Minnesota Geological Survey NEWSLETTER

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MINNESOTA GEOLOGICAL SURVEY, UNIVERSITY OF MINNESOTA
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HISTORY OF THE MINNESOTA SURVEY

On March 1, 1872, the enabling act creating the Geological and Natural History Survey of Minnesota was approved by Governor Horace Austin. The geological portion of the survey was to be "undertaken as soon as may be practicable, and be carried forward with such expedition as may be consistent with economy and thoroughness," and should comprise

> a complete account of the mineral kingdom as represented in the state, including the number, order, dip and magnitude of the several geological strata, their richness in ores, coals, clays, peats, salines and mineral waters, marls, cements, building stones and other useful materials, the value of said substances for economical purposes and their accessibility; also an accurate chemical analysis of the various rocks, soils, ores, clays, peats, marls and other mineral substances, of which complete and exact records shall be made.

W.W. Folwell, president of the University, had written the law, and it was within the University that the newly created organization was placed, no doubt to ensure its work would be conducted in a thoroughly scientific manner and—not coincidentally—to shield it from strong political pressures. The presence of the Survey at the University would also increase the young institution's prestige by making it the state center for all natural resource and history studies and collections.

Dept. of Geol. & Geophys.

Winchell may be remembered best for his stewardship of the Geological and Natural History Survey, but he was also one of the great generalists in the field of geology, a man whose breadth of knowledge and accomplishments are exhibited in such diverse areas as glacial geology and iron-formation research.

The man chosen to direct this comprehensive undertaking was 33-year-old Newton Horace Winchell, a field-trained geologist who brought with him to Minnesota experience gained from work in the Ohio and Michigan geological surveys. By the end of 1872, and after only four months on the job, Winchell had already made a preliminary survey of a good portion of the state (traveling by rail—passage provided gratis by the railroads) and written his first annual progress report.

Money problems plagued the Survey in its early years (the first year's appropriation was only $1,000) and sometimes limited planned activities. Winchell himself took outside employment on occasion to earn enough to cover his family's living expenses; this need for cash in part motivated his participation in General George A. Custer's expedition to the Black Hills in 1874. As the years passed, and thanks to Winchell's persuasive lobbying (backed by the Survey's heightened reputation for productivity and good work), lack of funding became less of a stumbling block.

University Archives

A young U.S. Grant in 1888. Grant was one of several distinguished geologists who began their geologic careers with the Winchell survey. He and N.H. Winchell would lay the groundwork for unraveling the complex stratigraphic succession of the ancient Precambrian Shield of the Lake Superior region.

Winchell and his assistants spent their summers at work in the field, traveling by foot, canoe, and wagon to every corner of the state. They mapped the rock formations, collected mineral and fossil specimens, and—the field season at an end—returned to the University to prepare the maps and reports. Their accomplishments are embodied in the 24 Annual Reports, 6 Final Reports, and 10 Bulletins that are the legacy of the Geological and Natural History Survey.

With the publication of the last volume of the Final Report in 1901, the work Winchell had set out to do was finished, and he retired. The Board of Regents discontinued geologic investigations in favor of the natural history portion of the Survey, which until then had received scant attention. Little geologic information was produced by the state during the first ten years of the 20th century, but in 1910 William Harvey Emmons of the the University of Chicago was asked to assume the chairmanship of the University's geology department. As a condition of his acceptance, Emmons insisted that

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a state geological survey be put on a firm and continuing basis. He wanted a survey because of the prestige it would bring, but also because such an organization would provide a means of obtaining federal money for geological research that otherwise would not be available.

In early 1911 the Board of Regents recommended that the Legislature appropriate funds to establish the Minnesota Geological Survey; the legal basis for this action came from the Revised Laws of Minnesota, 1905, instructing the regents to continue all work legislated as of that time. Because the Geological and Natural History Survey had never formally been terminated by law, it and the Minnesota Geological Survey existed simultaneously for several years after 1911.

Under Emmons, the Survey was assimilated into the Department of Geology and Mineralogy, an administrative arrangement that would last for the next 50 years. Meager funding during these years permitted only part-time work to be done on the geologic problems of the state. Faculty members and their students used the free summer months to do Survey field work. This symbiotic relationship between the Department and the Survey produced a generation of distinguished earth scientists and a voluminous collection of published work on various aspects of Minnesota geology.

Emmons was an able administrator and enthusiastic sponsor of Survey projects. He was replaced on his retirement in 1944 by the man who had for years been a source of counsel: Frank Fitch Grout. Grout's knowledge of Minnesota's geology was encyclopedic, his written contributions unequaled to this day. His tenure as director was short (so close was he to retirement when he began). In 1947 he was succeeded by George Melvin Schwartz, like Grout, a faculty member in the Department and a long-time researcher for the Survey.

Dept. of Geol. & Geophys.

F.F. Grout on a portage in northern Minnesota, 1938. Grout was a quiet but extremely effective teacher who trained hundreds of students in the art of field mapping, impressing on them the idea that no effort was too great, no detail too small, to receive earnest examination.

Schwartz initiated a cooperative venture (with the U.S. Geological Survey) of aeromagnetic surveying that was to have a major impact on the direction of geologic research in the state. Until then geologic mapping had of necessity focused on the accessible, exposed rocks of northeastern and extreme southeastern Minnesota, the only parts of the state free of extensive glacial cover. Such conventional mapping had in the past delineated Minnesota's high-grade iron-ore resources (by 1947 nearly depleted).

The aeromagnetic survey of the state collected data on the magnetic content of the buried bedrock; such information could then be used to asssess both the structure and composition of the rocks. Although the new program did not delineate any new iron-ore resources, it did reveal much about the geology below the drift that had not been known before.

G.M. Schwartz examining volcanic flows on the North Shore, 1925. Internationally renowned as an economic geologist, Schwartz also pioneered engineering and urban geology studies in Minnesota, most notably in work on the Twin Cities and Duluth metropolitan areas.

Schwartz retired in 1961 and with his retirement came a radical change in the organization of the Survey. For the 50 years from 1911 to 1961, the Survey had been intertwined with the geology department. Much valuable geologic work on the state had been done, but only on a part-time basis. By 1961, the Survey was felt by many to be out of touch with state needs for geologic information. To increase its effectiveness, it was separated, administratively, from the geology department (as had been done once before in Winchell's day) and given a full-time director.

The man selected was Paul K. Sims, a geologist with the U.S. Geological Survey. Under Sims, Survey funding began to increase, as did its full-time staff. He started programs in Paleozoic and Pleistocene geology, economic geology (industrial minerals, kaolin clay), and environmental geology, as well as bedrock and gravity mapping. The volume of geologic data and publications produced during his directorship rivaled that produced in the heyday of the Winchell survey almost a century earlier.

Sims strongly believed that the ever-increasing demands on the state's natural resources called for accelerated research and mapping in support of mineral exploration, especially in northern Minnesota. Unfortunately, the political leadership in the early 1970s from that part of the state concluded that several departments of the University, including the Geological Survey, had tied themselves too closely to "mining interests."

History Continued on back page.

PROJECT UPDATES

Bedrock Mapping in Northern Minnesota . . .

Mark Jirsa and Jim Miller continued long-term bedrock geologic mapping projects this summer—Mark in northeastern Itasca County and Jim on the North Shore. The first products of their detailed (1:24,000-scale) mapping are now in the final stages of review and editing. Mark's map is of the Precambrian rocks of the Sherry Lake quadrangle; Jim's, the bedrock geology of the Silver Bay and Split Rock Point NE quadrangles, Lake County.

Jim's mapping this summer focused on the Illgen City quadrangle, and portions of the Doyle Lake and Finland quadrangles. He was assisted in the field by Terry Boerboom and students Jim Dunlap, Mike Spicuzza, Susan Brink, and Dean Peterson, and he received some inspirational mentoring from University of Minnesota-Duluth professor John Green.

The North Shore mapping is part of the U.S. Geological Survey's COGEOMAP (Cooperative Geologic Mapping) program. Samples used in the Itasca County mapping were analyzed geochemically as part of a joint project with the Natural Resources Research Institute.

. . . and Supportive Drilling

This fall the Survey began a two-year scientific drilling program in north-central Minnesota in an effort to accelerate geologic mapping at the scale of 1:250,000 or larger. The aim is to provide a regional framework for the evaluation of mineral potential in the Archean greenstone-granite terrane of this area. The program is funded under the Rural Development Bill passed by the 1987 Minnesota Legislature.

This "rural initiative" program involves drilling about 80 test holes to bedrock in Itasca, Koochiching, and Beltrami counties, taking shallow (10 ft) cores, and a small number of longer (500 ft) cores across stratigraphy in appropriate geologic settings. To date, about 25 holes have been drilled in Itasca County.

The locations of drill holes were selected on the basis of preliminary aeromagnetic maps (U.S. Geological Survey), MGS gravity maps, and ongoing outcrop geologic mapping in northeastern Itasca County by Mark Jirsa.

The economic mineral potential of this area of north-central Minnesota is very similar to that of the Vermilion district near Ely; mapping here, though, is hampered by the glacial drift, which varies in thickness from less than 100 feet in the east to more than 300 feet in the west. Because of this extensive cover, maps created for this project will have to be compiled from interpreted geophysical data in light of the accumulated drilling and outcrop information, and from the drill core from private exploration on state leases (on file at the Department of Natural Resources-Minerals Division office in Hibbing).

Economic Geology

GRAPHITE. Many areas of Minnesota contain an abundance of graphite-rich slates and related rocks. Peter McSwiggen has begun an evaluation of the graphite resources of the Animikie basin. He is looking at the compositional and petrologic characteristics, distribution, and quality of graphite units in east-central Minnesota.

CLAY. Dale Setterholm and G.B. Morey have begun work on a two-year cooperative clay project involving MGS, the Mineral Resources Research Center, the Natural Resources Research Institute, and the Department of Natural Resources. The project's two main objectives are to identify and test *potential* clay resources for possible uses, and to study *known* kaolin clay resources for suitability as high-grade paper coating. MGS's participation will involve drilling to identify and characterize kaolinite resources.

Geophysics

The fifth biennium of the high-resolution aeromagnetic surveying program began this summer with support from the Legislative Commission on Minnesota Resources (LCMR). Plans for this biennium include the mapping of the northwestern and southwestern corners of the state; acquisition of data for the northwestern block is now nearly complete, and compilation of data from both blocks should be finished by next summer.

Other geophysical activities include the continuation of the Werner deconvolution analysis over central Minnesota by Bob Ferderer; completion of a seismic reflection, gravity, and magnetic study over the northern end of the Midcontinent rift system; and participation (with Andrew Streitz of the Minnesota Department of Natural Resources) in an experiment to observe seismic reflection signatures in the Sioux Quartzite.

Aeromagnetically Targeted Drilling

This year drilling focused on Lac Qui Parle, Big Stone, Traverse, Swift, and Chippewa counties of west-central Minnesota. Sixteen holes were drilled and cored to the Precambrian; 13 of the 16 intersected Cretaceous rocks. Dale Setterholm will be using the Cretaceous results to advance his interpretation of the stratigraphy and structure of the Cretaceous in southwestern Minnesota. Dave Southwick will assess the results from the Precambrian part of the drilling.

The drilling is funded by the Legislative Commission on Minnesota Resources as part of the aeromagnetic mapping program.

DAYTON-WINCHELL LEGACY

Priscilla Grew and G.B. Morey had lunch recently with George Draper Dayton II, who presented them with copies of his two-volume book, "Our Story," a recently published history of the Dayton family. Mr. Dayton's grandfather was Newton Horace Winchell, the first director of Minnesota's geological survey and founder of the University's department of geology. A chapter in the history is devoted to Winchell and includes a full-color reproduction of the first geological map of the state, which was published in 1872. Mr. Dayton has been a long-time benefactor of the University's School of Earth Sciences; his support in 1972 enabled the department to publish a volume on the 100th anniversary of geology at the University.

GRANT-IN-AID PROJECTS

MGS supports a small grant-in-aid program for research on the geology of Minnesota. Recipients are faculty members or students from colleges and universities within or outside the state. Grants are used mainly to cover field and laboratory expenses. The following are descriptions of two such grant-in-aid projects.

Sulfide Mineralization, Duluth Complex

For the past two years, Bernhardt Saini-Eidukat, a doctoral student in geology at the University of Minnesota-Minneapolis, has been studying the distribution and abundances of sulfide mineralization at the interface between the anorthositic and troctolitic series rocks of the Duluth Complex. The interface was examined at Duluth, in the Ely area, and on the Gunflint Trail. Over 40 samples collected in the course of the field work have been studied petrographically, and platinum, palladium, copper, and nickel assay data have been obtained on 25 selected samples. Eidukat is now working with Professor G. Bitsianes (Department of Civil and Mineral Engineering) on a fire assay facility. All six of the platinum-group elements (Pt, Pd, Os, Ru, Rh, Ir) (PGEs) will be analyzed to allow direct comparison of Duluth Complex PGE abundances with those of other major deposits, such as the Bushveld and Stillwater Complexes, and to determine the differences in source, transport, and emplacement of sulfide minerals and PGEs in the anorthositic and troctolitic series intrusions of the Duluth Complex.

Paul W. Weiblen is Saini-Eidukat's faculty advisor on the project.

North Shore Volcanic Group Mapping

John Green (Geology Department, University of Minnesota-Duluth) continues work on a detailed geologic strip map of the Keweenawan rocks along the North Shore. He is compiling data from his past mapping (going back intermittently to 1965) and petrographic and geochemical work, and integrating these with current field studies to produce a comprehensive picture of the stratigraphy, structure, and composition of the North Shore Volcanic Group (NSVG). The results will provide a reference base for future studies of the NSVG, as well as contributing to regional geophysical studies, such as GLIMPCE (Great Lakes International Multidisciplinary Program on Crustal Evolution), which is now underway on Lake Superior.

Green put in several weeks of mapping last summer near the city of Finland and in Lake County, completing his map from Silver Bay to Tofte. His work is being integrated with that of the COGEOMAP project in the Silver Bay-Finland area.

OTHER MGS GRANT-IN-AID PROJECTS

Geologic mapping, Virginia Horn/J. Welch, Gustavus Adolphus College
Geochemistry, Sonju Lake intrusion/K.E. Seifert, Iowa State University
Landsat linear features, central Minnesota/G.W. Shurr, St. Cloud State University
Ordovician biostratigraphy, Upper Mississippi River valley/W.F. Rice, E.P. Hedblom, University of Minnesota, Minneapolis
Jordan Sandstone, sedimentology and diagenesis/D.A. Thomas, University of Minnesota, Duluth (ended 6-30-87)
Oneota Dolomite, petrology/B.T. Hayden, University of Minnesota, Duluth (ended 6-30-87)

STAFF NEWS

* ***G.B. Morey*** and ***Dale Setterholm*** attended an informal meeting concerning arsenic in ground water, July 13-14, in Sioux Falls. Participants included MGS, the U.S. Geological Survey, the North Dakota and South Dakota Geological Surveys, the North Dakota Department of Health and State Water Commission.

* ***Priscilla Grew, Dave Southwick, G.B. Morey, Val Chandler,*** and ***Jim Miller*** attended the DOSECC, Inc., and U.S. Department of Energy's Scientific Drilling Workshop and field trip on the Midcontinent rift system, which was held in Duluth, September 22-25. Morey is a member of the steering committee and reporter for the northern segment of the rift.

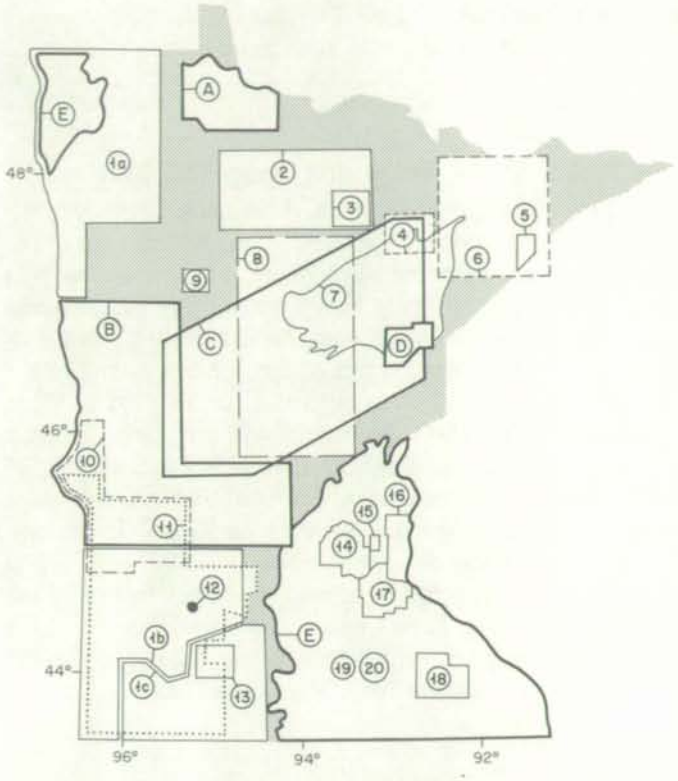
* ***Priscilla Grew*** received a travel grant from the Swedish Power Board to present a paper at the third International Conference on Deep Continental Drilling. The conference was held in Mora, Sweden, during September.

* ***Doug Bergstrom*** left the Survey in October to take a job at Braun Engineering in Eden Prairie, where he is now working as a project manager. He was replaced by ***Terry Boerboom,*** who has worked off and on for MGS since 1983.

* ***Priscilla Grew*** attended committee meetings in October on the organization of the the 28th International Geological Congress, which will be held in the United States in 1989. ***G.B. Morey*** has assumed organizational responsibility for a Congress field trip on the Early Proterozoic of the Great Lakes region.

* ***G.B. Morey*** was co-author with P.K. Sims and E.B. Kisvarsanyi of the recently published U.S. Geological Survey Bulletin 1815, entitled Geology and Metallogeny of Archean and Proterozoic Basement Terranes in the Northern Midcontinent, U.S.A.

SUMMARY OF RESEARCH AREAS



Areas of work in progress or recently published by MGS.

1. Aeromagnetic survey: 1a. Northwestern Minnesota block; 1b. Southwestern Minnesota block; 1c. USX donation/Chandler
2. "Rural Development" drilling/Southwick, Jirsa, Boerboom, McSwiggen
3. Bedrock geologic mapping in northeastern Itasca County/ Jirsa
4. Mesabi range hydrogeologic investigations/Bloomgren, Meyer
5. Bedrock geologic mapping on the North Shore/Miller, Boerboom
6. Geophysical interpretation of the central Duluth Complex/Chandler
7. Graphite resources of the Animikie basin/McSwiggen
8. Werner deconvolution analysis, central Minnesota/Ferderer
9. Hubbard County drilling project/ Southwick, Meyer, Bergstrom
10. Aeromagnetically targeted drilling in west-central Minnesota/Southwick, Setterholm
11. Cretaceous stratigraphy of southwestern Minnesota/Setterholm, Morey
12. Clay resource evaluation/Setterholm, Morey
13. Seismic reflection studies of the Sioux Quartzite
14. Hennepin County atlas (in progress)/Olsen, Bloomgren, Hobbs, Meyer
15. New Brighton mapping project (Twin Cities Army Ammunition Plant contamination sites)/Bloomgren, Meyer
16. Washington County atlas (in planning)/Olsen
17. Dakota County atlas (in planning)/Olsen
18. Olmsted County atlas (in progress/Olsen, Hobbs, Kanivetsky, Kuhns, Meyer
19. Stratigraphy of the Mt. Simon and Eau Claire formations/Mossler
20. Industrial uses of Minnesota limestones/Mossler
21. Paleomagnetism of the Sioux Quartzite, selected areas in southwestern Minnesota (not indicated on map)/Chandler, Bergstrom, Boerboom
22. Aquifer recharge project (entire state—not indicated on map)/Palen
23. INDEX: Statewide summary file of water-well records (not indicated on map)/Olsen, Kanivetsky, Bloomgren

Recent MGS Publications (see back page for details)

A. Scientific core drilling summary, north-central Minnesota
B. Aeromagnetic map, west-central Minnesota
C. Geologic map of the Penokean orogen, east-central Minnesota
D. Geology and geophysics, Denham-Mahtowa area
E. Paleozoic lithostratigraphic nomenclature

Mark Jirsa

MORE THAN CONNECTING DOTS

Geologic maps are basic to nearly all earth-science research and are used by scientists and non-scientists alike to address earth-related problems. Even though their users vary, most geologic maps are produced by state and federal geological surveys. In fact, I have long believed that geologic mapping is the chief purpose of these organizations. Unfortunately, despite the importance of geologic maps, their production has dropped steadily in the past 20 years, a decline I believe can be attributed to two factors.

First, mapping has fallen out of favor in many theoretically oriented geology departments. The idea that mapping is routine and will not lead to significant scientific results has been around for a long time. Indeed, some 25 years ago, when I was a graduate student, I was told that mapping was akin to connecting dots in a child's coloring book. This view of mapping is extreme, but consider the problems young academic scientists have in creating a reputation for themselves. Clearly, they and their students will gravitate toward research problems that produce quick, eye-catching results. In consequence, the pool of people capable of mapping will decline as the present generation of mappers retires.

Second, geologic mapping is both time-consuming and expensive. I once estimated that the mapping of one 7.5-minute quadrangle of moderate geologic complexity would take two to three years to complete and cost between $85,000 and $90,000. It is easy to understand why survey directors are tempted to defer geologic mapping in favor of less expensive programs with greater potential for short-term results. Like those in academia, many administrators feel they need eye-catching results to convince their legislators that what they are doing is significant.

Mapping will increase when qualified people are given the time to map. To increase the pool of qualified people, we must reconvince our colleagues that all geologic problems start in the field, and that the synthesis of diverse field observations is one of the profession's most demanding intellectual pursuits. A geologic map is objective—a record of facts—*and* subjective, presenting the geologist's interpretation of those facts. Because interpretation is involved, the quality of geologic maps improves with the maturity and experience of the mapper, and with advances in science.

Legislators need to understand that no geologic map is final, that mapping is a continuous process. Any map is a model based upon the mapper's understanding at the time the map was made. The rocks N.H. Winchell mapped 100 years ago are the same rocks today, but because new scientific concepts have evolved, his maps are obsolete. Any chronologic series of geologic maps shows how the gradual development of geologic knowledge leads to better and better approximations to actual conditions.

A decline in geologic mapping could be the beginning of intellectual stagnation in a geological survey, but a survey cannot content itself just with the making of maps; we must also serve at the interface between science and public policy. Support depends on the public perception of the value of our maps to society. We have to show how geologic knowledge can be used to solve specific problems.

Our job is cut out for us.

G.B. Morey

History Continued from page 2.

In 1973, the Minnesota Legislature eliminated several mineral-resource related programs at the University. The Survey's program was drastically curtailed. Sims returned to the U.S. Geological Survey, where he continues to do research today on the geology of the Lake Superior region.

Sim's successor was Matt S. Walton, an engineering geologist and former professor at Yale University. Under Walton's leadership, the Survey recovered rapidly from the funding setback of the 1973 legislative session. He stressed that the Survey did not exist to serve mining or other interests, or solely to fund research projects initiated by University professors and their graduate students. The Survey functioned best as a clearinghouse on *all* aspects of the state's geology, providing geologic information in a scientific and unbiased manner, and in a form that could be used to make decisions on the natural resources and environmental problems of the state.

Walton recognized that new techniques were needed to map the geology below the glacial drift covering 90% of the state. He initiated a program to collect logs, cuttings, and samples from water-well drilling and engineering test borings. But this was not enough. In 1979, and with the support of the Legislative Commission on Minnesota Resources, the Survey began a program of low-level, high-resolution aeromagnetic mapping more detailed than feasible before, supplemented by scientific drilling.

Walton retired in 1986. Priscilla C. Grew, a former California public utilities commissioner, is the Survey's newest director. She stands in a line reaching back 112 years to N.H. Winchell, who made the geological survey his life's work and yet wrote in 1889, "when this survey is finished, it can be considered only a commencement of the research that will yet to be conducted on the geology of the state."

Every year increases our knowledge of the geologic forces that shaped this state, and every year new needs for this information surface. The mission of the Survey is now, as it was under Winchell, to undertake and promote the scientific study of Minnesota geology and to make the results available to the public. Some things never change.

G.B. Morey

RECENT PUBLICATIONS

AEROMAGNETIC MAP OF MINNESOTA, WEST-CENTRAL MINNESOTA, TOTAL INTENSITY MAGNETIC ANOMALY, by V.W. Chandler. Scale 1:250,000, 2 pls. (Aeromagnetic Map Series A-6). $6.00.

USING GROUND-WATER DATA FOR WATER PLANNING, by B.M. Olsen, E.H. Mohring, and P.A. Bloomgren. 24 p. (Educational Series 8). $4.00.

SCIENTIFIC CORE DRILLING IN NORTH-CENTRAL MINNESOTA: SUMMARY OF 1986 LITHOLOGIC AND GEOCHEMICAL RESULTS, by S.J. Mills, D.L. Southwick, and G.N. Meyer. 48 p. (Information Circular 24). $4.00.

ANALYTICAL RESULTS OF THE PUBLIC GEOLOGIC SAMPLE PROGRAM, 1985-1987 BIENNIUM, by G.B. Morey and L.L. McDonald. 59 p. (Information Circular 25). $7.00.

GEOLOGY AND GEOPHYSICS OF THE DENHAM-MAHTOWA AREA, EAST-CENTRAL MINNESOTA, by P.L. McSwiggen. Scale 1:48,000 (Miscellaneous Map Series M-63). $5.00.

PALEOZOIC LITHOSTRATIGRAPHIC NOMENCLATURE FOR MINNESOTA, by J.H. Mossler. 36 p. (Report of Investigations 36). $6.00.

GEOLOGIC MAP OF THE PENOKEAN OROGEN, EAST-CENTRAL MINNESOTA: A REINTERPRETATION, by D.L. Southwick, G.B. Morey, and P.L. McSwiggen. Scale 1:250,000 (Open-File Map). $15.00. *This map is in review; the final version will be published later with an accompanying text in the Report of Investigations series.*

Mail orders must be accompanied by check or money order made out to the University of Minnesota. There is a $1.00 postage and handling fee, and Minnesota residents must add 6% sales tax (excluding postage and handling). A list of publications is available on request (include $1.00 for postage and handling if requesting by mail). Please direct inquiries and orders to Maps and Publication Sales, (612) 627-4782.

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