THE GEOLOGICAL SURVEY OF WYOMING

Gary B. Glass, State Geologist

FORTY-EIGHTH ANNUAL REPORT

of the

GEOLOGICAL SURVEY OF WYOMING

July 1, 1980 to June 30, 1981

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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 Survey's biennial budgets between 1960 and the present.

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 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.

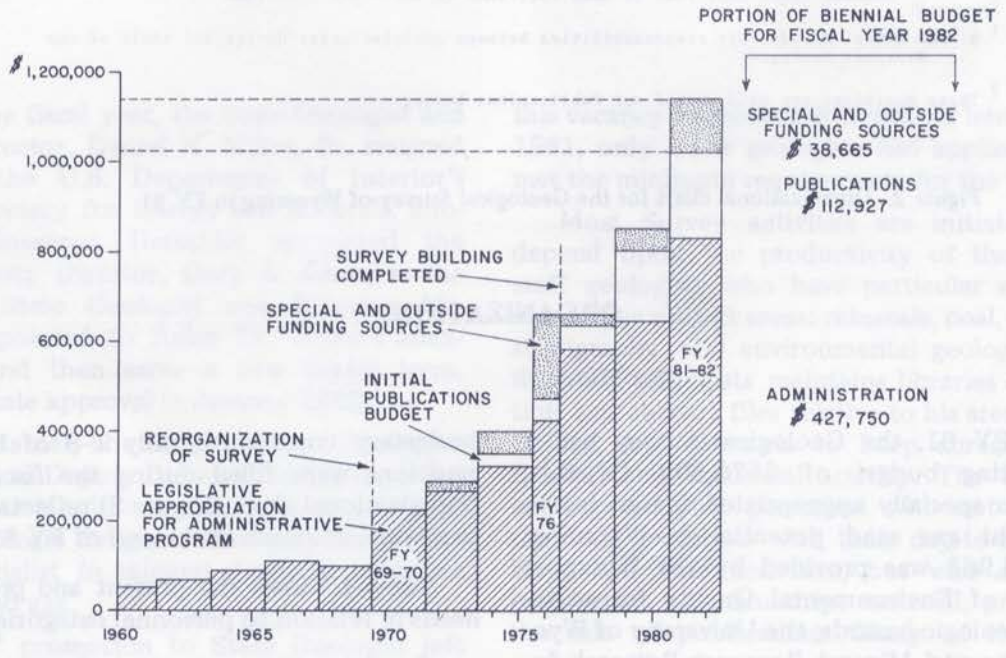


Figure 1: Biennial budgets for the Geological Survey (Funding for FY 82 is annotated to the right of the biennial budgets.

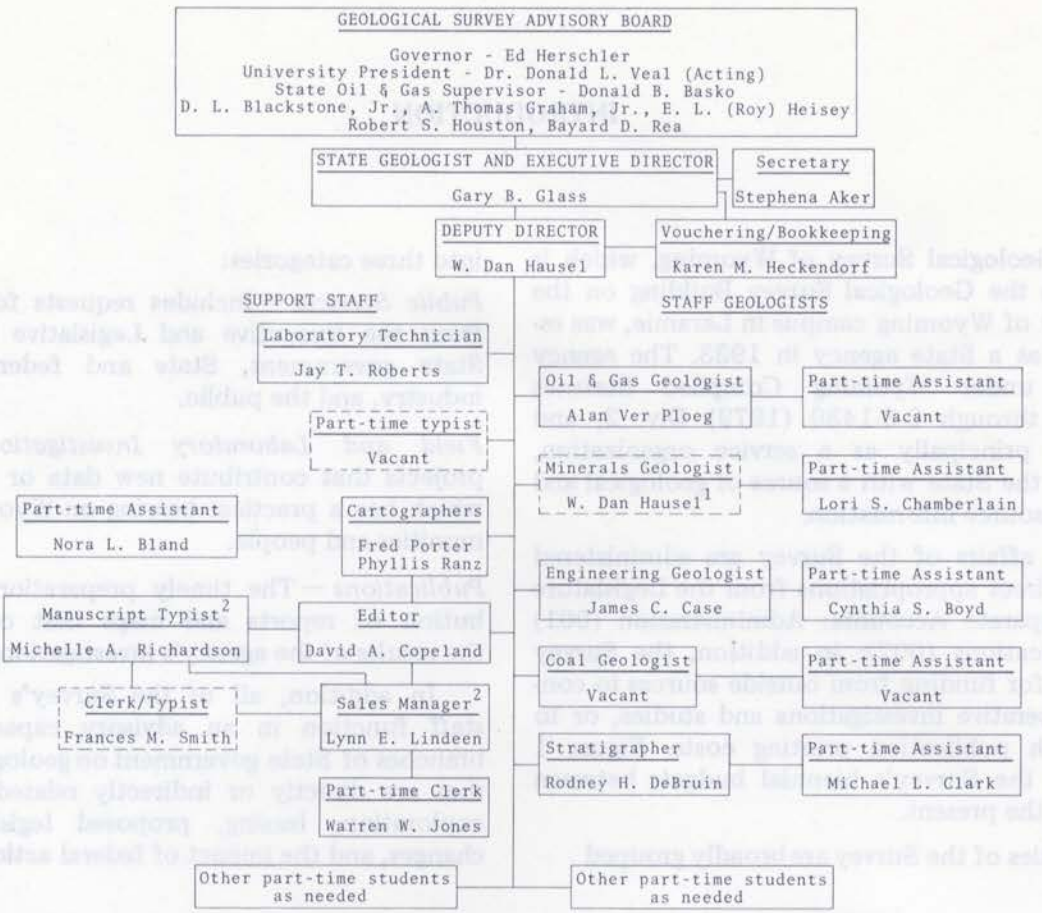


Figure 2. Organizational chart for the Geological Survey of Wyoming in FY 81

ORGANIZATION

During FY 81, the Geological Survey had a total operating budget of $576,892. Of this, $45,000 was specially appropriated for an inventory of tight gas sand potential in Wyoming; another $24,963 was provided by the Wyoming Department of Environmental Quality for an inventory of geologic hazards; the University of Wyoming's Mining and Mineral Resource Research Institute also provided $14,370 in financial support for the Survey's diamond investigations.

In FY 81, 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 organizational chart (Figure 2) reflects the Survey's personnel situation at the end of FY 81.

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

Several major personnel changes occurred in FY 81. Early in the year, Rodney H. DeBruin was reassigned to our Stratigraphy Section because we were unable to recruit a stratigrapher. Mr. DeBruin's old position as Environmental Geologist was filled by a new geologist, James C. Case.

Table I. 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	5*	5	5	5
Assistant Staff Geologists	0	0	0	0	2	3
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	2*	2	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	1*	1	1	1
Total Full-time Staff	14	14	17	17	19	20
Part-time Technical and Office Help (not all filled)	14	14	10	10	10	10
Total Number of Positions	28	28	27	27	29	30

*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. If these three positions are approved, four part-time positions will be eliminated. Requests for four new full-time positions in the FY 81-82 budget recommendation were not approved.

Late in the fiscal year, the State Geologist and Executive Director, Daniel N. Miller, Jr., resigned to become the U.S. Department of Interior's Assistant Secretary for Energy and Minerals. Subsequently, Governor Herschler appointed the agency's Deputy Director, Gary B. Glass, as the State's new State Geologist and Director. Mr. Glass was appointed to finish Dr. Miller's unexpired term and then serve a new 6-year term, subject to Senate approval in January 1982.

W. Dan Hausel, the Staff Minerals Geologist, was promoted to Deputy Director. In this capacity, Mr. Hausel functions in two capacities: as a Deputy Director (Geologic Program Manager) and as the Survey's specialist in mineral deposits, exclusive of coal, oil, and gas.

Mr. Glass' promotion to State Geologist left a vacancy for a Coal Geologist. Recruitment for this vacancy has proved difficult. As late as October 1981, only a few geologists had applied and none met the minimum requirements for the 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 the 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.

TABLE II. Allocation of staff activities by Section

	Oil & Gas	Minerals	Coal	Environ.	Stratigraphy
Services					
Public	15%	44%	38%	25%	15%
State Agency	10%	5%	7%	10%	10%
Federal Agency	5%	3%	5%	5%	5%
Field and Laboratory Projects	25%	15%	12%	20%	15%
Data Organization	25%	10%	15%	20%	25%
Report Writing and Editorial Reviews	10%	18%	17%	10%	20%
Administration	5%	2%	3%	5%	5%
Other Activities	5%	3%	3%	5%	5%

MAJOR ACCOMPLISHMENTS BY PROGRAM

ADMINISTRATION (01)

During FY 81, Survey personnel responded to about 15,000 telephone calls, letters, and personal visits from people requesting information and assistance relating to the geology and mineral resources of the State. Many of the 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. This is more than double the requests received in the previous fiscal year.

Table II shows a breakdown of time allocated to different types of activity by each of the Sections.

As evidenced above, each of the staff geologists, with the help of part-time personnel, conducted other activities in addition to the service role of his Section. General summaries and major activities of the various Sections are discussed below. A discussion of laboratory support activities is also included.

Oil and Gas Section (Alan J. VerPloeg)

The Oil and Gas Section functions as a principle 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 81, 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.

In a joint effort with the State Geologist, the Oil and Gas Section completed an inventory of tight gas sands in Wyoming. This project was funded by a special $45,000 appropriation by the Legislature and culminated in a reproducible open file report. As new data on the State's tight gas sand deposits are acquired, they are added to this report as an ongoing project.

The Section also began compilation of a comprehensive report on oil and gas activity in the Idaho-Wyoming-Utah overthrust belt. This report will be published in FY 82 as Report of Investigations No. 21.

In addition to the Tight Gas Sands report, the Oil and Gas Section also assisted in the publication of a third (1980) and a fourth (1981) edition of the tectonic map of the overthrust belt. Complete citations for these publications are listed in the later section on Publications. Outside papers were the summer, fall, winter, and spring petroleum outlook articles for the University of Wyoming's

Wyoming Issues publication.

Talks on Wyoming's overthrust belt were given at a seminar for the University of Wyoming's Physics Department and at a conference for Western State Foresters.

Minerals Section (W. Dan Hausel)

The Minerals Section functions as a principal source of information on Wyoming's base, precious, and industrial minerals, uranium, and construction materials. The Section also supervises and conducts independent and cooperative investigations on the characteristics and distribution of various mineral deposits. Also, fifty-five rock and mineral samples were identified for companies and individuals during FY 81.

Two major ongoing projects of the Section were investigations of diamondiferous kimberlite, and base, precious, and industrial mineralization associated with greenstone belts. The kimberlite program resulted in the location of two previously unreported kimberlite occurrences in the Laramie Range during FY 81. Geophysical surveys and geological mapping in the vicinity of the ultrabasic intrusives were completed and published in Preliminary Report No. 18.

Stream sediment sampling for kimberlite indicator minerals was conducted in the Laramie Range throughout FY 81. Several anomalous samples containing pyrope garnets and/or chrome diopside were found. The Survey is conducting detailed investigations of these regions for additional kimberlite intrusives. The Section's diamond investigations were partially funded by a grant from the University of Wyoming's Mining and Mineral Resource Research Institute ($14,370).

Examination of Wyoming's Archean greenstone belts for potentially economic mineralization began in FY 81. Such regions are exploration targets in that greenstone belts in the shield regions of Canada, Australia, and Africa are hosts for extensive precious, base, and industrial ore deposits. Initial reconnaissance by the Minerals Section has already identified significant gold mineralization in quartz veins and iron formations within the greenstone belts. During FY 82, the Section will attempt to determine the extent of the mineralization.

In addition to the preliminary report on diamond studies mentioned above, the Section prepared two outside papers on Wyoming's diamond-bearing kimberlites (published in the Texas Geological Society Newsletter and as the American Institute of Mining Engineers (AIME) Preprint 80-310); a paper for the Wyoming Geological Association titled, *Economic mineral deposits of Wyoming — a review*; and summer, fall, winter, and spring mineral outlook articles for the University of Wyoming's *Wyoming Issues* publication.

Talks on Wyoming's minerals and mineral industry were presented to a Society of Mining Engineers of AIME conference in Minnesota, to the West Texas Geological Society in Texas, to the Wyoming Mining Association's Teacher Seminar, to the Cheyenne Gem and Rock Club, and to two field outings of the Boy Scouts of America.

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 81, the Section co-authored and edited a guidebook to the coal geology of the Powder River Basin, which was published as Public Information Circular No. 14 (see complete citation in section on Publications Program). This publication was the outgrowth of a geological field conference which the Section organized for the Energy Minerals Division of the American Association of Petroleum Geologists late in FY 80.

Later in the year an unpublished guidebook was also prepared for a Hanna Basin field trip, which the Section organized for the Wyoming Geological Association and the University of Wyoming's Geology Department. Unfortunately a spring storm rained out all but three stops on that field trip to the coal fields of Hanna.

In addition, the Coal Section provided maps of underground coal mines and technical assistance to the Environmental Section's geological hazard study. Mined-out area maps of many of the older underground mining areas of the State were completed or begun. Work is continuing on this project, which is more fully described in the discussion by the Environmental Section.

Two reports of investigation on the chemical properties of Wyoming coals were begun in FY 81 and should be ready for publication in late FY 82. The Section prepared outside papers on Wyoming coal deposits for McGraw-Hill's *Keystone Coal Industry Manual* and for the Wyoming Geological Association; on coal geology activities for the

American Geological Institute's publication, *Geotimes*; on coal resources for the Rocky Mountain Section of the Geological Society of America; on the energy minerals of Wyoming for the Interstate Oil Compact Commission (IOCC); and on the outlook for Wyoming coal for the summer, fall, winter, and spring editions of the University's *Wyoming Issues* publication.

The section also presented talks on Wyoming's coal or energy minerals to the Wyoming Mining Association's Teacher Seminar, the Lions clubs of Laramie and Cheyenne, the Gillette Section of AIME, the University of Wyoming's Rocky Mountain Groundwater Symposium, and the IOCC.

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's biggest ongoing project is an inventory of Wyoming's geological hazards. This study includes inventories of landslides, earthquake data, areas of windblown sand, floodprone areas, avalanche areas, mined-out areas, subsidence areas, and toxic or poor quality waters. In FY 81, the project was partially funded by a $24,963 grant from the Land Quality Division of the Wyoming Department of Environmental Quality. The project continues into FY 82.

Late in FY 81, the Environmental Section began formulation of a data management and manipulation system that will utilize both the State of Wyoming and University of Wyoming computer systems. A CRT terminal was ordered in FY 81. This Section is acting in a lead capacity in this endeavor.

During FY 81, the Environmental Section published a Landsat II mosaic of the overthrust belt (Map Series MS-8B).

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 81, the Section completed a report on helium resources (Public Information Circular No. 16) which contains a map of helium occurrences in Wyoming. Work also began on a series of index maps which will depict geologic mapping in the State. The first map of this series shows the U.S. Geological Survey's Coal Resource Occurrence and Coal Development Potential (CRO/CDP) Open-file reports for Wyoming and was published in early FY 82 as Map Series MS-9A. The Section also collaborated with the Oil and Gas Section to write a comprehensive geologic report on the State's overthrust belt, which should be published in FY 82. A comprehensive bibliography of geologic reports in the overthrust belt was also started.

Laboratory Section (Jay T. Roberts)

This Section is the analytic and laboratory arm of the Survey and provides assistance to the various other sections when requested. The Survey's lack of sophisticated analytical equipment, however, has 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. The Section is augmented by various part-time employees of the other Sections as required.

The Laboratory Section has been supervising the examination of stream sediment samples from the diamond-bearing kimberlite project of the Minerals Section. A Wilfley table and mineral jig are used to obtain heavy mineral concentrates from panned stream sediment samples. Priority has been given to follow-up samples taken from areas where previous samples yielded kimberlite indicator minerals. A newly donated magnetic separator should prove useful in removing iron oxides, particularly ilmenite, which are abundant in the samples.

The Section has also improvised and improved

on the Survey's diamond processing laboratory. In the past, only grease table and heavy mineral separation techniques were available for diamond extraction. The Laboratory Section is designing an apparatus to recover diamonds by surface tension flotation. This technique takes advantage of the water-repellant character of diamond to "float" diamonds in the surface tension of water. In this process, the bulk of the sample, being water-wettable, sinks while the diamonds float. Initial tests indicate that this is an effective recovery method for diamonds one millimeter or less in diameter; the grease table is more effective for larger stones.

Most tested kimberlite samples are less than 50 pounds although one 470-pound sample was crushed and sorted in preparation for testing. Although no diamonds have been recovered, there are still many samples awaiting testing.

PUBLICATIONS (02)

The Publications Section of the Survey operated in FY 81 with a budget of $85,793. 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 81, the volume of inquiries increased to more than 13,000 which is almost three times the inquiries received in FY 80. In addition, the income from publication sales in FY 81 was $95,237, or more than twice that of 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 pubblications.

During FY 81, the Survey prepared and published the following new reports and maps:

Public Information Circulars

No. 14 Guidebook to the coal geology of the Powder River coal basin, by G.B. Glass.

No. 16 Helium: a vital natural resource, by Michael Clark.

Preliminary Reports

No. 18 Geological and geophysical investigation of kimberlites in the Laramie Range of southeastern Wyoming, by W.D. Hausel, P.R. Glahn, and T.L. Woodzick.

Map Series

MS-8A Tectonic map of the overthrust belt (3rd Edition), by D.L. Blackstone, Jr.

MS-8A Tectonic map of the overthrust belt (4th Edition), by D.L. Blackstone, Jr.

MS-8B Landsat II mosaic of the overthrust belt, by R.H. DeBruin and R.L. Oliver.

Open File Reports

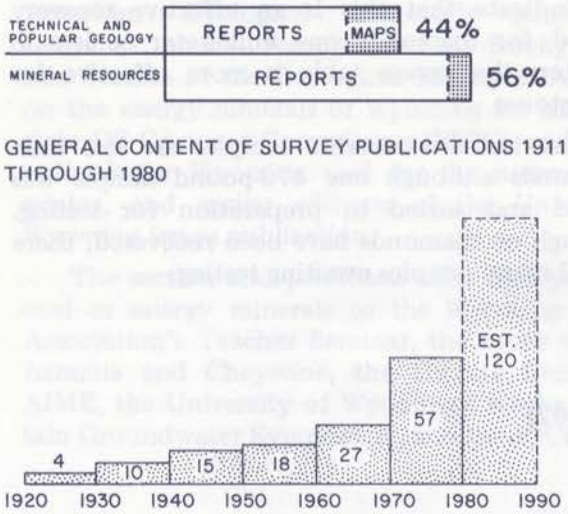
WGS 80-1 Helium gas in Wyoming, by D.R. Lageson.

WGS 81-1 Tight gas sand inventory of Wyoming, by D.N. Miller, Jr. and A.J. VerPloeg.

Miscellaneous

Reprint of U.S. Geological Survey Professional Paper 855: Geology of the Sage and Kemmerer 15-minute quadrangles, Lincoln County, Wyoming, by W.W. Rubey, S.S. Oriel, and J.I. Tracey, Jr.

The following additional publications were prepared in FY 81 and sent out for printing. Publication of these reports, however, was not completed in FY 81.



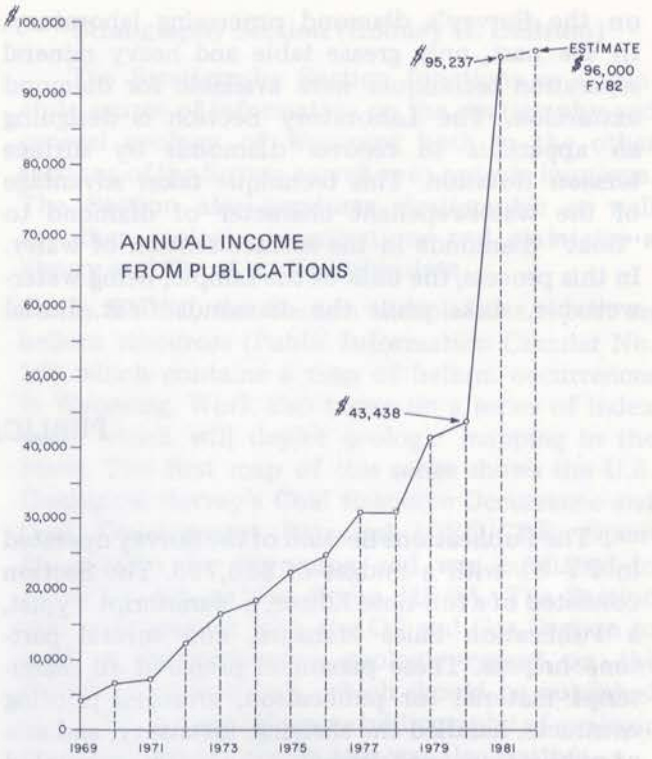


Figure 3. General content of publications; number of publications; and annual income from publications.

Bulletins

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

Public Information Circulars

No. 15 Mining laws of Wyoming — 1980, compiled by DEPAD and the Wyoming Geological Survey.

Map Series

MS-9A Index map to the U.S. Geological Survey's Coal Resource Occurrence and Coal Development Potential Open-file Reports in Wyoming, compiled by G.B. Glass.

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.

PROBLEM AREAS AND RECOMMENDATIONS

There are several problems confronting the Survey:

1. In FY 81 and again in FY 82, our Agency reduced its investigative and field activities by nearly 50 percent. This action was a consequence of the unprecedented increases in service-related inquiries that were received by both our staff geologists and our publications sales personnel. To handle this increased activity, we not only diverted part-time personnel from other duties, but we also worked them for longer hours. Consequently, the assistance that we normally provided our staff geologists for field studies and investigations was severely reduced. Similarly our appropriations for part-time salaries were such that we could only fill seven of our fourteen part-time

positions. In addition, there wasn't even enough part-time salary money to work these seven employees 20 hours a week (half-time).

To help rectify this problem and restore our full investigative abilities, we requested substantial increases in part-time salary appropriations for FY 83-84 as well as two new full-time support personnel — a secretary and a clerk/typist.

2. Because our Agency's Deputy Director doubles as our Minerals Geologist, he cannot devote full time to his Section's activities and complete his administrative, supervisory, and fiscal duties as Deputy Director. Because of this, we recommended approval of a second Minerals Geologist for the Survey's Minerals Section.

This new Minerals Geologist would specialize in nonmetallic industrial minerals and construction materials, an area of increasing interest to the State as its population centers grow and expand. Our Deputy Director would then specialize in the increasingly important metallic and precious minerals as well as other strategic minerals.

3. The Survey critically needs a new X-ray diffractometer as our present one is both obsolete and inoperable. Repairs on the old machine are estimated at $54,000 which is almost the cost of a new machine ($65,000).

Under the circumstances, we have, of necessity, greatly reduced our mineral and rock identification services. Unfortunately, our agency is the only State agency providing these services since the University's Natural Resources Research Institute lost its capabilities about 1-1½ years ago. Commercial laboratories do not routinely provide similar rock and mineral identifications. Because this instrument is the basic tool that a geologist uses for rock and mineral identification, we consider it a priority item of equipment in the FY 83-84 Biennial Budget Request.

4. Along the lines of the mineral royalty audits being conducted by State auditors, there is also 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).