Idaho Mining and Exploration, 2018-2019

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Staff Report 23-01
September 2023
Updated August 2025

Idaho Geological Survey
Morrill Hall, Third Floor
University of Idaho
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INTRODUCTION

The years of 2018-2019 continued the general downward trend of mining activity and production in Idaho. The state's highest value of non-fuel mineral production was in 2011 when the large Thompson Creek molybdenum mine was active. This staff report summarizes developments in the calendar years of 2018 and 2019. Additional details and photographs are in the annual visual presentations available on the Mines and Minerals page of the Idaho Geological Survey (IGS) website: https://www.idahogeology.org/geologic-resources/mines-minerals/current-historic-mining-activity. Of special note in 2019 was the 100th anniversary of the Idaho Geological Survey, which was started in 1919 in Moscow under the former name of Idaho Bureau of Mines and Geology.

Figure 1 shows a graph of Idaho's value of non-fuel mineral production totals for the period 2010 – 2019, as reported by the USGS. The numbers behind the graph are largely final but may contain some preliminary or estimated values. As reported by the USGS, Idaho's non-fuel mineral production of raw ore was approximately $465 million in 2018 and $463 million in 2019. This is about a $100 million drop from 2017. The decrease over several years is partly due to lower commodity prices but also a decrease in ore tonnage mined from the Lucky Friday mine. The large drop in value from 2014 to 2015 was a result of the termination of mining and conversion to care and maintenance status at Thompson Creek. In both 2018 and 2019, the USGS ranks Idaho as 35th by value, based on unadjusted State values. Industrial minerals make up about 85-90% of Idaho's value for the period 2018-2019. Active mine locations are shown in Figure 2.

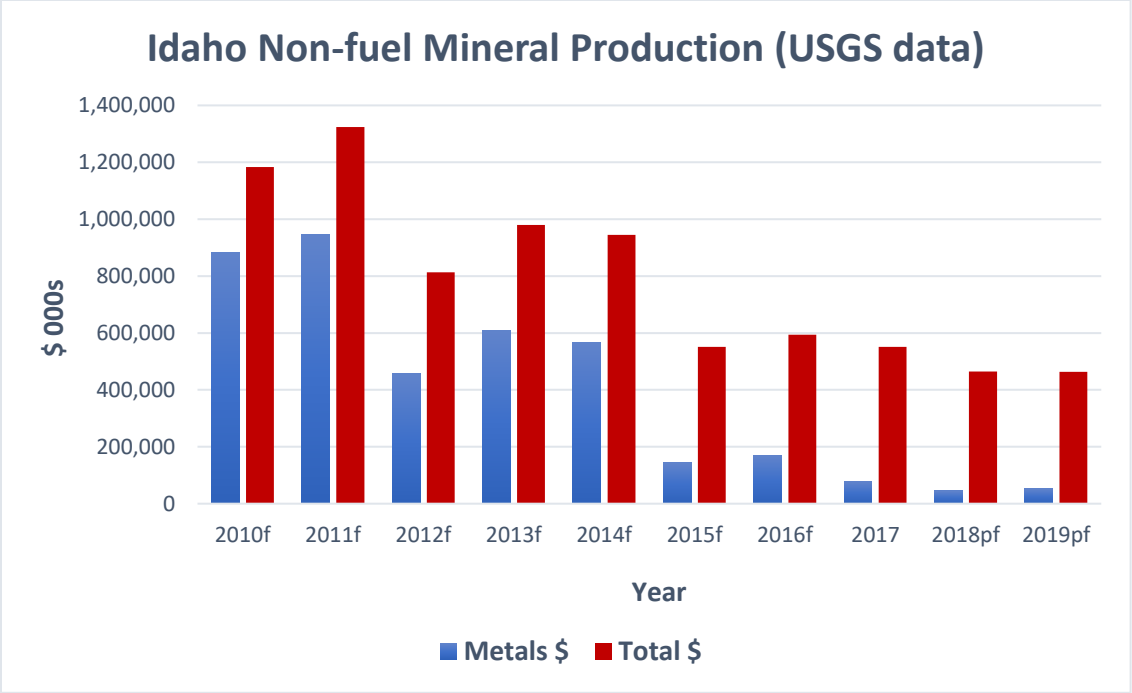

Figure 1. Value of Idaho non-fuel mineral production, based on USGS data by year. Most of the year's data are from final (f) statistics, with some preliminary (p) values for 2019. Metals are indicated in blue, while the difference between the blue and the red (total value) is from industrial minerals.

Final revised production values for Idaho non-fuel mineral production during the 2016-2017 period have not yet become publicly available from the U.S. Geological Survey (USGS), although the best available data from the USGS was included in the Idaho Geological Survey Staff Report 21-02 covering the years 2016-2017. Final 2018 and 2019 data can be found on the USGS website: https://www.usgs.gov/centers/national-minerals-information-center/mineral-industry-idaho

Production values for ten of Idaho's mined commodities are considered as "concealed" data and not released individually. The total combined value of the ten Idaho commodities in the concealed category was $254 million in 2019 and $299 million in 2018. That combined value includes the following commodities: feldspar, garnet (industrial), lead, lime, perlite (crude), phosphate rock, pumice and pumicite, sand and gravel (industrial), silver, and zeolites. Idaho is a leading producer of phosphate rock, construction sand and gravel, crushed stone, silver and lead. As several of those values are concealed, it is difficult to fully reconcile annual mineral value totals reported by the USGS; some data may be preliminary. Company-published production data for north Idaho mines in the Coeur d'Alene District is available in the Idaho Geological Survey's GeoNote 47 for the years 2000 – 2020. As can be seen in the actual production data, a notable event was the decrease in production of silver and base metals from Hecla's Lucky Friday mine for 2017 – 2019; this was due to a labor strike at the mine. Limited production was supplied by the salaried level employees, but overall, the 2018 – 2019 metal values were significantly down for the mine.

For 2018 – 2019, gold and silver prices were stable to moderately rising by late 2019 when spot prices reached close to $1460 per troy ounce for gold and $17 per troy ounce for silver. Rare earth prices also seemed to be on an upswing, possibly due to geopolitical influences. Base metals were showing cyclical to downward trends. The molybdenum spot price was in the doldrums at close to $10 per pound in late 2019. Cobalt prices were more volatile and interesting. The spot price of cobalt spiked to just over $40 per pound in the summer of 2018 after rising for a year, before it sharply declined and was down to about $16 per pound in November 2019. However, the price spike prompted a staking rush in the Idaho Cobalt belt at the end of 2017 into 2018.

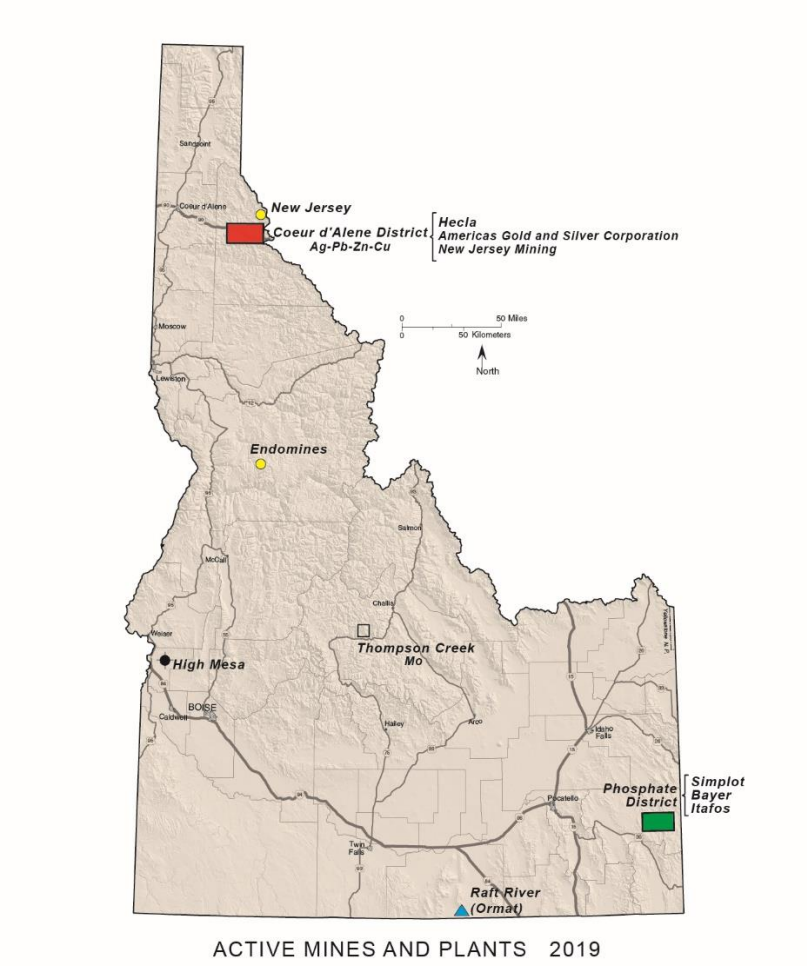

Figure 2. Location of active mines and plants in 2018 and 2019. Both the Coeur d'Alene district and the Phosphate district have been operating for over 100 years. Yellow dots are small gold mines. The open square indicates the inactive Thompson Creek mine; the black cross hair is for oil and gas production, and the blue triangle indicates a geothermal power plant.

METAL MINING

COEUR D'ALENE AND MURRAY DISTRICTS

North Idaho's Coeur d'Alene District, also known as the Silver Valley, has mined silver along with lead, zinc, copper, and antimony since 1884 from structurally-controlled, quartz-siderite-sulfide veins in deformed Mesoproterozoic Belt Basin metasedimentary rocks. The world-class district in Shoshone County is credited with over 1.24 billion troy ounces of silver. In 2018 – 2019 the north Idaho region was home to Idaho's metal mining industry.

Hecla Mining Company, operator of the Lucky Friday mine at Mullan, celebrated its 125th birthday in 2016. Hecla started in the Silver Valley in 1891 and has a large property position in the district. Current production has been from the Gold Hunter vein system (Fig. 3), accessed off the new #4 internal shaft located about a mile west of the surface hoist in the Silver Shaft. The #4 shaft is collared at the 4900 level and was completed in 2016 to the 8620 level, making it one of the deepest in the hemisphere at 9,587 feet below land surface. In 2016, the mine produced 3.6 million ounces of silver, but in March 2017, the miners went out on strike, partly over demands to control their own work assignments and shifts. The USW Local 5114 remained on strike for the remainder of 2017, and all of 2018 and 2019. Salaried employees performed limited mining and milling during the strike, but production was down significantly. Only 169,041 troy ounces of silver were extracted in 2018 and 632,944 troy ounces silver in 2019. Hecla investigated acquiring a Swedish-built remote vein miner machine during the work stoppage. In November 2019, a tentative settlement was reached between Hecla and the union with a ballot count taking place in mid-December. The settlement was approved, and production resumed early in 2020.

Americas Silver Corporation operated the Galena mine near Osburn. The mine complex includes the adjacent Coeur and Caladay properties plus two mills. The mine staff was using newly developed 3-D mine models to target and drill Ag-Pb veins in the upper portions of the mine from the 3700 to 2400 levels in 2018 as well as mining new stopes on the deep 5200 levels. However, needed hoist repairs in the 2nd quarter of 2018 negatively impacted ore production. The company agreed to combine with Pershing Gold, and that acquisition was completed in April 2019; the new company was renamed Americas Gold and Silver Corporation. Conventional and mechanical mining continued, along with 23,000 feet of drilling that resulted in two new vein discoveries on the 4900, yet hoist problems continued to plague the mine. A milestone agreement was negotiated when the company signed a joint venture agreement with Eric Sprott in September 2019, whereby Sprott would earn a 40% interest in the Galena in return for financing $20 million in new equipment and upgrades. The Recapitalization plan called for a new hoist in the Galena shaft, multiple repairs and development work, and increased exploration drilling (Fig. 4).

Figure 3. Close-up (see dark pencil in center for scale) of vein on 6200 sublevel, 16 stope, 30 vein, Gold Hunter system, Lucky Friday mine (2018). Left wall rock is green silty argillite, vein quartz is white, gray material is argentiferous galena, tan is siderite, and black is sphalerite. Photo width approximately 3 feet.

Figure 4. Galena miners driving drift with Jumbo to access new 075 vein, 4900 level (2019 photo).

North Idaho's Murray district, a major placer gold producer, is a short distance north of the town of Wallace in the Coeur d'Alene district. New Jersey Mining Company, an Idaho-based company, mined lode gold from their wholly owned, Golden Chest mine just east of Murray. Production was both from underground and an open pit with extracted ore trucked to their 360-tonne per day

flotation mill at Kellogg. Multiple orogenic-style gold-quartz veins are localized along the Idaho fault at the mine. Ore grades were in the 3 to 5 gram/tonne range. The company purchased a new CAT haul truck and loader. Production was approximately 4000 to 5000 ounces of gold per year. The company hosted a Belt Association field trip in September 2018.

Near Elk City, the Finnish company Endomines acquired TVL Gold LLC and the underground Friday mine, located along the Orogrande shear zone west of Elk City in Idaho County. The company did development and pre-production work in 2019 along narrow gold veins localized between the Monday and Friday faults. However, their flotation and gravity mill southeast of Elk City proved to be a long haul from the mine, and the tailings pond suffered damage from a harsh winter, hampering operations. Endomines also acquired the Buffalo Gulch and Deadwood deposits nearby, as well as the Rescue mine at Warren and the Kimberly gold mine in the Marshall Mountains.

PHOSPHATE MINING

Southeast Idaho's Phosphate District includes three large open pit mines and three processing plants, and all were in full operation (Fig. 5). Production was estimated at approximately 4 to 5 million tons of phosphate rock from the mines in Caribou County. The resource is part of the Meade Peak member of the Phosphoria Formation, a black phosphatic shale deposited over parts of Idaho, Wyoming, Utah and Montana in the Permian about 265 million years ago. The ore mineral is fluorapatite and ore grades are in the 25 to 30 weight percent P_2O_5 range. The shales are also enriched in trace elements such as carbon, uranium, vanadium, selenium and rare earth elements. As recognized in the 1990s, selenium is enriched dominantly in the middle waste shales and easily released when oxidized waters percolate through old waste dumps. The companies and agencies have been addressing this issue by capping old dumps and new overburden piles, plus segregating and backfilling waste rock to prevent oxidation and water contact at active mines.

Long-time phosphate miner Monsanto was acquired by international chemical and pharmaceutical producer Bayer in 2018, and Agrium was acquired by Itafos. The third company operating in the area is J.R. Simplot, a private, Idaho-based company. The phosphate rock was processed locally into phosphoric acid for fertilizer (Agrium/Itafos plant at Conda and Simplot's plant in Pocatello) or into elemental phosphorus (Monsanto/Bayer's plant at Soda Springs). Each of the company's mines and processing plant employs several hundred workers, providing a substantial economic base for southeast Idaho.

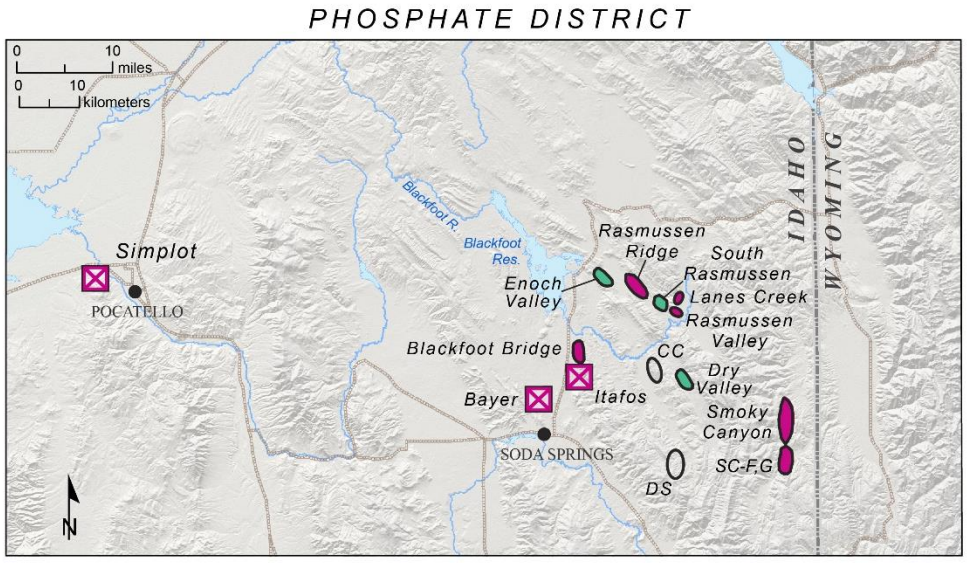

Figure 5. Location map of Phosphate District of southeast Idaho. Active open pit mines are in red ovals; green ovals are mines in reclamation; squares with red Xs are plants. DS is Dairy Syncline; CC is Caldwell Canyon property.

J.R. Simplot operated the Smoky Canyon mine near the Wyoming border. The F panel, or Manning Creek lease, was mined in both 2018 and 2019, and the G panel, or Deer Creek lease, accessed for mining in 2019. Simplot segregated the waste rock to isolate the more Se-rich material into infiltration-limited covered areas during concurrent reclamation (Fig. 6). The final Environmental Impact Statement (EIS) for the Dairy Syncline mine plan was released on November 8, 2019. The agency's preferred alternative was to allow mining with modifications. The property would have a 30-year mine-life. A smaller project, the East Smoky panel expansion, draft EIS went out for public review in September 2018.

Bayer took over operations at the Blackfoot Bridge mine after their acquisition of Monsanto. Mining by their subsidiary P4 continued in the North pit and then the Mid pit with backfilling of the North pit. The mine installed geosynthetic clay/laminated layer covers on the external overburden or waste rock piles during concurrent reclamation. In 2019, Bayer drilled 8,900 feet of exploration drilling in 28 holes on the Trail Creek lease; roads and pads were reclaimed. In August 2019, the agencies (Bureau of Land Management and U.S. Forest Service) issued a Record of Decision (ROD) approving the mine plan for the Caldwell Canyon property. The Draft EIS had been released November 30, 2018, for public review after the EIS process started in March 2017 following several years of study. The proposed Caldwell Canyon mine would have a 40-year mine life, and initial overburden would backfill the old Dry Valley mine of FMC.

Agrium's Conda Phosphate Operations, including the plant and active mines and leases, were sold to Itafos in late 2017 as part of a corporate merger and acquisition deal. Nu-west, was reorganized into a new company, Nutrien, retained ownership and responsibility to manage the reclamation of the older mines, including the South and Central Rasmussen Ridge property. Itafos began ore production at the Rasmussen Valley mine in early 2018 to supply feed for the Conda fertilizer

plant. In a novel collaboration, the initial overburden was sent to the nearby South Rasmussen pit which was previously mined by Monsanto and P4. Itafos also mined a private lease at the existing Lanes Creek mine. Itafos' ore was sent to the fertilizer plant at Conda. Stated capacity at the plant is 550 kt per year of MAP (monoammonium phosphate), super phosphoric acid and other products. Itafos was also reviewing exploration and development options for the Husky 1/ North Dry Ridge leases and the Paris Hills underground phosphate area located in Bear Lake County.

Figure 6. Smoky Canyon mine reclamation of F1 N pit in September 2018. Multi-layered caps are constructed over reclaimed waste rock areas.

OTHER INDUSTRIAL MINERALS

Idaho produces a variety of industrial minerals in addition to phosphate rock. Construction sand and gravel was the most widely mined and distributed material but more unique commodities mined included industrial and gem garnet, dimension stone, high-purity pumice and perlite, zeolites, feldspar, bentonite and calcium (Fig. 7). Industrial mineral operations in 2018 and 2019 changed little from prior years as markets were fairly stable, though not stellar. Particularly in southwest Idaho, demand was up somewhat for aggregate and construction sand and gravel. The

smaller industrial minerals plants and quarries are important segments to local economies in rural areas.

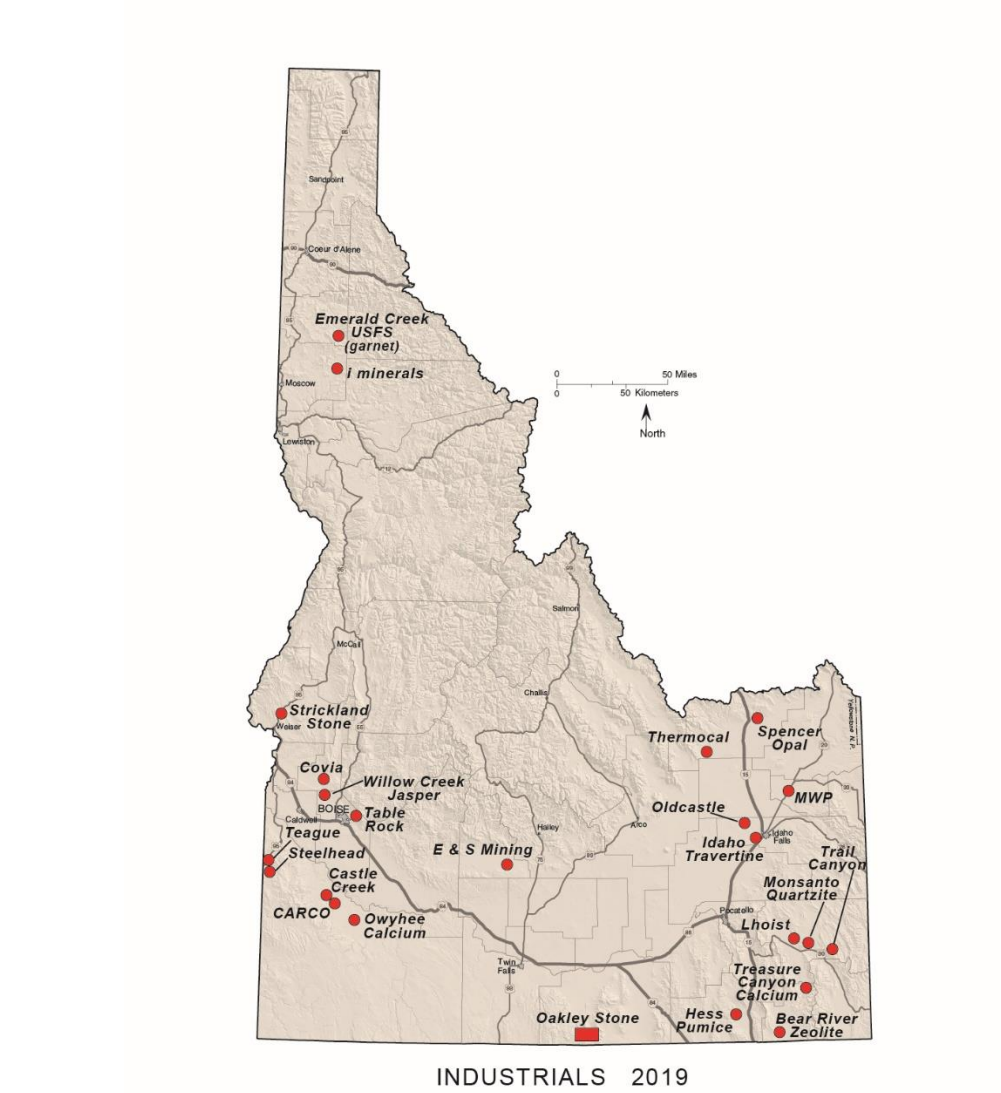

Figure 7. Location of Idaho's industrial mineral operations, excluding phosphate and aggregate quarries, in 2019.

In north Idaho, Emerald Creek Garnet continued to mine alluvial almadine garnets for abrasives and filtration uses. Opta Minerals Inc. owns Emerald Creek; the garnet operations started in the 1930s near Fernwood. Covia Corporation bought Unimin's industrial sand operation in Gem County in 2019. Feldspar and clean quartz were extracted from Tertiary lakeshore sediments and washed and packaged at Covia's plant near Emmett in southwest Idaho. The feldspathic sand is used in glass-making and other uses. Oakley stone, a durable micaceous quartzite which splits into thin sheets was mined by Northern Stone Supply, Sawtooth Stone, Scrivanich and smaller

operations from pits on Middle Mountain in Cassia County. The facing stone is also cut into tiles and exported for use in high-end residential and commercial buildings. Another unique Idaho deposit is the high-purity pumice mined at the Wrights Creek mine in Oneida County. The pumice is processed by Hess Pumice in a plant at Malad. The company uses special screens to separate size ranges of the pumice particles for use in lightweight aggregate and artificial stone, pozzolan, abrasives, filtration, and other markets. Hess also mines and processes perlite and produces grout and pozzolan. One of the only exploration projects for industrial minerals in recent years has been i-minerals' Bovill project in Latah County in north Idaho. The district is a historic clay producer and much of the project area is on state mineral leases. The i-minerals project was evaluating the potential for several commodities, including kaolin and metakaolin, halloysite, quartz and feldspar. Work in 2018 and 2019 included processing optimization studies, engineering, and completion of a 43-101 report by SRK in April 2019. However, the clay business is very competitive with the southeast US being a dominant producer.

ENERGY RESOURCES

Since about 2011, the Idaho Office of Energy and Mineral Resources (OEMR) has documented production, usage and governmental policy related to Idaho's energy use and resources. Hydropower dominates Idaho's energy production and supplies approximately half of the state's consumption. In 2019, OEMR listed hydropower capacity in the state at 2,700 MW from over 140 existing generating plants with the largest being the Hells Canyon Complex on the Snake River and Dworshak Dam on the Clearwater River. However, geothermal power and natural gas production contributed to Idaho's energy portfolio in 2018 – 2019.

OIL AND GAS

Commercial fossil fuel extraction in the western Snake River Plain of southwestern Idaho began in 2015-2016 with oil, gas, and condensate production from Alta Mesa Holdings wells (Fig. 8A). These wells target conventional clastic reservoirs in the Tertiary Glenns Ferry, Chalk Hills, and Payette Formations, located at depths of approximately 1,500 to 6,500 feet. The Willow field, near New Plymouth, consists of eight wells that collectively produced about 2.9 TCF of natural gas, 140,000 barrels of condensate, 100,000 barrels of NGLs, and 90,000 barrels of light oil during the 2018-2019 period. In early 2018, two successful exploration wells: Barlow 1-14 and Fallon 1-10, were drilled and completed near Fruitland, encountering approximately 175 feet of net pay in high-porosity and high-permeability sands (Fig. 8B). Additionally, in the fall of 2018, CPC Mineral drilled the Bell 17-2 exploration well in Bonneville County, southeast Idaho. Although natural gas shows were recorded in the Jurassic Twin Creek Limestone target zone, the well was deemed uneconomical and was subsequently plugged and abandoned. Ongoing petroleum system research

by the IGS in the Western Snake River Plain aims to identify potential source rocks and assess their hydrocarbon-generating potential.

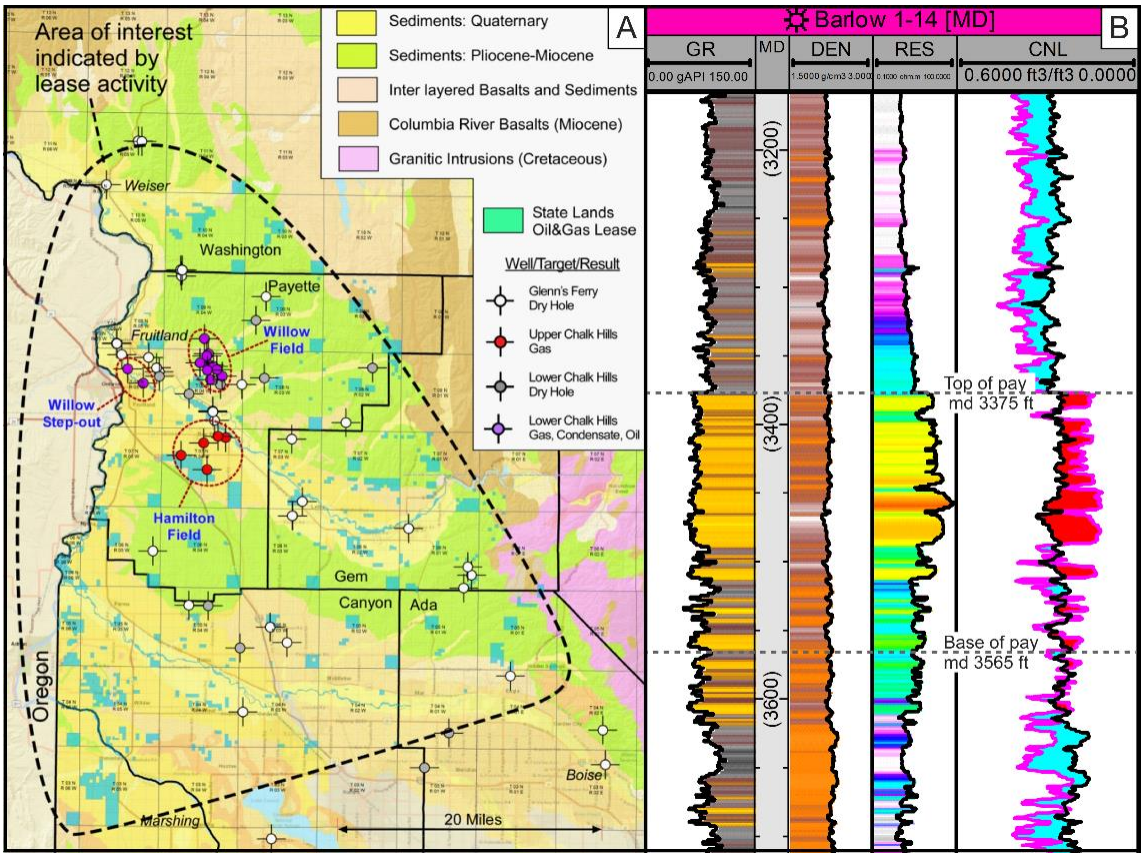

Figure 8. A) Simplified geology and location map of Idaho's hydrocarbon fields in 2018. B) Wireline logs illustrating the hydrocarbon zone encountered in the Barlow 1-14 well. GR is gamma ray log; DEN is density log; RES is resistivity log; CNL is compensated neutron log. Figure prepared by Mark Barton of the Idaho Geological Survey.

GEOTHERMAL ENERGY

Ormat operated the only commercial geothermal power plant in Idaho (Fig. 2). It is located at Raft River in southern Cassia County and provided about 11 MW of net capacity from a binary, water-cooled system. The state also has lower temperature resources which are used locally for heating in both urban and rural systems. In 2019, the U.S. Department of Energy was looking at research into Enhanced Geothermal Systems (EGS) which require reservoir stimulation.

MINERAL EXPLORATION

2018 saw an increase in major drilling programs for hard rock mineral commodities, particularly gold and cobalt (Fig. 9). Numerous drill rigs were kept active in 2018 and 2019 on advanced projects in Idaho. Some of the increased interest was a result of new, more mining-friendly federal government attitudes and policies including the late 2017 cancellation of the proposed sagebrush focal area withdrawals. Relatively stable and robust precious metal prices and a spike in the price of cobalt in 2017-2018 also helped enhance exploration interest. The Bureau of Land Management reported over 6,000 new mining claims filed in Idaho in 2018 and about 5,000 of those were in the Idaho Cobalt belt. Unfortunately, the cobalt price dropped significantly by the end of 2109 down to the $15 per pound range, versus its high of over $40 per pound spot price in early 2018.

NORTH IDAHO

Bunker Hill Mining Corporation, formerly Liberty Silver, was founded in 2017, to explore the historic Bunker Hill lead-zinc mine on the west end of the Coeur d'Alene district. The Bunker produced about 38 million tons of ore between 1885 and 1981 when the mine and smelter closed as the former owner, Gulf Resources, went bankrupt, laying off 2200 workers and opening the site to a now-completed CERCLA cleanup. The new company had financing problems and defaulted on their lease-purchase agreement with owner (Placer Mining Corp.), but in November 2018, the company renegotiated to reduce the payment for a year. It was also in discussions with the Environmental Protection Agency (EPA) about assuming costs of the water treatment plant in return for needed permits. The lease-option agreement was amended again in October 2019 for nine months and more favorable terms. A large zinc resource in the Quill zone and other areas was identified prior to the mine closure.

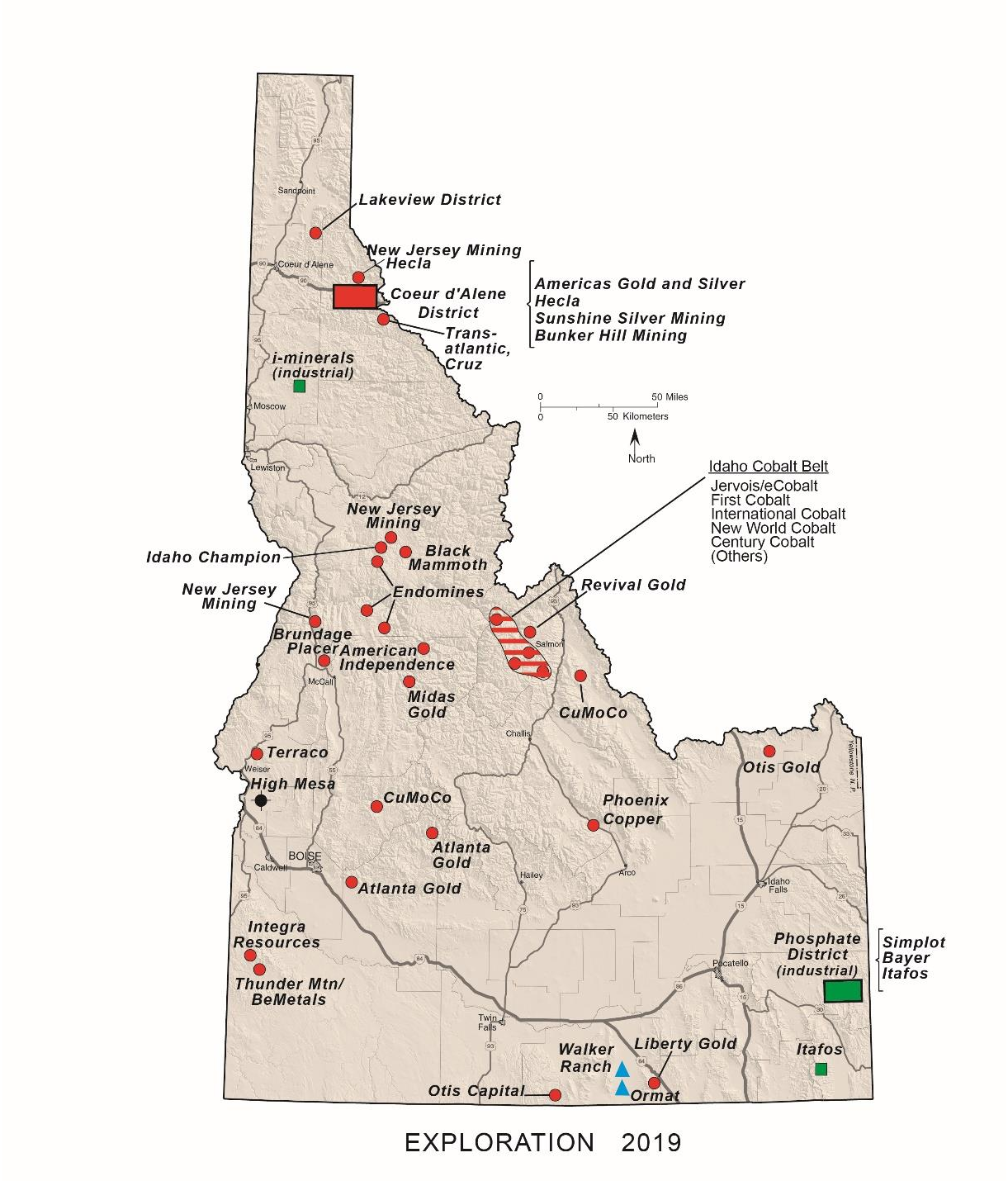

Figure 9. Location of major mineral exploration projects in 2019. Green rectangles are for industrial minerals; blue triangles are geothermal plants and projects; black crosshair is petroleum; all red dots and polygons are for metal exploration projects.

At Murray, Hecla did surface work and drilled 11 core holes on their Little Baldy project along the East Fork of Eagle Creek. They purchased the Tobbogan claims from New Jersey Mining and staked additional land. Mineralization is present as orogenic-style gold-quartz veins hosted in Belt metasedimentary rocks. The veins were likely contributors to the Murray gold placers.

New Vulcan Hill (NVH), a private company, did minor work on their polymetallic mining claims in the Lakeview district just south of Lake Pend Oreille.

West of the town of Elk City, Idaho Champion drilled at the Baner gold mine. They had good results along 500 meters of strike of the deeply oxidized zone which splays off the main Orogrande shear (Fig.10). Champion drilled 5,200m in 19 core holes in 2018 with intercepts including ICG2018-13 with 5.76 g/t Au over 12.65m at a shallow depth. Alteration around the shear zone is dominantly quartz-sericite-pyrite. Lack of funding prevented work the following year despite the favorable results.

Figure 10. Drilling at the Baner mine project of Idaho Champion, near Elk City, 2018.

STIBNITE-YELLOW PINE, VALLEY COUNTY

Evaluation by the U.S. Forest Service and other regulators of the 2016 NEPA Plan of Restoration and Operations (PRO) for the proposed Stibnite gold-antimony mine in Valley County was ongoing. The project developed by Midas Gold contained over 5 million troy ounces of gold and a significant antimony resource. Research by the Idaho Geological Survey and others has described

a complex history of overprinted mineralization with gold ores developed in an orogenic-style shear setting at approximately 62 Ma, while the antimony precipitated as the mineral stibnite 16 million years later. Due to historical impacts, including mining of strategic antimony and tungsten during wartime, multiple legacy environmental issues make the minesite and PRO plan complex and controversial. Midas proposed mining the gold to help pay for restoration of the site and re-establishment of fish passage up the East Fork of the Salmon River. The company continued metallurgy, geotechnical work, and geologic modelling in 2018, and they drilled several large volume water wells for pump tests in 2019. A draft EIS was anticipated at the end of 2019. However, in August 2019, the Nez Perce Tribe sued Midas over water quality issues and cited them as responsible for prior environmental damage from 100 years of mining. The designated Nez Perce tribal reservation is over 100 km north of Stibnite, but the tribe maintains a claim to fishing rights in the Salmon River watershed. Litigation and legal issues were still active at the end of 2019.

SALMON AREA, LEMHI COUNTY

Revival Gold continued an aggressive program at their Beartrack and Arnett Creek gold projects in Lemhi County near the historic placer workings at Leesburg. The Beartrack mine produced about 600,000 troy ounces of gold from Meridian Gold's open pit, heap leach mine from 1994 – 2000 prior to being reclaimed. Revival conducted 6,500 meters of diamond drilling in 13 holes in 2018. In 2019, the company added 3 core holes totaling 1,230m in the Joss target at Beartrack and 22 core holes totaling 3,830m at Arnett Creek. An NI 43-101 report released in July 2018 calculated a 33 million tonne indicated resource at over 1 g/t Au with mineralization open in several directions. The company conducted additional soil sampling and mapping at Arnett Creek and a 400-line-kilometer airborne magnetic survey along with expanding their land position and doing metallurgical tests. The two deposits at the "BTAC" project are two distinctly different gold-bearing systems that happen to be located within a few miles of each other and close to facilities remaining from Meridian's operation. The Beartrack mine exploited an orogenic-style gold-arsenopyrite vein along the Panther Creek and Coiner fault systems. The enigmatic mineralization at Arnett Creek is highly oxidized and hosted in a series of Paleozoic-age intrusions.

The Idaho Cobalt belt is a well-defined, northwest-trending belt of cobalt occurrences in Lemhi County west of the town of Salmon. Though all the occurrences in the approximately 30-mile by 5-mile belt are hosted in Mesoproterozoic rocks of the Apple Creek formation, the zone trends across geologic contacts and structures. The Apple Creek lithologies are principally siltites and argillites with some coarser sand units. Biotitite, a poorly understood, biotite-rich rock, is associated with some of the mineralized areas in the northern part of the belt. The cobalt mineral is largely cobaltite in the north with cobaltiferous pyrite dominant on the southeast; chalcopyrite is the copper-bearing mineral. Due to cobalt's use in rechargeable batteries and the price increase, several new companies initiated a staking war in the Cobalt belt. The 2018 list of companies included: New World Cobalt, eCobalt, International Cobalt, ePower Metals, Century Cobalt, Hybrid Minerals, Borah Resources, and First Cobalt. The two major companies active in 2019 included First Cobalt at the Iron Creek property and Jervois Mining, an Australian company, at the Idaho Cobalt Project (ICP). Jervois which purchased eCobalt in July 2019 to obtain the ICP and its RAM ore deposit, a 1997 discovery of Formation Capital Corp. (renamed eCobalt), which

is located adjacent to the historic Blackbird mine. By the end of 2019, most claims remained on many of the other land holdings although fewer companies were actively engaged in exploration.

The major cobalt producer was the now-closed Blackbird mine near the townsite of Cobalt in Lemhi County. Geologically, the tightly folded Belt-age metasedimentary rocks, were assigned to the Yellowjacket, and later the Apple Creek or other formations. The depositional age of the rocks is approximately 1.4 Ga. The Blackbird district has been split apparently along several thrust plates, presumed to be from Cretaceous convergence, and varying metamorphic intensity is displayed. The maximum metamorphic grade is garnet facies or higher to the northwest but only chlorite to biotite grade further south. The origin of the ores is debated, though Blackbird mineralization is partly stratabound in a banded siltite unit with multiple ore horizons. Some ore is locally remobilized along fold hinges. Cobaltite ($CoAsS_2$) with pyrite and chalcopyrite is dominant at Blackbird and the RAM, and there is a significant gold credit and locally anomalous rare earths. The best geochronology from recent USGS work suggests that cobalt was introduced early in the system, possibly during or shortly after sedimentation or associated with a 1370 Ma intrusive event, however, the details remain unclear.

In 2018-2019, the Idaho Cobalt Project of eCobalt/Jervois was the most advanced project in the Idaho Cobalt belt. The mine was permitted after discovery of the RAM deposit in 1997 but not developed until recently due to financing problems. Work in 2018 included construction and dirt work for the underground mine portal bench, mill facilities, tailings impoundment and water storage ponds (Fig. 11). In July 2019, Jervois Mining, an Australian firm, purchased eCobalt and the project in a deal valued at $44 million. The permitted NI 43-101 compliant measured and indicated (M and I) resource was listed at 3.87 Mt of 0.59% Co and 0.85% Cu plus 1.82 Mt inferred resource at 0.46% Co and 0.81% Cu, and a gold credit. The project was renamed the Idaho Cobalt Operation, or ICO. Jervois initiated a bankable feasibility study, metallurgy, and a footwall drilling program which intersected two new mineralized horizons. Jervois also initiated a scoping study for a processing facility.

Figure 11. Site overview in October 2018 of the Idaho Cobalt Project.

On the southeast end of the belt, First Cobalt, acquired US Cobalt and the Iron Creek project in June 2018. They conducted 18,000 meters of surface and underground core drilling along the No Name and Waite zones. They completed a Phase 2 drill program in early 2019 for a total of 43 diamond drill holes, along with geologic mapping and interpretation. The No Name deposit is accessed by historic adits on either side of Iron Creek. An additional zone or continuation is exposed in roadcuts above Jackass Creek further east. Mineralization at Iron Creek consists of cobaltiferous pyrite, often with magnetite and some chalcopyrite. In most areas, the copper zone is partly separate from the cobalt zone. Drilling expanded the strike and dip dimensions of the deposit, and the company was updating the resource calculation at the end of 2019. First Cobalt owns a refinery at Cobalt, Ontario.

International Cobalt Corporation, a Vancouver-based junior, reported a “grass roots” discovery in 2018 from surface rock-chip and soil samples south of the Blackbird mine patented claims and mill area in what they called the Raven and Ludwig zones. They also reported enriched rare earth and gold values in soils. Century Cobalt Corporation staked a large land package (the Emperium Cobalt Project) and conducted limited surface work.

An Australian company, New World Cobalt or New World Resources, also known as Codaho, drilled the Salmon Canyon Copper mine property in 2018. The project was referred to as the Colson Cobalt-Copper project; it is located on the far northwest end of the belt and is in schists and gneisses. The mine sits along the north bank of the Salmon River, a sensitive environmental site and a busy recreation corridor, though the property continues to the north out of sight of the river in the Long Tom area. New World conducted an extensive soil geochemical survey, IP survey and drilled 12 holes, totaling almost 5,000 meters (Fig. 12). One intercept on the Salmon Canyon target was 1.1 meters assaying 0.18% Co,1.43% Cu, and 0.74 g/t Au. The Australian company was permitted for additional drilling in the future.

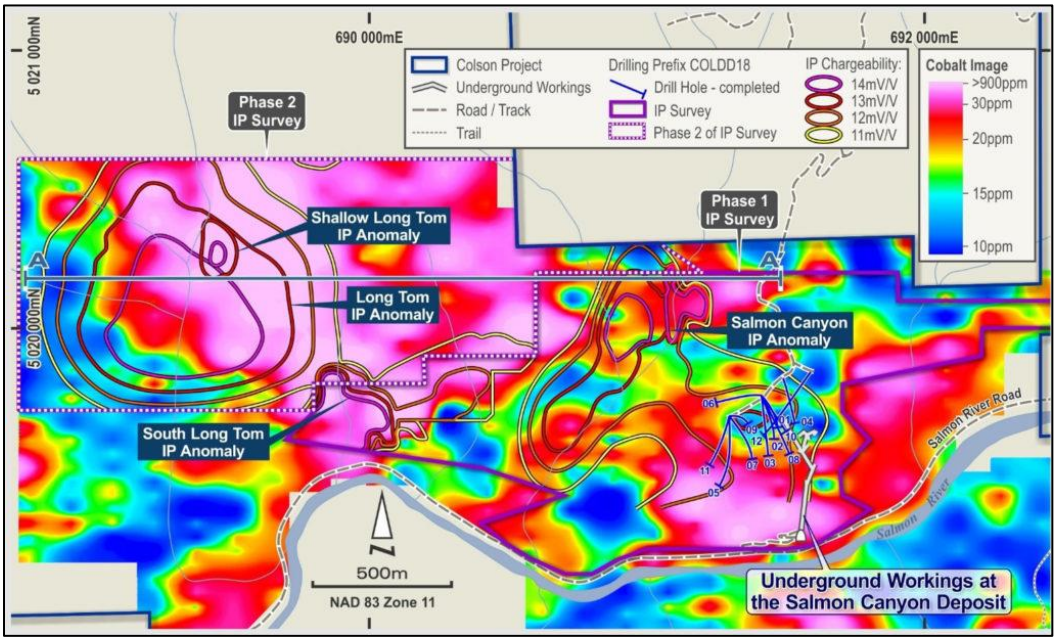

Figure 12. Cobalt in soils and IP targets at the Colson project of New World Cobalt, from company press release June 2019.

EASTERN AND SOUTHERN IDAHO

Otis Gold continued work on their Kilgore project in Clark County during both years. Kilgore is a low-sulfidation, epithermal gold-silver system which is hosted primarily in Tertiary volcanic rocks. In 2017, the company drilled mineralization in a sedimentary unit, the Aspen Formation, which is below the volcanics. Otis filed a new NI 43-101 resource in 2018 with an indicated resource of 825,000 ounces of gold in 44.6 million metric tons at a grade of 0.58 g/t Au. The company did additional soil surveys and flew Lidar. In 2019, Otis was drilling on a 12-hole RC program and completed a preliminary economic analysis for a 5-year mine life operation. Exploration was stymied when the Idaho Conservation League (ICL) sued the U.S. Forest Service over the new drill permit. A ruling was expected near the end of 2019. Kilgore is an environmentally sensitive project due to its location within the Greater Yellowstone region.

Phoenix Copper Ltd., alias PG Mining or affiliate Konnex, continued work on their Empire mine project at Mackay in Custer County. The deposit is a copper-zinc skarn which Phoenix drilled in 2018 (Fig. 13). In May 2019, they released a new NI 43-101 resource for an open-pit, SX-EW (solvent extraction/electrowinning) operation resource containing 73,872 tonnes copper, 29,813 tonnes zinc, 139,000 ounces gold and 6 million ounces silver. Phoenix was working on a bankable feasibility study and environmental baseline work with a drill program planned for 2020. They also staked the nearby Navarre Creek gold and Red Star polymetallic targets.

Figure 13. Blue chrysocolla and other secondary copper minerals along fractures in core from the Empire mine drilling in 2018.

In mid-2018 Liberty Gold, then Pilot Gold, acquired 100% of the Black Pine Project from Western Pacific Resources Corporation for $ 800,000 cash, stock shares and a small NSR payment. Black Pine in Cassia County near the Utah border is a large Carlin-type sediment-hosted gold district. Historically a mercury producer, the district was rediscovered by Noranda in the late 1980s and eventually mined by Pegasus from 1992-1997 with production cited as 435,000 ounces gold at a historic grade of 0.63 g/t Au from shallow pits. The mine closed at a time of low gold prices, but the data and property package was quite large. In 2017, Liberty reviewed the old data, had a small RC drilling program and applied to the Forest Service for a much larger drilling program. Liberty's geologists compiled the extensive data package and developed a 3D geologic and mineralization model. At Black Pine the geology consists of several plates of carbonate rocks displaced along low-angle detachment faults. In February 2019, Liberty received a new expanded plan of operations for up to 370 drillholes. They negotiated access rights with the BLM and commenced drilling in April with a total of 65,000 feet of reverse circulation (RC) drilling in about 90 holes completed in 2019. Six core holes and five large-diameter holes for bulk sampling were also drilled. Liberty reported two new mineralized zones from the drilling.

Integra Resources drilled another large precious metal project at the DeLamar mine in Owyhee County of southwestern Idaho. The DeLamar district includes three mineralized centers of Miocene-age, low-sulfidation epithermal mineralization, with the historic DeLamar mine operated as an open pit mine by Kinross until it closed in 1998. Production from the old high-grade veins

and the newer open-pit is estimated at about 1.6 million ounces of gold and 100 million ounces of silver. Integra acquired the reclaimed DeLamar mine in October 2017 and the adjoining Florida Mountain project in January 2018. Florida Mountain had been permitted as an open pit mine by Kinross, but there was only minor production before the project shut down due to the low metal prices. Integra quickly drilled over 20,000 meters in 2018, including some deep intercepts of good grades (over 5 g/t Au Eq) in the classic Trade Dollar vein system of Florida Mountain (Fig. 14). They also conducted metallurgy work, did airborne geophysics and surface soil sampling. The NI 43-101 compliant resource released in October 2019 listed an M & I resource of 3.9 Moz AuEq plus another 500K oz AuEq inferred.

Fig. 14. Core drilling in the Florida Mountain pit, of the Stone Cabin mine at Integra's DeLamar project in July 2019.

Also in Owyhee County, BeMetals explored the zinc skarn and high-grade polymetallic replacements at South Mountain, a private land package leased from Thunder Mountain Gold, a Boise-based company. BeMetals drilled 20 holes from underground at South Mountain (Fig. 15). Results included a 12-meter intercept of 18% zinc and 1.5% lead with 122 g/t Ag and 4 g/t Au.

Figure. 15. Dark sphalerite and pyrite in core from South Mountain, Idaho, 2019.

STATE ACTIVITIES 2018-2019

The Idaho Geological Survey had a very active geologic mapping program. From 1993 to 2018, the IGS received $ 4.3 million for geologic mapping through the Statemap program of the U.S. Geological Survey (USGS) and published 208 maps. Geologic maps and other publications are posted on the IGS website (www.idahogeology.org) and available for free downloads as pdf documents. In many cases GIS data is also available. In 2019, mapping was focused on the Salmon, Weiser, Preston, and Elk City areas, while new quadrangles in the Idaho Cobalt belt were funded by the USGS's Earth MRI program since cobalt was a critical mineral. Another new mapping project was an industry-funded, 1:24,000 scale map of two quadrangles centered around the Integra DeLamar mine project in Owyhee County.

The Survey debuted a new mines web application on a redesigned IGS web site. The map-based application makes it easier to search for information on the over 8,800 mineral properties in the database. Searches can be done by name, commodity, location, surface land management and

PLSS. A revised version of the mines database (DD-1) with additional references was released in 2019.

A major project has been a basin analysis and reservoir characterization to better understand the southwestern Idaho hydrocarbon fields of the western Snake River Plain. Industry collaboration, and particularly review of the seismic lines, has been a major part of the project. Drone-captured imagery of the field outcrop exposures was combined with the 2D seismic lines to document the facies architecture and assist with subsurface interpretations. The project is ongoing.

Hydrogeologic characterizations and groundwater modeling of the Big Lost River Basin and the Raft River Basin were also underway with funding from the Idaho Department of Water Resources and collaboration of the USGS. Geologic hazard studies included mapping of the Bear Lake fault and a paleoseismic investigation and a new effort to develop a state landslide database.

In minerals, the Idaho Department of Lands and the Idaho Mining Association passed legislation in 2019 to revise the state's regulatory oversight to include the surface impacts of underground mines and update various financial costs. The IGS commented to the state's Office of Energy and Mineral Resources on several wilderness and federal Forest Plan proposals. A new IGS Bulletin 31 was published in early 2019 with results of a multi-year, multi-collaborator investigation into the geology, hydrothermal alteration, and timing of gold-antimony-tungsten mineralization of the Stibnite Mining District. Also in 2019, as noted, the Survey celebrated its 100th Anniversary and inducted a new State Geologist.