

THE GEOLOGICAL SURVEY OF WYOMING
Gary B. Glass, State Geologist

FIFTY-FOURTH ANNUAL REPORT
of the
GEOLOGICAL SURVEY OF WYOMING
for Fiscal Year 1987
July 1, 1986 to June 30, 1987

by
Gary B. Glass



Laramie, Wyoming
October, 1987

THE GEOLOGICAL SURVEY OF WYOMING

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Introduction

STATUTORY AUTHORITY

The Office of the State Geologist was established in 1890 with the Wyoming State Constitution (Art. 9, Sec. 6) and modified by legislative enactment in 1969, 1975, 1977, 1979, and most recently Laws 1982, Ch. 62, §3 (Title 9, Ch. 2, Art. 8, W.S. 9-2-803). Gary B. Glass, the incumbent since June 18, 1981, was reappointed State Geologist by Governor Sullivan for a six year term beginning in March 1987.

The Geological Survey of Wyoming was created by the Legislature in 1933, and has since been modified by legislative

enactment in 1957, 1969, 1977, 1979, and most recently Laws 1982, Ch. 62, §3 (Title 9, Ch. 2, Art. 8, W.S. 9-2-803 through 9-2-809). The Survey's history, however, dates back to the time when Wyoming was a territory and to the Office of the Territorial Assayer in 1878. This short-lived office was followed by the Office of the Territorial Geologist and Mining Engineer (1881-1890). After Statehood, the Office of the State Geologist (1897-1932) was created. These beginnings eventually evolved into the Geological Survey (1933-present) as it is today.

AGENCY MISSION

The mission of the Geological Survey is to provide geologic and mineral and energy resources information that has a practical bearing on Wyoming's communities or people, and that contributes to the wise management of the State's geologic and mineral and energy resources.

To accomplish its mission in FY 87, the Geological Survey:

- provided data, advice, and assistance to both in-state and out-of-state inquiries, responding to more than 15,900 inquiries related to geology and mineral and energy resources; to the effective use of earth-science techniques, products, and information; and to requests for Survey publications and information on publications.

- prepared 57 new reports or maps that communicate information on the State's geologic and mineral and energy resources, and published those reports for

dissemination through the Publications Sales Section.

- maintained and expanded public files, data bases, and a library on the State's geologic and mineral and energy resources.

- assessed mineral and energy resources, documented their occurrences, and determined their origins and manners of occurrence through more than 16 field and laboratory investigations.

- facilitated the judicious use of Wyoming's geologic and mineral and energy resources through the review of 87 planning documents.

- identified and evaluated geologic hazards in Wyoming associated with earthquakes, floods, landslides, subsidence, shrinking-swelling clays, active faults, wind-blown sands, and naturally occurring toxic elements.

GOALS

The Geological Survey of Wyoming's goals are to make contributions to the welfare of the State's citizens within the context of its mission. These goals which are listed below, link the Survey's activities and programs to the State's needs:

Geologic framework

INCREASE KNOWLEDGE OF THE GEOLOGIC STRUCTURE AND GEOLOGIC FORMATIONS IN THE STATE TO PROVIDE THE SCIENTIFIC FRAMEWORK FOR MINERAL AND GEOLOGIC HAZARDS INVESTIGATIONS AND TO MEET UNFORESEEN FUTURE RESPONSIBILITIES.

This knowledge is acquired by geologic mapping; stratigraphic and paleontologic field studies; testing of conceptual models; and measurements of petrologic, physical, and chemical properties of rocks and minerals.

Mineral and energy resource assessment

INCREASE KNOWLEDGE OF THE DISTRIBUTION AND QUALITY OF THE STATE'S MINERAL AND ENERGY RESOURCES SO THAT GOVERNMENT OFFICIALS AND THE PUBLIC WILL BE ABLE TO FORMULATE AND EVALUATE POLICIES THAT AFFECT THE LONG-TERM AVAILABILITY OF THESE RESOURCES AND MAKE DECISIONS ABOUT THE WISE USE OF THE STATE'S LAND, MINERAL, AND ENERGY RESOURCES.

This knowledge is obtained by using techniques of resource evaluation including geologic mapping, reconnaissance exploration, and field and laboratory studies of rocks and minerals.

Mineral and energy resource processes

ENHANCE THE ABILITY TO DISCOVER HIDDEN OR AS YET UNRECOGNIZED MINERAL AND ENERGY RESOURCES BY DEVELOPING INFORMATION ON THE NATURAL PROCESSES BY WHICH MATERIALS IN THE EARTH ARE FORMED, TRANSPORTED, AND CONCENTRATED.

This knowledge is acquired by field investigations, laboratory analysis, and construction of conceptual models.

Hazards identification and prediction

IDENTIFY POTENTIAL GEOLOGIC HAZARDS AND IMPROVE THE ABILITY TO PREDICT THE LOCATION, TIME, AND SEVERITY OF NATURAL AND MAN-MADE HAZARDS TO MINIMIZE LOSS OF LIFE AND PROPERTY.

This knowledge is obtained by geologic mapping, field investigations, aerial photographic interpretation, and application of the rates of dynamic interactions of Earth processes.

Timely reporting of events and conditions

PROVIDE TIMELY REPORTING, AND FORECASTS WHEN POSSIBLE, OF MINERAL PRODUCTION AND REVENUES AS WELL AS IMPORTANT HYDROLOGIC AND GEOLOGIC EVENTS AND CONDITIONS OF IMMEDIATE CONCERN TO THE PUBLIC AND TO GOVERNMENTAL BODIES.

This is accomplished by continued analysis of mineral- and energy-related activities, man-related projects and the geologic conditions surrounding those projects, and timely dissemination of relevant information and warnings. Similarly, natural events are also monitored particularly in regard to how they might affect the public.

Coordination

IMPROVE THE COORDINATION OF EARTH-SCIENCE DATA COLLECTION, RESEARCH, AND MAPPING TO MINIMIZE DUPLICATION OF EFFORT, INCREASE DATA ACCESSIBILITY, AND REDUCE COSTS.

Coordination is carried out by sharing and(or) exchanging plans, technologies, and data bases with appropriate entities and by striving to standardize information formats.

Information dissemination

IMPROVE PUBLIC AND PRIVATE SECTOR ACCESSIBILITY AND UNDERSTANDING OF EARTH-SCIENCE INFORMATION AND TECHNOLOGIES.

This is achieved by publishing geologic maps and general interest, scientific, and technical reports on geology and mineral and energy resources; by making files available to the public; and by operating a public information center that provides answers to inquiries or enables potential users to

readily identify and obtain existing information.

Mission support

IMPROVE PRODUCTIVITY OF THE SURVEY TO EFFECTIVELY CARRY OUT ITS MISSION.

This is accomplished by maintaining a competent and innovative staff, by expanding computerized data bases, by expanding laboratory and field capabilities, and by deriving maximum benefits from available resources.

Organization

To accomplish its mission and achieve its goals, the Geological Survey operates under two programs:

Administration (01) - Applies to the overall programs and activities of the Agency with 13 full-time employees. Some funds from outside sources (State and Federal grants) are solicited to augment General Fund appropriations for the Administrative Program. In FY 87 these augmenting funds totaled \$109,527. The projects funded by these grants are part of the Administrative Program, and their continuation into future years is speculative as they are only funded on an annual basis.

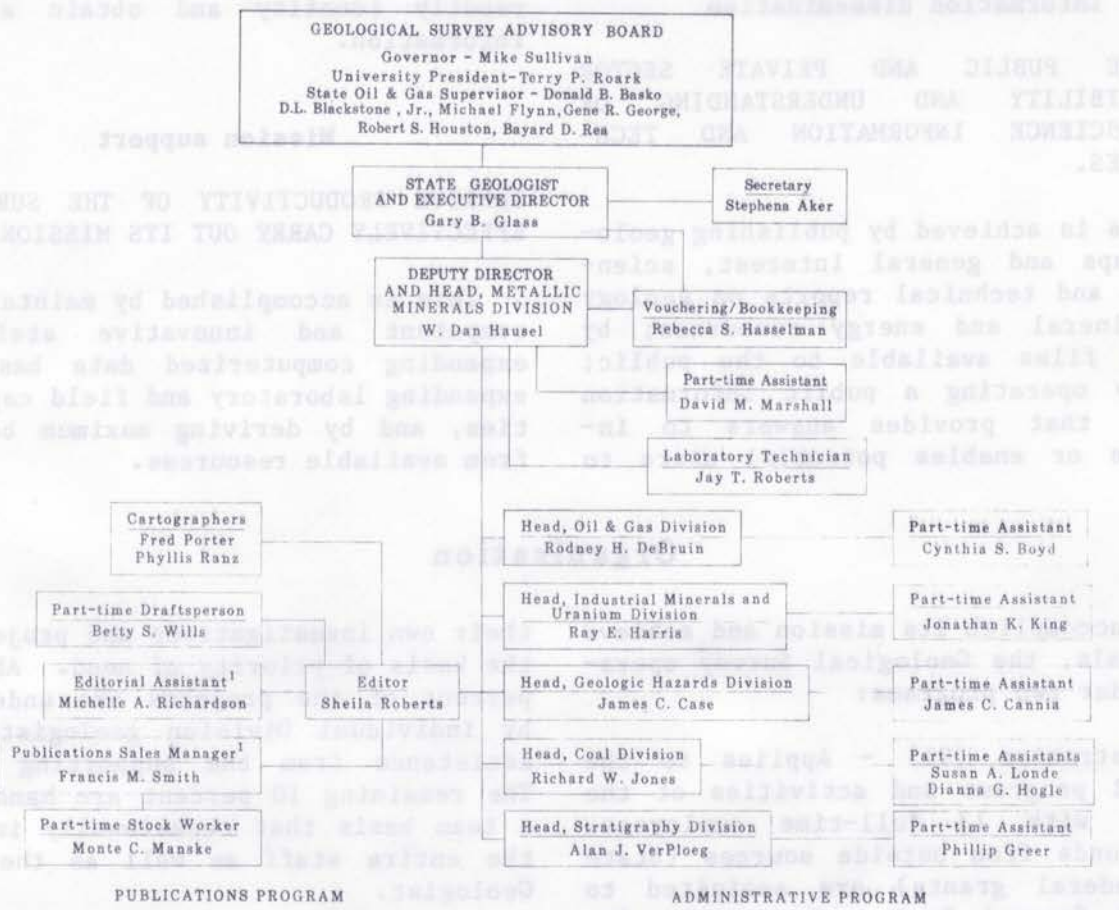
Publications (02) - Applies to the sale and(or) distribution of all publications prepared or handled by the Geological Survey, with two full-time employees. This program, which includes funds for supplies, equipment, commercial printing, and travel related to publication activities, is funded in its entirety by General Fund appropriations.

For operational purposes, the Agency's personnel are divided into professional staff (geologists and editor) and their respective supporting staffs (Figure 1). Because the Division geologists are experts in their field of geology, they are expected to initiate

their own investigations and projects on the basis of priority of need. About 90 percent of the projects are undertaken by individual Division geologists with assistance from the supporting staff. The remaining 10 percent are handled on a team basis that occasionally involves the entire staff as well as the State Geologist.

The geological staff (Figure 1) is comprised of the State Geologist and six one-man Divisions: Coal, Geologic Hazards, Industrial Minerals and Uranium, Metallic Minerals, Oil and Gas, and Stratigraphy. Each geologist is the head of his respective Division and enlists the part-time help of student assistants from the University of Wyoming as the need occurs and funds permit. Table 1 is a percentage breakdown of the Division geologist's activities. The Laboratory Section is a one-man section that provides analytical as well as field support to the geological staff.

The Agency has a Publications Division headed by the Editor. This Division consists of a Drafting Section, an Editorial Section, and a Publication Sales Section. The Drafting Section puts all illustrative materials (drawings, maps, charts, etc.) into publishable form and makes proof copies, and printer-ready



¹ These positions are paid out of the Publications Program.

Figure 1. Organization chart for the Geological Survey in FY 87.

Table 1. Percentage breakdown of Division geologists' activities.

	Range	Average
Services to the general public, State agencies, Federal agencies and others	40-60%	45.0%
Field and laboratory projects	10-20%	15.0%
Data organization	10-25%	17.5%
Report writing and editorial reviews	10-20%	15.0%
Administration	3-5%	4.0%
Other activities	2-5%	3.5%

negatives. The Editorial Section edits and puts all manuscripts into printer-ready formats, writes printing specifications, and sees that reports are satisfactorily published. The Publication Sales Section sells Survey publications over-the-counter and by mail, keeps an inventory of publications, and mails

exchange publications. Revenues from the sale of publications in FY 87 was \$70,387.

The biennial appropriations for these two programs are shown in Figure 2 along with FY 87 expenditures.

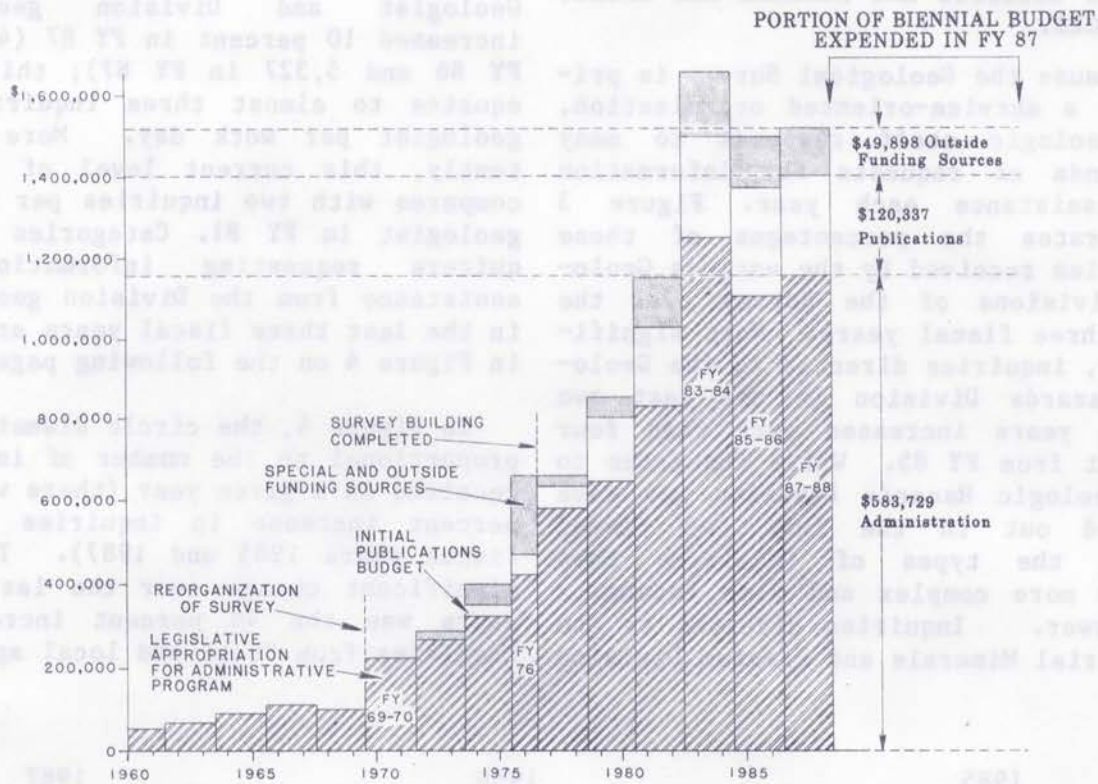


Figure 2. Biennial budgets for the Geological Survey (expenditures for FY 87 are annotated to the right of the biennial budgets).

Major accomplishments of the Administration Program

OBJECTIVES

The Administrative Program is implemented by the State Geologist, six geologic Divisions (Coal, Geologic Hazards, Industrial Minerals and Uranium, Metallic Minerals, Oil and Gas, and Stratigraphy), the Publications Division, and the Laboratory Section. To accomplish the Agency's mission and

goals as listed earlier, this program has four major objectives: (1) provide geologic information, advice, and assistance, (2) conduct field and laboratory investigations, (3) prepare and publish reports and maps, and (4) maintain records on geologic and mineral and energy resources.

ACCOMPLISHMENTS

For each of these major objectives, the activities and accomplishments of the Administrative Program of the Survey in FY 87 are described below:

1. PROVIDE INFORMATION, ADVICE, AND ASSISTANCE FOR ALL INQUIRIES ON THE STATE'S GEOLOGIC AND MINERAL AND ENERGY RESOURCES.

Because the Geological Survey is primarily a service-oriented organization, its geologic staff responds to many thousands of requests for information and assistance each year. Figure 3 illustrates the percentages of these inquiries received by the various Geologic Divisions of the Survey over the last three fiscal years. Most significantly, inquiries directed to the Geologic Hazards Division in the last two fiscal years increased more than four percent from FY 85. While inquiries to the Geologic Hazards Division may have leveled out in the last two fiscal years, the types of inquiries have become more complex and time consuming to answer. Inquiries directed to the Industrial Minerals and Uranium Division

increased even more than those to the Geologic Hazards Division, going from 13 percent of the inquiries in FY 85 to 20 percent in FY 87 - a seven percent increase.

Inquiries directed to the State Geologist and Division geologists increased 10 percent in FY 87 (4,837 in FY 86 and 5,327 in FY 87); this level equates to almost three inquiries per geologist per work day. More importantly, this current level of inquiry compares with two inquiries per day per geologist in FY 81. Categories of inquirers requesting information and assistance from the Division geologists in the last three fiscal years are shown in Figure 4 on the following page.

In Figure 4, the circle diameters are proportional to the number of inquiries received in a given year (there was a 32 percent increase in inquiries between fiscal years 1985 and 1987). The most significant change over the last three years was the 46 percent increase in inquiries from State and local agencies.

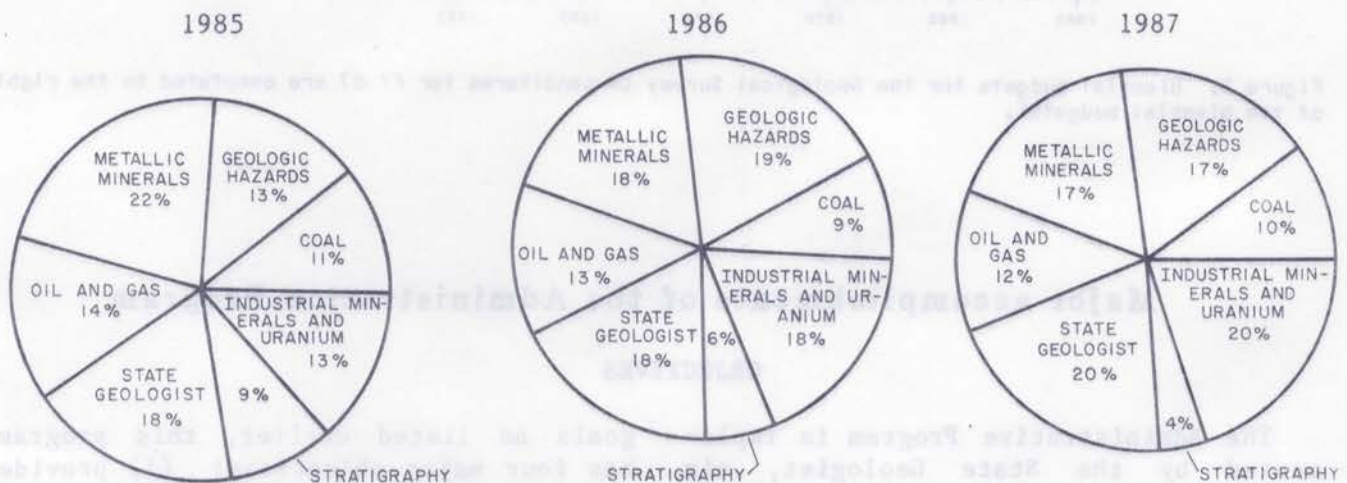


Figure 3. Percentage of inquiries directed to each of the Geologic Divisions, Fiscal Years 1985-1987.

1985 (4,020 INQUIRIES) 1986 (4,837 INQUIRIES) 1987 (5,327 INQUIRIES)

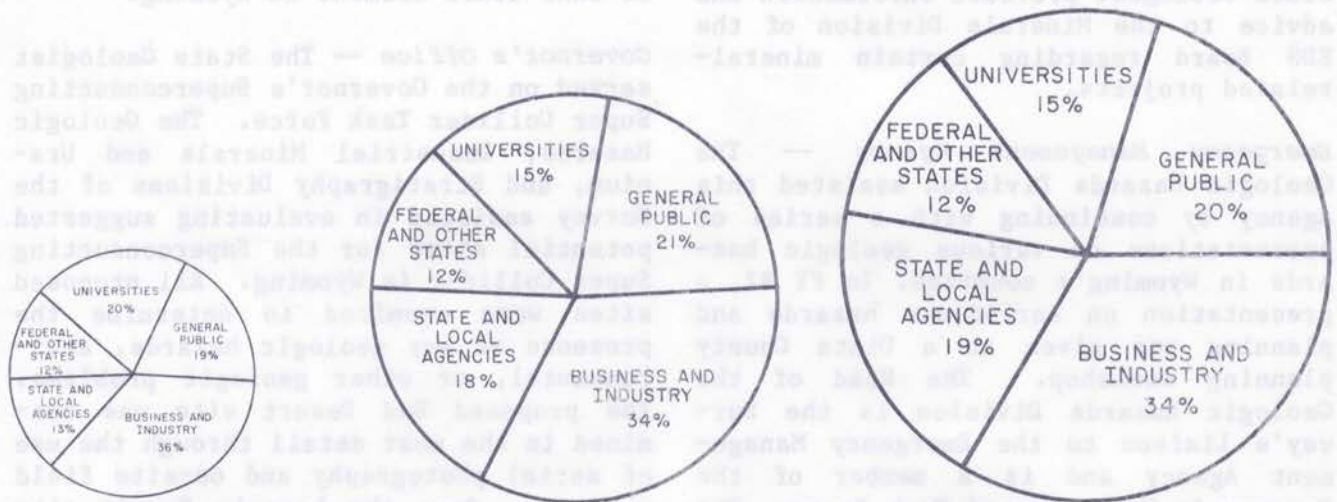


Figure 4. Percentage of inquiries directed to Geologic Divisions, arranged by category of inquirer, Fiscal Years 1985-1987. (The diameters of the diagrams are drawn in proportion to the total number of inquiries received each year).

In regard to State and local entities, these services are divisible into routine ongoing assistance and spot requests for assistance. Major ongoing assistance is now provided to seventeen State and local agencies rather than the traditional seven agencies listed in previous Annual Reports. The assistance provided these agencies is described below:

Department of Agriculture -- The Survey continued to provide drafting and technical assistance on the compilation of a *Land inventory map of Wyoming* which will be jointly published in FY 88. Another cooperative project titled, *Natural resource atlas of the Cheyenne 30x60-minute topographic map area*, was published by the Department of Agriculture in FY 87.

Archives, Museums, and Historical Department -- The State Geologist and Deputy Director (Metallic Minerals Division) continued cooperative efforts in the preparation of a Wyoming diamond exhibit for the State Capitol and in the coordination of plans for a traveling exhibit of Green River Basin fossils. The Survey's Deputy Director, who is the

Associate Curator of Mineralogy for the Wyoming State Museum, also provided rock samples for a mountain lion exhibit in the State Museum.

Consensus Revenue Estimating Group (CREG) -- The State Geologist is a member of the Consensus Revenue Estimating Group (CREG), which makes revenue estimates for use by the Governor and the Legislature, prior to each Legislative Session. In FY 87, updated estimates of mineral production and revenue were also required before and after the Legislative Session because of changing conditions. The State Geologist with advice and information provided by the Coal, Industrial Minerals and Uranium, and Oil and Gas Division Heads continually apprised CREG of the minerals situation throughout FY 87.

Economic Development and Stabilization Board (EDS Board) -- (1) The Industrial Minerals and Uranium Division of the Survey provided information on production trends and markets for industrial minerals, (2) the Geologic Hazards Division compiled information and generated files on geologic criteria for hazardous-waste disposal sites as well as

reviewed potential disposal sites suggested to the EDS Board, and (3) the State Geologist provided information and advice to the Minerals Division of the EDS Board regarding certain mineral-related projects.

Emergency Management Agency -- The Geologic Hazards Division assisted this Agency by continuing with a series of presentations on various geologic hazards in Wyoming's counties. In FY 87, a presentation on earthquake hazards and planning was given at a Uinta County planning workshop. The Head of the Geologic Hazards Division is the Survey's Liaison to the Emergency Management Agency and is a member of the Governor's Multi-hazard Task Force. The Head of the Oil and Gas Division also discussed the hazards related to hydrogen sulfide gas at the Uinta County Earthquake Planning Workshop.

Department of Environmental Quality, Land Quality Division -- (1) The Survey's Geologic Hazards Division provided reviews and recommendations on paleontologic portions of mining plans, (2) while the Metallic Minerals Division provided information and reclamation recommendations on 12 abandoned mine land reclamation projects in the Centennial Ridge mining district, the Industrial Minerals and Uranium and Coal Divisions also reviewed a number of other Abandoned Mined Land Reclamation Projects (AML) and made comments and(or) recommendations on reclamation strategies for these projects, (3) the Geologic Hazards and Coal Divisions wrote papers and presented talks on mine subsidence for the Governor's Workshop on Mine Subsidence, which was jointly sponsored by the University of Wyoming's Civil Engineering Department, the Department of Environmental Quality, and the Geological Survey of Wyoming, and (4) the Geologic Hazards Division compiled information and files on selenium occurrences in Wyoming and prepared a report and map titled, *Preliminary map of potentially seleniferous areas in Wyoming*. This information was provided to the Department of Environmental Quality, which

later formed a multi-agency group to assess the potentially hazardous effects of this toxic element in Wyoming.

Governor's Office -- The State Geologist served on the Governor's Superconducting Super Collider Task Force. The Geologic Hazards, Industrial Minerals and Uranium, and Stratigraphy Divisions of the Survey assisted in evaluating suggested potential sites for the Superconducting Super Collider in Wyoming. All proposed sites were examined to determine the presence of any geologic hazards, environmental, or other geologic problems. The proposed Red Desert site was examined in the most detail through the use of aerial photography and on-site field studies. Once the Laramie County site was selected, the Geologic Hazards Division with the help of other Division geologists assisted in the technical review and revision of Wyoming's actual site proposal.

Department of Health and Social Services -- Three Geologic Divisions participated in a radon monitoring project with the Department of Health and Social Services and the U.S. Environmental Protection Agency. To aid in the placement of 800 radon detecting canisters, a map titled, *Planning guide map for radon studies in Wyoming* was prepared by the Geologic Hazards Division in cooperation with the Industrial Minerals and Uranium Division. The Wyoming monitoring program will continue in FY 88, with the Geologic Hazards Division providing guidance for the placement of additional canisters in addition to beginning a long term program of site characterization in areas where radon in homes exceeds Federal standards.

In addition, the Stratigraphy Division compiled and prepared sixteen 1° x 2° quadrangle maps depicting known surficial structural features in the State. These maps showed faults and anticlinal structures with surficial expression. Potentially active faults were annotated as such on the maps. These maps were prepared as an addi-

tional aid for designing the radon sampling program.

Industrial Siting Administration -- Although no siting applications were reviewed in FY 87, the Survey will routinely review any applications submitted in future years as it has in the past.

Legislative Service Office -- Each September, the State Geologist and the Coal, Industrial Minerals and Uranium, and Oil and Gas Divisions estimate production and assessed value for minerals produced in the State. The Survey's estimates and those of several other State agencies are used to reach a consensus on future mineral production and assessed values. Later these consensus estimates are used by the Consensus Revenue Estimating Group (CREG) to provide a forecast of mineral revenue for use by both the Governor and the Legislature.

Lincoln County Planning Office -- The Geologic Hazards Division continued to work with the Lincoln County Planning Office in integrating concerns for geologic hazards into the County's Master Plan.

Oil and Gas Conservation Commission -- Wyoming Statute 30-5-103 makes the State Geologist one of the Commissioners of this regulatory agency. Monthly hearings were routinely 0.5-1.0 day long in FY 87 and involved 328 dockets. The State Geologist is the Acting Chairman of the Commission when the Governor is absent. Matters related to the Oil and Gas Conservation Commission, in addition to the hearings, routinely require another two or more days of effort by the State Geologist each month.

State Planning Coordinator and Governor's Clearing House -- The State Geologist and Heads of the Geologic Divisions reviewed 87 documents for the Governor's Clearing House in FY 87 and submitted written comments on 27.

Commissioner of Public Lands -- The Survey's Oil and Gas Division provided (1)

weekly reports of oil and gas activities on or near State lands, (2) oil and gas tract evaluations to assist with selecting tracts for the lease auction every other month, (3) an updated listing of oil and gas potential and sale results on 7,200 State lease tracts (currently, 500-600 tracts are rated every other month, which is a 44 percent increase over FY 86); the State Geologist reviewed and made recommendations on all commercial and scientific fossil-collecting permits (there were 8 applications in FY 87) and inspected the quarries. Spot assistance included the State Geologist's participation in the Teton National Park land exchange proposal, participation on a group evaluating potential State help in promoting the paleontological and historical attributes of Lincoln County, and joint participation with the Geologic Hazards Division in regard to a "youngite" deposit in a cave on State lands.

Uinta County Planning Office -- The Geologic Hazards Division continued to work with the Uinta County Planning Office in integrating concerns for geologic hazards into the County's Master Plan.

University of Wyoming -- (1) The State Geologist and several of the Survey's Division geologists continued to provide quarterly minerals outlook articles for publication in the Institute for Policy Research's *Wyoming quarterly update*, (2) the State Geologist and Deputy Director were appointed to the American Heritage Center's Advisory Board for the Anaconda Collection. In this capacity, plans for the care and use of the Center's Anaconda Collection were formulated and reviewed for an anticipated opening of the collection in FY 88, (3) the Survey's Deputy Director planned and designed exhibits on the Carissa gold mine (South Pass) and on kimberlitic and lamproitic rocks for the University's Geology Museum, (4) The Deputy Director sat on graduate thesis committees in the Department of Geology and Geophysics, (5) the State Geologist taught courses on the *Geology of Solid Fuels* and *Wyo-*

ming Coal Deposits for the Department of Geology and Geophysics until budget cuts curtailed the classes in FY 88, (6) the State Geologist served on the College of Agriculture's Advisory Council, (7) the Metallic Minerals Division continued field and laboratory research into diamond-bearing kimberlite deposits in Wyoming, partially funded by a cooperative agreement with the University's Mining and Mineral Resources Research Institute, (8) the State Geologist taught a series of workshops on the geology of the Fremont County Youth Camp for the College of Agriculture's State 4-H Conservation Camp, and (9) ongoing assistance and information was provided to faculty and students from several different departments of the University.

Water Development Commission -- The Geologic Hazards Division continued its investigation of the proposed Sandstone Reservoir project site in the Baggs-Savery area. Detailed information on slope stability was provided in a report titled, *Discussion of potentially unstable slopes or deposits that may be affected by waters of the proposed Sandstone Reservoir.*

In addition, spot requests for assistance were received in FY 87 from thirty-three State and local entities. The following is a list of these entities in FY 87:

- Albany County Economic Development Committee
- State Archaeologists's Office
- Attorney General's Office
- State Auditor's Office
- Casper College
- Big Horn County
- Carbon County Economic Development Board
- Employment Security Commission
- State Engineer's Office
- Department of Environmental Quality
 - Water Quality Division
- Fremont County
- Game and Fish Department
- Platte County
- Highway Department
- State Inspector of Mines
- City of Kaycee
- Department of Labor and Statistics
- Wyoming Legislature
- City of Lusk
- Natrona County Library
- Wyoming State Penitentiary
- Platte County Economic Development Committee

- Public Service Commission
- Recreation Commission
- Department of Revenue
 - Ad Valorem Tax Division
- Secretary of State's Office
- Sinks Canyon State Park
- Sweetwater County
- Sweetwater County Library
- Travel Commission
- University of Wyoming
 - Water Research Center
- Western Wyoming Community College
- Wheatland Irrigation District

Requests for information and assistance were also received and answered for sixty-three Federal, other state, or foreign entities as listed below:

Federal

- Army Corps of Engineers
- Bureau of Land Management
- Bureau of Mines
- Bureau of Reclamation
- Department of Commerce
- Department of Energy
- Energy Information Agency
- Environmental Protection Agency
- Federal Bureau of Investigation
- Federal Energy Regulatory Commission
- Federal Highway Administration
- Forest Service
- Fossil Butte National Monument
- General Accounting Office
- Geological Survey
- Housing and Urban Development
- Internal Revenue Service
- Department of Labor
- Mine Safety and Health Administration
- Minerals Management Service
- National Academy of Sciences
- National Museum of Natural History
- National Park Service
- Office of Surface Mining
- Securities and Exchange Commission
- Soil Conservation Commission
- Wyoming Congressional Delegation
- Yellowstone National Park

Foreign

- Bureau of Mineral Resources, Canberra, Australia
- Geological Survey of Western Australia
- South Australia Department of Mines and Energy
- British Columbia Ministry of Mines
- Institute of Experimental Mineralogy, Moscow, USSR
- West Germany Institute fur Geowissenschaften

Other States

- Alaska Geological Survey
- Arizona Geological Survey
- Boise State University
- California Geological Survey
- Colorado Geological Survey
- Colorado Interstate Gas Commission
- Colorado School of Mines
- Colorado Springs College
- Cornell University

Idaho Geological Survey
 Illinois Geological Survey
 Indiana University
 Iowa Geological Survey
 Kansas Geological Survey
 University of Louisville
 Minnesota Department of Natural Resources
 Missouri Geological Survey
 University of Missouri-Rolla
 Montana Bureau of Mines and Geology
 Nebraska Department of Environmental Control
 Nevada Bureau of Mines and Geology
 Oklahoma Geological Survey
 Oregon Securities Office
 Purdue University
 South Dakota School of Mines
 Tennessee Geological Survey
 University of Utah
 Utah Geological and Mineral Survey
 Utah State University

As an extension of this service-related function, the State Geologist, Division geologists, and the Editor collectively presented twenty-eight talks or briefings on mineral resources, geology, or geologic hazards to the following groups:

Albany County School District,
 (Beitel School), Laramie

American Association of Petroleum Geologists,
 Rocky Mountain Section (3 talks), Casper

Canadian geologists' field trip, Sheridan

Casper Oil show, Casper

Governor's Workshop on Mine Subsidence
 (2 talks), Laramie

Montana Geological Society and Yellowstone
 Bighorn Research Association, Red Lodge,
 Montana

Natrona County School District No. 1, Casper

Platte County Economic Development Committee,
 Wheatland

Society of Mining Engineers, Rock Springs Section,
 Rock Springs

State 4-H Conservation Camp (4 workshops), Lander

Uinta County Earthquake Planning Workshop,
 (2 talks), Evanston

Uinta County School Board, Mountain View

United Christian Ministry, Laramie

University of Wyoming, Civil Engineering
 Department (2 seminars), Laramie

Western States Seismic Policy Council, Jackson

Wyoming Geological Association (2 talks), Casper

Wyoming Mining Association, Teachers Workshop
 (2 talks), Casper and Cheyenne

Wyoming Planning Association, Green River

2. CONDUCT AND REPORT ON FIELD AND LABORATORY INVESTIGATIONS THAT CONTRIBUTE NEW GEOLOGICAL KNOWLEDGE TO THE STATE CONCERNING MINERAL RESOURCES AND OTHER MATTERS THAT HAVE A PRACTICAL BEARING ON WYOMING'S COMMUNITIES AND PEOPLE.

The following twelve investigations were completed in FY 87:

- (1) As a cooperative effort with the U.S. Bureau of Reclamation, the U.S. Geological Survey, and private consultants, the Geologic Hazards Division assembled reports on the Wheatland-Whalen fault system in Platte and Goshen Counties, the Star Valley-Grand Valley fault system in Lincoln County, and the Bear River fault system in Uinta County. Some follow-up work is planned on the latter two fault systems.
- (2) The Geologic Hazards, Stratigraphy, and Industrial Minerals and Uranium Divisions, and the State Geologist prepared geologic evaluations of Superconducting Super Collider (SSC) sites in the Red Desert as well as other sites in Wyoming for the Governor's SSC Task Force.
- (3) The Geologic Hazards Division coordinated with the University of Wyoming's Department of Geology and Geophysics in mapping the Rock Creek fault west of Kemmerer. Some follow-up is planned for this study.
- (4) Detailed information on slope stability in the vicinity of the proposed Sandstone Reservoir near Baggs was assembled by the Geologic Hazards Division. The project was done in response to inquiries by the Water Development Commission, a State Senator, concerned citizens and property owners, as well as private consultants.

(5) The Geologic Hazards Division assembled geologic and hazards information on the Little Horn Pump Storage Project near Sheridan for use by the participants in this project as well as others.

(6) The Stratigraphy Division compiled sixteen maps depicting known surficial structural features in Wyoming for publication. This project was requested and partially funded by the Wyoming Department of Health and Social Services in support of their radon sampling program.

(7) At the request of the City of Kaycee and its water consultant, the Stratigraphy Division assisted in the evaluation of a second city water well site to be drilled near Elk Mountain.

(8) The Industrial Minerals and Uranium Division assisted the city of Lusk in evaluating a limestone and dolomitic limestone deposit near Manville. A drilling project and geologic mapping was used to estimate the grade and quantity of the limestone resource at that site. A report was prepared for publication by the Survey.

(9) The Industrial Minerals and Uranium Division provided technical assistance to the Union Pacific and Burlington Northern railroads to help locate new sources of ballast in Wyoming.

(10) The Metallic Minerals Division completed a map of the Sweetwater Rocks Wilderness Study Area along the eastern margin of the South Pass greenstone belt in the southern Wind River Mountains. This project was funded in part by the U.S. Geological Survey.

(11) The Metallic Minerals Division provided technical advice and assistance on stratigraphic, structural, and petrologic interpretations of amphibolite-grade metamorphosed sedimentary and igneous rocks for a mining company drilling for a major gold deposit in Wyoming. Simi-

lar assistance was provided for several other gold prospects.

(12) The Head of the Metallic Minerals Division attended the Fourth International Kimberlite Conference in Western Australia. From observations during that visit, diamondiferous and barren lamproites in northwestern Australia can be compared with similar lamproites found in the Leucite Hills of Wyoming. In addition, a first-hand comparison of greenstone belts in Western Australia can be made with the greenstone belts of Wyoming. Greenstone belts are often highly mineralized.

Ongoing investigations include:

(1) The Metallic Mineral Division's field sampling and laboratory processing of diamond-bearing kimberlite from the Laramie Range and other areas of the State continued under a cooperative agreement with the University of Wyoming's Mining and Mineral Resource Research Institute.

(2) Reconnaissance surveys of mineral occurrences throughout the State continued as in-house projects in the Metallic Minerals and Industrial Minerals and Uranium Divisions.

(3) The Geologic Hazards Division continued a cooperative study of selenium occurrences in Wyoming with selenium researchers at the University of Wyoming, the U.S. Geological Survey, and the Department of Environmental Quality.

(4) The Geologic Hazards and the Industrial Minerals and Uranium Divisions continued a cooperative study of radon occurrences in the State with the Wyoming Department of Health and Social Services and the U.S. Environmental Protection Agency.

(5) Compilation of coal data for entry into the U.S. Geological Survey's National Coal Resources Data System was continued by the Coal Division.

(6) The Industrial Minerals and Uranium Division continued to compile maps of background gamma-radiation levels across Wyoming.

(7) The Metallic Minerals Division continued geologic mapping of the South Pass greenstone belt in the southern Wind River Mountains of Fremont County.

(8) The Geologic Hazards Division continued statewide research and mapping of geologic hazards. Primary emphasis is currently on landslides.

(9) The Stratigraphy Division continued geologic mapping of the southeastern Bighorn Mountains in Johnson, Natrona, and Washakie Counties.

(10) The Metallic Minerals Division and the Laboratory Section continued to provide mineral and rock identifications for the general public, other Survey Divisions, industry, other State agencies, and the University of Wyoming. Collectively, 261 samples were identified in FY 87.

(11) Work on a revised *Stratigraphic nomenclature chart for the State of Wyoming* continued as a joint effort of the Stratigraphy Division, the U.S. Geological Survey, and the Wyoming Geological Association. The Stratigraphy Division finished a first draft of the chart in FY 87.

(12) The Industrial Minerals and Uranium Division began a cooperative project with Albany County to evaluate a silica deposit northeast of Laramie. Field assistance and technical advice will continue into FY 88.

(13) The Industrial Minerals and Uranium Division began an investigation of the mineral occurrences in Platte County and their potential economic value for the Platte County Economic Development Committee. In FY 87, the Coal Division assisted by providing a subsurface study of the stratigraphy, structure, and areal extent of coal-bearing rocks in the County.

In a matter related to laboratory investigations, the Laboratory Section completed the renovation and installation of an atomic absorption spectrometer, which was donated by the University of Wyoming's Chemical Engineering Department. This instrument greatly increased the Survey's in-house capability for quantitative elemental analysis.

3. PREPARES AND PUBLISHES TIMELY AND SIGNIFICANT REPORTS AND MAPS THAT LEAD TO A BETTER UNDERSTANDING OF THE LOCAL AND REGIONAL GEOLOGY OF THE STATE AND ITS MINERAL RESOURCES.

The State Geologist, Heads of the Geologic Divisions, and the Editor and Editorial Assistant compile, edit, and(or) write many reports and maps for publication by the Geological Survey each fiscal year. In addition, manuscripts are sometimes accepted from authors outside the Survey.

The 57 publications prepared by the Survey in FY 87 set a new record as indicated on Figure 5. This represents a 633 percent increase between FY 80 and FY 87. This dramatic increase is the result of a concerted effort to increase the number of new publications. For comparison, only one additional full-time position was added during this period.

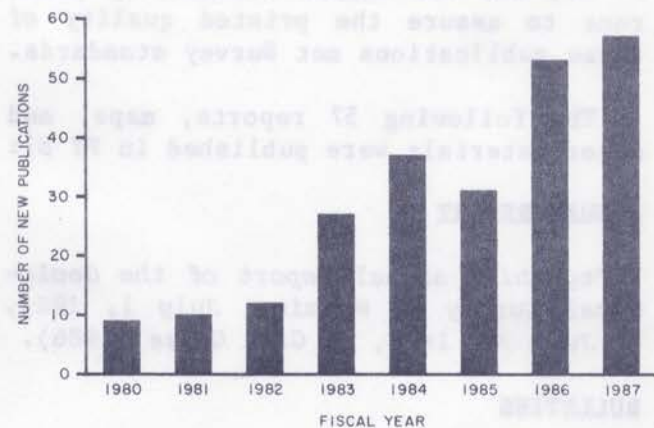


Figure 5. Number of new publications completed each fiscal year (1980 through 1987).

The Editor, after consultation with the State Geologist, establishes printing priorities. The two graphs in Figure 6 summarize the general subject matter of Survey publications and the number of new publications completed each decade. While the number of new reports and maps has steadily increased, there is an increasingly larger backlog of material that cannot be published in any given year due to budgetary constraints.

GENERAL CONTENT OF SURVEY PUBLICATIONS FROM FISCAL YEAR 1911 THROUGH FISCAL YEAR 1987

TECHNICAL AND POPULAR GEOLOGY	179 REPORTS AND MAPS	53%
MINERAL RESOURCES	157 REPORTS AND MAPS	47%

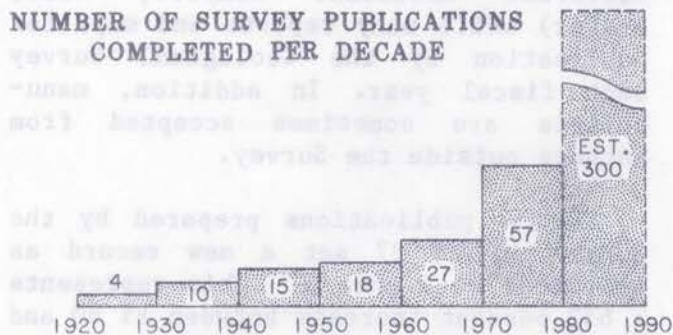


Figure 6. General content of publications and number of new publications per decade.

The Editorial Section prepared bid specifications for 26 printing jobs in FY 87, and the Editor attended 11 press runs to assure the printed quality of these publications met Survey standards.

The following 57 reports, maps, and other materials were published in FY 87:

ANNUAL REPORT

Fifty-third annual report of the Geological Survey of Wyoming, July 1, 1985, to June 30, 1986, by G.B. Glass (1986).

BULLETINS

Fossils of Wyoming: Bulletin 54, by M.W. Hager (reprinted 1987).

History of the Geological Survey of Wyoming: Bulletin 65, by W. Bryans, (1986).

Minerals and rocks of Wyoming: Bulletin 66, by W.D. Hausel (1986).

INFORMATION CIRCULARS

Geology of Wyoming, by G.B. Glass and D.L. Blackstone, Jr. (1987).

Guide to some rocks and minerals of Wyoming, by W.D. Hausel, F.K. Root, and K.G. Albert (1987).

Hints for rock hunting and prospecting in Wyoming, by W.D. Hausel (1987).

MAP SERIES

Index of geologic maps of Wyoming included in 1928-1949 graduate theses from the University of Wyoming: MS-9N, compiled by R.H. DeBruin (1986).

Index of geologic maps of Wyoming included in 1950-1959 graduate theses from the University of Wyoming: MS-9O, compiled by R.H. DeBruin (1986).

Index of geologic maps of Wyoming included in 1960-1969 graduate theses from the University of Wyoming: MS-9P, compiled by R.H. DeBruin (1986).

Index of geologic maps of Wyoming included in 1970-1979 graduate theses from the University of Wyoming: MS-9Q, compiled by R.H. DeBruin (1986).

Geologic map of the Stewart Peak Quadrangle, Lincoln County, Wyoming: MS-22, compiled by D.R. Lageson (1986).

OPEN FILE REPORTS

Diatomite (diatomaceous earth) in Wyoming: OFR 86-16, by R.E. Harris and J.K. King (1986).

Pumice, scoria, and pumicite in Wyoming: OFR 86-17, by R.E. Harris and J.K. King (1986).

Planning-guide map for radon studies in Wyoming: OFR 86-18, compiled by J.C. Cannia and J.C. Case, (1986).

Geologic maps of Wyoming included in 1980-1985 graduate theses from the University of Wyoming: OFR 86-19, compiled by A.J. VerPloeg and P.L. Greer (1986).

Sinter (including travertine) resources in Wyoming: OFR 86-20, by R.E. Harris and J.K. King (1986).

Ongoing studies on the geology of Wyoming: OFR 86-21, by P.L. Greer and A.J. VerPloeg (1986).

Ballast in Wyoming: OFR 86-22, by R.E. Harris (1986).

Potash resources of Wyoming: OFR 86-23, by R.E. Harris and J.K. King (1986).

Alum minerals in Wyoming (include alunite): OFR 86-24, by R.E. Harris and J.K. King (1986).

Preliminary geologic map of the Lewiston gold district, Radium Springs Quadrangle, Fremont County, Wyoming: OFR 86-25, by W.D. Hausel (1986).

Preliminary geologic map of the Anderson Ridge Quadrangle, Fremont County, Wyoming: OFR 86-26, by W.D. Hausel (1986).

Preliminary maps of known surficial structural features: compiled by A.J. VerPloeg, P.L. Greer, and J.K. King (1987).

Ashton 1° x 2° Quadrangle, 87-1A
Cody 1° x 2° Quadrangle, 87-1B
Sheridan 1° x 2° Quadrangle, 87-1C
Gillette 1° x 2° Quadrangle, 87-1D
Driggs 1° x 2° Quadrangle, 87-1E
Thermopolis 1° x 2° Quadrangle, 87-1F
Arminto 1° x 2° Quadrangle, 87-1G
Newcastle 1° x 2° Quadrangle, 87-1H
Preston 1° x 2° Quadrangle, 87-1I
Lander 1° x 2° Quadrangle, 87-1J
Casper 1° x 2° Quadrangle, 87-1K
Torrington 1° x 2° Quadrangle, 87-1L
Ogden 1° x 2° Quadrangle, 87-1M

Rock Springs 1° x 2° Quadrangle, 87-1N
Rawlins 1° x 2° Quadrangle, 87-1O
Cheyenne 1° x 2° Quadrangle, 87-1P

Epsomite (magnesium sulfate) in Wyoming: OFR 87-2, by R.E. Harris (1987).

Clay resources of Wyoming (including bentonite and fuller's earth): OFR 87-3, by R.E. Harris and J.K. King (1987).

Preliminary geologic map of the Mayoworth Quadrangle, Johnson County, Wyoming: OFR 87-4, by A.J. VerPloeg and P.L. Greer (1987).

Preliminary geologic map of the Red Fork Powder River Quadrangle, Johnson County, Wyoming: OFR 87-5, by A.J. VerPloeg and P.L. Greer (1987).

Columbium (niobium) and tantalum in Wyoming: OFR 87-6, by R.E. Harris and J.K. King (1987).

POSTCARD

The Wyoming State Fossil, *Knightia*.

PUBLIC INFORMATION CIRCULARS

Earthquakes and related geologic hazards in Wyoming: PIC 26, by J.C. Case (1986).

A geologic tour of Wyoming from Laramie to Lander, Jackson, and Rock Springs: PIC 27, by Brainerd Mears, Jr., W.P. Eckerle, D.R., Gilmer, T.L. Gubbels, G.A. Huckleberry, H.J. Marriott, K.J. Schmidt, and L.A. Yose (1986).

REPORTS OF INVESTIGATIONS

Coal resources of the Tongue River Member, Fort Union Formation (Paleocene), Powder River Basin, Wyoming and Montana: RI 35, by W.B. Ayers, Jr. (1986).

Geothermal resources of the southern Powder River Basin, Wyoming: RI 36, by K.L. Buelow, H.P. Heasler, and B.S. Hinckley (1986).

Mineral deposits of the Encampment mining district, Sierra Madre, Wyoming - Colorado: RI 37, by W.D. Hausel (1986).

WYOMING GEO-NOTES

No. 11: by G.B. Glass, R.H. DeBruin, R.E. Harris, R.W. Jones and W.D. Hausel (June, 1986).

No. 12: by G.B. Glass, R.H. DeBruin, R.W. Jones, W.D. Hausel, R.E. Harris, A.J. VerPloeg, and J.C. Case (October, 1986).

No. 13: by G.B. Glass, R.H. DeBruin, R.W. Jones, R.E. Harris, W.D. Hausel, A.J. VerPloeg, and J.C. Case (January, 1987).

No. 14: by G.B. Glass, R.H. DeBruin, R.W. Jones, W.D. Hausel, R.E. Harris, J.C. Case, and A.J. VerPloeg, (April, 1987).

ADVERTISING MATERIALS

Publications available from the Geological Survey of Wyoming, September, 1986, compiled by Sheila Roberts (1986).

Publications available from the Geological Survey of Wyoming, April, 1987, compiled by Sheila Roberts (1987).

Poster of Wyoming geology popular publications, designed by Sheila Roberts (1986).

In addition, the State Geologist, Division geologists, or the Editor wrote and(or) edited the following twenty-five papers and reports for outside publishers:

American Association of Petroleum Geologists Bulletin: *Developments in coal in 1985*, by S.A. Friedman, R.W. Jones, M.L.W. Jackson, and C.G. Treworgy (1986).

American Institute of Mining and Metallurgical Engineers, *Mining Engineering: Wyoming [Exploration in 1987]*,

by W.D. Hausel, R.E. Harris, and R.W. Jones, (1987).

Association of American State Geologists, *The State Geologists Journal: Wyoming [Geological Survey activities]*, by G.B. Glass, (in press).

International Journal of Coal Geology: *Fluorescence spectral analysis of resinite macerals from coals of the Hanna Formation, Wyoming, U.S.A.*, by S.C. Teerman, J.C. Crelling, and G.B. Glass (1987).

McGraw Hill, Inc., *Keystone Coal Industry Manual: Description of Wyoming coal fields and seam analyses*, by G.B. Glass (1987).

Montana Bureau of Mines and Geology Special Publication 94: *Belt Supergroup: a guide to Proterozoic rocks of western Montana and adjacent areas*, Sheila Roberts (technical editor) (1986).

Montana Geological Society and Yellowstone Bighorn Research Association Joint Field Conference and Symposium: *Influence of faulting on Upper Cretaceous-Lower Tertiary deposition, Bighorn Basin, Wyoming*, by S.E. Parker and R.W. Jones (1986).

U.S. Bureau of Mines Preprint from the 1985 Bureau of Mines Minerals Yearbook: *The mineral industry of Wyoming*, by K.E. Starch and G.B. Glass (1987).

U.S. Department of Energy: *Reconnaissance examination of selected oil sand and oil spring occurrences in Wyoming*, by A.J. VerPloeg (1986).

U.S. Geological Survey Water-resources Investigations Open File Report 83-545: *Coal, in Hydrology of Area 50, Northern Great Plains and Rocky Mountain Coal Provinces, Wyoming*, by G.B. Glass (1986); *Open File Report: Geology and mineral resources of the Sweetwater Rocks Wilderness Study Area, Fremont County, Wyoming*, by W.C. Day and W.D. Hausel (in press).

University of Missouri-Rolla, North American Conference on Tectonic Control of Ore Deposits and the Vertical and Horizontal Extent of Ore Systems: *Tectonic control of sandstone uranium deposits*, by R.E. Harris (in press); *Structural control of gold deposits in the South Pass greenstone belt, Wind River Mountains, western Wyoming (USA)*, by W.D. Hausel (in press).

University of Wyoming Civil Engineering Department, Proceedings of Governor's Workshop on Mine Subsidence; *Overview of coal mine subsidence in Wyoming*, by J.C. Case (1986); *Overview of Wyoming coal deposits and coal mining*, by R.W. Jones (1986).

University of Wyoming, Institute for Policy Research, Wyoming Quarterly Update: *Minerals update*, by G.B. Glass, W.D. Hausel, R.H. DeBruin, R.W. Jones, and R.E. Harris [volume 5, no. 4; volume 6, no. 1; volume 6, no. 2; volume 6, no. 3] (1986 and 1987).

Wyoming Geological Association 38th Annual Field Conference Guidebook: *Importance of the Overthrust Belt to Wyoming's petroleum industry*, by R.H. DeBruin (1987); *Preliminary report on gold mineralization, petrology, and geochemistry of the South Pass granite-greenstone belt, Wind River Mountains, Wyoming*, by W.D. Hausel (1987); *Industrial minerals of western Wyoming*, by R.E. Harris (1987); *Select geologic hazards in the Wyoming thrust belt, (abstract)*, by J.C. Case; *The Contact: Notes on the Fourth International Kimberlite Conference, Perth, Australia (abstract)*, by W.D. Hausel (1987); *Earth Science Bulletin: Alcova lake economic stop, Gypsum-Goose Egg Formation*, by Sheila Robert (1986).

4. GATHER AND CONTINUOUSLY UPDATE AND MAINTAIN FILES AND LIBRARIES ON ALL AVAILABLE REPORTS, RECORDS, MAPS, AND OTHER DATA RELATING TO THE SURFACE AND SUBSURFACE GEOLOGY AND MINERAL RESOURCES OF THE STATE.

In FY 87, the Agency (1) enlarged its inventory of mapped and identified geo-

logic hazards, particularly landslides, potentially-active faults, and seleniferous rocks, (2) examined and described numerous mineral occurrences across the State, (3) expanded its coal data in the Bighorn and Wind River Basins and (4) added over 1,417 new documents, reports, and maps to the University of Wyoming's Geology Library and the Survey's library and files through its publication exchange agreements with Federal, foreign, and other State agencies, as well as with the geological surveys of other States.

The Survey also maintains a "Confidential" file of drilling records from holes drilled on State mineral leases. As mandated in Wyoming Statute 36-6-102, all these subsurface drilling reports must be given to the Geological Survey within three years of drilling, after which they become a permanent file. These drilling records remain confidential for seven years after their receipt or until expiration of the lease, whichever is less (see also page 23).

With the exception of the "Confidential" drilling records mentioned above, files and libraries of the Survey are available to the public. A public-use area is provided on the second floor of the Wyoming Geological Survey Building. This area hosts microfiche and paper copies of many oil and gas well logs, aerial photography, unpublished geologic and mineral reports, U.S. Geological Survey and U.S. Bureau of Mines Open File Reports on Wyoming, U.S. Department of Energy uranium reports for Wyoming, Environmental Impact Statements, Industrial Siting Applications, numerous trade journals, scientific magazines, as well as other items.

In a concerted effort, the Coal and Oil and Gas Divisions continued to enter mineral resource data into the Survey's IBM PC/XT computers for easier management and manipulation of data. The initial goals of this computerization effort are the input of mineral production, reserves, and contract and price information.

REVENUE FROM ADMINISTRATIVE PROGRAM

The only revenue directly derived from the Administrative Program is for space rented to the U.S. Geological Survey on the second floor of the Wyoming Geological Survey Building. Rental for this space was \$5,920.20 in FY 87.

This lease, however, was not renewed in FY 88.

Revenue from the sale of Geological Survey publications is discussed under the accomplishments of the Publications Program (pages 19 to 22).

OUTSIDE FUNDING SOURCES (GRANTS)

Grants are another source of revenue. But unlike the publications sales and the rental revenues which go directly into the General Fund, grant funds are used by the Geological Survey to support special projects or investigations. These grants come from outside sources with the Survey providing service in kind. The Survey does not seek any General Fund appropriations for these types of projects as each project is 100 percent funded by the cooperating entity, be it State or Federal.

Investigations and projects of this sort provide data that the Agency otherwise could not assemble or collect in as timely a manner. In all cases, the Geological Survey only undertakes these projects when they support its mission or goals and are clearly of mutual benefit to the State of Wyoming. Each of these projects generally results in a salable publication. Revenue from the sale of these reports eventually repays a part of the in-kind expenses. The Survey is not dependent on these funding sources, but is only augmented by them when it is in the best interest of the State.

In FY 87, the Survey had ten outside grants totaling \$109,527. Of these funds, the Survey's grant-related expenditures in FY 87 were \$49,898. A summary of ongoing or completed grants in FY 87 (to include the expenditures from each grant) are summarized below: 01.05 (\$2,000) for compilation of maps depicting known surficial structural features

across the State. These funds, which partially funded the project, were provided by the Wyoming Department of Health and Social Services (Revenue Code 64071); 03.12 (\$7,836.71 carryover from FY 86) for geologic mapping in the South Pass-Atlantic City area, funded by the U.S. Geological Survey's COGEOMAP Program (Revenue Code 78008); 03.22 (\$9,766.19 carryover from FY 86) for geologic mapping in the southern Bighorn Mountains. These funds were provided by the U.S. Geological Survey's COGEOMAP Program (Revenue Code 78008); 03.60 (\$12,404.64 carryover from FY 86) for mapping of landslides in Wyoming, funded by the U.S. Geological Survey (Revenue Code 78001); 03.70 (\$6,305.15 carryover from FY 86) for entry of coal data into the U.S. Geological Survey's National Coal Resources Data System (NCRDS) (Revenue Code 78008); 03.13 (\$805.02) for another year's mapping in the South Pass-Atlantic City area (an extension of the 03.12 grant above), funded by the U.S. Geological Survey (Revenue Code 78008); 03.23 (\$1,552.91) for another year's mapping in the southern Bighorn Mountains (an extension of the 03.22 grant above), funded by the U.S. Geological Survey (Revenue Code 78008); 03.61 (\$400) to offset field costs in a selenium investigation in the proposed Sandstone Reservoir area, funded by the U.S. Geological Survey; 03.74 (\$6,827.74) for continuation of the NCRDS coal data entry project (see 03.70 grant above), funded by the U.S. Geological Survey (Revenue Code 78008); and 03.90 (\$2,000) for geologic mapping in

the Sweetwater Rocks Wilderness Study Area, funded by the U.S. Geological Survey (Revenue Code 78008). A tenth grant (01.52) for \$15,000 was received from the U.S. Bureau of Land Management at the very end of FY 87, and no expenditures were made in that fiscal year. This grant will allow the compilation and publication of coal drill hole and coal analytical data derived from Federal drilling projects over the last several years.

Although none of the above grants

currently extends past the 1987-1988 Biennium, the Survey anticipates that new, similar, cooperative working agreements will be developed during the 1989-1990 Biennium although funding from these outside sources is likely to be at reduced levels. It is anticipated that the COGEOMAP grants with the U.S. Geological Survey and the drilling report project with the U.S. Bureau of Land Management will be renewed when they expire in FY 87. The U.S. Geological Survey, however, may not renew their NCRDS project.

Major accomplishments by Publications Program

OBJECTIVES

Publications are an essential part of the Survey's overall service function as mandated by law (W.S. 9-2-805, part a, subsections iv and v). The Publications Program, which is supervised by the Editor, is the sales arm of the Survey and performs an essential role in the sale and distribution of information to the public. This Program also provides the funds for preparing and printing geological information collected and interpreted by Survey personnel or outside

authors. The Program has two full-time employees.

The major objectives of this Program are three-fold: (1) to sell Survey publications at prices that result in a reasonable return in revenues, (2) to improve public and private sector awareness and accessibility to earth-science information, and (3) to respond to inquiries related to Survey publications and publication techniques.

ACCOMPLISHMENTS

For each of these major objectives, the activities and accomplishments of the Publications Program in FY 87 are described below:

1. SELL SURVEY PUBLICATIONS AT PRICES THAT RESULT IN A REASONABLE RETURN IN REVENUES.

Expenditures for the Publications Program in FY 87 were \$120,337, which is five percent below expenditures in FY 85 and one percent below expenditures in FY 86. By way of background, the Publications budget has changed. It was originally only designed to provide funds for printing and distributing the Agency's

publications and for publications and maps purchased for resale (see Figure 2 on page 5). As the scope and volume of investigations and the style of reports and maps changed, the budget of the Publications Program grew to accommodate the increased activity. Changes were also made in the budgeting procedure. New line items were added for other kinds of supplies and services that were more closely related to publications than to the Administrative Program. In FY 79, the salaries of two employees were shifted over from Administration to Publications. These two employees evolved into the Publication Sales Manager and the Editorial Assistant.

Prices charged for individual items and quantities printed are based on actual printing costs and the nature of the item. Some publications are highly scientific or technical and have a limited market, others are specifically written for the general public. Some have an enduring market appeal, whereas others are timely, but sales are shorter term. This variety of publications allows the Survey to meet the needs of a varied public, from industry geoscientists who want timely information about Wyoming's mineral resources, to government agencies that want information for planning and development decisions, to tourists and Wyoming citizens who can be encouraged to understand and enjoy the State through its geology. It is important that the price of Survey publications be affordable to these groups, as a service to the State.

Part of the Publications Program is budgeted for "purchases for resale". In this way the Survey enhances the availability of special books and maps published by the U.S. Geological Survey or similar organizations, which have an appeal to Wyoming citizens or tourists. It is another type of information service. Topographic maps and the new *State geologic map* are two important items provided by this mechanism. Because nearly all these publications are purchased at 30-50 percent discounts, the rate of return on these items is substantial. For example, the estimated \$24,000 that will be used for the purchase of topographic maps in the FY 87-88 Biennium, will result in approximately \$45,000 in revenue to General Fund (a net gain of \$21,000).

Revenues generated from the sale of publications are deposited in the General Fund. Weekly tallies are reported to the State Geologist. Quarterly tally reports, which show monthly income totals and the number of each type of report or map sold, are submitted to the Geological Survey Advisory Board. Table 2 summarizes the percentage breakdown of revenue from publication sales by publication type for FY 87.

Table 2. Percentage breakdown of revenue from publication sales by publication type for Fiscal Year 1987.

32%	Topographic maps (Includes metric series)	\$22,513.00
19%	Bulletins	\$13,490.50
10%	Map Series	\$ 7,738.50
8%	Report of Investigations	\$ 5,472.00
7%	Public Information Circulars	\$ 4,616.00
5%	Geologic Map of Wyoming	\$ 3,555.10
4.5%	Open File Reports	\$ 3,192.00
3%	Geologic Highway Map	\$ 2,148.00
2%	Preliminary Reports	\$ 1,325.00
1%	Reprints	\$ 722.50
0.5%	County Resource Series	\$ 340.00
<hr/>		
92%	Subtotal	\$65,112.60
8%	miscellaneous publications and price difference for mailed publications.	\$ 5,274.66
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	Grand Total	\$70,387.26

Biennial budget requests for commercial printing funds are geared to revenue collected from the sale of publications during the two previous years. In other words, the funds requested of the Legislature for commercial printing costs are already on deposit in the General Fund. As a general rule, sales income had been increasing at the rate of \$6,500 per year until FY 81. Sales income in FY 81, however, increased a phenomenal \$51,799 over FY 80. With the subsequent recession, however, sales declined substantially, dropping to \$48,878 in FY 84. In an effort to increase annual revenues, prices were raised approximately 56 percent in late FY 85, and the preparation and publication of reports and maps were accelerated. A complete listing of the 57 Survey publications published in FY 87 is provided on pages 14 to 16. Slumping sales were successfully turned around in FY 85 (\$72,389), but decreased slightly again in FY 86 (\$71,317), and in FY 87 (\$70,387) (Figure 7). In the last three fiscal years, the Publications Program

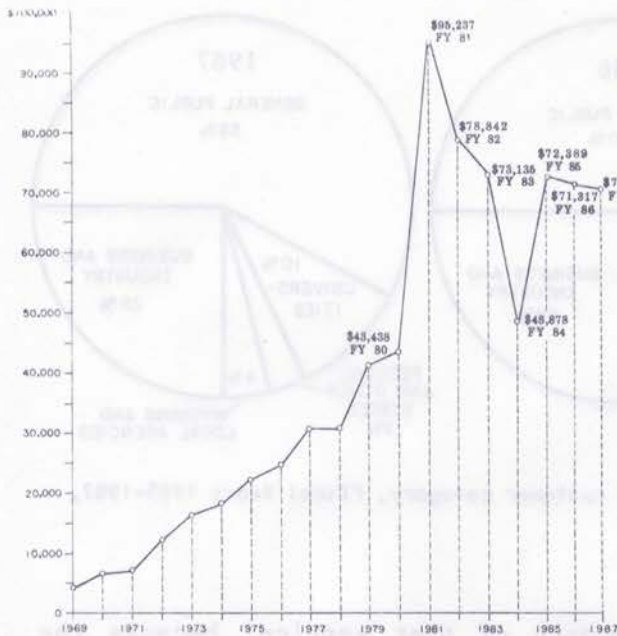


Figure 7. Fiscal year income to the General Fund from Survey publications.

recovered 57, 59, and 58 percent of its overall costs, respectively. This compares to only 40 percent recovered in FY 84.

Level funding and small cuts in the appropriations for the Publications Program over the last three years has necessitated some changes. Antiquated photographic and drafting equipment has been kept rather than replaced; several prepared manuscripts are deferred from publication until each following year; and an increasing number of publications are prepared as open files rather than sent out for commercial printing. For example, in FY 84 only 35 percent of the manuscripts were open filed, compared to 56 percent in FY 87. An open file report is one that is prepared in a reproducible format and is reproduced only as requested. The advantage to this procedure is the timeliness of release (it does not have to wait for available printing monies). The disadvantages are the often poor reproduction; the inability to adequately illustrate the reports, particularly in regard to photographs; and the sometimes high cost of reproduction, particularly if there are a number of large illustrations.

In FY 87, the Publication Sales Manager and Editorial Assistant responded to 2,891 written inquiries about publications, answered an average of 25 telephone inquiries per day, and received 4,432 publications sales, a slight increase over FY 86. The decline from the record 11,119 received sales in FY 81 reflects the general economic decline that has characterized the minerals and petroleum industries in that period. Figure 8 shows a percentage breakdown of revenues derived from the sale of publications over the last three fiscal years, arranged by customer category.

As evidenced by Figure 8, the revenues from sales to the general public have been steadily increasing since FY 85 (an increase of 12 percent). Most of this increase is attributed to increasing sales of topographic maps used for recreation as well as other purposes.

Table 3 points out that the volume of receipted sales in each customer category and the revenues derived from that customer category are not always directly proportional, i.e., although the business and industry category represents fewer purchases than the general public, the sales are for greater dollar amounts.

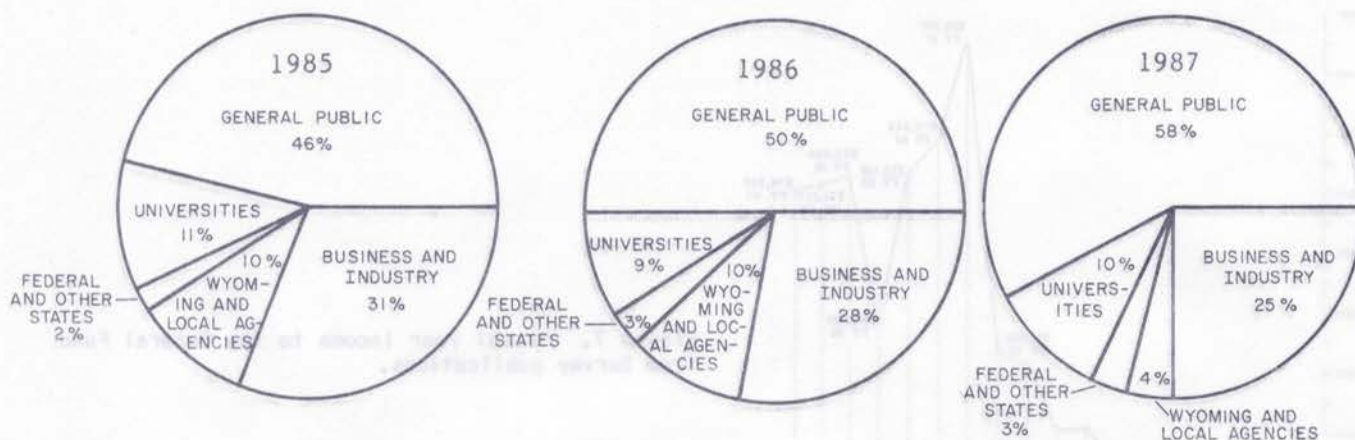


Figure 8. Percentage of publication revenue, arranged by customer category, Fiscal Years 1985-1987.

Table 3. Percentage breakdown of FY 87 publication sales by customer category and by sales revenue.

Category	Percent of Customers	Percent of Sales Revenue
General Public	75%	57%
Business and Industry	16%	25%
Wyoming and Local Agencies	2%	4%
Federal, Other States and Foreign	1%	3%
Universities	6%	10%

Responding to a request from the Advisory Board, the Publications Program in FY 87 included an increased effort to make the public aware of valuable earth-science publications available from the Geological Survey of Wyoming. In addition to the regular mailings of press releases describing new items, Survey publications were displayed and sold at ten meetings of professional geological associations and rock and mineral clubs in the region. This effort resulted in additional revenues of \$4,180.

Continuing an effort begun in FY 86, a poster describing the Survey's topographic map sales and another with information about some of the more popularly oriented publications on geology were produced and distributed in the region. Topographic map sales increased in FY 87 because of increased public

awareness of that service, because the Survey is now selling maps by mail order as well as over the counter, and because the Survey is now the only sales outlet in Wyoming with a complete inventory of Wyoming topographic maps.

Publications of the Geological Survey are also distributed free-of-charge to libraries and archives throughout the State. Limited numbers of each publication are also provided to other State agencies and branches of government and to elected officials on request. In addition, the Survey participates in publication exchange programs with all other state geological surveys, numerous foreign geological surveys, the U.S. Geological Survey, the U.S. Department of Energy, the U.S. Bureau of Mines, and other entities. These distributions do not add directly to sales revenue, but they provide an important service to the State and allow acquisition of publications from out-of-state agencies without direct charge. The publications acquired through the Survey's exchange agreements are subsequently donated to the University of Wyoming's Geology Library. In FY 87, an estimated 1,417 publications were received in exchange for Survey publications.

3. RESPOND TO INQUIRIES RELATED TO SURVEY PUBLICATIONS AND PUBLICATION TECHNIQUES.

As an offshoot of the Publications Program activities, the Publications Division answers a variety of inquiries in addition to those directed to the Publications Sales Section, as described above. Members of the publishing industry and advertisers regularly request information about Survey publications and many of these contacts result in free publicity for the Survey. Local governmental agencies, especially school districts, libraries, museums, and chambers of commerce occasionally inquire about publications, and in FY 87 there were several requests for the posters on topographic maps and popular publications. State agencies request information and posters.

The Editor also answers requests for information about Survey editing tech-

niques, policies, and procedures from agencies, organizations, and consultants. In FY 87 these came from the Wyoming Geological Association, the Western Research Institute, the University of Wyoming, the Montana Bureau of Mines and Geology, and the Kansas Geological Survey.

The cartographers, frequently advise University of Wyoming faculty, staff, and students on drafting techniques. They also occasionally advise consultants and members of the general public. The Cartographic Section provided a major service to the Wyoming Department of Agriculture by scribing and making a color proof of the *Wyoming land inventory map*. This map will be a joint Department of Agriculture/Geological Survey publication in FY 88.

Problem areas and recommendations

1. Wyoming Statute 36-6-102 requires a company that drills an exploration hole on a State lease to submit copies of all subsurface log reports (electrical, gamma-ray, neutron, density, resistivity, etc.) to the State Geologist within three years after completion of drilling. Copies become the property of the State to be retained within the permanent files of the Geological Survey. These subsurface log reports are held "confidential" for a period of seven years after receipt by the State Geologist or until expiration of the lease, whichever is the lesser period of time. If a lease is being held by production, all reports will be held confidential until the lease is terminated.

Although many companies have complied with this law, the small amount of data turned in suggests that there are many companies that have not complied. Because there is currently no requirement for a company to notify the State Geologist that they are drilling or have drilled exploration holes, there is no efficient way to verify the compliance with this law. Oil and gas companies

pose no concern as their logs are routinely turned into the Wyoming Oil and Gas Conservation Commission, thus meeting the provisions of this law since copies of these logs are forwarded to the State Geologist. Exploration logs for other minerals, however, present a problem.

Currently, when the State Geologist learns that subsurface drilling reports are available but not turned in, a letter to the delinquent companies, produces the reports. This procedure, however, only works when the State Geologist finds out holes were drilled and when he ascertains who to write to. Although at least a partial listing of exploration holes in Wyoming was acquired from the Land Division of the Department of Environmental Quality in FY 87, the Geological Survey lacked the funds and manpower to evaluate the value of the newly acquired information on drilling projects.

If this law is to be truly effective in gathering and preserving the valuable mineral resource information provided by

subsurface drilling information, it needs revised. The revisions should provide some mechanism that will alert the Geological Survey to the drilling of holes on State lands so that the Agency can monitor compliance with the law, i.e., timely follow-up letters can be written if the information is not received within three years of a drilling program. In addition, penalty provisions for noncompliance may be needed. The law would also be more valuable if it required oil and gas companies to at least run gamma-ray logs to the surface in all wells drilled on State lands.

2. There is still a need for a State Minerals Supervisor. In essence, this Minerals Supervisor would be comparable to Wyoming's Oil and Gas Supervisor with responsibility for verifying production reports, preventing waste and promoting conservation of the State's mineral resources, exclusive of oil and gas. In particular, there is no State agency specifically assessing mining and exploration activities on State-owned lands.

It is recommended that the responsibility and authority for such a position be assigned to the Department of Public Lands. Alternatively, it appears that the Board of Land Commissioners already has the authority to direct the State Geologist to make such appraisals at least on State or school lands through Wyoming Statutes 9-2-803, Paragraph (c), part (i). This alternative however, would require at least one additional full-time position in the Geological Survey.

3. The Geologic Hazards Division of the Survey has not only been responsible for compiling, mapping, and interpreting information on existing and potential geologic hazards in the State, but has also been responding to hydrologic inquiries involving water wells and dam sites. Over the last two years, requests for maps and information on geologic hazards has more than tripled. In particular, the State's Emergency Manage-

ment Agency has requested the Section's participation in preparing County Disaster Preparedness Plans. Similar requests have come from the counties that are involved. Responses to these requests have dominated the Division's activities and left little time for the equally important hydrologic inquiries, which have also increased in number.

The Geologic Hazards Division currently consists of one full-time Division geologist and one half-time assistant. The Division staff only expands in size if contracts or grants are acquired. Unfortunately, the contracts and grants that the Division has had required a specific product only indirectly related to disaster preparedness, and personnel hired under those terms have specific duties that relate only to the funded grant.

The existing staff could eventually address all the inquiries, however, the timetables requested by the Emergency Management Agency and the counties require much more accelerated responses if they are to be timely. Consequently, other important activities of the Division such as the assessment of naturally-occurring toxic elements (selenium and radon), have been considerably scaled down.

In order to free the Geologic Hazards Geologist to meet all these increased demands for information on geologic hazards, the Survey has suspended its activities related to ground-water geology and hydrology. Correspondence with the State Engineer's Office indicated that this hydrologic work was probably a duplication of effort as that office has personnel who can perform the same services. Since early FY 87, requests for assistance related to ground water and hydrology, directed to the Survey, have been referred to the State Engineer's Office.

4. The most pressing problem for the Survey is the need for additional funds in the purchase-for-resale distribution

category. These funds are needed to maintain a complete inventory of topographic maps for the State. Monies provided for this purpose produce substantial revenues for the General Funds. These sales have been accelerated over the last few years by advertising this service and by selling topographic maps by mail order. These two actions were deemed necessary because the Geological Survey of Wyoming is now the only sales outlet for topographic maps in Wyoming that carries a complete stock of all Wyoming maps. A person can still buy these maps in Denver, but it takes months by mail or a very long wait in line for over-the-counter sales. The Geological Survey Advisory Board has requested that every effort be made to maintain this service.

The problem lies in the fact that present appropriations do not provide enough money in the purchase-for-resale distribution category to replenish stocks as they are sold. During the last two years, \$10,000 was transferred from commercial printing funds to maintain this service. By doing this, the printing of several new publications prepared by our Agency were deferred. Continued deferrals are an extreme problem as the backlog of unpublished manuscripts is increasing each year anyway due to limited printing monies under the present level-funding budgets and previous budget cuts.

As justification for requesting additional funding in FY 89-90, we note that

for the \$24,000 spent in purchase-for-resale monies for topographic maps in the FY 87-88 Biennium, the General Fund realized approximately \$45,000 in revenue. This is a net gain of \$21,000. If the purchase-for-resale category is not increased by \$10,000, this service will have to be eliminated, thereby reducing revenue to the General Fund by approximately \$45,000 for the next Biennium, or a 32 percent decline in revenues from the Geological Survey's Publications Program. This estimate of lost revenue is slightly higher than the amount noted in the Agency's FY 89-90 Biennial budget request and stems from the omission of the metric series of topographic maps, which were inadvertently omitted in that earlier discussion.

As an added complication, the U.S. Geological Survey (the agency from which the topographic maps are bought) is considering reducing the 50 percent discount that they currently give to map dealers. It is not clear by how much they might reduce the discount. In our Expanded Budget for FY 89-90, we are asking that the purchase-for-resale category in the Standard Budget be increased by \$10,000 to offset the anticipated shortfall in funds in that Biennium. If the U.S. Geological Survey reduces their discount, the difference will be made up in FY 89 by using commercial printing money as a stop gap measure. Then, prior to the Supplemental Session, this service will be reassessed and perhaps additional funds will be requested.