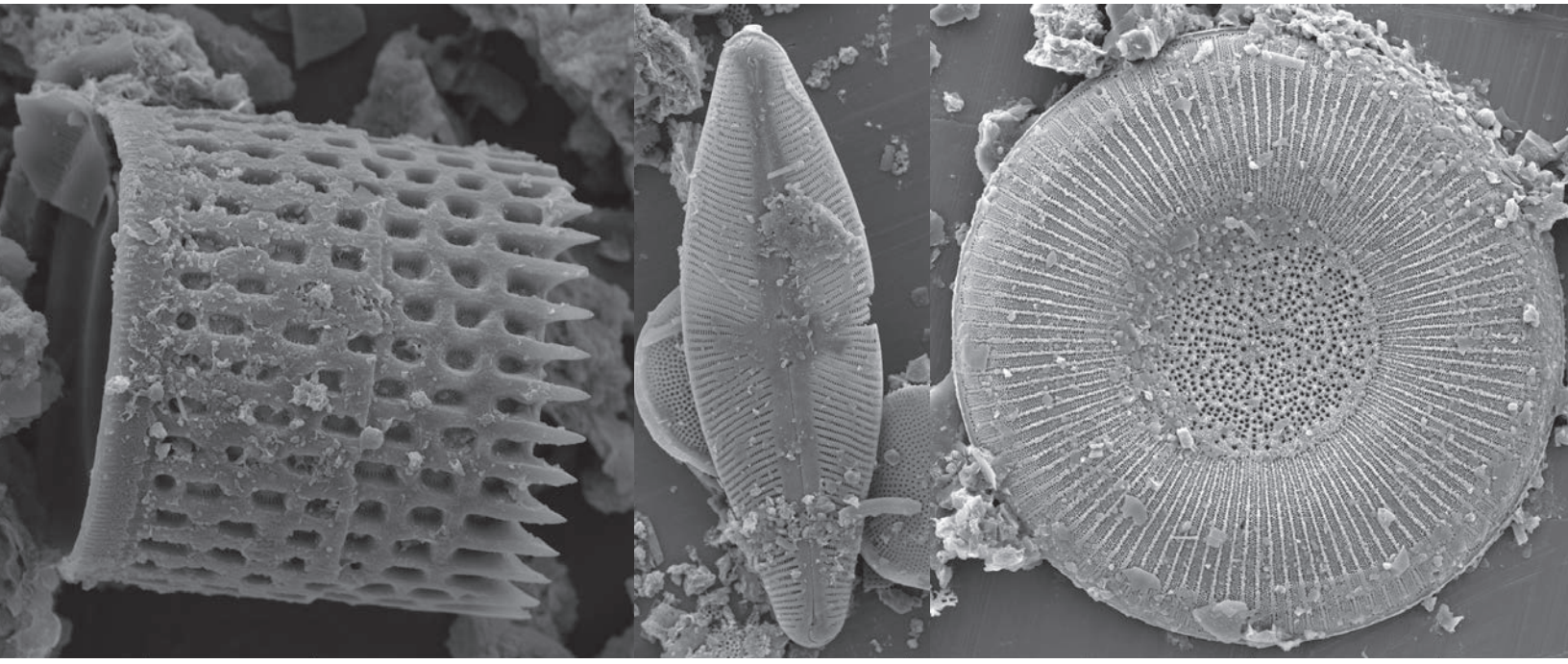
Annual Report
of the
Idaho Geological Survey



Fiscal Year 2018

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On the cover: Scanning electron microscope (SEM) photomicrographs of diatoms from middle to late Miocene Payette and Chalk Hills Formations in southwest Idaho. From left to right: *Aulacoseira* sp. (field of view 34 µm), *Navicula* cf. *aurora* (field of view 112 µm), *Lindavia* sp. (field of view 69.6 µm).
*Photo Credit: Dr. Jeffery Stone, Indiana State Univer*sity

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INTRODUCTION

Idaho Geological Survey (IGS) is the lead state agency for the collection, interpretation, and dissemination of geologic and mineral resource data for Idaho. The agency has served the state since 1919 and prior to 1984 was named the Idaho Bureau of Mines and Geology. Idaho Code Title 47, Chapter 2 provides the creation, purpose, duties, reporting, and offices of the Survey, and establishes the IGS Advisory Board. The IGS is a non-regulatory state agency that is administered as a Special Program of the University of Idaho. The Moscow Office is located on the University of Idaho campus, and the Boise Office is located in the Idaho Water Center. The agency is staffed by approximately 12 state-funded FTEs and 15 externally-funded temporary and part-time employees.

The Survey's mission is to provide the state with timely and relevant geologic information. IGS is committed to the advancement of geosciences and emphasizes the practical application of geology to benefit the citizens of the state. The Survey accomplishes its mission through applied geologic research and strong collaborations with federal and state agencies, academia, private sector partnerships, community service, and educational outreach activities.

The field of geology has several sub-disciplines, and the IGS is endeavoring to complement its staff with experts in these. Currently, the Survey has staffing in detailed geologic mapping, petroleum assessment, hydrogeology, economic geology, and geologic hazards. Members of the IGS staff acquire geologic information through field and laboratory investigations and through sponsored and cooperative research programs with partners at the local and federal level. The Survey's surface geologic mapping program is fundamental to solving and identifying a wide array of geologic problems and issues throughout the state. Both subsurface and surface geologic maps constitute a fundamental and objective scientific foundation on which land, water, mineral, and energy resource decisions are based. The Survey is a leader in the National Cooperative Geological Mapping Program, and about 200 geologic maps have been published from this program and are available for download from the agency website.

Historically, a central function of the IGS has been the production of maps with bedrock and surficial geology. The IGS Digital Mapping Laboratory is central to compiling, producing, and delivering digital geologic map products, technical reports, and publications from the geologic staff. Geographic information system

(GIS) technology has changed geologic maps by providing tools that enable geologic resources and structural features to be electronically stored, displayed, queried, and analyzed in conjunction with a variety of other data types.

Petroleum geologic assessment currently focuses on the Payette Basin oil and gas plays but is extending its reach into southern and eastern Idaho as well. Underway is basin analysis, including sequence stratigraphy, reservoir modeling and reservoir quality evaluation of the Payette systems.

Economic geology refers to the geology of earth materials useful to society; they include metallic minerals and non-metallics, known as industrial minerals. By statute, the Survey is Idaho's agency for obtaining and disseminating information on the state's mineral resources. This includes different types of projects, including compilation and preservation of information and databases on past Idaho mines and prospects, obtaining and providing information yearly on current mining and mineral exploration and development actions in Idaho, and research into the geologic characterization of the state's mineral deposits. All these data are used by natural resource companies exploring for new deposits, agencies tracking economic development, and agencies and companies doing environmental reclamation and remediation. In addition, the Survey's economic geologist answers numerous inquiries from the general public about mining and ore deposits.

The Survey's work evaluates seismic risk following areas of known faulting activity and potential news ones. Landslides and overall potential slope failures are also included under the heading of geologic hazards.

Hydrogeologic activities during the fiscal year have focused on building partnerships, pursuing projects, and supporting efforts that emphasize quantified study of inputs and outputs to groundwater systems and groundwater quality, with the goal of conserving and adequately planning Idaho's valuable water assets. Aquifer systems are modeled and assessed as the state's water needs for domestic, agricultural (crops and animal use), and all industrial uses grow.

The Survey continues to support development of geothermal resources in Idaho. Most recently, IGS research has focused on the geothermal potential of the Idaho fold and thrust belt in the vicinity of the Blackfoot volcanic field in southeastern Idaho.

Over time, the staff has developed wide-ranging interdisciplinary networks in support of its mission. Please refer to the *Partnerships* section for the many organizations currently involved in Survey projects. Details of the staff's professional engagement in the agency's mission are listed in the *Publications and Activities* section of this report.

Organization and Personnel

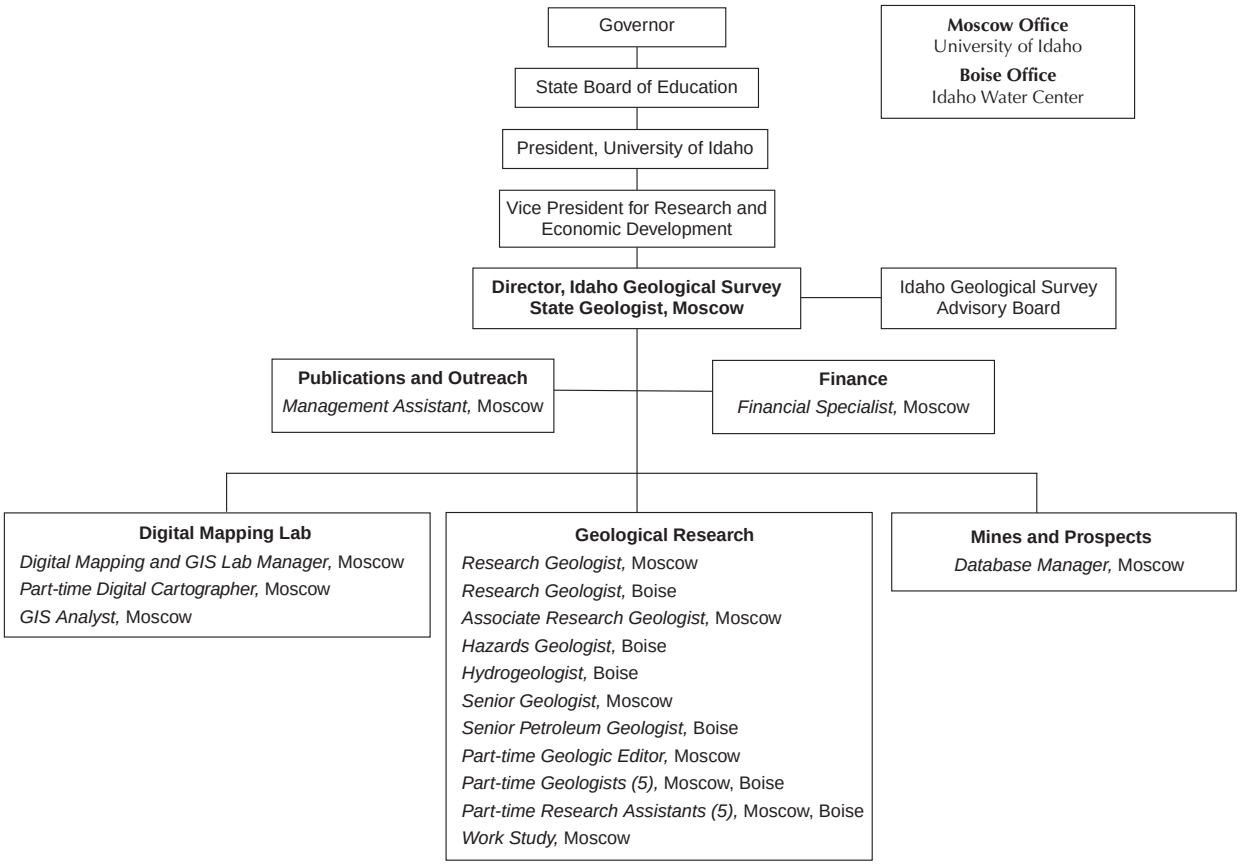
The IGS provided its geological services during fiscal year (FY) 2018 from the Moscow Office and Boise Office. Three vacancies were filled in FY 2018: Mark Barton, Senior Petroleum Geologist in Boise; Alexis Clark, Hydrogeologist in Boise; and Jonathan Sandquist, Digital Cartographer in Moscow.

In FY 2018, two long-term employees retired. After 30 years of service, IGS Digital Mapping and GIS Lab Manager Loudon Stanford retired in May 2018. The national search to fill this position is nearing completion, and the Survey hopes to have a new Lab Manager in early 2019. William Phillips, Associate Research Geologist, retired in June 2018 after 14 years with IGS. A search to fill this position has not started.

In May 2018, Glen Downing, Director of Office of Research Operations and Strategic Initiatives, filled the role of Acting Director, while Ed Ratchford remained State Geologist. The organization chart below represents personnel, reporting, and office locations effective during the majority of FY 2018.

Organization Chart

Idaho Geological Survey
FY 2018



Directory

Moscow Office

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

Boise Office

Idaho Water Center, Suite 201
322 E. Front Street
Boise, ID 83702
208-332-4420

Administrative and Support Staff

Glen R. Downing ..... Acting Director, Moscow (May-June 2018)
Michael E. Ratchford ..... State Geologist, Moscow (May-June 2018)
Michael E. Ratchford ..... Director and State Geologist, Moscow (July 2017-May 2018)
John R. Brabb ..... Financial Specialist, Moscow
Kristen M. Pekas ..... Management Assistant, Moscow

Research, Full-Time

Mark Barton ..... Senior Petroleum Geologist, Boise
Alexis Clark ..... Hydrogeologist, Boise
Dennis M. Feeney ..... Senior Geologist, Moscow
Virginia S. Gillerman ..... Research Geologist, Boise
Reed S. Lewis ..... Research Geologist, Moscow
Zach Lifton ..... Hazards Geologist, Boise
William M. Phillips ..... Associate Research Geologist, Moscow
Jonathan E. Sandquist ..... Digital Cartographer, Moscow
Loudon R. Stanford ..... Digital Mapping and GIS Lab Manager, Moscow
Christopher A. Tate ..... Mines and Prospects Database Manager, Moscow
Linda Tedrow ..... GIS Analyst, Moscow

Research and Support, Part-Time

Russell F. Burmester ..... Geologist
James C. Coogan ..... Geologist
Ashanna Dennis ..... Work Study
Thomas Jeute ..... Research Assistant
Korbon N. McCall ..... Research Assistant
Kurt L. Othberg ..... Geologist
Matthew A. Peterson ..... Research Assistant
D. Kate Schalck ..... Geologic Editor
Keegan L. Schmidt ..... Geologist
William Schuster ..... Research Assistant
David E. Stewart ..... Geologist
Eric D. Stewart ..... Geologist
Ander J. Sundell ..... Geologist
Kerrie N. Weppner ..... Geologist

Idaho Geological Survey
Advisory Board

Leslie Baker
Chair, Department of Geography and Department of Geological Sciences, University of Idaho

Susan Cleverly
Mitigation Section Chief, Idaho Office of Emergency Management

Chris Dail
Exploration Manager, Midas Gold Corporation

David Hawk
Representative, Office of the Governor

Mike McCurry
Chair, Department of Geological Sciences, Idaho State University

James "Jim" McNamara
Chair, Department of Geological Sciences, Boise State University

Dan Moore
Professor, Department of Geology, Brigham Young University - Idaho

Keith Nottingham
Geologist, American Geotechnics

Rich Reed
President, Idaho Association of Professional Geologists

Ex Officio: Glen R. Downing
Acting Director, Idaho Geological Survey (May-June 2018)

Ex Officio: Michael "Ed" Ratchford
Director and State Geologist, Idaho Geological Survey (July 2017-May 2018)

Idaho Geological Mapping Advisory Committee

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

Shawn Enright
District Geologist
Idaho Transportation Department

David Hawk
Representative, Office of the Governor
IGS Advisory Board
E2A Energy Analysis and Answers

Dale Kerner
Permitting Manager
Midas Gold Idaho, Inc.

Mark Kimsey
Research Assistant Professor
Intermountain Forestry Cooperative
Department of Forest, Rangeland and Fire Sciences
University of Idaho

Robin Kiska
Risk MAP Program Manager
Idaho Office of Emergency Management

Sean Long
Associate Professor, Earth Sciences
Washington State University

Jonathan Moore
Project Geologist
Hecla Mining Company

Shawn Nield
State Soil Scientist
U.S. Department of Agriculture
Natural Resources Conservation Services

Dennis Owsley
Technical Hydrogeologist
Idaho Department of Water Resources

David Pearson
Assistant Professor, Department of Geosciences
Idaho State University

Karen Porter
Geologist
Program Lead Leasable and Salable Minerals
Idaho State Office, Bureau of Land Management

John Rice
President
Rocky Mountain Environmental Associates, Inc.

Diane Wheeler
Forest Geologist
Caribou-Targhee National Forests

Fiscal Overview

In FY 2018, the Legislature funded the IGS its full budget request for salary and related benefits to continue operations and additional one-time capital outlay funding. The Survey's state appropriated budget for FY 2018 was $1,080,400, a $42,900 decrease from $1,123,300 in FY 2017. This decrease is from the removal of one-time funding that was received in FY 2017.

Grants and contracts expenditures increased 10% from $314,962 in FY 2017 to $347,857 in FY 2018. In FY 2018, expenditures came from 12 projects compared to 13 projects in FY 2017.

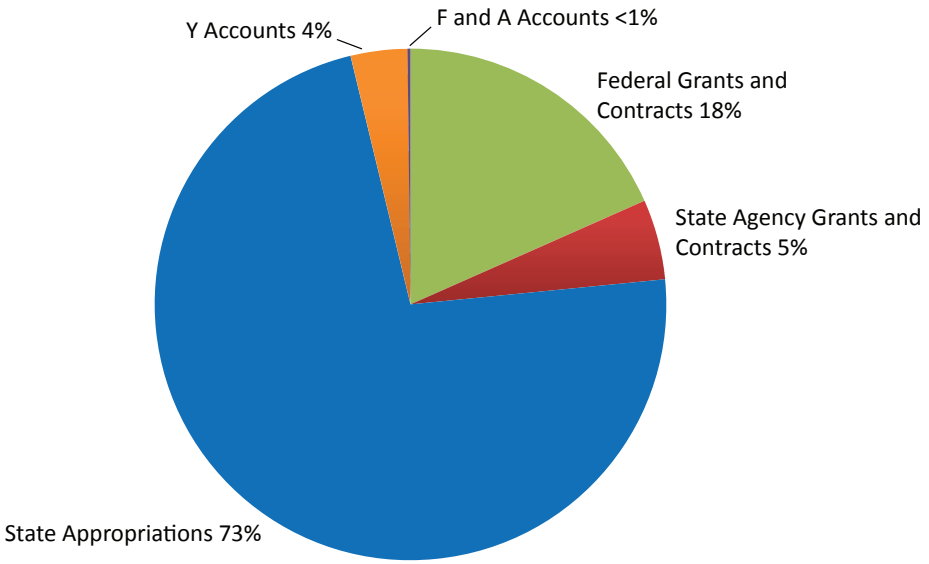
In May 2017, IGS requested to add two new positions (1.48 FTE) for FY 2019, Management Assistant in the Boise office and a Geologic Editor in the Moscow office, in addition to continuation of existing funding for salary and related benefits and operations ($99,414.00 total additional base funding). An additional capital outlay of $7,200 was also requested. The Legislature funded at a level consistent with FY 2018 salary, related benefits, and operations base budget with a moderate cost of living increase and did not fund the addition of two new positions.

Budget for FY 2018					
Category	Beginning Balance	Income or Appropriations	Actual	Expense	Ending Balance
Personnel		$ 1,039,400.00	$ 880,196.15	$ 880,196.15	$ -
Operating Expense		$ 33,000.00	$ 169,100.71	$ 169,100.71	$ -
Capital Outlay		$ 8,000.00	$ 31,103.14	$ 31,103.14	$ -
Total Appropriations		$ 1,080,400.00	$ 1,080,400.00	$ 1,080,400.00	$ -
U/I Personnel Funds		-		-	-
Y Accounts	$ 76,158.69	$ 31,156.28		$ 53,146.32	$ 54,168.65
F and A Accounts	$ 89,476.22	$ 13,721.68		$ 2,917.74	$ 100,280.16
Grants and Contracts	$ 358,438.85	$ 188,683.00	$ 347,856.72	$ 347,856.72	$ 199,265.13
Total	$ 524,073.76	$ 1,313,960.96	$ 1,428,256.72	$ 1,484,320.78	$ 353,713.94

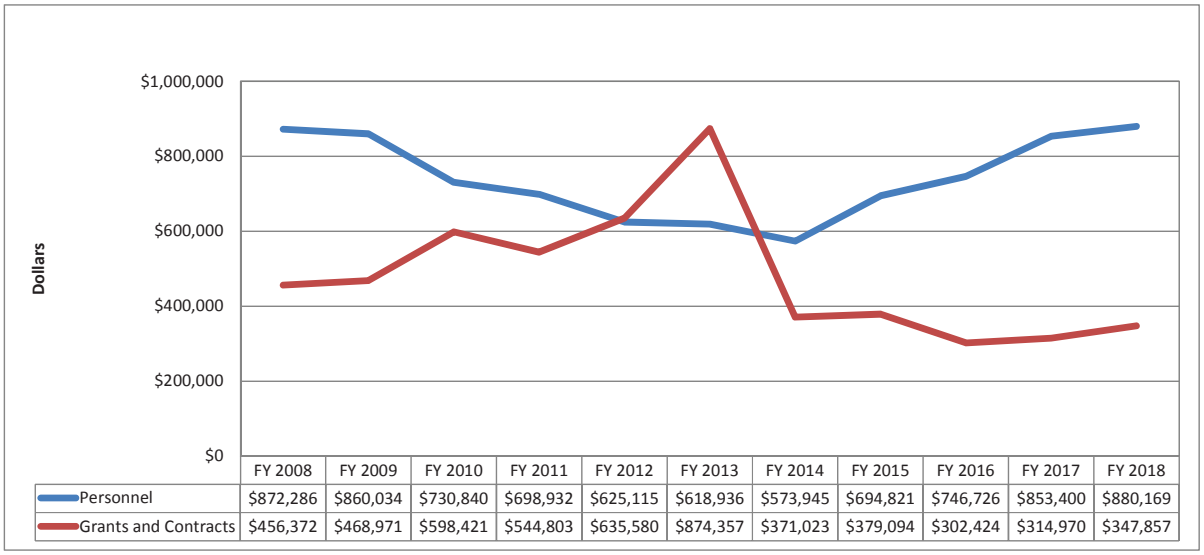
For FY 2020, IGS requested $80,400 in salaries and related benefits to bring all IGS exempt and classified staff up to 85% of the market-based rates set by the University of Idaho. In order to slow employee turnover, the University of Idaho has adopted a market-based compensation system to help address employee retention issues. IGS does not have access to General Education funds

that will assist the University with implementing this new compensation system and therefore requested funding to do so. IGS also requested 0.125 FTE for the Management Assistant in the Moscow and 0.31 FTE for the Senior Geologist in the Moscow. The FY 2020 request is pending.

Sources of Funding FY 2018



Personnel Costs and Grants and Contracts Expenditures FY 2008-2018



	FY 2008	FY 2009	FY 2010	FY 2011	FY 2012	FY 2013	FY 2014	FY 2015	FY 2016	FY 2017	FY 2018
Personnel	$872,286	$860,034	$730,840	$698,932	$625,115	$618,936	$573,945	$694,821	$746,726	$853,400	$880,169
Grants and Contracts	$456,372	$468,971	$598,421	$544,803	$635,580	$874,357	$371,023	$379,094	$302,424	$314,970	$347,857

PARTNERSHIPS

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

Association of American State Geologists

The IGS attended the Annual Meeting of AASG last spring held in Rehoboth Beach, Delaware. The AASG is a strong advocate for the funding and reauthorization of the U.S. Geological Survey (USGS) National Cooperative Geologic Mapping Program as well as research programs for data preservation, minerals, energy resources, and geologic hazards. AASG is an important partner with state geological surveys, the USGS, the National Geologic Map Database, and the annual Digital Mapping Techniques Workshops. AASG as an association, as well as its members, is a valuable resource for everyday operations at the IGS where advice can be sought from geologic surveys across the nation for issues ranging from alternative funding sources to engaging in geoscience policy at the state and national level.

Funding Partners

U.S. Department of Homeland Security, Federal Emergency Management Agency (Big Wood River Landslide Susceptibility Mapping) **Idaho Department of Lands** (Abandoned Mine Lands Project)	**Midas Gold Corporation** (Stibnite and Burnt Log Projects) **U.S. Geological Survey** (Reservoir Characterization and Petroleum Assessments; Statemap Cooperative Program; Data Preservation

Collaborators

Alta Mesa Holdings, LLC
Alta Science & Engineering, Inc.
American Exploration and Mining Association
American Geosciences Institute
American Water Resources Association, Idaho State Section
Association of American State Geologists
Belt Association
Boise State University
Brigham Young University-Idaho
Bryant University
Cedar Creek Resources
Center for Advanced Energy Studies
China Geological Survey
China University of Geosciences
College of Idaho
College of Western Idaho
Earthquake Engineering Research Institute
Federal Emergency Management Agency
Franklin and Marshall College
Geological Society of America
Geomark Laboratories
Governor's Office, State of Idaho
Hecla Mining Company
Ice Age Floods Institute
Idaho Department of Environmental Quality
Idaho Department of Lands
Idaho Department of Water Resources
Idaho Ground Water Monitoring Technical Committee
Idaho Historical Society
Idaho Mining Association
Idaho Museum of Mining and Geology
Idaho Office of Emergency Management
Idaho Office of Energy Resources
Idaho Oil and Gas Conservation Commission
Idaho Public Television
Idaho Science Teachers Association
Idaho State University
Idaho Transportation Department
Idaho Water Resources Research Institute
Idaho Youth ChalleNGe Academy
IHS Energy
Inside Idaho
Intermountain Forestry Cooperative
Isotech Laboratories
Latah County Library
Lewis-Clark State College
Midas Gold Idaho, Inc.
Missouri State University
Montana Bureau of Mines and Geology
Nevada Bureau of Mines and Geology
Northwest Knowledge Network
Oregon State University
Orma J. Smith Museum of Natural History
Owyhee Gem and Mineral Society
Palouse Prairie Charter School
Schlumberger Petroleum Services
Spokane Community College
Tobacco Root Geological Society
U.S. Bureau of Land Management
U.S. Forest Service
U.S. Geological Survey—Data Preservation
U.S. Geological Survey—Energy and Unconventional Fuels
U.S. Geological Survey—Minerals Program
U.S. Geological Survey—National Cooperative Geologic Mapping Program
U.S. Geological Survey—National Geospatial Program
U.S. Geological Survey—Water Resources Division
University of Idaho
University of Montana
University of Utah
Utah Geological Survey
Utah State University
Washington State University
Weatherford Laboratories
Western Colorado University
Western States Seismic Policy Council
Yellowstone Volcano Observatory

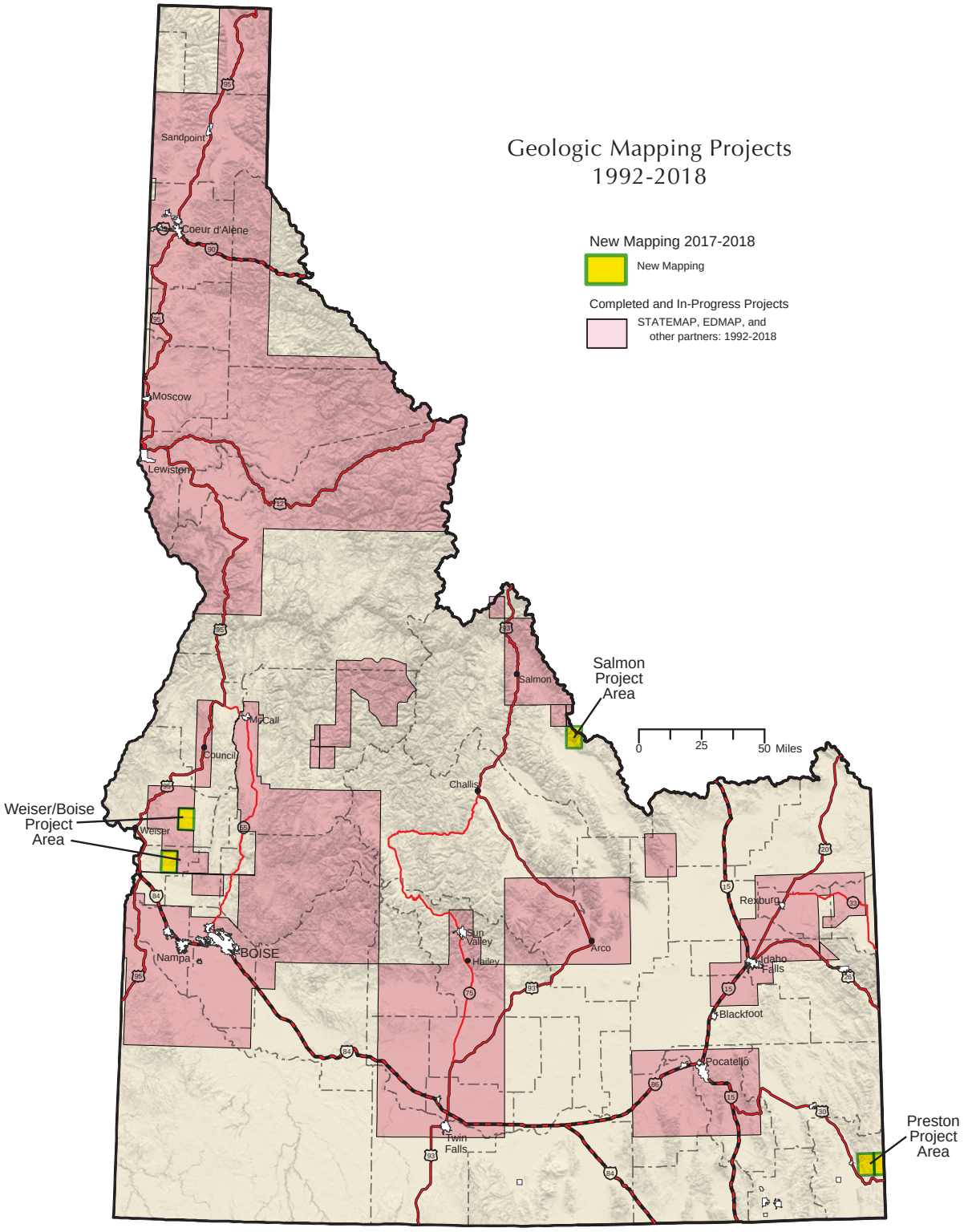
Research

Applied geologic research is the primary function of the IGS. Projects include those related to geologic mapping, hydrogeology, geologic hazards, mineral resources, geothermal energy, and oil and gas.

Geological Mapping and Related Studies

Many IGS research projects consist of geologic mapping of 7.5′ and 30′ x 60′ quadrangles. In the last two decades, the Survey has been mapping in areas selectively to address development impacts in urban settings; for recognition and assessment of new mineral, aggregate, and oil and gas resources; and identification and monitoring of geologic hazards 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 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 define groundwater resources; to aid in highway design and construction; and to define geologic resources on public lands, including federal lands, parks, recreation areas, and state endowment lands.

Funding of Idaho's geologic mapping program is shared by the Statemap component of the USGS National Cooperative Geologic Mapping Program and the Survey. Since 1993, Idaho has received over $4.1 million in federal funds and matched an equal amount of in kind salaried employee's participation to complete geologic mapping in Idaho. In FY 2018, new mapping was conducted in the Weiser-Boise, Preston, and Salmon project areas. During the year, Survey geologists mapped five 7.5′ quadrangles (Sheep Ridge, Crane Creek Reservoir, Geneva, Montpelier Canyon, and Goat Mountain) under the Statemap Program. Two 7.5′ quadrangle maps from the Weiser-Boise project area were posted to the website (Northeast Emmett and Midvale Hill); these inform the ongoing oil and gas exploration in this area, provide background information on potential geologic hazards, and provide hydrogeologic framework data for water resource planning. Two 7.5′ quadrangle maps from the Salmon project area (Agency Creek and Lemhi Pass) were also published, providing detailed geologic data for the thorium and rare-earth-element deposits in this region of the state. New project work in the Preston quadrangle is targeting an area with hydrocarbon potential,


Geologic Mapping Projects
1992-2018
New Mapping 2017-2018
New Mapping
Completed and In-Progress Projects
STATEMAP, EDMAP, and other partners: 1992-2018
Salmon Project Area
Weiser/Boise Project Area
Preston Project Area
0 25 50 Miles
Sandpoint
Coeur d'Alene
Moscow
Lewiston
Salmon
McCall
Council
Challis
Weiser
Nampa
BOISE
Sun Valley
Hailey
Arco
Rexburg
Idaho Falls
Blackfoot
Pocatello
Twin Falls

potential phosphate resources, and seismic hazards. A previously unmapped fault scarp was discovered in 2017 and soon-to-be released lidar imagery will help future mapping efforts in this corner of the state.

Mapping funded in part by Midas Gold Corporation along the proposed Burntlog Road Access Route near Stibnite was published, as was work for the Idaho Transportation Department (ITD) in the Smiths Ferry quadrangle south of Cascade. The Smiths Ferry mapping was in support of geologic work by industry and ITD geologists for a Highway 55 road-widening project. The IGS also released two Technical Reports with geologic mapping in the Kellogg East, Kellogg West, Grizzly Mountain, and Steamboat Creek 7.5′ quadrangles in Shoshone County authored by James L. Browne. Mr. Browne, a retired Hecla geologist, has worked on a volunteer basis with the IGS for almost 20 years and has produced 16 detailed 1:24,000-scale maps of the area from Coeur d'Alene east to Kellogg. He is currently mapping north of Kellogg near Murray, an area of continued interest because of historic gold production and ongoing exploration activity by Hecla and New Jersey mining companies.

Hydrogeology

Hydrogeologic activities performed by IGS during FY 2018 included manuscript technical review, public service, outreach, and education. Primary activities involved outreach with state and federal agencies (regulatory and non-regulatory) related to groundwater supply and quality issues in Idaho.

IGS provided technical review of a manuscript, *Miocene Evolution of the Moscow-Pullman Basin, Idaho and Washington,* authored by John H. Bush, Pamela Dunlap, and Stephen P. Reidel. Stratigraphic relationships within the Columbia River Basalt Group were evaluated using several methods to create paleogeographic reconstructions of the Moscow-Pullman Basin evolution during the Miocene. Once published, this manuscript and associated maps and cross sections will be available on the IGS website.

The results of the water balance analysis of the south Ross Fork Basin aquifer on the Fort Hall Reservation are pending review and subsequent publication on the IGS website. This work supports management decisions regarding future water supply shortages during drought conditions.

Outreach activities during FY 2018 included participation in the Ground Water Monitoring Technical Committee (led by Idaho Department of Environmental Quality), the Treasure Valley Modeling Technical Advisory

Committee (led by Idaho Department of Water Resources), and the Wood River Valley Modeling Technical Advisory Committee (led by Idaho Department of Water Resources). The Treasure Valley Modeling Technical Advisory Committee and Wood River Valley Modeling Technical Advisory Committee provide the respective modeling teams with input during the construction of numerical groundwater flow models. Assistance was also provided during an IGS-led field trip on June 20, 2018, by Dr. Virginia Gillerman for the Treasure Valley Modeling Technical Advisory modeling team comprised of Idaho Department of Water Resources and USGS representatives. The focus of the field trip was to provide geologic history and context for key formations to be included in the Treasure Valley numerical groundwater flow model.

Geologic Hazards

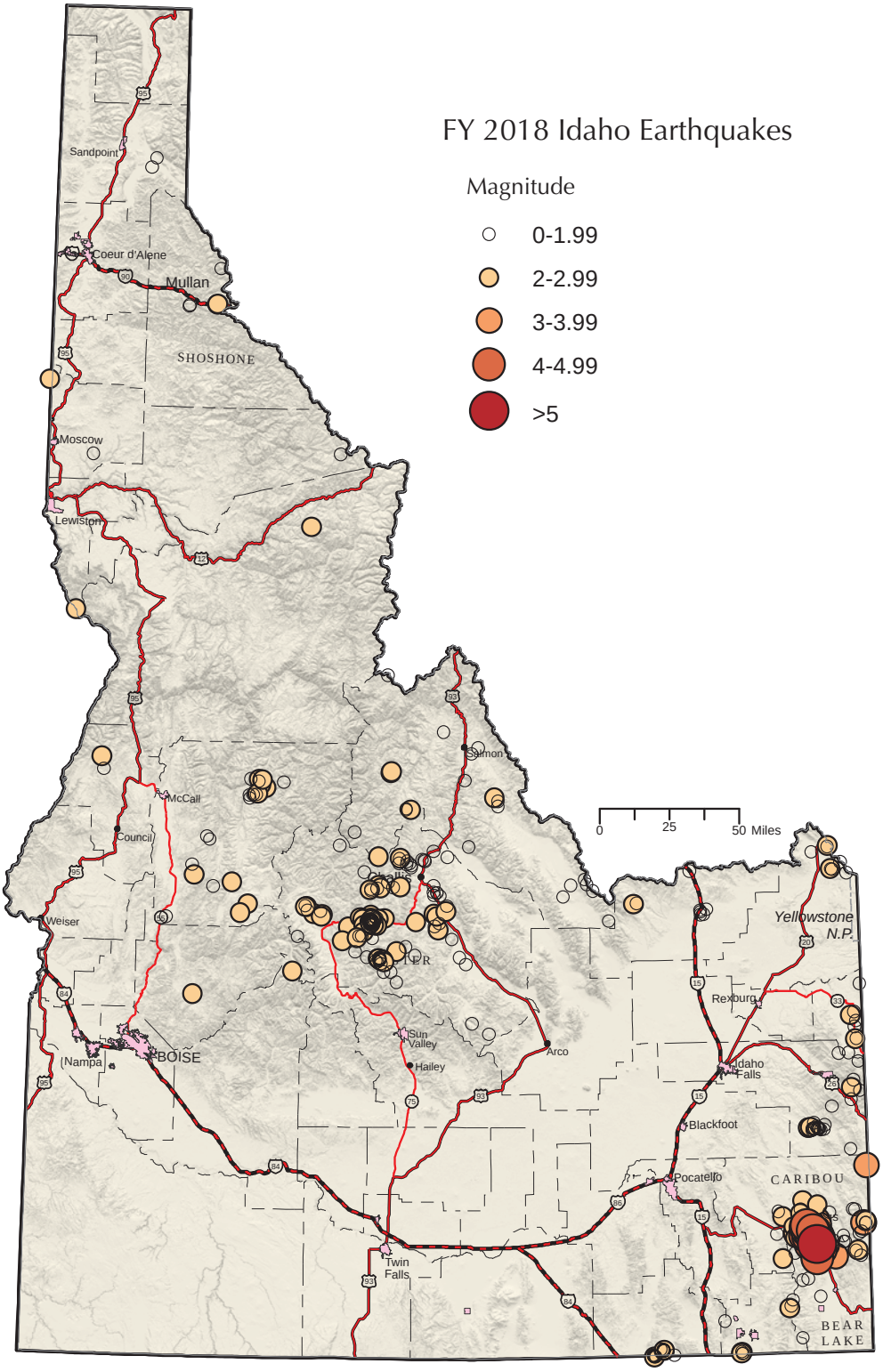
Overview

Idaho is prone to earthquakes, volcanic eruptions, landslides, and alluvial fan flooding. The Survey assists with mitigation of these hazards in several ways:

- Geological mapping through the USGS Statemap program provides baseline information on the location, size, and frequency of these hazards. This information may be incorporated into planning documents and also serves as the basis for more detailed studies.
- Expert opinion and advice are provided to state and federal agencies involved with Idaho hazard mitigation. This includes the Idaho Office of Emergency Management and the U.S. Federal Emergency Management Agency.
- Public education and outreach through publications, press releases, media interviews, social media, and public lectures.
- Participation in the Western States Seismic Policy Council (WSSPC). The WSSPC mission is to develop seismic policies and share information to promote programs that reduce earthquake-related losses.

Earthquakes

Survey staff are informed about Idaho and important regional earthquakes through seismic monitoring performed by the USGS, Montana Bureau of Mines and Geology, University of Utah, Idaho National Laboratory, and the Pacific Northwest Seismic Network. When an earthquake occurs, location, magnitude,



Earthquakes during FY 2018 in Idaho. Source: USGS-ANSS Comprehensive Earthquake Catalog for 07-01-2017 to 06-30-2018.

and shaking intensity data are posted within minutes by the USGS to their website. IGS staff members receive automated emails and cell phone texts for Idaho-area earthquakes and also check the USGS website for major regional activity on a regular basis.

In FY 2018, a significant earthquake sequence occurred near Soda Springs. The sequence started in early September 2017 with a magnitude 5.3 earthquake, followed by over 2,000 aftershocks. The sequence included 33 earthquakes with magnitude 4 to magnitude 5. Several of the larger earthquakes were felt across southeast Idaho and northern Utah, but no damage from any of these earthquakes was reported.

Also in FY 2018, approximately 50 earthquakes as large as magnitude 2.7 were recorded in the Challis area. These earthquakes are part of a continuing earthquake swarm that has been occurring for several years. No damage from any of these earthquakes was reported.

Volcanic Eruptions

The Survey collaborates with monitoring of regional volcanic activity as a member of the Yellowstone Volcano Observatory Consortium (YVO). YVO members consist of the USGS, Yellowstone National Park, University of Utah, and the geological surveys of Idaho, Wyoming, and Montana. In the event of volcanic ash eruptions from Cascade volcanoes, the Survey will collaborate with the USGS Cascade Volcano Observatory.

In FY 2018, no volcanic eruptions occurred in Idaho. However, seismicity related to Yellowstone volcanic activity occurred throughout FY 2018, with earthquakes as large as magnitude 3.6 recorded northeast of West Yellowstone, Montana.

Landslides

Landslides, debris flows, and alluvial fan floods occur frequently in Idaho's mountainous landscapes. Transportation networks such as highways and railroads are particularly vulnerable to these hazards.

In FY 2018, no significant landslide events were reported. However, landslide damage to several homes in the Boise foothills continued from FY 2016 and FY 2017.

In FY 2018, the Survey initiated a pilot project to map landslides along transportation corridors in the Panhandle region, in response to landslide activity

in FY 2017. The Survey also submitted a grant proposal to the ITD to develop an updated digital landslide database for the state.

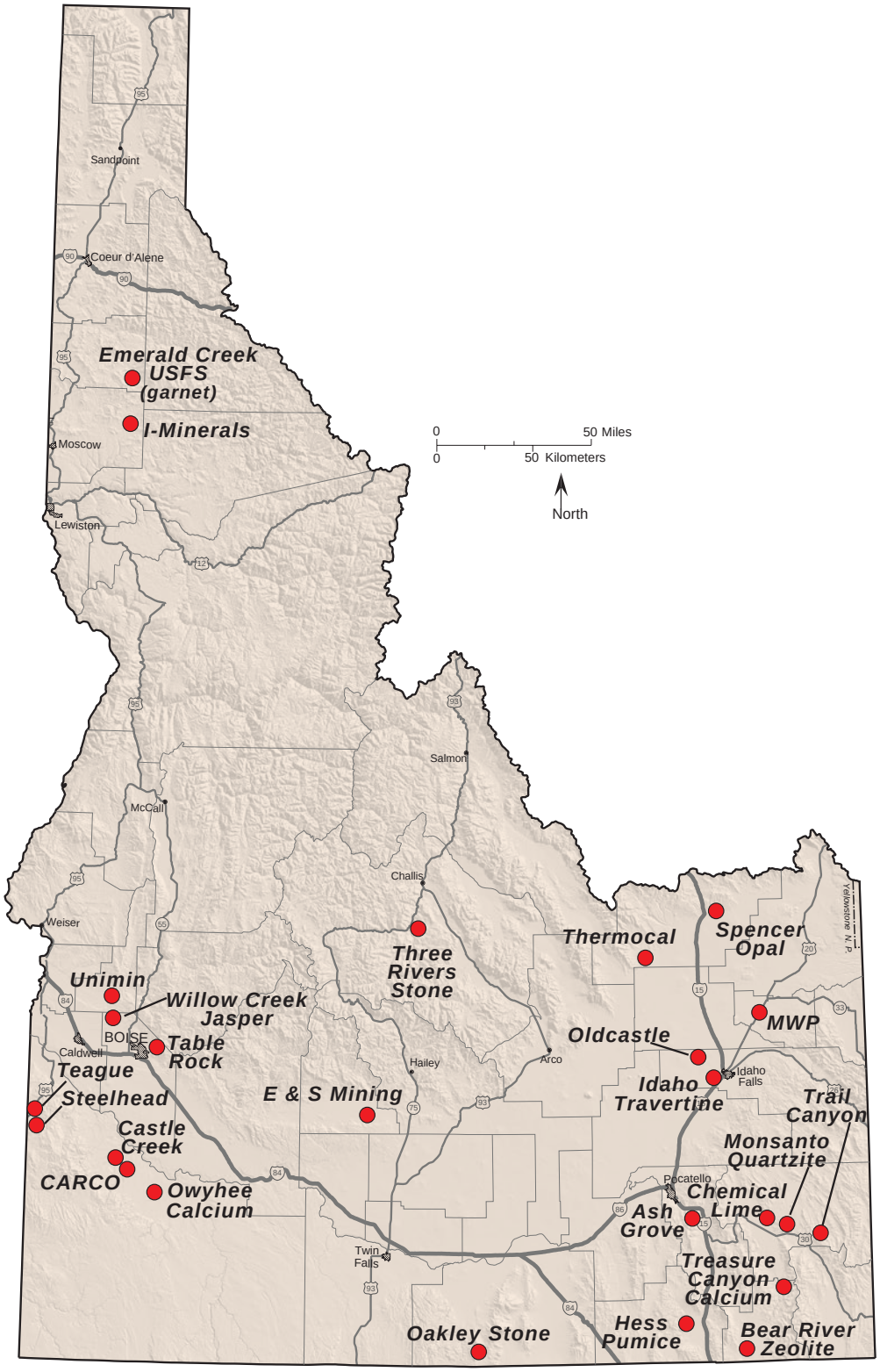
Mineral Resources and Mining

Active Mining and Exploration

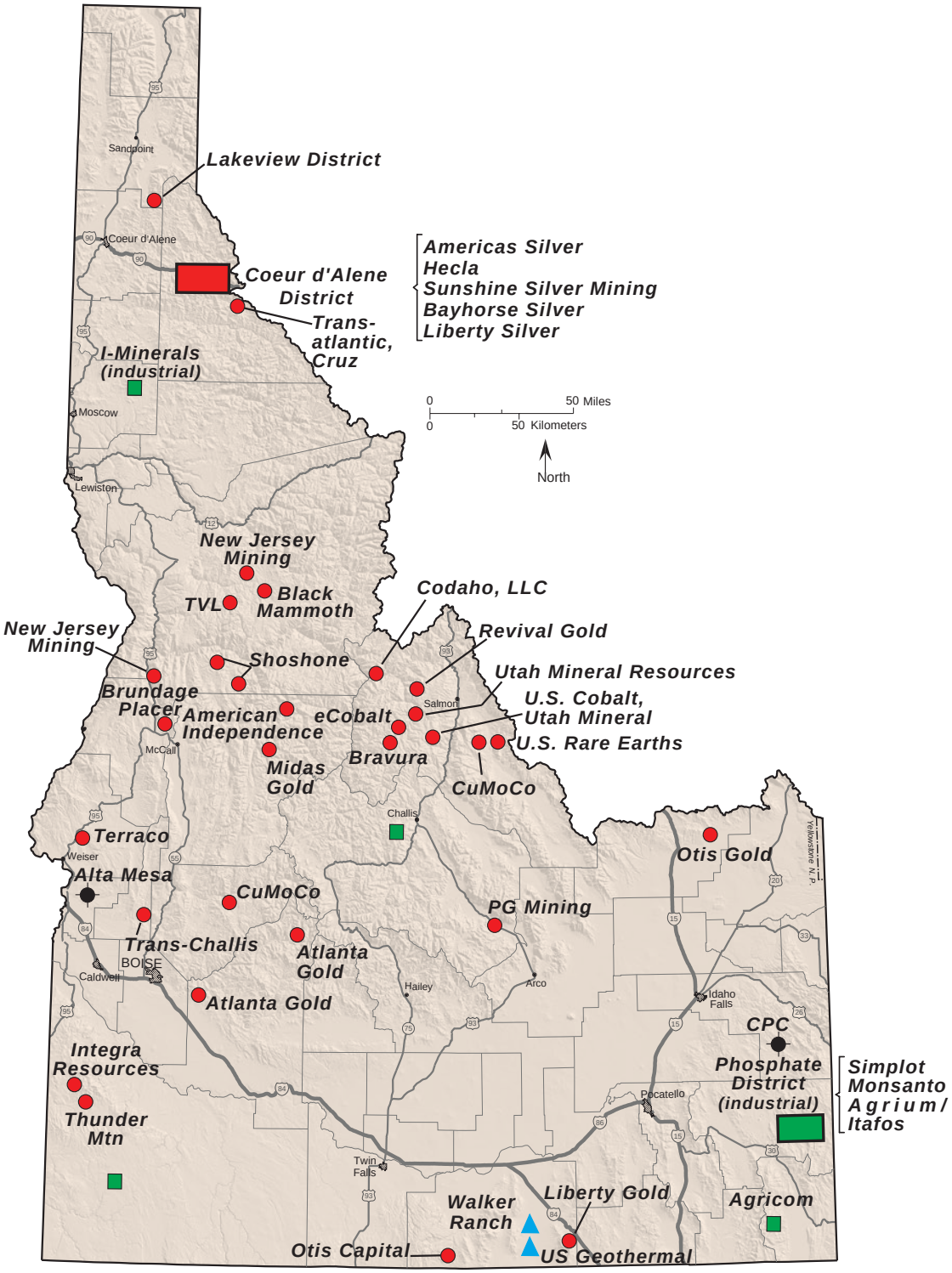
The IGS continued its responsibility of preparing an annual update on Idaho's mining and exploration industry. IGS is the lead state agency for mineral research and for compiling, disseminating, and archiving information on the state's mineral resources. Through a collaboration with the USGS, Idaho's information is part of the Idaho chapter of the Minerals Yearbook, a global compilation of developments and statistics on mining and minerals. For FY 2018, the annual minerals activity summary for calendar year 2017 was presented at the American Exploration and Mining Association annual convention in December. In 2017, exploration activity in Idaho was bolstered by stable commodity prices and a good economy overall, as well as new interest in cobalt due to its increasing demand for use in lithium-ion vehicle batteries. The Idaho cobalt belt in Lemhi County is the nation's only primary cobalt district. Cobalt prices were rising steadily through most of FY 2018 but peaked at over $43/pound in March 2018, and then dropped to about $32/pound by the end of June 2018. Precious metal prices were good enough during the fiscal year to promote renewed interest in several Idaho districts.

The USGS estimate of statewide nonfuel mineral production for Idaho in 2017 is not yet available. However, principal commodities mined included phosphate rock, construction sand, gravel, and crushed stone, and silver and lead. In FY 2018, three large phosphate mines continued operations in Caribou County, and Americas Silver Corporation mined silver and lead at the underground Galena mine in Shoshone County. Hecla's Lucky Friday mine remained on strike for FY 2018, but there was exploration interest by a new group, the Bunker Hill Mining Corporation, in the historic Bunker Hill lead-zinc-silver mine in Shoshone County. At Murray, New Jersey Mining operated the Golden Chest gold mine from both underground and the open pit. The Thompson Creek molybdenum mine remained on care and maintenance for the year.

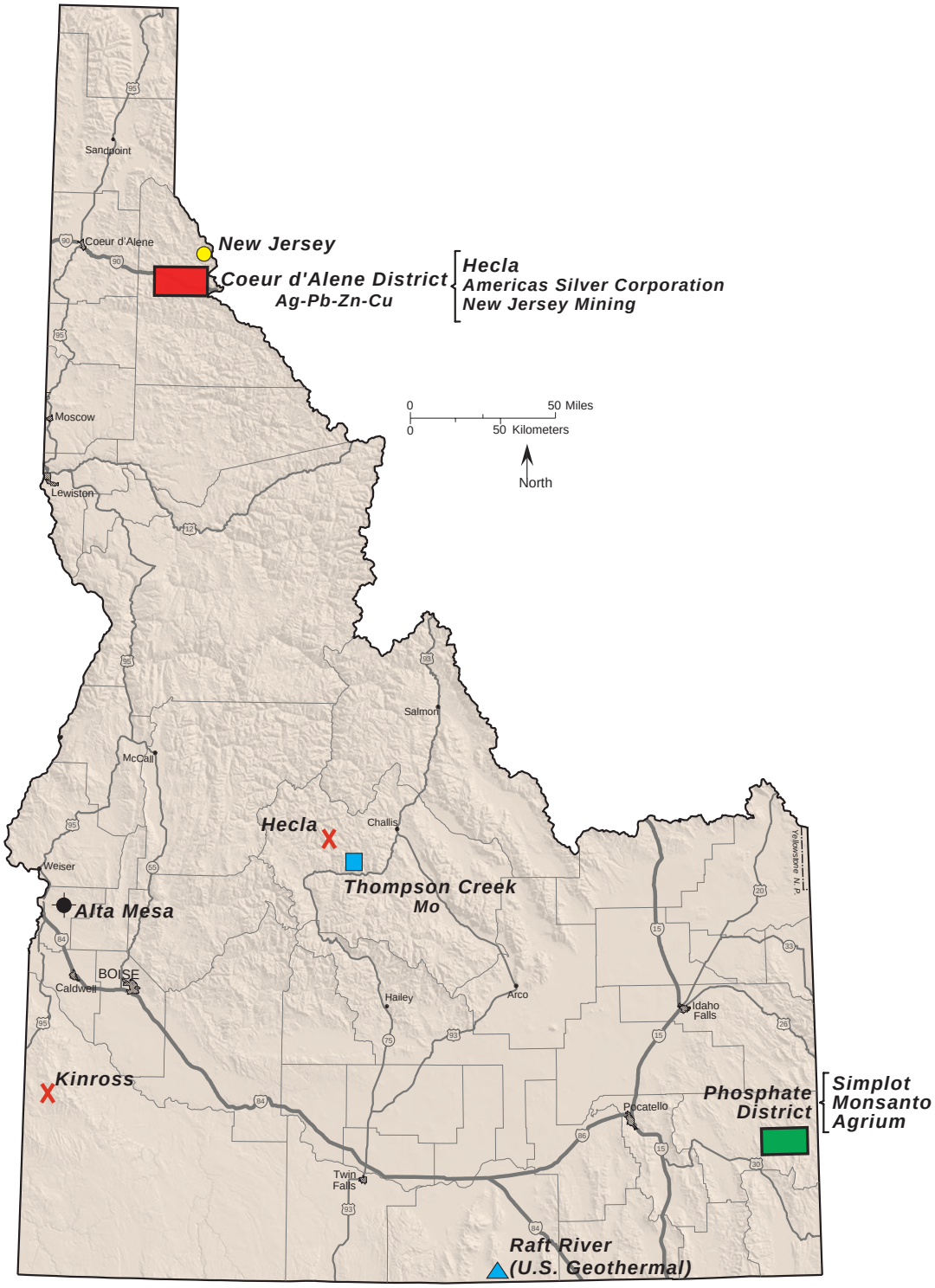
Exploration activity in calendar year 2017 and continuing into the first half of 2018 was robust in Idaho. Midas Gold worked on a feasibility study and continued the NEPA permitting process with the U.S. Forest Service for development of a new gold-antimony mine in Valley County at the historic



INDUSTRIALS 2017



EXPLORATION 2017



ACTIVE MINES AND PLANTS 2017

Stibnite district. Major drill programs were active at other precious metal districts, including Otis Gold at Kilgore in Clark County, Integra Resources at DeLamar in Owyhee County, and Revival Gold at the Beartrack mine in Lemhi County. Gold exploration was also underway near Elk City, Murray, and the old Black Pine mine in southeastern Idaho; copper was the primary target by PG Mining at the Empire mine. In the Idaho cobalt belt, eCobalt was constructing facilities and optimizing engineering and processing plans for a new cobalt-copper-gold mine at the RAM deposit on the periphery of the Blackbird mining district. First Cobalt, formerly U.S. Cobalt, was drilling from underground at the Iron Creek property on the southeast end of the cobalt belt. At least four other companies had claims and projects along the belt, which was staked over most of its 60 km length.

Minerals-Related Research

The major focus of research in FY 2018 was the preparation of a manuscript for an IGS publication documenting the geochronology and hydrothermal alteration studies at the Stibnite Au-Sb-W deposits in Valley County. Age and origin of the deposits have been controversial for decades. Data compilation, writing, and editing of the lengthy report occupied most of the year. The research resulted from a collaborative project with Midas Gold at the historic mining district, which is sometimes referred to as the Yellow Pine district. The multi-faceted research included field studies, petrography, age determinations, and isotopic and microprobe analytical work. Geoscientists at Boise State University, University of Alaska Fairbanks, Midas Gold, and USGS are collaborators. Results show three groupings of ages for the deposits with gold mineralization in two periods of the Tertiary at approximately 61 Ma and 50 Ma. Scheelite dates suggest that the tungsten and antimony mineralization is slightly younger at approximately 45 Ma. Common lead isotopic values indicate a very old crustal input to the ore fluids, and patterns of gold and trace element zonation in pyrite grains indicate a pulsed hydrothermal history compatible with the geochronology results. Planning was also underway for a future journal publication.

Energy

Geothermal

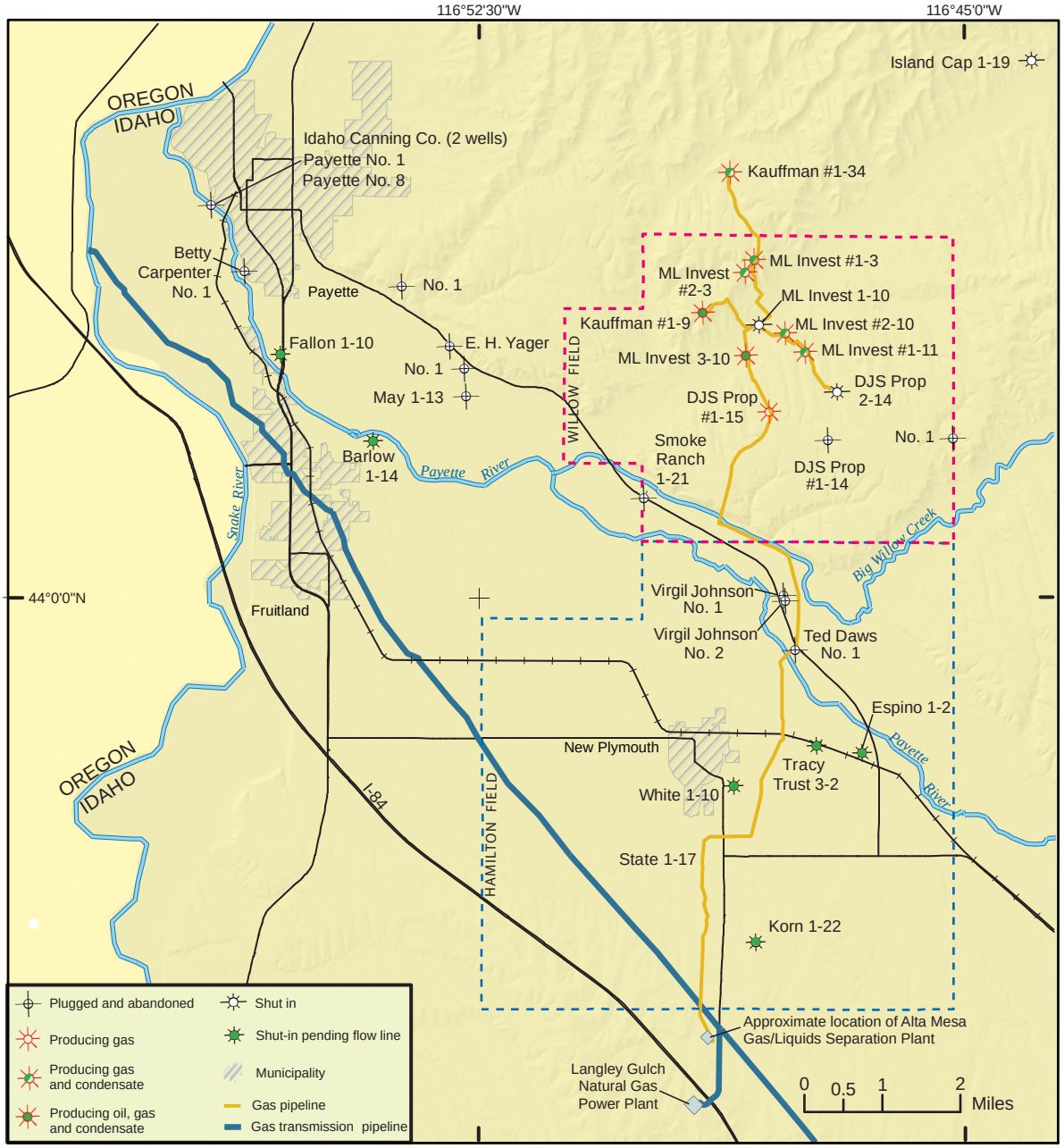
During FY 2018 IGS continued work on a technical report by John Welhan titled *A Hidden High-Temperature Geothermal Resource in the Idaho Thrust Belt: Conceptual Models and Economic Potential*. This report describes data

compiled for the National Geothermal Data System on the geothermal potential of the Idaho fold and thrust belt in the vicinity of the Blackfoot volcanic field in southeastern Idaho. The document includes information published in conference proceedings between 2011 and 2014, including the Geothermal Resources Council Transactions. Once finalized, the document will be made available on the IGS website.

Oil and Gas

Oil and gas exploration and development efforts have been focused on the western Snake River Plain, specifically areas proximal to the community of New Plymouth, to the north toward Midvale, and to the west toward Vale, Oregon. Drilling from 2010 to present has resulted in over 21 new well completions, eight of which are currently in production from the Willow field north of New Plymouth. In 2017, two successful step-out wells (Barlow 1-14 and Fallon 1-10) were drilled and completed four miles west of the Willow field near the community of Fruitland. Production from these wells is pending completion of a pipeline and related infrastructure. The IGS is monitoring activity in the field including the exploration and drilling of new wells, emplacement of pipeline and gas plant infrastructure, acquisition of 3-D seismic surveys, and mineral lease acquisition. Collaboration and research agreements between public and private entities (Idaho Department of Lands and Alta Mesa Holdings) have permitted the Survey to acquire subsurface data, sample producing wells, and begin the process of petroleum system modeling and assessment for the region. In 2015, the IGS was awarded a two-year research grant from the USGS to conduct reservoir characterization and petroleum assessment of this newly discovered resource in the southwestern part of the state. Furthermore, over $19 million in petroleum modeling software was donated to the Survey and the University of Idaho from industry partnerships including Schlumberger's Petrel Exploration & Production Platform, Schlumberger's PetroMod Petroleum Systems Modeling Software, IHS's Petra, and SMT's Kingdom Geological Interpretation Software. A digital map covering this area, *Southwestern Idaho Natural Gas Play* (Digital Web Map 172) is available for download on the Survey's website.

Drill core and well cuttings analysis, subsurface mapping, well log correlations, microfossil designations, source rock evaluation, chemical and isotopic analysis of natural gas and liquid condensates, and petroleum system modeling are included within the scope of research for the petroleum resources in southwestern Idaho. In 2017, gas and condensate samples were collected and analyzed from seven of the producing wells. Work is currently underway to understand the origin of the hydrocarbons and how they may be related to potential source rocks in the area.



Oil and Gas Play in Southwest Idaho, as of July 2018.

In conjunction with this scope of work, new geologic surface mapping projects are underway in the Weiser-Payette area with the objective of tying the surface geological units to reservoir rocks in the producing basin at depth. Since 2012, field-based mapping of Miocene and Pliocene sediments (Payette, Chalk Hills, and Glenns Ferry formations) and associated volcanics has been conducted in 12 quadrangles (1:24,000 scale) with seven maps available for download from the IGS website and five maps in final preparation stages prior to review. Work on unmapped quadrangles is expected to continue in FY 2019.

The IGS has also identified the areas of south-central and southeastern Idaho as prospective for oil and gas exploration and has near-term and long-term plans to conduct petroleum assessments in these regions of the state. Although the areas are sparsely drilled, and elements that make up a working petroleum system are poorly understood, the extension of hydrocarbon-producing units related to the Basin and Range of Nevada and Fold and Thrust Belt of Wyoming are present and hydrocarbon shows have been observed. Collaboration and research agreements between IGS and Cedar Creek Resources are now in place to gain further subsurface information to study the potential petroleum system in south-central Idaho. As new drilling and completion technologies have advanced in recent years, both areas should be reevaluated for oil and gas resources, particularly from unconventional reservoirs.

The IGS maintains files on over 200 historic oil and gas exploration wells in the state. These files include well reports and downhole logs provided by companies to the Idaho 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, industry reports, maps, and geophysical logs. Many are unique historic documents and in fragile condition. Recent geothermal and oil and gas exploration activities in Idaho have greatly increased the number of requests for these data. The Survey has scanned all the reports and logs and made them available for download from the IGS website, and 25 of the historic logs have been digitized and incorporated into the Weiser-Payette area subsurface petroleum system model. As other historic and contemporary reports become available, IGS will continue to enhance and expand the oil and gas archive geodatabase.

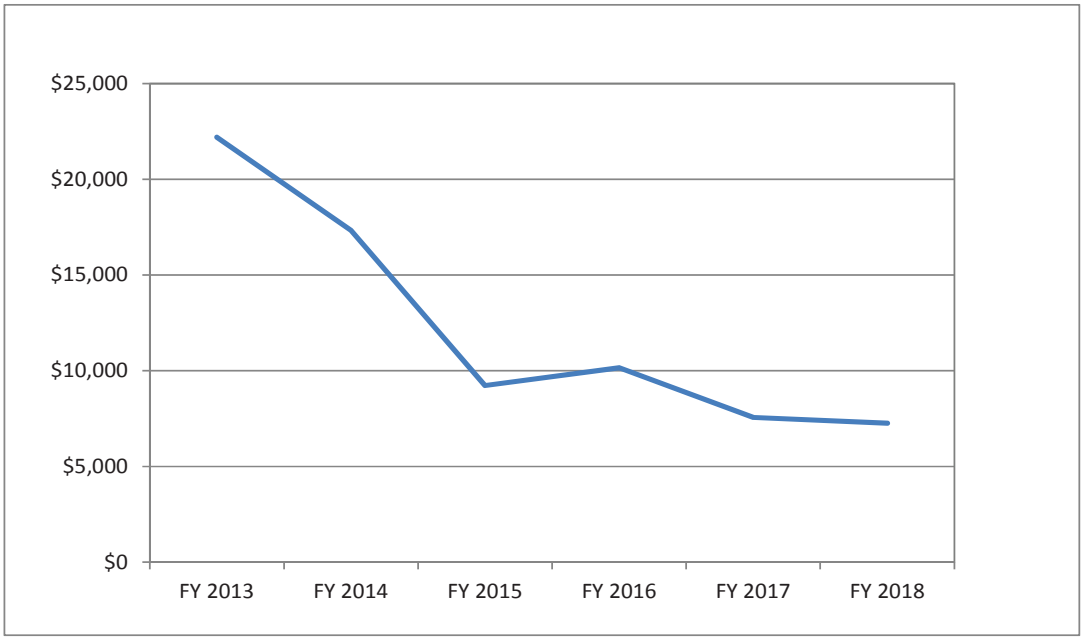
OUTREACH

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

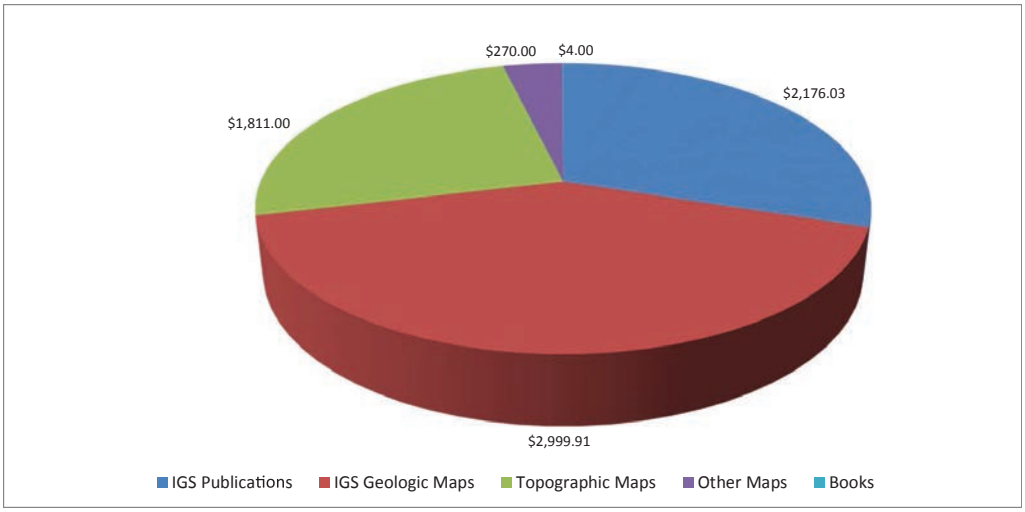
Publications

In FY 2018, IGS Geologic Maps outsold other types of publications, accounting for 41% of total sales. Since its release in 2012, the Geologic Map of Idaho has continued to be the best seller of IGS-produced publications. Nearly all publications are available for free download on the IGS website.

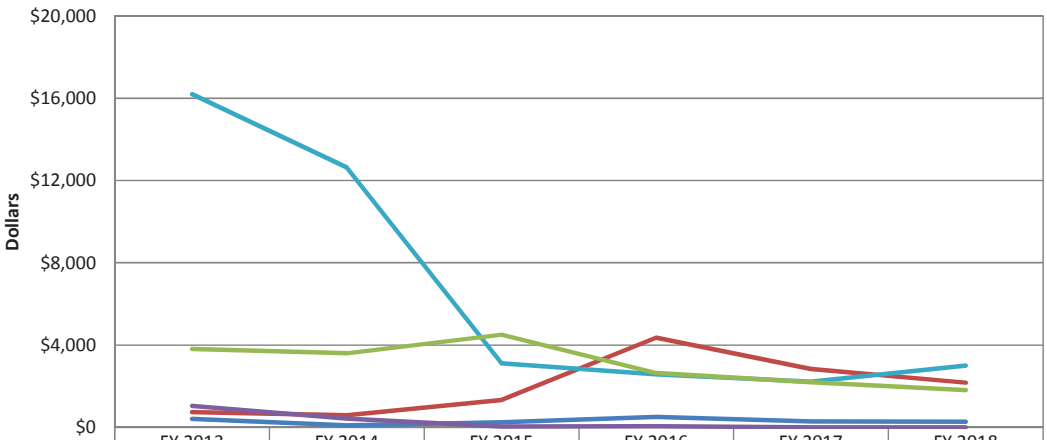
Total Publication Sales
FY 2013-2018



Publication Sales by Sales Category
FY 2018



Publications Sales by Sales Category
FY 2013-2018

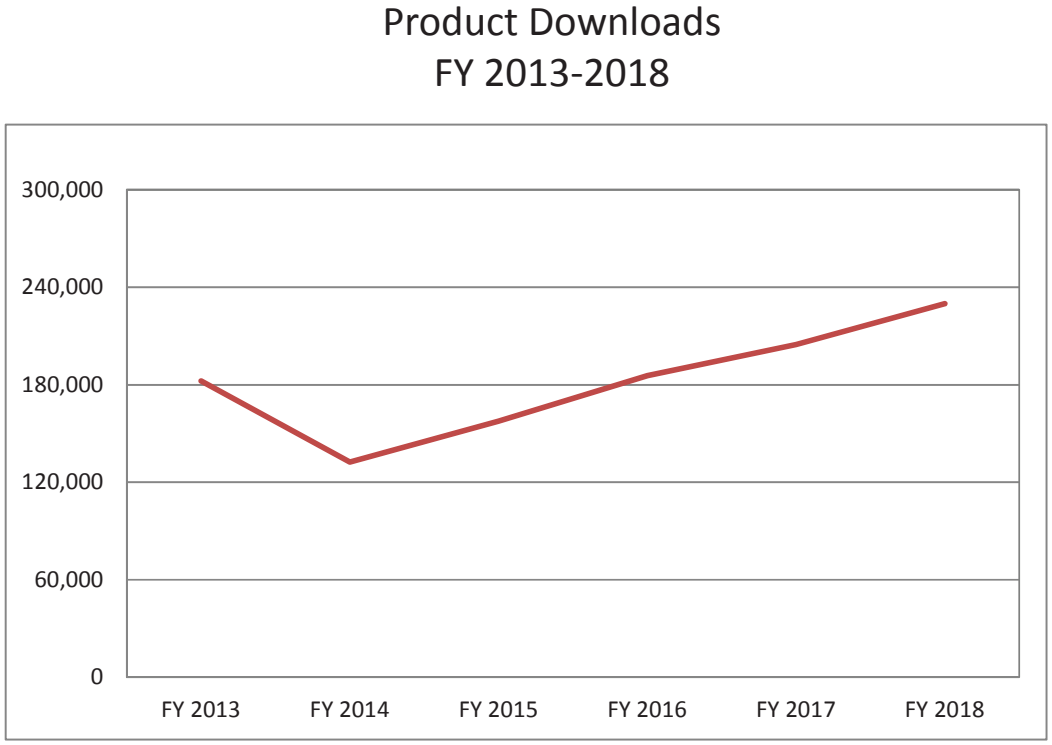


	FY 2013	FY 2014	FY 2015	FY 2016	FY 2017	FY 2018
IGS Publications	$736	$596	$1,334	$4,362	$2,840	$2,176
IGS Geologic Maps	$16,193	$12,626	$3,107	$2,585	$2,227	$3,000
Topographic Maps	$3,809	$3,602	$4,505	$2,644	$2,203	$1,811
Other Maps	$407	$96	$250	$504	$294	$270
Books	$1,050	$418	$35	$63	$0	$4

Website

www.idahogeology.org

In FY 2018 IGS worked with Northwest Knowledge Network, a unit within the University's Office of Research and Economic Development, to launch a new website. The content has been migrated to a content management system allowing IGS staff to add and edit content easily. The new website has a clean, modern design and offers an easy-to-use, faceted search function that allows visitors to quickly find and access geologic publications and data. Nearly all of Survey publications (over 980) are available for download at no cost. IGS also offers interactive web map applications to search, locate, and download documents and data. Thousands of additional mine documents were added to the Mines web application in FY 2018. More than 18,000 visitors used these web map applications to explore Idaho. In FY 2018, nearly a half million visits were logged on the website, and users downloaded over 200,000 products. Thirty-one new Survey publications were posted on the website this year which include geologic maps, GIS geodatabases, and digital analytical datasets.



Social Media and Newsletters

The IGS has maintained a social media presence on Facebook and Twitter (@IDGeoSurvey) since December 2013. Social media gives IGS the ability to reach a broader, nontraditional audience. IGS uses social media to announce new IGS publications; give details on statewide geology-related activities, hazards, warnings, and drills; post general geoscience information; and post job announcements. In FY 2018 our Facebook posts reached over 2,785 Facebook users. In FY 2018 IGS tweeted 35 times and currently has 1,122 followers.

In FY 2018, IGS distributed two Mines and Prospects newsletters via email. These newsletters highlight new and ongoing developments to the Survey's Mines web application and the Mines and Prospects database. The newsletter contact list consists of 69 individuals who have indicated an interest in mining records held by the IGS which are provided as free downloads via the Mines web application.

Digital Mapping and GIS Laboratory

The Survey's Digital Mapping Laboratory builds GIS to aid in the collection, interpretation, and dissemination of geologic and mineral data for Idaho. Included in this is digital cartography, spatial data management, database management and design, graphic design, desktop publishing, website support, and network system administration. The main products of these tasks are geologic maps and databases. Five 7.5′ geologic maps were digitized, and eight geologic maps and 27 GIS geodatabases compliant with USGS Geologic Map Schema (GeMS), formerly NCGMP09, were published in FY 2018. The published maps and geodatabases area available for download on the IGS website.

Databases and Archives

Database management and updates of active faults, mines and prospects, oil and gas wells, and geologic maps are a continuing effort. The databases are distributed to the public via the agency website.

- The Mines and Prospects database underwent operational improvements, as well as continued efforts to expand content and improve accuracy. In anticipation of delivering historic video captured during Abandoned Mine Lands field inventories, the database has been expanded to accommodate this new data format. The main access to Mines and Prospects data is via the Mines web application. Over 13,500 mine maps, unpublished reports, and other mining-related documents are now available for download through this web application.
- Twenty-seven GIS geodatabases compliant with GeMS were published in FY 2018.
- Three new gas wells in the western Snake River Plain, Payette County, were added to the IGS Oil and Gas database.

Earth Science Education

The IGS seeks to promote excellence in the teaching and practice of the earth sciences. Every October the IGS participates in the American Geosciences Institute (AGI) sponsored Earth Science Week. Earth Science Week is a chance for AGI, in cooperation with its partners, to help build a better understanding and appreciation of the earth sciences by delivering specially designed activities and resources to educators. The IGS received fifty Earth Science Week Toolkits, and as part of a broader, long-term approach to earth science outreach, kits were distributed to earth science and physical science teachers in southeastern Idaho. The IGS participated in the "Geologic Map Day" event during Earth Science Week by highlighting the recently published *Geologic Map of the Stibnite Quadrangle, Valley County, Idaho* on the IGS website and social media. In 2017 the IGS partnered with other state and federal agencies in support of "The Great Idaho ShakeOut", a statewide earthquake drill which encourages Idahoans to prepare for major earthquakes. We are increasing our outreach with a dedicated email and mailing list to provide earth science information to earth science and physical science teachers. The IGS also gives educational presentations, participates in outreach events statewide, and prepares outreach materials which are listed below.

A Geologist in Southeast Idaho, by Dennis M. Feeney: Bear Lake Middle School, Lynn Etcheverry's Engineering Design class, Montpelier, September 2018.

Forestry Field Course, by Zach Lifton: University of Idaho, McCall, May 2018.

Geology of Snake River, by Dennis M. Feeney: University of Idaho, Central American Youth Ambassador Program, Lewiston, May 2018.

Geology Rocks, by Reed S. Lewis: Libraries Rock! Latah County Library District Summer Program, Genesee, June 2018.

Idaho American Water Resources Association Speed Networking Event, by Alexis Clark: Boise State University, Boise, April 2018.

Idaho Geological Survey Exhibit, by Dennis M. Feeney and Reed S. Lewis: 63rd Annual Gem and Mineral Show, Owyhee Gem and Mineral Society, Caldwell, March 2018.

Idaho Geological Survey Exhibit, by Kristen M. Pekas: Idaho Science Teachers Association Conference, Pocatello, September 2017.

Idaho Geological Survey Mines and Prospects Newsletter v.1 2018, by Christopher A. Tate and Reed S. Lewis: Idaho Geological Survey, Email Newsletter, February 2018.

Idaho Geological Survey Mines and Prospects Newsletter v.2 2018, by Christopher A. Tate and Reed S. Lewis: Idaho Geological Survey, Email Newsletter, June 2018.

Introduction to Field Methods, by Zach Lifton: Central Washington University, Bishop, California, August-September 2017.

Mock Interview, Job Fair and Career Conversations Day, by Dennis M. Feeney, Kristen M. Pekas, and Michael E. Ratchford: Idaho Youth ChalleNGe Academy, Pierce, November 2017.

Mock Interview, Job Fair, and Career Conversations Day, by Kristen M. Pekas and Michael E. Ratchford: Idaho Youth ChalleNGe Academy, Pierce, May 2018.

Passages Board Member, by Dennis M. Feeney: Palouse Prairie Charter School, Moscow, May 2018.

Seven Steps to Earthquake Safety for College Students and Great Idaho Shakeout, by William M. Phillips: University of Idaho, Department of Geological Sciences Introduction to Physical Geology and Introduction to Physical Geology for Science Majors, University of Idaho, Moscow, October 2017.

PUBLICATIONS AND ACTIVITIES

Publications

Geologic Map of the Agency Creek Quadrangle, Lemhi County, Idaho, by Russell F. Burmester, Kurt L. Othberg, Loudon R. Stanford, Reed S. Lewis, and Jeffrey D. Lonn: Idaho Geological Survey Digital Web Map 182, scale: 1:24,000, 2018.

Geologic Map of the Burntlog Creek Area, Valley County, Idaho, by David E. Stewart, Eric D. Stewart, and Reed S. Lewis: Idaho Geological Survey Digital Web Map 180, scale 1:36,000, 2017.

Geologic Map of the Kellogg East and Southern Grizzly Mountain Quadrangles, Shoshone County, Idaho, by James L. Browne: Idaho Geological Survey Technical Report 17-1, scale 1:24,000, 2017.

Geologic Map of the Kellogg West and Southern Steamboat Creek Quadrangles, Shoshone County, Idaho, by James L. Browne: Idaho Geological Survey Technical Report 17-2, scale 1:24,000, 2017.

Geologic Map of the Lemhi Pass Quadrangle, Lemhi County, Idaho, and Beaverhead County, Montana, by Russell F. Burmester, Jesse Mosolf, Loudon R. Stanford, Reed S. Lewis, Kurt L. Othberg, and Jeffrey D. Lonn: Idaho Geological Survey Digital Web Map 183, scale: 1:24,000, 2018.

Geologic Map of the Midvale Hill Quadrangle, Washington County, Idaho, by Dennis M. Feeney and William M. Phillips: Idaho Geological Survey Digital Web Map 184, scale 1:24,000, 2018.

Geologic Map of the Northeast Emmett Quadrangle, Gem County, Idaho, by Dennis M. Feeney, Spencer H. Wood, Reed S. Lewis, William M. Phillips, Skye W. Cooley, and Dean L. Garwood: Idaho Geological Survey Digital Web Map 185, scale 1:24,000, 2018.

Geologic Map of the Smiths Ferry Quadrangle, Valley County, Idaho, by Keegan L. Schmidt, David E. Stewart, Reed S. Lewis, and William M. Phillips: Idaho Geological Survey Digital Web Map 181, scale 1:24,000, 2017.

GIS Geodatabase for the Geologic Map Compilation of the Pocatello 30 x 60 Minute Quadrangle, Idaho, by Loudon R. Stanford, William R. Schuster, Jane S. Freed, and Vance T. MacKubbin: Idaho Geological Survey Technical Report (GIS) 99-2, 2018.

GIS Geodatabase for the Geologic Map of the Boise Valley and Adjoining Area, Western Snake River Plain, Idaho, by Loudon R. Stanford, William R. Schuster, and Theresa Taylor Watt: Idaho Geological Survey Geologic Map (GIS) 18, 2018.

GIS Geodatabase for the Geologic Map of the Burntlog Creek Area, Valley County, Idaho, by Linda Tedrow, Loudon R. Stanford, and Jane S. Freed: Idaho Geological Survey Digital Web Map (GIS) 180, 2018.

GIS Geodatabase for the Geologic Map of the East Half of the Bonners Ferry 30 x 60 Minute Quadrangle, Idaho and Montana, by Loudon R. Stanford, William R. Schuster, Jane S. Freed, and Collette Gantenbein: Idaho Geological Survey Digital Web Map (GIS) 17, 2018.

GIS Geodatabase for the Geologic Map of the Mayfield Area, Ada and Elmore Counties, Idaho, by Loudon R. Stanford, William R. Schuster, and Collette Gantenbein: Idaho Geological Survey Digital Web Map (GIS) 144, 2018.

GIS Geodatabase for the Geologic Map of the Northern and Central Parts of the Idaho National Engineering and Environmental Laboratory, Eastern Idaho, by Loudon R. Stanford, William R. Schuster, Jane S. Freed, Mary Kauffman, Diana Boyack, and Tim Funderberg: Idaho Geological Survey Geologic Map (GIS) 35, 2018.

GIS Geodatabase for the Geologic Map of the Smiths Ferry Quadrangle, Valley County, Idaho, by Linda Tedrow, Loudon R. Stanford, and Jane S. Freed: Idaho Geological Survey Digital Web Map (GIS) 181, 2018.

GIS Geodatabase for the Geology of the Boise Basin Vicinity, Boise, Ada, and Elmore Counties, Idaho, by Loudon R. Stanford, William R. Schuster, Lori D. Snyder, Daryle R. Faircloth, Timothy D. Funderburg, Steve F. Mulberry, and Jane S. Freed: Idaho Geological Survey Map (GIS) 7, 2018.

GIS Geodatabase for the Reconnaissance Geologic Map of the Shoup and Horse Creek Area, Lemhi and Idaho Counties, Idaho, by Loudon R. Stanford, William R. Schuster, and Susan A. Wyman: Idaho Geological Survey Technical Report (GIS) 94-3, 2018.

GIS Geodatabase for the Surficial Geologic Map of the Coeur d'Alene Quadrangle, Kootenai County, Idaho, by Loudon R. Stanford, William R. Schuster, Jane S. Freed, Alan K. Schlerf, and Linda Tedrow: Idaho Geological Survey Surficial Geologic Map (GIS) 7, 2018.

GIS Geodatabase for the Surficial Geologic Map of the Genesee Quadrangle and Part of the Uniontown Quadrangle, Latah and Nez Perce Counties, Idaho, by Loudon R. Stanford, William R. Schuster, Jane S. Freed, and Linda Tedrow: Idaho Geological Survey Surficial Geologic Map (GIS) 13, 2018.

GIS Geodatabase for the Surficial Geologic Map of the Green Knob Quadrangle, Latah and Nez Perce Counties, Idaho, by Loudon R. Stanford, William R. Schuster, Jane S. Freed, and Linda Tedrow: Idaho Geological Survey Surficial Geologic Map (GIS) 10, 2018.

GIS Geodatabase for the Surficial Geologic Map of the Hayden Lake Quadrangle, Kootenai County, Idaho, by Loudon R. Stanford, William R. Schuster, Jane S. Freed, and Linda Tedrow: Idaho Geological Survey Surficial Geologic Map (GIS) 9, 2018.

GIS Geodatabase for the Surficial Geologic Map of the Hayden Quadrangle, Kootenai County, Idaho, by Loudon R. Stanford, William R. Schuster, Jane S. Freed, and Linda Tedrow: Idaho Geological Survey Surficial Geologic Map (GIS) 8, 2018.

GIS Geodatabase for the Surficial Geologic Map of the Michaud and Pocatello North Quadrangles, Bannock and Power Counties, Idaho, by Loudon R. Stanford, William R. Schuster, Jane S. Freed, and Linda Tedrow: Idaho Geological Survey Surficial Geologic Map (GIS) 14, 2018.

GIS Geodatabase for the Surficial Geologic Map of the Moscow East Quadrangle and Part of the Moscow West Quadrangle, Latah and Nez Perce Counties, Idaho, by Loudon R. Stanford, William R. Schuster, Jane S. Freed, and Linda Tedrow: Idaho Geological Survey Surficial Geologic Map (GIS) 11, 2018.

GIS Geodatabase for the Surficial Geologic Map of the Post Falls Quadrangle and Part of the Liberty Lake Quadrangle, Kootenai County, Idaho, by Loudon R. Stanford, William R. Schuster, Jane S. Freed, Steve Mulberry, and Linda Tedrow: Idaho Geological Survey Surficial Geologic Map (GIS) 5, 2018.

GIS Geodatabase for the Surficial Geologic Map of the Rathdrum Quadrangle and Part of the Newman Lake Quadrangle, Kootenai County, Idaho, by Loudon R. Stanford, William R. Schuster, Jane S. Freed, and Linda Tedrow: Idaho Geological Survey Surficial Geologic Map (GIS) 6, 2018.

GIS Geodatabase for the Surficial Geologic Map of the Robinson Lake Quadrangle and Part of the Viola Quadrangle, Latah and Nez Perce Counties, Idaho, by Loudon R. Stanford, William R. Schuster, Jane S. Freed, and Linda Tedrow: Idaho Geological Survey Surficial Geologic Map (GIS) 12, 2018.

Major Oxide and Trace Element Analyses for Igneous and Metamorphic Rock Samples from Northern Idaho, by Reed S. Lewis and Richard M. Gaschnig: Idaho Geological Survey Digital Analytical Data 13, 2017.

Major Oxide and Trace Element Analyses for Igneous and Metamorphic Rock Samples from West-Central Idaho, by Reed S. Lewis and Paul E. Myers: Idaho Geological Survey Digital Analytical Data 14, 2017.

Major Oxide and Trace Element Analyses for Igneous Rock Samples from the Grangeville and Fairfield 30 x 60 Minute Quadrangles, by Dennis M. Feeney, Reed S. Lewis, Dean L. Garwood, and John D. Kauffman, Idaho Geological Survey, Digital Analytical Data 12, 2017.

Major Oxide and Trace Element Analyses for Igneous Rock Samples from the Salmon 30 x 60 Minute Quadrangle, Idaho, by Reed S. Lewis: Idaho Geological Survey Digital Analytical Data 15, 2017.

Abstracts

Connecting Geologic Mapping to Subsurface Well Logs to Explore Idaho's First Producing Hydrocarbon Field in Payette County, by Renee L. Breedlovestrout and Reed S. Lewis: Geological Society of America Abstracts with Programs, v. 49, no. 6, 2017.

Gold-Antimony-Tungsten Deposits of the Stibnite District, Idaho, USA, and Comparison to Chinese Antimony Deposits, by Virginia S. Gillerman, Christopher Dail, and Mark D. Schmitz: Society of Economic Geologist Conference Proceedings, P163, 2017.

Mapping of Middle Miocene Volcanic Rocks in the Weiser Embayment, Southwest Idaho: New U-Pb TIMS Zircons Age Data and its Implications, by Dennis M. Feeney, Vincent H. Isakson, Reed S. Lewis, and Stanley A. Mertzman: Geological Society of America Abstracts and Programs, v. 49, no. 6, 2017.

Mapping of Miocene-Pliocene Lake Idaho and Payette Sedimentary Deposits North of the Western Snake River Plain, by Renee L. Breedlovestrout, Reed S. Lewis, Vince Isakson, Spencer H. Wood, and Dennis M. Feeney: Geological Society of America Abstract and Programs, v. 49, no. 6, 2017.

Present and Future of Geologic Mapping in the Pacific Northwest, by Ralph A. Haugerud, Jason D. McClaughry, and William M. Phillips: Geological Society of America Abstracts with Programs. v. 49, no. 6, 2017.

Proposed Updates to the Idaho Fault Database, by Zach Lifton: Geological Society of America Abstracts with Programs. v. 49, no. 6, 2017.

The Challis Magmatic Province in Idaho: a Review, by Richard Gaschnig, Jeffrey Vervoort, and Reed S. Lewis: Geological Society of America Abstracts with Programs, v. 49, no. 6, 2017.

U-Pb Scheelite LA-ICP-MS Dates from the Historic Yellow Pine Pit, Yellow Pine Au-Sb-W Mining Area, Central Idaho, USA, by Niki E. Wintzer, Virginia S. Gillerman, and Mark D. Schmitz: Geological Society of America Abstracts with Programs, v. 49, no. 6, 2017.

Reports

Geology and Geochronology of the Stibnite Mining District, Idaho: Alteration and Au-Sb-W Ore Deposition in a Long-lived, Tectonically Active Setting, by Virginia S. Gillerman, Mark D. Schmitz, J.A. Benowitz, and P.W. Layer: Idaho Geological Survey unpublished contract report to Midas Gold and draft for IGS technical report, November 2017.

Geologic and Geomorphic Hazard Assessment for Proposed Burntlog Road, Central Idaho, by Kerrie Weppner, Steve Obert, and Virginia Gillerman: Idaho Geological Survey unpublished contract #16717 report to Midas Gold, September 2017.

Geologic Map of the Crane Creek Reservoir Quadrangle, Washington County, Idaho, by Dennis M. Feeney and Keegan L. Schmidt: Deliverable to the U.S. Geological Survey for Statemap Program, scale 1:24,000, June 2018.

Geologic Map of the Geneva Quadrangle, Bear Lake County, Idaho, and Lincoln County, Wyoming, by James C. Coogan and David E. Stewart: Deliverable to the U.S. Geological Survey for Statemap Program, scale 1:24,000, June 2018.

Geologic Map of the Goat Mountain Quadrangle, Lemhi County, Idaho, and Beaverhead County, Montana, by Reed S. Lewis, David E. Stewart, Russell F. Burmester, Loudon R. Stanford, Kurt L. Othberg, Eric D. Stewart, and Jeffrey D. Lonn: Deliverable to the U.S. Geological Survey for Statemap Program, scale 1:24,000, June 2018.

Geologic Map of the Montpelier Canyon Quadrangle, Bear Lake County, Idaho, by James C. Coogan, Dennis M. Feeney, and Reed S. Lewis: Deliverable to the U.S. Geological Survey for Statemap Program, scale 1:24,000, June 2018.

Geologic Map of the Sheep Ridge Quadrangle, Payette County, Idaho, by Reed S. Lewis, Renee L. Breedlovestrout, Spencer H. Wood, Kurt L. Othberg, Loudon R. Stanford, and Mark D. Barton: Deliverable to the U.S. Geological Survey for Statemap Program, scale 1:24,000, June 2018.

Landslide Hazard Assessment for the Big Wood River Area, Idaho, by William M. Phillips and Zach Lifton: Deliverable to the U.S. Department of Homeland Security, Federal Emergency Management Agency, Cooperating Technical Partners for Risk MAP Program, December 2017.

Presentations

An Overview of the IGS Hazards Program, by Zach Lifton: Idaho Geological Survey Advisory Board Meeting, Boise, November 2017.

Database Publication and Derivatives: Data Multi-tasking to Reach a Wider Audience, by Christopher A. Tate: U.S. Geological Survey National Geologic and Geophysical Data Preservation Program Workshop, Salt Lake City, Utah, September 2017.

Geologic Hazards of Idaho, by Zach Lifton: Idaho State University, Department of Geoscience Colloquium, Pocatello, January 2018.

Geologic Hazards in Idaho, by Zach Lifton: Washington State University and University of Idaho Geology Seminar Series, Moscow, April 2018.

Gold-Antimony-Tungsten Deposits of the Stibnite District, Idaho, USA, and Comparison to Chinese Antimony Deposits, by Virginia S. Gillerman, Christopher Dail, and Mark D. Schmitz: Society of Economic Geologists Conference, Beijing, China, September 2017.

Idaho Geological Survey Overview and Current Projects, by Alexis Clark: Ground Water Monitoring Technical Committee Meeting, Boise, June 2018.

Idaho Mining and Exploration, 2017, by Virginia S. Gillerman: American Exploration and Mining Association Annual Convention, Reno, Nevada, December 2017.

Mapping of Middle Miocene Volcanic Rocks in the Weiser Embayment, Southwest Idaho: New U-Pb TIMS Zircons Age Data and its Implications, by Dennis M. Feeney, Vincent H. Isakson, Reed S. Lewis, and Stanley A. Mertzman: Geological Society of America Annual Meeting, Seattle, Washington, October 2017.

Mapping of Miocene-Pliocene Lake Idaho and Payette Sedimentary Deposits North of the Western Snake River Plain, by Renee Breedlovestrout, Reed S. Lewis, Vince Isakson, Spencer H. Wood, and Dennis M. Feeney: Geological Society of America Annual Meeting, Seattle, Washington, October 2017.

Mining in Idaho, 2017, and Stibnite Research Update, by Virginia S. Gillerman: Society of Mining Engineers, Boise Section, Boise, January 2018.

Overview of Idaho Geological Survey, by Michael E. Ratchford: Idaho Geological Survey Advisory Board Meeting, Boise, November 2017.

Proposed Updates to the Idaho Fault Database, by Zach Lifton: Geological Society of America Annual Meeting, Seattle, Washington, October 2017.

Shale-gas Development in the Mid-Continent US and an Emerging Conventional Gas/Liquid Condensate Play in Idaho, by Michael Ed Ratchford: PetroChina, Beijing, China, January 2018.

Technical Issues Facing Idaho, by Zach Lifton, Basin and Range Province Earthquake Working Group Meeting, Salt Lake City, Utah, February 2018.

The Geology of Idaho in Northwestern US – Resources and Geologic Hazards, by Michael Ed Ratchford: Bryant-Zhuhai School of Business, Zhuhai, China, December 2017.

The Geology of Idaho in Northwestern US – Resources and Geologic Hazards, by Michael Ed Ratchford: China University of Geosciences, Wuhan, China. January 2018.

Updates on the Geology of the Boise/Weiser Area: a Review of 5 Years of Geologic Mapping, by Dennis Feeney: Idaho Geological Survey Advisory Board Meeting, Boise, November 2017.

Update on the Soda Springs/Sulphur Peak Earthquake Sequence, by Zach Lifton: Idaho Office of Emergency Management, State Hazard Mitigation Plan Executive Meeting, Boise, November 2017.

Windermere and Cambrian-Ordovician Strata in the Stibnite-Edwardsburg Area, Central Idaho, by Reed Lewis: Washington State University and University of Idaho Geology Seminar Series, Pullman, Washington, January 2018.

Web Products

Conversion of Geologic Map of Idaho M-9 Geodatabase for Macrostrat Integration, by Christopher A. Tate: Idaho Geological Survey, February 2018.

Idaho Annual Mining Review (Regional Development) Files 1989-2015, by Christopher A. Tate, Virginia S. Gillerman, Earl H. Bennett, Reed S. Lewis, and Loudon R. Stanford: Idaho Geological Survey, November 2017.

Idaho Geological Survey Collections and Itemized Metadata on ScienceBase-National Digital Catalog: Mineral Property Files, Mine Maps, Mines and Prospects Database, Mines Web Application, Annual Mining Review, and Geochemical Data, by Christopher A. Tate: Idaho Geological Survey, October 2017.

Idaho Geological Survey Mines and Minerals Web Pages Update, by Christopher A. Tate, Loudon R. Stanford, Reed S. Lewis, and Virginia S. Gillerman: Idaho Geological Survey, November 2017.

PLSS Layer Addition to Web Application for Mines and Prospects of Idaho, by Christopher A. Tate, Loudon R Stanford, and Dustin Thomas: Idaho Geological Survey, July 2017.

Web Release of Idaho Geological Survey's Collection of Noranda Exploration's Blackbird Mining District Area Mineral Property Files, by William R. Schuster and Christopher A. Tate: Idaho Geological Survey, April 2018.

Operational Improvements

DataMaker-GeochemDBtoScienceBase, by Christopher A. Tate: Idaho Geological Survey, June 2018.

DataMaker-MPFtoScienceBase Version 1.0, by Christopher A. Tate: Idaho Geological Survey, July 2017.

DataMaker-MPFtoScienceBase Version 2.0: Re-code for NKN, by Christopher A. Tate: Idaho Geological Survey, June 2018.

Geochem: Database of Geolocated Whole-rock Sample Analyses for Idaho, by Dennis Feeney, Reed Lewis, and Christopher A. Tate: Idaho Geological Survey, May-June 2018.

Idaho Cadastral Survey Layer for Mines Web Application, by Christopher A. Tate, Loudon R. Stanford, and Dustin Thomas: Idaho Geological Survey, July 2017.

Idaho Geological Survey Mines and Prospects Verified Newsletter Contacts, by Christopher A. Tate and Reed S. Lewis: January 2018.

New Idaho Geological Survey Website, by Idaho Geological Survey and Northwest Knowledge Network: Idaho Geological Survey, June 2018.

Parser for Integration of Bureau of Land Management Idaho Active Claims Records to Geographic Information System, by Christopher A. Tate: Idaho Geological Survey, May 2018.

Printing with PDF printer: Reducing File Size for Downloads or Email, by Christopher A. Tate: Idaho Geological Survey, February 2018.

Media Interviews

Geology of the Pend Oreille Lake Area, Northern Idaho, Idaho Public Television, Outdoor Idaho Program, May 2018 interview for March 2019 show (R.S. Lewis).

Idaho Geological Survey Tool Showcases Over a Century of Statewide Mining Documents, Press Release, University of Idaho, https://www.uidaho.edu/news/news-articles/faculty-staff-news/2017-november/111617-igstool, November 2017 (C.A. Tate, R.S. Lewis).

Professional Activities

Affiliate Faculty, University of Idaho (V.S. Gillerman, R.S. Lewis, W.M. Phillips, M.E. Ratchford).

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

Affiliate Graduate Faculty, Boise State University (V.S. Gillerman).

Attendee, Association of American State Geologists Annual Meeting, Rehoboth Beach, Delaware, June 2018 (J.R. Brabb).

Attendee, Idaho's Water: Supply and Quality in a Time of Growth, Andrus Center for Public Policy Conference, Boise, April 2018 (A.L. Clark).

Attendee, Mine Safety and Health Administration Refresher Training, Bureau of Land Management, Boise, November 2017 (V.S. Gillerman).

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

Field Trip Assistant, Idaho Department of Water Resources-U.S. Geological Survey Groundwater Treasure Valley Flow Modelling Group, Boise, June 2018 (A.L. Clark).

Field Trip Leader, Tobacco Root Geological Society, Lemhi Pass, August 2017 (R.S. Lewis).

Field Trip Leader and Presenter, Idaho Department of Water Resources-U.S. Geological Survey Groundwater Treasure Valley Flow Modelling Group, Boise, June 2018 (V.S. Gillerman).

Field Trip Organizer, Belt Association, Cheney, Washington, September 2017 (R.S. Lewis).

Idaho Certified Water Rights Examiner (A.L. Clark).

Idaho Professional Geologist (A.L. Clark, D.M. Feeney, V.S. Gillerman, R.S. Lewis, Z.L. Lifton, W.M. Phillips, M.E. Ratchford).

Member, American Association of Petroleum Geologists (M.E. Ratchford).

Member, American Exploration and Mining Association (V.S. Gillerman, R.S. Lewis).

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

Member, American Water Resources Association (A.L. Clark).

Member, Basin and Range Province Earthquake Working Group (Z.M. Lifton).

Member, Basin and Range Subcommittee, Western States Seismic Policy Council (Z.M. Lifton).

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

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

Member, Ground Water Monitoring Technical Committee (A.L. Clark).

Member, Idaho Office of Emergency Management Seismic Technical Working Group (Z.M. Lifton).

Member, National Ground Water Association (A.L. Clark).

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

Member, Treasure Valley Modeling Technical Advisory Committee (A.L. Clark).

Member, Wood River Modeling Technical Advisory Committee (A.L. Clark).

Participant, American Exploration and Mining Association Convention, Reno, Nevada, December 2017 (V.S. Gillerman).

Participant, Association of American State Geologists Congressional Liaison Meeting, Washington D.C, March 2018 (M.E. Ratchford).

Participant, Geological Society of America Annual Meeting, Seattle, Washington, October 2017 (D.M. Feeney, R.S. Lewis, Z.M. Lifton).

Participant, Society of Economic Geologists Conference, Beijing, China, September 2017 (V.S. Gillerman).

Participant, U.S. Geological Survey National Geologic and Geophysical Data Preservation Program Bi-Monthly Preservation Techniques Webinars, July 2017-June 2018 (C.A. Tate).

Participant, U.S. Geological Survey National Geologic and Geophysical Data Preservation Program Workshop, Salt Lake City, Utah, September 2017 (C.A. Tate).

Participant, U.S. Geological Survey National Geologic and Geophysical Data Preservation Program Workshops and Focus Groups, January, April, May, 2018 (C.A. Tate).

Participant and Session Chair, Association of American State Geologists Annual Meeting, Rehoboth Beach, Delaware, June 2018 (M.E. Ratchford).

Promotion to Research Professor, Idaho Geological Survey, April 2018 (V.S Gillerman, R.S. Lewis).

Promotion to Research Associate Professor, Idaho Geological Survey, April 2018 (W.M. Phillips).

Reviewer, Geosphere manuscript, March 2018 (Z.M. Lifton).

Reviewer, Geophysical Research Letter manuscript, April 2018 (Z.M. Lifton).

Technical Advisor and Participant, Governor's Meetings on Bureau of Land Management Sage Grouse Related Minerals Withdrawal, Idaho Office of Energy Resources, Boise, July-December 2017 (V.S. Gillerman).

Oregon Certified Water Rights Examiner (A.L. Clark).

Oregon Registered Geologist (A.L. Clark).

Washington Certified Water Rights Examiner (A.L. Clark).

Washington Registered Geologist with Hydrogeologist Specialty (A.L. Clark).

Graduate Thesis Committees

Clay McDonie, M.S. Geology, Washington State University (R.S. Lewis).

Niki Wintzer, Ph.D. Geology, Washington State University (R.S. Lewis).

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 Corporation, July 2014-September 2017, $70,000).

Big Wood River Landslide Susceptibility Mapping: W.M. Phillips (U.S. Department of Homeland Security, Federal Emergency Management Agency, Risk MAP Program, October 2016-September 2017, $70,098).

Data Preservation 9: R.S. Lewis and D.M. Feeney (U.S. Geological Survey, August 2016-August 2017, $30,359).

Data Preservation 10: R.S. Lewis and D.M. Feeney (U.S. Geological Survey, August 2017-August 2018, $29,353).

Geologic Mapping in the Preston, Weiser, and Salmon Areas: R.S. Lewis and D.M. Feeney (U.S. Geological Survey Statemap Program, June 2017-June 2018, $167,755).

Geologic Mapping in the Preston, Weiser, Salmon, and Elk City Areas: R.S. Lewis and D.M. Feeney (U.S. Geological Survey Statemap Program, June 2018- June 2019, $159,330).

Idaho Department of Lands Abandoned Mine Lands Project, Task 4: R.S. Lewis (Idaho Department of Lands, February 2017-February 2019, $121,918).

Reservoir Characterization and Petroleum Assessment of Miocene Sedimentary Rocks, Southwestern Idaho: M.E. Ratchford, (U.S. Geological Survey, September 2015-May 2018, $30,000).

Surficial and Bedrock Mapping of Burntlog Road Corridor: V.S. Gillerman and R.S. Lewis (Midas Gold Corporation, June 2016-September 2017, $27,277).