for 40 Girl Scouts

Miscellaneous Activities

Material was prepared for use in public-information packets. This effort included reprinting of several maps and charts regularly provided as gratis handouts. Other items prepared for public distribution included rock and fossil specimens and packets containing reprints from the old Our Hoosier State Beneath Us series.

An annotated bibliography of all geologic articles that have appeared in Outdoor Indiana is available and is updated monthly. The bibliography is computerized.

The annotated bibliography of Geological Survey publications was kept current.

Technical consultation on certain geologic topics is provided on a request basis to persons from throughout Indiana. The following are typical of the geotechnical consultations provided by this office:

• With Jim Linn, Bloomington resident, re vibrations from trucks causing his home to shake; he and wife feared that they were over a cave that might collapse;
• With Susan Fadde, Lerner Publications, re environmental research projects currently under way at Survey;
• With Charles Smotherman, Army Ammo Plant, Newport, Indiana, re wanted a summary of the geology of the locale including Newport;
• With Julie Whidman, Chicago consultant, re glacial depositional models for Lake County;
• With Joann Mitock, Westinghouse Environmental, re help in converting bench mark information to state plane coordinates;
Indiana Geological Survey at Indiana University

- With Joe Miller, Dobler Associates, Chicago, re drift thickness and areal geology of Gary area;
- With Richard Eckhart, Ft. Wayne Magnavox Co., re helped him find aeromagnetic data for the Ft. Wayne area;
- With Leslie Simmons, National City Bank, Evansville, re possible damage to structures, including the bank, in the event of a large earthquake;
- With Indianapolis resident named Kirby re possible blast damage caused by American Aggregates Corp. quarry at Harding Street;
- With Brian Hendren, Woodward & Clyde Assoc., re geology of Tippecanoe Co.;
- With Marguerite Squires, local, re possible toxic effects of sand used to bed a swimming pool in her yard;
- With staff of Lonestar Stone Co., Bloomington, re possible causes for explosive rupture of limestone along exposed cut at their quarry;
- With Mario Orozco, Law Environmental, Des Plaines, re geology of the Gary area;
- With staff of Bloomington Parks and Recreation re proper method of filling sinkholes on the Winslow property;
- With Wilson Lutz, Manchester College, re the occurrence of harmonic seismic activity just prior to the eruption of a volcano;
- With Steve Sanders, Allstate Insurance, re earthquake epicenters and Richter values for quakes occurring in December, 1990;
- With Jim Slinkard, local, re reason why his lake suddenly drained one day;
- With Mike Satterfield, local, re remediation for an enlarging sinkhole near Simpson Chapel.
- With Richard Zedlock, U. of Missouri, re places to install markers for global positioning satellite interferometer;
- With Don Albeitz, Lieber State Rec. Area, re causes for rock failure along a trail at Cataract Lake and methods of remediation;
- With Jeff Wentwood, IT Corp., Gas City, re wanted to know the bedrock geology of that area;
- With Bob Mayhan, water well driller, re wanted advice on placement of geothermal well;
- With Kevin Rymer, consulting geologist, re wanted information on petroleum production from Silurian reefs in Indiana.

Numerous news releases were prepared, an annual report compiled, and various other reports on Geological Survey activities were provided to Indiana University, the DNR, the Assoc. of American State Geologists, etc.

A memorandum report was written for the Division of State Parks concerning the causes and remediation of rock failure along a trail at Cataract Lake.

Many service requests were filled for rock kits, information on the places to find rocks, minerals and fossils, and information on Indiana Limestone.

More than two dozen requests were met for information on bench mark location and for specialized map information such as latitude and longitude locations of specific sites.

**Statistical Summary**

<table>
<thead>
<tr>
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<th>Number</th>
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</thead>
<tbody>
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<tr>
<td>Days of field work</td>
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<tr>
<td>Incoming letters</td>
<td>133</td>
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<td>Outgoing letters</td>
<td>98</td>
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<tr>
<td>Total number of Survey vehicles</td>
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<tr>
<td>Miles traveled in section vehicle</td>
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<td>Public lectures</td>
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<td>Field trips</td>
<td>14</td>
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<tr>
<td>Rock kits</td>
<td>50</td>
</tr>
</tbody>
</table>
Specimens identified ........................................... ~ 100
Information packets mailed ................................... 73
Attendance at professional meetings ....................... 1
Exhibits installed for special occasions .................... 1
Environmental impact statements completed ............. 12
PUBLICATIONS AND EDUCATION SECTION

EDITING AND PRINT PRODUCTION

Permanent Personnel

Sheila K. Webster .................................................. Editor

Orientation And General Activities

The Editing and Print Production unit is responsible for editing manuscripts, reports, proposals, letters, and other documents written by the scientists of the Geological Survey. In addition, the Editor and her assistants write articles for GeoNews, which began publication in January, and occasionally for outside publication. The Editor prepares all camera-ready copy, prepares specifications and serves as liaison to printers to see publications through the printing process.

PROFESSIONAL ACTIVITIES

Sheila Webster completed the following projects:

EDITING

Annual Report


Special Reports

1) Sullivan, D.M., Natural Gas Fields in Indiana (no number assigned yet; this was a preliminary reading to smooth out stylistic problems, at Carl Rexroad's request)

Mineral Economics Series


Manuscripts for Outside Publication

1) Hill, J.R., "Indiana's Pure Gold" (Outdoor Indiana)
2) Rexroad, C.B., and W. J. Varker, "The New Genus Synclydognathus (Conodonta) from the St. Louis Limestone (Mississippian) in Indiana" (Indiana Academy of Sciences)
3) Thompson, T.S., "Lake-level Variation in Southern Lake Michigan During the Past 4,000 Years" (Quaternary Research)
4) D. L. Eggert, "Indiana's Potential Geologic and Engineering Response Capability to a Major Regional Earthquake" ( ).
5) B. D. Keith and L. H. Wickstrom, "Lima-Indiana Trend--U.S. Cincinnati and Findlay Arches" (AAPG
Atlas of Oil and Gas Fields).


Abstracts

2) Rene, R.M., and F.L. Stanonis, "Reflection Seismic Studies in Southwestern Indiana" (American Geophysical Union)
3) Rexroad, C.B., L.M. Brown, and S.E. Lieurance, "Conodont Paleontology of the Riverview Limestone Member of the Bond Formation (Pennsylvanian, Missourian) in Indiana" (Pander Society, Canadian Paleontology and Biostratigraphy Seminar series)
4) Thompson, T.A., "Lake-level Behavior During the Past 4,000 Years in the Southern Part of the Lake Michigan Basin" (International Association of Great Lakes Research)

Miscellaneous

1) Hester, N., Letter accompanying grant proposal, 1-8-91.
2) Hester, N., Memorandum concerning Survey participation in groundwater studies, 3-18-91.
3) IGS disclaimer regarding scale, to be inserted with digital maps.
4) Revised publications policies for John Hill and suggested additions.
5) Edited letter from Dr. Hester to Amy Stewart, Dept. of Commerce, 4-10.
6) Edited letter from Patrick Ralston to Gary Neale, NIPSCO (for Dr. Hester), 4-24.

ROUTED TO PUBLICATIONS COMMITTEE

Survey Publications

1) Bleuer, N.K., and others, Perceived Hard-ground vs. Soft-ground Earthquake Response in Metropolitan Evansville, Indiana, Related to Soil-Column Characteristics (Occasional Paper Maxi or equivalent)

Outside Publications

1) Hill, J.R., "Indiana's Pure Gold" (Outdoor Indiana)
2) Ault, C., "Indiana" (column for publication in SME magazine Mining Engineering).

Abstracts

1) Comer, J., "Paleoclimatic and Eustatic Controls on Sedimentation in Late Devonian Epeiric Seas of Western North America" (SEPM 1st Annual Theme Meeting)
2) Keith, B., "Trenton Limestone -- Glamorous Old Play or Attractive New Frontier?" (Eastern Meeting, AAPG)
3) Rexroad, C.B., L.M. Brown, and S.E. Lieurance, "Conodont Paleontology of the Riverview Limestone Member of the Bond Formation (Pennsylvanian, Missourian) in Indiana" (Pander Society, Canadian Paleontology and Biostratigraphy Seminar series)
4) Rene, R.M., and F.L. Stanonis, "Reflection Seismic Studies in Southwestern Indiana" (American Geophysical Union)
5) A. H. Fleming, "Use of Terrain Modeling to Identify Aquifer Protection Zones in a Complex Glacigenic Aquifer System, Northeastern Indiana" (Midwest Ground Water Conference).

GEO NEWS

Volume 1, Number 1 – 3

Sheila Webster:

1) Solicited articles and article ideas from IGS staff.
2) "Assembled" lead article
3) Edited other articles to fit both our diverse audience and the space available.
4) With suggestions from Dr. Hester, John Hill, Barb Hill, and Curtis Ault, selected illustrations for Vol. 1.
5) Prepared camera-ready copy and sent it to the printer.
6) Checked press proofs at printer in Terre Haute.

CAMERA COPY PREPARED

1) Bleuer, N.K., Nature of Glacial and Other Unconsolidated Sedimentary Sequences Interpreted Through Downhole Gamma-Ray Logging (Special Report 49)
2) GEO News, Vol. 1, No. 1, Spring 1991
3) Harper, D. Coalbed Methane in Indiana (Special Report 56)
5) Fraser, G. S., and N. K Bleuer, Geologic Framework of Ground-water Aquifers of the Kankakee River Lowland (Occasional Paper 60)
6) Bleuer, N. K., Nature of Glacial and Other Sedimentary Sequences Interpreted through Downhole Gamma-ray Logging (Special Report 49)
7) Hasenmueller, W. A, and C. H. Ault, Reference Core and Correlations of Key Beds on the Petersburg and Linton Formations (Pennsylvanian) in Indiana (Occasional Paper 57)
8) Fraser, G. S., and N. K. Bleuer, Geologic Framework of Ground-water Resources of the Valparaiso Moraine (Occasional Paper 59)
9) Thompson, T, and others, Land-based Vibracoring and Vibracore Analysis: Tips, Tricks, and Traps (Occasional Paper 58)

PRINTING ARRANGED

Bids Requested from Printers

1) Bleuer, N.K., Nature of Glacial and Other Unconsolidated Sedimentary Sequences Interpreted Through Downhole Gamma-Ray Logging (Special Report 49)
2) GEO News, Vol. 1, No. 1, Spring 1991
3) Gray, H. Relict Drainageways Associated with the Glacial Boundary in Southern Indiana (Special Report 45)
5) Harper, Denver, Coalbed Methane in Indiana (Occasional Paper 56)
6) Thompson, T.A., Architectural Elements and Paleoecology of Carbonate Shoal and Intershoreal Deposits in the Salem Limestone (Mississippian) in South-central Indiana (Guidebook 14)
7) D. Harper, Coalbed Methane in Indiana, Special Report 56.
8) 'Map of Indiana Showing Oil, Gas, and Products Pipelines' (Miscellaneous Map 53)
9) Hasenmueller, W. A., and C.H. Ault, Reference Core and Correlations of Key Beds on the Petersburg and
Indiana Geological Survey at Indiana University

Linton Formations (Pennsylvanian) in Indiana (Occasional Paper 57)
10) S. Cazee, Catalog of Well Samples of the Indiana Geological Survey (Directory 10)
11) Hasenmueller, W. A., Directory of Coal Producers in Indiana

Publications Sent Out for Printing

1) GEO News quarterly newsletter, masthead (1 year preprinted)
2) GEO News, Vol. 1, No. 1, Spring 1991
3) Gray, H., Relict Drainageways Associated with the Glacial Boundary in Southern Indiana (Special Report 45)
4) Harper, Denver, Coalbed Methane in Indiana (Occasional Paper 56)
6) Hasenmueller, W. A., Directory of Coal Producers in Indiana
6) Rupp, J. A., Structure and Isopach Maps of the Paleozoic Rocks of Indiana (Special Report 48)
7) Thompson, T. A., Architectural Elements and Paleoecology of Carbonate Shoal and Intershoal Deposits in the Salem Limestone (Mississippian) in South-central Indiana (Guidebook 14)

Meetings Related to Printing

1) Met with Dave Brinson and Jim Langen from Moore Langen Printing to discuss services they can offer through their new office in Spencer.
2) Met with Dave Brinson and Carl Walters of Moore Langen Printing to discuss more economical ways of printing, particularly from electronic rather than hard copy.
3) Met with Kathi Spicer, two other representatives of IU Printing Services, Sherry Cazee and Charlie Zuppann, to discuss the most cost- and time-effective way of publishing the directory of drill holes. Because the directory is very long, producing camera-ready copy in house would take many hours of printer and computer time, as would copying the data to diskettes, so I have asked for technical advice from IU Printing. However, their solution seems even more complex than our capabilities, so Charlie is looking into ways we can produce original copy to photo reproduce and bind.
5) Went to Moore Langen Printing, Terre Haute, to check press proofs of GEO News; also discussed electronic printing options with the head of their computer department.
6) Met several times with Sherry Cazee to advise her on publishing the well directory; also spoke to John Rupp about printing arrangements for the directory.
7) Met with Dave Brinson of Moore Langen Printing to discuss rough estimates of cost of a slick, 4-color, public-interest publication and a new format and look for the Publications List (at Dr. Hester's request).

MISCELLANEOUS

Potential Publications

1) Let's Look at Some Rocks
   In 11/90 I initiated a revision of the existing 1958 version of this publication, which, if brought up to date in terms of both content and design, I think could be a good seller. On 12/6/90, I gave John Hill a preliminary revision for his comments and for review by a geologist. On 3/26/91, Nelson Shaffer gave me his comments and suggestions.

2) Kathi Figgen, Managing Editor of Research and Creative Activity, published by Research and the University Graduate School, contacted me about the possibility of writing an article on IGS activities related to the environment. I spoke to John Hill, and briefly to Tony Fleming and Todd Thompson about their work on Allen County groundwater and the Lake Michigan shoreline, respectively.
3) **Adventures with Fossils**
   Began process of revising this circular; spoke with Carl Rexroad and John Hill about having a geologist/paleontologist review the book for scientific currency.

**Publications Section Activities**

1) Set up diskette templates for staff members to use in preparing their sections of the 1990-91 Annual Report.
2) Revised Editor's job description.
3) Discussed with John Hill some changes in policies affecting handling of manuscripts by publications section.

**Professional Development**

I attended the following courses:

1) **Offered by Human Resources Management:**
   a) G806A Electronic File Management
   b) G811A Project Management
2) **Offered by University Computer Services:**
   a) WordPerfect 5.1: Step 2
   b) WordPerfect 5.1: Step 3
   c) Desktop Publishing with WordPerfect
PUBLICATIONS AND EDUCATION SECTION

PUBLICATIONS SALES

Permanent Personnel

Pat Gerth ......................................................... Publications Specialist
Janis Fox ........................................................ Senior Publications Assistant

Orientation and General Activities

The Publications Sales Unit of the Publications and Education Section is the sales outlet for all Geological Survey publications. Orders for publications can be placed in person, by mail, or by telephone. A listing of Geological Survey publications is available free of charge on request.

During the past fiscal year the Publications Section sold 6,247 reports and 11,587 maps. It distributed without charge 1,450 reports and 1,033 maps to members of its own organization and to individuals, libraries, and companies in the United States and abroad. The Publications Section had 7,233 office customers and telephone calls, handled 2,361 incoming and 955 outgoing letters pertaining to geologic reports and maps.

11 reports, one new maps, and 66 revised maps were issued during the fiscal year. The publications list was revised three times.

The Publications Section began collecting the Indiana sales tax on January 3, 1989. Sales-tax receipts deposited between July 1, 1990 and June 30, 1991, were $1,329.71.

Reports and Maps Published by the Geological Survey

Bulletins


Circulars


Directories


Guidebooks

Mineral Economics Series


Occasional Papers


Petroleum Exploration Maps

New and revised Petroleum Exploration Maps (as of December 31, 1990): 3A, 3B, and 3C (Warrick County); 4A, 4B, and 4C (Sullivan County); 5A and 5B (Vigo County); 12, 12A, and 12C (Martin County); 13A, 13B, and 13C (Greene County); 14A and 14B (Clay County); 15A (Parke County); 16A (Vermillion County); 21A, 21B, and 21C (Dubois County); 22A (Jackson County); 23, 23A, and 23C (Knox County); 25A (Lawrence County); 26, 26A, and 26C (Daviess County); 30 and 30A (Harrison County); 34A (Marion County); 39, 39A, and 39C (Spencer County); 40, 40A, 40C (Perry County); 42A (White County); 45A (Boone County); 51, 51A, and 51C (Pike County); 52, 52A, and 52C (Van Buren County); 53, 53A, and 53C (Gibson County); 54, 54A, and 54C (Posey County); 59A (Allen County); 64A (Marshall County); 73A (Lake County); 74A (Miami County); 78 and 78A (Huntington County); 79 and 79A (Jay County); 81 and 81A (Delaware County); 84A (Ohio County); 86A (Dearborn County); 87A (Ripley County); 88A (Union County); 90A (Fayette County); 91A (Wayne County); 92A (Randolph County); 93A (Henry County); 95A (Decatur County); 96A (Shelby County); 98A (Hamilton County); 100A (Tipton County); and 101 (Union-Bowman Cons. Field Area, Gibson, Pike, and Knox Counties).

checked without revision Petroleum Exploration Maps (as of December 31, 1990): 17A (Fountain County); 18A (Owen County); 19A (Putnam County); 20A (Montgomery County); 24A (Monroe County); 27A (Orange County); 28A and 28C (Crawford County); 29A (Washington County); 31A (Brown County); 32A (Bartholomew County); 33A (Hendricks County); 35A (Morgan County); 36A (Johnson County); 37A (Tippecanoe County); 38A (Warren County); 41A (Benton County); 43A (Carroll County); 44A (Clinton County); 46A (Jennings County); 47A (Jefferson County); 48A (Scott County); 49A (Clark County); 50A (Floyd County); 55A (Steuben County); 56A (Lagrange County); 57A (Noble County); 58A (DeKalb County); 60A (White County); 61A (Kosciusko County); 62A (Elkhart County); 63A (St. Joseph County); 65A (Fulton County); 66A (Cass County); 67A (Pulaski County); 68A (Starke County); 69A (LaPorte County); 70A (Porter County); 71A (Jasper County); 72A (Newton County); 75A (Wabash County); 76 and 76A (Huntington County); 77 and 77A (Wells County); 80 and 80A (Blackford County); 82 and 82A (Grant County); 84A (Switzerland County); 85A (Ohio County); 86A (Dearborn County); 87A (Ripley County); 88A (Union County); 90A (Fayette County); 91A (Wayne County); 92A (Randolph County); 93A (Henry County); 95A (Decatur County); 96A (Shelby County); 98A (Hamilton County); 100A (Tipton County); and 101 (Union-Bowman Cons. Field Area, Gibson, Pike, and Knox Counties).

Special Reports

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<td>Bulletins</td>
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<td>Published reports sold</td>
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<td>Published maps sold</td>
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<td>Publications office customers and telephone calls</td>
<td>7,233</td>
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DRAFTING SECTION

Permanent Personnel

Richard T. Hill ....................................... Section Head
Rea W. Kersey ......................................... Cartographic Design Specialist
Roger L. Purcell ........................................ Senior Cartographic Specialist
*Kimberly H. Sowder .................................. Cartographic/Photographic Specialist

Hourly Personnel

*Eric Hartke ........................................... Drafting Assistant (July 1, 1990 to June 30, 1991)

*Salary paid in part from Department of Geological Sciences account

Orientation and General Activities

The primary function of the Drafting Section is to provide service to the commodity and research branches of the Geological Survey. The services consist mainly of the final preparation of maps and illustrations for publications, preparation of slides for talks, preparation of displays, mounting and framing of maps and photographs, and phototypesetting.

Completed Geological Survey Publications


Major Projects in Progress

Projects in progress are: Special Report 54, "Coal Mining in Knox County, Indiana"; Miscellaneous Map 54, "Map of Indiana Showing Thickness of Silurian Rocks and Location of Reefs"; Preliminary Coal Map 18, Owen County, Indiana; Special Report 50, "Coal Resources of Gibson county, Indiana"; Bulletin 63, "Lithostratigraphy of the Buffalo Wallow Gr. (Miss) on the subsurface of Indiana"; Special Report 55, "Geophysical Properties of the Basement Rocks of Indiana"; numerous grant and contract projects; and other miscellaneous jobs.
### Statistical Summary

<table>
<thead>
<tr>
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<th>Quantity</th>
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</thead>
<tbody>
<tr>
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<tr>
<td>Work Orders Completed</td>
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<td>Outside Publications</td>
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<tr>
<td>Slide projects</td>
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<td>Poster displays</td>
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<td>Total number of computer slides and duplicates</td>
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<td>Total number of maps and illustrations</td>
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<td>Incoming letters</td>
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<tr>
<td>Reviewed manuscripts</td>
<td>17</td>
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</table>
PHOTOGRAPHY SECTION

Permanent Personnel

Barbara T. Hill .......................................................... Manager of Photographic Services
*Kimberly H. Sowder .................................................. Senior Cartographic/Photographic Specialist

Hourly Personnel

Jefferson R. Kirby ..................................................... Photographic Assistant

* This position is shared with the Drafting Section.

Orientation and General Activities

The primary function of the Photography Section is to provide service to the commodity and research sections of the Geological Survey. These services consist mainly of the final preparation of maps and illustrations for publication, film processing and printing, photomicrography, photomacrography, field photography, color proofing of maps, and preparation of projection slides.

Completed Geological Survey Publications


Other Completed Projects

Produce prints to show effects of Limestone staining; Cross-sections and route map made for AAPG field trip; Prints for AAPG study on Oolites; Owen Award Certificates; Field photos shot and printed to show Earthquake liquefaction features for USGS; 10 cross-sections for EPA Grant Proposal;Slides for Department of Geological Sciences colloquiums; GSA poster and journal report; ACS-PRF Grant Proposal and AAPG article; GSA slides and poster displays; Indiana Academy of Science slides and posters; progressive documentation of construction of new Test Facility building;

slides and poster displays for American Geophysical Union; Aerial photographs for Indiana University Geologic Field Station; GSA Special Paper on Teays Valley Ground Water; Publication on New Albany Shale; Slides for meeting of International Association of Sedimentologists; International Geologic Congress display in Washington, D.C.; Slides for the Eastern Section AAPG; Poster display for Earthquake meeting at Geological Survey; Annual Geological Sciences Group photo; Whetstone quarry photos; Black & White prints of crystal...
models for Encyclopedia of Earth Sciences; Photomacrographs for NSF proposal; prints and halftones for Alumni newsletter; copies of 4 seismograms showing ancient earthquakes for seismograph research; photomacrographs of cores for Pennsylvania black shale project; publication on Friar Tuck Sedimentation Yield; publication on new genus of conodonts from the St. Louis Limestone (Miss.) in Indiana; Make hand-outs for news conference about Earthquake safety; Shoot and print visa portraits; Poster display for GIS conference in Indianapolis; photograph topographic maps for COGEO contract project; Shoot logo for Midwest ARC/INFO Users Conference; Certificates for Certified Professional Geologist; map to help Monroe County Planning and Zoning Board and the Indiana Limestone Institute with the assessment of Salem Limestone resources in Monroe County; display material for display cases on 1st floor hallway;

Miscellaneous Activities

During the month of July, a decision was made to purchase a metal halide lamp to replace the carbon arc lamp. The carbon arc lamp is used to expose less sensitive films, but emitted carbon monoxide fumes which are dangerous and against OSHA regulations, so a substitute had to be found. An in-depth investigation was conducted to find a suitable replacement which would adapt to the needs of the Section. This lamp was finally ordered and installed in December of 1990.

Barb Hill purchased several Kodak Stretch cameras to be used in taking panoramic shots of quarries, outcrop facies, etc. Some of the geologists were given instruction as to how to use them and then sent into the field with them on a trial basis. For the most part, they served the purpose quite well as the final prints are actually printed at 10 inches wide and require less piecing to be done.

Jefferson Kirby and Barb Hill spent several days with Dr. Michael Savarese to help him get his 35mm camera to adapt to his microscope setup. Some adaptation rings were purchased to help make this transition.

A series of 4 Safety Seminars hosted by the Department of Environmental Health and Safety were attended in order to make sure that the Photography Section fell into compliance with the University standards and OSHA standards as well.

The Photography Section purchased a PC Ethernet board for its 8088 computer. This connected the Photo Section to the network and allows the advantage of using Electronic Mail for correspondence to other people on the mainframe computers, both on campus and around the world.

Information was furnished in October to an earthquake expert from the U.S.G.S. on photographs taken in southern Indiana. These photographs were taken of geologic features indicating the existence of ancient earthquakes and were some of the best he had seen.

During the month of February, Barb Hill met with many people including Dr. Lee Suttner, Dr. Norman Hester, Carolyn McAvoy (Human Resources), and John Hill in order to try to work out an arrangement to fund a full-time position in Photography. This position has been retained as an hourly position without benefits for almost two years. A commitment of $4800 was made by the Department of Geological Sciences in lieu of the supplies which they purchase for Photography on an annual basis.

On March 14, 1991, Rich Fields (Head Photographer for Outdoor Indiana) came to look over our darkroom facilities. An agreement between Dan Henkle and Norm Hester offered the IGS darkrooms for use by Rich Fields on a once per week basis while the facilities at the new State House are being completed. Mr. Fields ended up not needing our facilities.

Pete Seal visited the Photography Section during April and looked through our historical limestone photographs. He later chose about 10 of these which he wanted printed in order to produce a documentary video on the history of limestone in Indiana. He hopes to air his video on Public television when it is completed.
Much groundwork was done on the database filing system for the Photography Section. This included organization of existing negatives into logical categories in order to be accessed by the Geological Survey staff. Many correspondences took place with retired staff members, industry people, and other departments on campus. This file is still in the formative stages.

**Statistical Summary**

<table>
<thead>
<tr>
<th>Description</th>
<th>Number</th>
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<tbody>
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<td>Photography work orders submitted</td>
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<tr>
<td>Photography work orders completed</td>
<td>158</td>
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<tr>
<td>Drafting work orders completed by Photography</td>
<td>80</td>
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<tr>
<td>Geological Survey manuscripts reviewed</td>
<td>16</td>
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<td>Classes attended</td>
<td>4</td>
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<tr>
<td>Total number of slides produced</td>
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<tr>
<td>Total number of black and white prints</td>
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<tr>
<td>Total number of film positives</td>
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<tr>
<td>Total number of negatives shot</td>
<td>366</td>
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<tr>
<td>Total number of rolls of film developed</td>
<td>1170</td>
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<tr>
<td>Total number of aerial photographs printed</td>
<td>671</td>
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<tr>
<td>Total number of photomicrographs/photomacrographs</td>
<td>1004</td>
</tr>
</tbody>
</table>
FIELD AND CONTRACT SERVICES

Permanent Personnel

Jay Arnold . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . Driller and Head
Sam Riddle . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . Driller

Orientation and General Activities

The Field Contract Services Section is administered by the State Geologist and provides support for projects of the Indiana Geological Survey requiring drilling of test holes and installation of monitoring well equipment for investigative purposes. Section personnel keep records of repair to Indiana Geological Survey buildings and vehicles and perform routine vehicle service and minor repairs. The Section Head is designated as the Indiana Geological Survey's Safety Officer and is responsible for correcting or reporting problems related to health, safety and hazardous waste.

Field Services

Rock drilling and auguring combined totaled 55 holes developed as monitoring wells for various projects and 17 augured drill holes for an Indiana University coal pile study.

Building Maintenance

The Section head coordinated or assisted in the remodeling of rooms S-201 and S-601 assisted in move of several staff employees to new offices. One-hundred forty-three building service requests were forwarded to Indiana University Physical Plant for action and 32 were acted upon by the Section Head. The Section Head attended five meetings concerning Geological Survey buildings with Physical Plant administrators. Monthly CR&R budget reports were completed for the financial officer and 17 conferences were attended with the financial officer to resolve book keeping problems related to building maintenance.

Safety

The Section Head worked with IU Health and Safety to promote The Indiana Geological Survey being in compliance with OSHA standards and attended four health and safety seminars. The Hazardous Waste Minimization Annual Report was transmitted to Indiana University.

Motor Vehicles

Field Services Personnel took on all service and minor repairs; resulting in a 30 percent savings in the second six months over the first six month period of the fiscal year. Through cost saving measures this was the fourth year in a row that vehicle costs were reduced while miles driven and miles per gallon of gasoline increased.
MINERAL STATISTICS

Introduction

State and federal agencies tabulate production data of mineral producers on a calendar-year basis. This report covers calendar-year 1990 rather than fiscal-year 1990-91.

The following coal production data is from the Indiana Bureau of Mines and Mining, coal-price data is from the U.S. Department of Energy, petroleum data is from the Division of Oil and Gas, Indiana Department of Natural Resources, and industrial mineral data is from the U.S. Bureau of Mines. Final tabulations for nonfuel data has not yet been released by the Bureau of Mines, so nonfuel data must be considered preliminary.

In 1990, the total value of Indiana mineral production was $1,368,158,000, representing an increase of 6.5% over 1989. This continues the trend of overall growth in the mineral industry and is an increase of 13.8% over 1988 figures. The value of coal continued to comprise the largest percentage of minerals produced in Indiana in 1990. Combined with crushed stone and cement, these commodities represented 84.5% of the total value of minerals produced in Indiana in 1990. The mineral industry responds to changes in the economy, highway development, the construction industry, and fuel needs of the country.

FUELS

Coal

Production

Coal continued to be the major commodity produced in Indiana with an increase of 8.2% over the quantity and an increase of 9.9 over the value produced in 1989. Warrick, Pike, Greene, and Daviess Counties continued to be the four major producing counties, together producing 71.2% of the coal in the state. Of this, Warrick produced 28.5%, Pike 16.8%, Daviess 13.3%, and Greene 12.6%. The value of coal production comprised 63.3% of the total value of minerals produced in Indiana during 1990. A dramatic increase was shown by Vigo County with an increase of 584.5% for quantity and 594.9% for value. This increase was due to the production of more than 1.7 million short tons of coal from AMAX Coal Company's Chinook Mine, which the Indiana Bureau of Mines did not report production from in 1989. Increases were also shown for Gibson (22.1%), Greene (9.6%), Pike (17.2%), Sullivan (57.4%), and Warrick (15.3%). Decreases were shown for Clay (43.2%), Daviess (11.5%), Dubois (6.6%), Knox (42.3%), Owen (85.8%), Spencer (5.4%), and Vermillion (9.0%). Reflecting its importance in the Indiana economy, numerous activities were reported in area newspapers, journals, and magazines.

Coal company news

Ziegler Coal bought British Petroleum's operations in Illinois, Indiana, and West Virginia for $115 million.

American Resources joined in partnership with Pittsburg & Midway Coal Mining Co., a division of Chevron, to mine a deposit of low-sulfur coal in Knox County near Monroe City. There is believed to be 100 million tons of coal at this location and it may cost $100 million to develop the field. Black Beauty, a division of American Resources, intends to hire as many as 800 miners by 1995 to help develop this field.

Hanson PLC, a British conglomerate already holding 72% of Peabody Coal Company's shares, bought the remaining 28% shares and reduced the Peabody working force by 275 white-collar employees. Under the new ownership, the St. Louis office was to have more corporate responsibilities, and Henderson was to be the
headquarters for the Midwest division.

Clean Air Act

The Clean Air Act Amendments were passed into law on November 15. The bill calls for limits on the amount of sulfur emissions permissible for 111 utilities in 22 states by the year 1995. A company that attains a level lower than that set for it can sell the difference as a credit to another company. Both the seller and the buyer are thus motivated to keep emissions as low as possible. These credits can run as high as $500 per ton of reduction. 200,000 extra pollution allowances were granted to Indiana, Illinois and Ohio. The addition of this feature to the bill may eventually save the nation $2-3 billion dollars annually, and an international market for the sale of pollution rights may develop. Exceeding the new limit set for sulfur emissions will result in a fine for the company of $2,000 per ton of emission over the limit. Nationwide, two hundred additional power plants will be required to meet tougher standards by the year 2000. Final costs of the Clean Air bill may be between $20 to $36 billion dollars, which may mean an increase to the average American household of between $300-$400 annually by the year 1995.

A state task force reported that passage of the Clean Air Act could result in the raising of Indiana electric rates an average of 8.17% by the year 2001, and the loss of 455 coal mining jobs by 1995. However, this could be offset somewhat by the addition of about 2,252 construction jobs to install scrubbers on utilities and 205 jobs to operate these scrubbers. It costs $100 million to install a scrubber, and Indiana's 4 largest utilities together expect to pay $2 billion to install scrubbers at their plants, but this is still considered the least expensive technology to cut emissions. However, it can take up to 4 years to install a scrubber, and it can add $8 to $12 per ton of coal to install and operate them.

Concern about the higher cost of Indiana coal may spur some companies to look at western coal. However, transportation costs may add $20 per ton of western coal purchased, and it can take up to one-third more western coal to produce the same amount of energy derived from Indiana coal. The Indiana Coal Forum was formed in May to encourage development of Indiana coal reserves. The Forum is composed of members from State government, the coal industry and unions, an environmental group, electric companies, a railroad company, and Purdue University's coal research group. Among the first topics discussed were a proposed carbon or Btu tax. Another purpose of the Forum is to study effects of the Clean Air Act on the Indiana coal market.

Several projects received funding to help find solutions to the problems passage of the Clean Air Act will pose for Indiana. Northern Indiana Public Service Co. (NIPSCO) gained approval from the Utility Regulatory Commission to build a $109.7 million flue gas desulfurization system at its Bailly plant. $50 million of this will be funded by the Department of Energy. This is expected to reduce the plant's sulfur dioxide emissions by 90%.

In June, two companies received loans from the Corporation for Science and Technology to help develop clean-coal burning technology. Bethlehem Steel's Burn's Harbor facility will receive $1.2 million and Richmond Power & Light's Whitewater Valley Plant will receive $800,000. The use of pulverized coal as fuel instead of the customary coke will be tested at Burn's Harbor, and a process to reduce sulfur emissions from burning coal will be tested at the Whitewater Valley Plant. The Department of Energy will provide an additional $8.5 million to the Whitewater Valley Plant and $31.6 million to the Burn's Harbor plant. This will be augmented by funds from the companies involved. Limestone will be used to remove the sulfur at the Burn's Harbor steel plant, and coal may replace up to 40% of the coke used. The Whitewater Valley plant will use a sorbent injection process called Lifac. This process also uses limestone and can reduce emissions by 75-85%. Under terms of the new bill, steel companies must meet the new air standards by the year 2020. Inland Steel announced plans with NIPSCO Industries and Sun Coal to open a new cleaner coke plant by the mid 1990's.

Because of the Clean Air Act, alternatives to coal may be practical for some uses. Fuel pellets are being tested at Ball State University as a potential source of energy to power boilers and other systems. The fuel pellets are composed of recycled materials, and different combinations of materials including garbage, plastics, and papers are being tested to see which combinations produce the least amount of hazardous emissions. The pellets will likely be combined with coal to produce enough energy to be useful. Fuel pellets are already being used in some states.
The nation's problems with Iraq spurred new talk of synthetic fuels development. The development of coal liquefaction and gasification processes would be advantageous to the coal industry. However, such development has not proved economically feasible so far. The crisis could also provide incentive to develop more efficient use of current fuels.

Reclamation and environmental coal issues

A bill to prohibit use of legal injunctions to stop companies from mining in such a manner as creates a nuisance to people living nearby was passed by the House, but failed to pass the Senate.

Plans for a Patoka River National Wildlife Refuge in Gibson and Pike Counties were postponed due to a provision in the 1977 Surface Mining and Reclamation Act which prevents surface coal mining in national refuges. An environmental impact study will need to be completed, and arrangements made with involved coal companies before plans can be resumed.

In April, the U.S. Office of Surface Mining began trying to clarify mining restrictions imposed by the 1977 Surface Mining and Reclamation Act regarding "valid existing rights" to mining in national forests and near other specified areas.

A bill to encourage remining of old mine sites (pre 1977) using new technology was passed by the House. The bill reduces the liability facing such endeavors produced by previous bills and establishes an insurance fund to help with unexpected events.

The Vigo Coal Company's Discovery No. 1 Mine near Buckskin won top coal reclamation honors presented by the Interstate Mining Compact Commission at their annual meeting September 25 in Gatlinburg, Tennessee.

Scott Paper Company may use the sludge from the process of recycling paper at a planned tissue plant for mine reclamation, saving the company the $25 million cost of an incinerator. One of the sites for the proposed paper plant is in Posey County, Indiana, and the other is in Daviess County, Kentucky.

The Division of Reclamation established a toll free number in December for persons with questions about mining and the reclamation of mines for coal, clay, shale, and oil shale. The number is 1-800-772-MINE.

Subsidence

The town of Cannelburg, situated over an abandoned mine, continued having problems with subsidence in 1990. Past mining conditions may be combining with present mining conditions to produce the problem. The city is surrounded on three sides by active mines at which blasting is common. A hearing was scheduled at Cannelburg in July by the House Subcommittee on Mining and Natural Resources to evaluate problems residents have had with the federally funded subsidence insurance program. A state campaign to inform people in affected counties of this program was launched in June. In August, The Department of Natural Resources denied a petition to consider the Cannelburg area unsuitable for mining, because the problem was not of a natural, but man-made nature and there was no authority to proceed further.

A memo written in March from the U.S. Office of Surface Mining lent support to a claim by a Sullivan county resident and his neighbors that water removed from two AMAX Minnehaha abandoned mine sites could lead to ground instability and subsidence. AMAX maintained that removal of the water was necessary to keep it from affecting nearby active mines. The residents feared that AMAX would try to mine the unstable area further. The Department of Natural Resources Division of Reclamation ordered the company to stop pumping water at an active Minnehaha mine site on August 2 because the same individual protested. The possibility of putting 200 miners out of work was the deciding factor in the Department of Natural Resources final decision in favor of AMAX Coal Company, but the water rights of these property owners were given further protection.
Methane

A Princeton high school was troubled with subsidence and methane problems from an abandoned coal mine beneath it. Officials thought that the problems were not enough to prevent the school from opening as scheduled, and were looking into ways of controlling and remedying the problems.

A more serious methane problem occurred near Princeton at the closed Indiana Refining Corporation plant located over an abandoned coal mine. The plant had been used to control methane when the mine was operating. Several people were evacuated from the area due to a leak that was finally controlled by filling the leaking pipe with cement.

Coal regulation

A methane explosion at a Pyro Mining Company mine in Kentucky in 1989 that killed 10 miners resulted in criticism for the way the Mine Safety and Health Administration (MSHA) regulates itself. Critics believe that MSHA made mistakes in regulating the Pyro mine and then was not willing to reveal those mistakes when investigating the accident. A bill to establish a national safety board to investigate all major industrial accidents was introduced to Congress in September. It included a provision to call on experts in fields related to the accident. In response to the criticism leveled against it, MSHA responded with several new regulatory measures. It stiffened rules imposed on coal companies showing a history of excessive violations. Those operators would not be eligible for $20 fines and would have to pay increased fines for serious violations. A "pattern of violations" rule was put into effect October 1. Companies with a history of violations could be closed down anytime within a 90-day period whenever a "significant and substantial" infraction was found, and be kept closed until no such infractions were found. A company with a higher-than-average number of citations can be flagged for extra surveillance by a new computer program being put into use by the agency. This will allow district managers to know more about what is going on within their districts. Also, maximum fines for mine-safety violations were increased three times, from $10,000 to $30,000. This may act to drive all fines up. These funds with an increase in OSHA fines could help reduce the nation's deficit by an estimated $1.1 billion.

The Office of Surface Mining planned a reorganization designed to give field personnel the power to make quicker decisions and to cut down on personnel. The two field offices in Pittsburgh and Denver would be converted to support centers.

Environmental lobbyists and a group of concerned citizens criticized federal and state coal regulators for attending an annual meeting with AMAX Coal company representatives that included a trip to the Indianapolis Speedway. Those regulators attending and AMAX representatives said that the day was a good opportunity to discuss coal regulations, that AMAX paid no expenses, and that representatives of other coal companies were in attendance.

Miner health and job concerns

Two United Mine Workers trust funds established to provide health care to union retirees and their families had a combined $88 million deficit. A commission established by the U.S. Labor Department studied the possibility of an industry-wide coal tax that would include both union and non-union companies to help reduce this deficit. This proposal was met with much opposition by non-union coal companies. Legislation was introduced, but was put on hold, to use money from the union's pension funds to help cover the deficit. Non-union companies would also be asked to help contribute to the benefit trusts.

The Black Lung program which was established to provide miners with the disease and widows of miners who died from the disease financial assistance, came under scrutiny at a hearing of the Subcommittee on Labor Standards of the House Committee on Education and Labor. Between 1982 and 1987, only 4.3% of 58,905 claims filed were approved. Many who initially got assistance later had to repay it, and widows almost never received
assistance. Critics of the program claim that this indicates a problem in the program that needs to be corrected. New legislation may be introduced by the Subcommittee to correct this problem.

To help counteract the negative aspects of the Clean Air Act, a provision was added to the bill for $250 million assistance for displaced miners. The unemployment assistance is designed to help support the miner while he is undergoing retraining.

Petroleum

Crude Oil

The amount of crude oil produced in Indiana in 1990 decreased by 9.3% as compared to 1989, but increased in value by 13.4%. The value of crude oil comprised 5.0% of the total value of minerals produced in Indiana during 1990. The petroleum industry will also be affected by the Clean Air Act. Gasoline with fewer pollutants must be supplied to 9 cities by the nation’s oil refiners by 1995. This presents a problem for the petroleum industry because technology does not yet exist to do this.

U.S. petroleum prices have been unstable since 1972, and it appears that this trend will be continuing. Indiana crude oil fell to $15.75 per barrel in the first quarter of 1990, a decline of $3.50 per barrel from the previous quarter. Prices then rose to $38.25 per barrel by the end of September. Prices had dropped to $26.25 per barrel by the end of December. Some of the price fluctuation in the second half of the year may be due in part to the Persian Gulf crisis. During 1990, 391 drilling permits were issued.

Natural Gas

The quantity of natural gas produced in Indiana fell by 4.1% in 1990 as compared to 1989, but value increased by 12.8% for this time period. The value of natural gas production comprised .1% of the total value of minerals produced in Indiana during 1990. Nationally, production of natural gas is expected to increase from 17.0 trillion cubic feet in 1989 to 20.7 trillion cubic feet by 2002, then drop due to a decrease in demand to 19.9 trillion cubic feet by the year 2010. Average annual wellhead prices are expected to increase at less than 5% per year through 1995. In April 1990, a futures market for natural gas was opened on the New York Mercantile Exchange. This will probably make natural gas prices more responsive to economic changes. The use of natural gas as fuel for electric-generating stations is expected to increase due to tighter air-pollution controls imposed by the Clean-Air Act.

INDUSTRIAL MINERALS

Cement

Portland and masonry cement showed an increase in quantity of production of 2.4% over 1989 and an increase of 7.5% in value of production for the same period. The value of cement production comprised 10.4% of the total value of minerals produced in Indiana during 1990.

Clay and shale
The quantity of common clay and shale production increased by 20.7% in 1990 as compared to 1989, but value of production decreased by 14.7% as compared to 1989. The value of common clay and shale production comprised .2% of the total value of minerals produced in Indiana during 1990.

**Peat and miscellaneous minerals**

Peat production showed an increase of 8.8% over the quantity reported in 1989. The value of peat was withheld for 1990. The value of peat combined with ball clay, gem stones, gypsum, industrial sand, lime, marl and dimension sandstone comprised 2.4% of the total value of minerals produced in Indiana in 1990. Nationally, the value of peat sales increased by more than 8% in 1990. There were 82 active peat operations in the nation, 5 of them in Indiana. Indiana produced 4.7% of the peat sold in the nation and Indiana with 10 other states produced 50% of the peat produced in the nation. It is expected that more peat will be used to fuel electrical powerplants in some parts of the country in the next five years. A power plant being built by EcoPeat in Florida could increase national peat production by four times.

**Sand and gravel**

The U.S. Bureau of Mines canvasses the sand and gravel industry in even-numbered years only; therefore, reported figures are estimated production for 1989 and actual production for 1990. Sand and gravel showed a decrease in quantity of production of 19.3% in 1990 as compared to 1989 estimated quantity of production with a corresponding 22.5% decrease in value of production during 1990. These figures are for construction sand and gravel only, the production and value of industrial sand are withheld for both 1989 and 1990. The value of sand and gravel has been rising steadily since 1982. The value of construction sand and gravel production comprised 5.6% of the total value of minerals produced in Indiana during 1990.

Robison Foundries was accused of allowing sand byproducts containing potentially harmful levels of some metals to pile up beside their business in Jeffersonville. Downtown businesses wanted the material removed, but the company claimed that the cost of hauling the sand to the landfill would put it out of business. The company purchased a sand recycling machine for the purpose of processing the old sand to make it suitable for road fill.

The aggregates industry was very concerned about wetlands legislation that was proposed, but not passed, in 1990. If it had been approved, 80% of sand and gravel operations could have been put out of business.

A new quarry site was being evaluated near Bunker Hill in Miami County by the Mill Creek Stone and Gravel Corporation. The company was also looking into reopening an older quarry to the north of Bunker Hill.

**Stone**

The U.S. Bureau of Mines canvasses the stone industry in odd-numbered years only; therefore, reported figures are actual production for 1989 and estimates for 1990.

**Crushed stone**

Estimated crushed limestone and dolomite production increased in 1990 by 1.4% over the quantity reported in 1989, and estimated value increased by 8.4%. Both quantity and value of crushed stone production has been increasing steadily since 1982, quantity of production increasing 65.1% over the reported production of 22,229,000 short tons reported for 1982, and value of production increasing 106.8%, more than doubling the value of $71,407,000 reported in that year. The value of crushed limestone and dolomite production comprised 10.8% of the total value of minerals produced in Indiana during 1990.
The France Stone Co. planned to open a new quarry in Putnam County, and Martin Marietta Aggregates planned to reopen the Cloverdale quarry, also in Putnam County. Problems facing the Cloverdale area may lead to the introduction of legislation which would more closely regulate the stone industry. There are currently no laws which regulate how close to a town a quarry can operate, or how many quarries can operate in a given area.

A discovery of a high-purity reefal limestone deposit 7 miles southeast of Kokomo by the Indiana Geological Survey stirred a great deal of interest in the aggregates industry. Information on the reef was published in Indiana Geological Survey Information Circular 3. American Aggregates Corporation optioned part of the reef.

Martin Marietta Industries considered opening an underground limestone mine at their Kokomo quarry.

**Dimension stone**

Estimated dimension limestone and dolomite production decreased 1.9% from the quantity reported in 1989, but increased 8.4% in value of production for the same time period. Production of dimension stone has been increasing steadily since 1982 which had a reported quantity of 135,000 short tons. Value of production dropped somewhat that year, but has been increasing since 1983 which had a reported value of $11,015,000. This is an increase of 44.2% in quantity since 1982 and an increase of 178.3% in value since 1983, when value is corrected for inflation. The U.S. Bureau of Mines has included a small quantity of dimension sandstone for some of these years in their reported totals. The value of dimension limestone and dolomite production comprised 2.2% of the total value of minerals produced in Indiana during 1990. Although this represents a small part of the total value of minerals produced in Indiana, Indiana is the largest producer of dimension limestone in the nation. Activities in the industry included the following.

The Indiana Soldiers and Sailors Monument in Indianapolis reopened after four years of renovation at a cost of $11.6 million. In addition to other improvements, the stone was sealed to prevent the stone from weathering.

Work continued on a limestone monument to honor Monroe County soldiers who died in Viet Nam.

Plans of reviving a project to build a pyramid and limestone tourist exhibit in Bedford with the help of Egyptian businessmen died from a lack of funding. But a small gift shop selling limestone items, purchased by members of the Elliott family, has served to stimulate some new tourism in the area. The owners of the gift shop have also been offering quarry tours of the Elliott Stone Co. quarry.

The Washington Cathedral was finished after 83 years of construction. It is built of limestone, much of which came from southern Indiana.

Plans were made to complete the Federal Triangle in Washington, D.C.. The building will be the nation's second largest government building and will be completed in about four years. It will probably be built mostly of Indiana limestone.

**Notice**

_The Geological Survey began the process of reorganization during fiscal 1990-91. Consequently, parts of this report are incomplete or missing._