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

FIFTY-SECOND ANNUAL REPORT

of the

GEOLOGICAL SURVEY OF WYOMING

for Fiscal Year 1985
July 1, 1984 to June 30, 1985

by

Gary B. Glass

Laramie, Wyoming
October, 1985

First printing of 300 copies by Lanier Printing, Cheyenne.

Copies of this and other reports of the Geology of Wyoming can be obtained from the:

The Geological Survey of Wyoming
P.O. Box 3008, University Station
Laramie, Wyoming 82071

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INTRODUCTION

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 encumbent since June 18, 1981, was reappointed State Geologist by Governor Herschler for a full six-year term in March 1982.

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). Under these statutes, the agency's principal functions are service-oriented and broadly grouped into four categories:

1. *Provide information, advice, and assistance for inquiries on geology and mineral resources* -- This includes requests for assistance from the Executive and Legislative branches of State Government, State and Federal agencies, industry, special interest groups, and the public.

2. *Conduct field and laboratory investigations* -- These are geologic or mineral resource projects that contribute new data or information which have a practical bearing on Wyoming's communities or people.

3. *Publish maps and reports* -- The agency publishes and distributes reports and maps that communicate the results of its investigations as well as some investigations by others.

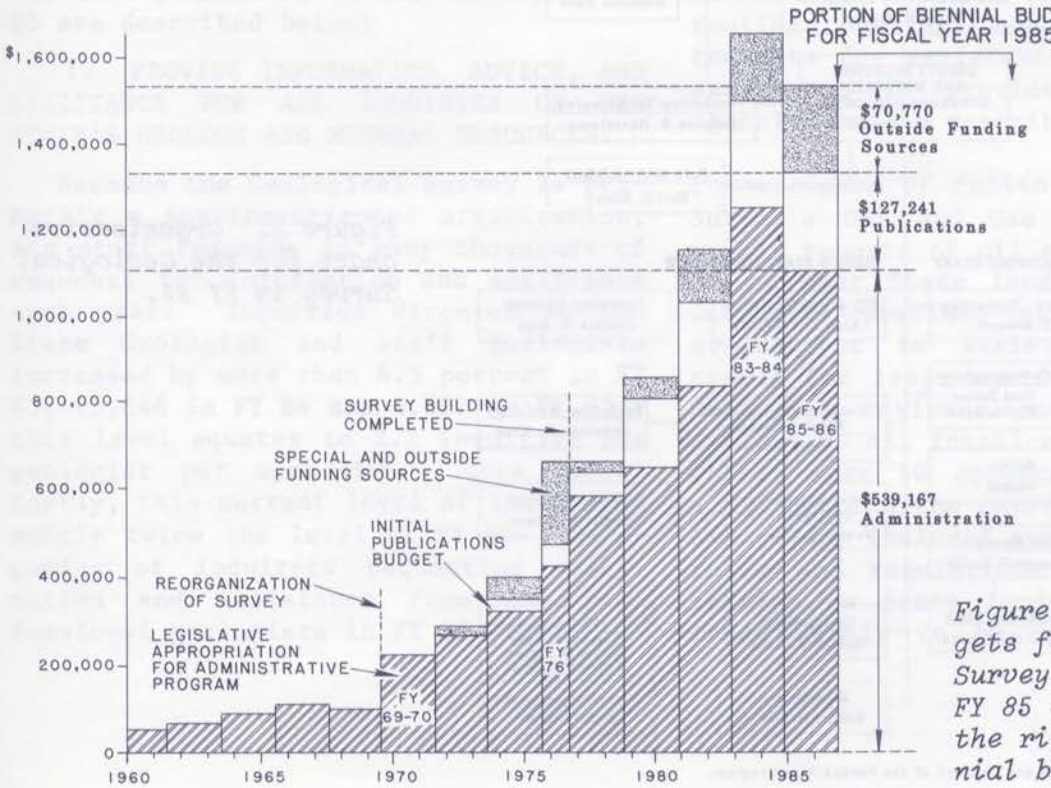


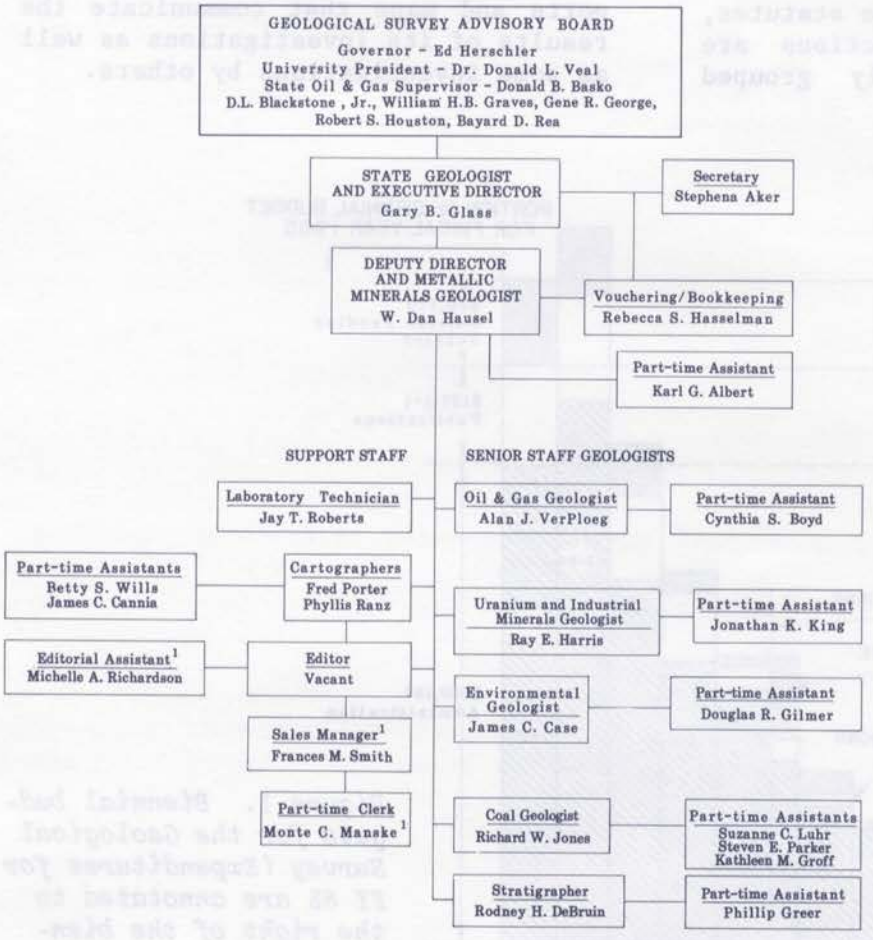
Figure 1. Biennial budgets for the Geological Survey (Expenditures for FY 85 are annotated to the right of the biennial budgets).

4. *Maintain files and libraries on the State's geology and mineral resources* -- These files are part of the agency's permanent records and, with few exceptions, are available for public use.

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, and shows that portion of the biennial budget expended in FY 85.

ORGANIZATION

For operational purposes, the agency's personnel are divided into professional staff (geologists) and support staff (Figure 2). Because each staff geologist is an expert in his field of geology, he is expected to initiate his own investigations and projects on the basis of priority of need. About 80 percent of the projects are undertaken by individual staff geologists with assistance from the support staff. The remaining 20 percent are handled on a team basis that occasionally involves the entire staff as well as the State Geologist.



[1]These positions are paid out of the Publications Program.

Figure 2. Organization chart for the Geological Survey in FY 85.

The geological staff (Figure 2) is divided into six one-man sections: Coal, Environmental, Metallic Minerals, Oil and Gas, Stratigraphy, and Uranium and Industrial Minerals. Each staff geologist is the head of his respective section and enlists the part-time help of student assistants from the University of Wyoming as the need occurs and funds permit. The Laboratory Section is another one-man section that provides analytical as well as field support to the geological staff.

In addition to the secretarial and clerical support staff, the agency has a Drafting Section, an Editorial Section, and a Publication Sales Section. The Drafting Section puts all illustrative material (drawings, maps, charts, etc.) into publishable form and makes proof copies and printer-ready 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.

FUNCTIONS AND ACCOMPLISHMENTS IN FISCAL YEAR 1985

As mentioned earlier, the Geological Survey has four major functions: (1) Provide geologic advice and assistance, (2) Conduct field and laboratory investigations, (3) Publish reports and maps, and (4) Maintain records on geologic and mineral information. For each of these major functions, the activities and accomplishments of the Survey in FY 85 are described below:

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

Because the Geological Survey is primarily a service-oriented organization, its staff responds to many thousands of requests for information and assistance each year. Inquiries directed to the State Geologist and staff geologists increased by more than 4.5 percent in FY 85, (3,846 in FY 84 and 4,020 in FY 85); this level equates to 2.2 inquiries per geologist per work day. More importantly, this current level of inquiry is nearly twice the level of FY 80. Categories of inquirers requesting information and assistance from the professional geologists in FY 85 were:

Category	Percentage
General Public	19%
Business and Industry	36%
Wyoming and Local Agencies	13%
Federal and Other States	12%
Universities	20%

In regard to State and local entities, these services are divisible into routine ongoing assistance and spot requests for assistance. Major ongoing assistance is provided to six State agencies and is described below:

Commissioner of Public Lands -- (1) The Survey's Oil and Gas Section provided weekly reports of oil and gas activities on or near State lands, (2) the State Geologist provided oil and gas tract evaluations to assist with selecting tracts for lease auction, (3) the State Geologist reviewed and made recommendations on all fossil-collecting permits (there were 10 applications in FY 85) and inspected the quarries, and (4) spot assistance included completely redrafted rules and regulations for fossil collecting on State lands; a map of coal lands likely to be mined in the near

future in support of the Ad Hoc AVF Coal Exchange Committee; aid in verifying coal tonnages mined from State lands; and recommendations on the Texas Energy and Kerr-McGee royalty requests, the Chevron land exchange, the Amax coal lease renewal, Shell Oil's special use permit, the release of lands withheld from mineral entry for diamond exploration, the protection of a unique cave found on State land, and mineral potential on several tracts of land considered in exchange for lands in the Grand Teton National Park.

Department of Environmental Quality, Land Quality Division -- (1) The Survey's Environmental Geology Section provided reviews and recommendations on paleontology portions of mining plans, (2) the Minerals Sections and Coal Section of the Survey reviewed more than 12 Abandoned Mined Land Reclamation Projects (approximately 300 mine sites) and made comments and(or) recommendations on reclamation strategies for approximately 100 mines, and (3) spot assistance included information on mine subsidence at Rock Springs, Glenrock, and Hanna and information on uranium *in situ* leach operations.

State Planning Coordinator and Governor's Clearing House -- The agency reviewed 71 documents in FY 85 and early FY 86 and submitted written comments on 14. These were the Resource Management Plans for the Pinedale Resource Area, the Shoshone National Forest, the Roadless Area supplement to the Targhee National Forest, and the Medicine Bow National Forest; environmental assessments for four oil and gas exploration wells; Environmental Impact Statements on the Medicine Bow and Shoshone National Forest Plans and the Jackson Lake Safety of Dams Project; Fisherman Creek Cattle and Horse Allotment Management Plan; Information Brochure on the Devil's Tower National Monument's Management Plan; and the Farmer's Home Administration's Natural Resources Management Guide.

Industrial Siting Administration -- The Survey reviewed and commented on applications for Chevron's Painter Reservoir Unit gas plant and the Amendment to Phase I and the Phase II plans for Exxon's La Barge Project.

Legislative Service Office -- Each September, the Survey estimates future production and assessed value for minerals produced in the State. The Survey's estimates and those of several other 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 to provide a forecast of mineral revenue for use by both the Governor and the Legislature.

Oil and Gas Conservation Commission -- Wyoming Statute 30-5-103 makes the State Geologist one of the Commissioners of this regulatory agency. Monthly hearings are routinely 1-1.5 days long. The State Geologist has been 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 one-half to one day of effort by the State Geologist each month.

Spot requests for assistance from State and local entities are many and varied each year. The following list highlights the requests made of the Survey in FY 85, but is not all inclusive:

Archives, Museums, and Historical Department -- collected and provided mineral and rock specimens for the State Museum. The Survey's Deputy Director is the Associate Curator of Mineralogy for the Wyoming State Museum.

Department of Administration and Fiscal Control, Research and Statistics Division -- provided mineral statistics and illustrations to update the *Wyoming data handbook*. The State Geologist is a member of DAFC's Consensus Revenue Estimating Group, which makes revenue estimates for use by the Governor and the Legislature, prior to each Legislative Session.

Department of Agriculture -- continued to provide drafting and(or) technical assistance on the compilation of a *Land inventory map of Wyoming* and a *Natural resource atlas of the Cheyenne 30x60-minute topographic map area.*

Department of Economic Planning and Development, Minerals Division --various Sections of the Survey provided information on mineral production, markets, or the location of mines or mineral occurrences.

Disaster and Civil Defense Agency --provided technical information on geologic hazards, particularly earthquakes.

Lincoln County -- provided assistance to the Lincoln County Planning Office in assessing geologic hazards in the Star Valley area and other areas of the County.

University of Wyoming, Institute of Policy Research -- provided quarterly minerals outlook articles for publication in the Institute's *Wyoming quarterly update.*

In addition, the Survey received requests for assistance or information from the Ad Valorem Tax Division, Game and Fish Department, Governor's Office, Highway Department, Department of Labor and Statistics, Public Service Commission, Recreation Commission, State Archaeologist, State Engineer, State Forester, State Laboratory, State Inspector of Mines, Treasurer's Office, Water Development Commission, and Water Quality and Solid Waste Divisions of the Department of Environmental Quality.

As an extension of this service-related function, the Survey's professional staff also presented twenty-one talks or briefings on mineral resources, geology, or geological hazards to the following groups: American Institute of Mining and Metallurgical Engineers, Society of Mining Engineers (National meeting; Black Hills, Casper, Laramie, and Powder River Basin Sections - five talks); American Institute of Professional Geologists (Wyoming Section); Cheyenne Gem and Mineral Society; Governor's Workshop on Earthquake Hazards in Wyoming (two talks); Laramie Rockologists; Nature Conservancy (Wyoming Natural Heritage Program); Society of Economic Paleontologists and Mineralogists (Rocky Mountain Section); Soil Conservation Society of America (Wyoming Chapter); University of Wyoming (Civil Engineering Department-two presentations); Wyoming Geological Association (two talks); and the Wyoming Mining Association's Teacher Workshops (two talks).

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 investigations were completed in FY 85:

(1) A study to evaluate rapid exploration techniques for diamond-bearing kimberlite.

(2) A characterization study of the Trapper Canyon tar sand deposit in the Bighorn Basin.

(3) Landslide mapping in a portion of southern Uinta County (Meeks Cabin Reservoir and Buck Fever Ridge Quadrangles).

Ongoing investigations include:

(1) Field sampling and laboratory processing of diamond-bearing kimberlite from the Laramie Range and State Line District as a cooperative project with the University of Wyoming's Mining and Mineral Resource Research Institute.

(2) Reconnaissance surveys of Wyoming's reported tar sand and heavy oil occurrences.

(3) Reconnaissance surveys of mineral occurrences throughout the State as in-house projects in the two Minerals Sections.

(4) Petrographic studies of hydrothermally-altered rock from the Absaroka

volcanic plateau of Park and Fremont Counties and the Silver Crown Mining District of Laramie County.

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

(6) Compilation of background radiation levels across Wyoming for publication as maps.

(7) Geologic mapping of the South Pass-Atlantic City area of Fremont County.

(8) Research and mapping of geological hazards, including seleniferous rocks.

(9) Geologic mapping of the southeastern Bighorn Mountains in Johnson, Natrona, and Washakie Counties.

3. PUBLISH 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 following 31 reports and maps were published in FY 85:

ANNUAL REPORTS

Fifty-first annual report of the Geological Survey of Wyoming, July 1, 1983 to June 30, 1984, by G.B. Glass (1984).

BULLETINS

Paleontology of the Green River Formation with a review of the fish fauna: Bulletin 63, by L. Grande, (revised 1984).

INFORMATION CIRCULARS

Diamond-bearing kimberlite pipes in Wyoming and Colorado, by W.D. Hausel, (revised 1985).

Field guide to some common rocks and minerals of Wyoming, by W.D. Hausel and K.A. Albert, (revised 1985).

Geology of Wyoming, by G.B. Glass and D.L. Blackstone, Jr., (revised 1985).

Hints for rock hunting and prospecting in Wyoming, by W.D. Hausel, (revised 1985).

Wyoming jade, by F.K. Root, (revised 1985).

MAP SERIES

Oil and gas map of Wyoming: MS-12, by T.R. Stephenson, A.J. VerPloeg, and L.S. Chamberlain, (1984).

Tectonic map of the Black Hills uplift, Montana, Wyoming, and South Dakota: by A.L. Lisenbee, (1985).

OPEN FILE REPORTS

Preliminary map of landslides and windblown sand deposits on the Newcastle 1° x 2° topographic map: OFR 84-11, compiled by J.C. Case and C.S. Boyd, (1984).

Preliminary map of earthquake epicenters in Wyoming: OFR 84-13, compiled by J.C. Case and C.S. Boyd, (1984).

Selected references used to compile the metallic and industrial minerals map of Wyoming: OFR 85-1, compiled by R.E. Harris and W.D. Hausel, (1985).

Selected references on construction materials in Wyoming: OFR 85-2, compiled by R.E. Harris and J.E. Meyer, (1985).

Foreland compressional tectonics; southern Bighorn Basin, Wyoming: OFR 85-3, by D.L. Blackstone, Jr., (1985).

Extent of coal-bearing rocks and locations of coal mines in the Bighorn Coal Basin, Montana and Wyoming: OFR 85-4, compiled by S.C. Luhr and R.W. Jones, (1985).

Baked and fused rock (clinker) within the Gillette 1° x 2° topographic map area: OFR 85-5, compiled by J.E. Meyer, (1985).

Uranium mines and uranium and thorium occurrences in Wyoming: OFR 85-6, compiled by R.E. Harris, (1985).

Baked and fused rock (clinker) within the Sheridan 1° x 2° topographic map area: OFR 85-7, compiled by J.E. Meyer, (1985).

Baked and fused rock (clinker) within the Newcastle 1° x 2° topographic map area: OFR 85-8, compiled by J.E. Meyer, (1985).

Background gamma radiation of the Torrington 1° x 2° Quadrangle, Wyoming and Nebraska: OFR 85-9, by R.E. Harris, (1985).

Bibliography and index to the geology of the Wind River Basin and adjacent uplifts in the vicinity of Fremont County, Wyoming: OFR 85-10, compiled by Philip Stoffer, (1985).

Tectonic map of the Bighorn Basin, Wyoming, showing oil and gas development through May, 1985: OFR 85-11, compiled by A.J. VerPloeg, (1985).

REPORT OF INVESTIGATIONS

Analyses and measured sections of 25 coal samples from the Hanna Coal Field of southcentral Wyoming (collected between 1975 and 1979): RI 27, by G.B. Glass and J.T. Roberts, (1984).

Economic geology of the Copper Mountain supracrustal belt, Owl Creek Mountains, Fremont County, Wyoming: RI 28, by W.D. Hausel, P.J. Graff, and K.G. Albert, (1985).

Geothermal resources of the Bighorn Basin, Wyoming: RI 29, by H.P. Heasler and B.S. Hinckley, (1985).

The geology, diamond testing procedures, and economic potential of the Colorado-Wyoming kimberlite province - a review: RI 31, by W.D. Hausel, M.E. McCallum, and J.T. Roberts, (1985).

REPRINT SERIES

A field guide to the Casper Mountain area: Reprint 45, by Wyoming Field Science Foundation, 1978, (1984).

WYOMING GEO-NOTES

No. 4: by G.B. Glass, W.D. Hausel, R.E. Harris, A.J. VerPloeg, and R.W. Jones, (September, 1984).

No. 5: by G.B. Glass, A.J. VerPloeg, W.D. Hausel, R.E. Harris, R.W. Jones, and J.C. Case, (December, 1984).

No. 6: by G.B. Glass, A.J. VerPloeg, R.W. Jones, W.D. Hausel, and R.E. Harris, (March, 1985).

No. 7: G.B. Glass, W.D. Hausel, R.E. Harris, A.J. VerPloeg, and R.W. Jones, (June, 1985).

The following 22 publications are already in preparation for publication in FY 86 or early FY 87:

INFORMATION CIRCULARS

Complete list of publications by the Geological Survey of Wyoming from its beginnings in the Territorial Period (1877-1890) to the present: compiled by G.B. Glass, (1985).

MAP SERIES

Index to U.S. Geological Survey Miscellaneous Investigations Maps (I) in Wyoming: MS-9D, compiled by R.H. DeBruin, (revised 1985).

Index to U.S. Geological Survey Water-Supply Paper maps in Wyoming: MS-9F, compiled by R.H. DeBruin, (revised 1985).

Index to U.S. Geological Survey Oil and Gas Investigations Maps (OM) in Wyoming: MS-9I, compiled by R.H. DeBruin, (1985).

Index to U.S. Geological Survey Open-file Reports that contain geologic maps for Wyoming: MS-9J, compiled by R.H. DeBruin, (1985).

Index to U.S. Geological Survey Cir-

culars, Folios, and Annual Reports that contain geologic maps for Wyoming: MS-9K, compiled by R.H. DeBruin, (1985).

Index of Geological Survey of Wyoming publications that contain geologic maps, excluding Open File Reports: MS-9L, compiled by R.H. DeBruin, (1985).

Index to Geological Survey of Wyoming Open File Reports that contain geologic maps: MS-9M, compiled by R.H. DeBruin, (1985).

Metallic and industrial minerals map of Wyoming: MS-14, compiled by R.E. Harris, W.D. Hausel, and J.E. Meyer, (1985).

Map showing the present configuration of the Heart Mountain fault and related features, Wyoming and Montana: MS-15, by W.G. Pierce, (1985).

Geologic map of Black Mountain Quadrangle, Wyoming: MS-16, by M.E. Finley, (1985).

Geologic map of Shell Quadrangle, Wyoming: MS-17, by K.A. Manahl, (1985).

Geologic map of Devils Kitchen Quadrangle, Wyoming: MS-18, by C.C. Reppe, (1985).

Geologic map of Greybull North Quadrangle, Wyoming: MS-19, by L.M. Kozimko, (1985).

Geologic map of Sheep Canyon Quadrangle, Wyoming: MS-20, by R.E. Ladd, (1985).

OPEN FILE REPORTS

Description of two test holes drilled in the vicinity of Yoder, Goshen County, Wyoming: OFR 85-12, by R.M. Summer, (1985).

Geologic map of Converse County, Wyoming: OFR 85-13, compiled by R.H. DeBruin, (1985).

PUBLIC INFORMATION CIRCULAR

Bibliography of graduate theses and dissertations on the geology of Wyoming, 1899 through early 1984 (exclusive of the University of Wyoming: PIC 24, compiled by G.B. Glass, (1985)

REPORT OF INVESTIGATIONS

Trapper Canyon tar sand deposit, Big Horn County, Wyoming: an exhumed stratigraphic oil trap: RI 30, by A.J. VerPloeg and R.H. DeBruin, (1985).

Petrology of Hanna and Ferris Formation coals from the Hanna Coal Field, Wyoming: RI 32, S.C. Teerman, J.C. Crelling, and G.B. Glass, (1985).

Oil and gas potential of the Washakie (South Absaroka) wilderness and adjacent study areas, Wyoming: RI 33, J.D. Love, (1985).

WYOMING GEO-NOTES

No. 8: by G.B. Glass, W.D. Hausel, R.E. Harris, A.J. VerPloeg, and R.W. Jones, (September, 1985).

In addition, the State Geologist and(or) the staff geologists prepared the following 21 papers and reports for outside publishers:

American Association for the Advancement of Science, Symposium Volume: *Wyoming an example of western coal development*, by G.B. Glass, (1984).

American Institute of Mining and Metallurgical Engineers Preprints: *An overview of the geology and production of Wyoming trona*, by R.E. Harris, (1984); *Gold in the South Pass greenstone belt, Wind River Mountains, Wyoming*, by W.D. Hausel, (in press); Proceedings Second Western Regional Conference: *Overview of Wyoming coal developments (abstract)*,

by R.W. Jones, (1984); *Economic geology of the Colorado-Wyoming kimberlite province*, by W.D. Hausel and J.T. Roberts, (1984); Mining Engineering: *Wyoming [mineral exploration summary for 1984]*, by R.W. Jones, W.D. Hausel, and R.E. Harris, (1985).

McGraw-Hill, Inc., Keystone Coal Industry Manual: *Wyoming [coal]*, by G.B. Glass, (1984 and 1985 revisions).

Nature Conservancy, Wyoming Natural Area Needs Workshop Proceedings: *Unique geologic features and features requiring special protection in Wyoming*, by J.C. Case and G.B. Glass, (1985).

Society of Economic Paleontologists and Mineralogists, Rocky Mountain Section Newsletter: *Economic geology of the Copper Mountain supracrustal belt, Wyoming (abstract)*, by W.D. Hausel, P.J. Graff, and K.G. Albert, (1984).

U.S. Bureau of Mines Preprint: *The mineral industry of Wyoming, 1983*, by K.E. Starch and G.B. Glass, (1985); [1983] Minerals Yearbook: *The mineral industry of Wyoming*, by K.E. Starch and G.B. Glass, (1985).

U.S. Department of Energy Report DOE/LC/10916-1661: *Tar sand occurrences in the Bush Butte Quadrangle, Wyoming, with emphasis on the Trapper Canyon deposit*, by A.J. VerPloeg and R.H. DeBruin, (1985).

University of Wyoming, Institute for Policy Research, Wyoming Quarterly Update: *Minerals outlook*, by G.B. Glass, W.D. Hausel, R.W. Jones, A.J. VerPloeg, and R.E. Harris, (September and December, 1984; March and June, 1985).

Utah Geological Association Guidebook: *Geology and gold mineralization of the South Pass granite-greenstone terrain, western Wyoming*, by W.D. Hausel, (in press).

Wyoming Geological Association Annual Field Conference Guidebook: *Preliminary report on tar sand occurrences in the Bush Butte Quadrangle, Wyoming, with emphasis on the Trapper Canyon deposit*, by A.J. VerPloeg and R.H. DeBruin, (1984); *Mineral resources of Permian and Pennsylvanian rocks in Wyoming*, by R.E. Harris and W.D. Hausel, (1984); the Contact [newsletter]: *Wyoming coal developments and future prospects (abstract)*, by R.W. Jones, (1985).

Wyoming Mining Association, The Mining Claim [newsletter]; *An overview of Wyoming coal developments*, by R.W. Jones, (1984).

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 85, the Agency (1) enlarged its inventory of mapped and identified geological hazards, particularly landslides 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 many thousands of dollars worth of documents, reports, and maps to the University of Wyoming's Geology Library and the Survey's library through its publication exchange agreements with Federal, foreign, and other State agencies as well as 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 the lesser (see also page 24).

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.

REVENUES GENERATED BY THE GEOLOGICAL SURVEY

The sale of reports and maps is an important function of the Geological Survey, and these sales provide the major source of direct revenue generated by the agency. Publication sales in FY 85 were $63,029, up 29 percent from the $48,878 collected in FY 84. With another $82,000 projected for FY 86 sales, the total publication revenues for the 1985-1986 Biennium will approximate $145,000. Although this estimated revenue for FY 85-86 is approximately 20 percent below the $164,000 goal set by the Joint Appropriations Committee in March, 1984, it is an increase of 18 percent over the $122,013 collected in FY 83-84. The projected revenue from publication sales in FY 87-88 is an estimated $180,000. To increase its publication revenues in the face of recessionary pressures, the Survey raised its prices and accelerated the preparation and publication of its reports and maps. Without additional staff, however, further acceleration of its preparation and publication activities is unlikely. As shown in Figures 3 and 4, there has been good correlation between Wyoming's mineral valuation and the sale of Survey publications, and mineral valuation has leveled off.

The only other direct annual revenue generated by the Geological Survey 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 $6,853.37 in FY 85.

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 are mandated or clearly of mutual benefit to the State of Wyoming, and each project usually results in a salable publication. Revenue from the sale of these reports eventually repays a part of the in-kind expenses. The Geological Survey is able to solicit these grants because of the

calibre of its professional geologists as well as its exemplary performance on past grants. 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.

The Survey's grant income from outside sources in FY 85 was $85,783. Survey personnel completed or are completing work on seven grants: 01.50 ($19,439 carryover from FY 84) for coal data acquisition, funded by the U.S. Geological Survey's National Coal Resource Data System (NCRDS) (Revenue Code 78008); 03.30 ($29,898 in FY 85) for continuation of the U.S. Geological Survey's NCRDS grant in FY 84 (Revenue Code 78008); 01.81 ($10,509 carryover from FY 84) for a reconnaissance survey of tar sand and heavy oil deposits in Wyoming, funded by the U.S. Department of Energy through the University of Wyoming's Industrial Fund (Revenue Code 64067); 03.10 ($8,245 for FY 85) for geologic mapping of the South Pass-Atlantic City area of Fremont County, funded by the U.S. Geological Survey's COGEOMAP Project (Revenue Code 78008); 03.20 ($10,070 for FY 85) for geologic mapping in the southern Bighorn Mountains, funded by the U.S. Geological Survey's COGEOMAP Project (Revenue Code 78008); 03.40 ($4,000 for FY 85) for support of the U.S. Geological Survey's COGEOMAP Projects (Revenue Code (78008); and 01.90 ($3,622 carryover from FY 83) for landslide characterization and mapping, funded by the U.S. Geological Survey (Revenue Code 78001). The landslide grant and first part of the NCRDS grants were completed in FY 85. In addition, in FY 86 the Survey expects $32,735 from the U.S. Geological Survey to continue landslide mapping (Revenue Code 78001); approximately $26,908 from the U.S. Geological Survey to fund the third year of their NCRDS grant (Revenue Code 78008); $10,070 to continue geologic mapping in the Bighorn Mountains, and $8,245 to continue mapping at South Pass, both funded by the U.S. Geological Survey (Revenue Code 78008).

Although none of the above grants currently extends past the 1985-1986 Biennium, the Survey anticipates that new, similar, cooperative working agreements will be developed during the 1987-1988 Biennium. The financial aspect of each future project will be handled on a case-by-case basis, and no grant can be accepted without the Governor's prior approval. It is hoped that the COGEOMAP and NCRDS grants with the U.S. Geological Survey will be renewed when they expire in FY 86.

MAJOR ACCOMPLISHMENTS BY PROGRAM

Administrative Program

General Fund appropriations for the Administrative Program were $550,128 in FY 85. This program implements the principal functions of the Geological Survey which are investigation and service as described above. The Survey acts as a collecting facility and clearing house for all information related to the geology of the State, present and future mineral resources that have economic and(or) scientific significance, and as a source of technical reports and maps important to Wyoming's communities, political entities, citizenry, and industry.

During FY 85, the professional staff of the agency provided service to more than 335 telephone, letter, and visitor inquiries each month (a 4.5 percent increase over FY 84); initiated or completed more than 12 separate field investigations; collected and analyzed numerous rock samples, including 106 mineral and rock identifications for the public; and examined and filed thousands of maps, aerial photographs, and subsurface geophysical logs. The State Geologist completely revised the rules and regulations for fossil collecting on State lands for the Commissioner of Public Lands, and agency geologists reviewed more than 74 documents related

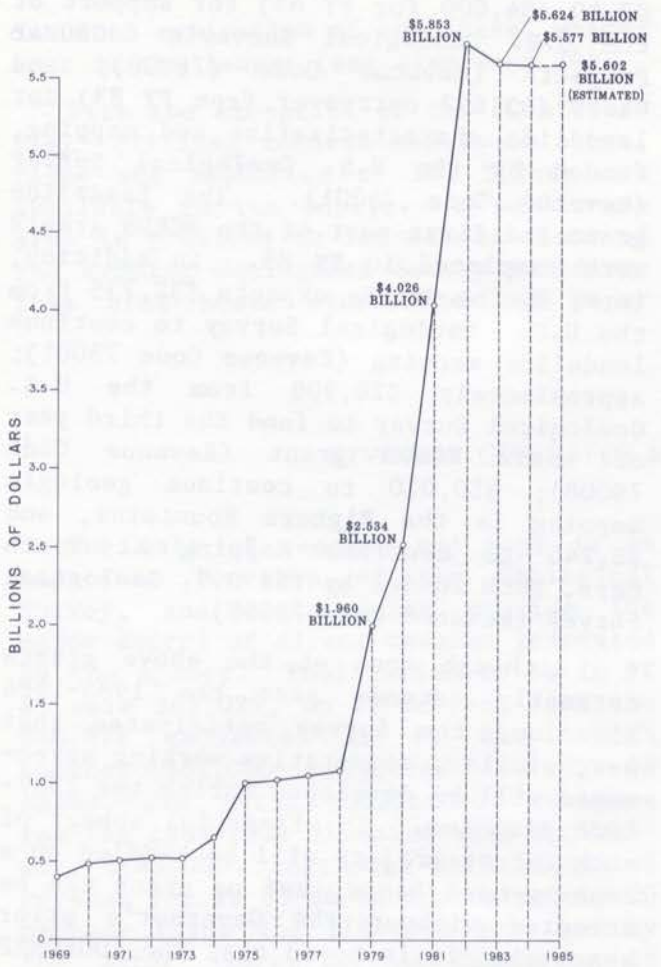


Figure 3. Assessed valuation of Wyoming's mineral production.

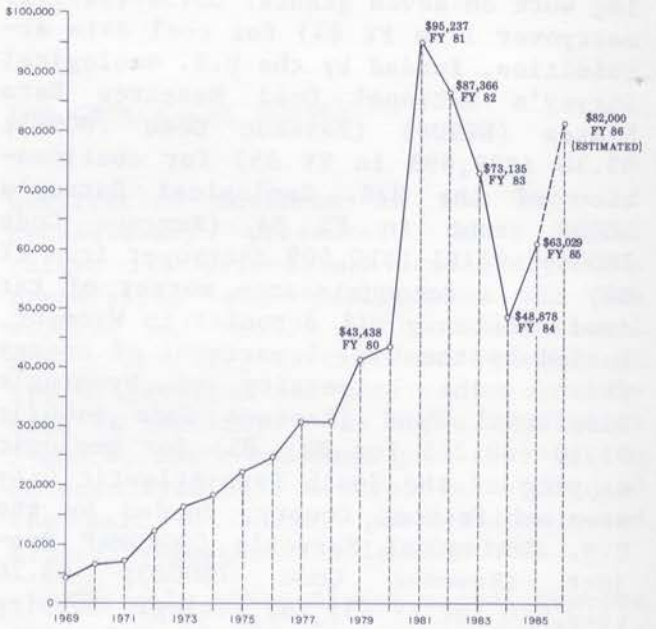


Figure 4. Annual fiscal year income from Survey publications.

to industrial siting, mineral development, mining, government actions, and land-use planning. Survey personnel researched, wrote, prepared, or edited 31 publications, which were published by the Survey in FY 85.

Each staff geologist is in effect the State's expert on a given subject and is responsible for collecting, organizing, interpreting, and communicating all information pertinent to his field of expertise. Communication not only involves the writing of in-house publications, but also includes the writing and presentation of additional papers and talks at civic, social, government, and scientific meetings. Whenever practical, in an effort to expedite work, the Survey solicits cooperative assistance from other State and Federal agencies and industry, as well as the University of Wyoming.

As time and funds permit, the staff geologists utilize special types of investigations and analyses that provide new information or verify geological interpretations that are especially relevant to Wyoming and its citizenry.

The State Geologist and professional staff are routinely called upon to act in an advisory capacity in an effort to assist the Executive and Legislative branches of State Government, city and county administrators, other State agencies, and occasionally Wyoming's Congressional Delegation.

Table 1 shows a percentage breakdown

Table 1. Percentage breakdown of staff 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%

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 State Geologist and the various sections are discussed below.

State Geologist (Gary B. Glass)

Besides routine administrative activities, the State Geologist principally functions in a service role as evidenced by 720 inquiries for assistance or information that were received and answered in FY 85. In some instances, the inquirer was also directed to an appropriate staff geologist for more information.

In other service-related activities, the State Geologist attended the Governor's Resource Management Tour of Teton and northern Lincoln Counties; met with the Legislative Service Office to forecast mineral production and valuation; met with the Consensus Revenue Estimating Group to select revenue projections acceptable to both the Executive and Legislative branches of government; reviewed and made recommendations on 10 applications for fossil-collecting permits and inspected seven active or proposed fossil-collecting quarries near Kemmerer; reviewed documents and reports and provided technical assistance and data to other State agencies; taught a three-hour course on the geology of solid fuels (coal, tar sand, and oil shale) and a one-hour course on Wyoming coal deposits as a part-time Lecturer of Geology at the University of Wyoming; and reviewed and added comments to 14 documents prepared for the Governor's Clearing House.

In this service-role, the following talks or briefings were also presented: talks on Wyoming's mineral industry and geology for the Laramie, Casper, and Powder River Basin Sections of the Society of Mining Engineers of the American Institute of Mining and Metallurgical Engineers and for the Wyoming Mining Association's Teacher Workshops in Casper and Cheyenne; a briefing on the mineral resources of Albany County for the Laramie Chamber of Commerce.

The State Geologist is also a member of the Governor's Water Forum, the Geothermal Resources Committee of the Interstate Oil Compact Commission, the State Land Exchange Task Force, the Ad Hoc AVF Coal Exchange Committee, the

University of Wyoming's College of Agriculture Advisory Board, and the Association of American State Geologists (AASG).

The State Geologist is also a Commissioner on the Wyoming Oil and Gas Conservation Commission (see earlier discussion on page 4). This is the only regulatory activity of the State Geologist or the Survey, and in this regard, the State Geologist serves on the Commission in his capacity as State Geologist rather than as the chief administrative officer of the Geological Survey.

In FY 85, the State Geologist authored or coauthored six articles or reports published by the Survey and nine published by outside publishers (see pages 6 to 9). Another three articles for publication by the Survey were in press at the end of the fiscal year.

Coal Section (Richard W. Jones)

The Coal Section serves as a major source of information on Wyoming's coal deposits and coal mining activity. Office, field, and laboratory investigations are designed to better define and characterize the State's coal resources through: collection and compilation of data, maintenance of a reference library and working files of coal-related data, and publication of maps and reports resulting from the investigations.

The Coal Section continued to provide coal data to a wide variety of users, including State and Federal agencies, the coal industry, geological and business consultants, market analysts, universities, and the general public. Over 441 inquiries were received and answered in FY 85; about 60 percent of the Section Head's time was required to answer these inquiries.

The compilation of a new *Coal resources map of Wyoming*, which began in FY 84, continued in FY 85. A second year of funding from the U.S. Geological Survey ($29,898) continued the Coal Section's project to enter coal data into the National Coal Resources Data System (NCRDS). Work on this cooperative project continued in the Bighorn and Wind River Basins.

The Coal Section continued to provide information to the Environmental Geology Section, other State agencies, consultants, and the public in regard to underground mine locations and subsidence features in the State.

In addition, the Section Head presented mineral and geologic briefings to the Black Hills Section of the Society of Mining Engineers and the Wyoming Geological Association; authored or coauthored five maps or reports published by the Survey as well as another six articles published by outside publishers (see pages 6 to 9).

Environmental Geology Section (James C. Case)

The Environmental Geology Section continued its program of defining, mapping, and analyzing geological hazards in Wyoming. As in the past, much time was spent on the classification and mapping of landslides with emphasis on the southwestern corner of the State. In related activities, the Section Head answered 529 inquiries for information and assistance in FY 85.

The Meeks Cabin Reservoir and Buck Fever Ridge Quadrangles in Uinta County were mapped with funding assistance from the U.S. Geological Survey. Extensive landslide, glacial, and terrace deposits were mapped, described, and analyzed. This study indicated that movement along SW-NE-trending faults in this area may have continued into the Quaternary. Future work will attempt to determine to what degree the faults are still active.

New landslides have been mapped, and older ones have been defined in greater detail in the Little Mountain - Miller Mountain area south of Rock Springs, where landslides continue to destroy the

local road network. A new pipeline trench, which cut through landslides in the area, was examined, resulting in some classification changes to older slides.

Work was begun on a geologic hazards analysis for the Star Valley portion of Lincoln County, Wyoming. It is suspected that numerous debris flows have occurred around the margins of the valley in the past. The Environmental Geology Section is mapping existing landslides and defining landslide-prone areas for use by land developers and planners.

Requests for earthquake information were numerous in middle to late 1984 and early 1985. An unpublished, in-house report, titled *Understanding earthquakes with a discussion of Wyoming earthquakes*, was prepared to more effectively respond to these inquiries. The report explained the causes of earthquakes, the types of faulting involved, and the methods used to describe earthquakes. In addition, the Section Head was instrumental in reducing the response time between an earthquake event and the availability of detailed information on the location and size of the event. This detailed data comes from the U.S. Geological Survey's Earthquake Information Center in Colorado.

A talk on *Historic earthquakes and other geologic hazards in Wyoming* was presented to the Governor's Workshop on Earthquake Hazards in Wyoming, which was held in Rock Springs. A new earthquake epicenter map, compiled by the Environmental Geology Section, was presented at that meeting. The Section also prepared and presented statewide maps on active faults, liquefaction-prone areas, mined-out areas and mine subsidence, landslides, windblown sand deposits, shrinking-swelling clay zones, and seleniferous areas.

Two other presentations were made in FY 85. A talk on *Mapping activities of the Geological Survey of Wyoming* was presented to the Wyoming Chapter of the Soil Conservation Society of America. Another talk on *Unique geologic features requiring special protection* was presented at the Wyoming Natural Heritage Program's Wyoming Natural Area Needs Workshop in Riverton, Wyoming. As an outgrowth of that meeting, numerous unique or rare geologic features were identified and described.

An update of the Wyoming Agricultural Experiment Station's work on the occurrence of selenium in Wyoming was begun. A literature search is in progress. A draft map, which shows seleniferous areas in Wyoming was prepared and is now being modified for publication. It is hoped that a multidisciplinary group can be assembled in FY 86 to study the effects of selenium in Wyoming.

Housing subdivisions at Gillette, in the Meeks Cabin Reservoir area of Uinta County, and at Evanston were examined in the field and analyzed for slope stability. Short reports were prepared for each of the sites. Numerous other areas were analyzed utilizing aerial photographs and existing maps.

The Environmental Geology Section assisted the Wyoming Department of Environmental Quality in the analysis of a potential landfill site in Platte County. An abandoned iron ore mine was suggested as a possible site. Unless extensive hydrologic surveys prove otherwise, use of this site could result in the contamination of a major aquifer in the area. In FY 86 the Environmental Geology Section will assist in determining if an alternative site is available.

A prime function of the Environmental Geology Section is to provide timely analyses of the potential geologic hazards at various sites across the State. These analyses will continue to improve in accuracy as the Section's mapping of geologic hazards expands. The highest priority of the Section is to map geological hazards in Wyoming and to make the information available in an understandable format.

Laboratory Section (Jay T. Roberts)

The primary function of the Laboratory Section is to provide analytical services to the staff geologists. The Section will also, on occasion, provide such services to the general public. During FY 85, 349 analyses, physical tests, and rock and(or) mineral identifications were performed on 140 samples submitted to the Section by staff geologists, State agencies, and the general public. In addition, the Section provides assistance in field investigations, and purchases, constructs, and maintains much of the laboratory and other equipment in use at the Geological Survey.

Tools and techniques routinely used by the Section include x-ray diffraction, arc emission spectroscopy, mineral separation apparatus, and laboratory equipment for a variety of chemical, petrographic, sample preparation, and physical-testing procedures. The Section has also increased its use of the University of Wyoming's x-ray spectrometer for elemental analyses.

The Laboratory Section performed mineral separations in support of the Metallic Minerals Section's diamond exploration projects, and with this Section, coauthored a Survey paper, which reviewed the economic geology of the Colorado-Wyoming Kimberlite Province and the Survey's diamond-testing procedures.

In support of the Uranium and Industrial Minerals Section's investigations on southern Wyoming bentonites, the Section performed a variety of chemical and physical tests on a suite of bentonite samples from the Steele Shale. Tests and analyses included size fractionation, identification of clay and minor mineral constituents by x-ray diffraction, Marsh funnel viscosity determination, flocculation tendency, and methylene blue capacity.

The Section has been investigating x-ray diffraction techniques for the quantitative analysis of mineral mixtures and successfully applied the technique to the analysis of carbonate rock samples submitted by the Uranium and Industrial Minerals Section. The standardization and application of the method to a wider range of minerals, particularly the major rock-forming silicates, is an ongoing project of the Section.

Other ongoing projects of the Section include x-ray diffraction analysis of feldspars, evaluation of wet chemical methods for the analysis of gold, and standardization of the University of Wyoming's x-ray spectrometer for quantitative elemental analysis.

Metallic Minerals Section (W. Dan Hausel)

The Metallic Minerals Section functions as the principal source for information on Wyoming's base, precious, ferrous, ferroalloy, and strategic metals, and precious and semiprecious stones, and on Precambrian geology. The Section supervises and conducts independent and cooperative investigations on the characteristics and distribution of various mineral deposits throughout the State and adjacent areas, and conducts regional field mapping investigations related to Precambrian geology and to the geology of various metallic mineral deposits. Mining companies, geologic and engineering consultants, universities, prospectors, environmental groups, other State agencies, Federal agencies, and the general public obtain information and assistance from the Section.

In its service role, Section personnel examined and identified more than 106 rock and mineral specimens for the general public, industry, and the University of Wyoming; answered at least 881 inquiries; led field trips to the Independence gold mine of the Centennial Ridge District for the University of Wyoming's Civil Engineering Department, to the State Line Kimberlite District and to the Pole Mountain-Happy Jack area

for a group of geologists and prospectors; and demonstrated seismic exploration techniques to the University of Wyoming's Civil Engineering Department. The Section Head also visited several mines and prospects at the request of various Wyoming residents to make suggestions on prospecting. Information booths were set up for an International Civil Engineering Convention at the request of the University of Wyoming's Engineering Department and for the Wyoming State Gem and Mineral Show. Several manuscripts were reviewed for the U.S. Geological Survey and the U.S. Bureau of Mines.

The Land Quality Division of the Wyoming Department of Environmental Quality requested continued assistance with its Abandoned Mine Land Reclamation Projects. The Section Head provided recommendations on geologic, economic, and scientific values, and on ways to preserve these values. In many cases, the Section provided underground maps and information on rock competency that will be used in the planning stages for reclamation.

In conjunction with the Environmental Geology Section, the Section provided input for the site geology at the historic Chicago iron mine. This mine was under evaluation as a potential waste-disposal site by the Solid Waste Management Division of the Wyoming Department of Environmental Quality.

Additionally, the Section Head is the Deputy Director of the Geological Survey, is a member of some graduate thesis committees in the University of Wyoming's Department of Geology and Geophysics, and is the Associate Curator of Mineralogy for the Wyoming State Museum. In FY 85, the Section Head authored or coauthored 11 reports or maps published by the Geological Survey, six reports published by outside publishers and presented eight talks or briefings to various organizations.

The Section continued its investigations on diamondiferous kimberlite in Wyoming. One project, funded by the University of Wyoming's Mining and Mineral Resource Research Institute (MMRRI), involved the search for diamond-bearing kimberlite and lamproite in the Laramie Range of southeastern Wyoming and in the Leucite Hills of southwestern Wyoming. In southeastern Wyoming, stream sediment samples were collected by panning and further concentrated on a Wifley table in the laboratory. The final heavy mineral concentrates were examined microscopically for "kimberlitic" indicators -chromian diopside, pyrope garnet, and picroilmenite. Newly discovered kimberlite diatremes were sampled and tested for diamonds using a grease table and a skin flotation device. Requests for the designs of the Survey's diamond extraction laboratory were received from the U.S. Bureau of Mines and the Geological Survey of Alaska. Both agencies were considering developing diamond laboratories.

To date, this project has been extremely successful. Two new areas of diamond potential have been outlined (the Sheep Rock and Happy Jack-Pole Mountain areas). In the Sheep Rock area, the Metallic Minerals Section discovered a single, small, 40-foot-diameter kimberlite plug in 1980. Since that discovery, stream sediment sampling has outlined a large area along Middle Sybille Creek that could have more kimberlite occurrences.

In the Happy Jack-Pole Mountain area just east of Laramie, Section personnel collected 35 stream sediment samples from South, Middle, and North Lodgepole Creeks that contained anomalous kimberlitic minerals. Microprobe analyses of selected purple to lavender garnets show as much as five to six percent Cr_2O_3 and 17 to 18 percent MgO. One, 120-foot-diameter structure was discovered straddling a NNW lineament near North Lodgepole Creek. Samples collected from the diatreme-like structure (Eagle Rock structure) have yielded one yellow-orange pyrope garnet. Currently, Karl Albert, a graduate student and

part-time Survey employee, is mapping and searching the Happy Jack-Pole Mountain area for additional diatremes as a thesis project.

Sampling of lamproite in the Leucite Hills has produced no diamonds to date. Because the leucite and olivine-bearing lamproites in this area are similar to the diamond-rich lamproites in Australia, the Survey is committed to sampling these rocks in greater detail. In June 1985, several hundred pounds of material were sampled and will be tested for diamond.

As an outgrowth of these diamond-exploration projects, the Section Head coauthored two papers that were published in FY 85 (see pages 7 and 9), and solicited six papers and chaired a session on diamond exploration in the United States for the American Institute of Mining and Metallurgical Engineers' regional meeting in Denver. The session was well attended with standing room only. The Section Head also began to prepare and write a paper on the distribution of kimberlites and continental evolution in the Northern Hemisphere. The paper is a cooperative project between the Geological Survey of Wyoming and the U.S. Geological Survey.

In regard to other metallic mineral deposits, the Section prepared a report on the Copper Mountain area that was published by the Survey in 1985 (page 7). Related to this project, the Section Head presented the findings of this report to the Rocky Mountain Section of the Society of Economic Paleontologists and Mineralogists in Denver, in a talk title, *Economic geology of the Copper Mountain supracrustal belt, Wyoming.*

The Section continued a regional study of the South Pass supracrustal belt along the southern tip of the Wind River Mountains. Most of the gold and iron ore produced in Wyoming was mined from South Pass, and the region is still of major interest to mining companies, prospectors, historians, and tourists, even though only about one-half of the supracrustal belt has been mapped.

The Section is preparing geologic maps of the South Pass area at a scale of 1:24,000. When completed, this project will result in geologic maps of eight 7½-minute quadrangles, a regional map of the entire supracrustal belt, and underground maps of accessible mines. This project is partially funded by the U.S. Geological Survey's COGEOMAP Program.

At the end of FY 85, a preliminary geologic map of Radium Springs Quadrangle had been completed; Lewiston Lakes Quadrangle was partially done; and 16 preliminary mine maps were completed. Sampling in the Lewiston mining district (Radium Springs Quadrangle) produced several interesting gold assays, to include gold in assays of a banded iron-formation. Ultramafic flows(?) were also mapped at the base of the supracrustal complex in the Lewiston Lakes area. These rocks consist of aphanitic serpentinites, spinifex serpentinites, and tremolite-actinolite schists (komatiites?). Because no whole-rock analyses have been run on these rocks to date, their petrology is still unclear.

The Section Head submitted a paper for publication to the Utah Geological Association and an abstract to the American Institute of Mining and Metallurgical Engineers - Society of Engineering Geologists annual meeting to be held in New Orleans in 1986. Other activities related to South Pass included talks presented to the Laramie Rockologists and to the Cheyenne Gem and Mineral Society and preparation of a field guide for the 1985 International Archean Geochemistry Field Conference to be held in the Wind River Mountains in August, 1985.

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,

oil shale, and tar sand deposits. In FY 85, 542 inquiries on oil and gas matters were answered by Section personnel. In regard to requests from other State agencies, the Section prepared its annual forecast of oil and gas production and value per unit for the Legislative Service Office. All new oil and gas discoveries were routinely evaluated with regard to State mineral ownership, and discoveries on or near State lands were reported to the Commissioner of Public Lands on a weekly basis.

In addition, the Section also maintained a library of petroleum-related data and conducted independent investigations on hydrocarbon-bearing deposits in the State. The Section received and filed substantial amounts of new subsurface information provided by the petroleum industry and directed to the Survey through the Wyoming Oil and Gas Conservation Commission. In addition, numerous electric logs were donated to the Survey by oil companies and private consultants. These logs will be incorporated into the well log library, filling gaps in the collection.

The Section's *Oil and gas map of Wyoming* was printed and released for sale in early FY 85. The 1:500,000 scale map shows all of Wyoming's oil and gas fields, pipelines, refineries, gas plants, and major oil shale occurrences.

A field reconnaissance study of tar sand and heavy oil occurrences in Wyoming continued in FY 85. Fourteen different localities were examined, sampled, and mapped in the Bighorn Basin, Wind River Basin, Washakie Basin, Powder River Basin, and Overthrust Belt. This project is partially funded by a grant with the U.S. Department of Energy (administered by the University of Wyoming's Industrial Fund), and should be completed in the first half of FY 86.

A final expanded report on the Trapper Canyon tar sand deposit was completed for publication in early FY 86. The report titled *Trapper Canyon tar sand deposit, Big Horn County, Wyoming: an exhumed stratigraphic oil trap* will be released as Report of Investigations 30 (page 8). Results of this characterization study, funded by the U.S. Department of Energy, are presented in the report, which includes a geologic map of Bush Butte Quadrangle (1:24,000 scale). A condensed version of this report was submitted to the Wyoming Geological Association and included in their 1984 Field Conference Guidebook titled *Permian and Pennsylvanian geology of Wyoming*. Another condensed version of the results of the above study was published by the U.S. Department of Energy in late FY 85 (page 9). This report is titled *Tar sand occurrences in the Bush Butte Quadrangle, Wyoming, with emphasis on the Trapper Canyon deposit*.

Late in FY 85, work was completed on a *Tectonic map of the Bighorn Basin*. This 1:250,000 scale map was published as Open File Report 85-11 (page 7). The map shows the major structures and faults in the basin relative to the Pennsylvanian Tensleep Sandstone surface. Oil and gas fields as well as dry wildcat tests are also shown.

In addition, late in FY 85, work was initiated on a study of the Goose Egg Formation in the eastern Bighorn Basin in an attempt to delineate areas with potential for Tensleep Sandstone stratigraphic traps in undrilled areas between tested structures. An isopach of the Goose Egg Formation is being constructed along with electric log cross sections. The report should be completed in FY 86.

The Section Head authored or coauthored six reports or maps published by the Survey in FY 85 and six reports published outside the Survey (see pages 6 to 9).

Stratigraphy Section (Rod H. DeBruin)

The Stratigraphy Section functions as a principal source of information on the

stratigraphy and general geology of Wyoming. In FY 85, 373 requests for information from industry, the general public, universities, and government agencies were answered. The Section also maintains and solicits materials for a reference library and working file of stratigraphic data. The Section also conducts stratigraphic as well as other geologic investigations, often in support or in cooperation with other Sections of the Survey.

The Stratigraphy Section is collaborating with the Oil and Gas Section on a characterization study of reported tar sand deposits throughout the State. Partial funding for this project came from the U.S. Department of Energy in FY 84 and FY 85. A final report on this study will be published in FY 86.

The Section completed or revised six indexes to geologic mapping in Wyoming (U.S. Geological Survey Miscellaneous Investigations Maps, Oil and Gas Investigations Maps, Circulars, Folios, and Annual Reports with maps, and Open-file Reports; Geological Survey of Wyoming publications with maps to include a separate index of Open File Reports). Four index maps to thesis maps prepared for the University of Wyoming's Department of Geology and Geophysics were begun in FY 85. The Section reviewed two 1:24,000 scale geologic maps (Black Mountain and Shell Quadrangles) submitted by Iowa State University's Department of Geology. These maps will be published in early FY 86 along with three other submitted maps (Devils Kitchen, Greybull North, and Sheep Canyon).

Compilation of a geologic road log for Interstate 80 across southern Wyoming was nearly completed in FY 85.

The Section Head contacted universities across the Nation to identify those with geologic field camps or other geologic projects in Wyoming. The results of this survey will be published in FY 86 along with an index map depicting each university's areas of study in Wyoming.

Work progressed on a geologic mapping project on the southeastern flank of the Bighorn Mountains. This project is being conducted in cooperation with the U.S. Geological Survey under their COGEOMAP Program. During FY 85 and early FY 86, preliminary geologic maps of two 7½-minute quadrangles were completed.

If the program is extended to subsequent years, a total of twenty quadrangles will be mapped at a scale of 1:24,000. In conjunction with the U.S. Geological Survey, preparation and compilation of the first maps will be used to demonstrate the applicability of digital techniques to geologic mapping and map production.

The Section Head coauthored two articles published outside the Survey (page 9), and presented a talk on Wyoming geology to the Governor's Workshop on Earthquake Hazards in Wyoming.

Uranium and Industrial Minerals Section
(Ray E. Harris)

The Uranium and Industrial Minerals Section is a major source of information on radioactive minerals (uranium- and thorium-bearing) and the industrial minerals bentonite, gypsum, limestone and dolomite, phosphate, trona, zeolites, and construction material (sand, gravel, clinker, etc.) in Wyoming. Other minerals of sedimentary origin and assorted industrial minerals and rocks such as talc and anorthosite are also the responsibility of this Section. In FY 85, 534 requests for information regarding these commodities were answered for private citizens, State and Federal government agencies, and private industry. While inquiries for uranium bentonite, and trona information decreased, inquiries for limestone, dolomite, construction aggregate, and especially mineral sulfur increased.

A report on the background gamma-radiation of the Torrington 1° x 2° Quadrangle was completed and published as Open File Report 85-9. Field work for the Cheyenne 1° x 2° background radiation map was completed in FY 85. Publication of the Cheyenne Quadrangle, however, will be delayed until the geologic map of the area is published by the U.S. Geological Survey. Field work for the Ashton and Newcastle 1° x 2° sheets was begun in FY 85. Both are about 75 percent complete.

The Section, in conjunction with the Metallic Minerals Section, completed a 1:500,000 scale *Metallic and industrial minerals map of Wyoming*, which was published in FY 85. Another 1:500,000 scale map showing construction materials in Wyoming was completed for publication in FY 86. Three 1:250,000 scale maps, showing baked and fused rock (clinker) occurrences (Gillette, Sheridan, and Newcastle 1° x 2° topographic map areas), were also prepared and published as Open File Reports (pages 6 and 7).

Section personnel authored or coauthored a list of selected references used for the *Metallic and industrial minerals map of Wyoming*, a list of selected references on construction materials, and a map of uranium occurrences in Wyoming, which were all published by the Geological Survey as Open File Reports (page 6).

Work continued on a study of nonconformity-related uranium occurrences in Wyoming. Areas surveyed in FY 85 included the Cambrian-Precambrian nonconformity in the Black Hills, Shirley Mountains, northeast slope of the Wind River Mountains, and part of the west flank of the Teton Range. Field work for this project is now about half complete.

In addition, studies of tantalum and rare earth elements (REE) continued with several REE minerals identified from an area in the northern Bighorn Mountains; studies of zeolites continued with sampling of occurrences in the Lysite Mountain and Beaver Rim areas; laboratory studies of bentonite samples in southern Wyoming were performed and laboratory procedures and methods were perfected; field studies of carbonate rocks in southeastern Wyoming were completed; a study of a possible brick-clay deposit near Laramie was begun. A compilation of uranium analyses in Wyoming water was also begun.

The Uranium and Industrial Minerals Section also prepared quarterly reports and annual summaries of mineral exploration and production; maintained working files and a reference library on industrial minerals in Wyoming; provided technical advice to the Wyoming Department of Environmental Quality regarding bentonite mining activities, information on uranium *in situ* leach operations, and information on limestone quarries scheduled for reclamation; and exchanged information on gravel pits and aggregate sources with the Wyoming Highway Department.

The Section Head presented a talk titled *An overview of the geology and production of Wyoming trona* to the Society of Mining Engineers meeting in Denver. This talk was published as an American Institute of Mining and Metallurgical Engineers' preprint. Another talk, titled *Mineral resources of Permian and Pennsylvanian rocks in Wyoming*, was presented at the Wyoming Geological Association's Annual Field Conference. This talk, coauthored by the Head of the Metallic Minerals Section, was later published in the Wyoming Geological Association's Annual Field Conference Guidebook for 1984.

In FY 85 Section personnel authored or coauthored a total of 11 reports or maps published by the Geological Survey and seven articles published outside the Survey.

Publications

The Publications Program of the Survey is simply a means of communicating some of the geological information collected and interpreted by the professional staff to the public at large. Publications, however, should be viewed as an integral part of the Survey's overall service function as stipulated by law (W.S. 9-2-805, part a, subsections iv and v).

Through the years, the Publications Budget has changed. Originally, it was designed to provide funds to pay for just the printing and distribution of the agency's publications as well as maps for resale. As the scope and volume of investigations and the style of reports and maps changed, 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. The Publications Budget in FY 85 was $127,777.

The priorities as to what material will be published and what will not are established by the State Geologist after consultation with the professional staff and the Editor. There is always a backlog of material that cannot be published in any given year because of publication cost, which in turn is dependent upon the characteristics of the material (size, color, illustrations, etc.), and the volume to be printed, type of binding, and whether it requires typesetting or can be photocopied.

In addition to editing and laying-out reports and maps prepared by the Survey's professional staff, the Editorial and Drafting Sections of the Survey write and prepare some in-house reports on their own. In particular, bibliographies, publication lists, reprints, and some information circulars are done solely by the publications staff. Editing and manuscript preparation of reports and maps submitted for publication by outside authors routinely require above average efforts by this staff. In FY 85 and early FY 86, for example, fifteen outside manuscripts were revised to ensure that they conformed to Survey standards before they were published by the agency.

The two graphs in Figure 5 summarize the general subject matter of Survey publications and the number of new publications completed each decade.

A separate part of the Publications Program is budgeted as "Purchases for Resale". This is simply a separate mechanism to make available special publications and maps published by the U.S. Geological Survey or similar organizations and which have an appeal to Wyoming citizens or tourists. It is in effect another type of geological service. Topographic maps and the new *State geologic map* are two important items provided by this mechanism.

In FY 85, the publications sales staff responded to 4,642 requests for publications (over-the-counter, phone, or mail orders). Although this is more requests than FY 84, it is a significant decline from the record 11,119 inquiries in FY 81, and reflects a decline due to recessionary pressures. A percentage breakdown of publication customers in FY 85 is:

Category	Percent of Customers	Percent of Sales Revenue
General Public	78%	53%
Business and Industry	12%	27%
Wyoming and Local Agencies	2%	5%
Federal and Other States	2%	3%
Universities	6%	12%

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. Prices for individual items are based of fifteen years of experience 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.

In every instance, biennial budget requests for printing funds have been geared to revenue collected from the sale of publications during the two previous years. In others 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/year until FY 81. Sales income in FY 81, however, increased a phenomenal $51,799 over FY 80. With the subsequent recession, however, sales have declined substantially, dropping to $48,878 in FY 84. In 1984, the Legislature requested that the Survey try to increase its publication's revenues to 75 percent of the overall budget for the Publications Program (this equates to approximately $82,000 per year). To accomplish this goal, prices were raised slightly and the preparation and publication of reports and maps were accelerated. Slumping sales were turned around in FY 85 ($63,029) and are expected to reach $82,000 in FY 86.

Publications of the Geological Survey are 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, as well as some other entities.

A complete listing of reports and maps published in FY 85 is provided on pages 6 to 7).

GENERAL CONTENT OF SURVEY PUBLICATIONS
FROM FISCAL YEAR 1911 THROUGH FISCAL YEAR 1985

TECHNICAL AND POPULAR GEOLOGY	100 REPORTS AND MAPS	44%
MINERAL RESOURCES	126 REPORTS AND MAPS	56%

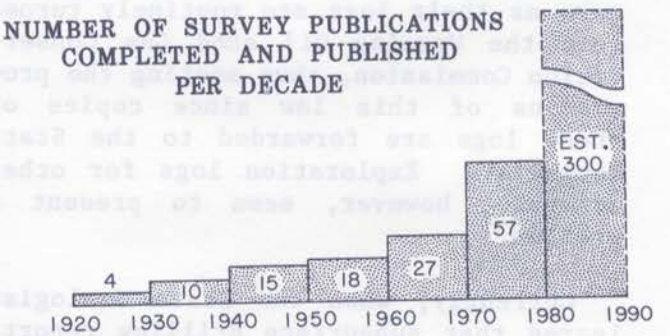


Figure 5. General content of publications and number of new publications per decade.

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 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 annd 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, seem to 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, usually 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.

If this law is to be truly effective in gathering and preserving the valuable mineral resource information provided by subsurface drilling information, it needs revisions. 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., 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 should be added. 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 responsiblity 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 may already have 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 would require at least one additional full-time position in the Geological Survey.

3. With revenues from Wyoming's mineral industry leveling off or at least growing more slowly, forecasting of future tax revenues has become more important and more difficult. These forecasts, particularly on the short term, would be much more accurate and timely if the State were receiving monthly mineral production reports.

Quarterly reports are less desirable, but certainly better than no reports at all. Although the Oil and Gas Conservation Commission already prepares monthly reports for oil and gas production, there is no similar requirement for any other minerals produced in Wyoming.

In the case of coal, the Survey has subscribed to a commercially available report that summarizes coal production reported to the Federal Energy Regulatory Commission (derived from Form 423). Similar monthly data for uranium and trona are not available from Federal agencies because they are "confidential". Although acquisition of this "confidential" data would undoubtedly require the support of both the Governor and Wyoming's Congressional Delegation, it would avoid duplication of effort.

In a similar vein, anyone needing production statistics for Wyoming's mineral industries realizes there is little agreement between the production reported by the Ad Valorem Tax Division, the Oil and Gas Conservation Commission, and the State Inspector of Mines. There is even less agreement with similar production statistics for Wyoming published by the U.S. Department of Energy and the U.S. Bureau of Mines. This is because reporting requirements vary with the individual agencies. This problem will persist until the gathering of production data is relegated to one entity.