THE GEOLOGICAL SURVEY OF WYOMING

Gary B. Glass, State Geologist

FORTY-NINTH ANNUAL REPORT

of the

GEOLOGICAL SURVEY OF WYOMING

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INTRODUCTION

The Geological Survey of Wyoming, which is located in the Geological Survey Building on the University of Wyoming campus in Laramie, was established as a State agency in 1933. The agency operates under Wyoming Compiled Statutes 9-3-1420 through 9-3-1430 (1979) Div. 2, and functions principally as a service organization, providing the State with a source of geological and mineral resource information.

Fiscal affairs of the Survey are administered through direct appropriations from the Legislature in two separate Accounts: Administration (001) and Publications (002); in addition, the Survey contracts for funding from outside sources to conduct cooperative investigations and studies, or to assist with publication printing costs. Figure 1 illustrates the historical and present aspects of the Survey's biennial budgets.

The activities of the Survey are broadly grouped into three categories:

Public Services — Includes requests for assistance from the Executive and Legislative branches of State government, State and federal agencies, industry, and the public.

Field and Laboratory Investigations — Special projects that contribute new data or information which has a practical bearing on Wyoming's communities and people.

Publications — The timely preparation and distribution of reports and maps that communicate the results of the agency's investigations.

In addition, all of the Survey's professional staff function continuously in an advisory capacity for all branches of State government on geological matters that are directly or indirectly related to mineral exploration, leasing, proposed legislation, rule changes, and the impact of federal actions.

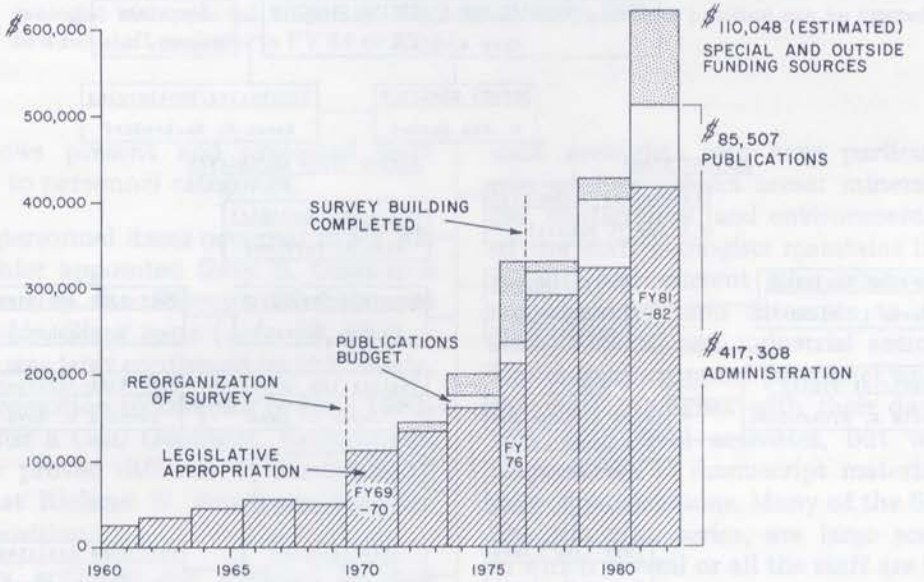
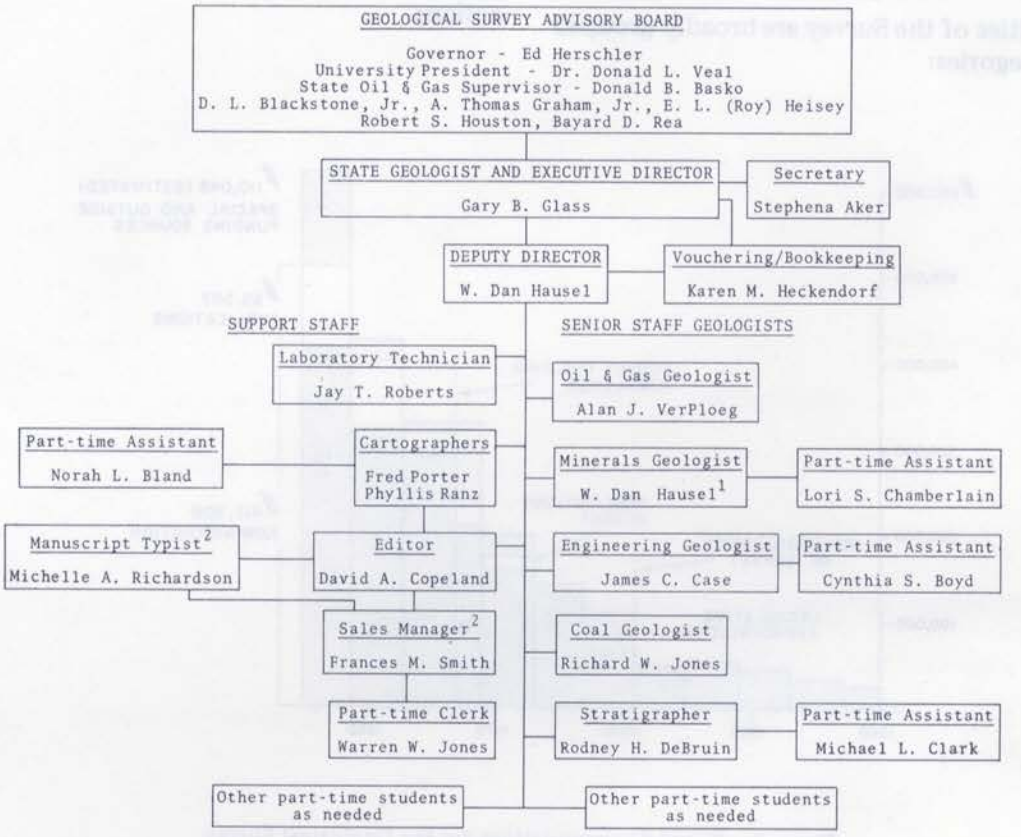


Figure 1: Biennial appropriations for the Geological Survey

ORGANIZATION

During FY 82, the Geological Survey had an appropriated budget of $540,677 for the Administrative and Publications Programs. In addition, (1) $17,865 was provided by the Department of Environmental Quality for an inventory of geologic hazards, (2) the University's Mining and Mineral Resource Research Institute provided $10,800 for diamond investigation and $1,700 for solution mining research, (3) the University's Geology Department provided $7,300 from a NASA-sponsored study of remote sensing techniques in diamond exploration, and (4) $1,000 was received in honorariums for short courses presented to the American Association of Petroleum Geologists.

In FY 82, the Geological Survey was authorized 14 full-time and 14 part-time positions. Owing to budgetary constraints, only 6-8 of the part-time positions were filled during the fiscal year. The following organizational chart reflects the Survey's personnel situation at the end of FY 82.



[1] W. Dan Hausel divided his responsibilities between administrative duties and those of our Minerals Geologist. A new staff minerals geologist position was authorized for FY 83-84.

[2] These positions are paid out of our Publications Budget.

Figure 2. Organizational chart for the Geological Survey of Wyoming in FY 82.

Table 1. Present and projected staff needs

	1981	1982	1983	1984	1985	1986
State Geologist and Director	1	1	1	1	1	1
Geologic Program Manager (Deputy Director)	1	1	1	1	1	1
Staff Geologists	4	4	4	4	5	5
Assistant Staff Geologists	0	0	1*	1	0	0
Laboratory Technician	1	1	1	1	1	1
Editor	1	1	1	1	1	1
Cartographers	2	2	2	2	2	2
Secretary	1	1	1*	1	2	2
Bookkeeper/Secretary	1	1	1	1	1	1
Publications Sales Manager	1	1	1	1	1	1
Manuscript Typist	1	1	1	1	1	1
Clerk/Typist	0	0	0*	0	1	1
Total Full-time Staff	14	14	15	15	17	17
Part-time Technical and Office Help (not all filled)	14	14	14	14	12	12
Total Number of Positions	28	28	29	29	29	29

*Requests were made in the FY 83-84 budget recommendation for a fifth staff geologist, a second full-time secretary, and a full-time clerk/typist, but only an assistant staff geologist was approved. Hopefully, this assistant staff geologist position can be upgraded to a full staff geologist in FY 84 or FY 85.

Table 1 shows present and projected staff needs in relation to personnel categories.

Two major personnel items occurred in FY 82. Governor Herschler appointed Gary B. Glass to a full six-year term as the Survey's Director and State Geologist. Mr. Glass' term (June 18, 1981 — March 1, 1987) was later confirmed by the Senate.

Mr. Glass' promotion to Director in June 1981, left a vacancy for a Coal Geologist. Recruitment for this vacancy proved difficult. It was not until March 1982, that Richard W. Jones was hired to fill that vacant position.

Most Survey activities are initiated by and depend upon the productivity of the individual staff geologists who have particular expertise in one of five subject areas: minerals, coal, oil and gas, stratigraphy, and environmental geology. Each of the staff geologists maintains libraries of information and current files relative to his area of responsibility, and attempts to keep abreast of state, federal, and industrial activity. The agency also employs support personnel who not only assist the staff geologists with their day-to-day, laboratory, and field activities, but who also handle preparation of manuscript material, printing, and sale of publications. Many of the Survey's projects, like the map series, are large scale team efforts in which several or all the staff are involved.

MAJOR ACCOMPLISHMENTS BY PROGRAM

ADMINISTRATION (01)

During FY 82, Survey geologists responded to about 3,156 telephone calls, letters, and personal visits from people requesting information and assistance relating to the geology and mineral re-

Table 2. Percentage Breakdown of Staff Geologists' Activities

	Range	Average
Services to the general public, State agencies, federal agencies, and others	40-50%	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%

sources of the State. For comparison, inquiries in FY 81 numbered 2,960 compared to 1,846 inquiries in FY 80. This equates to 1.8 inquiries per day in FY 80, 2.4 inquiries per day in FY 81, and 2.5 inquiries per day in FY 82. Many of these responses required only a few minutes to complete because the information was readily available; other types of requests required up to several hundred man-hours of effort because new material had to be obtained, organized, drafted, and printed for appropriate presentation.

Table 2 shows a percentage breakdown of the Staff Geologists' activities by category.

As evidenced above, each of the staff geologists, with the help of part-time personnel, conducted other activities in addition to their service role. General summaries and major activities of the various Sections are discussed below. A discussion of laboratory support activities is also included. Appropriations for the Administrative Program were $427,750 in FY 82.

Oil and Gas Section (Alan J. VerPloeg)

The Oil and Gas Section functions as a principal source of geologic information on Wyoming's oil, natural gas, and oil shale deposits. In addition, the Section maintains a library of petroleum-related data and conducts independent investigations on hydrocarbon-bearing deposits in the State.

Throughout FY 82, the Section continued to receive and file substantial amounts of new subsurface information provided by the petroleum industry and directed to the Survey through the Wyoming Oil and Gas Conservation Commission. All new oil and gas discoveries were evaluated with regard to State mineral ownership and reported to the Commissioner of Public Lands.

Late in FY 82, the Oil and Gas Section, in conjunction with the Stratigraphy Section, initiated work on a characterization study of the Trapper Canyon Tar Sand Deposit southeast of Shell, Wyoming, on the western flank of the Bighorn Mountains. In FY 83, funding for this project will be provided by the University of Wyoming's Institute of Energy and Environment in response to a grant from the U.S. Department of Energy's Laramie Energy Technology Center.

Report of Investigations No. 21 — *The search for oil and gas in the Idaho-Wyoming-Utah salient of the Overthrust Belt* was completed and published in FY 82. In addition, Public Information Circular No. 17 was completed, presenting an overview of Wyoming's oil and gas industry.

Outside papers included *Wyoming's oil and gas industry — past, present, and future*, which was written for and presented at the 32nd Annual Field Conference of the Wyoming Geological Association in September 1981. In addition, summer, fall, winter, and spring petroleum outlook articles were written for the University of Wyoming's *Wyoming quarterly update* publication. Also in May 1982, the Section organized the academic poster sessions and commercial exhibits for the joint meeting of the Wyoming Geological Association, the University of Wyoming's Geology Department and the Geological Survey of Wyoming.

Minerals Section (W. Dan Hausel)

The Minerals Section functions as a principal source of information on Wyoming's base, precious, industrial, and uranium minerals as well as construction materials. The Section also supervises and conducts independent and cooperative investigations on the characteristics and distribution of

various mineral deposits throughout the State and adjacent areas. Mining firms, citizens and prospectors of Wyoming and adjacent areas obtain information and assistance on prospects and on rock and mineral identifications from this Section.

In FY 82, the Section continued its investigations of diamond-bearing kimberlite in the Laramie Range. One on-going project involved stream sediment sampling of drainages near Sybille Canyon and in the vicinity of Happy Jack. Sampling during FY 82 was designed to isolate the source of anomalous stream sediment samples that were collected in FY's 81 and 82. This project was funded by two grants ($7,185 and $14,370) from the University's Mining and Mineral Resource Research Institute (MMRRI). Much of the larger grant was spent in FY 81 in that it was funded for September 30, 1980 to September 30, 1981.

A second on-going kimberlite research project is a NASA-sponsored joint venture between the Minerals Section and the University's Geology Department. This project will investigate rapid exploration techniques for diamond-bearing kimberlites. Potential kimberlite targets will be located by remote sensing, followed by field investigations (geophysical surveys, geological mapping, and stream sediment sampling). During FY 82, magnetics, electromagnetics, and electrical resistivity surveys were run over a group of known kimberlites in an effort to develop characteristic geophysical responses. This project is funded by a grant from the University's Geology Department ($17,450). Because the grant is funded for February 1, 1982 to February 1, 1983, the grant was partially expended during FY 82.

Late in FY 82, a project funded by the University's MMRRI ($4,990) resulted in preliminary geological field investigation of low-grade base and precious metal deposits that may be amenable to solution mining research. The grant funded research for the period June 1, 1982 to August 31, 1982. More than a dozen deposits were examined with the bulk of the investigation concentrating on low-grade copper and minor gold-silver mineralization in the Silver Crown District of the Laramie Range. The Copper King deposit and alteration patterns were mapped in detail, and approximately 100 samples were collected for later alteration research by petrographic microscope and X-ray diffraction methods. The Copper King contains a low-grade resource of 10 million tons of 0.30 percent copper and 0.038 ounces of gold per ton. Additionally, three abandoned underground mines and a few square miles of surface geology were mapped as part of the Copper King project.

Papers published by the Minerals Section during FY 82 included: *Economic mineral deposits of Wyoming — a review*, published in the 1981 Wyoming Geological Association Guidebook; *Ore deposits of Wyoming*, Geological Survey of Wyoming Preliminary Report No. 19; and summer, spring, fall and winter mineral activity and economic updates published in the University's *Wyoming quarterly update*.

Papers prepared in FY 82 that are scheduled for publication in FY 83 are: *General geologic setting and mineralization of the porphyry copper deposits, Absaroka volcanic plateau, Wyoming*, Wyoming Geological Association 1982 Guidebook; *Geology of Elmers Rock greenstone belt, Laramie Range, Wyoming*, Geological Survey of Wyoming Report of Investigations No. 14; and *Radioactive occurrences and uranium mines of Wyoming*, which will be published as a Survey Bulletin.

The Minerals Section presented a paper on economic mineralization of base and precious metal deposits in Wyoming to the 1981 Wyoming Geological Association field conference, and a talk on exploration and mining techniques of diamond-bearing kimberlite to the University of Wyoming Geology Club. Additionally, as a co-sponsor, preparations and field trip guides were undertaken in FY 82 for the International Archean Geochemistry Field Conference held in Wyoming early in FY 83.

Finally, the Minerals Section assisted in the review of some University of Wyoming graduate theses related to igneous petrology and mineral deposits, assisted the U.S. Forest Service in their review of minerals management planning, and provided the Forest Service with field assistance in a known diamond-bearing area under consideration for a federal land exchange.

Coal Section (Gary B. Glass)

The Coal Section serves as a major source of information on Wyoming's coals, coal-bearing rocks, and coal mining activity; conducts laboratory and field investigations of the characteristics and distribution of the State's coal resources; and maintains a library and file of coal-related data.

In FY 82, the Section was handicapped by the lack of a staff coal geologist between June 1981 and March 1982. For this reason most activities were service-related. The Section authored an outside paper for the 32nd Annual Field Conference Guidebook of the Wyoming Geological Association titled: *Coal Deposits of Wyoming*, and prepared

quarterly outlooks for the University's *Wyoming quarterly update* publication.

In addition, the Coal Section continued to assist in the Environmental Section's geological hazard study. Work is continuing on this project, which is more fully described in the discussion by the Environmental Section.

Environmental Section (James C. Case)

The main functions of the Environmental Section are to compile, create, and make available pertinent information on environmental and engineering geology matters in Wyoming. In this regard, field investigations are as much a function of the Section as its service responsibilities.

The Environmental Section both reviewed and generated information for various environmental impact statements and plant siting applications. Numerous reports on land development suitability were submitted to the U.S. Department of Housing and Urban Development for their use in developing environmental impact statements for proposed subdivisions. The Section is assisting various county agencies with their county development plans. Areas geologically unsuitable for development are being defined.

Color infrared aerial photographs were recently acquired and catalogued for most of the State. They are available for viewing in the Section's remote sensing lab. The photographs have been of great assistance in an ongoing geological hazards-unique geological features study. Approximately 1,000 7½-minute quadrangle maps have identified geological hazards delineated on them. The hazards include landslides and landslide prone areas, mine subsidence, avalanche areas, windblown deposits, and flood prone areas. Approximately 100 unique geological features worthy of preservation have been identified to date.

The computer programs for a data management and manipulation system have been completed and tested. The system will store geologic log information and recall it in a number of ways — by basin, county, township, latitude-longitude, oil and gas field, well number, or by formations penetrated. A plotting program is also operable. Data entry has begun and will be an ongoing project for a number of years. In FY 83, various contouring packages will be investigated.

A report and series of maps on geological hazards in Wyoming should be released in FY 83. A more general report on construction problems related to Wyoming geology is also planned.

Stratigraphy Section (Rodney H. DeBruin)

The Stratigraphy Section functions as a principle source of information on the stratigraphy and general geology of Wyoming both to the other sections of the Survey as well as to outside inquirers. The Section also conducts stratigraphic as well as other geologic investigations and maintains a library and file of stratigraphic data.

In FY 82, this Section and the Environmental Section modified and created a number of computer programs for the manipulation of petroleum data. These programs are now operational and should benefit all the sections once the data is entered into the system. The Section also collaborated with the Oil and Gas Section on a comprehensive geologic report on the State's overthrust belt, which was published as Report of Investigations No. 21. In conjunction with the Oil and Gas Section, work was also started on a grant to study the Trapper Canyon Tar Sand Deposit in the Bighorn Basin.

Work is continuing on a series of index maps which depict geologic mapping in the State. So far, three have been published as Map Series MS-9A, MS-9B, and MS-9C. Three more should be published in the near future. Work was started on a *Stratigraphic Atlas of the Bighorn Basin*. This is a continuing project and eventually all the basins in the State will be completed.

Laboratory Section (Jay T. Roberts)

This Section is the analytical and laboratory arm of the Survey and provides assistance to the various other sections when requested. The Survey's lack of sophisticated analytical equipment and, more importantly, its lack of fume hoods have for the most part restricted this Section's activities to field sampling, sample preparation for thin section, chemical, and X-ray diffraction analysis, interpretation of X-ray diffraction patterns and other mechanical processing of samples, i.e., crushing, sieving, and sluicing. Using fume hoods in the University's Geology Department, some heavy mineral separations and chemical tests were conducted that provided additional qualitative descriptions of geologic samples.

The Laboratory Section has continued the concentration of stream sediment samples from the diamond-bearing kimberlite project of the Minerals Section. Both follow-up samples from areas of previous kimberlite indicators, as well as samples from areas not previously investigated, are being concentrated. A magnetic separator, Wilfley table, and

a mineral jig are used to obtain heavy mineral concentrates from field-panned samples. The Laboratory Section has occasionally assisted in the collection of field samples for the kimberlite project.

The Section is also processing crushed kimberlite samples to extract diamonds. A grease table and surface tension floation apparatus is used for this processing. A redundant procedure is used to help increase the diamond recovery from the rather small samples (5 to 500 lbs.). In this redundant procedure, the ore is further disaggregated by subjecting it to several days of tumbling. The ore sample is then reprocessed. Concentrates have been obtained from several kimberlite samples from the Laramie Range and State Line areas. Some very small diamonds have been recovered from the Sloan kimberlite in the State Line area, but for the most part, the concentrates need further concentration before an assessment of the diamond content can be made.

The Laboratory Section has been active in the evaluation and selection of laboratory equipment to enhance the Survey's analytical capabilities. In June, an Olympus BH-T microscope, which uses both transmitted and incident light, was purchased. The microscope should aid in the positive identification of diamonds and heavy mineral kimberlite indicators as well as a variety of other lab applications. The Section also evaluated X-ray powder diffractometers for purchase in FY 83. As a result, an automated system capable of semiquantitative phase analysis was ordered in July 1982. The new instrument should be installed by January 1, 1983.

PUBLICATIONS (02)

The Publications Section of the Survey operated in FY 82 with a budget of $112,927. The Section consisted of a full-time Editor, a Manuscript Typist, a Publication Sales Manager, and several part-time helpers. These personnel prepared all manuscript material for publication, arranged printing contracts, handled the shelving, inventory, and sale of publications, and deposited the income generated from sales into the General Fund.

All of the material published by the Survey is initiated by the staff geologists or by invited outside authors. In either case, the geologists conduct investigations, compile data and photographs, and prepare a manuscript. The Publications Section takes over at that point. They supervise the drafting of illustrations and prepare and assemble a final manuscript that will be suitable for a printer. All printing contracts are negotiated by the Editor through DAFC.

As mentioned above, the Publications Section handles all telephone, letter, and over-the-counter sales of the Survey's publications. In FY 82, the number of sales transactions was 7,995, which is below the record 11,119 transactions in FY 81, but still 400 transactions above FY 80. In addition, the income from publication sales in FY 82 was $87,366. Although this is a decline of $7,871 from the record sales of $95,237 set in FY 81, the FY 82 income is still more than twice the sales collected in FY 80.

The three graphs in Figure 3 summarize the general subject matter of Survey publications, the number of new publications completed each decade, and the annual income derived from the sale of Survey publications.

During FY 82, the Survey prepared and published the following new reports and maps:

Bulletins

No. 61 Bibliography and index of Wyoming uranium — 1973, by C.E. Banks, David Copeland, and W.D. Hausel.

Map Series

MS-9A Index map to U.S. Geological Survey Coal Resource Occurrence and Coal Development Potential open-file reports in Wyoming, compiled by G.B. Glass.

MS-9B Index map to U.S. Geological Survey Geologic Quadrangle Maps in Wyoming, compiled by R.H. DeBruin.

MS-9C Index map to U.S. Geological Survey Miscellaneous Field Studies Maps (MF) in Wyoming, compiled by R.H. Debruin.

Open-File Reports

82-1 Report on investigations related to prospecting for diamond-bearing kimberlite and related placer deposits in Wyoming, by W.D. Hausel.

82-2 Report on selected gold-bearing samples, Seminoe Mountains greenstone belt, Carbon County, by W.D. Hausel.

Preliminary Reports

No. 19 Ore deposits of Wyoming, by W.D. Hausel.

Public Information Circulars

No. 15 Mining laws of Wyoming — 1980, compiled by

DEPAD and the Wyoming Geological Survey.

No. 17 Wyoming's oil and gas industry, by A.J. VerPloeg.

Reprint Series

No. 37 Oil and gas prospecting beneath the Precambrian of foreland thrust plates in the Rocky Mountains, by Robbie Gries.

No. 38 Geology of the Sage and Kemmerer 15-minute quadrangles, Lincoln County, Wyoming, by W.W. Rubey, S.S. Oriel, and J.I. Tracey, Jr.

Report of Investigations

No. 21 The search for oil and gas in the Idaho-Wyoming-Utah salient of the Overthrust Belt, by A.J. VerPloeg and R.H. DeBruin.

The following additional publications were prepared in FY 82 and sent out for printing. Publication of these reports, however, was not completed in FY 82.

Map Series

MS-10 Geologic map of the Dick Creek Lakes, Dunrud Peak, Francs Peak, Noon Point, and Twin Peaks quadrangles, Fremont, Hot Springs, and Park counties, Wyoming, by W.H. Wilson.

Preliminary Report

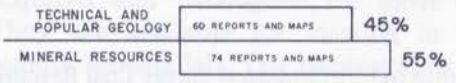
No. 20 The Thermopolis hydrothermal system, with an analysis of Hot Springs State Park, by B.S. Hinckley, H.P Heasler, and J.K. King.

Report of Investigations

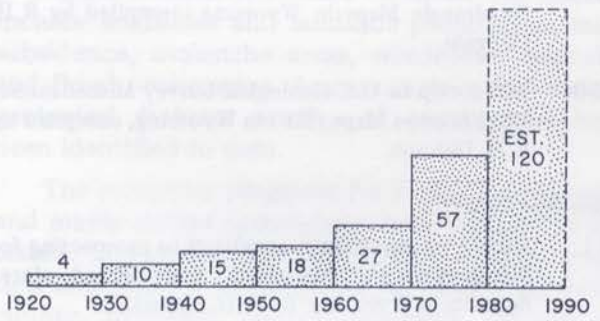
No. 14 Geology of the Elmers Rock Greenstone Belt, Laramie Range, Wyoming, by P.J. Graff, J.W. Sears, G.S. Holden, and W.D. Hausel.

No. 15 Geology of the headwater area of the North Fork of Owl Creek, Hot Springs County, Wyoming, by K.A. Sundell.

Copies of all new Survey publications are distributed free of charge to all county and public libraries in Wyoming, and to State agencies and officials in State government who request them. The Survey also participates in a nationwide interlibrary exchange program with other state geological surveys, an international exchange program with geological surveys of many foreign countries, and exchange agreements with the U.S. Geological Survey, U.S. Bureau of Mines, Department of Energy, and Bureau of Land Management.



GENERAL CONTENT OF SURVEY PUBLICATIONS 1911 THROUGH 1981



NUMBER OF SURVEY PROJECTS COMPLETED AND PUBLISHED PER DECADE

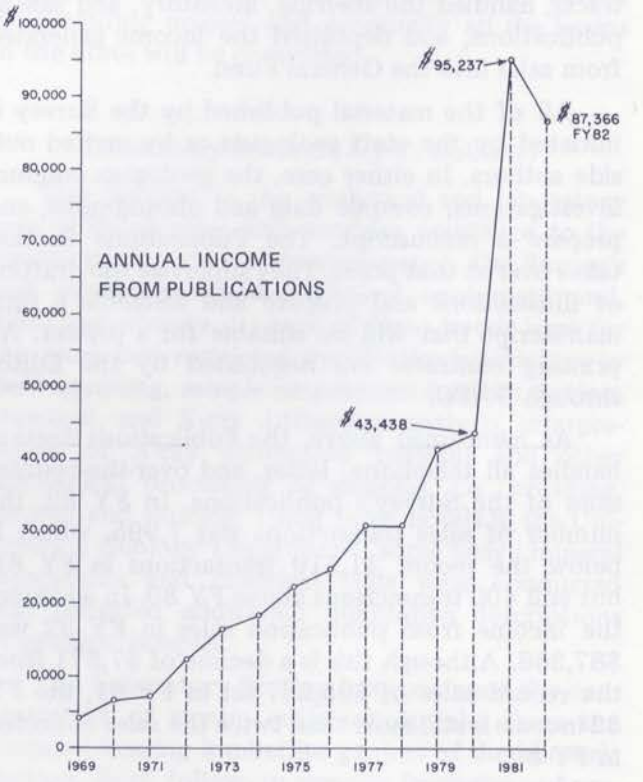


Figure 3. General content of publications; number of publications; and annual income from publications.

PROBLEM AREAS AND RECOMMENDATIONS

1. We again note that 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 preventing waste and promoting conservation of the State's mineral resources, exclusive of oil and gas. In particular, there is no State agency currently assessing mining and exploration activities on State-owned lands to assure that the State's mineral resources are not wasted by inefficient or uncaring operators.

It is recommended that the responsibility and authority for such a position be assigned to the Board of Land Commissioners. Alternatively, it appears that the Board of Land Commissioners may already have the authority to direct the State Geologist to make such appraisals at least on State or school lands (Wyoming Statutes 9-3-1406).

2. When our building was constructed in 1976, the basement laboratory and rest rooms were left unfinished. Our staff and activities have increased enough in the last six years that we now need those facilities. In addition, the lack of *adequate* fume hoods in our existing laboratories has seriously restricted the analytical capabilities of our research. As now designed, we not only cannot use any toxic chemicals, but even highly aromatic compounds produce obnoxious odors that accumulate to irritating levels. The lack of these fume hoods makes most chemical activities in the building a health and safety hazard. For this reason, we must take all our chemical as well as heavy mineral separation work over to the Geology Building where safe hoods are made available to us whenever possible. Unfortunately, the heavy demands on these hoods by faculty and students frequently render them inaccessible to us.

We have contacted DAFC Purchasing in this regard, and with their help, we will request funds to complete the basement laboratory and rest rooms and install fume hoods in the new lab as well as in the existing laboratories on the first and second floors. We plan to have our request to the Capitol Building Commission in early FY 83.