2023 TAKEAWAYS FOR IDAHO

**Highlights**
- Continued federal government and industry interest in critical minerals
- Mines operating
- Good drill results
- New terrains for exploration
- Mining is a topic of public discussion? – even if barely understood
- Major Discovery – Hercules Property, Cu Porphyry?

**Lowlights**
- Judge’s revocation of Caldwell Canyon phosphate mine plan
- Cobalt prices down: ICO on care and maintenance
- Lucky Friday fire
- Prices so-so, costs up
- Permitting times
- Lack of US processing options
OPERATING LARGE MINES

- **Coeur d’Alene District: World-class Silver**
  - Hecla: Ag-Pb-Zn-Cu
  - Americas Gold & Silver: Ag-Pb-Zn-Cu
  - Idaho Strategic Resources: Au
  - Bunker Hill: Development
  - Silver Valley Resources: Exploration

- **Western Phosphate Field**
  - Simplot: Mine, Fertilizer Plant
  - Itafos: Mine, Fertilizer Plant
  - Bayer: Mine, Elemental P Plant

- **Molybdenum**
- **Renew Stripping at Thompson Creek**
COEUR D’ALENE DISTRICT
(SILVER VALLEY)

Ag: 1.26 Billion troy ounces
(39,083 metric tons since 1884)
Pb: 7.8 million metric tons
Zn: 3.07 million metric tons
Cu: 191,000 metric tons
Sb: Yes

Quartz-siderite-sulfide veins hosted in folded Proterozoic-age Belt sediments

IGS GeoNote 47
HECLA: LUCKY FRIDAY MINE

21 Stope LH Top Cut, photo from Hecla Mining Co.

2023: 3 million ounces Ag (to end July)

# 2 Shaft, secondary egressway - fire: August 2023. Shut down rest of year to construct bypass with 1600 feet of ramp and new raise. Insurance expected to cover some costs.

UCB Mining (underhand closed bench) - very successful, productive, reducing risk
AMERICAS GOLD & SILVER: GALENA MINE

Galena Complex JV: 60% Americas 40% Eric Sprott

2023 3rd Qtr. Ag production (209,000 ounces Ag) up 44%; cash costs down vs. 2022.
New Galena Hoist installed and operating. Doubles capacity. Lidar used to image shaft. Final shaft repairs contracted to Moran Mining & Tunnelling Ltd. to be done by end of Q1-2024.

IDAHO STRATEGIC RESOURCES: GOLDEN CHEST MINE

- **GOLD at Murray District**
- **Expanded Au production – mining 791 level, H-Vein and I-Vein**
- **Drilling to extend H-vein and Idaho vein at depth**
  - 18.7 gpt Au over 2.24 meters, below current mine level.
- **Mill at Kellogg**
CENTERRA GOLD: THOMPSON CREEK MO MINE CUSTER COUNTY, ID


Fall, 2023: Centerra PFS - phased restart; commenced stripping to access Phase 8 Mo ore. Hired 20. Stopped toll milling.

Langeloth, PA: Metallurgical facility for producing technical grade Mo oxide

Nov. 2023

Nov. 30, 2023: Mo spot price $25/lb.
IDAHO PHOSPHATE INDUSTRY

- **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 + MT, WY, UT)**
J.R. SIMPLOT COMPANY: SMOKY CANYON MINE

- **Mining F Panel**, Re-access to B Panel and Layback
- **Mined G Panel with in-pit crusher; transitioning out for winter**
- **East Smoky Extension – connect to B pit**
- **Concurrent Reclamation**
- **Slurry line to Pocatello fertilizer plant – small leak fixed**
- **Permitted Dairy Sync line – next mine, long-term**
BAYER: BLACKFOOT BRIDGE MINE

- Overview photo, reclaimed pit in foreground
- Mining in South Pit
- Ore to Elemental P Plant in Soda Springs
- Caldwell Canyon Mine Plan:
  - 2019 EIS and ROD approval by BLM
    - 2 years of construction at Caldwell
  - 2021: Lawsuit against BLM over sage grouse
  - Jan./July 2023: Judge Winmill vacated EIS, ROD
    - Back to the beginning

Blackfoot Bridge mine, Mid Pit and South Pit, looking SW
Nov. 22, 2023: BLM Notice for **new EIS for revised mine/reclamation plan** (RMRP) of proposed Caldwell Canyon mine of P4 Production (i.e. Bayer). Virtual scoping meeting on Dec. 7, 2023. Agency and company hope to fast track the EIS and release draft in mid-2024.
**BAYER PLANT 2023:** REPLACED ORE STACKER WITH NEW, FASTER, RAIL-BASED TIPPLE

Demolition of Stacker/Tripper
COMPLETED SAFELY AND ON-SCHEDULE

BC-04 and BC-05
BC-04 SET IN PLACE, TUNNEL UNDER PLANT ROAD NEARING COMPLETION

BC03 and BC04
CONVEYOR INSTALLATION

Stacker Gantry Base set on tracks
Second Major Milestone
ITAFOS: RASMUSSEN VALLEY MINE

- **Mining Phase 7**
- **Typical dark, black phosphorite**
- **Permitted Husky/N. Dry Ridge - in construction mode 2023**
  - 13-years of ore
  - Haul Road, rail loadout, shop upgrades at N. Dry Ridge portion

Sept. 2023: Rerouting public road

N. Dry Ridge
Geochemical Reconnaissance of Critical Minerals from the Western Phosphate Field of Idaho, Montana, Wyoming, and Utah

- Three-year project, $525,000 grant from the USGS EMRI Initiative. *(IGS and other state surveys)*

- Critical minerals (CM) such as REEs, Vanadium, Chromium, and Nickel are enriched in black shales and phosphorites of the Permian Phosphoria Formation.

- CM represent a potential byproduct from an existing phosphate mining and processing Industry.
Project Timeline and Deliverables

Earth MRI Phosphoria Project Timeline

- **2023**
  - Four-state fieldtrip to mines: 5/2023
  - Historical data compilation: 6/2023-8/2023
- **October**
  - Begin USGS sample submission: 10/2023
  - Summer field work: 3/2024-5/2024
- **2024**
  - Spring field work: 7/2024-8/2024
  - Four-State Fieldtrip: 8/2024
- **2025**
  - Begin compiling report: 11/2024
- **End of Project**
  - Final report due to USGS: 9/2025

Deliverables:

- Database
- Petrology/Sedimentology
- Enriched Horizons
- Regional X-Sections
- Summary Maps
INDUSTRIAL MINERALS 2023

- Many small, long-lived quarries and plants
- Rural areas, private property, family operations
- Recent years: acquisitions by corporations
- Construction sand and gravel – not on map

- Nov. 9 State auction – 89-acre parcel for sand & gravel returned $550,000 premium bid on mineral lease near Boise. Goes to fund for public school endowment.

Thermocal Minerals: Lidy Hot Springs – travertine/calcium
EXPLORATION 2023

- **MULTIPLE COMMODITIES:**
  - Precious and base metals
  - Alloy metals and rees
- **LOOK AT ONLY A FEW LARGER PROJECTS**
- **DOD, DOI FEDERAL DOLLARS FOR CRITICAL MINERALS**
  - State mapping and research, USGS EMRI $
- **PERMITTING TAKES FOREVERRRRRRR; RESULTS CAN BE LITIGATED; NO MINING LAW REFORM YET**
- **SMELTERS AND REFINERIES ARE OVERSEAS**
- **FINANCIAL MARKETS SLOW**
- **METAL PRICES & ECONOMICS IMPORTANT**
- **NEW DISCOVERY IN 2023 !!!!!!!!**
BUNKER HILL MINING CORPORATION:
BUNKER HILL MINE RESTART
AG-PB-ZN

- **Rapid Restart of historic Bunker Hill mine – Newgard-Quill zinc orebody**
- **Water Treatment Plant and Deal with EPA**
- **Site Clean-up, New electrical, etc.**
- **Mill Equipment purchased, on-site**
- **2022: 2000-foot decline to connect #5 and 6 level**
- **Installed new, enlarged Russell portal (16’x16’)**
- **New UG compressor, shop facilities under construction**
- **Tailings/paste backfill design & engineering work**
- **New Mucker acquired**
- **Contractors include Ausenco, Tierra Group, CMC Mining**

Russell Portal – Oct. 2023
SILVER VALLEY METALS: RANGER-PAGE PROJECT

- **Newcomers:** ~ 2020 with experienced geos
- **West of Bunker Hill mine, similar ores**
- **Utilized Ex-ASARCO, other properties**
- **Blackhawk Mine, Crown Point, Ranger, Page and others**
- **No prior modern work**
- **Target intersections of Spring, Government Gulch faults; Leapfrog modelling**
- **IP/Resistivity Survey 2022 and Geochem**
- **2023 Trenching: Vein structures and gossan**
- **(Anomalous to ~ 10pt Ag, plus Pb, Zn leached)**
PERPETUA RESOURCES:
PROPOSED STIBNITE AU-SB MINE, VALLEY COUNTY

- Gold-Antimony mine NEPA Analysis: **FEIS end of 2023?**
- State permitting as well. Lawsuits likely regardless, in spite of settlement with Nez Perce Tribe.
- Multi-million ounce Au + Sb

- **DOD $ 15 funding** to demo military grade Sb-trisulfide concentrate, domestic supply chain.
- **Ammunition Needed**

While we wait, let’s do emergency remediation of tails, material from WW2 era. (EPA ASAOC)
**HERCULES SILVER COMPANY**

**Western Idaho Accreted Terrain**
- Triassic-Jurassic Convergence; Andesitic volcanics, Rhy.
- Anglo-Bomarc work & drilling 1960s-80s.
- Oxide Ag-Mn mineralization widespread at surface
- Large surface Cu Geochem anomaly
- 2022 Phase 1 Drilling – shallower, Ag hits;
- 2022 IP/Hargeability anomaly – part of area

**2023 Program**
- 6,100-meter (~20,000') drilling, 26 holes
- Testing prior IP anomaly at depth
- Intersected “blind” porphyry copper style alteration/mineralization (Phyllic)

**HER-23-05: Announced October 10, 2023**

**185 Meters of 0.84% Cu,**
- 111ppm Mo, 2.6 g/t Ag
- Inc. 45 m of 1.94% Cu

- Conducted 3D IP survey over property
- Acquired nearby Mineral District claims –
  - Historic porphyry Cu exploration

Hercules Mine: Ag-Mn, Copper too!

Mn coatings
November 2023: Barrick Gold purchased 12% of Hercules’ shares

Hercules Rhyolite (yellow) is underlain by andesitic package and 7 Devils volcanics (green). Lots of geology?

For more: Chris Longton’s talk on Thursday

Open in all directions
HERCULES (JAN. 2, 2024 PRESS RELEASE)

HER-23-11: 183 m of 0.3% Cu, 25 g/t Ag.

HER-23-21: 161 m of 0.45% Cu, 4 g/t Ag, 148 ppm Mo
INTEGRA RESOURCES:
DE LAMAR PROJECT

- **Classic Epithermal Tertiary Precious Metal Veins, Owyhee County, Idaho**

- **De Lamar and Florida Mtn. Mines (Kinross Mine Closed ~2000) Historic Production ~1 M oz Au and 100 M oz Ag from Veins, Open Pits**

- **2023: Drilled Stockpile/Backfill with Sonic, RC Drilling. Added 504,000 ounces AuEq. M&I, plus inferred to New Mineral Resource Estimate**

- **Metallurgical/Geotech Drilling**

INTEGRA RESOURCES: DE LAMAR PROJECT

Florida Mtn. Stone Cabin pit, Oct. 2023

GeoTech Drilling - high wall stability assessment
THUNDER MTN. GOLD: SOUTH MOUNTAIN PROJECT
AU, AG, ZN SKARN AND CARBONATE REPLACEMENT ORE, OWYHEE COUNTY

- **Private Land, underground (high grade polymetallic ores); Idaho Company; available**
- BeMetals 2022: Phase 2 drilling
  - 2,400m in 25 holes
- Focus on extending Texas Zone and infill DMEA Zone.
- 2019 (Phase 1, 20 DH for 2,290m):
  - SM19-006: 15.7 m @ 21% Zn, 147 g/t Ag, 8 g/t Au
- Metallurgy and mineralogy studies, 2021
- 2023 updated Mineral Resource: M&I tons UP 7.7%, Inferred UP. Grades > 11% Zn + Ag, Au
Navarre claims:
Au, Ag on fault
Eocene volc./int.
2023: 28 Drillholes
  Initial results, low-grade Au
  Added 400 claims

Empire mine tram house, 2021

Empire Open Pit:
metallurgy, updating resource
LIBERTY GOLD:
BLACK PINE PROJECT, CASSIA COUNTY

- **FORMER PEGASUS HEAP-LEACH AU MINE:**
  - Carlin-style in Oquirrh Fm.
  - Complex structure and late exhumation
- **MULTIPLE ZONES AND PITS; OXIDIZED**
- **DRILLED ALL YEAR; 51 SQ. KM PROPERTY**
- **RANGEFRONT ZONE – NEW DISCOVERY; BACK RANGE**
- **DRILLED 1000TH HOLE THIS YEAR; 160 DH FOR 29,662 METERS IN CURRENT PLAN**
- **PERMITTING AND BASELINE STUDIES INCLUDING WATER AND SAGE GROUSE; UPDATING RESOURCE; MINING PRE-PLAN OPS SUBMITTED TO AGENCIES IN SEPT.**
- **M3 CONSULTING – LEAD ENGINEER FOR PFS**
- **FINANCING: PURCHASED & RESOLD ½ % NSR TO WHEATON.**
LIBERTY GOLD: BLACK PINE PROJECT

2023 RC exploration drill program: 27,461 meters
2024 Pre-feasibility pending

Infrastructure: highway, water well, 25 KV powerline, very few trees, site design
Permitting and NEPA ahead; Forest Service lead
SALMON REGION, LEMHI COUNTY

- STATE MAPPING – STATemap, EMRI, INDUSTRY PROJECTS
- BELT ASSOCIATION/TRGS MEETING – JULY 2023
- GOLD EXPLORATION
- CRITICAL MINERALS: COBALT, RARE EARTH ELEMENTS (REEs)
FREEMAN GOLD: LEMHI GOLD PROJECT

- **Nov. 2023:** Filed 43-101 Technical Report with PEA on Lemhi Gold
  - Open Pit, 80K oz/yr. Operation, 11 years
    - 851,900 oz Au output
  - Carbon-in-leach processing
  - Good paybacks, $190 M CAPEX
- **Drilling 2021-22**
- **Near Old Placer workings**
- **Geology? Highly faulted, flat-lying shears**
- **Grade 0.88 g/t Au average**
- **A Gr's Ditch Creek Discovery in 1980s**
  - Off Pat Hughes Creek, N of North Fork
  - Free gold in oxide zone
REVIVAL GOLD: BEARTRACK & ARNETT CREEK (BTAC)

- Two separate projects and mineralized systems – both Au
- Revival – acquired 2017
- Beartrack Mine (site of Meridian Minerals open pit mine with ~600K oz Au extracted) from NE-trending orogenic Au-As system
- Arnett Creek (historic placers on oxidized Au mineralization) - Haidee, Italian mine, etc.
REVIVAL GOLD: BEARTRACK MINE TREND

• Deep High-Grade Intercepts 10 g/t over 11 m in Joss
• Metallurgical Testing
• Heap Leach Potential for oxide
• Infrastructure partly remains

PFS Aug. 2, 2023: 43-101 by Kappes, Cassiday for Rapid Restart of Heap Leach
REVIVAL GOLD: ARNETT CREEK PROJECT

2023 Drilling: All on Arnett Creek area, near surface oxide gold mineralization. Paleozoic intrusive complex
16 Core Holes, 3400 m
AC23-115D: 3.9 g/t Au over 20 m
AC23-106D: 0.9 g/t Au over 12.8 m
Surface Sampling
Drilled Roman’s Trench, Midlands, Haidee targets
Critical Minerals in Salmon region, ID and MT
Long-term IGS Geologic Mapping Effort

New USGS Airborne Mag/Rad Data Release, ID Cobalt Belt: Phelps, 2022
https://doi.org/10.5066/P9TLBM4U
Rob Morgan showing drill results to TRGS Field Trip at Diamond Creek, July 2023:

Drilled in fire year of 2022.

Massive monazite, Mineral Hill prospect, 2023: Sample 98241: 23 % Total REEs.
IDAHO STRATEGIC RESOURCES:
LEMHI PASS

Trenched, sampled and reclaimed in same day. Trenched 3 prospects. Results pending. Complex geology.
MEGADO MINERALS: NORTH FORK PROJECT

Surface Sampling, Mapping

Hyperspectral Survey

Meeting with Forest Service, regulators to scope Silver King proposed Drill Program (2024). Photo courtesy of Opal Adams.
IDAHO COBALT BELT

- Mesoproterozoic banded/coarse siltite, Apple Creek Fm.
- NW-trending 30-km linear belt.
- Co, Cu prices up: critical minerals. Au, local REEs. OOPS - Down
- Current mapping by IGS
- Two large projects:
  - Jervois Mining ICO (RAM deposit, N of Blackbird mine (B))
  - Electra Battery Materials (Iron Creek, IC) – Env. Work in 2023
  - Koba Resources (BP, SCC), Champion Electric (Twin Peaks)

AGE? Mesoproterozoic with overprinted Cretaceous deformation?

Regional geologic-map inset (after O’Neill & others, 2007), showing the Belt-Purcell basin, the Lemhi sub-basin, and the Idaho cobalt belt.

Geologic Map of the Eastern Salmon River Mountains (after Evans and Green, 2003), showing Co-Cu deposits and Cu-Co prospects of the Idaho cobalt belt. From SE to NW, prospects and deposits are:
- IC = Iron Creek prospect (p)
- BP = Black Pine deposit (d)
- CNC = CoNiCu (p)
- HS = Haynes-Stellite mine (d)
- B = Blackbird Deposit (D)
- SR = Sweet Repose (p)
- TP = Tinkers Pride (p)
- EHC = Elkhorn Cr. (p)
- SCC = Salmon Canyon Cu (p)

Metamorphic grade increases from SE to NW (Nold, 1990).

Bookstrom, et al., 2016: GSA Special Paper 522

Only domestic Co reserves
Primary Co resource
JERVOIS GLOBAL: IDAHO COBALT OPERATION (ICO)

- **Copper-Cobalt-Gold**
- **ICO: Only Domestic Primary Co**
- **Co price down**
- **March 2023, suspended final construction**
- **DOD $15 million funding for drilling and BFS to study construction of U.S. refinery**
  - Site selection underway
  - Prior refinery selection was Brazil
  - Drilling Underway Late 2023 at Sunshine Prospect
  - Deposit open along strike, depth
  - Metamorphosed, complex geology
East portal opened at Idaho Cobalt Operations; November 2021. West portal development is in 110 feet.

April 2022: RAM Portals
Announced 2022 drill program to increase resource base
ADDITIONAL IDAHO EXPLORATION AND STATE ACTIVITIES

- **Sunshine Silver: Ag**
- **Electra Battery Materials at Iron Creek: Co-Cu**
- **Champion Electric: Co-Cu**
- **Excellon: Kilgore Au**
- **Nev-Gold: Nutmeg Mtn. Au**
- **Stallion: Antimony Ridge Au-Sb**
- **EMX: Elk City Au**
- **Idaho Copper: Cumo Cu-Mo**
- **Modroo: Leadville Au**
- **Kennecott: Gilmore Base Metals**

- Geologic Mapping Program
- Data Preservation
- Oil and Gas Production
- Geothermal
- Ground Water Studies
- Natural Hazards

**Thanks!**
Virginia Gillerman, vgillerm@uidaho.edu
Idaho Mining and Exploration, 2023

Presented at American Exploration and Mining Association in December 2023, with added material in January 2024, as presented to Boise Section of SME.

Thanks to AEMA, SME organizers and numerous agency and industry folks for providing information and field tours.

Summary and Takeaways for Idaho Mining in 2023

2023 was a mix of highlights and lowlights for Idaho mining and exploration. The large mines were operating; exploration projects saw some excellent results in old and new terrains, and there was a major new discovery drilled – a copper porphyry system at the old Hercules mine in western Idaho. Data preservation of historic mine information assisted in many exploration projects. Government and industry interest in critical minerals continued, due to supply chain concerns and foreign domination of mineral extraction and
processing. On the negative side, the lengthy permitting times, lack of US processing options, and impermanence of mineral tenure in the US continued. In Idaho, a federal judge revoked the previously approved mine plan for a large phosphate mine (Caldwell Canyon), and the Idaho Cobalt Operation was put on care and maintenance due to low cobalt prices. The Lucky Friday mine at Mullan closed for the second half of the year due to a fire.

Idaho’s Active Large Mines

Idaho has two “world-class” mining districts:
Coeur d’Alene District in north Idaho – in the top ten districts globally for silver production with over 1.26 billion troy ounces of Ag since 1884 plus large amounts of Pb, Zn, Cu and Sb. Producing mines in 2023 were owned by Hecla Mining and Americas Gold & Silver; major exploration projects were underway by Bunker Hill Mining, Sunshine Silver, and Silver Valley Resources. Idaho Strategic Resources operated a gold mine at Murray.
The second world-class district, producing for over a century, was in the Western Phosphate Field of southeast Idaho with 3 companies mining and processing. In central Idaho, there was new activity at the large Thompson Creek Mo mine which was closed in 2014 due to economics.

Metal Prices: Economics is a large part of mining and the mineral industry. These four examples graph the prices of selected metals over the past 5 years, from 2019 till about December 2023. Gold and silver prices were relatively stable and high over 2023. However, the price of cobalt fell significantly in early 2023, affecting operations in Idaho. In contrast, the molybdenum price increased, rising with an early spike but backing down to a still improved price. Metal and commodity prices are set internationally and reflect both supply and demand, but in some cases are also affected by domestic and international political, trade, technological and societal issues.
Map: Coeur d’Alene District (Silver Valley)

Historic production from the famous Coeur d’Alene was tabulated and summarized in GeoNote 47 of the Idaho Geological Survey. Through 2020, metals produced included over 1.26 billion troy ounces of silver, equivalent to over 39,000 metric tons of silver metal, plus 7.8 million metric tons of lead, 3.07 million metric tons of zinc, 191,000 metric tons of copper, and a significant amount of antimony (Sb). The ore consists of quartz-siderite-sulfide veins that cut folded and faulted Proterozoic meta-sedimentary rocks of the Belt Supergroup. On the map, the red squares represent operating mines and the green squares are other mines, several with active exploration projects. All the mines are located in Shoshone County and the district has been mined since 1884.
Hecla Mining Company: Lucky Friday mine

At Mullan, mining at the Lucky Friday was going well during the first half of the year with their new UCB (underhand closed bench) mining technique. The UCB method blasts the ore in the stope and reduces the built-up seismic strain and risk before the actual mining. The company had extracted about 3 million ounces of Ag from the deep (~ 6900 level) Gold Hunter veins through the Silver Shaft (left photo) before a fire started in the #2 shaft (right photo) in August. The #2 shaft is the secondary escapeway for the mine. Operations were shut down and the fire extinguished with no injuries, but the mine was closed for the remainder of the year to construct a bypass ramp and raise connection needed to re-establish the escapeway.
Americas Gold & Silver: Galena Mine Complex

The Galena mine, and nearby Coeur mine, are operated by Americas Gold & Silver, with a 40% stake from Eric Sprott investments. The Galena increased Ag production 44% year to year in the 3rd quarter. The mill, shown here, is a standard flotation mill and ships its concentrates to Trail, BC, and overseas. The funding from Sprott started a couple of years ago and has enabled major rehabilitation of mine infrastructure and a large exploration program.

Galena mine: New Hoist

The Galena shaft has been a bottleneck to mine operations. A new (used) hoist, shown here, was installed in 2023. It will double hoisting capacity. Lidar was also used to “map” the shaft and a contract let to Moran for final shaft repairs. The exploration program included 39,000 feet of core drilled in just the first half of the year. Thanks to the Sprott funds, the company has drilled over 200,000 feet of core since 2019 on multiple
targets in the mine, increasing the silver resource significantly and drilling a number of ore grade intercepts on several deep levels including the Caladay Lead Zone off the 4900. Silver production in 2023 was 2.04 million ounces, a 56% increase over 2022.

Idaho Strategic Resources: Golden Chest mine

Located in Murray, a short distance north of the Silver Valley, the Golden Chest mine is a gold mine, with both open pit and underground operations. Idaho Strategic, a local company based in Coeur d’Alene, also operates a processing mill at Kellogg. At the mine, they increased gold production by mining the higher grade, recently discovered H-vein. The gold-quartz veins are hosted in folded metasedimentary rocks. A drill intercept on the H-vein assayed 18.7 g/t Au over 2.24 meters. The mine had a good year.
Centerra Gold: Thompson Creek Molybdenum mine

The large open pit mine in Custer County, near Clayton, mined molybdenum and produced Mo products from the roaster in Langeloth, PA, until December 2014 when the mine was put on care and maintenance due to low Mo prices and completion of Phase 7 ore extraction. Phase 8 ore, which had been drilled and permitted in 2014, will require approximately two years of pre-stripping. Following a pre-feasibility study for a phased restart, Centerra hired about 20 new employees in the fall and commenced pushing back the high walls and stripping waste rock to access the Phase 8 ore. In late 2023, molybdenum prices were about four times higher than in 2013.
Idaho Phosphate Industry

Idaho’s second “world-class” mining district is the Phosphate district of southeast Idaho. Phosphate, a leasable mineral, is the largest segment of the state’s mineral industry with production of 4-5 million metric tons annually, ranking third among the states. Ore is processed in 3 large plants (red squares on map), owned by Simplot, Bayer, and Itafos, each with mines in Caribou County. Active mines are in red and some recent inactive, reclaimed ones shown in green. The plants produce either fertilizer or elemental phosphorus and employ hundreds of people. The ore is sedimentary phosphorite of Meade Peak member of the Permian Phosphoria Formation, which has been folded and faulted, exposing numerous outcrops in a four-state region. Interest in critical minerals has initiated a new geochemical reconnaissance project, funded by the USGS. Many trace elements are known to be enriched in the mudstone and phosphatic sediments over the 4-state area.
J.R. Simplot Company: Smoky Canyon mine

At the Smoky Canyon mine, near the Wyoming border, Simplot continued mining the F and G panels. They also returned to the B panel, located closer to the mill and a future expansion to the East Smoky lease. As at all the mines, reclamation is done concurrently with mining. The photo shows the black ore in the pit and in the foreground, the green, terraced and reclaimed areas and overburden piles. Pits are infilled as much as possible subsequently to being mined. Milled ore is transported via slurry pipeline to Simplot’s phosphoric acid fertilizer plant at Pocatello.

Bayer: Blackfoot Bridge Mine

Bayer bought Monsanto a few years ago and that included the phosphate operations and the only elemental phosphorus plant in North America. Bayer mined ore at the South Pit of their Blackfoot Bridge mine. The mine is nearing completion of its planned life, and the company was preparing to move to their Caldwell Canyon mine, which
was approved in 2019 by the agencies and had been under construction, in spite of a 2021 lawsuit against the Bureau of Land Management (BLM) over sage grouse habitat. The company was shocked in January and July this year by decisions of federal Judge Winmill that vacated and revoked both the EIS and Record of Decision approving Bayer’s mine plan. The verdict was due at least in part to effects on sage grouse, not solely at Caldwell Canyon but phosphate properties in total.

Bayer: Caldwell Canyon

Construction and preliminary earthwork was underway at the Caldwell Canyon site (left photo) prior to the judge’s decision. While work stopped on federal leases, Bayer had two major engineering projects on private land. One project was at the Dry Valley site, a former FMC mine, where the new ore would be loaded into rail cars, and a new tipple tower and ore handling system was built.

In late November, the BLM published a notice for a new revised mine plan and Environmental Impact Statement.
(EIS) for the Caldwell Canyon project. Both the BLM and the company were hoping to fast track the process before the current mine runs out of ore, in order to avoid negative effects on the local community.

Bayer produces elemental phosphorus from their plant at Soda Springs. The plant is just west of a highway and currently ore trucks unload ore. Ore from the Caldwell Canyon project, once opened, would be transported by rail, and the company had a large engineering project to replace the old stacker and install a conveyor system through a tunnel under the road to a new stockpile area and rail-accessible gantry for unloading ore into the plant. The project was completed safely and on schedule in 2023.
Itafos: Rasmussen Valley Mine

Itafos, a public company, purchased Agrium’s interest a few years ago. Mining continued in Phase 7 at their Rasmussen Valley mine (right photo). The dark black rock by the equipment is the ore. Itafos received their permit for a new project at the Husky/North Dry Ridge property and they commenced initial work. Photos show brush clearing and soil removal (and stockpiling) at North Dry Ridge. A public road is being rerouted around part of the project. The new mine would have about a 13-year mine life.
The organic-rich sequence of the Phosphoria Formation has long been known to be anomalously enriched in several elements, including some critical minerals such as rare earth elements (REEs), vanadium, chromium, and nickel. Due to the large volume of phosphate rock extraction and processing, these elements are potential byproducts. The USGS provided a $525,000 grant to the 4 states (ID, MT, WY, and UT) with outcrops of the Phosphoria Basin rocks to conduct a geochemical reconnaissance project assessing the critical mineral distribution in a geologic and stratigraphic context across the basin. The project is lead by the Idaho Geological Survey. The map on the right shows a simplified distribution of the Permian Phosphoria rock outcrops and sub-basins.
EMRI Phosphoria Project Timeline and Deliverables

Data from the stratigraphic sections, core, geochemical analyses, and drone imagery will be synthesized into a final report published through the USGS and individual state surveys. Here are some examples of what will be included in that report. We’re looking forward to the results of this project and the increased understanding we’ll have of these critical minerals, rare earth elements, and metals within the Western Phosphate Field, that are vital to our national economy and security.

Idaho’s Industrial Minerals 2023 (non-phosphate)

Idaho has a number of other industrial minerals, including sand and gravel pits and crushed stone quarries not shown on this map. The photo shows Thermocal Minerals calcium operation near Lidy Hot Springs in rural eastern Idaho. Pumice and dimension stone are two of the better-known commodities produced in Idaho. Many of the small mines have been operating for
decades. However, construction sand and gravel and crushed stone are the largest and most valuable, contributing a significant portion of the dollar value. The aggregate is needed to supply a building boom in the Treasure Valley (Boise area) and other growing cities. Value of the aggregate is indicted by the premium bid of $550,000 received at a state auction for a mineral lease on scarce gravel deposits near highways and urban areas.

Idaho Mineral Exploration in 2023

It was a busy year with exploration for a variety of commodities. Federal funds allowed the IGS to conduct mapping and research in Lemhi County which hosts critical REEs and cobalt deposits. Financial and logistical concerns of exploration companies included depressed prices of cobalt, a difficult financial investment scene, a lack of domestic processing options and lengthy permitting timelines without progress on reforms.
Exploration efforts were very successful at many properties and one important, exciting new discovery was made at the Hercules property in western Idaho. The map shows company names and locations of exploration projects for metals and REEs in red and industrial minerals in green. The Ormat geothermal power plant is indicated by the blue triangle and the commercial oil and gas field of the western Snake River Plain is in black.

Bunker Hill Mine: Development and Restart, Coeur d’Alene district

Bunker Hill Mining continued to advance reopening the large, historic Pb-Zn-Ag mine, focusing on the Newgard-Quill zinc orebody. Key activities during 2023 included modelling from the historic maps and past drilling, site clean-up and mill equipment purchases, new electrical and other infrastructure upgrades, enlargement of the Russell portal to accommodate mechanized mining equipment, engineering and mine plan optimization, and
financing to support the restart. Zinc is on the list of critical minerals and the mine has been a major zinc producer from veins in the folded Belt host rocks on the western part of the district. The Russell portal accesses the #5 level.
Silver Valley Metals: Ranger-Page project

Just west of the Bunker are several historic mines, including the Ranger and Page properties, which were acquired in 2020 by a small company, Silver Valley Metals. They unitized the historic land holdings of Asarco and others, which had not been explored in modern times. In 2022, they did surface exploration and an IP/Resistivity survey, one of the few surface geophysical efforts in the district. They also digitized the old workings and geology into Leapfrog and identified targets based on structural intersections and geochemistry. In 2023, the company tested some of those targets with trenching which revealed oxidized vein structures and anomalous gossan geochemistry. Like elsewhere in the Silver Valley, mineralization is in narrow, high-grade veins that will require drilling or underground work to fully explore.
Perpetua Resources: Proposed Stibnite Au-Sb mine, Valley County

Perpetua, formerly known as Midas Gold, continued to await the revised Final EIS from the Forest Service for their Plan of Restoration and Operations (PRO), which was initially submitted in 2016. The company has proposed an extensive reclamation and restoration of legacy and new disturbances as part of their plan to mine approximately 4 million troy ounces of gold and an antimony resource. In 2023, the company received approval from the EPA to conduct emergency remediation of tailings and other material left from mining during World War II. Remining at the complex legacy site has proved controversial in spite of the environmental improvements proposed. The US Dept. of Defense awarded the company $15 million to demonstrate an antimony supply chain needed by the military for ammunition. The Final EIS and Record of Decision is now scheduled for likely release in the first half of 2024.
Hercules Silver Company: New Discovery in Western Idaho

Hercules Silver Company, a junior explorer, acquired Anglo-Bomarc and their Hercules silver mine property west of Cambridge, ID, in 2020. The company did surface sampling followed by an IP survey and a few short drill holes in 2022. Silver-manganese oxide mineralization and anomalous copper geochemistry is widespread at surface. In 2023, the company drilled longer holes to test the IP/chargeability anomaly from 2022. On October 10, 2023, Hercules announced assays for discovery hole HER-23-05 of 185 meters of 0.84% Cu, with 111 ppm Mo and 2.6 g/t Ag. A higher-grade zone within that intercept was 45 meters of 1.94% Cu. By the end of the year, the company had drilled 6100 meters of core in 26 holes and were confident that alteration and chemistry indicated a concealed porphyry copper, hosted in volcanic rocks of the western Idaho accreted terrain. Late in the year, Hercules ran a new IP survey and leased the nearby
Mineral district, previously explored for copper.

Hercules Silver: Leviathan Porphyry System

Surface Cu geochemistry and the IP anomaly, with partial coverage due to a bovine logistical problem, is shown in the map on the left; an early cross-section of the discovery hole is shown in the middle. The copper system is hosted in andesitic volcanics below the Hercules rhyolite. There is an enigmatic conglomerate unit in between. Quartz porphyry units intrude the andesitic sequence. Visible in the core box photo are a variety of veins cutting the rocks.
Hercules: Additional Drill Results

Additional drill results were released at the new year for Hercules Silver Corporation’s new discovery. A map and section from the Jan. 2, 2024, press release for HER-23-08, HER-23-11 and HER-23-21 are shown. The intercept in HER-23-11 was 183 meters of 0.3% Cu with 25 g/t Ag. The intercept in HER-23-21 was 161 meters of 0.45% Cu with 4 g/t Ag, and 148 ppm Mo. The section also interprets a fault at the contact of the rhyolite package and the basal conglomerate, and shows grade increasing towards the west. Given the buried nature of the system, details and zoning interpretations will likely change as more results are available and future work done. The company, with financial and technical support from Barrick, is planning a larger program in 2024.
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INTERRA RESOURCES: DE LAMAR PROJECT

- Classic epithermal, porphyryCU-style veins, Owyhee County, ID
- De Lamar and Florida Mtn. host Miocene-age veins and Ag-Au mineralization.
- Historic production ~1M oz Ag and 100M oz Au from veins, open pits.
- 2023: Drill stockpile/backfill with Sonic, RC drilling, added 504,000 oz Ag from M&I, plus inferred to new mineral resource estimate.
- Metallurgical/geotechnical drilling.
- Advancing permitting for heap leach mine, mine plan in Q4 2023. Baseline studies, facilities/process design, water balance, etc. to start NEPA early 2024.

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Integra Resources: Photo of Florida Mountain work

De Lamar and the nearby Florida Mountain mineralized centers host epithermal Miocene-age veins and disseminated and stockwork Ag-Au mineralization. The Stone Cabin pit, shone on the left, was initiated by Kinross on top of Florida Mountain above the historic, high-grade veins mined underground in the late 1800s. Hints of those veins and shears are evident in brown iron-stained zones that come out of the pit wall in back. Integra did Geotech drilling to evaluate the stability of the steep high walls in the existing pit.
Thunder Mountain Gold: South Mountain Project, Owyhee County

South Mountain consists of marbles and sediments cut by intrusive rocks; it stands as an isolated mountain surrounded by younger volcanic rocks. Zinc skarn and polymetallic replacement deposits there are rich in precious metals and form pipes and replacement zones as indicated on the section. The private property is controlled by a local company, Thunder Mountain Gold, who was focused on re-evaluating the prior exploration drilling by BeMetals. A new mineral resource calculation increased the tonnage of base and precious metals. The company would welcome inquiries about financing options for future exploration.
Phoenix Copper: Empire mine project, Custer County

The old Empire mine tram house sits above the valley and town of Mackay as an excellent and scenic reminder of Idaho’s rich mining history. Phoenix Copper has been exploring at Mackay for several years; they are working on developing a potential oxide copper open pit resource at the Empire and conducting reconnaissance exploration in the region. In 2023, they continued work to update the mineral resource and a feasibility study on the copper deposit. Mineralization is hosted in a skarn system related to an Eocene porphyry. Exploration drilling in 2023 was focused to the west on their Navarre claims. The 28 drill holes targeted Au and Ag on a fault zone in Eocene volcanics.
Liberty Gold: Black Pine project, Cassia County

Liberty Gold has been exploring Black Pine for several years and reached a milestone in 2023 with their 1000th hole. Pegasus had operated a heap leach mine in this Carlin-style gold district. That operation closed at a time of very low gold prices. Liberty drilled all year, and some of the assays and holes are shown on the map of the newly discovered Rangefront zone. Liberty is transitioning to a more intensive permitting stage and submitted a pre-mining plan to the agencies in September.

Oxide gold is concentrated in limestone units within a series of stacked fault slices of the Oquirrh Formation. A several-kilometer-long zone of known pits and resource areas trends northwest. The project is in the low foothills of the Black Pine Mountains, just north of the Utah border.
Liberty Gold: Black Pine Details

Drill results for their Back Range zone are shown in the map on the left. Overall, the company drilled 27,461 meters in 2023; much of that footage was reverse circulation. Project location and the multiple mineralized zones are better shown on the right. The project encompasses both BLM and Forest Service managed land, is largely scrub and sagebrush dominated vegetation and sits a few miles from the interstate highway. Liberty has secured water rights and a 25KV powerline exists to the site.

Salmon Region Exploration and IGS Activities, Lemhi County

The area, indicated by the blue oval on the map, around the town of Salmon continued to be a hotbed of geological and mineral-related activity in 2023. The Idaho Geological Survey had several mapping and research projects there, and the Survey helped organize a joint Belt Association and Tobacco Root Geological
Society meeting in Salmon. Field trips along the Salmon River (left photo) and to the Diamond Creek REE prospect (right photo) of Idaho Strategic Resources were two of many. While critical minerals such as cobalt and rare earths are targets of several companies in the area, gold was also a big attraction.

Freeman Gold: Lemhi Gold Project, Lemhi County

Freeman Gold filed a new technical report on results of their work at the Lemhi Gold project north of North Fork. The PEA resource is about 850,000 ounces of gold, to be mined over 11 years, and it is based on drill results from the past two years. The deposit consists of faulted, flat-lying mineralized shear zones and is next to old placer workings on Pat Hughes Creek.
Revival Gold has two projects in one – the Beartrack mine, a former Meridian Minerals’ open pit gold mine, and the adjacent Arnett Creek project, both located several miles west of Salmon, and near remaining infrastructure from the now closed mine facilities. Geologically, the two deposits, both gold, are quite distinct, though both were initially discovered from large placer deposits. Beartrack exploits a northeast-trending, steep shear zone with orogenic-style 68 Ma gold-arsenic-silica mineralization in Precambrian units. Arnett is highly oxidized and hosted in a Paleozoic alkaline intrusive complex. The 2023 measured and indicated (M&I) resource is 86 million metric tons at 0.87 g/t Au with about half of that as heap leachable, oxide material.
Revival Gold: Beartrack trend

Photos of some of the processing facilities left from the Meridian mine are on the top of the slide. Below is a longitudinal section from Revival along the Beartrack shear zone showing the Meridian pits and, in blue, the oxide, heap leachable resource remaining. Yellow areas indicate the total mineral resource, as calculated at said gold price. Orange areas are potential underground resource with deep high grade (e.g. 10 g/t Au) zones at the previously unmined Joss area. The positive pre-feasibility study for a solely heap leach scenario was released in August 2023.

Revival Gold: Arnett Creek Project

Photos of drilling and scenery at Revival’s Arnett Creek project are on the top part of the slide. In 2023, the company drilled 18 core holes totaling 3400 meters on three of the targets labelled on the map in the lower left. The background colors are a 2019 survey of
Total Magnetic Intensity (TMI) which show a magnetic high in the area underlain by the Crowded Porphyry. The red outline is the mineralized footprint. Magnetite is part of the alteration assemblage at Arnett.

Rare Earth Elements (REEs) and Critical Metals in the Salmon Region

Both cobalt, an alloy metal, and rare earth elements are on the federal critical mineral list, and both are found in northwest-trending, parallel zones in Lemhi County, and for the REEs also in adjacent Montana. The center map shows quadrangles where the IGS has recent and ongoing geologic mapping projects. Also shown are occurrences of cobalt (green dots) and REEs and/or Nb (red dots). As detailed in the downloadable GeoNote 44 on the left, Idaho produced rare earths from placer deposits in the 1950s. The “hard rock” occurrences along the REE Belt near Salmon are different. Both Th-REE quartz veins and carbonatite
horizons are present. The map on the right shows the new airborne magnetic survey flown by the USGS as part of their Earth MRI program. It was released in 2022 and covers the Idaho Cobalt belt.

Idaho Strategic Resources: Diamond Creek and Mineral Hill REEs, Lemhi County

Idaho Strategic Resources’ chief geologist, Rob Morgan, showed off results from their post-fire late 2022 drilling at the Diamond Creek REE-Th property to TRGS field trip participants. The vein zones are highly oxidized and host significant rare earth mineralization. On the right is a photo of massive monazite, a REE-bearing mineral from their Mineral Hill project west of North Fork. The monazite, which can contain several percent REEs, is from one of the several carbonatite horizons that transect the area, extending into the Sheep Creek drainage, MT.
Idaho Strategic Resources: Lemhi Pass project, Lemhi County

Idaho Strategic also has claims in the Lemhi Pass Th-REE-Fe district on the southeast end of the belt. This area hosts numerous quartz veins, replacements, and oxidized, iron-rich prospects. The mineralization at Lemhi Pass is unusually enriched in neodymium (Nd), one of the REEs most prized for batteries and magnets. The company received permits to trench three areas late in the year. In each case, the trench was dug, sampled and reclaimed the same day. District geology is complex but not well-exposed. It has been studied by the USGS and IBMG in the 1970s, and more recently by the IGS. Exactly how the three REE prospects along the NW-trending belt relate geologically to the other areas is still problematic and a subject of active research.
Megado Minerals: Mineral Hill/North Fork, Lemhi County

Megado Minerals is an Australian company which acquired claims in the North Fork area (Mineral Hill district) in 2022 shortly before the Moose fire erupted. The band of carbonatite occurrences continues into Sheep Creek, MT as thin horizons with high grade Ce-rich monazite and other minerals typical of carbonatites. Megado’s surface sampling, shown in their graphic on the left was paired with a hyperspectral survey. Results and work in the area by all parties is hampered by extreme terrain, poor access, lack of outcrop and burned areas with abundant deadfall trees. Megado narrowed in on one area and initiated permitting with the Forest Service to drill at the Silver King prospect. Elsewhere in the area, Idaho Strategic is actively exploring in the same belt, and the IGS is conducting geologic mapping of two quadrangles with funding from the USGS.
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Jervois Global: Idaho Cobalt Operation (ICO), Lemhi County

Jervois, an Australian company, acquired eCobalt (successor to Formation Capital) in 2019; Formation had discovered the RAM deposit, now the ICO. In October 2022, Jervois celebrated the opening of the ICO, the only primary Co mine in the country. However, with Co prices falling, the company suspended final construction in March 2023. Construction of the mine, mill and camp was essentially complete. In the fall, Jervois received $15 million from the US Dept. of Defense for additional drilling and a bankable feasibility study for construction of a domestic Co refinery. A contract for site selection for a refinery was let, and in the fall, a surface drilling program underway on the
Sunshine prospect, one of several known Co zones on the property. In addition to cobalt, the ores contain copper and gold, with some local rare earth values as well.

The RAM orebody is along strike and presumably a continuation of the Blackbird mine horizons (owned by Blackbird Minesite Group on patented property). It is accessed by portals (East and West) and a spiral ramp driven into the steep hillside, as shown in the photos above. The ore zones dip steeply and are hosted in metamorphosed and deformed Apple Creek formation, particularly near or in biotite-rich rocks which may be metamorphosed mafic tuffs or exhalative alteration zones. The US government funding will be used for an underground drill program in spring of 2024.
Additional Exploration Projects and State Activities

Not all projects are described in this presentation due to time limits. Some others are listed here: Sunshine Silver, Electra Battery Materials at Iron Creek Cu-Co, Champion Electric and Koba Resources in the Cobalt belt, Excellon Resources at Kilgore Au-Ag prospect, Nev-Gold at the Nutmeg Mtn. Au prospect, Stallion Gold at Antimony Ridge Au-Sb, EMX Royalty in the Elk City region, Idaho Copper at the Cumo Cu-Mo deposit, Modroo prospecting the Leadville area, and Kennecott looking at the Gilmore district. Undoubtedly there are others.

The IGS continues to have a very active geologic mapping program, data preservation efforts, oil and gas assessment, ground water studies and natural hazards mapping, as well as projects in mining and mineral deposit research. Learn more at: www.idahogeology.org