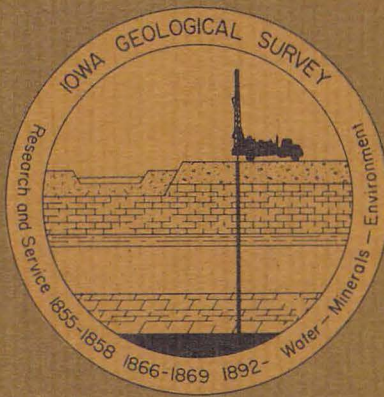


ANNUAL REPORT



of the
STATE GEOLOGIST
to the
GEOLOGICAL BOARD

Volume 50
31 December 1979

GEOLOGICAL BOARD

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STATE OF IOWA
IOWA GEOLOGICAL SURVEY

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Iowa
a place to grow

Stanley C. Grant
Director and State Geologist

Orville J. Van Eck
Associate State Geologist

Donald L. Koch
Assistant State Geologist

March 25, 1980

To: Governor Robert D. Ray, Chairman
and Members of the Geological Board

Gentlemen:

Herewith is the Annual Report of the State Geologist in accordance with the requirements of the code of Iowa, Section 305.7 and Section 17.4. It describes the activities and accomplishments of the Iowa Geological Survey for the period of 1 January 1979 to 31 December 1979. The legal responsibilities of the Iowa Geological Survey (IGS) are set forth in the Iowa Code, Chapters 305 and 84.

Services to and for other state agencies and divisions of government continue to increase. By reassigning priorities we have been able to support these functions without an increase in permanent personnel.

New programs are presently being undertaken only where contract funding can be provided to us. Persons are hired with Executive Council approval annually for no more than the contract period.

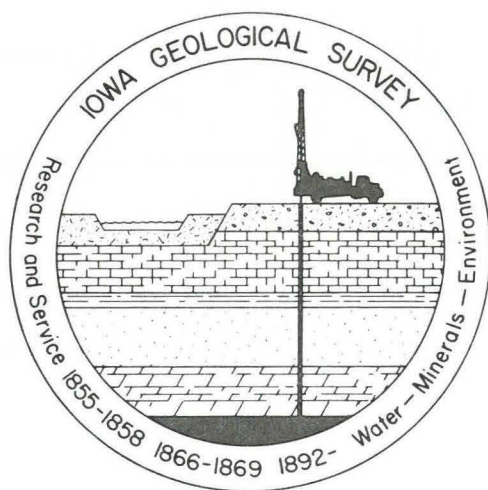
Construction was completed on our new core/sample library, laboratory, office, and warehouse building at the Oakdale Campus of the University of Iowa. Much core still is stored under inadequate conditions in the basement of another building. An addition to the new warehouse will be sought in the near future so that all of our rock library can be housed as a unit, with space to accommodate new acquisitions.

Respectfully submitted,


Stanley C. Grant
Director and State Geologist

SCG/bam
enclosure

ANNUAL REPORT
OF THE
STATE GEOLOGIST
TO THE
GEOLOGICAL BOARD



COMPILED BY
DONALD L. KOCH
ASSISTANT STATE GEOLOGIST

VOLUME 50
31 DECEMBER 1979

TABLE OF CONTENTS

	Page
Letter of Transmittal	
Functions of the Geological Survey.....	1
Table of Organization	4
IGS - USGS Cooperative Research	6
Consultative, Advisory, and Information Services	7
Geological Studies Division	8
Missouri River Investigations	8
Quaternary Map Project	9
Cooperative Applied Soils Research	9
Plum River Fault Zone Investigations	11
Dam Inspection Program	12
Stratigraphy and Economic Geology	13
Cretaceous Aquifer Study	13
Well Logging	16
Hazardous Waste Storage	16
Geohydrology of the LaBounty Site	17
Borehole Geophysics	19
Other Studies and Service	19
Oil and Gas	20
Coal Division	22
Research Progress	23
Service Functions	24
Project Termination	25
Water Resources Division	26
Water Resources Services	27
Field Investigations	28
National Water-Use Data System	29
Silurian-Devonian Aquifer Study	30
Potential Reservoir Site Study	30
Elements of Water Resources Management	31
Contracts and Grants	32
Coal Resources	32
Tectonics and Seismicity	32
GREAT II	33

	Page
Technical Services Group	34
Remote Sensing Laboratory	36
Laboratory Functions	36
Priority Projects	37
Landsat Demonstration Project	37
Data Systems Division	38
Computer Programming	38
Systems Analysis and Planning	39
IWARDS	40
Illustrating Division	41
Administrative and Support Service Group	42
Administrative Services	43
Accounting Services	43
Support Services	43
Library Services	44
Maps and Publications	45
Topographic Maps	45
Publications	45
Geological Survey Publications	46
Publications in Preparation	46
Extrinsic Papers	47
Sales	48

ILLUSTRATIONS

	Page
Figure 1. Functional Relationships of the Iowa Geological Survey..	3
Figure 2. Staff Organization and Responsibility Assignment.....	5
Figure 3. Water Yields from the Dakota Sandstone.....	15
Figure 4. Geologic Containers for Hazardous Wastes.....	18

Iowa Geological Survey

ANNUAL REPORT

Volume 50

31 December 1979

FUNCTIONS OF THE GEOLOGICAL SURVEY

The fundamental function of the Geological Survey is to collect, interpret, and report information on basic geologic features and products of the state, including surface and groundwater. As the principal repository for basic geologic and water data, the Survey makes every effort to secure all such data, and in turn, to make that data meaningful and available to individual citizens and to all agricultural, industrial, and governmental organizations.

In addition to the basic data program, the Survey conducts various research programs aimed at furthering the geologic and hydrologic knowledge of the state. The programs range from re-evaluation of extant data to complex data gathering surveys. To implement research in hydrology and to expedite topographic mapping in the state, the Survey uses the authority granted in Chapter 305.8, Code of Iowa, to cooperate with the Water Resources Division and the Topographic Division of the U.S. Geological Survey in cost-sharing programs. The knowledge gained through research will lead not only to better management and protection of our known resources, but to discovery and utilization of new resources as well.

The basic method of information dissemination is in the formal reports published by the Survey. In the absence of a report on a particular area, and where a detailed report is necessary for a specific purpose, unpublished special reports are provided. To further the value of the reports, the

Survey acts in a consultative capacity to those who seek assistance. Except where the state can expect to acquire important information, consultations with private consulting firms are not performed, but our data bank and files are available for their use.

In its role as a consultant, the Survey has the responsibility of providing information about naturally occurring resources. In this context the Survey assumes a strong responsibility in advising local and regional planners as to the effects various land uses will have upon the environment under the existing geologic and hydrologic conditions of a given area.

The Survey is a resource agency for a variety of state agencies that exercise regulatory power. The research and problem solving mandate given the Survey by the legislature separates us from the regulatory agencies in such a way as to permit us to perform an unbiased service for the enforcement and regulatory branches of government such as the Attorney General, the Department of Agriculture, the Iowa Natural Resources Council, Iowa Conservation Commission, Iowa Department of Health, Iowa Department of Environmental Quality, Mines and Minerals Division of the Department of Soil Conservation, and the Iowa Department of Transportation as well as county and municipal governmental units.

Many aspects of environmental preservation require a detailed, sophisticated knowledge of the nature of earth materials and the nature and behavior of water in a region. Our staff have the highly specialized training and experience in Iowa geology to fulfill these needs at minimal cost to the state.

The functional relationships of the Geological Survey to federal, state, and local governmental agencies, and to the private sector are shown in figure 1.

IOWA GEOLOGICAL SURVEY

<u>Research Cooperative Programs</u>	<u>Consultation, Advisory, and Data- Source Services</u>	<u>Participation in Other Agencies</u>
U.S. Geological Survey Groundwater (50/50) Surface Water (50/50)	Iowa Citizens Iowa Department of Reveue Iowa Water Well Drillers	Iowa State Map Advisory Council Iowa Conservation Education Council Iowa City Chamber of Commerce
National Aeronautics and Space Administration	Local and Regional Planning Commissions Iowa Counties and Municipalities	Environmental Concerns Comm. Department of Environmental Quality
U.S. Bureau of Mines	Iowa Commerce Commission	Inter-Agency Resources Council
U.S. Geological Survey Geologic Division	Iowa Development Commission Office for Planning and Programming	Department of Soil Conservation Land Rehabilitation Advisory Board
U.S. Department of Agriculture	Iowa State Department of Health Department of Environmental Quality Air and Land Quality Commission Chemicals and Water Quality Com- mission	Watershed Advisory Board Conservancy District Task Force U.S. Department of Agriculture Conservancy District Coordinating Committee
	University Hygienic Laboratory Iowa Department of Justice Iowa Natural Resources Council Iowa Department of Soil Conservation Iowa Agricultural Experiment Station State Archaeologist Iowa Department of Agriculture Iowa Department of Transportation Iowa Preserves Board Iowa Conservation Commission The University of Iowa University of Northern Iowa Iowa Department of Public Instruction U.S. Department of Agriculture SCS Private Industry Engineering Consultants	Energy Policy Council

Figure 1. Functional Relationships of the Iowa Geological Survey

TABLE OF ORGANIZATION

Figure 2 shows the table of organization of the Geological Survey for this date. The current table of organization is a result of the need to

1. maintain an organizational framework that permits ready adaptation to changes in agency programs,
2. retain sufficient flexibility with staff assignments such that appropriate personnel can readily respond to routine and emergency information requests from other agencies and
3. develop a management structure that satisfies the requirements of the Iowa Merit Employment Department for supervisory personnel.

The level of attainment achieved by any viable organization is limited only by the caliber of its employees. The Geological Survey is fortunate to have enlisted the services of talented, enthusiastic employees in every sector of its operations. Their efforts maintain the esteem of the agency.

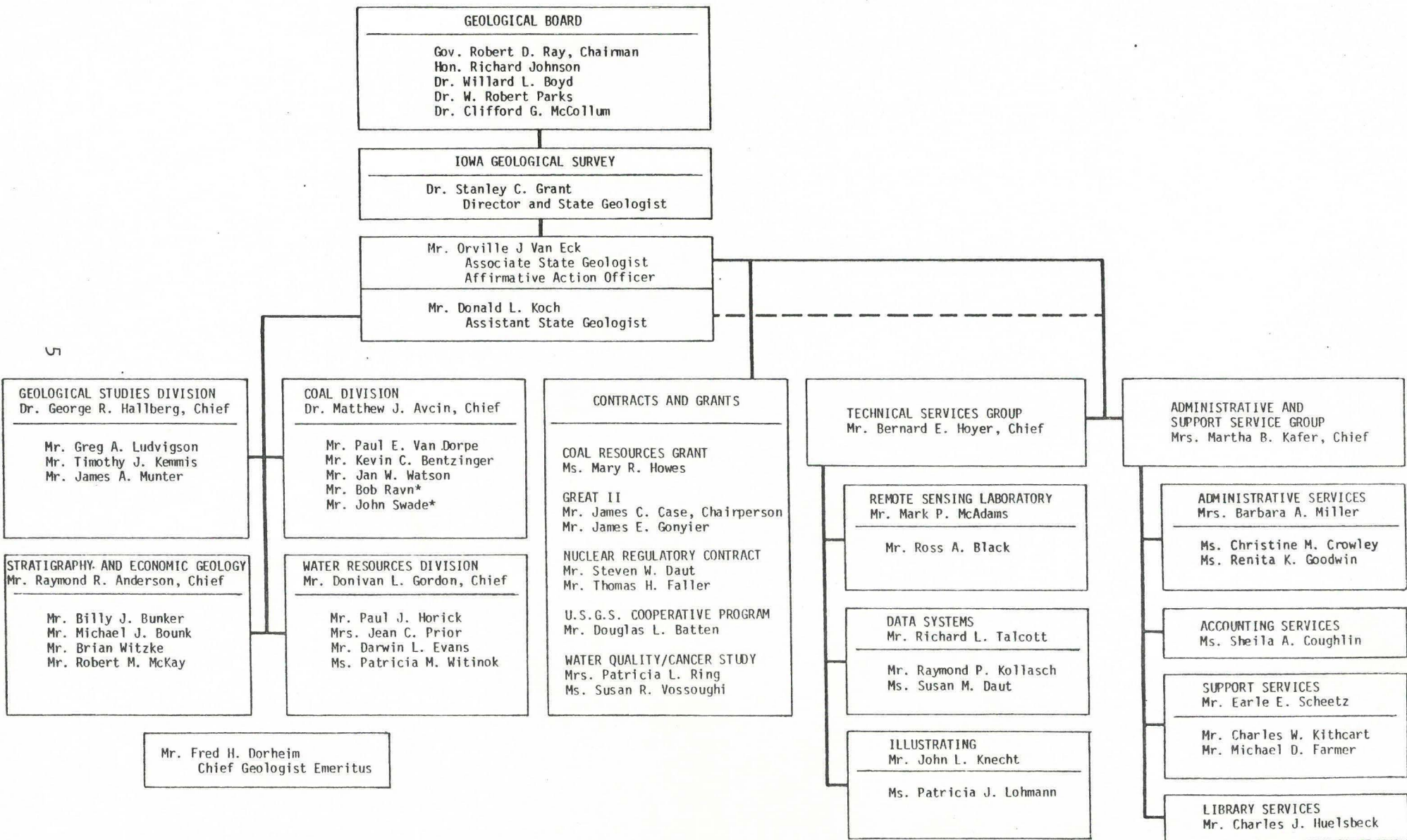


Figure 2. Staff Organization and Responsibility Assignment

* permanent part-time

IGS - USGS COOPERATIVE RESEARCH

The Geological Survey uses the authority granted in Section 305.8, Code of Iowa, to cooperate with federal agencies in cost-sharing programs for geologic and hydrologic research in Iowa.

During the current reporting period, the Survey continued a 50/50 cost-sharing cooperative program with the Water Resources Division of the U.S. Geological Survey. The objectives of the program are threefold:

- to collect, analyze and publish information on the occurrence and quality of ground-water resources -- the scope of research may range from the study of a single aquifer system of limited areal extent to analysis of a multiple system of aquifers on a state-wide basis;
- to maintain surveillance of the ground-water resources through a network of observation wells so that water-level and chemical quality changes can be monitored;
- to maintain a system for collection and compilation of basic records of daily stage and flow rate of streams and the concentration and total load of sediments carried by streams.

As greater demands continue to be made on our water resources, the need increases for objective and impartial investigations. The data acquired through this cooperative research program forms the foundation for good water-management policies and comprehensive planning. Projects under this program are closely monitored to ensure that the state's needs are addressed.

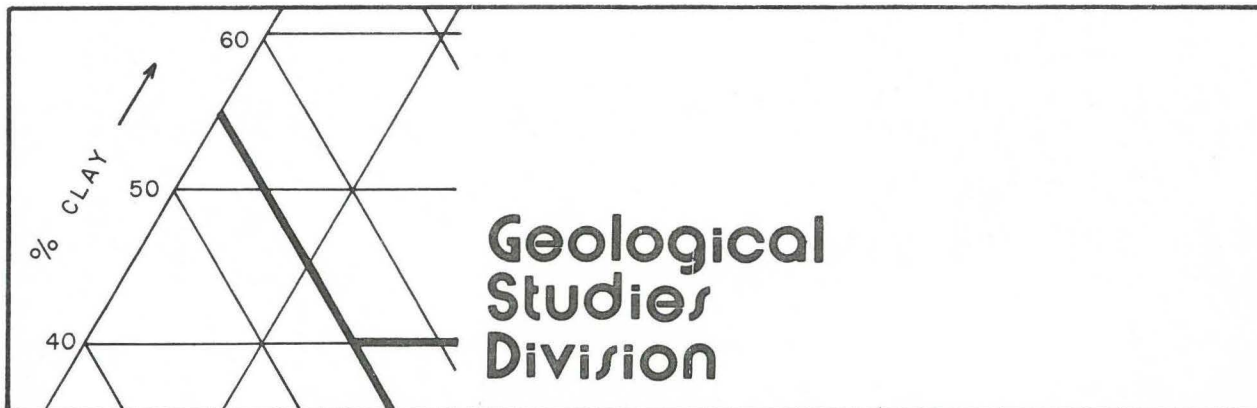
CONSULTATIVE, ADVISORY, AND INFORMATION SERVICES

The Survey yearly responds to hundreds of requests for geologic and hydrologic information from various state and federal agencies, consulting engineers, well drillers, industries and citizens. These services frequently require interpretation of data and quite often on-site investigations in various parts of the state. With continued public concern over environmental and energy problems, the number of requests has increased substantially. The manner in which the requests are answered is largely predicated by the nature and scope of the request.

For those requests that are general in nature, one of the publications of the Survey often will fulfill the needs. For those of a more specific or localized nature a special letter report is prepared. These reports are generally interpretive.

In contrast to the requests for interpretive reports, we also are called upon to supply much basic data. Recognizing this need some time ago, we have worked to develop an automated geologic and hydrologic data bank. These efforts have progressed to the point where we now can provide such data rapidly with comparatively little demand on staff time and at a nominal cost to the user.

The public interest in, and concern about energy and environmental problems has resulted in a greater demand for public addresses by staff members. These have ranged from short presentations to various service groups, to seminars devoted to specific subjects. The results have been gratifying in that there seems to have developed among the general public an entirely new appreciation of our earth resources.



GEOLOGICAL STUDIES DIVISION

The primary task of the Geological Studies Division is to conduct and coordinate applied studies that are fundamental to the understanding of Iowa's physical resources. Such studies may be independent of other Survey divisions or may be performed in support of other division projects. In addition, many of the studies are done in cooperation with other agencies, especially soils-related investigations. Timely dissemination of the results is particularly important. When it is appropriate, papers are published by the Geological Survey. Short notes and papers that are directed to a more limited audience are made available through extrinsic publications.

Dr. George R. Hallberg, Chief

Missouri River Investigations

Under contract with the Iowa Conservation Commission, the Division completed a report which quantifies the natural and man-made changes that occurred in the channel area of the Missouri River from its natural condition, to its present highly controlled regimen. A series of maps between 1879 and 1976, with documented measured values, shows the changes in river mileage, sinuosity, channel area, and the water, island, and bar

area within the channel. These changes have resulted in significant resource losses to Iowa in terms of land, wildlife habitat, water area, recreation potential, and other conservation resources. The report will aid the Conservation Commission to further evaluate these losses and, hopefully, to mitigate potential future losses.

Quaternary Map Project

A new surficial geologic map of Iowa was completed this year as part of a nationwide mapping program of the Geologic Division, U.S. Geological Survey. Staff of the Geological Studies Division compiled the map and coordinated work with other states to produce a regional map that includes Iowa and adjacent portions of Illinois, Missouri, Nebraska, South Dakota, Minnesota, and Wisconsin. The regional map will be published by the U.S. Geological Survey.

At a scale of 1:1,000,000, the map depicts the distribution and composition of the surficial geologic materials -- both soils, and surficial bedrock exposures. Although the map is limited in scope and by scale, it will serve as a useful interim product until more detailed surficial engineering-geologic mapping is done.

Cooperative Applied Soils Research

Staff of the Geological Studies Division direct, coordinate and/or participate in ongoing cooperative research programs with staff of the Iowa Cooperative Soil Survey (USDA - Soil Conservation Service and Iowa State University Experiment Station and Extension Service), and the Geotechnical Research Group, Department of Civil Engineering, Iowa State University. These research programs are designed to:

1. Establish a modern detailed understanding of the stratigraphic and geologic relationships of surficial materials in Iowa.
2. Apply these relationships, through the use of 3-dimensional soil-landscape models to assist and improve soil survey operations.
3. Quantitatively evaluate engineering properties and problems associated with survey mapping units or geologic units, as appropriate.

Several publications have been completed under these cooperative programs. One report presents analyses of highway engineering properties for 264 soil types in Iowa. Another report documents the utility of this data in an actual case study. Geotechnical research on loess materials which cover about 38% of Iowa is reviewed in an open-file report.

Three other projects related to soils investigations are nearly completed. These include a detailed analysis of Pleistocene stratigraphy in east-central Iowa, a study of shrink-swell problems of Iowa soils, and a series of maps that depict geologic hazards in Iowa.

As an ongoing part of the cooperative applied soils research, the Survey provides geologic data and topographic maps to aid in the initial stages of county soil surveys. Division staff participate in field reviews to assess mapping problems. Work also continues on the comparison and correlation of particular soil series with large magnitude floods, and the cooperative evaluation of remote sensing applications to soil surveys.

High altitude imagery is a major element of a study to produce an engineering-geologic evaluation of the Des Moines Lobe. The Des Moines Lobe is an area of relatively young glacial deposits in north-central Iowa, and it occupies all or parts of 29 counties. This project involves the integrated use of soil survey information with geologic and engineering

data, and with remote sensing information -- high altitude color-infrared photography. The photography was obtained by the IGS Remote Sensing Laboratory, cooperatively with the Iowa Department of Soil Conservation, the USDA - Soil Conservation Service, and the U.S. Army Corps of Engineers.

These applied cooperative research programs have enlarged the engineering-geologic data base on soils materials. The availability of more comprehensive data on cohesion, angle of internal friction, bearing capacity, optimum moisture and density, Atterberg limits, and shrinkage properties for soil profiles and their geologically correlative parent materials can significantly reduce the cost of siting investigations for housing, commercial and industrial developments.

Plum River Fault Zone Investigations

The Plum River Fault Zone consists of a band of broken, shattered rocks from 300 to 3,000 feet in width, along a line through southern Jackson, northwestern Clinton, southern Jones, and southern Linn Counties. The fault zone has been under study since 1977. The existence of this structure holds important implications in nuclear power plant siting. Also, highly productive water wells occur where the wells are located within the zone of shattered rocks and on the downthrown (north) side of the fault zone where a greater thickness of the carbonate rock sequence is preserved. In addition, it is possible that deeper drilling along the zone of shattered rock could result in the discovery of metallic mineral deposits such as galena (lead) or sphalerite (zinc).

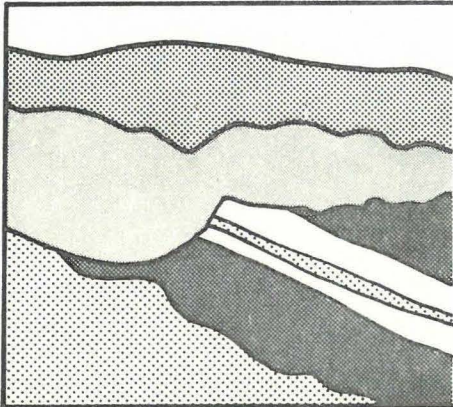
Investigations of the fault zone by Division staff during 1979 included regional geologic mapping, stratigraphic studies, and preliminary studies of rock fabric and chemistry. Other studies were conducted by four University of Iowa graduate students, under supervision by Survey

staff. These studies include field mapping and geophysical surveys of selected segments of the fault zone. The geophysical studies involve precise measurements of the gravity and magnetic fields in the area. These studies will provide information on the geometry and geologic history of the fault zone so that potential resources associated with the zone can be evaluated further.

Dam Inspection Program

Division staff have continued to assist the Iowa Natural Resources Council and the Rock Island District, U.S. Army Corps of Engineers in making dam inspections. These inspections are funded under the Federal Dam Safety Act (PL 92-367). Ten dams were inspected in 1979, and 20 dams have been inspected to date. Eight dams are scheduled for inspection in 1980.

For each dam that is inspected, the Survey submits a report on the soils and general geology of the site. The reports include information on soil types, permeability, joints, shrink-swell characteristics, and the composition of the bedrock.



Stratigraphy & Economic Geology

STRATIGRAPHY AND ECONOMIC GEOLOGY

Division staff investigate earth materials that range in age from more than one billion years to sediments deposited in modern stream valleys. The topics reviewed below illustrate the diversity of applied research projects to which staff members lend their individual or collective expertise. Some of the projects are short-term studies. Others are of longer duration or are ongoing. All of them result in increased knowledge of Iowa's physical and historical geology, and thereby improve our capability to assist in the development and management of the state's natural resources.

Raymond R. Anderson, Chief

Cretaceous Aquifer Study

The Cretaceous aquifer, generally referred to as the Dakota Sandstone, is the principal source of water for domestic use and crop irrigation in the upland areas of northwest Iowa. Although it is known that yields are sufficient to support irrigation in some areas, an intensive research program was started to define the capacity of the aquifer system to sustain large withdrawals on a regional basis.

The Iowa and U.S. Geological Surveys began a drilling program as part of the Cretaceous aquifer study in July, 1977. Thirty-six test holes have been drilled to date with a total footage of 18,522 feet. Fifteen of the test holes (7,410 feet of drilling) were completed this year. These wells are drilled through the entire sequence of Cretaceous rocks. Nearly all previously drilled wells in the region, whether for municipal domestic, or irrigation use, penetrate only to the upper or middle portion of the Cretaceous sequence. With complete penetration the physical limits of the aquifer system can be defined.

All available geologic data have been incorporated into a hydrogeologic model which shows that sandstones of the Dakota aquifer were deposited by ancient rivers which flowed from the northeast to the southwest. These sandstones and associated clayey mudstones buried an older land surface which had topographic relief of over 500 feet. This buried land surface was not unlike the rugged topography seen today in northeastern Iowa. The buried ancient river valleys now contain thick deposits of relatively clean sandstone that can be expected to sustain yields of more than 500 gallons per minute. Parts of the upland areas of the old land surface, however, are covered by thin, clayey sandstones that cannot sustain yields of more than 100 gallons per minute. The Dakota aquifer is present in 84 percent of the study area, but can be expected to sustain yields of more than 500 gallons per minute over only 69 percent of the study area. Figure 3 summarizes the predicted water availability from the Dakota aquifer in northwest Iowa.

This hydrogeologic model is by no means complete -- it is very general and qualitative. Additional stratigraphic, sedimentological and hydrologic information will eventually permit quantitative modeling of the entire hydrologic system so that the response of the groundwater system of

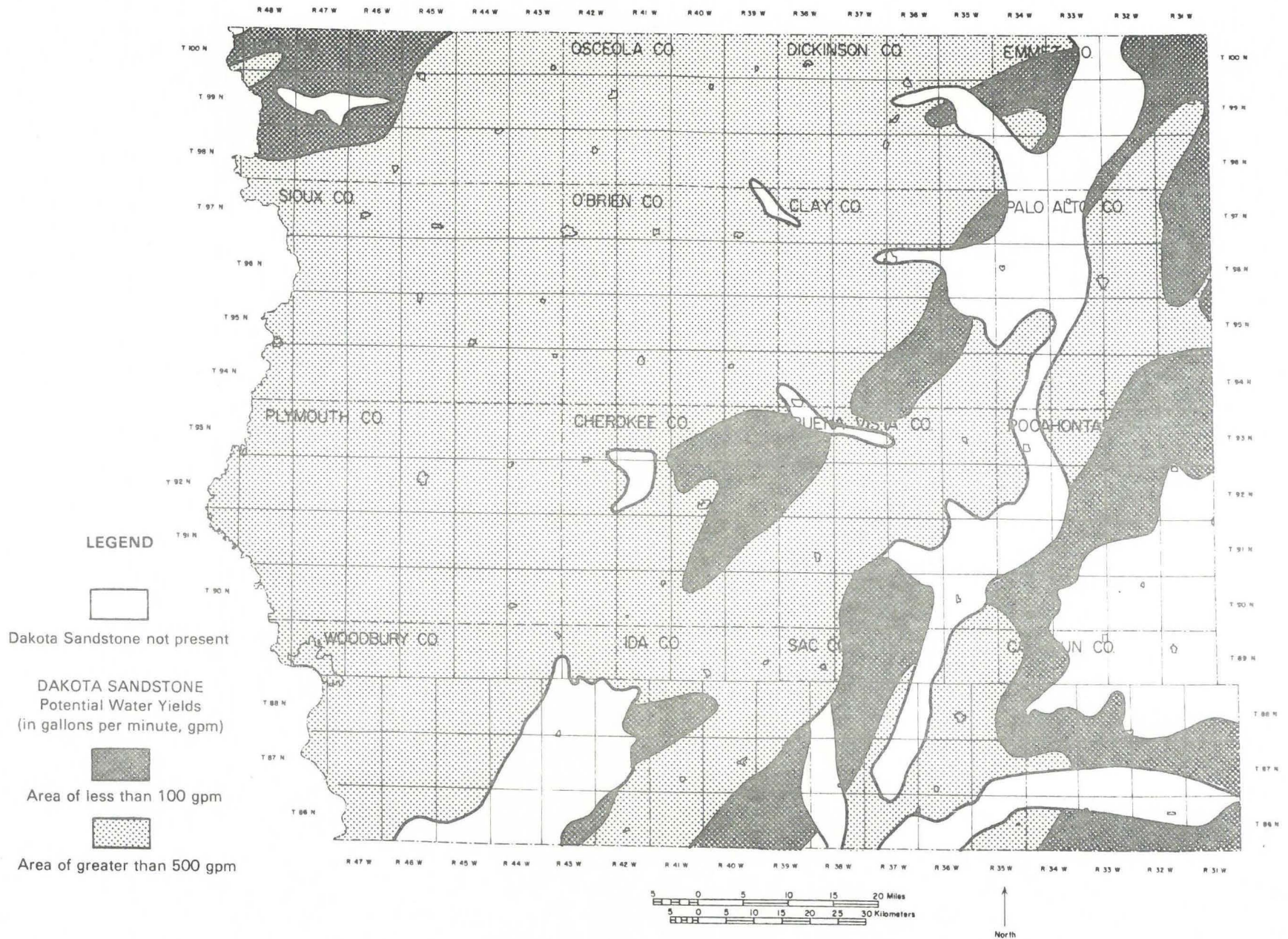


Figure 3. Potential water yields from the Dakota Sandstone in northwest Iowa.

northwest Iowa to large withdrawals in concentrated areas can be predicted more accurately.

Water quality problems are severe in many supplies derived from the Dakota aquifer. Water samples will be collected from different zones within the aquifer system to determine if significant differences in water quality occur. Such differences could result in improved supplies with appropriate well construction design.

Well Logging

Well logging involves microscopic examination of drill cuttings to describe the physical properties of the rock units penetrated. The descriptions, along with colored graphics, show the rock composition, texture, fossil content and correlation of the rock units. Hydrologic information also is recorded. These "strip logs" comprise the basic data bank on the geology of the state.

This year, drill cuttings from 60 wells were logged for a total footage of 35,000 feet. In addition, cores from 24 drill sites (4,000 feet) were studied. Over the last several years, the number of well samples logged has decreased commensurately with the load of service work. Currently, samples from about 7,800 wells remain to be logged. Priority is placed on deep municipal and industrial wells and those wells located within special project areas.

Hazardous Waste Storage

The Division has continued investigations which were initiated last year to identify rock units that could be utilized as containers for hazardous waste storage. Requisite parameters for these rocks include low permeability and an inherent capacity to reduce the toxicity and

isolate the wastes from present or potential future ground water resources.

Shale formations have the highest potential as host rocks for hazardous waste storage. Because no regulatory criteria exist, we have applied some arbitrary requirements that appear to be reasonable with respect to site selection for trench or bored storage: 1) the shale should be laterally continuous and be at least 50 feet thick; 2) for economical development, the shale should be overlain by no more than 20 feet of consolidated material and/or no more than 50 feet of unconsolidated materials. Figure 4 shows the distribution of shale units that are being investigated.

Areas of the state that contain thick intervals of glacial sediments might also be suitable for hazardous waste storage. Reconnaissance work will be started in 1980 to identify target areas where high clay content sediments are isolated from water-bearing sand and gravel deposits and from bedrock aquifers.

Geohydrology of the LaBounty Site

Division staff provided technical assistance to the Iowa Department of Environmental Quality (DEQ), the U.S. Environmental Protection Agency (EPA) and Salsbury Laboratories during the drilling of a new series of monitoring wells at the LaBounty dump site in Charles City. Drill cuttings and core samples were described to define the composition of the unconsolidated sediments and bedrock. Water samples will be collected until June, 1980. These samples will provide data on arsenic concentrations and other water quality parameters, and will permit identification of any leachate plume(s). This background information will aid in evaluating the effectiveness of placing a cover of low-permeability material over the disposal site. Further ground water quality studies (and surface water monitoring) after emplacement of the cover will be used to determine the need for any future

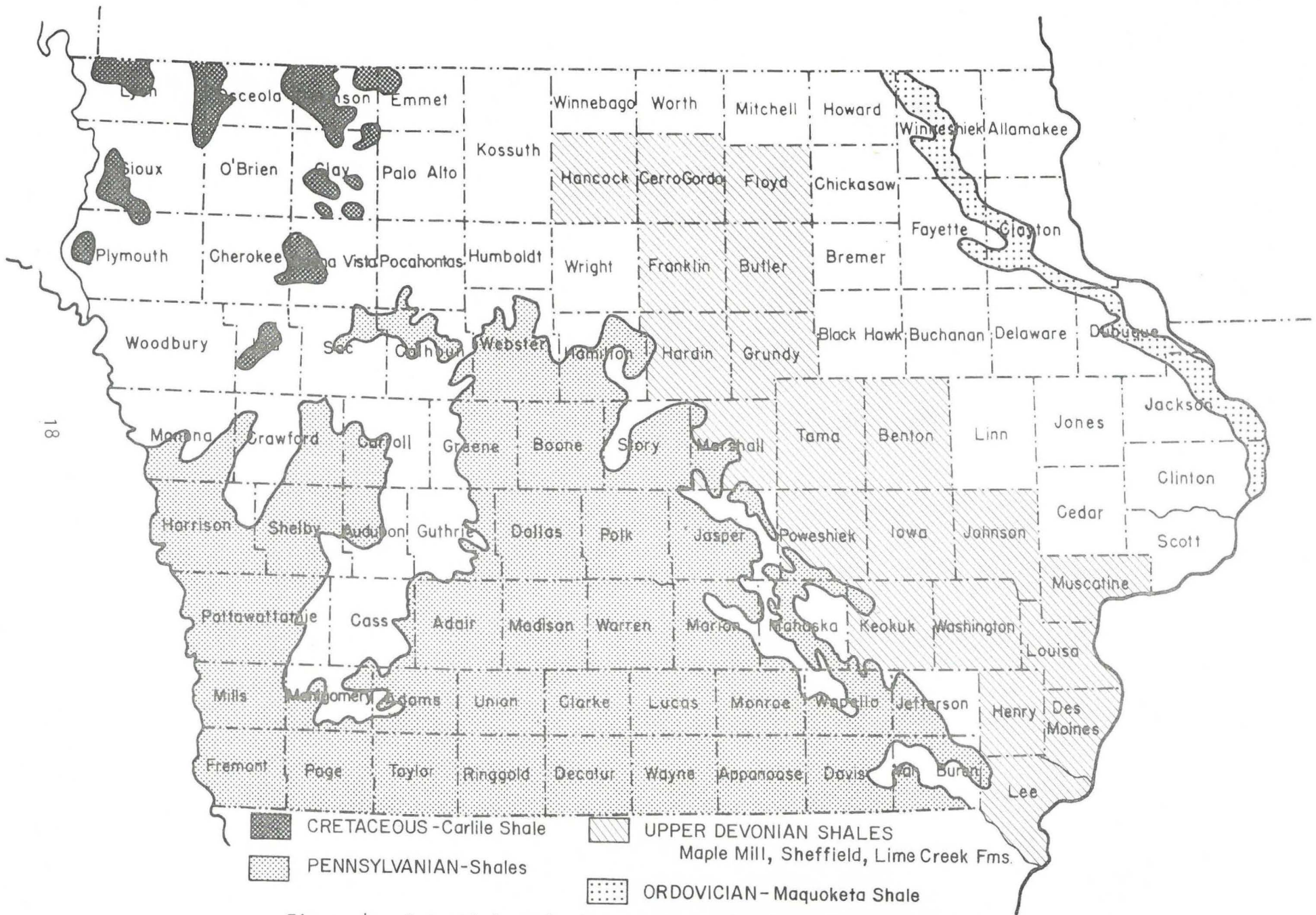


Figure 4. Potential geologic containers for hazardous waste storage.

remedial work at the site.

IGS also assisted the University Hygienic Laboratory and EPA in selecting specific private and municipal wells between Charles City and Cedar Rapids for water sample analyses. These wells were selected on the basis of the stratigraphic sequence at each site, and on recharge/discharge relationships to the Cedar River. Data from the analyses will provide information on the extent of contamination and possible contaminant migration pathways in both the ground water and surface water systems. To date, no arsenic contamination has been detected in ground water downstream from the LaBounty site.

Borehole Geophysics

Geophysical logs of boreholes provide a valuable source of information on the geologic and hydrologic parameters of Iowa's aquifers. When arrangements can be made, we are running geophysical logs on wells drilled for municipalities, industry and private institutions, especially on wells that are drilled to the deeper aquifers. Borehole logs obtained include electric (spontaneous potential-resistivity), caliper (hole diameter) temperature, conductivity and natural gamma logs. This year, logs were run on five municipal wells, one stratigraphic test well, and one oil test for a total of 15,735 feet. These records also are extremely valuable to the well owners, particularly when remedial work is necessary.

Other Studies and Services

A variety of other studies are in progress, and many service functions have been performed. The following are typical of both:

- Compilation of a state-wide systematic review of stratigraphic information to encourage exploration by the petroleum and base metal industries.

- Synthesis of magnetic and gravity data to interpret the structural relationships and mineral resources potential of Iowa's deeply buried igneous rocks.
- Investigation of alternative aggregate resources sites in the vicinity of a proposed greenbelt along the Des Moines River.
- Reviewing geologic data to minimize the impact of proposed highway construction on natural resources such as gypsum, coal and aggregate reserves.
- Providing geologic information to well contractors.
- Serving as resource persons, along with other division staff, in organized geological-environmental educational forums.

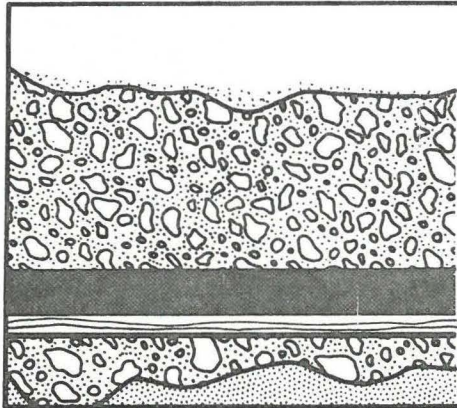
Oil and Gas

As provided in Chapter 84 of the Code of Iowa, the State Geologist is designated as the Administrator of Oil and Gas, and he is responsible for administering the provisions of Chapter [580] 12 of the Iowa Administrative Code. His duties include the issuance of drilling permits for oil/gas exploration or production, including underground gas storage; the maintenance of all administrative, geological and production records; and surveillance of associated well or facilities abandonment.

Two drilling permits for oil and gas were issued during 1979. Both were issued to Kinderhook Oil and Gas, Inc. for exploratory test drilling in Montgomery County. To date neither test has been drilled to completion.

The Geological Survey continues to serve as consultant to the Iowa Commerce Commission in the review of procedures being followed by Northern Natural Gas Company in the abandonment of the Vincent gas storage reservoir. The original acreage under lease for this facility when abandonment began in 1971 was 12,373 acres. Gas Storage Agreements on approximately 10,133

acres on the outer periphery of the field have been dropped through December, 1975, leaving 2,240 acres under lease. The total gas-in-place as of December 26, 1979 was 2,408,632 Mcf (thousand cubic feet).



Coal Division

COAL DIVISION

The primary objective of the Coal Division has been to define Iowa's coal resource base in terms of its quantity, quality, and distribution, with an ultimate goal of assisting in the revitalization of Iowa's coal industry in an environmentally and socially acceptable manner. The Coal Division has designed its analysis program to extract the maximum amount of information from every potential data source. Stratigraphic, paleontologic and geochemical analyses have comprised the principal research efforts. Data from these studies permit assignment of relative ages to individual coal beds, construction of a model that will aid in the interpretation of depositional environments, and ultimately will provide a predictive tool for coal deposits between control points. With this framework, site-specific exploration and definition of reserves can be accomplished by the coal industry.

Dr. Matthew J. Avcin, Chief

Research Progress

Detailed studies of spores and pollen (palynology) recovered from cores, mines, and surficial exposures of coal have added significantly to our knowledge of the age relationships of Iowa's coal beds. Additionally, studies of the microfauna (conodonts) from adjacent rock units provide control for interpreting the changing environments of deposition which resulted in the complex stratigraphic sequence that characterizes Iowa's coal-bearing rocks. Together, the results of these studies have allowed us to refine our stratigraphic model for coal deposition, and have improved our predictive capabilities for areal assessment of both the number of coal beds and their thicknesses in unexplored areas.

Publication of An Introduction to the Stratigraphic Palynology of the Cherokee Group Coals of Iowa is a major contribution to the literature on coal. It will become an important reference for other coal researchers in Iowa and in other midwestern states. Stratigraphic Ranges of Miospores in Coals of the Des Moines Series of Southern Iowa will be published in 1980. Correlations for most of the coal beds sampled to date will be summarized in this report.

Two additional palynology papers will be published in professional journals. The decision to publish these papers elsewhere is based primarily on economic considerations. However, both are important in establishing the scientific framework of palynological research in Iowa.

The results of conodont research will be summarized in two publications. One will document the importance of conodonts for interpreting the depositional environments of the rock units which encase the coal beds. The second publication will set forth a system for biostratigraphic correlation of rock units independent of that used for the coal beds.

Geochemistry is another important part of the coal exploration program. Geochemical data generated by the Coal Division under a cooperative agreement with the U.S. Geological Survey and the Department of Energy is being prepared for publication. Correlations made possible by the palynology research have enhanced the value of the chemical data. These data have been grouped by coal horizon, and several presentation formats are being considered to maximize their practical application.

Service Functions

The Coal Division has continued to supply basic information on coal occurrence, coal quality and environmental issues related to coal extraction. Information requests originate from coal companies, governmental agencies, various research groups, and from private citizens.

Requests for information about the extent of previous mining activities have increased markedly. This has resulted from two areas of concern. First, miners are increasingly encountering abandoned underground workings where none were thought to be present. Secondly, architects, engineers and planning groups are becoming alert to construction problems associated with abandoned underground mines.

The Survey's mine files are also researched as a supplement to coal resource information requested by the Department of Transportation for preparation of environmental impact statements on proposed highway construction. The data is valuable for planning alternate highway routes in areas where coal resources are either intact or have been mined previously. Similar reviews are made on existing and proposed dam sites.

Staff of the Coal Division continued to serve as the state's liaison with, and consultant to the Office of Surface Mining (OSM) on mine subsidence. Technical assistance was provided to OSM during their drilling

project to investigate subsidence at the C.E. Erickson Co. warehouse in Des Moines. Also, Coal Division personnel are participating in a special OSM Task Group to establish a policy for abatement of mine subsidence in Des Moines and other areas where subsidence could occur.

Project Termination

Late in 1979 the Geological Survey was informed that the coal exploration/research program probably would not be funded beyond June, 1980. Subsequently, several program changes were made to ensure that maximum benefit could be derived from all research endeavors. The following program elements were adjusted.

- Drilling locations were expanded to greater than 6-mile centers to obtain more regional coverage of the coal-bearing strata.
- Release of drill sample descriptions was rescheduled to March 15, 1980.
- Only key sample intervals will be processed for paleontological studies.
- Identification and correlation information for all samples not addressed in the publications described above will be organized and placed on open file.



Water Resources Division

WATER RESOURCES DIVISION

The lead responsibility for water resources service and research functions is assigned to the Water Resources Division. However, today's water resources problems must be addressed through a multidisciplinary approach that requires support and assistance from other divisions of the Geological Survey. The primary goal of the Water Resources Division is to effect public service and research that will promote a better understanding of Iowa's water resources and further enhance the Geological Survey's position as the state's principal advisor and consultant in the area of water resources. This goal can be achieved through the following objectives:

- To collect, catalog, index and archive information on the occurrence, distribution, quality, development and use of water in the state.
- To provide advisory services to the public, private industry, agriculture and the state in relation to the development, use, management, protection and conservation of the state's water resources.
- To research and report findings concerning the occurrence, distribution, quality, development potential and status of the state's water resources.

- To identify and research water problems, as a division or in cooperation with other divisions or agencies, related to the development, use, protection, conservation and management of the state's water resources.
- To provide technical support to the agency, the state, or other state and federal agencies in the areas of data acquisition, research drilling and testing.
- To keep current with developments in research and applied technology in the fields of surface and ground water hydrology and water resources planning and management.

Donivan L. Gordon, Chief

Water Resource Services

Collectively, about 25% (1500 hours) of Division staff's time was required to synthesize geohydrologic data for detailed interpretive reports on the availability and development of ground water resources. The number of requests for this information increased by 30% compared to 1978. In addition about 250 staff hours were required for related field investigations, pumping tests, and participation in meetings and public hearings. Requests for water resources information derived from a wide range of users as follows:

<u>Category</u>	<u>No.</u>
Municipal	138
Industrial-Commercial	37
Domestic	93
Irrigation	13
Housing Developments	30
Rural Water Systems	23
Recreation	7
Livestock Operations	9
Regional or County	27
Pumping Test Analysis	6
Other	85
	458

Because of the current high per capita use of water and because many shallow domestic and municipal wells locally are subject to stress even during periods of "normal" precipitation and recharge, we anticipate continued demand for information in this area of service work. For these reasons a new report format has been developed on a county-wide scale for Iowa's 99 counties. These county reports will provide ground water data at a low cost and will obviate the task of responding to most information requests by individual letter reports. Each county report will be about 20 pages in length, and will be designed for photocopy reproduction which will facilitate periodic updating. Reports have been completed for Dallas, Keokuk, Jefferson, Monroe, Wapello and Washington Counties. The format for these reports is pictorial, and each contains the following information:

1. General geologic setting
2. Approximate depth(s) to potential water-bearing zone(s).
3. Expected quality of water from the various zones.
4. Anticipated sustainable withdrawal rates (in gallons per minute).
5. Index of typical wells.
6. Common water quality problems and drinking water standards.
7. Index of available topographic maps
8. Agencies that may be contacted for assistance.
9. List of drilling contractors that service the county.

Field Investigations

Because of the Geological Survey's advisory role to other state agencies, field studies often are necessary to obtain and evaluate geohydrologic data related to actual or potential conflicts in water use and problems of water quality degradation. Similar studies occasionally are conducted for local governmental units. Division staff cooperated in the following investigations during 1979 for the agencies listed:

Iowa Natural Resources Council;

- Water withdrawal and potential drawdown impact of an irrigation project near Davenport, Scott County.
- Potential ground water degradation and withdrawal impact on private wells in the vicinity of a limestone mine, Poweshiek County.
- Drawdown impact on private wells caused by quarry dewatering at Keota.
- Determination of potential drawdown impact caused by new industrial wells at Mason City and Davenport.
- Interference and drawdown impact on private water supply near a power plant, Woodbury County.

Department of Environmental Quality;

- Source of nitrate contamination in municipal water supply, Sheffield.
- Location of new well field to replace wells with unacceptable nitrate concentrations, South Amana.

Dubuque County Health Department;

- Potential ground water contamination related to an abandoned quarry

City of Stanwood;

- Water supply development problem from a new well.

National Water-Use Data System (NWUDS)

In cooperation with the U.S. Geological Survey, Division staff led a 13-member, state-level task force to investigate the benefits of participation in the NWUDS program. The objective of the program is to provide a federally standardized, quantitative data base to define how much, for

what purpose, what quality, and where water is used in the nation. A key element of the program is the development of strong cooperation and participation by the states. The incentives offered by USGS to the states include planning assistance, financial support, and the opportunity to develop and operate water-use data programs (systems) that are designed to meet their unique water planning and management needs.

Members of the task force met several times over a 6-month period to analyze Iowa's existing water-use data programs and data holdings. They recognized that extant water-use information is the least available and least reliable data collected (at both the state and national level), and recommended that Iowa should participate in the NWUDS program, with IGS as the principal cooperator. A cooperative agreement with the USGS will be finalized early in 1980, and all state agencies with interests in water-use data will assist in planning and implementing the program.

Silurian-Devonian Aquifer Study

The Silurian-Devonian aquifer system is a major source of water, particularly for municipalities and industry, over much of eastern Iowa. The results of work on this 3-year study will be published in an atlas format to show the distribution and thickness of the aquifer, and to describe its hydrologic characteristics, including water level relationships, yield potentials, and water quality. Well control points are widely separated in parts of the study area. Division staff conducted pumping tests on four new municipal/industrial wells to obtain additional control points.

Potential Reservoir Site Study

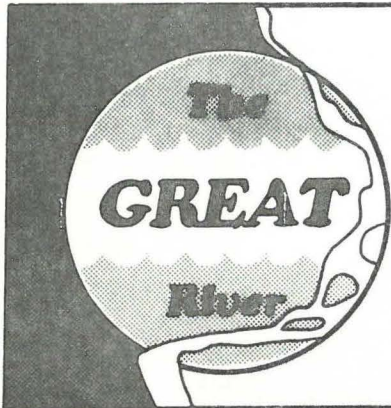
Work has started on a 2-year study designed to identify potential surface water storage sites for nine southwestern counties. These counties

experience chronic water supply/quality problems. Reservoir storage could be the optimal solution. Potential sites will be evaluated in relation to topographic position, soils properties, drainage inflow, sediment inflow, and storage capacity. Two classes of reservoirs will be considered: 1) those that could supply the water needs for communities with up to 2,500 residents; and 2) those that could supply county distribution systems and serve a population of about 12,000.

Elements of Water Resources Management

Iowa faces new challenges as it enters a new decade in the management of its water resources, particularly ground water. The growth of our agricultural and industrial economies, plus increasing public demands for goods and services, greater recreational opportunities, and strengthened environmental controls each carry with them new demands for water. Conflicts between users will become more common and the problems of water allocation will become more complex. The Iowa Natural Resources Council has promulgated new rules to quantitatively address certain problems of water allocation and ground water withdrawals. Through these regulations the state has placed limits on withdrawals from the Jordan and Dakota aquifers, limits on head reduction in the Jordan Aquifer, and limitations on withdrawals from alluvial aquifers that could potentially deplete streamflows during periods of low flow.

Regulation is only one element in the scheme of efficient and wise water resources management. Others that must be considered are water use and consumption (collectively resource depletion) and reserves evaluation (including replenishment). These latter elements have been given high priority within the spectrum of the Water Resources Division's programs.



Contracts & Grants

CONTRACTS AND GRANTS

The Geological Survey has participated in or has been the principal investigator for several contract and grant projects with other state and federal agencies. For projects that require additional staff, positions are established only for the duration of the contract or grant. Some of these projects were mentioned earlier in this report. A general summary of the other projects is presented below.

Orville J Van Eck, Associate State Geologist

Coal Resources

This contract with the U.S. Geological Survey will expedite the completion of field studies related to the Survey's coal exploration program. Descriptions of natural exposures and old strip mines made over several decades are being updated and refined to add to the basic data derived from core drilling.

Tectonics and Seismicity

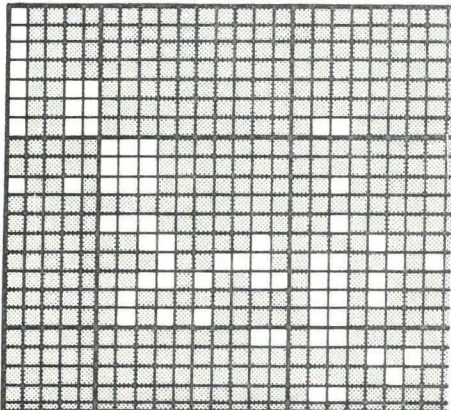
No quantitative information on seismic activity is available for the southwestern Iowa portion of the mid-continent region. Through a contract

with the Nuclear Regulatory Commission (NRC), a network of seismic stations will be established to obtain background data in advance of any future proposals for siting nuclear power plants at locations near southwestern Iowa. Equipment has been installed at a station near Carbon (Adams County), from which data is telemetered to a receiving center at our Iowa City office. Additional stations will be established in the spring, 1980 near Elkhorn (Shelby County), Pisgah (Harrison County), Treynor (Pottawattamie County), and Riverton (Fremont County). Other work under this contract has included the construction of maps that show structural features, thickness of glacial sediments, bedrock topography, and known and inferred composition of the deep crystalline rocks.

GREAT II

Work has continued since August, 1977 on a contract with the U.S. Corps of Engineers, Rock Island District, to coordinate activities of the Dredged Material Uses Workgroup, Great River Environmental Action Team II (GREAT II). The following contractual responsibilities were completed:

- Mineralogical and size-grade analyses on sediment samples from all pools within the study area.
- Report on the suitability of dredged sand for fine aggregate.
- Selection of dredged-material disposal sites for the short term (5 years) and long term (50 years). A channel maintenance plan developed by the work group included information on costs and environmental impacts of various dredging and disposal methods.
- Market study to determine demand for dredged material in the study area. Demand for, as well as an estimated value of dredged material was determined on a pool-by-pool basis.
- Draft copy of the Dredged Material Uses Work Group appendix.



Technical Services Group

TECHNICAL SERVICES GROUP

Coordination of remote sensing, computerized data processing, and graphic arts is effected through the Technical Services Group. These work units are primarily service-oriented operations. The Remote Sensing Laboratory, Data Systems and Illustrating sections provide services internally to Geological Survey staff, but each also works in close cooperation with other government agencies. Their goal is to provide information in useful formats. All require comparatively large amounts of space for mechanical, electronic, or optical equipment.

The Remote Sensing Laboratory is cooperating with NASA and several state agencies to develop a computer information system which will utilize satellite-derived data. Data Systems is increasing its capabilities for computer analysis of geographically distributed data. Further, both operations need to provide map products which are useable either as interim or final products. This leads directly to services provided by Illustrating. Overall, the Technical Service Group is well organized to serve the needs of its component units and the needs of the other Survey Divisions.

As a result of the successful application of computer-processed Landsat data to several Iowa resource problems, final arrangements have been made to procure a minicomputer system. The Iowa Landsat Demonstration Project (see discussion under Remote Sensing Laboratory, page 37) revealed the power of computer-processed natural resource data as a tool for evaluating soil erosion and to monitor land use conversions.

The acquisition of this computer processing system will enhance all Technical Service capabilities. Installation of the system should be completed in June, 1980. Software provided by NASA will quickly enable the Remote Sensing Laboratory to process Landsat data and merge it with other resource information. Digitizer software will be adapted to the system to make digitizing both easier and more versatile. Further, this will enable direct access to resource information to be included for analysis with Landsat data.

Geologic files, IWARDS files, and geophysical data will all be adapted, maintained and processed using the minicomputer system. Graphics software and plotting capabilities will aid Survey staff to better interpret geologic and hydrologic data through readily accessible and useable formats. These techniques will also benefit our graphic arts services. The time available for illustration and design will be increased, and the time required for repetitive tasks and alterations will decrease.

The Technical Services staff expended a major amount of time during 1979 in planning and purchasing the minicomputer system. The facility will integrate all Survey computer capabilities and will allow more coordinated development and utilization within a stable, controlled environment. Components of the system include:

1. Perkin-Elmer 3220 minicomputer (512,000 Bytes of core) and operator console.
2. Standard tape and disc (80,000,000 Bytes) peripherals.
3. Two graphics/data entry terminals.
4. Digitizer
5. Comtal color image processing unit.
6. Electrostatic printer/plotter.

During the past year, the Chief of Technical Services has participated in the Earth Resources Data Council, a national panel of state representatives under the auspices of the National Governors' Association and the Council of State Planning Agencies. This panel has worked to develop a network to coordinate information on remote sensing and related natural resources issues, and to influence federal policies on these issues, especially the satellite program, to assure that the interests of the states continue to be recognized.

Bernard E. Hoyer, Chief

Remote Sensing Laboratory

Laboratory Functions

The Remote Sensing Laboratory (RSL) has two primary functions. First, it assists governmental agencies, business, and private citizens to locate, acquire, interpret and utilize aerial and satellite imagery of the state (approximately 150 inquiries of this nature were handled by RSL in 1979). Secondly, the RSL provides research, technical and support services to agencies responsible for managing Iowa's natural resources. The RSL has assisted the Division of Mines and Minerals in their program to monitor coal strip mines. Also, RSL helped to coordinate the efforts of several federal agencies in the acquisition of high altitude imagery.

Priority Projects

Activity in 1979 was dominated by conducting and evaluating the Iowa Landsat Demonstration project (see below), and by subsequent planning for the purchase of a compatible computer system for implementation of digital Landsat processing. Research was conducted on digital flood mapping, statistical evaluations of bedrock trends, structural and geophysical analyses associated with studies of the Mid-continent gravity anomaly, and on the development of optimal algorithms to related land use and wildlife habitat. Also, plans were completed for acquisition of high altitude imagery during 1980.

Iowa Landsat Demonstration Project

Representatives from the Iowa Departments of Agriculture and Soil Conservation, the Conservation Commission, ISU Extension Service, and the U.S. Soil Conservation Service worked with RSL staff to test the application of Landsat data to the problems of soil erosion and loss of prime agricultural land. The demonstration project was coordinated at IGS and was accomplished at the Earth Resources Laboratory in Slidell, Louisiana, under NASA's Regional Applications Program.

The North Branch Basin in Madison County was selected to evaluate potential soil loss. Landsat data was acquired by computer processing 1973 and 1978 Landsat data. Other data values necessary to compute the Universal Soil Loss Equation were either derived from, or were applied to digitized modern soil survey data. When combined within a common geographic data base, the equation was solved for potential soil loss in every two-acre cell within the North Branch Basin. The resultant geographic data base is a very powerful analysis tool for evaluating trends that are important to management of Iowa's soil erosion problems. Besides

computing potential soil erosion, crop rotations and crop acreage changes by slope classes or even soil types can be documented.

A similar geographic data base was established around the city of Ankeny to measure the amount of conversion of prime agricultural land to non-agricultural uses between 1950 and 1977. Satellite data, combined with digitized interpreted aerial photography and soil survey data, revealed that about 770 acres of prime agricultural land were converted to urban uses between 1950 and 1973. About 680 additional acres were converted to urban uses between 1973 and 1977.

Data Systems Division

Computer Programming

Computer processing capabilities of the Division continue to expand as new techniques are applied to research programs of the Geological Survey. New research projects spur the development of new computer programs which, in turn, add to the research capabilities of Survey staff. The combined result is a highly effective system that meets the needs of the agency in data processing, data management, and direct application in a problem-solving mode.

Several major computer programs were developed for use in processing computer maps. These are user-oriented programs. They involve "conversation" between the user and the computer program, and the program issues "prompts" to aid the user in selecting appropriate steps in the processing of mapped data. One program that has been heavily employed since its creation this year is used to calculate the latitude and longitude of points on a base map. Previously, staff had to calculate thousands of data point locations by hand measurement and interpolation. Now, a week's worth of manual calculations can be accomplished in one hour.

Other computer programs are being developed for use with a digitizer and graphics terminal. These programs will permit the entry of map data to produce map displays. The maps can be displayed or printed at different scales, with different combinations of data series.

The entry of tabular data is greatly facilitated by a new program that executes on the data entry terminal. This program allows a facsimile of the data coding form to be constructed. The form is filled and paged as the operator enters data. The program also employs a user-oriented instruction set, and can be operated by persons without computer programming expertise.

On-the-job training for new staff is a third area of great importance in data processing. The Geological Survey has been fortunate to have relatively long-term staff with the ability to contribute specialized education to new personnel.

Systems Analysis and Planning

Because of its rapidly expanding role in natural resources investigations, the data processing unit has had to study trends in the demands on its services, and the resources available to meet those demands. Of paramount importance has been the task of integrating analyses of different kinds of needs so that new equipment, programs and task priorities effect the greatest benefit for the effort and expense involved. Data Systems staff have:

- Specified data structures, functional capabilities and user command structures for map processing programs.
- Contributed to the evaluation of equipment for analyzing data from satellites.

- Implemented procedures for documenting programs, data files and service activities.

IWARDS

The Iowa Water Resources Data Systems (IWARDS) was created through the Inter-agency State Water Plan Framework Study. IWARDS has the goal of improving the availability and accessibility of water-related data to potential users.

Through a contract with the University of Iowa Department of Preventive Medicine, a program was developed to accelerate the encoding of water quality data under the auspices of the USGS - IGS cooperative agreement. Water quality data on all municipal water supplies will be used to study the association between certain water quality parameters and the incidence of cancer. In addition to the data-encoding phase, the contract includes the generation of specially formatted, computer-derived maps. This phase of the contract is directly tied to the development of new computer mapping capabilities discussed earlier.

A location directory file has been created to organize the water quality data needed by University researchers. The directory file contains town names, census place codes, latitude and longitude locations, map-based coordinate locations, zip codes and other information. Data can be merged readily in this directory file by cross referencing locational parameters used by different data producers.

Development, documentation and implementation of the IWARDS data management software is ongoing. The software, located at the Comptroller Data Processing Center, is accessed by the Geological Survey via telephone link. Program modules for entering and updating IWARDS files are being written and tested. Staffs of the State Archaeologist's Office and the

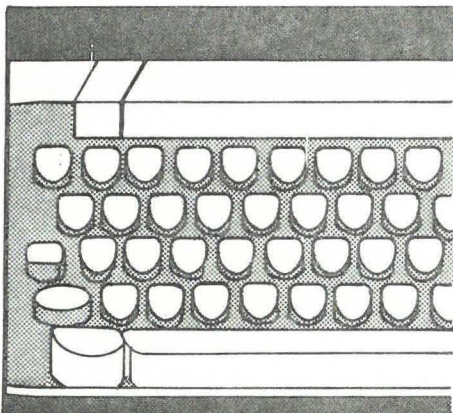
Conservation Commission have expressed interest in using this package, and IWARDS participation in an electronic data transfer arrangement between the University Hygienic Laboratory and the Department of Environmental Quality is under consideration. Several discussions and demonstrations have been conducted to evaluate the potential mutual benefits of cooperative use.

Illustrating Division

Quality graphic art is a fundamental, inseparable part of producing much of the resource information that is generated and distributed by the Geological Survey. The ability to communicate effectively is enhanced dramatically by the use of attractive, clear illustrative materials, whether the illustrations are to be used in publications, for displays, or for slide presentations. Staff of the Illustrating Division are responsible for conceptual design and layout work as a service to all divisions of the Geological Survey. The publications listed in this report contain examples of the quality work completed during 1979. Major illustrative work for the report period was done for:

- Iowa Geology
- Missouri River in Iowa, 1879-1976
- Ground Water Resources, Dallas County
- Ground Water Resources, Jefferson County
- Ground Water Resources, Wapello County
- Ground Water Resources, Keokuk County
- Hydrogeologic Studies in Northwest Iowa
- Palynology of Cherokee Coals in Iowa

The Division's darkroom is now located at the Survey's new Oakdale Campus facility.



Administrative & Support Service Group

ADMINISTRATIVE AND SUPPORT SERVICE GROUP

The Administrative and Support Service Group is responsible for all personnel services, elements of budget planning and preparation, and supervision and coordination of administrative functions. Every effort is made to reduce administrative costs wherever possible without a reduction in the in the quality or scope of services.

Hiring, promotions, and job reclassifications are managed by the Administrative Officer. We are seeking changes for the Geologist position series in order to improve promotional capabilities and to reduce supervisory requirements that are imposed by the Iowa Merit Employment Department. The following personnel changes occurred during 1979.

Christine M. Crowley -- Clerk Typist III, hired July 2; promoted to
Secretary I.

Steven Daut -- Geologist I hired under the Nuclear Regulatory Contract,
February 1.

Thomas H. Faller -- part-time Geologic Technician hired under the
Nuclear Regulatory Contract, October 26.

James E. Gonyier -- Geologist I hired under the GREAT II contract,
March 2.

Logan K. Kuiper -- Geologist II; resigned May 8.
Patricia J. Lohmann-- Graphic Artist; hired July 2.
Barbara A. Miller -- promoted to Confidential Secretary III.
Robert M. McKay -- Geologist I, hired January 22.
James A. Munter -- Geologist II, hired September 28.
Patricia L. Ring -- Data Entry Operator II, hired August 6.
Susan R. Vossoughi -- Computer Operator, hired September 7.
Patricia M. Witinok -- Geologist I, hired August 31.

Mrs. Martha B. Kafer, Chief

Administrative Services

Secretarial, communications and reception services are provided by Administrative Services. In addition, this division is responsible for mail distribution and publication sales, and maintenance of an adequate map and publication inventory. This year, incumbents developed procedures handbooks for their work responsibilities. These handbooks will result in improved work performance, and will decrease the amount of time required for training new employees when vacancies are filled.

Accounting Services

Accounting, record keeping, payroll and purchasing services for all programs are provided by Accounting Services. Detailed quarterly budget reviews are prepared so that Management can evaluate the budget standings. A procedures handbook also was developed for accounting.

Support Services

The several responsibilities of Support Services range from the collection of basic data to maintenance of the Geological Survey's vehicle fleet. Personal contacts with drilling contractors, primarily through a

regular schedule of visits to collect sets of drill cuttings, and laboratory preparation of the drill cuttings for microscopic study are major responsibilities. Other functions include cataloging and shelving of additions to both the drill cuttings and core library, publications inventory maintenance, and the performance of a variety of support services to nearly all Geological Survey programs.

Some of the regular activities of Support Services staff were interrupted during the spring and summer while they moved our rock library and warehouse operations to a new office-laboratory-warehouse facility at the University of Iowa's Oakdale Campus.

Library Services

In addition to providing research topics and materials to undergraduate and graduate geology students in the state's universities and colleges, the majority of publications received through the Geological Survey's worldwide publication exchange program are submitted to the library of the University of Iowa Geology Department. The Survey retains only those periodicals, circulars and other publications that serve its special needs.

Duties performed by Library Services include:

- Cataloging new publications
- Compiling articles for Staff Notes (issued monthly) and for Iowa Geology (issued annually).
- Researching reference materials for special projects.
- Updating the IWARDS bibliography

MAPS AND PUBLICATIONS

Topographic Maps

Topographic map quadrangles of Iowa are produced under a cooperative agreement between the IGS and the U.S. Geological Survey Mid-continent Mapping Center, Rolla, Missouri. These maps are used for planning airports, highways, dams, pipelines, transmission lines, industrial plants and other construction projects. Also, these maps are important to hydrologic research and mineral exploration. Citizens are rapidly discovering the advantages of topographic maps for planning outdoor recreation activities.

The long-sought goal of 100% topographic map coverage of the state is nearly a reality. The status of topographic mapping as of December, 1979 is:

<u>Number of 7½ Minute quadrangles</u>	<u>% of State Coverage</u>	<u>Availability</u>
744	68	Printed; available at IGS
249	23	Preliminary copies only; available from USGS, Rolla, MO.
83	7.5	Mapping in progress
<u>16</u>	<u>1.5</u>	Mapping not started
Total 1,092	100	

Publications

Educational publications on such topics as fossils, minerals and landforms are extremely popular with Iowa's citizens. As an example, over 5,000 copies of A Regional Guide to Iowa Landforms have been purchased since December, 1976. Most of our technical reports, such as water resources publications, are designed so that they can be readily utilized by consulting firms, contractors and private citizens. More esoteric reports are written for a scientific audience with specialized areas of interest.

The listings that follow show reports published by the Geological Survey, reports which are in preparation, and papers that were either published in other journals or presented at professional meetings.

Geological Survey Publications

- Anderson, R.R., 1979, Matlock taconite Body: Open-file Report, 7 p.
- Avcin, M.J., et.a., 1979, Coal resource program Report, 13 p.
- Gordon, D.L., 1979, Ground water resources of Jefferson County: Open-file Report 79-51, 27 p.
- Hallberg, G.R., Harbaugh, J.M., and Witinok, P.M., 1979, Changes in the channel area of the Missouri River in Iowa, 1879-1976: Special Report Series 1, 32p.
- Harbaugh, J.M., 1979, Ground water resources of Dallas County: Open-file Report 79-25, 25 p.
- Huelsbeck, C.J., et. al., 1979, Iowa Geology: No. 4, 39 p.
- Ludvigson, G.A., and Bunker, B.J., 1979, Status of hydrogeologic studies in northwest Iowa: Open-file Report, 37 p.
- Ludvigson, G.A., and McAdams, M.P., 1979, New evidence of early Ordovician tectonism in the Upper Mississippi Valley: Technical Information Series No. 10, 29 p.
- Lutenegger, A.J., Hallberg, G.R., and Handy, R.L., 1979, Review of geotechnical investigations of loess in North America: Open-file Report, 15 p.
- Witinok, P.M., 1979, Groundwater resources of Keokuk County: Open-file Report 79-54, 27 p.
- Witinok, P.M., 1979, Groundwater resources of Wapello County: Open-file Report 79-90, 27 p.
- Ravn, Robert L., 1979, Introduction to the stratigraphic palynology of the Cherokee Group (Pennsylvanian) coals of Iowa: Technical Paper No. 6, 117 p., 22 pls.

Publications In Preparation

- Bunker, B.J., and Ludvigson, G.A., The Plum River fault zone in east-central Iowa: Technical Information Series No. 10.
- Hallberg, G.R., Pleistocene stratigraphy in east-central Iowa: Technical Information Series No. 11.

- Ravn, R.L., Stratigraphic ranges of miospores in coals of the Des Moines Series of southern Iowa: Technical Paper No. 7.
- Wahl, K.D., et. al., Alluvial ground-water resources of the Floyd River Basin: Water Supply Bulletin No. 12.
- Wahl, K.D., and Bunker, B.J., Geohydrology of the Silurian-Devonian carbonate units in the Cedar Rapids area: Water Supply Bulletin No. 13.

Extrinsic Papers

- Anderson, R.R., 1979, A study of the regional tectonics and seismicity of southwest Iowa: Iowa Academy of Science Abstract, 91st Session, Mt. Vernon, Iowa.
- Anderson, R.R., McKay, R.M., and Witzke, B.J., 1979, Field trip guidebook to the Cambrian stratigraphy of Allamakee County: Geological Society of Iowa, 12 p.
- Black, R. A., and Anderson, R.R., 1979, Miscroseismic targets near the intersection of the Nemaha Ridge and the Keweenaw Mafic Belt: Abstract American Geophysical Union, North Central Meeting, Columbus, Ohio.
- Bouck, M.J., 1979, Some factors influencing phreatic cave development in Silurian strata of Iowa: Iowa Academy of Science Abstract, 91st Session.
- Carmichael, R.S., and Anderson, R.R., 1979, Earthquakes in Iowa; past, present, future: Iowa Academy of Science Abstract, 91st Session.
- Case, James C., 1979, Dredged material uses; Appendix to final report of GREAT River Environmental Action Team II, 125 p.
- Chung, Pyung-Hi, 1979, Waste dredged material for construction: Department of Civil Engineering, Engineering Research Institute, Ames, Iowa, Project 1357, 62 p. (GREAT II contract).
- Hallberg, G.R., Home sewage disposal and water resources: in Iowa State Univ. Ext. Ser., Exp. Sta. Special Report; in press.
- Hallberg, G.R., Baker, R.G., and Legg, A mid-Wisconsinan pollen diagram from Des Moines County, Iowa: Proceedings Iowa Academy of Science; in press.
- Hoyer, B.E., 1979, Holocene geology of the Cherokee Sewer Site: Iowa Academy of Science Abstract, 91st Session.
- Hoyer, B.E., 1979, Iowa Remote Sensing Program: Earth Resources Laboratory; Regional Applications Program Symposium, Biloxi, Mississippi.
- Hoyer, B.E., 1979, Assessment and monitoring of soil resources using a digital geographic data base: Annual Meeting, Professional Soil classifiers of Iowa.

- Kemmis, T.J., 1979, Some aspects of the Des Moines glacial lobe as inferred from landform/sediment associations: American Geophysical Union Abstract, Midwest Meeting, Columbus, Ohio.
- Kemmis, T.J., Hallberg, G.R., and Lutenecker, A.J., 1979, Geotechnical implications of till sedimentation and stratigraphy in the Midwest: Association of Engineering Geology, Abstract.
- Ludvigson, G.A., and Bunker, B.J., 1979, Regional facies distribution in the Dakota Formation (Upper Cretaceous) in northwest Iowa: Geological Society of America, North-Central Section, V. 11, No. 5, p. 234 (Abstract).
- McKay, R.M., Anderson, R.R., and Prior, J.C., 1979, Geology in the Johnson County area: in Johnson County Environmental Field Trip Guidebook, Johnson County Soil Conservation District, Iowa City, Iowa.
- Van Eck, O.J., Anderson, R.R., Black, R.A., and Daut, S.W., 1979, Regional tectonics and seismicity of southwest Iowa: Annual Report FY-79, NUREG/CR-0955, U.S. Nuclear Regulatory Commission, Washington D.C.
- Van Zant, K., Hallberg, G.R., and Baker, R.G., A Farmdalian pollen diagram from east-central Iowa: Iowa Academy of Science Proceedings; in press.
- Witzke, B.J., 1979, Middle Ordovician stratigraphy in northwest Iowa: Iowa Academy of Science Abstract, 91st Session.
- Wollenhaupt, N.C., and Hallberg, G.R., 1979, A case for utilizing pedogenic and geologic stratigraphy to reduce sampling and testing variability for highway soils investigations: 30th Annual Highway Geology Symposium, Portland, Ore., 19 p.

Sales

The combined sales for maps and publications totaled \$15,200. Topographic maps are sold at the price set by the U.S. Geological Survey (currently \$1.25 per 7½ and 15 minute quadrangles). The selling price for IGS publications is based principally upon printing costs, and the majority of publications are priced under \$3.00.