IDAHO MINING AND EXPLORATION, 2022

VIRGINIA S. GILLERMAN
IDAHO GEOLOGICAL SURVEY, BOISE
2022 HIGHLIGHTS

- Critical Minerals are Critical!
- Metal Prices Good but Down from 2021
- New Cobalt Mine Opens
- Drill, Drill, Drill
- Covid – minor issue
- Salmon Area – Moose Fire Delays
- Silver and Phosphate Districts Full Production
- Several Advanced Projects Advance
- CHALLENGES: Labor and Supplies availability and Inflation

Jervois’ Idaho Cobalt Operation – Oct. 2022
ACTIVE MINES: WORLD-CLASS DISTRICTS

- **Coeur d’Alene District:**
  - GeoNote 47: Silver Valley Production (2000-2020) and Total
  - 1884-2020: 1,256,535,306 tr. oz. Ag or 39,083 metric tons Ag
  - 7.8 M metric tons Pb
  - 3 M metric tons Zn + Cu, Sb
  - 2 underground mines operating; one in re-opening

- **Phosphate: Going Strong**
  - 22 % of US phosphate rock
  - 4% of global phosphate production
  - 4 large mines (open-pit)
  - $ 2 billion value-added products to US economy
  - ~ 1200 direct jobs

- **Processing Only:**
  - Mo concentrates, Centerra’s Thompson Creek Mill

- **Gold Mines:** Murray, Elk City
HOST ROCKS: Mesoproterozoic Belt Basin

VEINS: Quartz-siderite-sulfides (galena-sphalerite or tetrahedrite-rich)

ORIGIN: syngenetic metals (1.4 By) + Cretaceous metamorphic veins?

PRODUCTION: HUGE! Top 10 Ag Districts in World (> 39,000 metric tons Ag)

GALENA MINE DDH 55-144
2022 Update:
• Full year of full production after labor strike, 2017-2020. **Approx. 3.5 M oz. Ag in 2021. ~ 4.3 Moz in 2022.**
• Infrastructure improvements.
• New longhole blasting method.
• Underhand closed bench (UCB) mining method. Uses longhole blasting. Reduces seismic risk in stopes.
• *UCB increased productivity and eliminated need for remote mining machine.*

CDA veins are quartz (white)-siderite (tan) – sulfides. Gray in this photo is galena (PbS).

Mining Gold Hunter veins. Reserves to 8200 level.
Gold Hunter 30 vein Long Section

**UNDERHAND CLOSED BENCH MINING METHOD**

Large scale blasting proactively manages seismic risk and increases throughput

- The UCB method uses advanced drilling and blasting techniques to fragment the mineralized ore zone
- Safer: miners work below engineered backfill and above a de-stressed zone
- More Productive: larger and less handheld equipment, more task-based mining
- Allows for greater control of the release of seismic energy, resulting in improved safety

“Increased productivity by 42% from 2016 to 2021.”
(Wes Johnson, Hecla engineer, at IMC)
AMERICAS GOLD AND SILVER CORPORATION:
GALENA MINE COMPLEX
(JOINT VENTURE INVESTMENT WITH 40% ERIC SPROTT)

- Phase 1 (ended June 2021); Phase 2 Underway:
  - Massive, successful exploration
    - 120,000 feet drilling + 45,000 feet exploration/definition drilling in 2022
    - Silver Vein in 55-216: 1.2m @ 4000 g/t Ag and 3.9% Cu
  - Replaced reserves and increased resource (+ 38% P & P; + 72% increase M&I, + 36% inf. Ag in 2021)
  - Galena Hoist replacement 70% complete; Rehab and development work on 7500 feet of drift
  - New mining equipment

Galena mine: 1953-2022
238 million oz. Ag
Galena Hoist Replacement – concrete pours complete, electrical installation in progress; start-up near end 2022. $ 9 M project.

Geologist C. Samson, 3200 level

Driller’s Helper and Core, 3700 level

Deepest resource is 6400 feet below ground and open at depth.
IDAHO STRATEGIC RESOURCES (IDR): (FORMERLY NEW JERSEY MINING), LISTED ON NYSE

2022: IDR increased mining and milling tons, working toward 20,000 oz./yr. Company-owned drill rig; drilled new high grade shoots on Klondike, Joe Dandy, and Paymaster veins. End of 2021, completed 25 core holes (6507m) with intercepts of 2 – 12 g/t range). Acquired new Alder Creek prospect at Murray. Mill at Kellogg. Also REEs: Salmon area exploration

Endomines
Friday mine, Elk City

• Orogrande Shear
• Underground
• Shipped 1st Au Con, Q2, 2020
• Care and Maintenance for 2022
• Exploration Drilling from underground: 8 holes for 342 m
• 5 holes intersected > 8 g/t Au

Visible gold in Au-quartz vein, Golden Chest mine, 2022
WESTERN PHOSPHATE RESERVE

- Annual production: 4-5 million tonnes ~ 22% of US total
- Idaho: 86 leases, 43,000 acres
  - J.R. Simplot
  - Bayer
  - Itafos
- 3 Processing Plants
  - Phosphoric Acid Fertilizer (Simplot, Itafos)
  - Elemental P (Bayer)
- Permian Phosphoria Formation
  - Meade Peak Member
  - ~ 265 Ma
  - 4 states (ID, MT, WY, UT)
  - Black organic-rich mudstone and phosphorite
  - Enriched in critical minerals (V, U, REEs, F)
- New USGS-funded EMRI project: Geochemical Data Collection and Stratigraphy (IGS-led with MT, WY, UT Surveys)
J.R. SIMPLOT CO.: SMOKY CANYON MINE

2022: Mining F, G; Access through idle Panel B pit to East Smoky. Special use permits needed for Dairy Syncline facility move.
BAYER/P4: BLACKFOOT BRIDGE MINE

• Mining in South Pit
• Backfilling Mid Pit with waste rock from South Pit
• EOP (external overburden pile) constructed and reclaimed
• Cover lysimeters installed
• GCLL installation
BAYER/P4: 
**CALDWELL CANYON MINE (NEW)**

- ROD in August 2019
- Facilities for new mine at site of old FMC Dry Valley mine
- Leases transferred to P4/Bayer in 2021
- Ore stockpile area, load-out tipple
- Dry Valley D-pit will be backfilled with waste rock from Caldwell Canyon mine (Nov. 2022)
- Phase 1 pre-stripping for Caldwell Canyon mine started
- Drilled 53 holes (9495 feet total) in South Pit area
**ITAFOS: RASMUSSEN VALLEY MINE**

- Mine started 2018
- Overburden to P4’s South Rasmussen mine, avoids EOP
- Some overburden to Lanes Creek mine for backfill
- Mining 6 of 9 phases planned
- Itafos also mined and is reclaiming the Lanes Creek mine (private lease)
- Nutrien reclamation at North Rasmussen Ridge in final stage

Phase 6 overburden removal

Phase 5 (depleted)
ITAFOS: **HUSKY 1/DRY RIDGE** (PERMITTING)

- Final EIS published November 2022
- BLM – Forest Service
- Will need Special Use and Stream Mitigation Plan
- Estimated mine life: 14 years
- On-lease disturbance 1,145 acres

Husky lease area with exploration roads
INDUSTRIAL MINERALS

- **GRAVEL, Gravel, Gravel**
- Construction boom
- **Building stone**: Oakley stone, Table Rock Sandstone
- **North Idaho**: *Emerald Creek Garnets shut down in July 2022 by owner Opta Minerals. Maintaining leases.*
- **SE**: Hess Pumice – good year, perlite (sales up); Bear River Zeolite

Your order was prepared millions of years ago - it is now ready for shipment!

[https://www.sawtoothstoneidaho.com/](https://www.sawtoothstoneidaho.com/)

Oakley Stone quarries on
Middle Mountain
4 State of Idaho Leases in Boise Area: Over $1 million in premiums into state coffers. This site is 220 acres total about 4 miles from I-84.

Breaking ground (Aug. 2022) on Blacks Creek State lease: est. 18 million cu. Yards pit run for $355,000 in auction premiums.
IDAHO GEOLOGICAL SURVEY 2022

- Geologic Mapping
  - USGS Statemap, Earth MRI Funding
  - Elk City
  - Weiser/Boise
  - Preston
  - Salmon and Co Belt

- Geologic Hazards

- Groundwater

- Data Preservation
  - Don Adair Collection

- Energy and Mineral Resources
  - Oil and Gas
  - Critical Minerals (EMRI)
    - Phosphoria Fm. REEs
    - Sheep Creek – Mineral Hill Mapping (anticipated)
  - IGEM: Diamond Creek REEs with ISR

www.idahogeology.org

Reed Lewis in the Belt

Don Adair – Boise Consulting Geologist
Idaho Petroleum Systems

Western Snake River Plain (proven)
- Conventional petroleum system in the early stages of exploration and development. **Operator Snake River Oil and Gas**, drilled three wells in 2022 that are in the process of being evaluated and converted to producers. The IGS is involved in research to characterize the petroleum system and its hydrocarbon potential.

South-central Idaho (speculative)
- Possible petroleum system suggested by reports of oil seeps within Permian age strata exposed on the flanks of the Cassia Mountains. IGS intends to collect samples to determine the nature of the hydrocarbons and their possible source.

South-eastern Idaho (speculative)
- Possible petroleum system suggested within the fold-and-thrust belt based on the existence of nearby producing fields in Wyoming and Utah.
August: Release of new USGS-funded, helicopter-flown, airborne magnetics/radiometric survey of Idaho Cobalt Belt. 3 mining companies contributed extra funds. Contractor was Sander Geophysics Ltd. (Ontario, Canada). Flown Fall, 2021 at 200-m line spacing.
Western Phosphate Field Critical Minerals Project

- 3 year, $525K project (Sept. 2022-Sept. 2025) funded by the USGS Earth MRI Initiative involving state surveys from Idaho (IGS), Wyoming (WSGS), Utah (UGS), and Montana (MBMG).
- Project objective is to study the occurrence of critical minerals (REE’s, Cr, V, F) in the Meade Peake and Retort Members of the Permian Phosphoria Formation.
- Current production from the Western Phosphate Field has the potential to produce approximately 5,520 tons of REE’s representing approximately one-quarter of current US demand (Emsbo, 2016).
• Wow! Busy, Busy
• New Cobalt Mine – Jervois’ ICO
• Bunker Hill, Stibnite Gold – “development” with critical minerals
• Advanced Projects near permitting: BTAC, Black Pine, DeLamar
• Cobalt Belt and REEs
• Moose Fire – Salmon Area
• Western Idaho Terranes
BUNKER HILL MINING CORP.: BUNKER HILL MINE
RAPID RESTART

- Updated 43-101
- PFS – October 2022: Phase 1 robust
- Purchased Mine
- Financing – Sprott and other
- Purchased Pend’Oreille Mill
- Moved Mill to Bunker Hill
- Restart Technical Plan
- Private Land
- UG Ramp to connect 5 and 6 levels

Historic Pb-Zn-Ag mine (~ 35 M tons ore, 1887-1982).
Known 8 mt Zn ore reserve (Quill) at closing. Using IGS-preserved mine records in 3D mine modelling.
BUNKER HILL RESTART

Met testing and mine design (long hole stoping)
Mill & processing facility design: Pb, Zn cons
New ball mill (1800 tpd)
Geostats for resource updates –
Geotech study on UG and DDH core
Paste backfill/tailings management – reduces AMD issues
Surface 3D IP survey in 2021 – inversion models and new targets
Historic Asarco drilling below Page workings (2644 ft)
Inc. Crown Point, Ranger, Blackhawk, Wyoming, Curlew and Page mines

Silver Hammer Mining:
Silver Strand mine
- Drone Magnetics
- Phase II Drilling:
  - 11-hole program (1100m) planned
- Underground Ag-Au veins
- N of Coeur d’Alene

SVM 2021 acquisition

SVM New Target Areas:
- Shallow
- IP and Mag Anomalies
- Defining Drill Targets
- Additional Surface Work
- West of Bunker Hill
PERPETUA RESOURCES: STIBNITE GOLD PROJECT

SDEIS: Released Oct. 28, 2022

- FS chooses Modified Mine Plan as Preferred Alternative
- Addresses legacy issues
- Water management
- Reduced tons and disturbed acres
- Public meetings Dec. 6-8.

Public Comments Due: Jan. 10, 2023

4 M oz. Au plus Sb

2022 Consent Order: construction to address historic tails/waste in river
HERCULES SILVER CORPORATION:

HERCULES SILVER MINE

- Western Idaho’s Accreted Triassic - Jurassic Arc Terrane
- Acquired Anglo-Bomarc in 2020
- Extensive Data Package (Don Adair)
- Digitized to GIS: 300 historic DH
- Historic IP, Soils, etc.; 3D Leapfrog
- New Geologic Mapping and Soil Survey, Terraspec Analysis, 3D IP survey

Name Change from Bald Eagle

RC drilling started in October
EXCELLON RESOURCES: KILGORE

Kilgore Project 2022:
• 6 DDH, total 7037 feet (2145m) with deepest 1572 ft.
• Tertiary volcanics and underlying Aspen Fm.
• IP and MT geophysical survey
• Assays and results pending; reclaimed disturbed areas
• ICL/GYC lawsuit against FS Nov. 2021 DN/FONSI
• Prior work by Echo Bay, Otis Gold (2019 Tech Report)
  • ~ 800K to 1 M ounces Au resource

Eastern Idaho
Epithermal Au-Ag system in Clark County, 45 miles west of Yellowstone NP

JV with Centerra Gold:
• Oakley – Blue Hill Project
• 7 DH – Cold Creek (3), Blue Hill (4), 4003 feet total
Human-caused July 17. Burned > 130K acres; 2 pilots killed.
REVIVAL GOLD: BEARTRACK & ARNETT CREEK

- Two projects – 2 systems
- **Arnett**: Heap Leach Oxide Au
- **Beartrack**: Orogenic Au system mined by Meridian by open pit, heap leach Beartrack mine
- Expanding 2022 indicated resource of 65 M tonnes @ 1 gpt Au + 46 M tonnes inferred (**4 M oz. total, heap + mill open pit**)
- Initiated PFS engineering work (mid-2023)
- Deep high-grade zones: Joss (1000m strike) with grades of > 7 gpt Au over 5 m drilled in broader zone
- BT22-243D had 7.9 gpt Au over 2.9 m and 47 m of 2 gpt Au at S end South Pit
- Mine facilities and Leesburg townsite wrapped for fire and saved
REVIVAL GOLD: BTAC

HAIDEE DEPOSIT

2022 drill program

• 18 drill holes completed to infill & expand oxide open pit material
• Favorable setting and leach recoveries
• Deposit remains open

18.9 g/t gold over 5.3 meters drilled width from 441.4 m to 446.7 m down hole depth within 4.34 g/t gold over 110.6 meters drilled width in BT21-240D

1: 1.5 m @ 13.95 g/t Au
2: 1.2 m @ 23.9 g/t Au
3: 1.1 m @ 12.85 g/t Au
4: 1.5 m @ 22.3 g/t Au

See Revival Gold December 2, 2021 press release for detailed results.

Joss Target Longitudinal Section
SHOWING GRADE-THICKNESS
Beartrack-Arnett Gold Project

Mineralization in some DH holes truncated by post-mineral faulting.

September 2022
FREEMAN GOLD: LEMHI GOLD PROJECT

- Near North Fork and Moose Fire
- Oxide, near surface Au – fractured rocks
- July 2022 NI43-101 resource of ~ 750K oz. Au @ 1 gpt indicated + 250K oz. inferred
- Phase 2 drill program > 13,000m in 57 holes
- Metallurgy and PEA in progress
- Patented ground

Former AGR property. Placer area

GF22-001C had 55m of 0.55 g/t Au; inc. 18 m at 1.1 g/t

- Drilled 10 holes in 2021 for 2063 m
- Low-sulfidation, epithermal system with brecciated quartz veins
- Some encouraging intercepts:
  - BG21-06 with 3 gpt Au over 11m
- Just off Panther Creek (and fault zone?) by historic Gahsmith Gold mine
- CSAMT: Resistive zones
CRITICAL MINERALS IN IDAHO: IDAHO COBALT BELT AND REES

• REEs: permanent magnets used in cell phones, electronics, wind turbines, cars and jets, defense applications and other high tech

• Rare earth elements (REEs):
  • La, Ce, Pr, Nd, Pm, Sm, Eu, Gd, Tb, Dy, Ho, Er, Tm, Yb, Lu, + Y

• Co: Li-ion batteries, superalloys, etc.

IDR Map: Expanded land holdings to 11,000 acres in REE-Th Belt (12/22)

Megado Minerals’ North Fork REEs Project: Mineral Hill Dist.: Acquired in June 2022; historic exploration Ti, Nb, REEs with grab samples to ~ 3% TREO
COBALT BELT AND REES IN LEMHI COUNTY
Superimposed on new USGS airborne magnetics

Legend

- Exploration Project (CuCo)
- Exploration Project (Au)
- Mine (CuCo)
- Cobalt Mines and Prospects (IGS)
- Ylab
- Ylac
- Clear Creek Special Management Area
- Lemhi County
- Salmon River
- City

REE Exploration:

- Diamond Creek (IDR)
- Roberts (IDR)
- Mineral Hill – N. Fork (IDR, Megado)

Geology modified after Bookstrom et al., 2016.
Drilled 12 holes for ~ 4,000 feet
July – pulled drill rig off due to Moose Fire
End of October – finished drilling before winter
Trenched Lucky Gem prospect
IDAHO’S NEW COBALT MINE: JERVOIS GLOBAL
IDAHO COBALT OPERATION (ICO)

- October 7, 2022:
  - Official Opening of Jervois’ Idaho Cobalt Operations (ICO) Mine

- Attended by Idaho Gov. Brad Little, Australian Ambassador to U.S., the Hon. Arthur Sinodinos, DOE Undersecretary for Science Dr. Geri Richmond, plus Jervois’ executives and others.

- Only U.S. cobalt mine; full capacity by end Q1 2023. Co concentrate to SMP refinery (Brazil). ~ $108 M development budget.

- Drilling: 46,000 ft. infill and expansion; completed 28,000 ft. Switch to underground drilling for winter.

- Underground ramp and infrastructure construction with two portals at RAM deposit.
IDAHO COBALT OPERATION: RAM PORTALS

Oct. 2022 Surface mill construction: Co, Cu cons

Host: Apple Creek Banded siltite (metamorphosed)

July 2022 East and West Portals, RAM deposit.

SMD is mining contractor. Spiral ramp decline; ore dips 55°; standard cut and fill mining.
ELECTRA BATTERY MATERIALS: IRON CREEK PROJECT

- Hydrometallurgical refinery and Battery Complex in Ontario, Canada
  - Recycling: Li-ion batteries, black mass, etc.
  - Scoping study – Ni sulfate product
  - Primary ore feed (i.e. Iron Creek)

Kasparite (Mg-Co sulfate)

Dan Pace at Ruby Zone
ELECTRA BATTERY MATERIALS: IRON CREEK (CU-CO) DEPOSIT

- Drilled 43 DDH in 2019 and 43-101 resource
- 2020 IP/Resistivity survey; metallurgy for cobaltian pyrite.
- 2021: 6 holes
- **2022: 1,674 m focused on Ruby zone**
- Research (CSM, IGS) and Metallurgy
- More soil sampling, permits for additional drilling

Ruby zone: 1.34 % Co in IC22-03
KOBA RESOURCES: COLSON (SALMON CANYON CU), BLACKPINE CU-CO PROJECTS

Significant prior exploration work by Codaho and Formation Capital.

2022 Work

- Blackpine IP survey; drilling at Swift (458m in 3 holes).
- Colson Project UG sampling, 2 DH (986m) – LongTom, Rattlesnake. Affected by Moose Fire.
- Assays pending.

Colson Project: Salmon Canyon Copper mine: 1964-1979 Cu-Co-Au ore from underground

2 other project areas in Co Belt, Li in Canada

LIBERTY GOLD: BLACK PINE PROJECT (SOUTHEAST IDAHO’S GOLDEN BLACK PINE)

Former Pegasus mine; Carlin-type, Au deposit with cluster of multiple deposits.

2022 Drilling: RC, ~ 65,000 meters
263,000 meters drilling (2021)

- Outdated - July, 2021, Initial Mineral Resource of 1.7M ounces Au indicated @ 0.5 gt Au
- Q1 2023: update mineral resource
- Drill permits over large area
- Acquired water rights Q4 2022; hydrologic studies
- Metallurgy and baseline environmental work
- Drill permitted for large area
- In the desert! – no fish, streams
- 3 RC drills in field still

Stacked plates of Oquirrh Fm. clastics, limestones

CD Pit with range-front fault

Rangefront Discovery (2021)
LIBERTY GOLD (NOVEMBER PRESENTATION – OXIDE GOLD IN GREAT BASIN)

Black Pine Opportunity

- 7 km-long section illustrates shallow nature of oxide gold mineralization and room for expansion
- Gold within reach of a drill and also a pit across the permitted area
- Large gaps in gold mineralization remain to be tested, including Discovery Zone to Back Range

2021 new discovery
INTEGRA RESOURCES: **Delamar, Florida Mtn, & More**

- Drilling @ Florida, Delamar, Black Sheep greenfield targets
- Permitting – MPO (mine plan) for end of 2023
- Environmental: Acid-Base and Column Tests, Fish/Wetlands surveys
- **Heap leach scenario (8-year mine-life) with mill option later**
- 11,000 m drill program on low-grade stockpiles:
  - Estimate ~ 60 mt of oxide ROM stockpile could extend mine-life.

Silver City District Historic Production: ~ 1.6 M oz. Au and 100 M oz. Ag
Good drill results after Jan. 2022 resource estimate.
(Total P & P of 1.8M oz. Au, 92M oz. Ag)

"Hey guys, are there fish in these desert streams?"
New Discovery

Best Silver Assay: 14 kg/t Ag
80.40 g/t Au and 14,054 g/t Ag
in 397 m of 1.66 g/t AuEq.  (IDE-22-228)

Sullivan Gulch:
New vein zone
Adjacent to PFS
2022 pit shell

Naumannite Crystals

Check Integra’s website for more and future updates.
THANK YOU!

• Many other great projects:
  • Phoenix Copper at Mackay
  • BeMetals and Thunder Mtn. Gold at South Mountain
  • Idaho Champion at Champagne mine
  • Idaho Champion and others in Cobalt Belt
  • Western terrane potential: Constantine, Stallion Gold
  • NevGold at Nutmeg Mountain for hot spring gold!
Slide 1: These notes are to accompany the December AEMA presentation on Idaho Mining and Exploration, 2022, by Virginia S. Gillerman of the Idaho Geological Survey. The slides are numbered, and these notes follow in sequence. Material on the slides is not all repeated in the notes, but some additional material was added such that the information is timely up to December 30, 2022.

Slide 2: 2022 was a good but challenging one for Idaho’s mineral industry – particularly in terms of logistics and costs. Inflation and supply chain issues and delays, as well as the availability of financing and permits, were significant concerns. Metal prices, which had risen in 2021, were decreasing, though still reasonable. Critical minerals were the hot topic – both in terms of policy and on-the-ground activity, and a new cobalt mine, the only one in the nation, opened in the fall in Lemhi County. Many companies reported active exploration and encouraging drill intercepts.
Slide 3: The famous Coeur d’Alene District, also known as the Silver Valley, is one of the top ten global silver producers. GeoNote 47, which is available for download on the IGS website, compiles the past 20 years of production and totals the district’s historic silver production from 1884 through 2020 at 1,256,535,306 troy ounces of Ag, along with major tonnages of lead, zinc, and copper. The district has also produced antimony, a critical mineral. Idaho’s second “world-class district” is the Western Phosphate Field in southeast Idaho which is going strong and produces over a fifth of the U.S. phosphate rock.
Slide 4

GALENA MINE
DDH 55 - 144

HOST ROCKS:
Mesoproterozoic Belt Basin

VEINS:
Quartz - siderite - sulfides (galena - sphalerite or tetrahedrite - rich)

ORIGIN:
syngenetic metals (1.4 By) + Cretaceous metamorphic veins?

PRODUCTION: HUGE!
Top 10 Ag Districts in World (> 39,000 metric tons Ag)

Slide 5

HECLA: LUCKY FRIDAY MINE

16 Stope - Vein
2022 Update:
• Full year of full production after labor strike, 2017 - 2020. Approx. 3.5 M oz. Ag in 2021. ~ 4.3 M oz in 2022.
• Infrastructure improvements.
• New longhole blasting method.
• Underhand closed bench (UCB) mining method. Uses longhole blasting. Reduces seismic risk in stopes.
• UCB increased productivity and eliminated need for remote mining machine.

CDA veins are quartz (white) - siderite (tan) - sulfides.
Gray in this photo is galena (PbS).

Mining Gold Hunter veins. Reserves to 8200 level.

Slide 5: Hecla operates the Lucky Friday mine near Mullan. Production and operations at the deep underground mine were recovering nicely after a nearly 3-year long labor strike. Silver production for 2022 is estimated at 4.3 million troy ounces, up from about 3.5 million in 2021. A major advancement was implementation of a new mining method, underhand closed bench (UCB) mining, which has greatly reduced the risk of rock bursts by relieving seismic stress in the stopes.
Slide 6: The deep resource at the Gold Hunter vein system in the Lucky Friday extends over 9500 feet below surface to below the bottom of the #4 shaft at the 8620 level as is seen on the long section of the 30 vein. The new shaft was completed in May 2016. Rock bursts have been a significant danger at the Friday for many years. The new UCB method uses longhole drilling and blasting to fragment the ore zone prior to mining, thereby releasing the seismic energy and allowing miners to access the ore below engineered backfill and above the de-stressed zone. Hecla engineers noted a 42% increase in productivity from 2016 to 2021.

Slide 7: Americas Gold and Silver Corporation operates the Galena mine near Osburn. The complex includes the nearby Coeur mine and adjacent exploration property. Thanks to a 40% joint venture with Eric Sprott, the company has focused on a major rehabilitation and exploration program at the Galena. Phase 1 drilling ended in June 2021 with 120,000 feet of drilling and Phase 2 is underway with over 45,000 feet of drilling this year to date. Silver Vein intercepts such as 1.2 m of 4000 g/t Ag and 3.9% Cu in hole 55-216 have lead to significant increases in reserves and resources. Replacement of the Galena hoist is 70% complete, and additional rehabilitation of underground workings was underway.
Slide 8: Concrete pours for the new Galena hoist were complete and electrical connections were being made at the mine. The new hoist will enable reliable access to all levels of mine including the deeper resource areas being drilled.

Slide 9: Switching to gold, Idaho has two modest sized gold mines. New Jersey Mining renamed itself Idaho Strategic Resources (IDR) and obtained listing on the New York stock exchange early in the year. The home-grown Idaho company is based in Coeur d’Alene and operates a mill at Kellogg. IDR mines gold from both open pit and underground at the Golden Chest mine near Murray. They increased tonnage during the year with a goal of 20,000 troy ounces of gold annual production. They drilled and drifted on new shoots in the Klondike, Joe Dandy and Paymaster veins. One drift intercepted visible gold in the Klondike vein. They also acquired and drilled four exploration prospects in the Murray district, which was one of Idaho’s first placer gold producers. IDR is also active in exploring for rare earth elements (REEs) in Lemhi County. Endomines, a Finnish company, owns the underground Friday gold mine near Elk City. The mine remained on care and maintenance, but the company did drill 8 exploration holes.
during the year, with 5 intersecting good gold grades.

Slide 10: Idaho’s largest mineral industry is not in metals, but in industrial minerals. Three to four large open pit mines in southeast Idaho’s Caribou County, mine 4-5 million metric tons of phosphate rock annually, about 22% of U.S. production. The three large companies (J.R. Simplot, Bayer, and Itafos) also operate 3 large processing plants in the area that make fertilizer or elemental phosphorus. The ore is sedimentary phosphorite in the Meade Peak member of the Permian Phosphoria Formation. The Phosphoria is known to be enriched in trace elements, some of which are classified as critical minerals. Because of that, the U.S. Geological Survey is funding a new 3-year multi-state study, led by the IGS, to geochemically assess the Phosphoria for its REE potential.
Slide 11: J.R. Simplot operates the Smoky Canyon mine, located near the Wyoming border. Mining continued in the F and G panels with development work underway on the East Smoky deposit. Over the next few years, Simplot’s operations will move to the newly permitted Dairy Syncline area.

Slide 12: Bayer purchased Monsanto a few years ago, including their phosphate operations. Mining continued in the South Pit at the Blackfoot Bridge mine. Waste rock was being backfilled into the Mid Pit.

Slide 13: As seen in this time lapse sequence, Bayer has been installing advanced design, multi-layered covers with geosynthetic liners and clays, to cap overburden piles to mitigate any chance of water infiltration into the piles. Surface or groundwater infiltration has been blamed for oxidation and mobilization of naturally enriched selenium from parts of the ore stratigraphy.
**Slide 14:** In 2019 Bayer and its mining subsidiary P4 obtained a permit for a new mine at Caldwell Canyon, located over the ridge from the now-closed Dry Valley mine. Bayer is using the Dry Valley site and some of the remaining facilities there plus constructing others. They also plan to backfill one of the old pits. Bayer drilled 53 holes and was pre-stripping in the South pit at Caldwell.

**Slide 15:** Itafos is the third company in the area. They mined Phases 5 and 6 at the Rasmussen Valley mine and conducted concurrent reclamation. Mining at the private lease Lanes Creek mine was concluded and reclamation work underway. Itafos ore goes to their phosphoric acid plant at Conda.

**Slide 16:** Itafos is in the final permitting stages for its Husky 1/North Dry Ridge project. The Final Environmental Impact Statement was published in November 2022 and the public comment period due to close near year’s end. Pending final review and approval by the BLM and U.S. Forest Service, additional special use and stream mitigation permits will be needed prior to starting the new mine development. The 1,145 acres of disturbance on the lease will allow an estimated 14 years of new mine life and continued phosphate rock processing at Conda.
Idaho has a number of other, smaller industrial mineral operations. Most numerous and with considerable economic impact are sand and gravel and crushed stone aggregate operations. Dimension stone is quarried at several pits on Middle Mountain south of Oakley, at the Table Rock Sandstone quarry above Boise, and elsewhere in the state. In North Idaho, Emerald Creek Garnet, a long-time producer of industrial garnets from alluvial deposits, was shut down in July by owner Opta Minerals, an international company. The leases are being maintained to preserve future options. Pumice and perlite are mined and processed by Hess Pumice in Malad; Bear River Zeolite continued to operate its quarry and plant near Preston.
Slide 18: Idaho has numerous sand and gravel pits around the state. Near Boise, new leases of state land attracted over $1 million of additional premiums at auction. A busy construction industry demanded more aggregate.

Slide 19: The Idaho Geological Survey (IGS) was very active in 2022. Major programs are listed here and more details and publications are available at the website: [www.idahogeology.org](http://www.idahogeology.org). A collection of maps and files on mineral properties, accumulated by long-time Boise-based consulting geologist, Don Adair, was donated to IGS for archiving. Groundwater studies were published or underway for the Big Lost River and Raft River basins in cooperation with the Idaho Water Board and U.S. Geological Survey.
Slide 20: Idaho’s western Snake River Plain hosts a conventional hydrocarbon system in Tertiary sands and lake beds. Operator Snake River Oil and Gas drilled three new wells. Research by the Survey’s petroleum geologist is underway to characterize the system and assess its potential.

Slide 21: One of the year’s highlights was the release of a new airborne geophysical survey for the Idaho Cobalt Belt west of Salmon. The area was flown to support IGS mapping in the Idaho Cobalt Belt of Lemhi County. The mapping and geophysics are funded by the U.S. Geological Survey’s Earth MRI program. Three mining companies working in the area also contributed dollars to expand the area flown with the helicopter-flown magnetics and radiometric survey.

Slide 22: Another highlight of the year was the start of a new project, summarized here, to geochemically assess rare earth elements (REEs) and other critical minerals in the Phosphoria Formation of southeast Idaho and surrounding states. It is also a USGS funded Earth MRI project and will involve state surveys in Wyoming, Montana and Utah.
Slide 23: 2022 was a very active year for mineral exploration and development projects in Idaho. Highlights are listed here, with the most notable being the commissioning of a new cobalt mine that will be the only primary cobalt mine in the nation. Cobalt is a critical metal for Li-ion batteries used in many high-tech devices, as well as for high quality alloy steels. The following slides provide snapshots of the major projects. For many, assays are still pending.

Slide 24: Starting in the north, Bunker Hill Mining Corporation is working on restarting the huge Bunker Hill Pb-Zn-Ag mine near Wardner in the Silver Valley. Zinc was recently added to the federal critical minerals list, providing an impetus to the effort. The company purchased Teck’s mill at the closed Pend’Oreille mine in Washington and moved it to the Bunker Hill site. In October, they released a Preliminary Feasibility Study which calculated robust economic parameters for a Phase 1 restart of the mine. IGS rescued the historic mine maps and files from the historic mine and those preserved files have been instrumental in the 3D-mine modelling of the ore bodies.
Slide 25: Bunker Hill focused on rehabilitation of the underground workings access ramp and announced in December that the 1800-foot underground decline was completed by contractor CMC between the 5 and 6 levels, allowing access to Level 8 at the top of approximately 2 million tons of mineralized rock off the Newgard ramp. The project restart target is late 2023. Installation of the mill components, including a ball mill, was underway along with other design and construction needs for a new process plant. Engineering and mine design studies are looking at a paste backfill system to manage and reduce tailings, as well as to alleviate potential acid mine drainage.

Slide 26: Silver Valley Metals is in an early exploration stage at their Ranger-Page project, located just west of the Bunker Hill, and encompassing several old mines in the district. The company was reviewing results of 2021 geophysical surveys and conducted surface work and target definition for future drilling. Silver Hammer Mining drilled 11 holes from underground at the Silver Strand mine north of Coeur d’Alene. The precious metal veins there are distinct from the main district. Not noted on the slide was a new exploration project by Sunshine Silver Mining and Refining at the famous Sunshine mine on Big Creek. The Sunshine mine closed in 2001 but it was the largest single silver producer in the district with about 350 million ounces of silver and antimony.
production to its credit from rich tetrahedrite veins.

Slide 27: Switching to gold in central Idaho, another highlight of the year was the long-awaited release of the Supplemental Draft Environmental Impact Statement for Perpetua Resources’ (formerly Midas Gold) proposed gold and antimony mine in Valley County at the historic Stibnite/Yellow Pine mine site. The public comment period ends on January 10, 2023. The preferred alternative is the company’s modified mine plan which includes extensive pre-, syn- and post-mining clean-up and remediation of the legacy issues at the site. Stibnite was a major producer of tungsten and antimony for the U.S. government during both world wars. A consent order with the EPA allowed the company to commence work in 2022 to remove historic tailings and waste material from the floodplains prior to mining. In mid-December, the company announced receipt of a $ 24.8 million Critical Minerals Award under the Defense Production Act. The funds will be used to complete advanced engineering and environmental studies in conjunction with final NEPA
permitting. The aim is to promote domestic production of antimony trisulfide needed for defense-related materials.

Slide 28: For the first time in decades, there was serious exploration in the Triassic-Jurassic accreted terranes of western Idaho. Hercules Silver Corporation, formerly Bald Eagle, acquired the Anglo-Bomarc property in 2020, along with an extensive data package compiled by Don Adair. Silver-rich mineralization is associated with a rhyolite unit within the arc rocks northwest of Cambridge. The company did surface mapping, sampling and IP work along with drilling 9 holes totaling 1,995 feet in the fall to test the Hercules Adit and Frogpond zones. The low-cost track-mounted RC drill rig hit highly fractured ground and the holes had to be stopped in mineralization short of the planned depths. Additional drilling is planned for next year.
Slide 29: Excellon Resources drilled the Kilgore gold project in eastern Idaho; permitting delays and a 2021 lawsuit by the Idaho Conservation League and Greater Yellowstone Coalition had delayed the work. Six core holes for 7,037 feet were drilled to test targets in the volcanics and Cretaceous sediments. Initial results, announced late in the year included EX22KG001 with 0.74 g/t Au over 115.6 meters, including a 0.65-meter interval of 26.5 g/t Au. A geophysical survey of 75 line-kilometers of 3D IP/MT and surface rock-chip sampling program was also completed in 2022. In southern Idaho, Excellon is in a joint venture with Centerra Gold on two area at the Oakley-Blue Hill project, where Centerra drill seven holes.

Slide 30: Lemhi County and the region around the town of Salmon was the loci of intense exploration activity in 2022. Unfortunately, in mid-July, the Moose Fire started near North Fork on the Salmon River and the fire spread south to just above the town of Salmon and west to the historic gold placer mining area of Leesburg, adjacent to the Beartrack mine. The human-caused fire burned into late October and caused havoc on several exploration properties as well as for the many local residents and tourists floating the rivers.
Slide 31: Revival Gold continued work on its two advanced projects, Beartrack and Arnett Creek, though with delays and logistical complications from the fire which was easily visible from the reclaimed leach pad of the Beartrack mine facilities. Revival continued drilling with 4 core holes on the Joss zone where they have previous intercepts south of and below the South pit mined by Meridian. Indicated Beartrack-Arnett mineral resources are 65.0 million tonnes at 1.01 g/t Au (2.11 million ounces) plus another 46 million tonnes at 1.31 g/t Au inferred.

Slide 32: At the Haidee deposit at Arnett Creek, 18 drill holes for 2,900 meters were completed to expand and infill the oxide, open pit gold resource. Assays were pending. Four diamond drill holes totaling 2,600 meters were completed at the Beartrack-Joss zone. Deep drilling at the Joss zone, located just south of the Beartrack mine, intersected high-grade gold (> 7 g/t Au) in three of the four holes where deep mineralization was intersected west of the Panther Creek fault. The fourth hole had weakly anomalous gold on the east side of Panther Creek fault. Overall intercepts of Joss arsenopyrite vein stockwork mineralization in 20 core holes averages 7.7 g/t Au over 5.5 meters drill width within a broad zone of lower grade material. The Joss area is capped by a thick sequence of Tertiary volcanic and sedimentary cover and
the mineralization extends over a kilometer in strike length.

Slide 33: Freeman Gold reported drilling 57 holes at the Lemhi Gold Project near North Fork.

Slide 34: Ophir Gold Corporation did not drill their Breccia property near Musgrove and Porphyry Creeks off Panther Creek, but they did report 2021 results including a 3 g/t Au over 11 m intercept and identification of resistive zones in a CSAMT survey.
Slide 35: Critical minerals were a major emphasis for work in the Salmon area due to federal interest and the localization of two important northwest-trending belts of occurrences in Lemhi County: the Idaho Cobalt Belt (ICB) and the Lemhi Pass – Mineral Hill REE-Th belt. However, the Moose Fire created havoc for exploration efforts of two companies working on rare earths and one of the cobalt explorers. Megado Minerals, an Australian junior company acquired a sizeable land package west of North Fork in part of the Mineral Hill district. They were able to conduct initial surface sampling and mapping of some of the known Nb, Ti, and REE prospects. Idaho Strategic Resources (IDR) expanded their land holdings in Mineral Hill but focused on their Diamond Creek project near Salmon.

Slide 36: This map shows the two belts of Co (green dots and squares and red square) prospects and the REE occurrences (red dots) overlain on the new airborne magnetic survey which was released by the USGS. The new cobalt mine (Idaho Cobalt Operation) is the red square and the green squares show the Cu-Co drill projects in 2022. Companies and REE project areas are indicated by the arrows and list on the right side of the slide.
Slide 37: Idaho Strategic Resources had to delay their core drilling at the Diamond Creek a few miles northwest of the town of Salmon due to the rapid growth of the Moose fire in July. As is evident in the photo, the fire torched the REE-Th vein property but IDR was still able to drill 12 holes, totaling about 4,000 feet in the fall. The veins at Diamond Creek are very similar to those at Lemhi Pass to the southeast. Assays are pending. Samples of the core and surface trench material will be provided to researchers at the University of Idaho and the Idaho Geological Survey as part of the IGEM project.

Slide 38: The highlight of the year for Idaho’s mineral industry was the official start and commissioning of the nation’s only primary cobalt mine, the Idaho Cobalt Operation (ICO) by Jervois Global, an Australian firm. Idaho Governor Brad Little and Australian Ambassador to the U.S., Hon. Art Sinodinos were among the dignitaries who attended the ceremony and ribbon-cutting at the minesite on October 7, 2022. The ICO is located just north of the Blackbird mine and will exploit the RAM deposit which was a 1997 discovery by Formation Capital Corporation. The deposit is open in several directions and Jervois conducted a 28,000-foot drill program to expand and infill the resource. Cobalt concentrates will go to a refinery in Brazil which Jervois purchased.
Slide 39: Surface milling and man-camp facilities for the ICO are located on a flat plateau above the steep hillside where two portals have been driven to access the ore. SMD is the mining contractor and spent the year excavating the spiral ramp decline and needed underground facilities. The cobaltite-bearing ore horizon is likely an extension of the Blackbird zones hosted in the Apple Creek Formation.

Slide 40: Electra Battery Materials’ Iron Creek Cu-Co project is on the southeast end of the Idaho Cobalt Belt. The company has focused on restarting and rebuilding a hydrometallurgical refinery at Cobalt, Ontario for processing primary ore feed but also for recycling “black mass” from Li-ion batteries which contain cobalt. Black mass is the material remaining after a battery is dismantled and shredded. In December, Electra announced the launch of a demonstration plant designed to recover and recycle not just cobalt but accompanying nickel,
lithium, copper and graphite at the black mass processing facility and refinery complex. The Iron Creek property includes the No Name adit zone and the Ruby zone of mineralization, both of which host cobaltian pyrite ores associated locally with chalcopyrite and magnetite. Late in the year, Electra announced that it has signed an option on the CAS property a few miles to the north.

Slide 41: Exploration at Iron Creek in 2022 focused on research metallurgy studies, additional soil sampling, and a modest diamond drill program at the Ruby zone. Four holes, totaling 1674 meters, were drilled. Electra had some impressive intercepts like the one shown – Hole IC22-03 with 1.34% Co – though drilling problems hampered recovery. Work was continuing to better understand the system and to permit future pads in the steep terrain.
Slide 42: Koba Resources Limited, another Australian company, acquired the Colson Cu-Co project from Codaho. Colson is centered on the past-producing Salmon Canyon Copper mine on the northwest end of the Idaho Cobalt Belt and adjacent to the Salmon River. However, extensive geochemical and geophysical work by Codaho in the past few years outlined several targets away from the river corridor. Work and access to the Colson project was severely impacted by the Moose fire due to closures of the river road. The company did manage to conduct underground sampling and drill two holes for 986 meters. Koba also acquired the Blackpine mine, another historic copper producer, located in the middle of the ICB. Formation Capital did considerable surface work and drilling at Blackpine in the 1990s. At Blackpine, Koba drilled 3 holes at the Swift prospect. Koba also has the early-stage Panther and Elkhorn prospects in the ICB. The company acquired two projects with known lithium pegmatites in Quebec and Ontario late in 2022.
In southeastern Idaho, Liberty Gold continued a massive exploration effort on their Black Pine property in Cassia County, site of a former Noranda “re-discovery” and a Pegasus open pit mine and heap leach operation from 1991 through 1998, producing approximately 435,000 troy ounces of gold from several pits. Centered around the historic Tallman or Black Pine mercury mine, the district hosts Carlin-style, sediment-hosted gold mineralization in multiple stacked plates of faulted Oquirrh Formation limestones and calcareous siltstone. Liberty acquired the property and an extensive dataset in 2016 from Western Pacific. Liberty drilled 67,000 meters in 324 holes, primarily reverse circulation (RC) but including 14 large-diameter metallurgical core holes. They expanded mineralization in the F, E, M, CD and Rangefront zones. The later was a new discovery in 2021. Liberty also secured water rights sufficient for a large mining operation and additional land for infrastructure.
Slide 44: The large areal extent of multiple zones of mineralization in the district is evident in the plan map and sections which show the large number of drill holes intersecting gold at grades over 0.6 g/t Au. Hole LBP750 on the southern edge of the Discovery zone intersected 0.60 g/t Au over 80 meters from 24 to 105 meters depth. Three rigs operated into the winter and drilling will continue again in January. An updated resource estimate is planned for the first quarter of 2023.

Slide 45: Over in southwestern Idaho’s Owyhee County, Integra Resources continued work on the DeLamar project, which includes several past mines operated by Kinross. Historic production in the late 1800s was from high-grade epithermal veins. Integra drilled at Florida Mountain, DeLamar, and several areas in the Black Sheep greenfield targets. Environmental baseline and geochemical assessment studies were in progress. Integra geologists were developing new models of alteration and ore controls. A preliminary plan featured a heap leach operation with a subsequent decision on milling; development of a mine plan proposal is targeted for late 2023. An 11,000-meter drill program to assess left-over mineralization in low-grade stockpiles and prior waste dumps was implemented late in the year. Initial results were encouraging and, if viable, that material could add to the heap leach mine-life.
Slide 46: Sullivan Gulch is the area on the southeast side of the De Lamar pit. Integra has discovered a new previously unknown and unmined vein zone at Sullivan Gulch. The drilling has produced several deep, but spectacular intercepts, such as the one shown here from IDE-22-228. The large vug is filled with naumannite crystals, a silver selenide mineral. The gray stockwork veinlets are also mineralized. The silver assay of 14 kg/t Ag is the highest recorded on the project. The interval ran over 80 g/t Au and 14,054 g/t Ag in a wider zone which averaged 1.66 g/t AuEq over 397 meters. Such material would need underground development and a mill operation for processing.
There are many other smaller or less advanced projects underway as well, but there is not time to discuss them in detail. Some are listed here along with the exploration map. At year’s end, BeMetals announced that due to other projects overseas, they were terminating their South Mountain option agreement with Thunder Mountain Gold, Inc., of Boise. The property hosts zinc and polymetallic skarn and replacement-type mineralization in Owyhee County. NevGold discovered a new outcropping epithermal vein near the Idaho-Almaden mine at Nutmeg Mountain and was planning a winter drilling program. More details are available on company websites.