

# Idaho Mining and Exploration, 2014-2015

Virginia S. Gillerman  
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Staff Report 21-01  
June 2021

Idaho Geological Survey  
Morrill Hall, Third Floor  
University of Idaho  
Moscow, Idaho 83844-3014

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# Idaho Mining and Exploration, 2014-2015

Virginia S. Gillerman<sup>1</sup>, Alexis Clark<sup>1</sup>,  
Mark Barton<sup>1</sup> and Earl H. Bennett<sup>2</sup>

## INTRODUCTION

While 2013 indicated the end of a global mineral commodity supercycle, 2014 and 2015 continued a stable but low-key time for the mining and mineral exploration industry in Idaho. This staff report briefly summarizes the Idaho minerals industry during the two calendar years, 2014 and 2015. Additional details may be found in the annual visual presentations on the Idaho Geological Survey (IGS) website: <https://idahogeology.org/geologic-resources/mines-minerals/current-historic-mining-activity>

With metal prices trending sharply downward in the second half of the year, 2014 was a trying time for Idaho's metal mines and mineral exploration industry. Industrial minerals, including the phosphate district, fared somewhat better. 2014 also saw the completion of mining from the stockpiled Phase 7 ore at the large Thompson Creek molybdenum mine in December, 2014. Stripping for Phase 8 had been curtailed in 2012, forcing the mine on care and maintenance in December, 2014, with a skeleton crew of only 52 employees. However, mining continued at the two operating underground properties in Shoshone County's famous Silver Valley, although "cost-cutting" was an objective.

The state's mining related employment in July, 2014, was 2,586 persons with about an equal number in the chemical manufacturing industry which includes the three phosphate processing plants located in southeastern Idaho.

The United States Geological Survey maintains records of nonfuel mineral production in the states, based on annual surveys. In 2013, Idaho's mineral production value was \$ 988 million. In

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<sup>1</sup>Idaho Geological Survey.

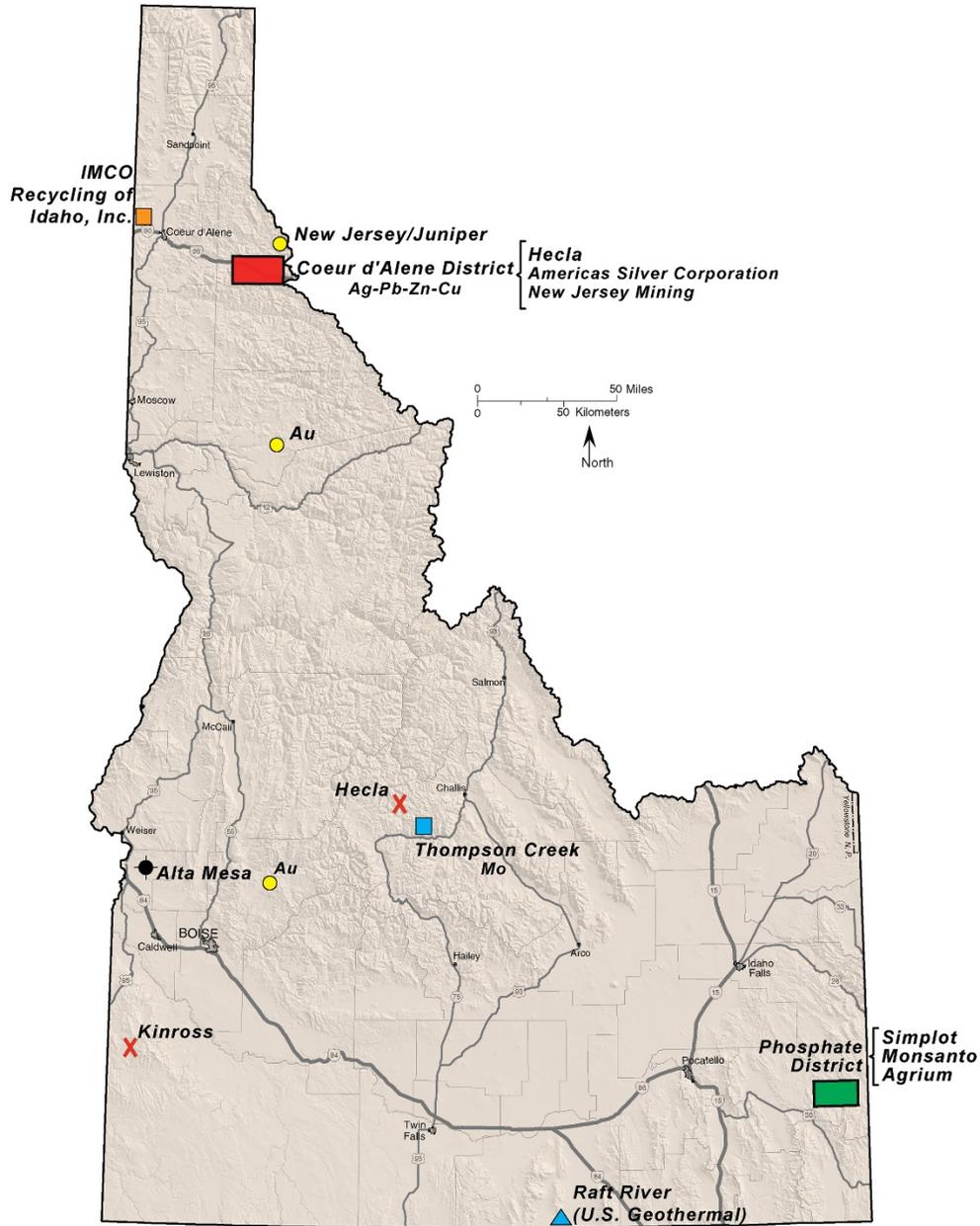
<sup>2</sup>Idaho Geological Survey, retired.

2014, it was \$ 912 million, according to the USGS Minerals Yearbook 2014 Advance Release Idaho chapter. This ranked Idaho 27th among the states. Molybdenum concentrates were the highest value commodity, followed by phosphate rock, construction sand and gravel, silver, and lead, according to the USGS Mineral Commodity Summaries 2015. The USGS values consider only the raw phosphate rock, not the finished product.

Due to the end of production at Thompson Creek, the value of Idaho's mineral production in 2015 dropped to \$ 539 million (USGS, revised 2016 Minerals Yearbook) with the leading commodities being phosphate rock, construction sand and gravel, silver, lead, and crushed stone, and Idaho's mineral industry was dominated by industrial minerals. Employment in the mining sector was tallied at 2,413 jobs in October, 2015, according to the Idaho DFM, a significant drop from the July, 2014 number. Metal prices were also on a downward trend and an economic slowdown in Asia had many worried about demand. Though the spot price of gold spiked to near \$ 1300 per troy ounce in January, 2015, it fell to below \$ 1100 per troy ounce by November. Silver was relatively stable in 2015 at \$ 14 - \$16 per troy ounce, but molybdenum oxide dropped from near \$ 8 per pound to about \$ 5 per pound in late 2015.

Figure 1 shows the location of active or recently closed mines in 2015. Figure 2 shows the value of Idaho's total non-fuel mineral production by year. In 2014, metals accounted for approximately 60 % of Idaho's value, but in 2015, metals were only 26% of the state's non-fuel production value.

A major regulatory and political issue affecting the minerals industry, as well as other land uses, was the federal notice in September, 2015, that the Department of Interior was proposing to withdraw 3.8 million acres of public land in Idaho from mineral entry to preserve habitat of the Greater Sage-Grouse. The announcement triggered preparation of a two-year process to prepare an Environmental Impact Statement (EIS), along with a temporary segregation of such withdrawn lands for sagebrush focal areas (SFAs) while the EIS was being written and public scoping conducted.



ACTIVE MINES AND PLANTS 2015

Figure 1. Location of mines and active plants in 2014 and 2015. The red X indicates a closed gold mine in reclamation. Yellow dots are small gold mines. The black cross hair is for oil and gas production, and the blue triangle indicates a geothermal plant.

## Idaho Non-fuel Mineral Production

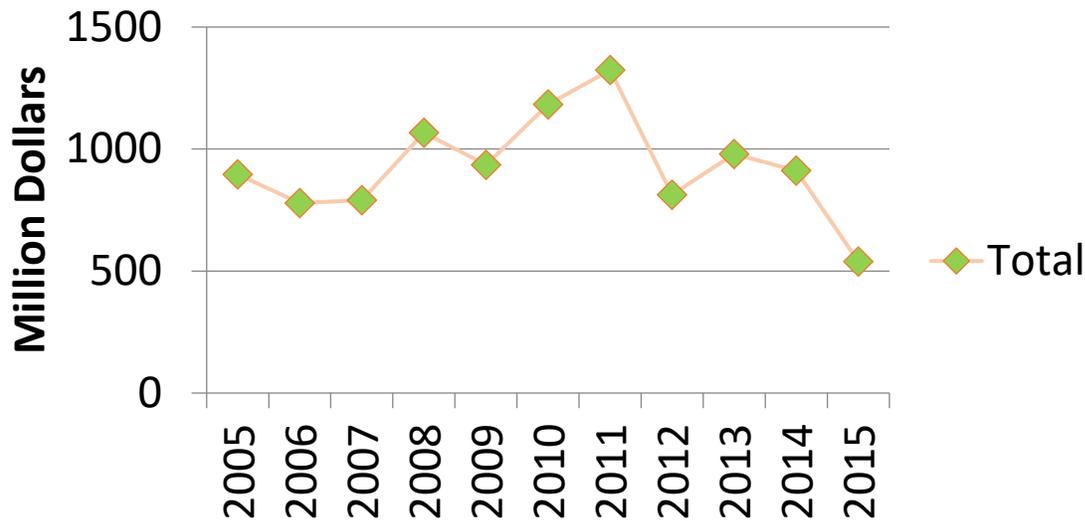


Figure 2. Idaho's non-fuel mineral production value from 2005 through 2015, based on final data from USGS.

## METAL MINING

In both 2014 and 2015, precious metal mining was concentrated in the Coeur d'Alene District of northern Idaho (Fig. 1). Since 1884 the district has produced over 38,568 metric tons (1.24 billion troy ounces) of silver and major amounts of base metals and antimony from quartz-siderite-sulfide veins in folded and faulted Precambrian metasedimentary rocks of the Belt Supergroup. Two deep underground mines were in operation: Hecla Mining Company's Lucky Friday mine at Mullan and U.S. Silver and Gold's (later Americas Silver Corporation) Galena mine complex (Fig. 3). According to company reports, the two mines together produced about 4.86 million troy ounces of silver in 2014 and about 4.1 million troy ounces of silver in 2015.

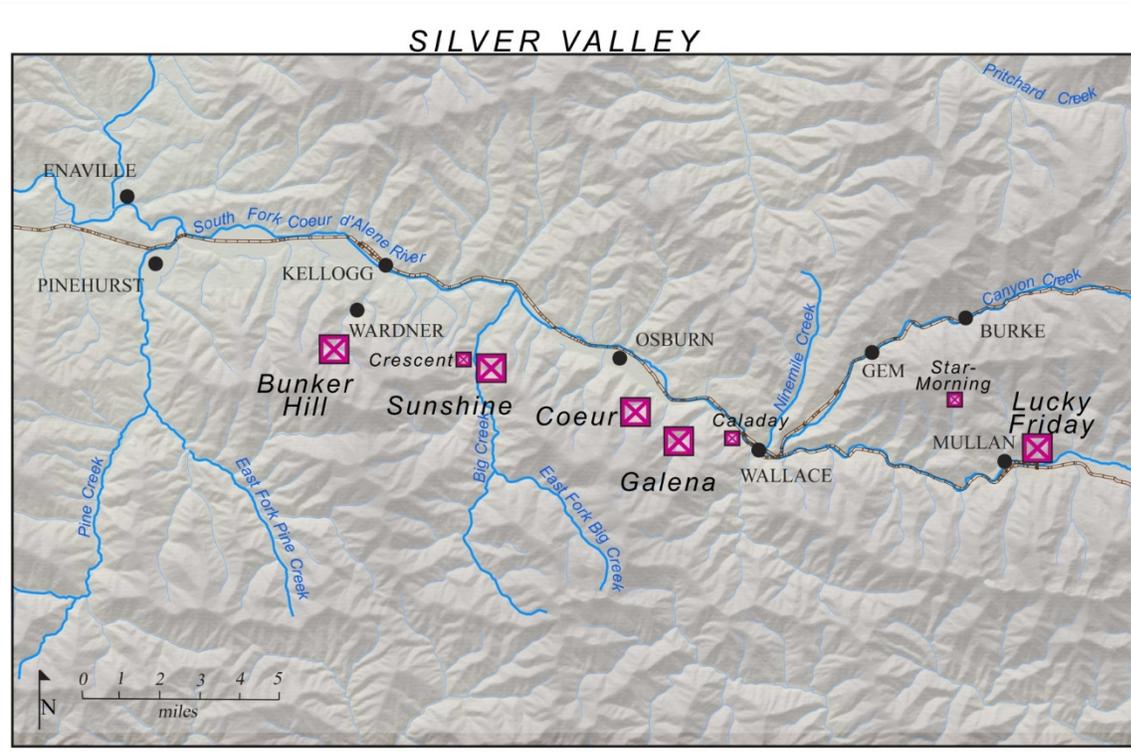


Figure 3. Map of the Coeur d'Alene district, also known as the Silver Valley. The I-90 highway is the line along the South Fork of the Coeur d'Alene River.

The Lucky Friday mine had been closed for repairs to the Silver Shaft and other work in 2012 and part of 2013, but the mine was at full production in 2014-2015. In addition to silver, the mine produced significant lead and zinc from the Gold Hunter vein system on the 4900 to 6300 levels. Shaft sinking continued on the #4 shaft, an 18-foot diameter, cement-lined internal shaft collared on the 4900 level. By late 2015, the crews had gotten down to about the 8100 level (Fig. 4). The new shaft was critical to access newly discovered high grade veins at depth.

U.S. Silver and Gold operated the Galena mine complex which includes the Coeur and Caladay properties. They continued to struggle to get costs down and in late 2014 announced a merger agreement to form Scorpio Mining Corporation, which also had a silver mine in Mexico. In 2015, the corporate name changed again to Americas Silver Corporation. In 2014, they worked on cost-cutting and shifted production to Ag-Pb ore which is processed in the Galena mill. They also evaluated the Ag-Cu veins of the Caladay zone. Production in 2014 at the Galena was 1.6 million ounces of silver. The 2015 drill program totaled 26,000 feet and intersected numerous high grade Ag-Pb intervals.



Figure 4. View looking up the #4 shaft at Lucky Friday mine (Fall, 2014).

Near Murray, a few miles north of the Silver Valley, New Jersey Mining Company started a joint venture with Juniper Resources, affiliated with Small Mine Development, to develop and mine underground at the Golden Chest mine. The venture operated from January to September, 2015, producing at grades of 6.5 g/t from the Skookum Shoot and sending the ore to the New Jersey mill at Kellogg. The lease was terminated in September, 2015, with New Jersey retaining the option to acquire the entire project.

Molybdenum mined at Thompson Creek Metals Company's open pit Thompson Creek mine near Clayton has been a major part of Idaho's metals output for several decades (Fig. 5). Phase 7 production averaging about 15 million pounds a year ended in December of 2014 when the mine was placed on care and maintenance as prices dropped and the company opted to retain cash. Before it closed, the mine produced 17.37 million pounds of molybdenum in 2014, after producing nearly 21 million pounds in 2013. Over 120 workers were laid off, with only a few retained for minor stripping and maintenance at the mill, which opened as a toll facility in 2015. Phase 8 resource and mine expansion was in permitting, but in 2012, the company had stopped the stripping and layback necessary to expose the Phase 8 resource. The mine had been a major economic force in Custer County since its inception in 1973. It continued on care and maintenance status throughout 2015.



Figure 5. Thompson Creek mine in September, 2014. Mining stopped in September with stockpiled ore being processed into December, 2014.

## PHOSPHATE MINING

The Idaho Phosphate District, one of the nation's leading producers, is located in southeastern Idaho and exploits the Permian-age Phosphoria Formation. Idaho hosts some of the highest grade of phosphate rock in the Phosphoria Basin, which extends to neighboring states. Ore consists of organic-rich, phosphatic black shale beds, referred to as the Meade Peak Member, and averages nearly 30%  $P_2O_5$  by weight. Three large, open pit mines in Caribou County provided feedstock for three plants which produced fertilizer or elemental phosphorus (Fig. 6). Markets and prices were slightly lower but stable. Each plant employs about 300 to 400 people, with additional personnel working at the mines.

## PHOSPHATE DISTRICT

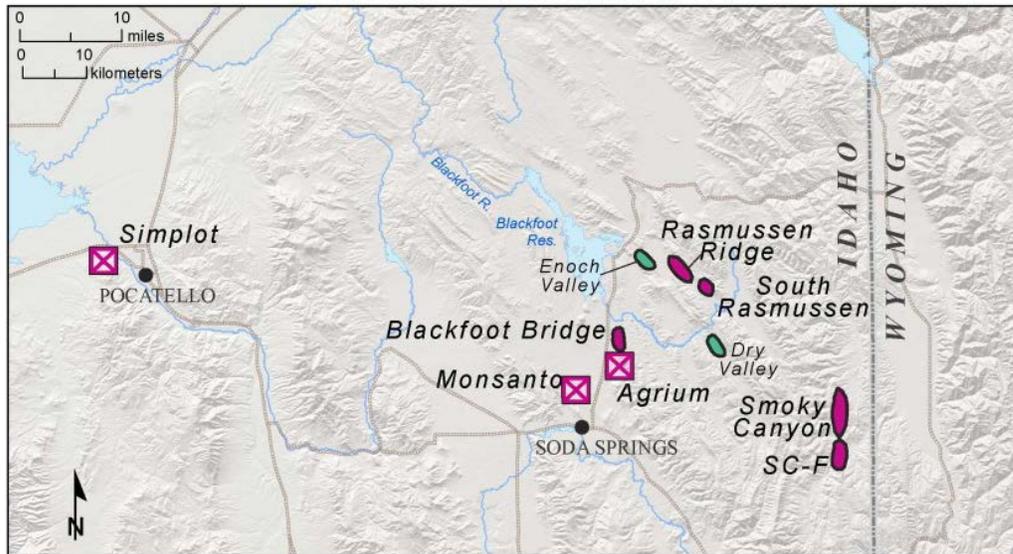


Figure 6. Southeast Idaho Phosphate District map. Squares with Xs are processing plants. Red ovals are active mines and green ovals are reclaimed mines.

Monsanto operated their elemental plant at Soda Springs. The plant uses electric arc furnaces to produce as much as 250 million pounds of phosphorus annually. The company was mining the North pit at its Blackfoot Bridge mine, which opened in 2013. Monsanto also did reclamation work at its South Rasmussen mine and drilled 37 exploration holes at the Caldwell Canyon property during 2014 to 2015.

J.R. Simplot Company mined panels B and F at its Smoky Canyon operation, while backfilling panel E and constructing a haul road to panel G. Simplot was also working on a design cover using the local Dinwoody Shale. Slurried ore is pumped over 80 miles via pipeline to the Don fertilizer plant in Pocatello. Simplot made upgrades to the plant, bought new haul trucks and a loader, and received a Sentinels of Safety recognition award from the National Mining Association in 2015. Together, the mine and plant employed about 700 persons. Simplot was working on collecting baseline data for the EIS on its 2133-acre Dairy Syncline property and an EIS at the East Smoky extension property.

Agrium, a publicly-owned Canadian agrichemical firm, operated the phosphoric acid fertilizer plant at Conda. Capacity at the plant is about 500,000 tons of monoammonium phosphate (MAP) and superphosphoric acid (SPA) fertilizer per annum (Fig. 7). The company was mining panel B at their North Rasmussen Ridge mine, backfilling panel A and finishing reclamation of the Dry Valley mine, originally mined by FMC. Agrium was also working on an Environmental Impact Statement for a new Rasmussen Valley mine and drilling at the North Dry Ridge property in the summer of 2014. Late that year, Agrium discontinued permitting activities at Dry Ridge to focus on the Rasmussen Valley property. A Draft EIS was released by the Bureau of Land

Management, U.S. Forest Service and cooperating agencies on September 18, 2015, for the Rasmussen Valley project. An innovative aspect of the new mine proposal is a collaboration to use Monsanto's nearby, closed South Rasmussen pit for a backfill area, thus reducing external overburden piles on Agrium's site and improving reclamation at South Rasmussen.

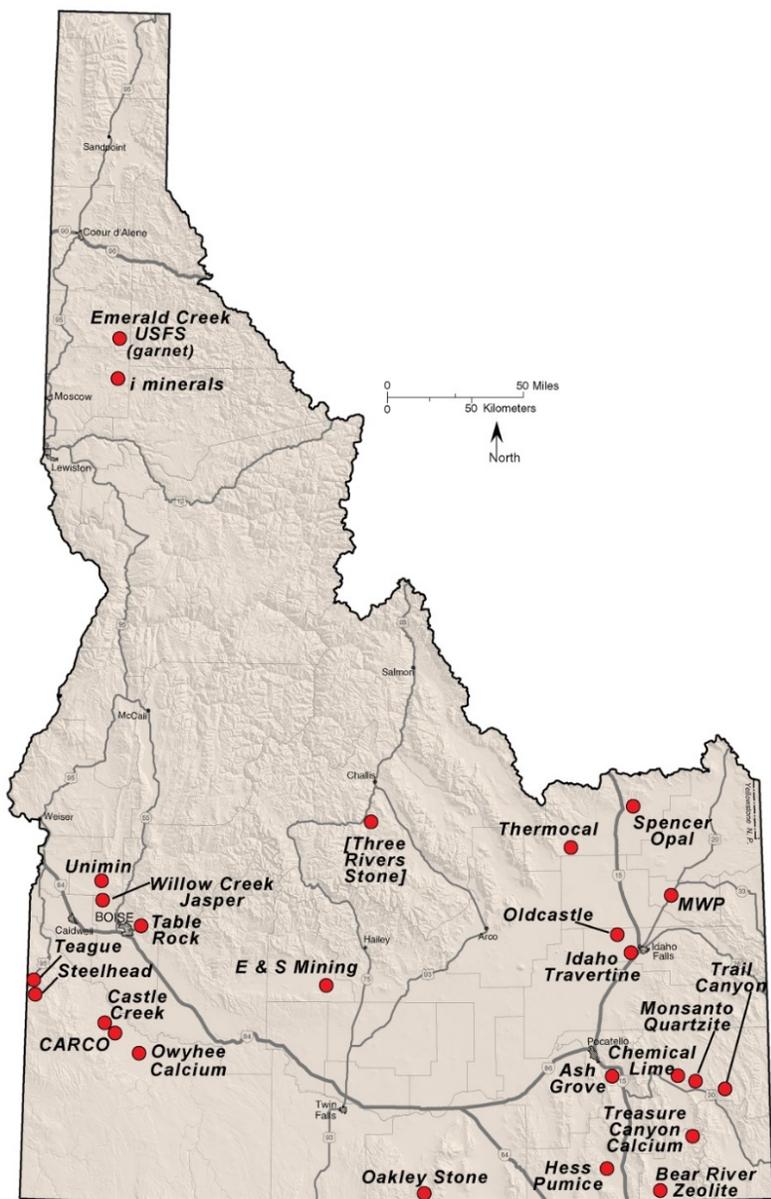


Figure 7. Agrium's Conda phosphate processing plant, November, 2015, looking west.

A new company, Fertoz, explored near the Husky/Dry Ridge area in 2014. Paris Hills Agricom Inc. continued to hold the private and state land near Bloomington in Bear Lake County. It was doing feasibility studies for an underground phosphate mine.

## OTHER INDUSTRIAL MINERALS

Idaho has a number of smaller industrial mineral operations which are important to rural economies. Markets were generally good, but competitive, allowing stable operations, although some were affected by potential sage grouse restrictions. Figure 8 shows the location of the industrial mineral operations in 2015.



## INDUSTRIALS 2015

Figure 8. Map of Idaho's non-phosphate industrial mineral operations.

In northern Idaho, i-minerals was active on their Helmer-Bovill property in Latah County. The area around Bovill was a major clay producer in the first half of the 20<sup>th</sup> Century. The company drilled 17 holes at the Kelly's Hump area in 2014, intersecting halloysite as well as more common clay. The halloysite has a nanotube structure which allows its use in high tech applications that fill the tubes with pharmaceutical, pesticides, or other ingredients. Test sampling and sales of old feldspar-quartz sand tailings were also underway. In 2015, i-minerals was incorporating the data into a new bankable feasibility study and looking at optimization strategies for a multi-commodity operation.

Emerald Creek Garnet, a subsidiary of Opta Minerals Inc., had a good year in 2014 and 2015 mining placer garnets for use in water jets, filtration and abrasives. Their leases are on Emerald Creek and Carpenter Creek as well as along the St. Maries River. Reclamation is a standard practice. Commercial garnet mining in the basins started in the 1930s.

Dimension stone of various types was quarried in several locations in southern Idaho. Gerhard Borbonus Landscaping continued to quarry silicified Table Rock Sandstone from the historic quarry above Boise. In eastern Idaho, Idaho Travertine cut travertine from their Medicine Lodge quarry at the cutting and finishing plant in Idaho Falls, but 2014 was a slow year.

Idaho's largest dimension stone producing region is the Oakley Stone quarries in Cassia County in southern Idaho. Several companies quarried the thin-splitting, micaceous quartzite for flagstone, facing stone, and tiles. Northern Stone Supply was the largest producer, but Scrivanch, Oakley Mountain Stone, Sawtooth Stone, and Oakley Valley Stone were also active. Demand was up about 10 % for the unique product.

Hess Pumice Products in Malad continued to grow in 2014 though business slowed a bit the following year. Their ultrapure pumice was used in paint, abrasives, and as light weight aggregate in cultured stone produced by JV partner Creative Mines in Malad. Other Hess companies included Hess Pozz (pozzolan), Idaho Minerals (perlite) and US Grout.

Additional operations included Unimin's sand plant at Emmett, CARCO's clay mine in Owyhee County, Teague Zeolites, E & S Mining and Trucking which acquired the Highway 20 pumice pit near Fairfield from Mountain West Products in 2015, and U.S. Antimony's Bear River zeolite mine near Preston, which increased sales and equipment in 2015.

In 2014, the Idaho Geological Survey released a report entitled, "Lithological characterization of active ITD aggregate sources and implications for aggregate quality" (IGS [T-14-1](#)). The research work, sponsored by the Idaho Transportation Department (ITD), describes the geology and susceptibility to alkali-silica reactivity of aggregate used for concrete in Idaho. A "Digital Database of Selected Aggregate Material Sources for Idaho" ([DD-9](#)) was also released. In both 2014 and 2015, an active construction industry utilized increased tons of sand and gravel over the prior few years.

## ENERGY

### GEOHERMAL

IGS' compilation of geothermal activities for the 2014-15 calendar years summarizes exploration, development, and use of high-temperature geothermal resources in Idaho for electricity generation or industrial-scale applications. 'High-temperature' typically is regarded as subsurface temperatures greater than 75°C (167°F), suitable for binary cycle geothermal power plant operation. This summary highlights exploration and development and industry activities

associated with Idaho's high-temperature geothermal resources; it may not be an exhaustive account of all activities that took place in 2014-15.

Idaho also continued to use its geothermal resources for low-to-moderate temperature applications (i.e., greater than 20°C or 68°F). These uses include, but not are limited to, district and residential heating, aquaculture, greenhouses, and recreation.

### *Industry Production and Exploration*

US Geothermal continued operation of the Raft River geothermal power plant in the Raft River basin in Cassia County during 2014 and 2015, with output of around 9.4 MW in 2015. Major facility overhaul, completion of planned annual maintenance outages at all three operating facilities, and replacement of bearings on both power plant turbines took place in 2015 (<https://www.sec.gov/Archives/edgar/data/1172136/000106299316007238/exhibit99-1.htm>, accessed 6/7/2020). US Geothermal announced plans to increase output to its full contract amount (13 MW) with Idaho Power Company (details available at: <https://www.thinkgeoenergy.com/u-s-geothermal-acquires-cash-flow-interest-and-ownership-in-raft-river-project/>, accessed 6/7/2020).

Agua Caliente drilled one geothermal well in the Raft River basin in 2015 as its first project (Walker Ranch geothermal project) with the goal of constructing geothermal power plant facilities. More information can be found at: <https://www.blm.gov/programs/energy-and-minerals/renewable-energy/geothermal-energy/regional-information/idaho>, accessed 6/5/2020 and on Aqua Caliente's website: <http://www.aguacalienteinc.com/overview.html>, accessed 6/5/2020.

Ormat Technologies applied for the rights to use hot water from Panther Creek Hot Springs for development of a 10-20 MW power generation facility in Lemhi County. The US Forest Service solicited comments on an Environmental Impact Statement (EIS) in October 2015 for three contiguous, non-competitive geothermal lease applications comprising the Big Creek Geothermal Leasing Project in the Salmon-Cobalt and North Fork Ranger Districts.

### *Research and Geothermal Studies*

The DOE-funded Raft River geothermal field Enhanced Geothermal System (EGS) demonstration project in Cassia County at injection well RRG-9 ST1 continued in 2014-15 to better understand well performance and reservoir response. Several publications are available at: <https://geothermal.stanford.edu/publications>, accessed 6/7/2020. Precambrian quartzite and quartz monzonite at depths greater than 1,500 meters (5,000 feet) comprise most of the fracture-dominated geothermal system. Bradford and others (2014) reported thermal stimulation and injectivity testing beginning in summer 2013 at variable flow rates with increased permeability response. Conceptual and numerical models of flow paths to RRG-9 ST1 were developed with continued injection (totaling 254 million gallons) and response monitoring, suggesting two major fracture zones intercept the well (Bradford and others, 2015). Plummer and others (2015) described RRG-9 ST1 hydraulic and thermal response to testing and provide interpretations.

Welhan and others (2014) conducted a study of potential high-temperature geothermal resources in the Blackfoot Volcanic Field in southeastern Idaho within Idaho's thrust belt in Bingham County. This system is masked by a cold-water aquifer (Eastern Snake Plain Aquifer), limiting

surface expression of the deeper, geothermal resource. This study used available geohydrologic and geothermal datasets to evaluate hypotheses about resource potential, sources, and pathways.

The U.S. Department of Energy (DOE) Frontier Observatory for Research in Geothermal Energy (FORGE) program selected the Idaho National Laboratory (INL) site in the Eastern Snake River Plain (ESRP) to develop, test, and improve techniques to advance enhanced geothermal system (EGS) technology. EGS is an unconventional geothermal technology that requires injecting fluid (typically water) into hot host rock at depths on the order of 8,000 feet to 12,000 feet to stimulate heat flow through fractures. The heated, injected fluid is returned back to the surface where it is used for generating electricity (see <https://www.energy.gov/eere/geothermal/how-enhanced-geothermal-system-works>, accessed 6/5/2020). Idaho has favorable conditions for geothermal energy production with temperatures greater than 90°C (194°F). However, additional research and development are needed for EGS to be cost effective.

In 2015 the Snake River Geothermal Consortium (SRGC) conducted a Phase 1 program at the INL site for development of a geothermal conceptual model. The project identified favorable conditions for implementing EGS across the ESRP. Associated reports and datasets can be found at: <https://www.energy.gov/eere/forge/idaho-national-laboratory>, accessed 6/3/2020.

Project HOTSPOT received DOE funding to evaluate the use of Play Fairway Analysis for geothermal exploring of the western Snake River Plain beneath Mountain Home Air Force Base (MHAFB) in Elmore County. Play Fairway analysis is commonly used in petroleum exploration as a statistical method for risk-based ranking with the objective of increasing success and lowering costs. This technique has recently been used for locating ‘blind’ hydrothermal systems masked by overlying, cold aquifers. This work identifies specific plays with sufficient heat, accessible fluids, and fracture permeability suitable for geothermal development. More information on this technology may be found at: <https://www.energy.gov/eere/geothermal/play-fairway-analysis>, accessed 6/5/2020. Nielson and others (2015) published the MHAFB project details. More information is available at <https://gdr.openei.org/submissions/284>, accessed 6/5/2020.

### *Geothermal References*

Bradford, J., Ohren, M., Osborn, W.L., McLennan, J., Moore, J., and Podgorney, R., 2014, Thermal stimulation and injectivity testing at Raft River, ID EGS site, *in* Proceedings, 39<sup>th</sup> Workshop on Geothermal Reservoir Engineering, SGP-TR-202, 9 p. Available at: [https://pangea.stanford.edu/ERE/db/IGAstandard/record\\_detail.php?id=19789](https://pangea.stanford.edu/ERE/db/IGAstandard/record_detail.php?id=19789) (accessed June 7 2020).

Nielson, D.L., Shervais, J., Evans, J., Liberty, L., Garg, S.K., Glen, J., Visser, C., Dobson, P., Gasperikova, E., and Sonnenthal, E., 2015, Geothermal Play Fairway Analysis of the Snake River Plain, Idaho, *in* Proceedings, 40<sup>th</sup> Workshop on Geothermal Reservoir Engineering, SGP-TR-204, 9 p. Available at: <https://pangea.stanford.edu/ERE/pdf/IGAstandard/SGW/2015/Nielson.pdf> (accessed June 5 2020).

Plummer, M., Huang, H., Podgorney, R., Bradford, J., and Moore, J., 2015, Reservoir Response to Thermal and High-Pressure Well Stimulation Effects at Raft River, Idaho, *in* Proceedings, 40<sup>th</sup> Workshop on Geothermal Reservoir Engineering, SGP-TR-204, 9 p. Available at:

[https://pangea.stanford.edu/ERE/db/IGAstandard/record\\_detail.php?id=20569](https://pangea.stanford.edu/ERE/db/IGAstandard/record_detail.php?id=20569) (accessed June 7 2020).

Welhan, J., Gwynn, M., Payne, S., McCurry, M., Plummer, M., and Wood, T., 2014, The Blackfoot Volcanic Field, Southeast Idaho: A Hidden High-Temperature Geothermal Resource in the Idaho Thrust Belt, in Proceedings, 39<sup>th</sup> Workshop on Geothermal Reservoir Engineering, SGP-TR-202, 13 p. Available at: <https://pangea.stanford.edu/ERE/pdf/IGAstandard/SGW/2014/Welhan.pdf> (accessed June 8 2020).

## OIL AND GAS

### *Resources*

The state of Idaho has one region known to contain reserves of oil and gas (southwest) and several others (southeast, south-central) believed to have potential based on geologic similarity to known accumulations in Nevada and Wyoming (Figure 9). The 2014-2015 timeframe was one of growth for Idaho's oil and gas sector, with the majority of activity focused on Idaho's emerging southwestern oil and gas play.

Beneath the western Snake River Plain of southwest Idaho and eastern Oregon, conventional accumulations of condensate, gas, and oil, have been encountered at depths ranging from 1,500-6,000 feet. The accumulations occur within fault-bounded structures and stratigraphic traps associated with the evolution and filling of a NW-trending rift basin during the late Miocene to early Pliocene. Source rocks are presumed to be terrestrial sediments associated with the lower Chalk Hill or underlying Payette Formations. Although drilling in the region dates back to 1903, the first commercial success did not occur until 2010 when Bridge Resources (Calgary, Canada) completed the ML Investment 1-10 well in

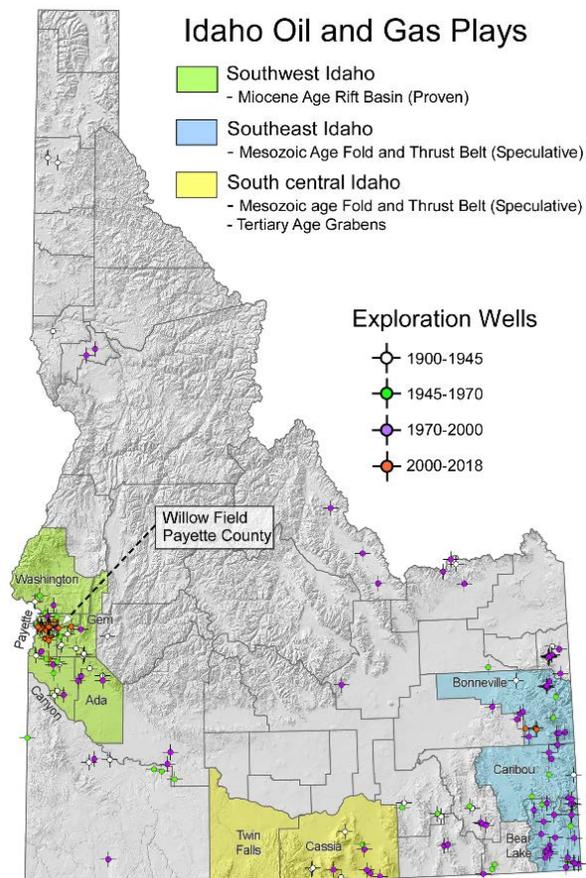


Figure 9. Regions with potential oil and gas resources in Idaho

Payette County, about 5 miles north of the town of New Plymouth. Bridge proceeded to drill ten more exploration wells in 2010. Although most wells encountered hydrocarbons, only two, the DJS Properties 1-15 and State 1-17, would eventually be brought online and produced. In early 2012, Bridge Resources sold its interest in the play to Alta Mesa Holdings (Houston, Texas) who is currently the primary operator in the region. In late 2012, Alta Mesa collected a small 3D seismic survey in the area surrounding the discovery well that showed a series of anomalies suggestive of additional hydrocarbon accumulations. In 2013, a second commercial well (ML Investment 2-10) was drilled into one of the anomalies and the area around the producing wells referred to as the Willow Field. Other companies holding an interest in the play include Trendwell Energy (Rockford, Michigan) and Snake River Oil & Gas, a subsidiary of Weiser-Brown (Magnolia, Arkansas).

Southeast Idaho is a region of highly deformed strata referred to the Fold and Thrust Belt. It was created during the Sevier Orogeny approximately 160 to 50 million years ago and extends from northern Canada to southern California. The eastern edge of the belt passes through southeastern Idaho and western Wyoming where it contains structures (folds and faults) capable of trapping hydrocarbons. The area in eastern Idaho was lightly explored in the 1950s and more intensely explored in the 1980s after several large fields (Fogarty Creek, Painted Reservoir East, and Whitney Canyon-Carter Creek) were discovered across the border in Wyoming. Although hydrocarbon shows have been reported from several dry holes, no productive wells have been drilled in in the southeastern part of the state.

The south-central region in Idaho represents an amalgamation of several potential plays that are based on ones identified in Nevada and Utah. Geologically the area is complex consisting of a Mesozoic Fold and Thrust Belt overprinted by Tertiary metamorphic core complexes and Basin and Range tectonics. Potential source rocks include the Mississippian Chainman Shale and the early Tertiary Elko Formation, both of which are under investigation as possible unconventional resource plays in central and northeastern Nevada by Cabot Oil and Noble Energy, respectively. Conventional accumulations are possible in fold and thrust anticlinal traps, such as the Covenant field in Central Utah, or with Basin and Range structures such as the Railroad Valley Feld in Nevada. Overall, south-central Idaho is unexplored with little known about the petroleum geology of the region.

### *Activitis*

Oil and gas-related activities in the state of Idaho during the 2014-2015 timeframe involved aspects of exploration, development, leasing, and regulation.

Exploration activities included the collection of 3D seismic surveys in the Southwest and Southeast regions and the drilling of an exploration well in Canyon County (Southwest Region). In January of 2014, a 3D seismic survey of approximately 78 square miles was completed in Payette County to the west of the Willow Field where the original 2012 survey was collected. In October, a survey of approximately 210 square miles was completed in Payette and Gem Counties to the east of the 2012 survey. Both surveys were collected for Alta Mesa Holdings by Dawson Geophysical. In southeastern Idaho, CPC Minerals LLC, completed a 2D seismic survey in 2014 to better understand the local geology in the area around Grays Lake in Bonneville

County where they drilled a dry hole (CPC-17-1) in 2007. Maps showing survey boundaries can be found on the Idaho Oil and Gas Conservation Commission website at <https://ogcc.idaho.gov/maps/>. In March of 2014, the Smith 1-10 exploration well was drilled by Trendwell Energy at a location 30 miles to the south of the Bridge ML Investment 1-10 discovery well. The well was deemed a dry hole and subsequently plugged and abandoned in June of 2014. Total depth was 4,178 ft with the bottom of the well terminating in a series of basalts that appear at a depth of 3,825 ft. It is not known whether any hydrocarbon shows were observed as the mud log is not publicly available. However, based on the wireline logs, targeted sands expected in the lower part of the well were not encountered.

Development activities focused on the Willow Field in Southwestern Idaho included the buildout of required infrastructure and the drilling of additional development wells by Alta Mesa Holdings. Four development wells were drilled in 2014 (DJS Properties 2-14, Kauffman 1-34, ML Investment 1-11, Kauffman 1-9) and two drilled at the end of 2015 (ML Investment 1-3, ML Investment 2-3). Infrastructure buildout involved the construction of an offsite processing facility (referred as the Highway 30 processing facility), an onsite gathering facility (referred to as the Little Willow gathering Facility), and eleven miles of flowlines tying producing wells to the gathering facility. The system became operational on August 1<sup>st</sup>, 2015, whereby Idaho became the 31<sup>st</sup> hydrocarbon producing state in the USA. At the end of 2015, five wells were producing at the Willow Field with a combined volume of approximately 50,000 BOE per month and a product stream of 30 percent liquid hydrocarbons and 70 percent natural gas. Development wells drilled in 2015 are currently shut-in and slated to come online in 2016 pending construction of flow lines. Monthly production reports from the field can be found at the Idaho Oil and Gas Conservation Commission website (<https://ogcc.idaho.gov/monthly-and-annual-reports/>)

Idaho Department of Lands (IDL) conducts oil and gas lease sales when eligible lands are available for lease and nominated by the public. Auctions are public, advertised, and awarded based on an oral bonus bid/acre. Public lease size is restricted to all the state lands in one section or about 640 acres. Private leasing is unregulated. In January of 2014, The Idaho Department of Lands conducted an oil and gas lease sale for more than 8,700 acres of State-owned lands located in the southwest region. Alta Mesa Idaho (AM Idaho LLC) was awarded leases on all 8,714 acres and paid \$694,373 in bonus bids. The other bidder was Trendwell Energy Corp. The leases consisted of approximately 3,475 acres in Canyon County; 2,355 acres in Gem County; 1,443 acres in Payette County; 944 acres in Owyhee County; and 495 acres in Washington County. The high bid was \$300 per acre and the largest bid was \$83,840 for one tract containing 640 acres in Gem County. The average bid per acre was \$79.68.

Within the state of Idaho, the Idaho Oil and Gas Conservation Commission (IDC) is responsible for regulating oil and gas-related activities in the state. Primary roles include the conservation of oil and gas, the protection of correlative rights, and the preservation of surface and groundwater resources. In 2015, the IDC continued to strengthen its regulatory scheme through the passage of several new laws including; the making of oil and gas production records public, the setting of rules for cooperation among companies developing the same pool of oil and gas reserves, and the setting of application fees to cover the state's costs.

# MINERAL EXPLORATION

Overall, metal prices and markets were on the decline during 2014 and 2015. It was not the best of times for mineral exploration, and financing was reported to be difficult. Another obstacle in 2015 was the announcement of proposed federal land withdrawals related to preserving sage grouse habitat. Even so, there were some good exploration projects in Idaho in 2014 and in 2015 (Figure 10), though many projects were inactive.

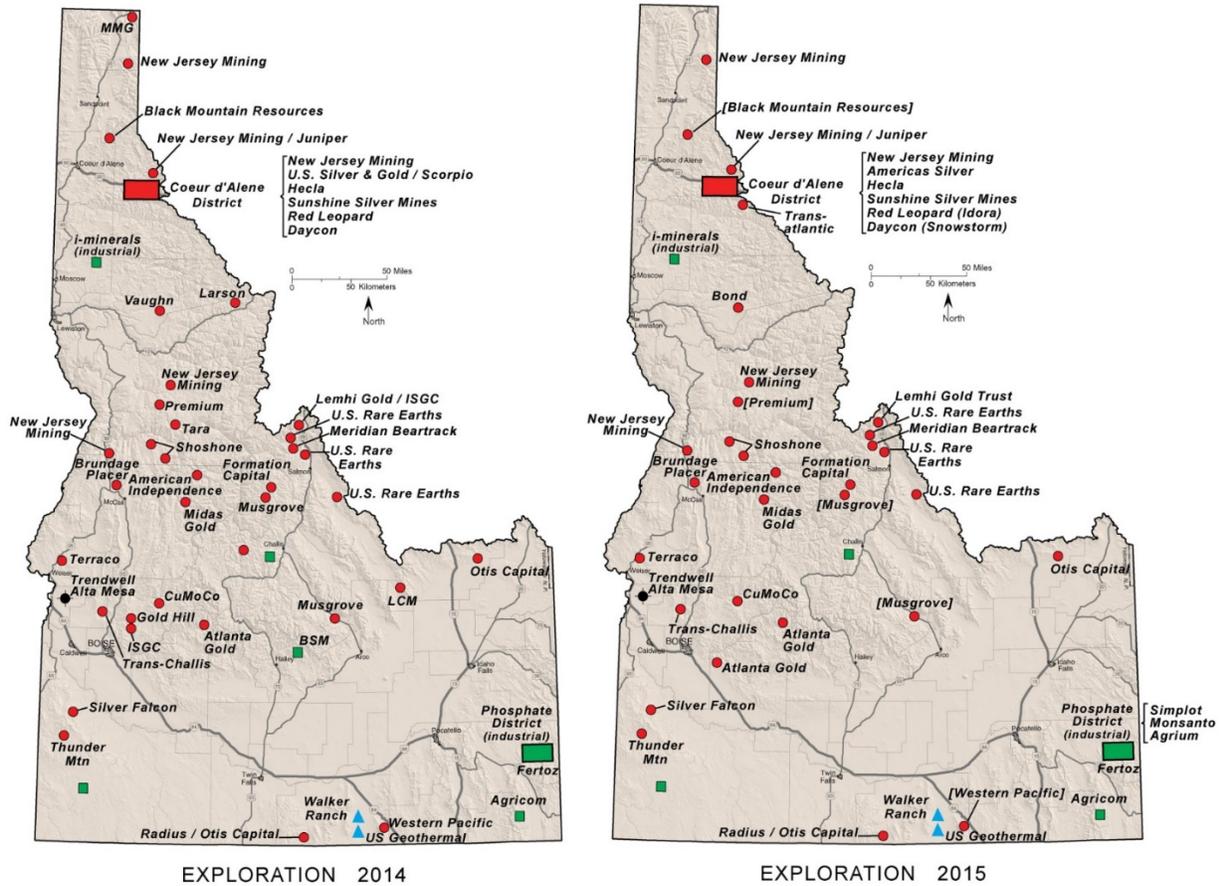


Figure 10. Location of Idaho exploration projects in 2014 and 2015.

## NORTH AND WESTERN IDAHO

In northern Idaho, Hecla and U.S. Silver conducted active in-mine exploration at the Lucky Friday and Galena mines, respectively. In 2014, Hecla was drilling out the deep Gold Hunter deposit with holes collared a mile below surface (Fig. 11). A new company, Bunker Hill Ventures, announced plans to revitalize and hopefully restart the famous Bunker Hill mine on the western side of the Coeur d'Alene district. The large mine was a major lead-zinc producer.

. In late 2015, Bayhorse Silver optioned a 75% interest in silver-lead-zinc mining claims at Government Gulch (south of Kellogg in the Silver Valley) from Blackhawk Exploration who had purchased the property, free from past liabilities, from a Trust set up by the Environmental Protection Agency (EPA).

The EPA and its partner, the Idaho Department of Environmental Quality, continued reclamation and remediation work at the Coeur d'Alene River Basin site, including 75 residential yard and commercial cleanups, removal of contaminated material from Ninemile Creek, road paving, and other projects. Much of the work was done by local contractors.

The famous Sunshine mine was held by Sunshine Mining and Refining who also owned the refinery. The mine, which closed full operations in 2001, is credited with a historic production of 350 million troy ounces of silver from tetrahedrite-rich ore. From 2011-2014, the company drilled Upper Country veins in the upper levels of the mine and filed an updated preliminary economic assessment and NI 43-101 report in 2014. The report calculated a total resource of 11.16 million metric tons at a grade of 827 g/t Ag, 0.16% Cu, and 0.26% Pb.

In 2014, Daycon Minerals drilled six holes near the historic Snowstorm mine, north of the Lucky Friday. Daycon had leased the property from Timberline Resources. The target was stratabound Cu-Ag mineralization in the Lower Revett quartzite. Drilling intersected disseminated copper sulfides, plus tetrahedrite and galena over 70-foot widths, similar to occurrences known at the Rock Creek deposit in Montana. In 2015, Daycon conducted field mapping and sampling at the Snowstorm property.

New Jersey Mining and joint venture partner, Juniper Resources, with contractor Small Mine Development of Boise were putting in a new portal and underground ramp at the Golden Chest mine at Murray in 2014 (Fig. 12). The work led to mining and gold production in 2015.

In Boundary County near the Canadian border, MMG drilled four holes in 2014, targeting Sullivan-type zinc deposits in the Prichard Formation. They reclaimed the site and did not return.

A new project in 2015 was Transatlantic Mining Corporation drilling at the Monitor mine, a 1900s era high grade Au-Cu vein system south of the Coeur d'Alene District. They drilled 15 core holes for 9000 feet, looking for high grade shoots. The project was impeded by safety and fire restrictions due to a very bad fire season.



Figure 11. Exploration drill, Lucky Friday mine, 6500 level, 2014.



Figure 12. Portal work, Golden Chest mine, Murray, 2014.

At Orogrande, just southwest of Elk City in Idaho County, Premium Exploration started a winter drilling program in early 2014 to evaluate underground potential of the Friday deposit along the Orogrande shear zone. Fourteen core holes were drilled from late 2013 through March 2014 to investigate the zone, which had a 43-101 resource of about 1 million ounces of lower grade material in the low sulfidation vein system. Results announced in October included 5.23 g/t Au over 112.8 meters (including 34.2 g/t Au over 6.6 meters) in hole PFR2014-6, as well as additional intercepts. By the end of 2014, Premium was reorganizing and seeking financing for additional drilling. The project was inactive in 2015.

In western Idaho New Jersey Mining reopened the private McKinley underground mine near Lucille. The small mine was patented in 1909, and the adit exposed auriferous pyrite in the Fiddle Creek Schist, part of the Riggins Group of the accreted terrane. After channel sampling, New Jersey set up a customized backpack drill and drilled 21 holes of BX core, totaling 1270 feet (Fig. 13). No additional drilling was done the following year, though the company kept an interest in the region.



Figure 13. New Jersey Mining drilling underground at the McKinley mine, Idaho County, Idaho.

## CENTRAL AND EASTERN IDAHO

The region around the town of Salmon in Lemhi County is one of Idaho's most mineralized regions, although on-the-ground activity in the area was relatively sparse in 2014 and 2015 due to lack of funds and metal prices (Fig. 10).

In the Idaho Cobalt Belt, Formation Capital kept its Idaho Cobalt Project on care and maintenance status. The stratabound Cu-Co-Au ores of the Ram deposit were discovered by Formation in 1997 and appear to be extensions of the mined horizons at the Blackbird mine on the other side of the hill. In April, 2015, the company released a positive Preliminary Economic Analysis (PEA) for an 800-ton per day underground Co-Cu-Au mine with a 12-year life and considerable exploration potential. Substantial construction and infrastructure improvements were made at the fully permitted site, including a wetlands mitigation pond and work on a crusher pad (Fig. 14). Increased use of cobalt in rechargeable batteries was a positive influence on markets.



Figure 14. Wetlands mitigation pond at the Idaho Cobalt Project, 2015.

U.S. Rare Earths held claim blocks hosting rare earth and thorium veins in the Lemhi Pass district of Idaho and adjacent Montana. In 2014, they collected a bulk sample at the Last Chance mine, which is on the Montana side, and in August, 2015, the company signed an agreement with Oakridge National Lab to study and license a special MSX (membrane-assisted solvent extraction) process to recover and separate neodymium, dysprosium, and praseodymium from electronic waste and also for processing ore from the Lemhi Pass rare earth claims.

Other properties in the Salmon area were inactive except for water sampling, reclamation and very minor placer gold production.

In central Idaho, near the town of Yellow Pine, Midas Gold Corporation was very busy collecting baseline environmental data and conducting engineering studies to support the environmental impact statement and mine plan proposal for a new gold-antimony mine at Stibnite in Valley County. Midas was also informing local citizens about the project. A prefeasibility study completed in late 2014 calculated a mineral resource of 5.4 million ounces gold indicated, plus significant antimony, a critical mineral. While no drilling was done in 2014, Midas worked on detailed mapping and sampling and hosted state and federal scientists researching the complex geology of the Stibnite area (Fig. 15).



Figure 15. Gold-mineralized jasperoid next to sanded limestone near the Fern mine, Stibnite district.

Midas was also busy at Stibnite in 2015, with additional permitting, engineering site characterization, environmental baseline data collection, and reclamation projects to restore the site, which has been heavily impacted by 100 years of mining. The company planted 7000 trees, installed solar power at the remote site, and conducted a short auger drilling program to characterize the old leach and tailings areas. Midas also hosted over 10 educational programs for kids and conducted over 34 site tours for the public.

## SOUTHERN IDAHO

Cumoco's giant (over 2 billion tons) Cumo molybdenum deposit in Boise County received some interest from Chinese investors, but the project was inactive in 2014 due to permitting delays and large forest fires in the area. Low molybdenum prices continued into 2015 when Cumoco received a supplemental Environmental Assessment from the U.S. Forest Service in October to

allow additional drilling. The company worked on engineering optimizations to cut costs and road agreements with the county. The project, located in the headwaters of the Boise River, is strongly opposed by environmental groups.

Atlanta Gold Inc. installed a patented water treatment process to remove arsenic from historic mine water discharges from the 900 level adit in the Atlanta mining district of Elmore County. A new subsidiary company, Hydroclean Resources, was formed to supervise the passive water treatment. Atlanta and contractor Knife River Corporation also trenched and mined surface ore at the Neal district, which is only 15 miles from Boise. The ore was stockpiled on the private land.

In eastern Idaho, Otis Gold Corporation worked on an environmental assessment for additional drilling of the North Target area at their Kilgore project in Clark County. Kilgore is a young, epithermal Au-Ag system hosted in Tertiary volcanics. In 2015, they drilled 19 RC holes, totalling 10,500 feet, in two areas (Fig. 16). From previous work, the project has a NI 43-101 compliant resource of 520,000 ounces of indicated gold (27.3 million metric tons at 0.59 g/t Au) plus 300,000 ounces of inferred resource (20.2 million tons at 0.046 g/t Au).

Otis also had a grass roots exploration property, Blue Hill, in southern Idaho. Radius Gold drilled 5 core holes for 1308 meters at Blue Hill in late 2014 but did not intercept the feeder structures they were looking for.

Other properties shown on Figures 10 in southern Idaho were largely inactive or had only minor work. The Mines and Minerals page of the IGS website (<https://www.idahogeology.org/geologic-resources/mines-minerals/current-historic-mining-activity>) contains additional details in the yearly visual presentations.



Figure 16. Otis Gold drilling at Crabclaw NW area at Kilgore deposit, 2015.