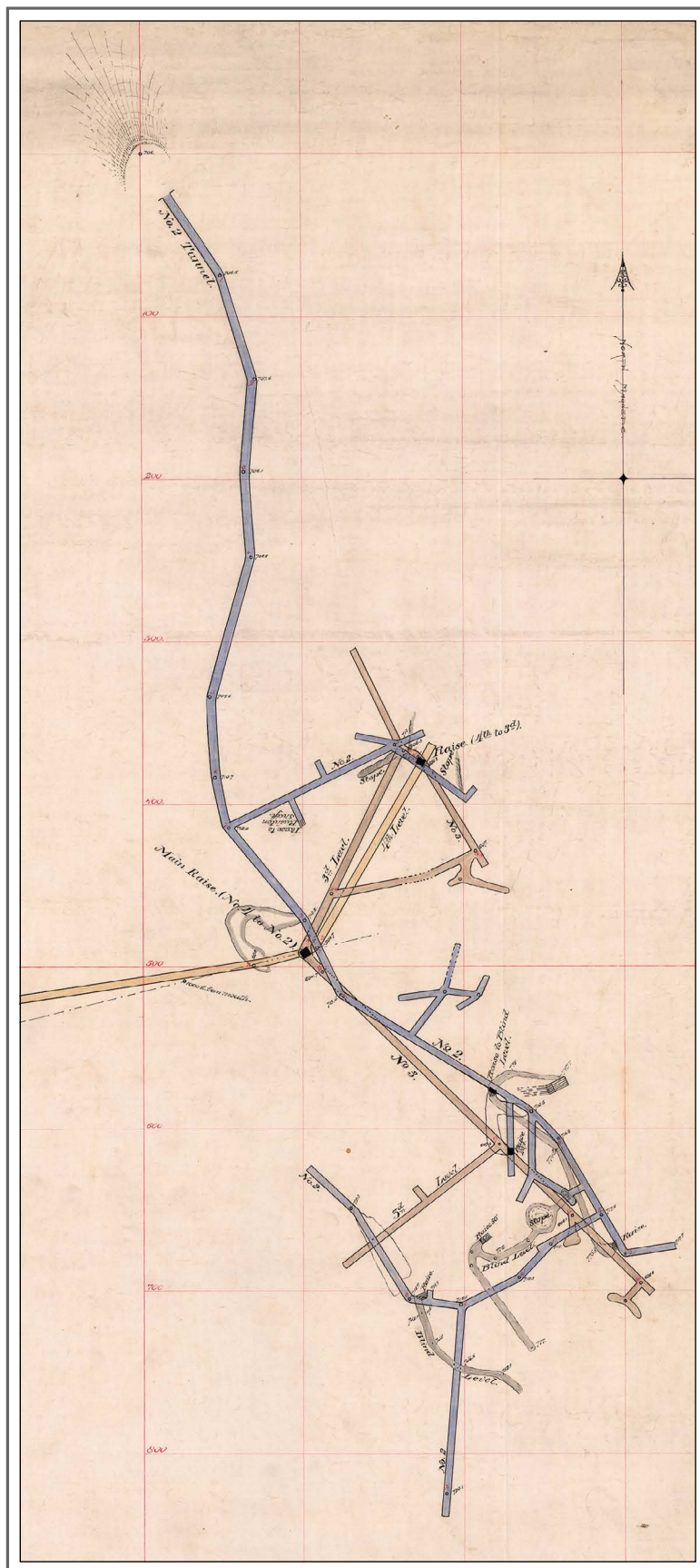


ANNUAL REPORT
of the
IDAHO
GEOLOGICAL
SURVEY

FISCAL YEAR
2014



Annual Report of the Idaho Geological Survey

Fiscal Year 2014

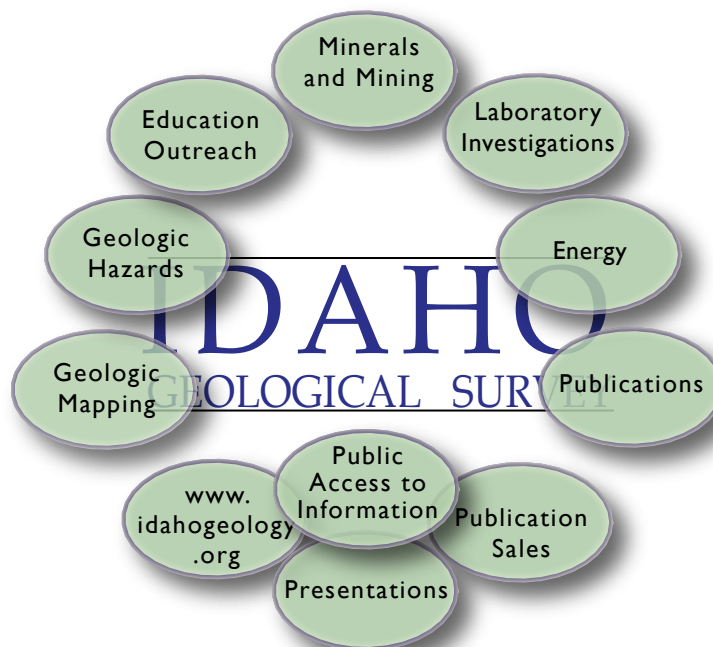
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INTRODUCTION

The Idaho Geological Survey (IGS) is the lead agency for collecting and disseminating geologic information and mineral data in the state. The agency has served the state since 1919 and prior to 1984 was named the Idaho Bureau of Mines and Geology. The IGS is a non-regulatory state agency that is administered as a Special Program of the University of Idaho. In addition to its main office in Moscow at the University of Idaho, the Survey has satellite offices in Pocatello at Idaho State University and in Boise at the University of Idaho Water Center and Boise State University. Survey staff includes 9 state-funded employees and 14 externally funded temporary and part-time employees. Staff geologists conduct applied research with a strong emphasis on producing geologic maps and providing technical and general information about Idaho's geologic setting, earth resources, and geologic hazards. Externally funded projects enhance this research.

Over time, the staff has developed wide-ranging interdisciplinary networks in support of its mission. For a one-year snapshot of what has been a very productive synergy, refer to the *Partnerships* section for the many organizations currently involved in Survey projects. This is a tribute to the staff's interest, initiative, and ingenuity in building these relationships. Details of the staff's professional engagement in the agency's agenda are in the *Publications and Professional Activities* section at the end of this report.

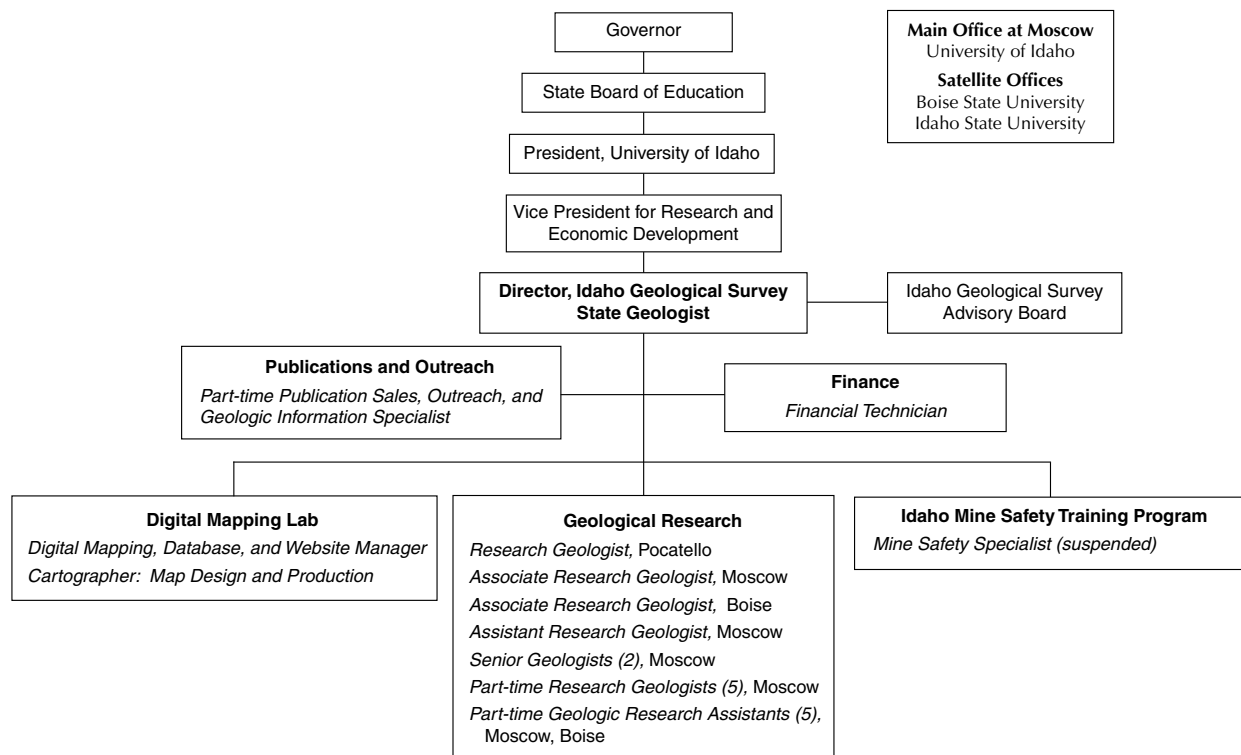


ORGANIZATION AND PERSONNEL

Roy Breckenridge, Director and State Geologist, retired in July at the beginning of the fiscal year. Roy joined the IGS in 1978 and conducted research on surficial deposits, geologic hazards, and energy resources. In 2004 he became the Idaho State Geologist and, along with Kurt Othberg, Co-Director of the Survey. Since Kurt's retirement in June, 2011, Roy had assumed the full Director duties. Reed Lewis was appointed Interim Director in FY 2014 and a national search for a new Director and State Geologist was initiated. Otherwise, state-supported staffing levels remained stable.

Organization Chart

Idaho Geological Survey Fiscal Year 2014



Directory

Main Office at Moscow

Morrill Hall, Third Floor
University of Idaho
875 Perimeter Drive MS 3014
Moscow, ID 83844-3014
208-885-7991

Branch Office at Boise

Idaho Water Center, Suite 242
322 E. Front Street
Boise, ID 83702-7359
208-332-4420 Fax 208-332-4400

Branch Office at Pocatello

Physical Science, Room 201B
Idaho State University
MS 8071
Pocatello, ID 83209-8071
208-282-4254 Fax 208-282-4414

Administrative and Support Staff

Reed S. Lewis.....Interim Director, Moscow
Tracy Kanikkeberg.....Financial Technician, Moscow

Research, Full-Time

Dennis M. Feeney.....Senior Geologist, Moscow
Jane S. Freed.....Cartographer, Moscow
Dean L. Garwood.....Senior Geologist, Moscow
Virginia S. Gillerman.....Associate Research Geologist, Boise
Reed S. Lewis.....Associate Research Geologist, Moscow
William M. Phillips.....Assistant Research Geologist, Moscow
Loudon R. Stanford.....Manager, Digital Map and GIS Lab, Moscow
John A. Welhan.....Full Research Geologist, Pocatello

Research and Support, Part-Time

Nicholas E. Bandy.....Research Support
Russell F. Burmester.....Geologist
Kara N. Fletcher.....Work Study-Research Support
Jesse A. Hinshaw.....Work Study-Research Support
Susan J. Jones.....Research Support
Alyson R. Kral.....Technical Records Specialist
Mark D. McFadden.....Geologist
Michelle L. Mori.....Work Study
Kurt L. Othberg.....Geologist
Keegan L. Schmidt.....Geologist
Darin M. Schwartz.....Research Support
Cody J. Steven.....Research Support
David E. Stewart.....Geologist
Kerrie N. Weppner.....Research Support

Idaho Geological Survey Advisory Board

Mickey Gunter
Chair, Department of Geological Sciences,
University of Idaho

David Hawk
Representing Office of the Governor

Jack Lyman
Executive Director,
Idaho Mining Association

Rich Reed
President,
Idaho Association of Professional Geologists

Tom Schultz
Director, Idaho Department of Lands

Mark Stephensen
Idaho Bureau of Homeland Security

Leif Tapanila
Chair, Department of Geological Sciences,
Idaho State University

David Wilkins
Chair, Department of Geosciences,
Boise State University

Ex Officio: Reed Lewis
Interim Director,
Idaho Geological Survey

Idaho Geological Mapping Advisory Committee

William Capaul – Chairman
District Geologist
Idaho Transportation Department

James R. Bartolino
District Ground Water Specialist
U.S. Geological Survey

Stephen Box
Research Geologist
U.S. Geological Survey Minerals Program

Paul Gessler
Professor of Remote Sensing & Geospatial Ecology
College of Natural Resources, University of Idaho

Nancy F. Glenn, Ph.D., P.E.
Professor, Boise Center Aerospace Laboratory
Department of Geosciences, Idaho State University

Janet Hohle
Project Manager - Clearwater Focus Program
Idaho Governor's Office of Species Conservation

Clint Hughes
Geologist
Nez Perce-Clearwater National Forests

Jim Myers
Senior Exploration Geologist
Hecla Silver Valley, Inc.

Paul F. Pedone
NRCS State Geologist (OR/ID)
Natural Resources Conservation Service – USDA

Kenneth C. Reid
State Archaeologist and Deputy SHPO
Idaho State Historic Preservation Office

Mark L. Stephensen
Mitigation Section Chief
State Hazard Mitigation Officer
Idaho Bureau of Homeland Security

Scott Van Hoff
Geospatial Liaison to Alaska and Idaho
U.S. Geological Survey

Sean Vincent
Hydrology Section Manager
Idaho Department of Water Resources

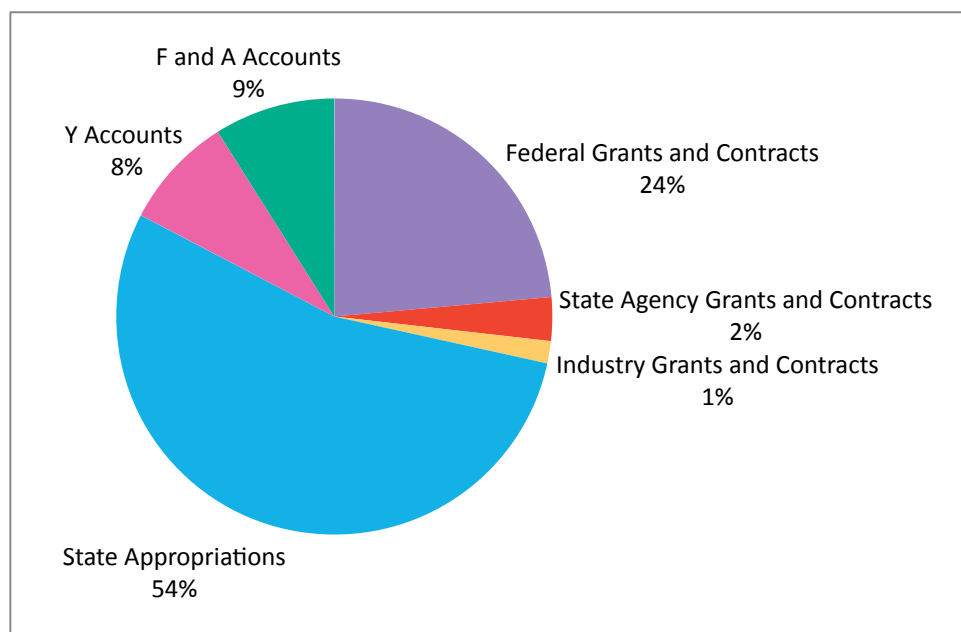
Sylvie White
Geographer/Cartographer
TerraPen Geographics

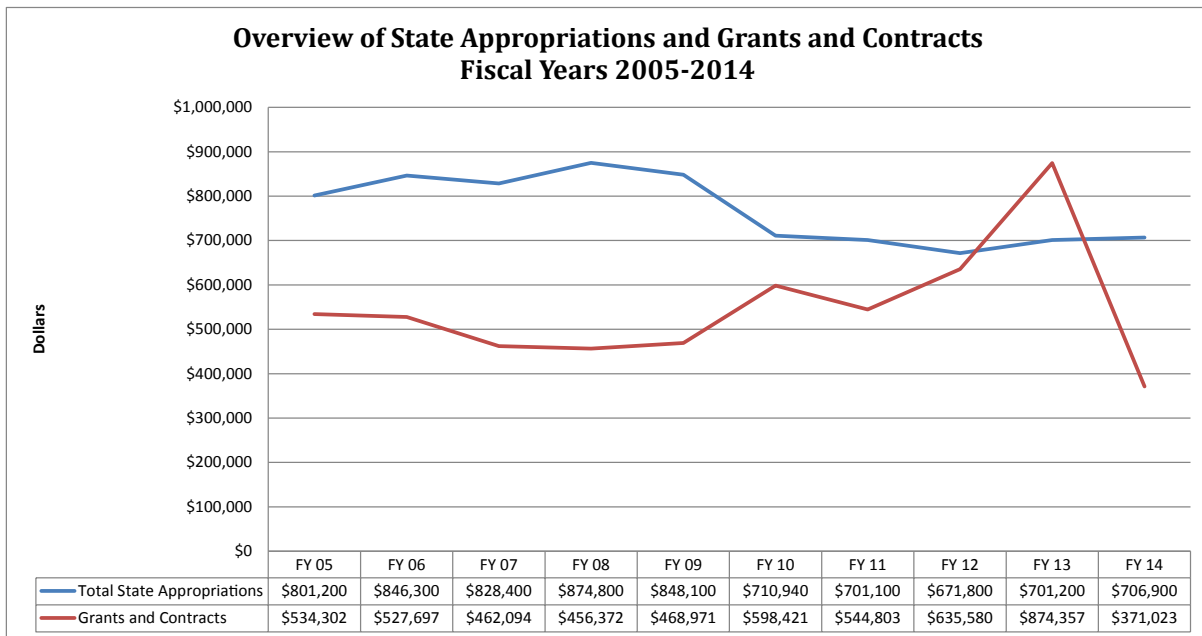
FISCAL OVERVIEW

The Survey's state appropriated budget for FY 2014 was \$706,900, an increase from \$701,200 in FY 2013, but still well below FY 2005-FY 2009 funding levels. The mandated reductions in the state budget base have affected the agency's mission in research, public service, outreach, and education. Grants and contracts decreased to \$371,023 in FY 2014 from \$874,357 in FY 2013, largely as a result of completion of the DOE-AASG Geothermal Project and the ITD Aggregate Quality Project.

Budget Fiscal Year 2014				
Category	Beginning Balance	Income or Appropriations	Expense	Ending Balance
Personnel		\$ 573,945.27	\$ 573,945.27	\$ 0.00
Operating Expense		\$ 87,772.12	\$ 87,772.12	\$ 0.00
Capital Outlay		\$ 45,182.61	\$ 45,182.61	\$ 0.00
Total		\$ 706,900.00	\$ 706,900.00	\$ 0.00
U/I Personnel Funds		\$ 0.00	\$ 0.00	\$ 0.00
Y Accounts	\$ 60,288.04	\$ 109,110.40	\$ 26,536.41	\$ 82,573.99
F and A Accounts	\$ 116,811.71	\$ 0.00	\$ 5,660.13	\$111,151.58
Grants and Contracts		\$ 371,023.31	\$ 371,023.31	\$ 0.00
TOTAL	\$ 177,099.75	\$1,126,745.67	\$1,110,119.85	\$193,725.57

Sources of Funding





PARTNERSHIPS

The Survey's statewide mission encourages interdisciplinary partnerships and collaboration with many other agencies, organizations, and universities. This broad cooperation ranges from direct grants for individual projects to the collegial sharing of expertise and information. On the national level, the Survey is also directly involved in the initiatives of the Association of American State Geologists. These alliances offer many opportunities to engage in projects that enhance the agency's applied research and outreach.

Association of American State Geologists

The Survey is an active participant in the Association of American State Geologists (AASG). The Interim Director represented Idaho at the AASG Spring Liaison in Washington, D.C. and the Annual Meeting in Lexington, Kentucky. The AASG is a strong advocate for the funding and reauthorization of the U.S. Geological Survey's National Cooperative Geologic Mapping Program (NCGMP) as well as research programs for data preservation, minerals, energy resources, and geologic hazards. AASG is an important partner with the U.S. Geological Survey and the National Geologic Map Database and the annual Digital Mapping Techniques Workshops.

Funding Partners

Association of American State Geologists Idaho Bureau of Homeland Security Idaho Department of Environmental Quality Idaho Department of Lands Idaho National Laboratory	Idaho State University Idaho Transportation Department Midas Gold Corporation U.S. Department of Energy U.S. Geological Survey
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Collaborators

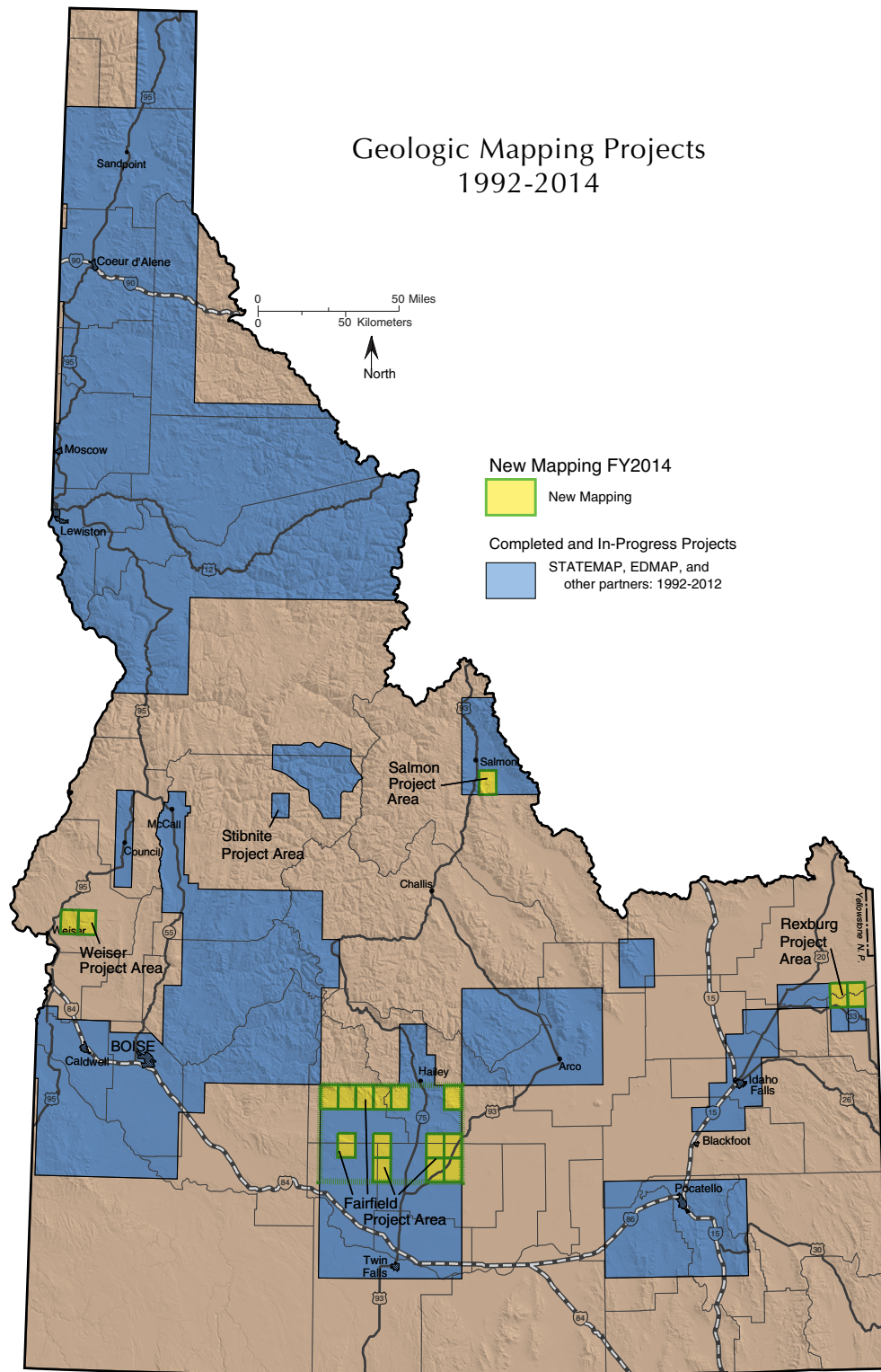
<p>American Geological Institute Association of American State Geologists Bannock County Groundwater Overlay Advisory Committee Bannock County Planning and Zoning Department Belt Association Boise State University Brigham Young University-Idaho Center for Advanced Energy Studies City of Pocatello Water Department, Planning Department, and Environmental Department Energy and Geoscience Institute, Utah ETH Zurich Franklin and Marshall Department of Earth and Environment Sciences Ice Age Floods Institute Idaho Bureau of Homeland Security Idaho Concrete and Aggregate Producers Association Idaho Department of Environmental Quality Idaho Department of Lands Idaho Department of Water Resources Idaho Environmental Forum Idaho Geospatial Council Idaho Ground Water Monitoring Technical Committee Idaho Historical Society Idaho Mining Association Idaho National Laboratory Idaho Public Television Idaho Science Teachers Association Idaho State University Idaho Transportation Department Inside Idaho Intermountain Forest Tree Nutrition Cooperative</p>	<p>Midas Gold Corporation Montana Bureau of Mines and Geology National Association of Geoscience Teachers National Science Foundation, Geoscience Directorate North Idaho College Northwest Knowledge Network Northwest Mining Association Oregon Department of Geology and Mineral Industries Portneuf Watershed Partnership Shoshone-Bannock Tribal Water Resources Department Spokane Community College Tobacco Root Geological Society U.S. Army Corps of Engineers U.S. Bureau of Land Management U.S. Forest Service U.S. Geological Survey University of Alaska-Fairbanks University of Idaho University of Montana University of Utah University of Wisconsin-Madison Utah Geological Survey Utah State University Valley County Local Emergency Planning Group Wallace District Mining Museum Washington Division of Geology and Earth Resources Washington State University Western States Seismic Policy Council Wyoming Geological Survey Yellowstone National Park Yellowstone Volcano Observatory</p>
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RESEARCH

Geological Mapping and Related Studies

The foundation of all IGS research projects is a dedicated effort of geologic mapping and publishing this information as 7.5' and 30' x 60' quadrangles. Before 1990, geologic mapping in Idaho was primarily conducted in localized rural areas to facilitate extraction of earth resources. In the last two decades, the Survey has been mapping in areas selectively to address development impacts in urban settings, for assessment of possible new geologic resources, and identification and monitoring of geohazards such as earthquake seismicity and landslides. The Idaho Geologic Mapping Advisory Committee (IGMAC) assists the Survey by assessing Idaho's mapping necessities and addressing long-term plans for geologic mapping. Idaho's geologic map products have been used, for example, to designate landslide hazards; to define mineralization potential; to delineate rock units that form boundaries of aquifers; to show geologic materials for engineering needs; to better predict groundwater resources; to aid in highway design and construction; and to define geologic resources on public lands, including federal lands, parks, recreation areas, and Idaho's endowment lands.

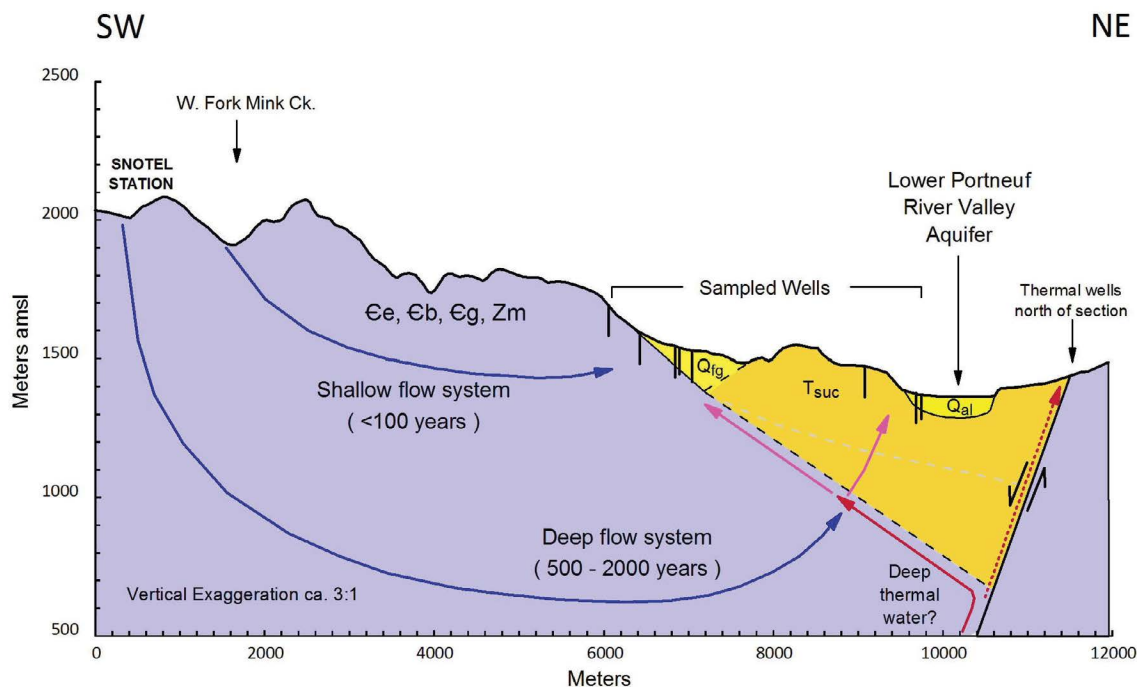
Funding of Idaho's geologic mapping program is shared by the STATEMAP component of the National Cooperative Geologic Mapping Program. Since 1993, Idaho has received over \$3.5 million in federal funds and matched an equal amount of state money to complete geologic mapping in Idaho. In FY 2014, the Idaho Survey was again in the top six in the nation among all STATEMAP proposals. In addition to existing projects in the Salmon, Fairfield, and Rexburg areas, new mapping was conducted in the Weiser area. During the year, Survey geologists mapped five 7.5' quadrangles (Drummond, Lamont, Mann Creek SE, Nutmeg Flat, and Sal Mountain), and mapped and compiled one 30' x 60' quadrangle (Fairfield) under the STATEMAP Program. Mapping was also conducted in the Stibnite 7.5' quadrangle with funding provided by Midas Gold Corporation. Geologic mapping results were highlighted with numerous posters and talks at the joint Rocky Mountain-Cordilleran GSA section meeting in Bozeman in May. Also, IGS geologists led a 3-day field trip prior to the meeting across areas of Survey mapping from Pittsburg Landing in Hells Canyon to Lolo Pass on Highway 12.



Hydrogeology

The Survey's hydrogeological work comprises various areas of applied research, with elements of outreach and education. Research activities cover a wide range of topics, including aquifer hydrogeology; water levels and geochemical indicators of flow system processes; ground water contaminant sources; and water-supply potential of aquifers. Outreach and education activities involve ongoing communication with tribes, regulatory agencies, planners and private well owners around the state, as well as active participation in graduate teaching and research mentoring at Idaho State University.

Research activity in 2014 focused on geochemical tracing of flow systematics in the recharge source area of the lower Portneuf River Valley's (LPRV) municipal aquifer, as part of the Idaho EPSCoR MILES project (Managing Idaho's Landscapes for Ecosystem Services). The Survey's funded research investigated the residence times, sources, and flow paths of ground water in the principal recharge corridor of the LPRV aquifer, an area that has been a focus of much of IGS's hydrogeologic research in the past. The project identified and quantified a deep ground water contribution to the LPRV system, constrained flow-system residence times with carbon-14 and tritium dating, and proposed a heretofore unrecognized source of recharge to the LPRV aquifer that originates as old, thermal ground water upflow along the valley's basin-bounding fault and a major unconformity at the base of the Tertiary section.

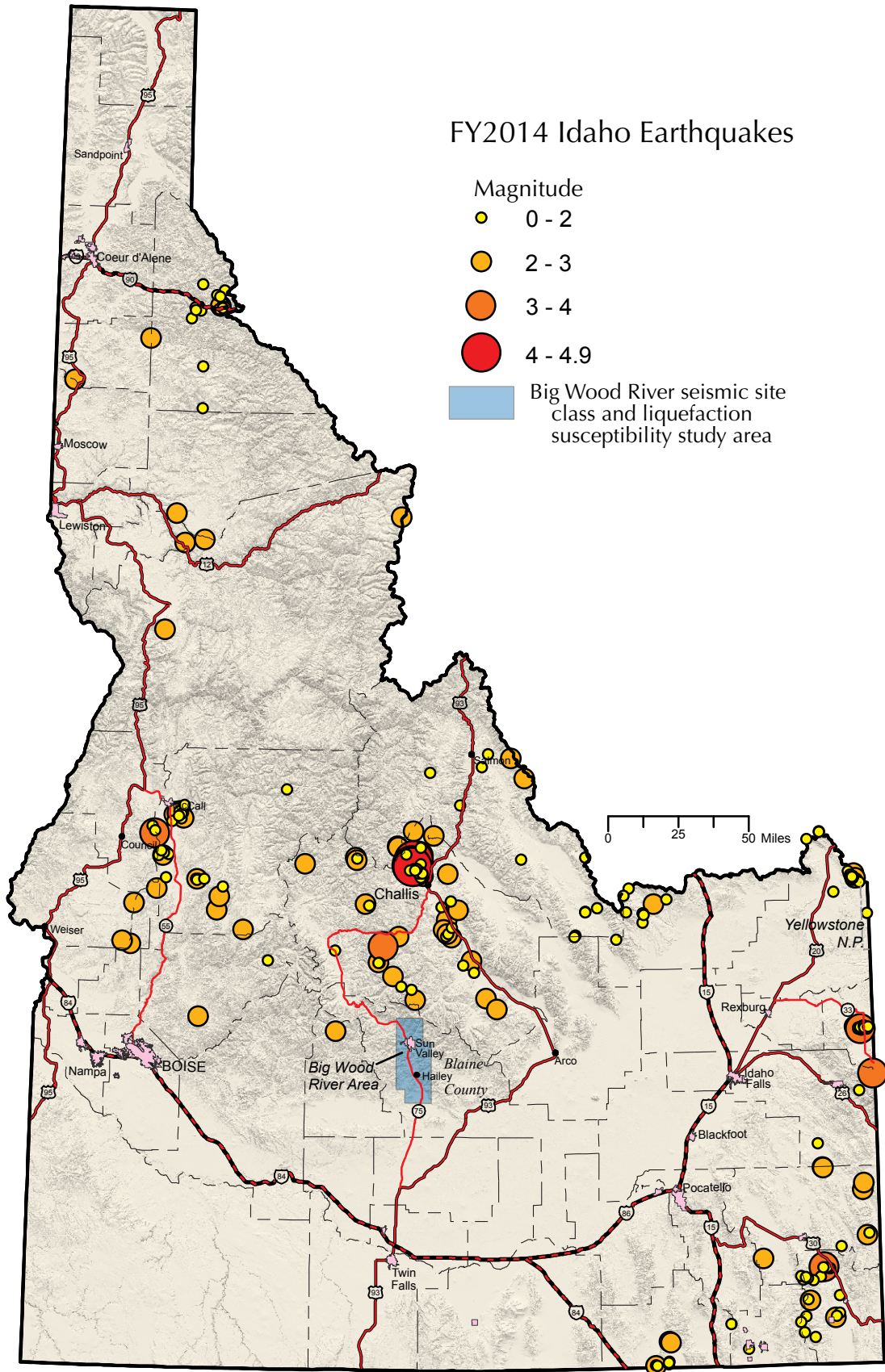


Simplified hydrogeologic cross section through the Mink Creek recharge corridor of the southern lower Portneuf River Valley, showing inferred flow paths of locally-derived meteoric recharge and deep, thermal ground water (ca. 25°C) rising along the eastern graben-bounding fault and the Tertiary basin's bedrock unconformity. Ee, Eb, Eg, and Zm — Neoproterozoic and Cambrian bedrock; T_{suc} — Tertiary basin fill; Q_{fg} and Q_{al} — Quaternary surficial units.

Geologic Hazards

Idaho is prone to earthquakes, volcanic eruptions, landslides, and flooding. The Survey works to support mitigation of these hazards in several ways:

- Public awareness and status of on-going hazard events are addressed through the Idaho Geological Survey website and direct contact with the public and news media by personal interviews, e-mail, telephone, and occasional public lectures or field trips. A Survey staff member has been identified by the University of Idaho as a designated point of contact for natural hazard issues. Requests to the University for hazard information are directed to the Survey in this way. For example, in April 2014, an earthquake swarm in the Challis area generated considerable media interest. Interviews of Survey staff concerning the swarm were presented on regional television, radio, and newspapers.
- Survey staff are informed about Idaho earthquakes through seismic monitoring performed by the U.S. Geological Survey, Montana Bureau of Mines and Geology, the University of Utah, and the Idaho National Laboratory. When an earthquake occurs, location and magnitude data are automatically posted by the USGS to the internet. A Survey staff member receives automated emails and cell phone texts for Idaho-area earthquakes exceeding magnitude 3, and also checks the USGS site for regional activity on a daily basis.
- The Survey is a member of the Western States Seismic Policy Council (WSSPC). The Council's mission is to develop seismic policies and share information to promote programs that reduce earthquake-related losses. In FY 2014, a Survey staff member served as the chair of the Basin and Range Province Committee of WSSPC. This committee focuses on earthquake hazards of Idaho, Wyoming, Montana, Utah, Nevada, Arizona, and New Mexico.
- The Survey collaborates with monitoring of the active Yellowstone volcanic system by the U.S. Geological Survey, the University of Utah, and Yellowstone National Park. The Survey is a member of the Yellowstone Volcano Observatory Consortium (YVO) together with the geological surveys of Wyoming and Montana. A Survey staff member participates in bi-monthly YVO phone briefings and in FY 2014 attended the YVO Consortium meeting at Mammoth Hot Springs, Wyoming.



- The Survey provides expert opinion and advice to state and federal agencies involved with Idaho hazard mitigation. In FY 2014, the Survey performed the following hazard mitigation activities at the request of the Idaho Bureau of Homeland Security (IBHS):
 - Participated in meetings of the Idaho Seismic Hazard Advisory Committee. This committee provides expert advice on issues related to earthquake hazards and risk reduction strategies.
 - Participated in review and revision of the Idaho State Hazard Mitigation Plan. Updating the State Hazard Mitigation Plan qualifies Idaho for all available federal assistance in the event of disasters. It provides a framework to save lives and reduce vulnerability to natural and human made hazards. The Survey focuses on earthquake, volcanic eruption, landslide, and flooding portions of the plan.
 - Partnered with the IBHS to produce an annual report for WSSPC on Idaho earthquake hazard mitigation activities. This report also documents earthquake activity occurring within Idaho.
 - Conducted mapping of seismic site classes and liquefaction susceptibility in the Big Wood River area of Blaine County. This work was funded by IBHS and is available for free download on the Survey website.
- Geological mapping conducted through the STATEMAP program provides baseline information on the location, magnitude, and frequency of hazards. This information is incorporated into planning documents and also serves as the basis for more detailed studies, such as mapping of landslides.

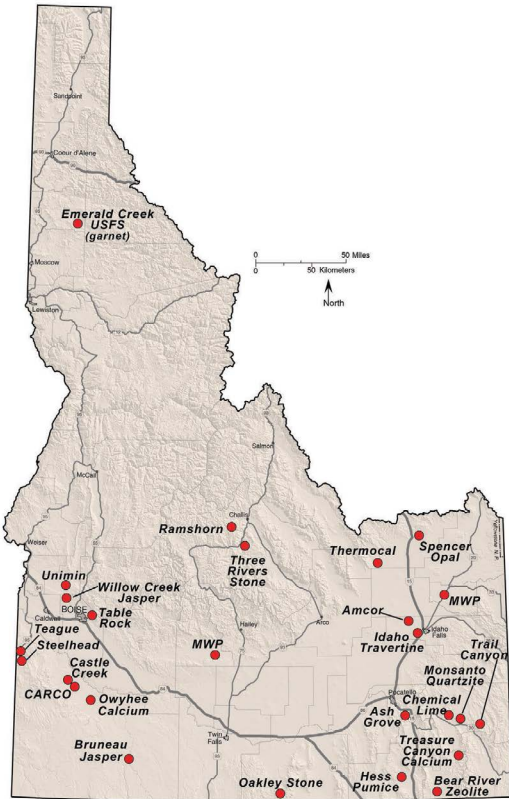
Mineral Resources and Mining

Active Mining and Exploration

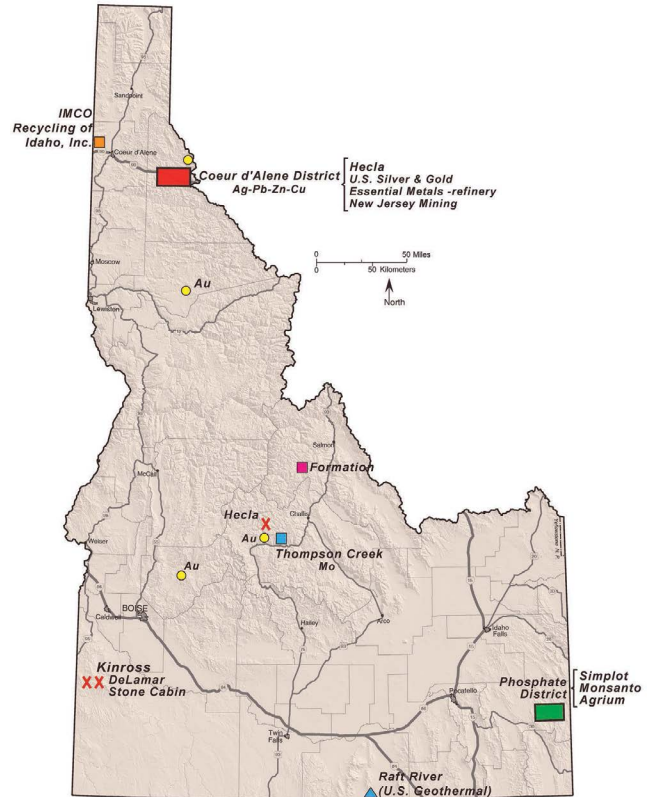
Since its inception in 1919, the Idaho Geological Survey (IGS), formerly known as the Idaho Bureau of Mines and Geology, has been providing information for and documentation of the mineral industry of Idaho. The IGS collaborates with the U.S. Geological Survey in production of the Idaho chapter of the Minerals Yearbook, a widely used global compilation of developments and statistics in mining and minerals information. The 2013 calendar year Idaho mining review was presented at the Northwest Mining Association convention in December. While there were still many great projects, the signs of an industry slowdown were apparent. Due to declining commodity prices and the temporary closure of the Lucky Friday mine, Idaho's nonfuel mineral production value for calendar year 2013 is estimated at \$991 million, down significantly from the revised record 2011 value of \$1.324 billion reported by the USGS. Molybdenum was the largest value commodity with phosphate rock being second in value for 2013. While markets for industrial minerals, including phosphate rock, were stabilizing, a lack of investor financing restricted exploration and development projects for junior companies in 2013, and only a handful reported new drilling. The larger projects included oil and gas exploration in southwestern Idaho, geothermal drilling at Raft River, gold exploration at the Stibnite and Beartrack deposits, and rare earth exploration in Lemhi County and adjacent Montana.

Minerals-related Research

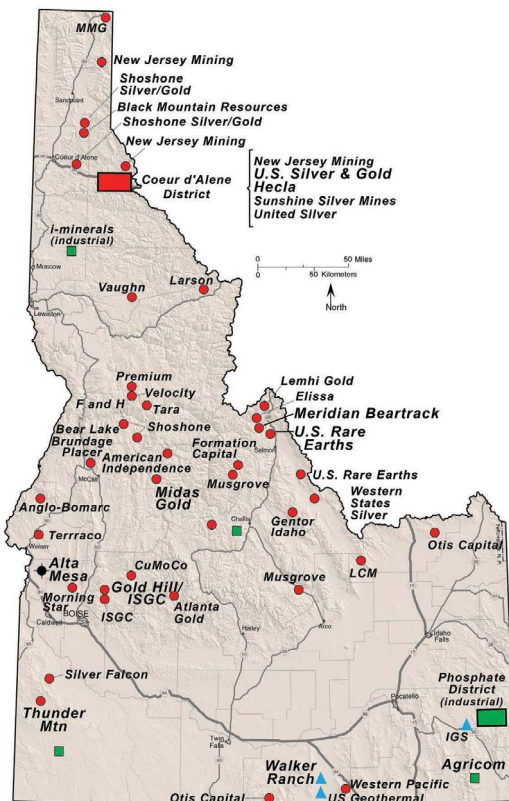
Work continued on two multi-year minerals research projects during FY 2014. The first project, a collaborative effort with the Idaho Department of Transportation, was completed in the first half of FY 2014 and published as a research report by ITD and as Technical Report T-14-1 by IGS. The report and accompanying map document aggregate lithology from 40 Idaho concrete-certified sources and correlate it with measures of alkali-silica reactivity (ASR). Rock types of the aggregate samples were quantitatively inventoried and the data compared with the new geologic map of Idaho and other literature sources to identify potential aggregate source units. Petrographic study of mortar bars, prepared for commercial AASHTO T 303 testing of ASR expansion potential, was conducted to better understand which rock types are the most reactive. The research results were enthusiastically received by the ITD and presented at the Rocky Mountain Geological Society of America meeting in May.



INDUSTRIAL MINERALS



ACTIVE MINES AND PLANTS



EXPLORATION

Maps showing mining and exploration activity in Idaho for calendar year 2013.

The second project, funded by and in collaboration with Midas Gold Corporation, involved ongoing geologic mapping of the Stibnite 1:24,000 quadrangle and a petrologic and geochronologic study of the complex gold-antimony-tungsten mineralization in the Stibnite Mining District, Valley County. A second phase of the project received additional funding from Midas and will continue the research for two more years. Work during FY 2014 included continuation of geologic mapping, petrographic study, and geochronologic sampling and analysis of detrital zircons, intrusives, and vein rocks. By the end of FY 2014, preliminary results from the geochronology were available and indicated evidence for a Paleozoic age of at least part of the mapped stratigraphic section. Collaborators at Boise State University measured several precise U-Pb ages for early Cretaceous plutons in the district, and the University of Alaska, Fairbanks, laboratory analyzed samples of potassium feldspar associated with mineralized veins. The argon ages on the vein-related feldspars were Eocene, consistent with textures seen in the petrographic work.

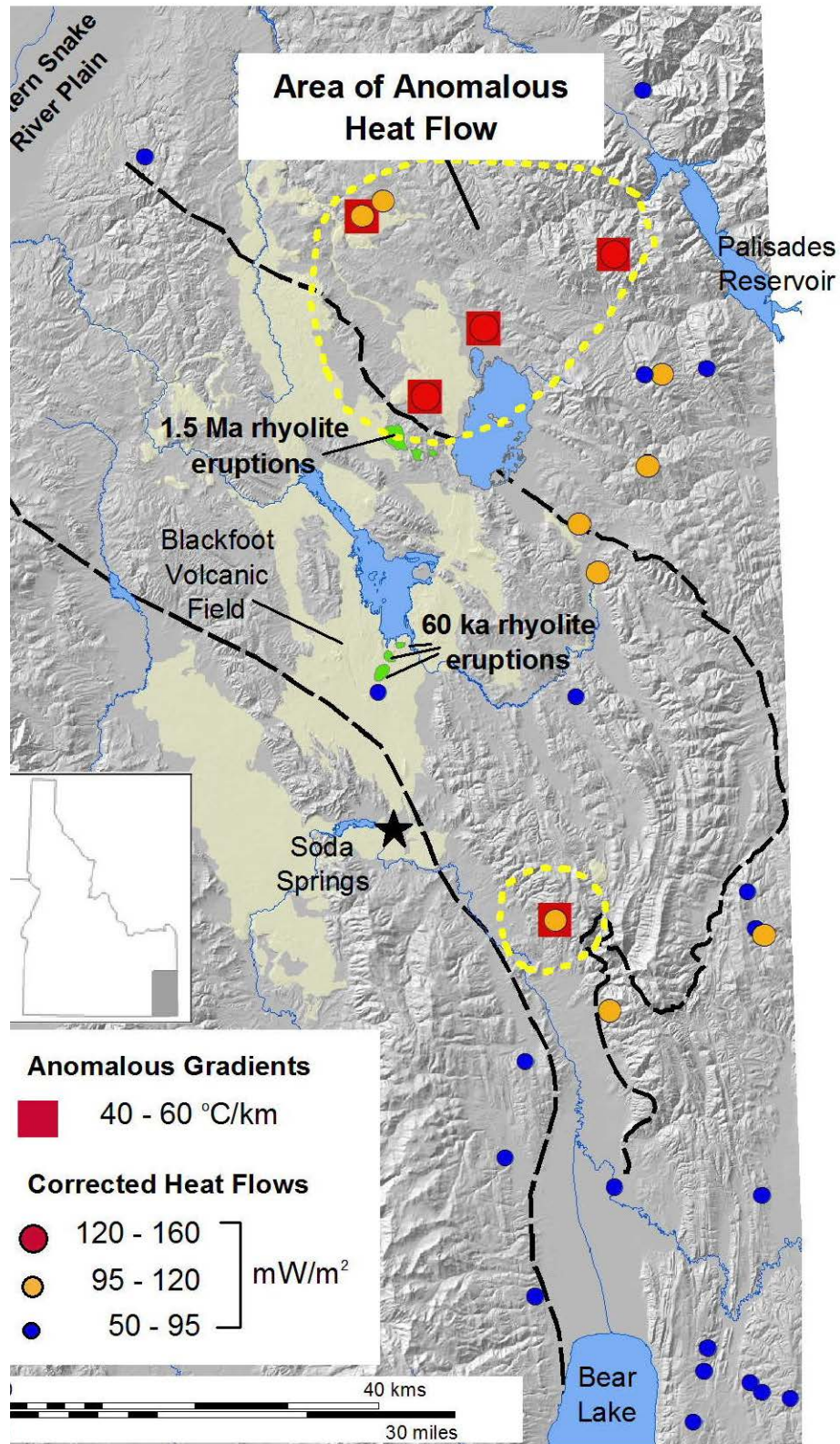
Energy

Geothermal

The Survey completed work on a three and a half year contract funded by the Department of Energy's National Geothermal Data System (NGDS) project. The \$870,000 Idaho Geological Survey award was administered by the Arizona State Geological Survey (AZGS) on behalf of the Association of American State Geologists (AASG) to compile geothermal information and acquire new heat flow data (summarized below) to stimulate geothermal energy development in Idaho and the U.S. All data are cataloged in the NGDS and accessible via a browser interface.

- 2733 geothermal and oil/gas exploration wells, including 996 well logs, 613 formation tops, 181 DSTs
- 1255 whole-rock chemical analyses, including radioactive-elements, of igneous and volcanic rocks
- 404 thermal springs
- 249 Quaternary and younger faults (591 total Miocene to Holocene age faults)
- 191 previously unavailable bibliographic listings of Idaho-specific geothermal literature
- 102 new thermal conductivity measurements from three thermal gradient holes drilled in southeast Idaho
- 51 web and email links to Idaho-specific agencies responsible for permitting geothermal development
- 34 corrected heat flow measurements (31 deep wells + 3 shallow thermal gradient holes)
- 1 state digital geologic map and database

One of the major successes of the project which DOE/AASG are highlighting is the discovery of a previously unrecognized high-temperature geothermal resource in the Idaho thrust belt north of Soda Springs associated with magmatic heat beneath the Blackfoot volcanic field. A comprehensive set of reports documenting the geothermal potential of this area is currently being prepared, based on the results of the NGDS project. Presentations and published conference proceedings at the Stanford Geothermal Workshop (February), the Center for Advanced Energy Studies (CAES) in June, and the Geothermal Resources Council (October), as well as presentations at ISU, BSU and UI during 2014 elicited considerable interest.



Newly identified geothermal resource in the vicinity of the Blackfoot volcanic field, defined by high heat flow values in deep (3-5 km) oil and gas exploration wells of southeast Idaho's thrust belt. Heavy dashed lines indicate the Paris and Mead thrust faults; extent of late Quaternary basalt lava flows shown in yellow, and locations of rhyolite domes, in green.

IGS obtained seed money from NSF's Research Coordination Network group at Texas Christian University to host a proposal-development workshop to identify and promote research opportunities in this geothermal system. The two-day August workshop was organized by the IGS and was convened in Idaho Falls at CAES with a generous financial match provided by that institution. The workshop brought together 18 researchers from ISU, UI, BSU, and the INL as well as Oregon State University, Rice University, Auburn University and Utah's Energy and Geoscience Institute, among others. Several more who could not attend have also expressed interest in participating. The workshop generated much enthusiasm and a commitment to developing a major research proposal. With assistance from ISU and UI colleagues, a research white paper was developed to solicit NSF and/or DOE interest in a multi-institutional research project focused on the southeast Idaho prospect.

In addition to that project, the Survey is collaborating with the INL in their bid to create an R & D facility on or near the INL Reserve to demonstrate energy development from the rhyolitic rocks underlying the eastern Snake River Plain via enhanced geothermal system (EGS) technology.

Oil and Gas

The Idaho Geological Survey maintains files on about two hundred historic oil and gas exploration wells in the state. These files include the reports and logs provided by companies to the Oil and Gas Commission from 1903-1988. The files were transferred to the IGS in 2009 from the Idaho Department of Lands and consist of drilling correspondence, permits and applications, reports, maps, and geophysical logs. Many are unique historic documents and in fragile condition. Recent geothermal and oil and gas exploration in Idaho has greatly increased the number of requests for these data. The Survey has now scanned all of the reports and logs and made them available for download from the IGS website.

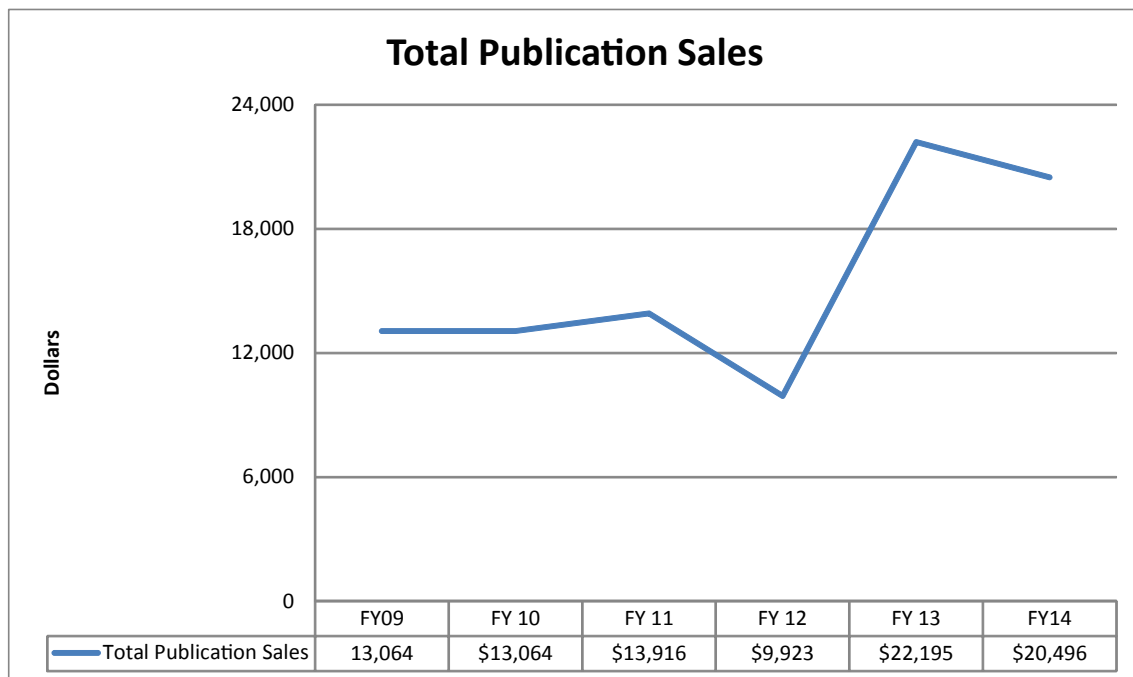
Recent oil and gas exploration efforts in Idaho have been focused on the western Snake River Plain and areas to the north toward Midvale. One project of particular note is the development of the Hamilton and Willow gas fields in Payette County. Drilling from 2010 to recent has resulted in over 10 new exploration wells and production of Idaho's first commercial gas from a well near New Plymouth. A new geologic mapping project, funded by STATEMAP and matching state appropriations, was initiated in June of 2013 in the Weiser 30' x 60' quadrangle. One goal of this work is to better understand the geologic setting of the current oil and gas play in this part of the state.

OUTREACH

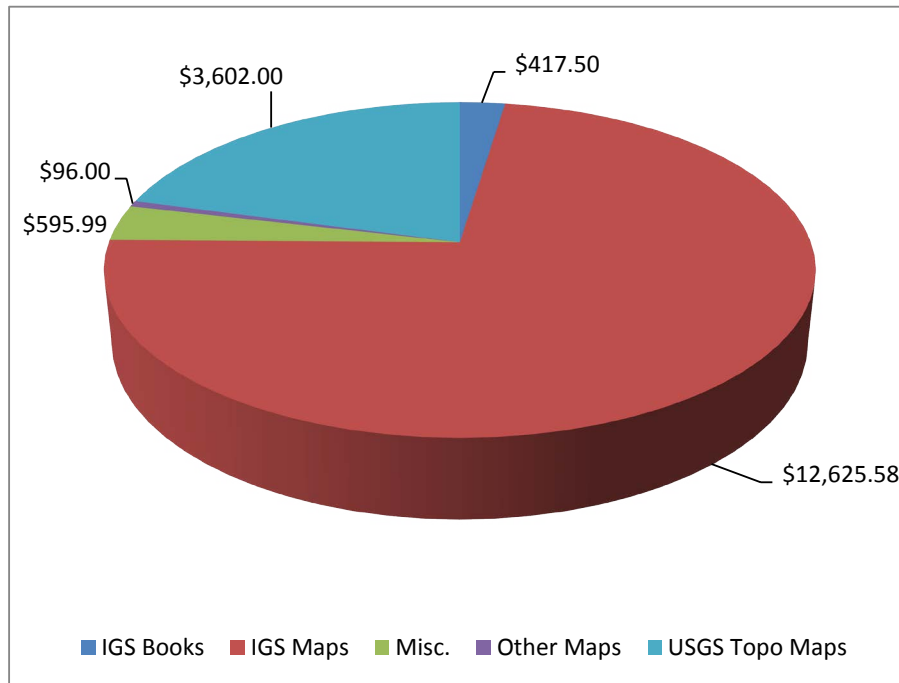
The Survey disseminates geologic data on Idaho primarily through IGS publications, the agency website, in-house collections, and efforts by the staff to educate the public in the earth sciences.

Publications

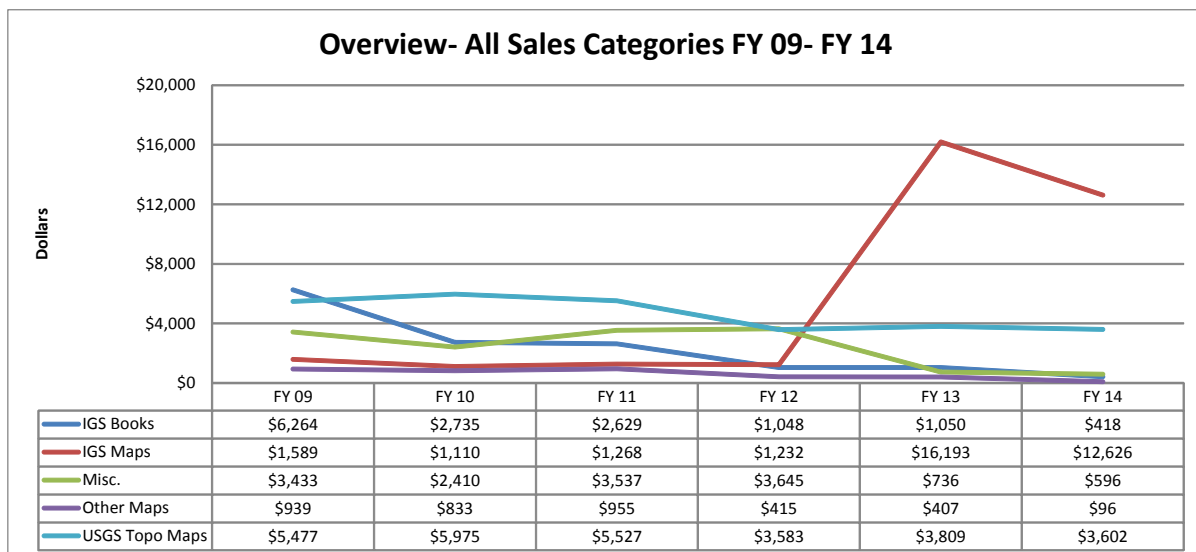
Total publication sales were down from FY 2013, but still exceeded the FY 2010, FY 2011, and FY 2012 sales amounts. As in FY 2013, the bulk of the revenue came from sales of the newly revised *Geologic Map of Idaho*, which was released in October, 2012. Sales of topographic maps remained steady, accounting for about 21 percent of total sales.



Publication Sales in Dollars



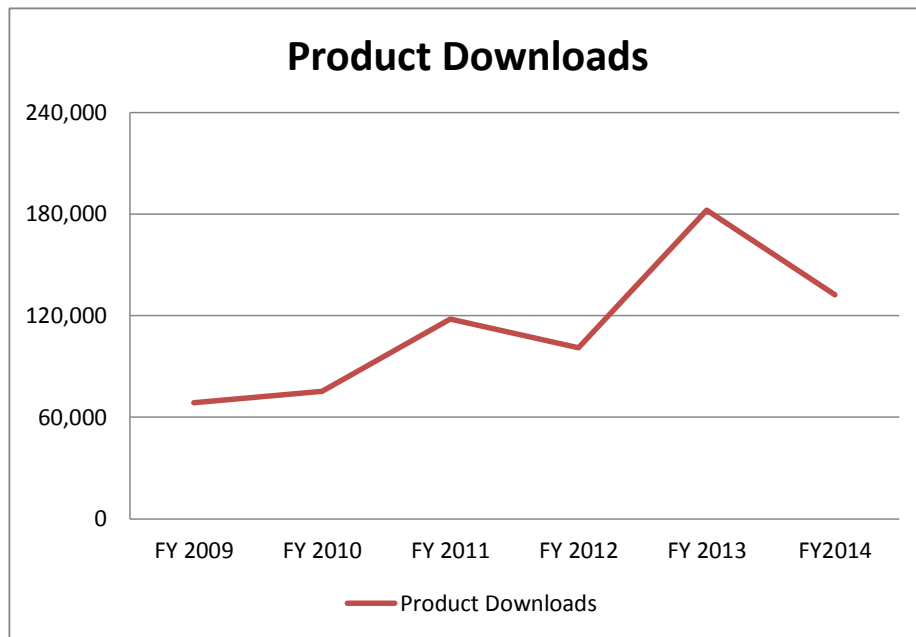
Overview: All Sales Categories FY 09-14



Website

www.idahogeology.org

The website provides customers easy access to IGS publications and data. Nearly all of Survey publications (over 950) are available free for download in PDF format. Finding information on the website has been simplified through search engines. The Survey entered the social media world by adding Facebook and Twitter accounts to connect users with IGS activities. Geothermal Resource information has been added to the Energy section of the website. In FY 2014, 434,000 visits were logged on the website and users downloaded 132,000 products. Eighteen new survey publications were posted on the website this year.



The Digital Mapping and GIS Laboratory

The Survey's digital mapping and GIS laboratory provides services that include digital cartography, spatial data management, database management and design, network system administration, graphic design, desk-top publishing, and website support. The lab continues to compile geology from around the state in geologic map databases, in addition to producing geologic map products. Eighteen 7.5' geologic maps were digitized (as stand-alone or compilation efforts) and ten geologic maps were published this year. All are available as printed products or can be viewed free on the web. The Survey also acquired a large-format plotter for printing color maps in-house.

Databases and Archives

Databases continue to be an important way of managing and distributing information to IGS customers via our website. Database updates of active faults, mines and prospects, oil and gas wells, and survey publications are an ongoing effort. The largest archive is the Mineral Property Files and associated Mine Map Collection, both of which increased in size as donated files were indexed and scanned thanks to funding provided by the Idaho Department of Lands and the USGS. Web delivery of the Mine Map Collection is anticipated for FY 2015. This year the Survey began to migrate geologic map data into the NCGMP09, a new national voluntary standard for geologic map data. This is being accomplished by both new conversion tools for migrating existing geologic data and redesigned capture tools in ESRI ArcMap for producing geologic maps and their datasets.

Mine Safety Training

The U.S. Department of Labor's Mine Safety and Health Administration (MSHA) distributes federal grants to 49 states and the Navajo Nation. Grant funds are used to support health and safety training courses and programs designed to reduce mining accidents, injuries, and illnesses.

The Idaho Geological Survey suspended MSHA training in FY 2012 and is presently evaluating whether to resume the program. MSHA training is available in neighboring states and interested individuals are directed to those facilities.

Earth Science Education

The American Geosciences Institute sponsors Earth Science Education Week in cooperation with its member societies on behalf of the geoscience community. In October, the Survey distributed Earth Science Education Week packets to teachers at the Idaho Science Teachers Association meeting in Pocatello. In addition, over sixty State Geologic maps were distributed free to science teachers that were attending the conference from across the state. An additional 300 State Geologic maps were distributed by mail to all middle and high schools in the state, including teaching packets and points of discussion. Funding for the distribution of the maps was provided by the Department of Geological Science at the University of Idaho. This followed an earlier map distribution by the Idaho Gem Club to all of the grade schools in the state. Proceeds for that effort were obtained from sales of Earth Science and Lapidary specialty license plates.

The Idaho Geological Survey participates in meetings and field trips associated with the Pacific Northwest section of the National Association of Geoscience Teachers annual field conference. The Survey represents Idaho as a state councilor to the section. This year we presented the status and discoveries of the IGS, and participated in field trips in and around Wenatchee, Washington.

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- Hells Canyon to the Bitterroot Front: A Transect from the Accretionary Margin Eastward Across the Idaho Batholith*, by Reed S. Lewis, Keegan L. Schmidt, Richard M. Gaschnig, Todd A. LaMaskin, Karen Lund, Keith D. Gray, Basil Tikoff, Tor Stetson-Lee, and Nicholas Moore, *in* Shaw, Colin A., and Tikoff, Basil, eds., *Exploring the Northern Rocky Mountains: Geological Society of America Field Guide 37*, p. 1-50, 2014.
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A Unique, Magmatically Associated Geothermal System in the Idaho Thrust Belt: Research Opportunities, by John A. Welhan: Center for Advanced Energy Studies, Special Geofluids Science Seminar Series – “Sed Heat” Information Webinar, June.

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Copper and REE-Th Metallogeny in Lemhi County, Idaho: Magmatism and Repeated Hydrothermal Activity along a Paleozoic Continental Margin, by Virginia S. Gillerman: Society of Economic Geologists 2013 Conference, Whistler, British Columbia, Canada, September.

- From Toilet to Tap: Nitrate Contamination in Ground Water, Eastern Snake River Plain*, by John A. Welhan: Guest lecture, Idaho State University G4406, Environmental Geology, December.
- Geologic Hazards and Mitigation Activities in Idaho*, by William M. Phillips: Yellowstone Volcano Observatory Consortium Meeting, Mammoth Hot Springs, Yellowstone National Park, Montana, May.
- Geology and Mining Careers and Water Center Flume Tour*, by Virginia S. Gillerman and Bob Basham: Junior Achievement Job Shadow Program, Caldwell Adventist School, February.
- Geomorphic Mapping with LiDAR*, by William M. Phillips: Seminar, Department of Geography, University of Idaho, Moscow, November.
- Got Data, Now What?: An Idaho Geological Survey Online Map Application*, by Loudon R. Stanford: GIS Day at the University of Idaho Library, Moscow, November.
- Idaho Mining and Exploration, 2013*, by Virginia S. Gillerman: Boise State University Geosciences Department GO497/597 Special Topics (Ore Deposits) Class, April.
- Idaho's Thorium Deposits and Lemhi Pass District Geology*, by Virginia S. Gillerman: Meeting with Governor Otter, Lee Barron, and Staff, Boise, June.
- Mapping Idaho Aggregate Quality by Integrating Geologic Maps with Petrologic Observations*, by Kerrie N. Weppner, Virginia S. Gillerman, and William M. Phillips: Geological Society of America joint Rocky Mountain-Cordilleran section meeting, Bozeman, Montana, May.
- Mesoproterozoic(?) to Paleozoic Strata in the Stibnite-Edwardsburg Area, Central Idaho*, by Reed S. Lewis, David E. Stewart, Eric D. Stewart, Vincent H. Isakson, Darin M. Schwartz, and Jeffrey D. Vervoort: Geological Society of America joint Rocky Mountain-Cordilleran section meeting, Bozeman, Montana, May.
- Overview of the Opportunities for Educational Diversity in the Geosciences*, by John A. Welhan: Institute for Tribal Energy, Asset Management and Mining student field trip, August.
- Quick Look at NCGMP09 and an Idaho Example*, by Loudon R. Stanford: Utah Geological Survey Geologic Mapping Group, Salt Lake City, Utah, April.

- Structural and Volcanic Development of the Weiser Embayment, West-Central Idaho*, by Dean Garwood and Dennis Feeney: Geological Society of America joint Rocky Mountain-Cordilleran section meeting, Bozeman, Montana, May.
- Summary of NCGMP09 Implementation Progress at the Idaho Geological Survey*, by Loudon R. Stanford: Digital Mapping Techniques 14, Newark Delaware, June.
- The Blackfoot Volcanic Field: A New Paradigm for Hidden High-Temperature Geothermal Resources in the Northeastern Basin & Range*, by John A. Welhan: Guest lecture, Idaho State University G6601, Geosciences Seminar, October.
- The Blackfoot Volcanic Field, Southeast Idaho: A Hidden High-Temperature Geothermal Resource in the Idaho Thrust Belt*, by John A. Welhan: Thirty-Ninth Workshop on Geothermal Reservoir Engineering, Stanford University, February.
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- The Blackfoot Volcanic Field, Southeast Idaho: A New Paradigm for Hidden Geothermal Resources in the Northeastern Basin and Range /Idaho Thrust Belt*, by John A. Welhan: Center for Advanced Energy Studies Geofluids Science Seminar Series, November.
- The Earth*, by Virginia S. Gillerman and Jeffrey Johnson: Idaho Public Television Science Trek, Broadcast, <http://www.idahoptv.org/sciencetrek/topics/earth/>, April.
- The Great Falls Tectonic Zone: a View from Idaho*, by Reed S. Lewis: Montana Bureau of Mines and Geology Seminar, Butte, Montana, May.

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Idaho Oil and Gas, by Dean L. Garwood: Idaho Geological Survey Web page update, June.

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IGS CAD geologic map data to NCGMP09 schema tools (version 2.0), by Loudon R. Stanford and Bill Richards: Idaho Geological Survey, January-June.

National Geothermal Data System Workshop, by John A. Welhan: Idaho Geological Survey for Serving IGS Data on the National Geothermal Data System, October.

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Could a Deadly Landslide Happen in Idaho?, by: KTVB News, <http://www.ktvb.com/home/Could-a-deadly-landslide-happen-in-Idaho-252062741.html>, March, 2014 (V.S. Gillerman).

Earthquakes Rock Challis, University of Idaho Argonaut, <http://www.uiargonaut.com/2014/04/28/earthquakes-rock-challis-recent-swarm-of-earthquakes-a-concern-for-challis-residents/>, April 29, 2014 (W.M. Phillips).

Hundreds of Earthquakes Strike Central Idaho, Rattling Nerves, Reuters, <http://www.reuters.com/article/2014/04/16/us-usa-earthquakes-idaho-idUSBREA3F03D20140416>, April 15, 2014 (W.M. Phillips).

Lack of Scientific Equipment in Idaho Makes Understanding Challis Earthquakes More Difficult, Boise State Public Radio, KBSX, <http://boisestatepublicradio.org/post/lack-scientific-equipment-idaho-makes-understanding-challis-earthquakes-more-difficult>, April, 2014 (A. Cotterell, V.S. Gillerman).

NGDS Project Overview and New Geothermal Resource Discovery, University of Idaho Argonaut, June 18, 2014 (J.A. Welhan).

NGDS Project Overview and New Geothermal Resource Discovery, Idaho Falls Post Register, June 23, 2014 (J.A. Welhan).

Recent Swarm of Earthquakes in Idaho Under Scrutiny, Los Angeles Times, <http://www.latimes.com/nation/nationnow/la-na-nn-idaho-quakes-20140415-story.html>, April 16, 2014 (W.M. Phillips).

Seismic Equipment Registers Tremor Southeast of Lewiston, Lewiston Tribune, [digital version not available] June 13, 2014 (W.M. Phillips).

Whole Lot of Shakin' Goin' On, Coeur d'Alene Press, http://m.cdapress.com/news/local_news/article_359ce512-1fa8-516c-9d89-339fdc476e2e.html?mode=jqm, April 18, 2014 (W.M. Phillips).

Professional Activities

Adjunct Faculty, Boise State University (V.S. Gillerman).

Affiliate Faculty, Idaho State University (J.A. Welhan).

Affiliate Faculty, University of Idaho (V.S. Gillerman, R.S. Lewis, W.M. Phillips, J.A. Welhan).

Affiliate Faculty, Washington State University (R.S. Lewis, W.M. Phillips).

Committee Member, Idaho State Hazard Mitigation Plan Executive Committee (W.M. Phillips).

Committee Member, NCGMP09 Steering Committee (L.R. Stanford).

Committee Member, University of Idaho Unmanned Aerial Systems Workshop Planning Committee (W.M. Phillips).

Committee Chair, Basin and Range Province Committee, Western States Seismic Policy Council (W.M. Phillips).

Co-Editor, Belt Symposium V and other papers, Northwest Geology, August (R.S. Lewis).

Co-Organizer, Topical Session T4. Precambrian II: Meso- and Neoproterozoic Evolution of Western Laurentia, in Honor of Don Winston, Geological Society of America Joint Rocky Mountain and Cordilleran Section Meeting, Bozeman, Montana, May (R.S. Lewis).

Co-Organizer, Topical Session T6, Yellowstone–Snake River Plain–Columbia River Volcanic Province: Geology, Petrology, Geophysics, and Geodynamics, Geological Society of America Joint Rocky Mountain and Cordilleran Section Meeting, Bozeman, Montana, May (W.M. Phillips).

Fellow, Society of Economic Geologists (V.S. Gillerman).

Field Trip Chairman, Belt Symposium V and Tobacco Root Geological Society Annual Field Conference, July-August (R.S. Lewis).

Field Trip Co-Leader, Hells Canyon to the Bitterroot front, Idaho, Geological Society of America Joint Rocky Mountain-Cordilleran Section Meeting, May (R.S. Lewis).

Field Co-Trip Leader, Lewiston Area, Idaho, Geological Society of the Oregon Country, May (D.L. Garwood, R.M. Breckenridge).

Field Trip Co-Leader, Northern Idaho, Ice Age Floods Institute, June (R.M. Breckenridge, D.L. Garwood).

Field Trip Co-Leader, Seven Field Trips near Salmon, Idaho, Belt Symposium V and Tobacco Root Geological Society Annual Field Conference, July-August (R.S. Lewis).

Field Trip Co-Leader, Two Field Trips near Salmon, Idaho, Belt Symposium V and Tobacco Root Geological Society Annual Field Conference, July-August (L.R. Stanford).

Field Trip Leader, Geothermal well site reclamation, Bureau of Land Management, October (J.A. Welhan).

Field Trip Leader, Idaho Phosphate Mines, May (V.S. Gillerman).

Field Trip Leader, Soda Springs Geothermal Study Area, University of Utah research colleagues, September (J.A. Welhan).

Field Trip Member, Blewett Pass and Ingalls Ophiolite, Pacific Northwest Section meeting of the National Association of Geoscience Teachers, central Washington, June (D.L. Garwood).

Field Trip Member, Glacial Geology of Lake Chelan Area, Pacific Northwest Section meeting of the National Association of Geoscience Teachers, central Washington, June (D.L. Garwood).

Field Trip Member, Ice-Age Floods and Flood Basalts of the Soap Lake to Odessa Area, Pacific Northwest Section meeting of the National Association of Geoscience Teachers, central Washington, June (D.L. Garwood).

Field Trip Member, Nutmeg Mountain Property, Idaho, Boise State University Class Trip, May (V.S. Gillerman).

Field Trip Member, Periglacial Geology of the Wenatchee Valley, Pacific Northwest Section meeting of the National Association of Geoscience Teachers, central Washington, June (D.L. Garwood).

Field Trip Member, Soda Springs Geothermal Study Area, Axel Schmitt and Research Colleagues, November (J.A. Welhan).

Idaho Professional Geologist License, February (W.M. Phillips).

Idaho Professional Geologist License Exam, March (R.S. Lewis).

Judge, University of Idaho Innovation Showcase, graduate student presentations, April (W.M. Phillips).

Member, American Geophysical Union (W.M. Phillips).

Member, Boise Section of Society for Mining, Metallurgy and Exploration, Inc., (V.S. Gillerman).

Member, Coeur du Deluge Chapter, Ice Age Floods Institute (D.L. Garwood).

Member, Geological Society of America (V.S. Gillerman, W.M. Phillips, R.S. Lewis).

Member, Geological Society of Nevada (V.S. Gillerman).

Member, Geothermal Resources Council (J.A. Welhan).

Member, Idaho Ground Water Monitoring Technical Committee (J.A. Welhan).

Member, Idaho Ground Water Monitoring Technical Committee, Nitrate Priority-Area Subcommittee (J.A. Welhan).

Member, North American Geoscience Teachers (D.L. Garwood).

Member, Northwest Mining Association (V.S. Gillerman, R.S. Lewis).

Member, Society for Mining, Metallurgy, and Exploration (V.S. Gillerman).

Member, Western States Seismic Policy Council (W.M. Phillips).

Participant, American Association of Petroleum Geologists, Basic Well-log Analysis Course, Austin, Texas, April–May (D.M. Feeney).

Participant, Digital Mapping Techniques 2014 Workshop, Newark Delaware, June (L.R. Stanford).

Participant, Geology Community of Use, US TOPO meeting, November, January, February, March, May (L.R. Stanford).

Participant, Idaho State Hazard Mitigation Plan Executive Committee Teleconference, February (W.M. Phillips).

Participant, Meetings with Utah Geological Survey Geologic Mapping Group, Salt Lake City, Utah, April (L.R. Stanford).

Participant, National Geothermal Data System Workshop, Las Vegas, Nevada, October (J.A. Welhan).

- Participant, NCGMP09 Steering Committee Meeting, May (L.R. Stanford).*
- Participant, NCGMP09 Working Group Meetings, November, December, January, March, April, (L.R. Stanford).*
- Participant, U.S. Geological Survey Meeting to Discuss Groundwater Information Needs in Areas of Oil/gas Development, Boise, August (J.A. Welhan).*
- Participant, Yellowstone Volcano Observatory Consortium Meeting, Mammoth Hot Springs, Yellowstone National Park, Montana, May (W.M. Phillips).*
- Representative, Spring Liaison meeting of Association of American State Geologists, Washington, D.C., March (R.S. Lewis).*
- Representative, Annual meeting of Association of American State Geologists, Lexington, Kentucky, June (R.S. Lewis).*
- Representative, Bureau of Homeland Security (BHS) State Agency Emergency Coordinator's Working Group, Boise, March, June (V.S. Gillerman).*
- Representative, Spring Liaison meeting of Association of American State Geologists, Washington, D.C., March (R.S. Lewis).*
- Reviewer, Geothermics manuscript, May (J.A. Welhan).*
- Reviewer, Journal of Geology manuscript, March (R.S. Lewis).*
- Reviewer, Lithosphere manuscript, April (R.S. Lewis).*
- Reviewer, Rocky Mountain Geology manuscript, June (R.S. Lewis).*
- State Councilor representing Idaho, North American Geoscience Teachers (D.L. Garwood).*
- Team Leader, Incubator Proposal, Sedimentary Rock Geothermal Systems, Texas Christian University Energy Institute (J.A. Welhan).*
- Technical Advisor, Bannock County Groundwater Overlay Advisory Committee (J.A. Welhan).*
- Technical Advisor, Department of Environmental Quality on statistical tools for ground water quality monitoring (J.A. Welhan).*
- Technical Advisor, Idaho State University's National Science Foundation "Opportunities for Educational Diversity in the Geosciences" (J.A. Welhan).*

Technical Advisor, ISU College of Pharmacy ground-water study of pharmaceuticals in drinking water (J.A. Welhan).

Technical Advisor, Shoshone-Bannock Tribes' Water Resources Department (J.A. Welhan).

Technical Advisor, Statistical Tools for Ground Water Quality Monitoring, Department of Environmental Quality (J.A. Welhan).

Graduate Thesis Committees

Darin Schwartz, M.S. Geology, University of Idaho (W.M. Phillips).

Liane Stevens, Ph.D. Geology, University of Montana (R.S. Lewis).

Rachael Hoover, M.S. Geology, Washington State University (W.M. Phillips).

Rebecca Ohly, M.S. Geological Sciences, Idaho State University (J.A. Welhan).

Grants and Contracts

Additional Geologic Mapping and Study of Hydrothermal Alteration, Mineralization and Geochronology In and Near Stibnite Mining District, Idaho: V.S. Gillerman and R.S. Lewis (Midas Gold, Inc., July 1, 2014-June 30, 2016, \$70,000).

Aquifer and Stream Recharge Processes in the Lower Portneuf Valley Watershed: G. Thackray, J. Welhan and M. Shapley (Idaho EPSCoR MILES/I-SEED program; January 15-August 30, 2014, \$13,002).

ARRA Geothermal Data Compilation Project: J.A. Welhan and R.M. Breckenridge (DOE-AASG, May 2010-January 2014, \$412,389).

ARRA Geothermal New Data Supplement Project: J.A. Welhan and R.M. Breckenridge (DOE-AASG, June 2011-January 2014, \$457,663).

Cooling in Fractured Geothermal Reservoirs: Software Tools: J.A. Welhan, co-PI (DOE-INL LDRD, October 2012-September 2015, \$524,000).

Geologic Mapping in the Rexburg, Weiser, Salmon, and Fairfield Areas: R.S. Lewis, W.M. Phillips, D.L. Garwood, and D.M. Feeney (U.S. Geological Survey STATEMAP Program, June 2013-May 2014, \$189,701).

Geologic Mapping in the Rexburg, Weiser, Boise, and Salmon Areas: R.S. Lewis, W.M. Phillips, D.L. Garwood, and D.M. Feeney (U.S. Geological Survey STATEMAP Program, June 2014-May 2015, \$175,275).

Geologic Mapping of Stibnite 7.5' Quadrangle and Pilot Investigation of Hydrothermal Alteration, Mineralization and Geochronology within Stibnite Mining District, Idaho: V.S. Gillerman and R.S. Lewis (Midas Gold, Inc., May 2012-December 2014, \$75,000).

Idaho Department of Lands Abandoned Mine Lands Project, Task 2: R.S. Lewis (Idaho Department of Lands, May 2012-February 2015, \$89,857).

Lithologic Characterization of Active ITD Aggregate Sources and Implications for Aggregate Quality: V.S. Gillerman and B. Phillips (Idaho Transportation Department March 2011-December 2013, \$119,999).

Recruiting and Retaining Native American Students in the Geosciences: J.A. Welhan (subcontract to ISU, NSF, December 2011-August 2014, \$17,122).

USGS Geological Survey FY2011 Data Preservation Program: R.S. Lewis (United States Geological Survey, September 2013-September 2014, \$23,261).

Valley County Idaho Seismic Site Class and Liquefaction Susceptibility Study: W.M. Phillips (Idaho Bureau of Homeland Security, November 2013- August 2014, \$63,000).