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LETTER OF TRANSMITTAL

June 30, 1967

The Honorable Cecil D. Andrus
Governor of Idaho

Dr. Richard D. Gibb
President, University of Idaho

Gentlemen:

We are pleased to present you with the third Annual Report of the Idaho Geological Survey as directed in Idaho Code, Section 47-201 through 47-204. This is the thirty-eighth year of the agency (formerly the Idaho Bureau of Mines and Geology from 1919-1964).

The Survey held its first annual Idaho Field Geology Workshop for earth science teachers of secondary schools. The workshop was organized and conducted in cooperation with the Department of Geology and Geological Engineering at the University of Idaho. Twelve enthusiastic teachers participated in this program designed to give them experience on how geologic research is conducted in the field.

The Survey continues to fulfill its mandate as the lead agency for the collection, interpretation, and dissemination of all geologic and mineral data for Idaho. The activities described in this report are divided between applied research and public service.

Respectfully submitted,

Maynard M. Miller
Director and State Geologist

Earl H. Bennett
Associate Director

1GS—Since 1919, Serving the State Through Geologic Research

The University of Idaho is an equal opportunity/affirmative action employer and educational institution.
INTRODUCTION

Developments in Minerals, Mining, and Energy in Idaho

geology

analytical services

NEVADA
The major news during the year was the announcement by Maynard M. (Mal) Miller that he would be stepping down July 1, 1987, as director of the Survey, state geologist, and dean of the University of Idaho’s College of Mines and Earth Resources. Dr. Miller became the dean/director in 1975. He was instrumental in engineering the passage of legislation in 1984 that reorganized the Idaho Bureau of Mines and Geology into the Idaho Geological Survey. This April at the College of Mines’ annual banquet, the Survey honored Mal for his leadership and dedication over the past 12 years. A search for a new dean/director was underway before the end of the fiscal year.

In August the Survey conducted its first field geology workshop for earth science teachers. The workshop is another project in the agency’s service program for earth science education. Responses from the teachers gave this inaugural field camp high marks.

Earthquake safety and seismicity in the state have received special attention from the Survey in two projects. One is a study of earthquake risk in Idaho’s schools. The other is the placement of the first seismograph station intended to be a part of an eventual seismic network for Idaho.

Before the end of the fiscal year, the Survey was able to provide each staff member with a computer. The computerization of the agency, not only in its daily business but also in its research and publishing, is nothing short of
revolutionary. Computers have become such a necessary tool to productivity that it is almost impossible to work without them.

The legislature continued to be fiscally conservative, keeping state agencies on no-growth budgets. The Survey’s request to open branch offices at Boise State University and Idaho State University was approved by the University of Idaho and the State Board of Education but was not funded by the legislature. Nevertheless, support for these offices is growing statewide. Next year the Survey will again pursue opening these offices.
Maynard M. (Mal) Miller will soon be leaving his duties as dean of the College of Mines and Earth Resources (COMER) and director of the Idaho Geological Survey. Later in 1987 Mal takes on new challenges when he "steps up" from administrator to full-time professor and researcher with COMER. For many years Mal has been involved in geologic and glaciological studies in Tibet and on the Juneau ice field in Alaska. Mal is recognized internationally for his work in glaciology and is currently studying global climatic change. He is also at present an emissary for the University of Idaho, working to establish cooperative academic programs with the major geoscience universities in China.

Dr. Miller became dean and director in 1975. Under his leadership the Survey doubled its research staff and built a respectable publications program. In 1984 the agency underwent a sweeping reorganization. That year Mal
initiated legislation that removed the agency, then called the Bureau of Mines and Geology, from the Department of Lands and established it as a special statewide program at the University of Idaho. The agency was renamed the Idaho Geological Survey and had its research role more clearly defined as the lead state institution for the collection and dissemination of geologic and mineral information. During this period Mal forged strong ties with the mining industry, and because of his sincere efforts the Survey continues today to have many friends and supporters in industry.

One measure of the Survey’s progress during Mal’s tenure was the great increase in publication sales. Sales rose dramatically from $7,584 in 1975 to $50,350 in 1982 and then averaged over $40,000 a year after that. This remarkable growth was due in large part to the emphasis Mal put on the agency’s publishing enterprise by hiring in 1977 a full-time editor. In contrast with this success, however, Mal also faced tough choices for the agency. Budget cutbacks, imposed by the state in 1981, forced the loss of personnel and signaled the first of repeated declines in annual appropriations. It is a credit to Mal’s direction that the Survey weathered these rough fiscal
times with its reputation intact. The first publication released by the agency after it became the Idaho Geological Survey is perhaps significant also as a symbol of survival. The book was the *Cenozoic Geology of Idaho*, a 725-page volume of 42 papers—the biggest publishing project undertaken by the Survey in its 68-year history.

The Idaho Geological Survey has been served well by Dr. Miller. He leaves a competent professional staff in place with a well-defined mission for the future. We look forward to seeing what new peaks Mal will conquer as his adventurous career turns another corner. His staff wishes him all the best.
microprobe investigations

SERVICE
Service must be flexible and amenable to changing times. Over the years the Idaho Geological Survey has assumed a service role in areas not specifically mandated in its enabling act. Many services are undertaken by the staff to address important matters as they arise. For example, the agency has started two new statewide programs, one to support earth science education and the other to establish a seismic-monitoring network. In the future, the Survey will continue to adopt new programs to better serve the changing needs of the state.
Chinese Scientists Visit Idaho

The Survey went international in May and played host to four distinguished scientists from China. The visiting scholars were part of an exchange program between the University of Idaho and mining schools in China. For its part, the Survey treated the visitors to a grand tour of selected mining areas in the state. The agency conducted field trips to the Coeur d'Alene mining district, the phosphate district, the Thompson Creek molybdenum mine, the Delamar silver mine, and of course all the geology in between. Both hosts and guests had a great time. After the long busy days, everyone enjoyed the nightly banquets and numerous toasts that are traditionally part of such excursions.

Disaster Preparedness

The Survey has been charged by an executive order of the governor to formulate and direct the state's geologic hazard reduction effort. This goal requires geologists on the staff to identify and analyze hazards statewide. In addition, the agency is to assign a representative to the damage-survey and hazard-mitigation teams formed to respond to geologic disasters or emergencies. The Survey's role is coordinated through the Bureau of Disaster Services in cooperation with a number of other state agencies such as the Department of Water Resources' dam safety section and the Department of Transportation. This year a state committee was formed to evaluate a new seismic risk map to be included in the revised Unified Building Code. The committee succeeded in changing a risk map developed on the national level to more accurately reflect the risk in Idaho.

In addition the Survey answered an increasing number of hazard inquiries from the public. A common query comes from people moving to Idaho who want information regarding the geologic conditions of an area or at a specific site.

Earthquake Awareness

The Survey maintains a record of the frequency and distribution of earthquakes in the state and answers inquiries from the public regarding seismic activity. Based on the agency's expanding earthquake research, staff geologists are able to provide the public with up-to-date information. The Survey also disseminates information on earthquake safety and emergency response procedures.
Earth Science Education

Continuing the objectives started in FY-86 for supporting earth science teachers in Idaho, the Survey co-sponsored a summer field workshop, mailed out Earth Science Announcements, and helped with initial plans for a statewide professional earth science association. Updating the mailing list of earth science teachers is now an annual fall procedure. At present, the names of more than 350 secondary school teachers are entered into the computer data base.

Through contact with the American Geological Institute, the Survey lent its own moral support to national efforts to boost earth science education. One outcome of this liaison was a paper given by a staff geologist on field geology workshops for teachers. The paper was presented in a symposium at the Geological Society of America’s Cordilleran Section meeting at Hilo, Hawaii.

The Survey worked to encourage ideas for publications that emphasize the use of Idaho’s geology in the classroom. A staff geologist participated in planning a video series earmarked for 8th and 9th grades.

The agency promoted earth science in other ways. During National Library Week, a staff geologist spoke to junior-high school students on the subject of reading and its importance to the activities of scientists.

Field Geology Workshop

In conjunction with its support for earth science education, the Survey conducted on August 1-10, 1986, its first annual Idaho Field Geology Workshop. Twelve participants and two instructors camped at Ponderosa State Park in the McCall area and studied surficial and bedrock geology. Specifically designed for teachers, the workshop provided an opportunity to keep further informed about geology through field research exercises. The participants successfully mapped geology and ran a geophysical survey. Their most satisfying moments came in learning how geologic investigations work and in experiencing the thrill of discovery. The program’s success has ensured plans to repeat the workshop in a different part of the state next year.

Meetings and Conferences

A number of prestigious geologic conferences and meetings are scheduled for Idaho in the near future. The Survey is involved in the preparation, planning, and committee work as well as in writing papers and giving field trips for the following meetings:

- The Rocky Mountain Section of the American Association of Petroleum Geologists to be held for the first time in Idaho at Boise in September 1987.
- The Geological Society of America, Rocky Mountain Section, meeting to be held at Sun Valley in May 1988.
- Plans are already underway for the Survey also to publish the GSA’s field trips in cooperation with the meeting’s sponsor, the Geology Department of Idaho State University.
- The 24th Annual Symposium on Engineering Geology and Soils Engineering to be held in Coeur d’Alene in April 1988.
- The 28th International Geological Congress to be convened in Washington, D.C. in 1989. Field trips will be conducted in parts of Idaho for the meeting.
- The joint meeting of the Rocky Mountain and Cordilleran Sections of the Geological Society of America to be held in May 1989 at Spokane, Washington. The Survey is a cosponsor of the Spokane meeting together with Eastern Washington University and the University of Idaho.
Microprobe Laboratory

The Survey's microprobe laboratory offers a number of services to the public. These range from identifying minerals for the operators of small mines in the state to assisting students and faculty with research problems. For FY-87, the laboratory provided geochemical analyses on the following:

- Opaque oxides from a study area at Pittsburg Landing.
- A gold occurrence in diorite from Republic, Washington.
- A study of feldspars in mylonites, conducted with faculty from Idaho State University.
- Samples of volcanic ash.
- A supposed platinum occurrence from a mine near Orogrande.

In addition, rock samples from prospectors and state and federal agencies were sent to the laboratory for analysis and identification.

Mines and Prospects in the State

The Survey has developed extensive data on the mines and prospects in the state. Thousands of localities have been inventoried for their minerals and the amount of ore mined. Information about these sites is being revised regularly and is available through publications and material on file at the agency's office. The twenty maps published in the *Mines and Prospects Map Series* cover the state and list the locations of over 8,000 mineral sites. The Survey published this year, at 1,000,000 scale, a redrawn version of *Mining Districts of the State of Idaho* originally released in 1941.

Mining Industry Review

Idaho experienced a notable increase in exploration activity in FY-87 with 38 projects underway. This upturn in mineral interest was tempered, however, by the closing of silver mines in the Coeur d'Alene district and by poor markets for some of the phosphate companies in southeast Idaho. The 1985 report detailing the events in the state's mining industry was released in June. Information for the report was contributed by mineral experts and geologists from the U.S. Forest Service, the U.S. Bureau of Land Management, several state offices, and over a hundred private companies. The Survey answers numerous inquiries every year about Idaho's mineral resources. The agency is constantly upgrading and adding to its collection of mining and mineral information.
New Computer Programs

All staff have been assigned personal computers. The machines are an essential tool for daily tasks and research, and members have been quick to utilize their productive capabilities. Several extensive data bases have already been set up. Computer programs in BASIC were written for public and agency use. These included programs to recast garnet end members, to determine CPW norms, and to calculate temperatures and oxygen fugacities based on microprobe analysis of iron-titanium oxides.

Oil and Gas

The Survey maintains information on oil and gas exploration activity in Idaho. The agency answers inquiries from lease applicants and exploration companies regarding the petroleum potential of various areas in the state. Staff geologists provide geologic information to the regulatory agencies including the Idaho Oil and Gas Conservation Commission and the Bureau of Minerals in the Idaho Department of Lands. These two agencies administer oil and gas permits and oversee leasing, drilling, and seismic exploration. For its part, the Survey maintains a library of electric logs and drill cuttings open for public inspection. During FY-87 three wells were drilled and two additional drilling permits were granted. An estimated $5 million was spent by the oil industry in Idaho. Still, to date there has been no petroleum production in the state.

Thesis Maps

The Survey continues to publish through its Technical Report Series those thesis maps provided by geology graduates whose research was conducted in Idaho. This service has become more popular each year.
RESEARCH

Pamphlet No. 104
July, 1955

STATE OF IDAHO
Robert B. Sayler, Governor
Idaho Bureau of Mines and Geology
J. B. Forrester, Director

Flotation Tests on an Oxidized Lead-Zinc Ore from the Coeur d'Alene District, Idaho

by

Lewis S. Prater

UNIVERSITY OF IDAHO
Moscow, Idaho

geochemical exploration

geologic hazards

Annual Report 1987
The bread and butter of most state surveys is applied research, and it is no different for the Idaho Geological Survey. Applied research refers to those scientific studies of geologic problems related to human activity. It is the kind of study the state’s citizens find they need most. By contrast, basic research, while no less important scientifically, seeks solutions to problems that may not have an immediate or direct impact on daily lives. The Survey undertakes applied research in the state’s interest. Subjects may range from identifying mineral resources to cataloging earthquake faults. A key ingredient to these studies is understanding the geologic structure of the state. Consequently, geologic mapping and data collection are strong components of the agency’s applied research.

Idaho is still largely undiscovered geologically and has vast areas that have not been mapped or studied. Into this unchartered ground have stepped the Survey’s geologists who continue to collect and analyze primary scientific data. While the Survey can field only a small research staff, its five members have combined among them 58 years of direct professional experience in the state. This veteran staff has built over the years durable research programs and has developed a wide-ranging expertise on the state’s geology and mineral resources.

The following projects represent the range of current research.
Accreted Terranes of Western Idaho

Between 100 and 200 million years ago, large land masses that we might today call islands crashed into the western edge of the North American continent. The collision was not a speedy affair as would happen between cars on city streets. The impact of these great bodies took millions of years before the shoving and crumpling stopped. When it was over, the island masses were fused to the larger land body. Geologists call this large-scale geologic movement plate tectonics and the process of adding island masses or terranes to the continent accretion. Parts of what is now western Idaho came into existence by this process. The area of these accreted terranes includes the Seven Devils, Cuddy, and Hitt Mountains and the other land masses now buried by younger rocks.

In studying these terranes, the Survey is furthering our understanding of the state’s geologic history. The knowledge gained from these studies can be applied, for example, to those scientific efforts at unraveling the potential for mineral resources in the area. During FY-87, geologists continued field work on ultramafic occurrences in western Idaho. They located, identified, and mapped the rock types and minerals concentrated along the boundary between the accreted terranes and the earlier-formed part of North America. Ultramafic rocks are important sources throughout the world for gold, talc, asbestos, and the chromium/nickel/platinum-group elements.

Boise Quadrangle

In the Boise 1° x 2° quadrangle, the Survey completed field work and compiled the geology for the Lucky Peak 7 ½-minute quadrangle. This was accomplished concurrently with mapping by other geologists from the Boise area in the adjoining Boise South 7 ½-minute quadrangle. The mapping of these quadrangles has contributed to developing a conceptual model for the late Cenozoic geology of the western Snake River Plain. Researchers produced a stratigraphy for the basaltic lavas that cap terraces of the Boise River by using, in part, the paleomagnetism of the lava flows.

More regionally, the Survey identified terraces and other geomorphic surfaces of the Boise River valley. Relict soils were studied to help correlate those geomorphic surfaces. Beyond the Boise valley, a staff geologist began mapping the highest gravel surfaces in the western Snake River Plain to correlate depositional events.

Cayuse Creek Geochemistry and Mapping

Reconnaissance geochemical and geological mapping continued in the Cayuse Creek drainage in northern Idaho. This year mapping and stream sediment sampling were completed on 20,000 acres in the Rhodes Peak, Cayuse Junction, and Horseshoe Lake 7 ½-minute quadrangles. The fifty samples collected this year will be analyzed with other samples when the project is completed so that all samples can be examined using the same techniques. Final geological and geochemical maps will be published after the program is completed.
Chemistry of Tetrahedrite

Research continued into the chemistry of tetrahedrite, the major silver-bearing mineral in the Coeur d’Alene mining district. A paper will be presented next year detailing the results.

Earthquake Safety for Idaho Schools

The Survey was awarded a $15,500 contract from the Idaho Department of Education and the Idaho Bureau of Disaster Services to study the earthquake risk in Idaho’s schools. This project will evaluate the seismic risk in the state as well as inventory the structural characteristics of individual school buildings. These data will be used to develop seismic safety standards for recommendation to the State Board of Education. The multi-disciplinary project includes faculty and graduate assistants in geophysics, civil engineering, and education.

Hailey CUSMAP

The Survey continued its mapping of the Hailey 1° x 2° quadrangle in support of the U.S. Geological Survey’s Conterminous United States Mineral Appraisal program (CUSMAP). Staff geologists mapped parts of six 7 ½-minute quadrangles—Grouse Butte, Jumbo Mt., Sprout Mt., Deer Mt., High Prairie, and Hill City. They also mapped several major northeast-trending faults of probable Eocene age as well as new exposures of Tertiary volcanic and intrusive rocks. Near Chimney Peak, a roof pendant composed of metamorphic rocks of unknown age is underlain by a major decollement. This structure indicates the pendant moved to the south, towards the Camas Prairie. Several gabbroic plugs and dikes intrude near or into the northeast-trending faults. New mapping has expanded the size of the so-called pegmatite zone of the Idaho batholith. The zone now extends from the Iron Mountain fault to Cathedral Rocks. Ore deposits and prospects in the area appear to lie along major northeast- and northwest-trending faults.
Landslide Inventory

The Survey began a cooperative study with the U.S. Geological Survey to inventory landslides in Idaho. This is the first-ever attempt at a statewide data base for mass earth movements. Scientists gathered information from all available published sources and from contact with other researchers. Information on nearly 3,000 landslide sites in Idaho is being entered into data files. Individual sites are being classified by their location, size, elevation, aspect, slope, geology, and type of movement. These data will be invaluable for use in site studies and geotechnical investigations.

Little Salmon River Alluvial Gravels

The Survey and the Geography Department at the University of Idaho continued their research under a grant to study the history of gravel deposition along the Little Salmon River. Preliminary mapping shows a complex system of terraces partly related to landslide activity in the narrow valley. Researchers collected volcanic ash and charcoal for dating. The project will extend into next year.
Long Valley Landform Map

In the spring the Survey published Landforms and Surface Deposits of Long Valley, Valley County, Idaho, This unique publication reinterprets the surficial geology of Long Valley as a map of landforms and surface deposits. Long Valley is one Idaho’s key multi-purpose resource areas, stretching from Lake Fayette and McCall to south of Cascade. It already has environmental pressures on its land resources and will face more problems as its permanent and recreational population grows.

The new map presents the general deposits associated with the area’s landforms and appraises the soil conditions important to cultural activities such as construction and waste disposal.

Two ideas controlled the design of this map so that its scientific data would appeal to, and be useful for, a broad spectrum of landowners, land developers, and local planners. One was to furnish an attractive base upon which to show the geologic information. For this, false-color infrared photographs of the area were used to make the locale easily identifiable and to clearly portray the valley’s landforms. The other idea was to provide a geologic analysis of the landforms through easily read descriptions and comparisons. A tabular outline of soil characteristics presented as part of this map allows the reader to quickly identify the various engineering properties and applications for the area’s land.
Mines and Prospects Map Series

Another map in the popular Mines and Prospects Map Series is being revised and updated. The second edition of the map of the Hailey 1° x 2° quadrangle will contain a new category of information—the production figures for many of the mines. These data, obtained from the U.S. Bureau of Mines, have been compiled so that tonnage figures and the amount of each metal produced at a mine can be shown. Production numbers are included for the period from 1902 to 1979. Users will now be able to quickly separate the major mines from marginal prospects. This cannot be done now without referring to the original literature citation for each property.

Quaternary Mapping in Northern Idaho

Large-scale mapping in the Sandpoint 1° x 2° quadrangle has clarified the stratigraphy and age relationships of the surficial deposits. The area is undergoing increased economic development that ranges from mining to tourism and recreation. Much of the panhandle of Idaho is covered by Quaternary glacial deposits. These deposits dominate most land-use issues, including water, waste disposal, soil properties, and construction materials. The Survey completed field mapping for several quadrangles in the Priest Lake area; these maps are now being compiled. Mapping will begin in the Clark Fork 15-minute quadrangle, a key area to understanding the Quaternary geology of this region.

Seismicity and Neotectonics

Research undertaken by geologists and geophysicists of the Survey and the University of Idaho is addressing the state’s seismicity. This year most of the work concentrated on modeling the attenuation of rock types to match major historical earthquakes. The scientists have also delivered several papers on these new models that enable geologists to assign values of seismic risk for a site. This information is being plotted on new maps called isomagnitude maps. The scientists are now refining these maps as a realistic tool for evaluating earthquake risk in Idaho.

During FY-87 the North Idaho Seismic Array was put into operation to monitor seismicity in the northern part of the state. The array is sponsored by the Survey, the University’s Geology Department, and the Idaho Mining and Mineral Resources Research Institute. The Survey released several new reports based on data from the new station. These reports included events at Riggins and rock bursts in the Coeur d’Alene mines. The scientists plan to expand the network for better coverage of earthquake activity along the Lewis and Clark line.

MINERAL

Annual Report 1987
Snake River Plain
Volcanic Province

The Snake River Plain is the most prominent geologic feature in Idaho and home to three-quarters of the state’s citizens. This vast region has the greatest economic activity in the state. Agriculture, Idaho’s leading industry, is concentrated there. Large portions of the dollars from tourism, the third leading force in the state’s economy after lumber production, are produced there as well. The scientific scrutiny of the geology across this great area has important applications to future economic development.

This geologic province was formed mainly by volcanic processes during the past 12 to 15 million years. The long-term goals of the Survey’s investigations in the plain are two-fold: first, to develop geologic maps of key areas, especially where data are needed to guide the future use of land, minerals, and water resources; second, to come to a greater understanding of the geologic processes that formed the province. The following projects focused largely on the western part of the plain:

- In the Sheep Creek 1:100,000 quadrangle, geologic mapping was completed for the Grassy Hills, Cowan Reservoir, and Triguero Lakes 1/2-minute quadrangles. The main objective in the Sheep Creek quadrangle is to map and study the Bruneau-Jarbidge eruptive center. A few million years ago, this structurally down-dropped region erupted large volumes of silicic volcanic rocks. It is also the area that subsequently erupted large rhyolite lava flows and many basalt lava flows.

- Geologic mapping has begun in the Wild Horse Butte 7 1/2-minute quadrangle of the Boise 1° x 2° sheet. This work is expected to be completed during FY-88. Mapping the Wild Horse Butte quadrangle is the first step in mapping the Murphy 1:100,000 sheet.

- Work continued on compiling chemical analyses of volcanic rocks from the Snake River Plain. This project is to bring together, in computer files and in one or two published Survey documents, all the available chemical analyses of rhyolite, basalt, and other volcanic rocks from the plain.

- Research began in the Lake Hills area, northeast of Carey. This study is being done in cooperation with other geologists from Idaho State University, the National Science Foundation, Rice University, and The Open University of the United Kingdom. The study will develop a stratigraphic understanding of the silicic volcanic units on the northern margin of the plain. The geologists are also investigating the large-scale rheomorphic features that formed in the silicic volcanic units as they subsided into the zone from which they erupted.
Mines and prospects of the Challis Quadrangle, geological documents

Annual Report 1987
The Survey produced several publications of note in FY-87. The agency’s first annual report in the name of the Idaho Geological Survey was released during the year. This report gave the Survey the occasion not only to explain its research and service but also to profile for the first time the members of the staff. Two maps were added to the Map series. One is a smaller scale, redrawn version of Clyde Ross’s popular map of the state’s mining districts. The original had been out-of-print for years. The other map is the surficial geology of Long Valley in Valley County. This map is significant for its break with the traditional format of topography overlaid by geology. Instead, it has used high-altitude infrared photographs for the base. The uniqueness of the map is discussed in the Research section of this report. The second edition of the Challis quadrangle in the Mines and Prospects Map Series was released to waiting buyers. The 20-map Series was originally published in 1981. The Challis quadrangle is the first second-edition to be completed for the series. The Survey also issued several Technical Reports and two yearly reviews of the state’s mining industry.

The Survey has been looking at ways to broaden its publication output. One is to encourage contributions from other scientists and organizations. These submissions would of course have to be in the agency’s interest to publish. For example, the timing of major scientific meetings to be held in the Northwest in the next two years gives the Survey a golden opportunity to expand its publications. Already, the agency has worked out arrangements with the Geology Department of Idaho State University to publish the road logs for the
Geological Society of America’s meeting at Sun Valley in May 1988. And there are other important meetings coming in 1989. The Survey may decide to become involved with these depending upon the successful outcome of this project.

Sales for FY-87 remained below the average for the previous five years. Only a few hundred dollars separated the year-end total from that of FY-86. One factor that has influenced these sluggish sales is the lingering slump in mining and in mineral exploration. The troubled times in the mining industry have curtailed demand from this frequent user of the Survey’s research.

For FY-87 the following reports and maps were released.
Information Circulars


Maps

Mines and Prospects
Map Series

- Mines and Prospects
  Map Series.
  Mines and Prospects of the
  Challis Quadrangle, Idaho,
  second edition, by Victoria
  E. Mitchell, William B.
  Stroud, Gail S. Hustedde,
  and Earl H. Bennett, 56 p.

MINERALS, MINING, AND ENERGY
IN IDAHO, 1985

maps & books
Technical Reports


FUNDING AND BUDGET

Idaho got little relief from the recession that has gripped the state for the past several years. Budgets again were lean. Most state agencies received only a small percentage increase over last year. The boost in operating expense funds for the Survey, however, enabled essential programs to continue. The outlook for future state funding may be improving. Economic reports circulate that the state should be enjoying better times ahead.

The bright spot for the agency was the increase in federally funded projects. Funding from federal and other sources rose from $78,551 last year to $120,322 this year. Major research efforts included the U.S. Geological Survey-supported Boise COGEOMAP, Hailey CUSMAP, and geologic hazard studies. The Survey's success in obtaining these projects is due to the determined initiative of the staff.
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<td>25,654</td>
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<td>1971</td>
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<td>1976</td>
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<td>1977</td>
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<td>1979</td>
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<td>1980</td>
<td>314,400</td>
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<td>1986</td>
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<td>30,990</td>
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<tr>
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<td>1987</td>
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<td>1988</td>
<td>332,600</td>
<td>35,000 (est.)</td>
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* Biennial appropriations through 1971

1 Includes sales of all Bulletins (1-7) only from 1919 to date
2 Sales of Bulletins only
3 Cash in fund
4 IGS begins sale of topographic maps
5 IGS releases first List of Publications

Annual Report 1987
# RECENT BUDGET HISTORY

**Fiscal Years 1985-1987**

<table>
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<th></th>
<th>FY-85</th>
<th>FY-86</th>
<th>FY-87</th>
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<td>PERSONNEL</td>
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<td>257,500</td>
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<td>OPERATING EXPENSE</td>
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<td>45,000</td>
<td>47,100</td>
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<td>CAPITAL OUTLAY</td>
<td>-</td>
<td>-</td>
<td>-</td>
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<tr>
<td><strong>Total</strong></td>
<td>277,500</td>
<td>302,500</td>
<td>305,400</td>
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# OVERVIEW OF GRANTS AND CONTRACTS

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<tr>
<th>FUNDING AGENCY</th>
<th>PROJECT/ITEM</th>
<th>AMOUNT</th>
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<tbody>
<tr>
<td>University of Idaho Research Foundation</td>
<td>Salmon River gravel</td>
<td>$ 3,892</td>
</tr>
<tr>
<td>Seed Grant Council</td>
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<td></td>
</tr>
<tr>
<td>University of Idaho Research Foundation</td>
<td>Lake Idaho</td>
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<tr>
<td>Seed Grant Council</td>
<td>School Hazards</td>
<td>$ 15,500</td>
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<td>Idaho Bureau of Disaster Services</td>
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<tr>
<td>U.S. Bureau of Mines</td>
<td>Idaho geology</td>
<td>$ 6,000</td>
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<td>U.S. Geological Survey</td>
<td>Hailey CUSMAP</td>
<td>$ 44,224</td>
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<tr>
<td>U.S. Geological Survey</td>
<td>Landslide inventory</td>
<td>$ 19,900</td>
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<td>U.S. Geological Survey</td>
<td>Boise COFOEOMAP</td>
<td>$ 20,000</td>
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<td>Idaho Mining and Mineral Resources Research Institute</td>
<td>Computer</td>
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<td>Idaho Mining and Mineral Resources Research Institute</td>
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<tr>
<td>Idaho Mining and Mineral Resources Research Institute</td>
<td>Field Geology for Teachers</td>
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<td><strong>TOTAL</strong></td>
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<td>$120,232</td>
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Idaho Geological Survey
## State Geological Survey Employees

### INCOME TO STATE GEOLOGICAL SURVEYS

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<tr>
<th>State</th>
<th>Direct Appropriation</th>
<th>Transferred Other</th>
<th>Total</th>
<th>Federal Funds</th>
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### TOTALS

$111,357,434 $73,414,408 $4,069,887 $17,837,424 $6,163,032 $1,140,957 $1,509,055 $6,000

### Notes

1. Fiscal Year: April 1, 1987—March 31, 1988
2. Fiscal Year: July 1, 1987—June 30, 1988
3. Fiscal Year: September 1, 1986—September 30, 1987
4. Fiscal Year: October 1, 1986—September 30, 1987
5. No report.


### Annual Report 1987
PERSONNEL

Maynard M. Miller
Director/State Geologist

Earl H. Bennett
Associate Director

Bill Bonnichsen
Supervisory Geologist

Roy M. Breckenridge
Supervisory Geologist

Julie Gange
Clerical Specialist

Charles R. Knowles
Supervisory Geologist
Dreaucine Bonner
Clerical Specialist

Dreaucine Bonner brings varied public relations skills to her position with the Survey. After graduating from Boise State College, she worked for United Airlines at the international reservation desk, and later as ticketing manager for Four Seasons Travel in Boise.

For several years she was an interior decorator for Nadine Miller and other shops in Boise. She moved to Moscow to finish her interior design degree and was designing for Final Touch in Pullman, Washington, prior to joining the Survey.

Charlotte Fullerton
Secretary/Records Manager

Charlotte Fullerton, a Montana native and graduate of the University of Montana (home economics major/business education minor) joined the staff in June 1987 as the new Secretary/Records Manager replacing Melinda Nichols. Charlotte has several years' experience in office management and accounting gained as secretary/bookkeeper for the mechanical contracting business she and her husband owned and operated in Hamilton, Montana. Also a former teacher, she plans to complete work on a master's program in Human Development and Family Relations at the University of Idaho.

Jennifer Pattison Hall
Publications Assistant

Jennifer Pattison Hall joined the staff in August as Publications Assistant in the editorial section. She has worked for eleven years in the printing and publications fields, and during those years won several Printing Industry of America awards. She brings to the Survey valuable experience in both design and production, as well as an enthusiasm for computers and desktop publishing. Her background in geology is limited to childhood years following her parents up and down the Mother Lode country in California, and four years in Mexico at the San Luis Rey mine.
Wayne C. Adams began working as a Geologist for the Idaho Geological Survey in 1986. He received his B.S. in geology from the University of Oregon in 1980 and is completing his M.S. in Geological Engineering at the University of Idaho.

Wayne has four years of experience, from 1980 to 1984, in soils engineering and slope stability while employed by the U.S. Forest Service's Geotechnical Engineering in Oregon and Washington.

He is currently the project leader in charge of the design and implementation of the landslide inventory of Idaho. This statewide inventory is a jointly funded one-year project in cooperation with the U.S. Geological Survey.

Jon Gustafson worked for Idaho Geological Survey in 1986-1987 as an illustrator. His educational background includes a BFA in Fine Arts (1967) and a BA in Education (1972) from Washington State University. He spent several years as a medical illustrator, graphics illustrator, and science illustrator for WSU before forming several businesses.

Jon now spends most of his time running JEM Enterprises, JMG Appraisals, Moscow Moffia Writers' Program, and J. Martin and Associates Literary Agency. Also a writer, he has entries in several encyclopedias and a book, *Chroma, the Art of Alex Schomburg*, in current release. His specialty seems to be a jack-of-all-trades.
STAFF PUBLICATIONS & PROFESSIONAL ACTIVITIES

igneous-metamorphic
STAFF PUBLICATIONS AND ACTIVITIES

EARL H. BENNETT

Publications


Abstracts


In Press


Presentations

Cœur d'Alene District, Yesterday and Today, The: Cœur d'Alene Chamber of Commerce luncheon, Cœur d'Alene, May.

Correlation of Plate Motions in the Pacific and Igneous Events in the Pacific Northwest Since the Cretaceous, The: Department of Geology and Geological Engineering, University of Idaho, March; Department of Geology, Western Washington University, April; and Department of Geology, Oregon State University, April.

History of 100 Years of Mining in the Fabulous Cœur d'Alene District of Idaho, The: Idaho Association of Elected Officials, Cœur d'Alene, October; visiting delegation of Chinese scholars and mining industry representatives, Cœur d'Alene, May.


Regional Developments in Idaho's Mining Industry: Regional Developments Session, 92nd Northwest Mining Association Convention in Spokane, December.

Professional Activities

Bulk Mining Symposium, Nevada Geological Association, Reno, Nevada, April.

College of Mines and Earth Resources' Advisory Board Meeting, University of Idaho, November and April.

College of Mines and Earth Resources' Retreat, University of Idaho, February.

Idaho Mining Association's Congressional Dinner, Washington, D.C., February.

Member, Belt Association.

Member, Geological Society of America.

Member, Northwest Mining Association.

Northwest Mining Association's Convention, Spokane, Washington, December.

Ore Deposits Modeling Workshop, Denver, Colorado, January.
President, College of Mines and Earth Resources' Alumni Group (C2A2).
Rocheotee Mine dedication in Nevada, October.
Thunder Mountain Mine dedication, September.
Trustee, Northwest Mining Association.
U.S. Geological Survey's western cluster meeting in Portland, Oregon, October.
Various computer classes for a week, University of Idaho's Computer Center, December.

Graduate Thesis Committees
Emma Forster, M.S., History, University of Idaho.
Earl McCurley, M.S., Geology, University of Idaho.
Victoria Mitchell, Ph.D., Geology, University of Idaho.
Mark Pugh, M.S., Geology, Western Washington University.
Michael Ratcliff, M.S., Geology, University of Idaho.
Diane Scholick, Ph.D., Geology, Washington State University.

Grants And Contracts
Computer Grant (Idaho Mining and Mineral Resources Research Institute $1,500).

Bill Bonnichsen

Publications

Abstracts

In Press
Geologic Map of the Big Jacks Creek, Little Jacks Creek, and Duncan Creek Wilderness Study Areas, Owyhee County, Idaho, by D. H. Kauffman and B. Bonnichsen: U.S. Geological Survey Miscellaneous Field Studies Map, scale 1:50,000.

Presentations
Distinctions Between Rhyolite Lava Flows and High Temperature Welded-Tuff Sheets in the Snake River Plain, Idaho: Idaho Association of Professional Geologists, Boise; Department of Geology, Idaho State University, Pocatello; and E.G. & G. Geology Group, Idaho National Engineering Laboratory, Idaho Falls; October.
Melting of Duluth Complex Inclusions and Footwall Rocks as a Possible Source of Keweenawan Felsic Rocks: Symposium on Keweenawan Geology, Geological Society of America Meeting,
ROY M. BRECKENRIDGE

Professional Activities
Co-leader with K. L. Othberg, earth science teachers' field trip to Hells Canyon, April.
Field trip to Columbia River Basalt, southeastern Washington, sponsored by Washington State University, May-June.
"Friends of Rhylolite" annual field trip, eastern Snake River Plain, August.
Idaho Academy of Science meeting, Moscow, judged geology talks, April.
Member, Ad Hoc committee to arrange for publication of the field trip guidebooks for the 1989 Geological Society of America meeting to be held in Spokane in May, 1989.
North-Central Section meeting, Geological Society of America, St. Paul, Minnesota, and field trip to the North Shore of Lake Superior, April-May.
Northwest Mining Association's Convention, Spokane, Washington, December.

Graduate Thesis Committees
Thomas G. Borovicka, M.S., Geology, University of Idaho.

Grants And Contracts
Lake Idaho - A Key to Unlocking Our State's Geologic History (University of Idaho Research Council Seed Grant Program, $5,000).

ROSMARIE BUCK

Publications

Abstracts

In Press

Presentations

Professional Activities
Geology Writer, National Testing Service, Graduate Record Examination in Geology.
Idaho Superconducting Supercollider Proposal, Geotechnical Group, Idaho Department of Commerce.
Member, Ad Hoc committee for Seismic Zonation of Idaho.
Member, Dean Search Committee, University of Idaho, College of Mines and Earth Resources.
Member, Executive Committee, Western States Seismic Policy Council, elected term 1986-1987.
Member, Steering Committee for 1987 Rocky Mountain Section Meeting, Boise.

Graduate Thesis Committees
Wayne Adams, M.S., Geological Engineering, University of Idaho.
Bruce D. Cochran, Ph.D., Geology, University of Idaho.
John McKinness, M.S., Geology, University of Idaho.
Kurt L. Othberg, Ph.D., Geology, University of Idaho.
Christopher Shaw, M.S., Geology, University of Idaho.
William G. Uhrich, M.S., Geology, University of Idaho.
Mark Welford, M.S., Geography, University of Idaho.

Idaho Geological Survey
Grants And Contracts
Quaternary Alluvial History of the Little Salmon River Basin (University of Idaho Research Council, April 1986 to October 1987, $3,892).
Seismic Safety Standards for Idaho Schools (Idaho Department of Education and Idaho Bureau of Disaster Services, $15,500).

JULIE GANGE

Publications

CHARLES R. KNOWLES

Abstracts
Phase Relations in the System Ag2S-Cu3S-PbS-Bi2S3 by C. Knowles, L. Y. Chang, and D. U. Wu: 14th General Meeting of the International Mineralogical Association, Stanford University, 1986.

Professional Activities
Chairman, Radiation Safety Committee, University of Idaho.
Hells Canyon Geological Society, annual field trip, August.
Idaho Association of Professional Geologists, annual meeting, Ketchum, April.
International Mineralogical Association, 14th General Meeting, Stanford University, July.
Microbeam Analysis Society, 21st Annual Conference, Albuquerque, New Mexico, August.
MAYNARD M. MILLER

Publications


VICTORIA E. MITCHELL

Publications


Professional Activities

Member, Geological Society of America.

Member, Society of Economic Paleontologists and Mineralogists.

Northwest Mining Association's Convention, Spokane, Washington, December.

Grants and Contracts

Compilation of mining production data for the Hailey 1° x 2° quadrangle (Idaho Mining and Mineral Resources Research Institute, January to June 1987, $1,421).

MELINDA NICHOLS

Publications

KURT L. OTHBERG

Publications

Abstracts

In Press

Presentations
Application of Surficial Geology to Ground Water and On-Site Sewage Treatment: Field Geology for Teachers, McCall, August.
Glaciation and Glacial History of Idaho: Field Geology for Teachers, McCall, August.
Interpreting Landforms in Long Valley, Idaho: Field Geology for Teachers, McCall, August.
Late Cenozoic Geology Near Lucky Peak Dam, Idaho: Idaho Association of Professional Geologists, Boise, September.
Soils and Soil Identification in Glacial Deposits: Field Geology for Teachers, McCall, August.

Graduate Thesis Committees
Sam Matthews, M.S., Geology, University of Idaho.

Grants And Contracts
Landslide Hazards Inventory of Idaho (U.S. Geological Survey, September 1986 to November 1987, $10,000, joint project with R. M. Breckenridge).
Summer Field Geology Research for Secondary Earth Science Teachers (Idaho Mining and Mineral Resources Research Institute, $2,150).

Professional Activities
Co-organizer, initial planning meeting for an association of Idaho's earth science teachers, Idaho Science Teachers Association Annual Meeting, October.
Member, committee to reorganize the geomorphology course at the University of Idaho.
Member, planning committee for the Seismic Safety in Idaho Schools Project.
Organizer and co-leader with B. Bonichchen, earth science teachers' field trip to Hells Canyon, April.
ENABLING ACT

IDAHO GEOLOGICAL SURVEY ENABLING ACT
SENATE BILL 1269
47th IDAHO LEGISLATURE, 2nd REGULAR SESSION—1984

47-201. GEOLOGICAL SURVEY CREATED—PURPOSE—ADVISORY BOARD. There is hereby created the Idaho geological survey, to be administered as a special program at the university of Idaho under the authority of the board of regents of the university of Idaho. This survey will conduct business heretofore carried out by the Idaho Bureau of Mines and Geology. The survey shall be the lead state agency for the collection, interpretation, and dissemination of geologic and mineral data for Idaho. Such information is to be acquired through field and laboratory investigations by the staff of the survey and through cooperative programs with other governmental and private agencies. There is hereby established an advisory board for the survey, consisting of the following members: The dean of the college of mines and earth resources of the university of Idaho, who shall be director of the survey and board chairperson (nonvoting); the chairman of the department of geology at Boise State University; the chairman of the department of geology at Idaho State University; the president of the Idaho mining association, so long as said association continues to exist and elect a president; the governor of the state of Idaho or his designated representative; a member of the board of land commissioners designated by the state land board; the president or his designee of the Idaho Association of Professional Geologists; and two (2) members at large selected by the director from other state or federal organizations, or from the private sector with a direct interest in the survey’s programs, both serving two (2) year staggered terms, all of whom shall serve as members of the said board and shall be compensated as provided by section 59-509(6), Idaho Code.

47-202. MEETINGS—OFFICE—STATE GEOLOGIST. The advisory board shall hold annual meetings at the university of Idaho, Boise State University or Idaho State University on the first Monday of June of each year and such other meetings as may determine. The chief office of said survey and the office of its secretary shall be maintained at the university of Idaho. The director of the survey, or a professional geologist in the survey, if so appointed by the director, is designated state geologist.

47-203. DUTIES—PUBLICATIONS—COOPERATION WITH OTHER AGENCIES—SATELLITE OFFICES. It shall be the duty of the said state survey to conduct statewide studies in the field; laboratory studies; prepare and publish reports on the geology and mineral resources of the state; maintain laboratory facilities to perform noncommercial mineral and chemical analyses; fix a price upon printed reports not used in exchange with other state bureaus or surveys, universities or public libraries, and deposit receipts from sales in a printing fund to be used for the preparation and publication of reports of the survey, and for no other purpose. The survey shall be allowed to seek and accept funded projects from and cooperative programs with other agencies for support of the survey’s research and service activities as authorized by the board of regents. All funds received from these projects shall be used for said projects and services. The survey shall be allowed to have satellite offices at the geology departments of Boise State University and Idaho State University.

47-204. REPORTS. The state geological survey shall annually, or before the first day of January, make to the governor of the state and to the president of the university of Idaho a report detailing major events during the previous year concerning the geology and mineral resources of the state; a report of its expenditures and of the work of said survey during the preceding year, and budget requests for the following year; and it shall make a similar report of its doings and its expenditures to the state legislature through the legislative council.