



ABSTRACTS

ALASKA MINERS ASSOCIATION
2025 ANNUAL CONVENTION & TRADE SHOW
UNLEASHING ALASKA'S STRENGTH

NOVEMBER 3-6, 2025
DENA'INA CIVIC AND CONVENTION CENTER
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ALASKA MINERS ASSOCIATION

2025 ANNUAL CONVENTION & TRADE SHOW

TRACK ONE

GEOSCIENCE INVESTIGATIONS

Geologic framework of the Goodpaster and Richardson mining districts

Authors: Evan Twelker, Rainer Newberry, Travis J. Naibert, J. Wesley Buchanan, and Michael L. Barrera, Alaska Division of Geologic & Geophysical Surveys

The Goodpaster and Richardson mining districts of Interior Alaska are well-endowed with gold and accessory critical minerals. Despite the district's discoveries, and almost two decades of production at the Pogo mine, much remains to be understood about the genesis and district-scale spatial controls of this mineral system. Drawing on our recent geologic mapping and analytical work conducted through the Earth Mapping Resources Initiative (Earth MRI), we examine the broader geologic framework of the district and place mineralization into this context.

Recent DGGS mapping divides the host metamorphic rocks into three assemblages, groups of rocks with shared geologic histories, which apparently represent three structural panels during Jurassic orogenic and mid-Cretaceous extensional events. The Lake George assemblage is dominated by paragneiss, granite to quartz diorite orthogneiss, amphibolite, and batholith-scale bodies of augen orthogneiss. The Fairbanks-Chena assemblage, in contrast, includes a wider range of lithologies including garnet-bearing schist, siliceous paragneiss, marble, calc-silicate gneiss, graphitic schist, granitic orthogneiss, amphibolite, and lesser augen orthogneiss. The greenschist facies Butte assemblage is the structurally highest assemblage, locally preserving Triassic argon cooling ages, which indicate ties to the allochthonous Yukon Tanana Terrane.

Garnet-biotite geothermobarometry indicates that Lake George and Fairbanks-Chena assemblages follow separate, but parallel, P-T paths, suggesting that the two assemblages are separated by a regional extensional detachment fault. Both assemblages experienced decompression and heating, with the Lake George P-T path crossing the muscovite + quartz to sillimanite + K-feldspar + liquid reaction boundary. The result is a regional fluid release event, which includes local flux melting of metasedimentary rocks, recrystallization, and zircon overgrowths dated ca. 117-110 Ma. Voluminous granitic magmatism, ca. 112-108 Ma, marks the tail end of this extensional event and is concentrated overwhelmingly in the footwall of the main detachment structure separating the allochthonous and

parautochthonous assemblages. Both melt generation and pluton emplacement may be extensionally facilitated.

The most significant deposits of the district, including the Pogo mine and the SAM (Naosi) and LMS resources, are hosted in low angle shear vein systems near the boundary between the Lake George and Fairbanks-Chena assemblages, which we infer to be a regional detachment. The mineralization is difficult to date, but age determinations for the district range from 113 to 93 Ma. Our interpretation is that this ~20 Ma span reflects a long-lived mineral system, and that vein formation and mineralization at a range of pressures is responsible for the range of ductile to brittle textures observed. In our view, the mineral system is driven by extension, including decompression-related melt generation (adding heat to the upper crust), metamorphic fluid generation via muscovite to sillimanite phase transition, and structural control along or near second-order extensional detachment faults.

Multi-scale structural and petrochronologic applications to better refine mechanism and timing of mineral systems, Alaska

Author: Regan, S.P., Munk, L., Hofmann, F., Graham, N., and Acosta, M.

The physical mechanisms and conditions of precious metal and critical mineral deposits provide essential constraints informing exploration and production strategies. The Alaska Critical Mineral Collaborative (ACMC) is a UAF-lead effort integrating various scientific expertise to provide a streamlined multidisciplinary approach to resolve long-standing knowledge-gaps. Herein, we will focus on a series of examples integrating field-based structural analysis with microstructural and textural constraints with in-situ petrochronologic approaches to constrain the timing, physical mechanisms, and geometry of various precious metal and critical mineral deposits. Work to be highlighted is detailed in-situ monazite petrochronology on inverted metamorphic belts throughout central and southeast Alaska and their relationship to regional orogenic-gold mineralization, constraining the physical mechanisms for graphite mineralization in the Kigluaik Mountains, evidence for progressive localization during gold mineralization at POGO, origin of Nb-bearing carbonatite at Tofty. In addition, we will highlight some preliminary in-situ zircon petrochronologic work at Bokan Mountain in southeast Alaska, informing the timing and physical controls on U,Th, and HREE mineralization. These examples will be used as a spring board to introduce the ACMC and the new faces and philosophies of the growing Critical Minerals effort at the Geophysical Institute, University of Alaska Fairbanks.

Alaska's Critical Mineral Collaborative: Powering Innovation and National Leadership

Authors: Lee Ann Munk, Director, UAF Alaska Critical Minerals Collaborative

The Alaska Critical Minerals Collaborative (ACMC), launched in mid-2024 at the University of Alaska Fairbanks, is rapidly emerging as a national leader in critical mineral innovation. In less than a year, ACMC has forged powerful partnerships across industry, government, Alaska Native Corporations, venture capital, and research institutions. A significant milestone was reaching the final round of the U.S. National Science Foundation Regional Innovation Engines competition, one of only 15 teams selected from over 300 applicants nationwide. The proposal unites 30+ partners and carries the full support of the Governor, Legislature, and Alaska's congressional delegation. If awarded, the program would bring up to \$160 million to Alaska to accelerate breakthrough R&D, commercialize new technologies, and unlock more of the state's vast critical mineral resources, fueling domestic supply chains and advancing U.S. energy and economic security. This momentum is drawing strong interest from national labs and universities eager to collaborate on Alaska-focused mineral innovation. With federal and state alignment, ACMC is positioned to make Alaska a global hub for critical minerals, a catalyst for innovation, investment, and national leadership.

EXPLORATION PROJECT HIGHLIGHTS

Resurrecting the Tripple Z Prospect

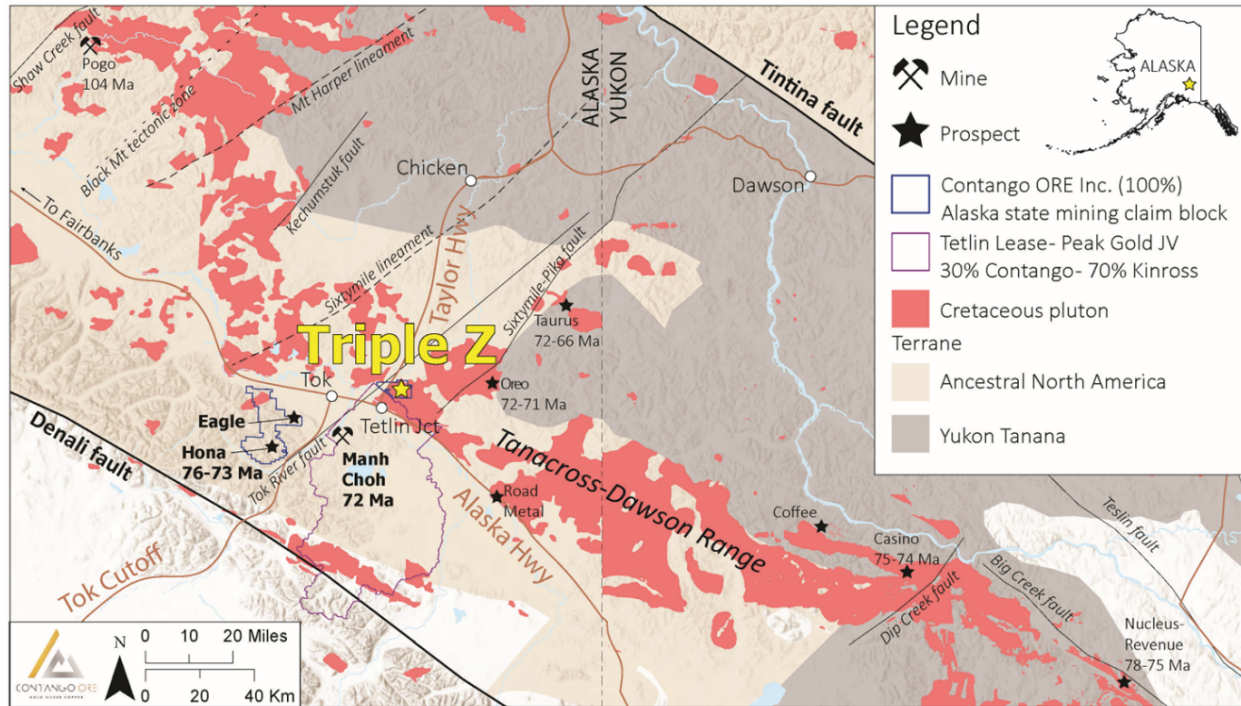
Authors: Kei Quinn and Dave Larimer, Contango Ore

Contango Ore's Triple Z prospect, located northeast of Tetlin Junction, Alaska, represents a highly prospective target for porphyry-style copper-gold-molybdenum (Cu-Au-Mo) mineralization. Spanning approximately 14,800 acres across 95 State mining claims, the project has historically faced exploration constraints due to unresolved land status. Until recently, only the eastern portion of the property was authorized for full mineral exploration activities. However, the transfer of "State Select" lands from federal ownership (BLM) to the State of Alaska was finalized in late 2024, enabling year-round access and unlocking the full potential for advanced resource delineation.

Triple Z is underpinned by a robust integration of geological, geochemical, and geophysical datasets, positioning it as a compelling Cu-Au-Mo porphyry-style exploration target. The lithological framework comprises Lower Paleozoic metasedimentary units intruded by a multiphase felsic to intermediate plutonic suite, including quartz porphyry, quartz-feldspar porphyry, hornblende-biotite granodiorite, and biotite granite. Geochemical analyses reveal elevated concentrations of Cu, Mo, Au, As, Bi, Sn, W, and Ag, with trace element enrichment patterns indicative of a magmatic-hydrothermal system temporally associated with the Late Cretaceous metallogenic epoch characteristic of Interior Alaska porphyry systems.

Soil and rock geochemistry delineate coherent multi-element anomalies spatially correlated with induced polarization (IP) chargeability and conductivity highs, suggesting the presence of sulfide-rich zones. Hydrothermal alteration assemblages—potassic, argillic, phyllic, silicic, and propylitic—alongside multiple vein generations (A-, D-, and EDM-type), reflect a complex and evolved mineralizing system. Drill core from six holes totaling 1,990.04 meters confirms both disseminated and vein-hosted mineralization. Zonation patterns observed in the core suggest the presence of proximal and distal porphyry facies. Despite limited drilling, high-grade intercepts (e.g., Au up to 3.099 g/t, Cu up to 0.77%, Ag up to 677 g/t) and strong elemental associations (e.g., Au-Cu-Co-Fe-S vs. Au-Ag-As-Mn-Pb-Zn) reinforce the interpretation of a zoned porphyry system with significant exploration upside.

Track 1. Exploration Project Highlights



The Flat Gold Project: The Perspective in 2025

Peter Kleespies, Trent Newkirk, Varina Zinno; Tectonic Metals Inc.

The Flat Gold Project is located in southwestern Alaska, just 40km north of the Donlin Gold Project within the Iditarod Quadrangle. It covers 99,840 acres of primarily Doyon, Limited owned land within the Kuskokwim Mineral Belt of the Tintina Gold Province. The Flat property hosts intrusion-related gold mineralization analogous to that found at the Fort Knox (Alaska) and Eagle (Yukon) gold mines and consists of a multiphase Cretaceous age (68.3 to 73.2 Ma) Chicken Mountain igneous complex (CMIC). The CMIC intruded into the Kuskokwim sedimentary and volcanic sequences north of the right-lateral Nixon Fork-Iditarod Fault, which generated a long history of placer mining, producing an estimated 1.4 million ounces of alluvial gold since 1908.

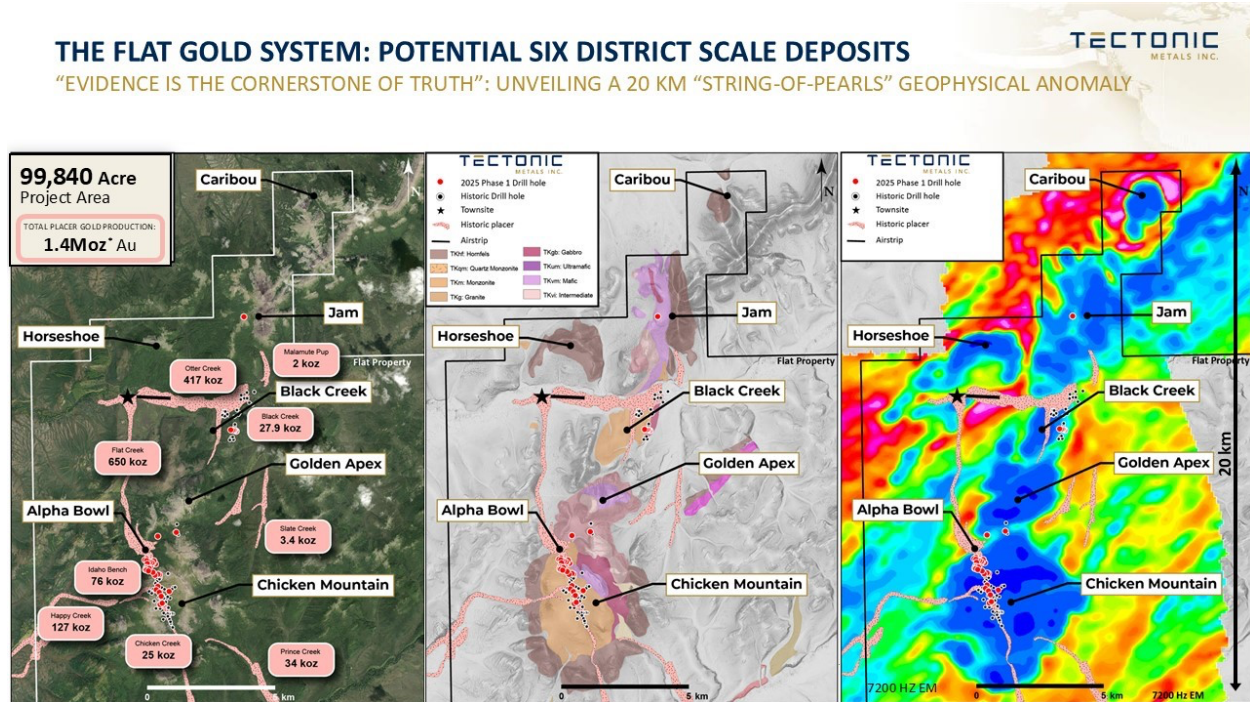
Since initiating exploration in 2022, Tectonic Metals Inc. has advanced Flat through ~22,000 m of combined diamond-core and reverse-circulation drilling, two phases of metallurgical testing, petrography, reprocessing and geophysical inversion work of regional magnetic data, and a high-resolution drone magnetic survey. In 2024, reverse circulation drilling beneath extensive historic placer spoils north of Chicken Mountain at the Alpha Bowl target identified gold mineralization hosted within coarse-grained biotite-pyroxene, which returned 1.20 g/t Au over 65.5 m. Subsequent Phase 1 sectional drilling through the Alpha Bowl in 2025 demonstrated that the coarse-grained intrusion is continuous with the main Chicken Mountain body and that gold mineralization persists northward along at least 1200 m of strike length beyond the historically defined Chicken Mountain zone.

Gold mineralization occurs primarily as sheeted “productive” quartz-vein arrays within the biotite monzonite to quartz monzonite phases, associated with sericite-altered rocks. At Chicken Mountain, the productive quartz/sulphide veins trend NNE to NNW with steep moderate westerly dips and host Au+Bi+Te +/-As mineralization. “High-level” epithermal textured veins hosting Au+Sb+/-As+/-Hg+/-W mineralization have been observed in cross-cutting and discrete spatial settings suggestive of a protracted, multi-episodic mineralizing event. Late-stage WNW orientation white clay and calcite veins do not host significant gold mineralization and are observed to crosscut and offset the earlier productive quartz bearing assemblages.

Magnetic inversion modelling of regional data has revealed that low-susceptibility to very low-susceptibility domains coincide with drilled mineralization, implying a close relationship between reduced, magnetite-poor intrusions and gold deposition. Tectonic completed a high-resolution drone magnetic survey during 2025, and ongoing 3D inversions and development of magnetic based exploration vectoring will refine exploration targeting.

Flat’s 2025 Phase 2 drilling focused upon the historic Chicken mineralization zone with section-based drilling as the initial step towards an inaugural inferred mineral resource estimate. Drilling was conducted along ~1500 m of mineralized strike, with additional infill and resource delineation

drilling slated for 2026. Significant exploration and discovery potential remains on the project, particularly on additional blind-to-surface targets in the Golden Apex and Black Creek target areas, as well the northern regions of the Flat Volcano-Plutonic Complex lying north of Otter Creek, which has seen very limited modern exploration.



Trust Land Office Advances Icy Cape Gold and Industrial Heavy Minerals Project with independent Technical Report and Resource Estimate

Jusdi Warner and Dr. Karsten Eden, Trust Land Office

The Alaska Mental Health Trust Land Office (TLO) announces the completion of an independent technical report in the NI43-101 style for the Icy Cape Gold and Industrial Heavy Minerals Project, marking a major milestone in the Trust's efforts to generate sustainable revenue for its beneficiaries.

Located near Icy Bay in the Gulf of Alaska, the 48,000-acre property has been under active exploration since 2015. The project targets placer gold and industrial mineral sands, including garnet, zircon, and rutile. Following a strategic pivot in 2017 toward high-volume marine sands, TLO advanced exploration in sediments exceeding 200 feet in thickness.

Following extensive reconnaissance, airborne magnetic surveys, drilling, and applied research, TLO identified four primary prospects. The Grinder prospect was selected for advanced drilling and bulk sampling between 2022 and 2024, guided by 3D aeromagnetic gradient data. Field teams collected densely spaced drill-core samples to support resource modeling and metallurgical testing.

The 2025 compliant technical report includes resource estimates for gold and garnet, and will be formally presented at the Alaska Miners Association Annual Convention. The findings confirm the commercial viability of the project and reinforce the Trust's commitment to responsible land management and economic development.

This work represents years of disciplined exploration and strategic planning. We're proud to advance a project that aligns with our mission and offers long-term value for Trust beneficiaries.

From Surface Clues to Subsurface Systems: Exploration and Discovery in the Emerging Illinois Creek CRD District

Sage Langston-Stewart, Principal Geologist at Alaska Silver (formerly Western Alaska Minerals)

The Illinois Creek District is located in west-central Alaska, approximately 250 miles west of Fairbanks. Originally discovered by Anaconda Copper in the 1980s, the district is now home to five evolving mineral projects under Alaska Silver's land tenure, hosting gold, silver, copper, lead, and zinc mineralization.

Alaska Silver's recent exploration has focused on expanding the known Waterpump Creek resource and evaluating new targets along the broader Illinois Creek–Waterpump Creek Carbonate Replacement Deposit ("CRD") corridor. In 2025, two key areas were drilled: Waterpump Creek South and the newly defined Silver Sage prospect.

At Waterpump Creek South, Alaska Silver conducted a targeted drilling campaign (4 HQ diamond drill holes, 2,057.6m) aimed to extend the high-grade massive sulfide mineralization first discovered in 2021 (75 Moz @ 980 g/t AgEq Inferred; see press release, Feb. 22, 2024). Drilling results provided critical insights into structural offsets and alteration zonation, aiding in vectoring toward potential extensions of the high-grade mineralization, particularly in the South Block.

Approximately 5 km south of Waterpump Creek, the Silver Sage zone represents a significant exploration breakthrough. First identified through anomalous soils and siliceous float, the area has since been trenched and drilled. Trench T45 ("The Galena Trench") intercepted a strongly mineralized breccia with semi-massive galena and cerussite over a 15-meter-wide zone (still open), with a central, higher-grade core approximately 1 meter thick. Nine drill holes (906.5 m) confirmed the presence of multiple mineralized structures, significant indicator element leakage, and pervasive CRD-style alteration.

Trenching also revealed a broader mineralized footprint:

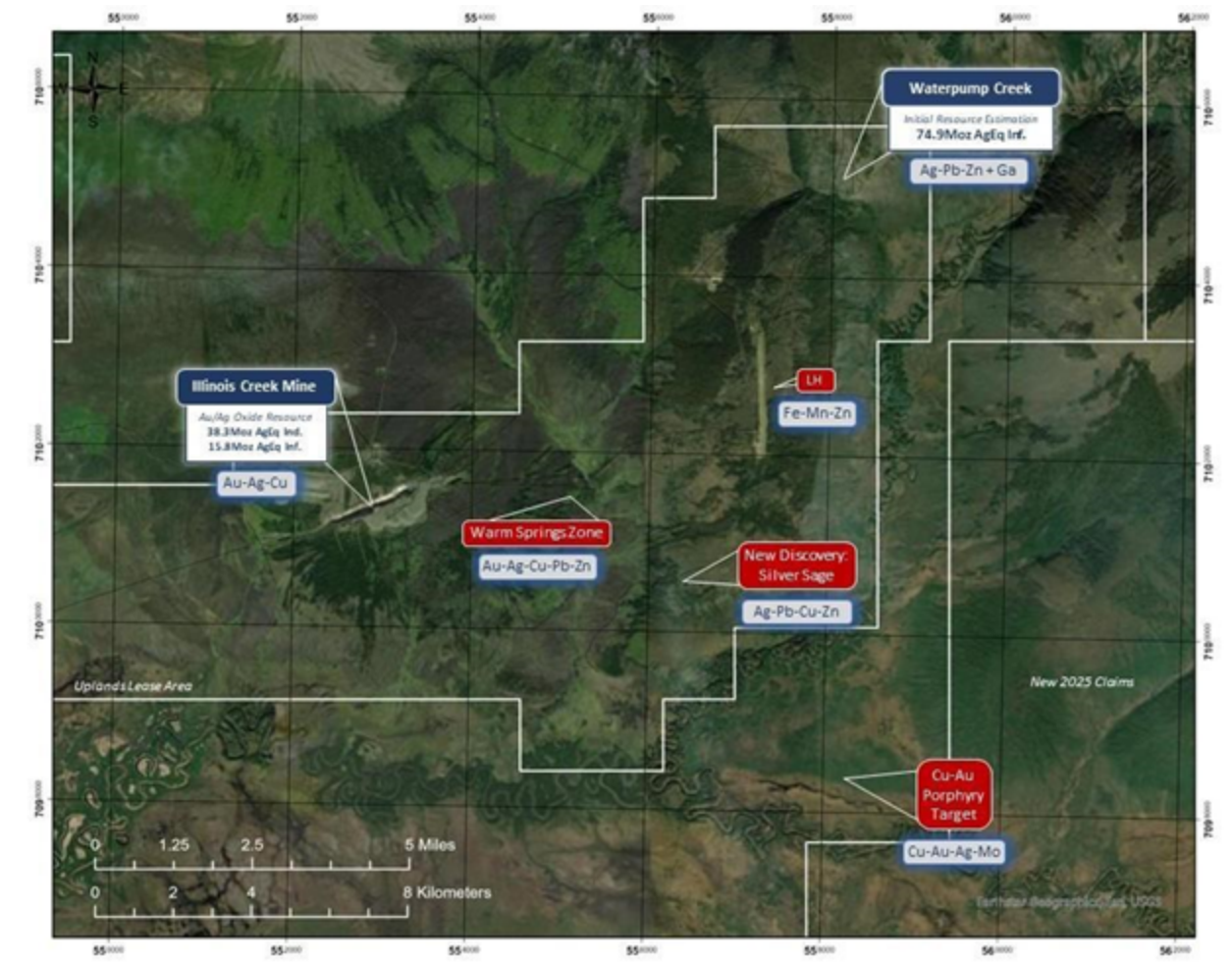
- Trench T48 ("The Indiana Jones Trench"), 380 m SSW of T45, intercepted oxidized breccia with high-grade lead-silver-zinc mineralization.
- Trenches T44, T46–T50 indicate extensive alteration and mineralization continuity over a ~550 m strike length and >1.1 km alteration halo.

Track 1. Exploration Project Highlights

These findings suggest a much larger, structurally complex mineralized system, with potential connections to a causative porphyry source hypothesized near Dee's Spring, at the California Creek—Little Mud River confluence.

In addition, interpretation of the 2024 SkyTEM geophysics by the US Geological Survey and Alaska Dept of Geological & Geophysical Survey has significantly aided in district structural and stratigraphic understanding, shifting the greater interpretation of the district. The Illinois Creek district and Round Top porphyry are now hypothesized to be in the center of large-scale southeast plunging anticlines, creating the perfect structural trap for CRD mineralization.

The integration of surface geology, geophysics, trenching, and drilling in 2025 has greatly expanded the understanding of the district's CRD potential and has established high-priority targets for the 2026 exploration season.



Doyon In-Region Exploration Update

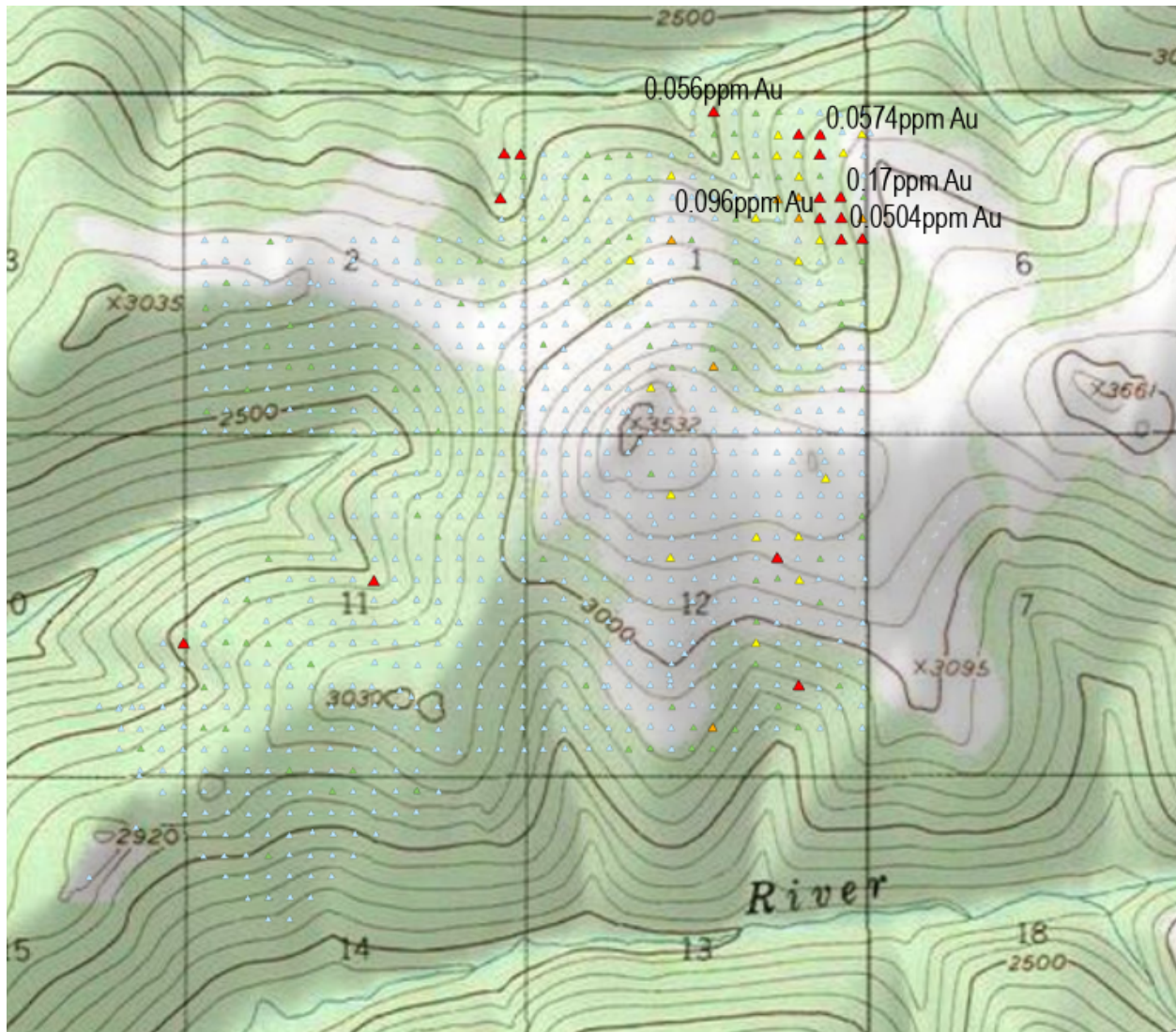
Matthew Hanson, Doyon Limited

In 1971, the Alaska Native Claims Settlement Act (ANCSA) returned a portion of traditional lands to newly created Alaska Native Corporations. Village corporations selected contiguous land around their villages while Doyon, Limited was required to select the available even/even and odd/odd townships surrounding the village, creating the checkerboard pattern of land ownership we see today. If land was unavailable for conveyance around a village, Doyon could select land elsewhere and historical exploration efforts were focused on these 'deficiency lands' – selections specifically chosen for their resource potential. In 2024, Doyon began to focus its internal exploration efforts on the underexplored checkerboard townships along the Alaska Highway.

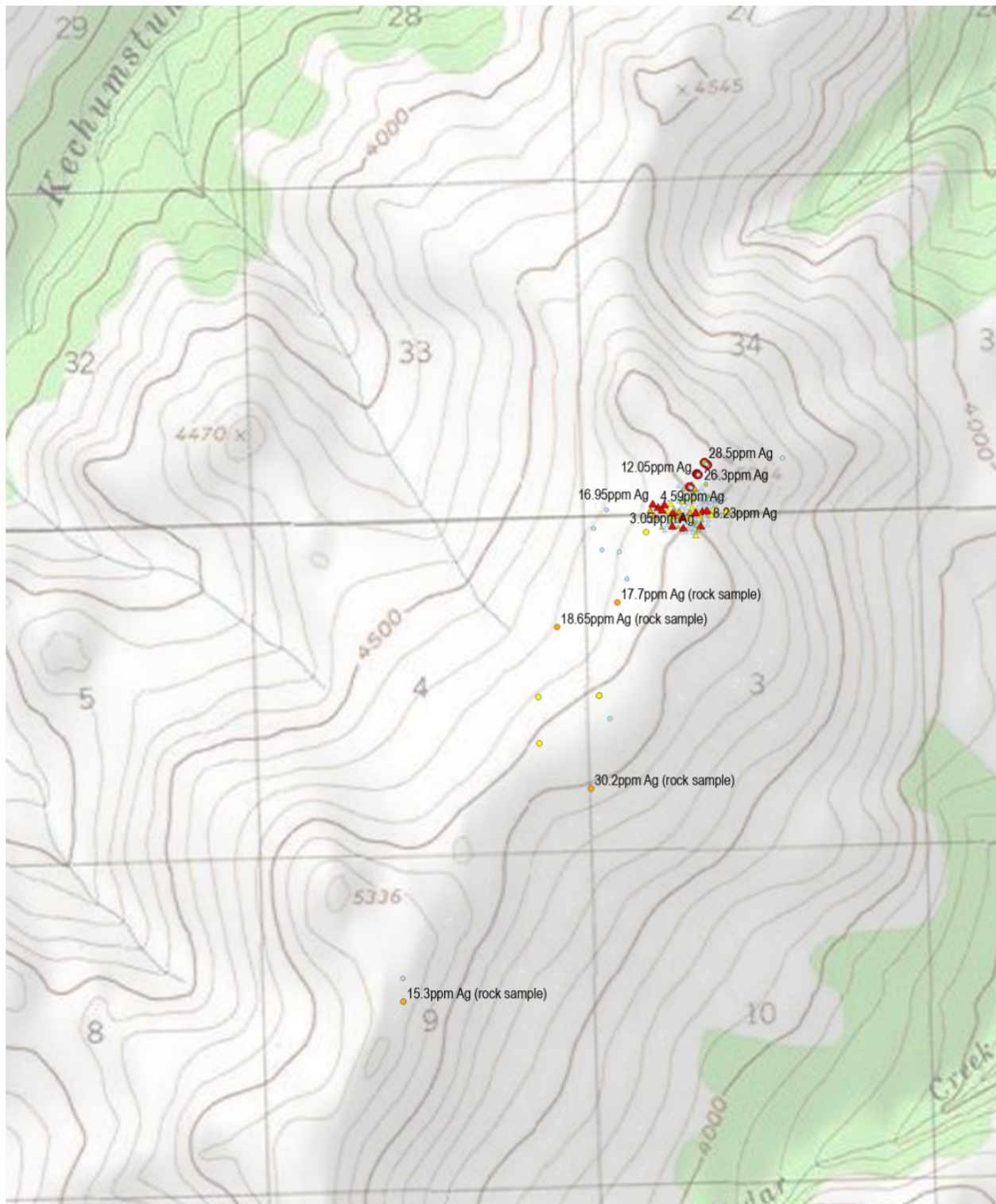
In 2025 Doyon conducted a small initial survey of the townships by the Goodpaster and Volkmar rivers. These townships are within the Black Mountain Trend – consisting of a series of NE/SW shear zones cutting through paragneiss, orthogneiss, weakly metamorphosed granodiorites, and serpentinite. Jesse Jennings led a small soil sampling program to test mineralization potential. The results show an approximately 400 meter by 600 meter gold-in-soil anomaly, with other anomalous samples along the edges of the grid.

During exploration in the Veta Block (south of the Mitchell prospect), a silver-bearing vein system was discovered with values up to 226 ppm silver across 500 meters. Follow up sampling in 2025 extended the strike length of the silver system another 2.5 kilometers, with rock samples up to 30.2 ppm silver. A small soil grid defined a 300 meter by 50 meter crosscutting silver anomaly, with values up to 16.95 ppm silver and 120 ppb gold. Three hand-dug trenches, totaling 46 meters, returned results of 28.55 ppm and 17.5 ppm silver across 1.5 meters and 2.0 meters, respectively.

Volkmar Soil Grid



South Mitchell Silver Prospect



New insights on the genesis and upside potential of the Pyramid porphyry copper system

Russ Eley, MDF Global

Pyramid is one of a handful of Cu-Mo-Au Porphyry systems located along Alaska's Aleutian Peninsula that arguably shouldn't exist due to the relatively thin crust (~38.5 km). Despite this, Pyramid has delivered impressive drill intercepts, and new observations are shedding light on why this system exists, the potential for its resource to grow, and on the implications for other systems along the arc, and in similar arc settings around the globe.

Despite hosting the type-locality for fertile, hydrous "Adakite" melts (Adak Island), the porphyry copper potential of the Aleutian Arc is often overlooked and poorly understood. Pyramid, located 32 km from the town of Sand Point, is the largest known porphyry copper system along the arc, with a historical resource of 69Mt @ 0.51% CuEq (0.49%Cu, 0.02%Mo, 0.114g/tAu at a 0.35%CuEq cut-off). At first glance, this modest resource seems to support the notion that the Aleutian Arc has low potential compared to other porphyry belts around the globe. However, Pyramid's significant drill intercepts (e.g. 260m @0.56%Cu), high-grade zones containing >1%Cu, and new discoveries in the camp indicate exciting upside potential, and raise important questions about how a significant system like this formed, especially given the relatively thin crust.

Dated to between ~6.9Ma and 6.5Ma, Pyramid is the youngest deposit within a long-lived camp (5.5My) that was the focus of rapid and significant uplift, evidenced by the telescoping of advanced argillic alteration adjacent to and partially overprinting the potassic core of the system. The current resource is associated with a zone of grey-green sericitic alteration and accompanying C-veins overprinting earlier EDM, A & B-veins that form a halo around the 'barren' high temperature core at Pyramid Central. Hypogene chalcopyrite has been pervasively replaced by supergene chalcocite & covellite across the deposit, contributing to the elevated copper grades. A newly recognized late-mineral, argillic-altered diatreme breccia located immediately east of the current resource is thought to extend the longevity and resource potential of the system – analogous to the giant porphyry systems around the globe where the largest, highest-grade resources often occur above the youngest, deepest intrusions. New discoveries of other significantly telescoped porphyry mineralization across the camp emphasize the importance of these processes, and exploration potential, at Pyramid.

We believe that the combination of long-lived fertility ramp-up, hypogene telescoping and supergene enrichment are the crucial elements that contributed to the formation of the Pyramid system, and offer valuable clues that could aid the discovery of similar systems in relatively thin crustal settings around the globe.

PERMITTING REFORM & THE IMPLICATIONS FOR MINERAL DEVELOPMENT

Permitting Reform and the Implications for Mineral Development

Author: Cal Craig, Ambler Metals LLC

Mine Permitting is an ever-evolving process that drives data collection, design and engagement with a myriad of stakeholders including project developers, government agencies, land holders, Non-Governmental Organizations, local residents, and many other interested parties. The paths to gain authorization are as unique as the mineral deposits being sought; no two are exactly alike, and there is no "one size fits all". Permitting reform is often mentioned as the key to unlocking Alaska's vast mineral wealth, but real, meaningful updates to the Permitting process have been few and far between. Until now.

When it rains, it pours, and a slew of Executive Orders, court rulings, guidance documents and regulatory changes have fundamentally shifted the Permitting landscape on a state and national level at an unprecedented pace. With their decades of experience, the panelists at this year's AMA Environmental Session will help the audience sift through the legal and regulatory changes that impact the mining industry in Alaska. It's an exciting time in mining, so come join us and learn about how Alaska has been "unleashed"!"

ADVANCED EXPLORATION

Golden Summit Project, Alaska

Author: Kristina Walcott - Freegold Ventures Limited

The Dolphin Gold Deposit: Geology, Resource Growth, and Recent Developments

Geological Setting and Deposit Characteristics

The Dolphin gold deposit is located within the Dolphin stock and its surrounding metasedimentary rocks. The Dolphin stock is composed mainly of granodiorite and tonalite, closely mirroring the geological makeup of the nearby Pedro Dome pluton. Geological analyses have dated the Dolphin stock to approximately 89–90 million years, placing it in the same age range as the Fort Knox pluton, which hosts Kinross Gold's Fort Knox gold mine.

Discovery and Early Exploration

Freegold Ventures Limited began exploring the Dolphin deposit in 1995, discovering low-grade gold mineralization during the initial drilling campaign. The first NI 43-101 compliant mineral resource estimate for the project was completed in 2011. Drilling from 2011 to 2013 (~29,000m) continued to expand the resource. However, it was only in 2019 that interest in further exploration was rekindled after a new geological interpretation suggested the potential for higher-grade mineralization following a detailed review of historic drilling results, along with level and block model plans. A targeted drilling program began in February 2020 to test this hypothesis, with the first drill hole (GSDL2001) intercepting 188 metres grading 3.69 g/t Au.

Resource Expansion and Metallurgical Progress (2020–2024)

Since 2020, the Golden Summit Project has developed into one of North America's largest undeveloped gold resources. The significant increase in resource ounces and grade results from targeted drilling campaigns from 2020 to 2024 (over 130,00 metres), ongoing improvements to geological models, and a better understanding of the mineralization controls. Positive metallurgical test results have further advanced the project. Ongoing drilling has delineated zones of higher-grade mineralization and converted previously waste areas into potentially economically viable mineralized zones. Additionally, the continued westward expansion has led to the discovery of new higher-grade zones, resulting in both an increase in indicated gold resources and grades. Recovery rates exceeding 90% have been achieved using sulphide-oxidizing techniques, including BIOX®, POX, and the Albion Process™. The current Golden Summit resource (July 2025) includes an Indicated Primary Mineral Resource of 17.2 million ounces at 1.24 g/t Au and an Inferred Primary Mineral Resource of 11.9 million ounces at 1.04 g/t Au, calculated using a 0.5 g/t cut-off grade and a gold price of \$2,490.

Ongoing Optimization and Future Drilling

To further improve project economics, trade-off studies are planned to assess the impact of higher recovery rates against capital and operating costs. These studies will also review alternative cut-off grades and strip ratios. The 2025 drilling program is currently underway, with a total of 30,000 metres planned and five drill rigs in operation. Metallurgical testing is ongoing, and results are continuing to be promising. As of October 2025, 37 drill holes totalling approximately 24,000 metres have been completed in the 2025 drill program, and five additional holes are in progress. A significant number of assay results are pending. Drilling is expected to continue until mid-December and resume in February 2026. The results from the 2025 drilling campaign will be incorporated into an updated mineral resource estimate, which will support the upcoming Pre-Feasibility Study (PFS).

Geologic, Environmental, and Permitting Updates at Graphite Creek

Author: Kirsten Fristad, Graphite One Inc.

Graphite One has completed a feasibility study on the Graphite Creek deposit and initiated the mine permitting process. Graphite remains a critical mineral in the United States as a key component of lithium-ion batteries that currently is predominantly supplied by China. With the USGS 2021 designation as “the largest graphite deposit in the United States”, Graphite One’s Graphite Creek deposit has the potential to meet the United States’ growing graphite needs for many generations to come. Graphite One plans to develop an open pit mine at Graphite Creek located 40 miles North of Nome. The mine will produce graphite concentrate that will be shipped to a secondary treatment plant in Ohio. The secondary treatment plant will further process the graphite into many products including active anode material for lithium-ion batteries.

The Graphite Creek Project was listed on the FAST-41 Federal Permitting Dashboard in June and submitted a permit application to the Army Corp of Engineers under the Section 404 Clean Water Act in August. The 2025 field season at Graphite Creek focused on continuing environmental baseline studies and advancing geologic understanding of the deposit. This talk will highlight the technical advancements resulting from recent field activities as well as a status update on where we are in the permitting process.

New Amalga Gold Project – Developing an Ultra-Low-Footprint Underground Mine in Southeast Alaska

Author: Kyle Mehalek, PE (OreLogic LLC) – Lead Consultant, UG Mining & Planning – Grande Portage Resources Ltd.

Summary:

The New Amalga Gold Project consists of a sub-parallel mesothermal quartz vein system located approximately 20 miles from Juneau, AK hosting a high-grade resource of over 1.4M gold ounces indicated plus 0.5M gold ounces inferred. The project is located near transportation infrastructure in an area frequently utilized for outdoor recreation by Juneau residents. It is therefore being advanced as a direct-ship operation (DSO) to include a small-footprint underground mine utilizing sensor-based ore sorting then transporting material offsite for processing at an existing third-party facility, eliminating the need for onsite tailings storage.

Location and Background:

The New Amalga (formerly Herbert Gold) project is Located 19 miles northwest of downtown Juneau and 4 miles east of Glacier Highway, within Herbert River Valley of the Tongass National Forest (Fig 1). The original federal lode claims date to 1986, pre-dating the Roadless Rule. Grande Portage Resources Ltd became involved in 2010 and has since conducted over \$20M worth of exploration work.

Geology, Resource and Exploration:

The deposit is a “Juneau Gold Belt” type mesothermal quartz-sulfide vein system consisting of several sub-parallel vein structures. Mineralogy is dominantly quartz with lesser carbonate, arsenopyrite, pyrite, galena, sphalerite, scheelite and occasionally visible gold. The host rock is granodiorite and quartz diorite with alteration extending as much as several meters into the wallrock adjacent to the veining, consisting of sericite, chlorite and carbonate-altered quartz diorite. (Fig 2)

The current resource estimate (July 2024), informed by over 210 drillholes and 35 channel samples, contains an Indicated Resource of 1,438,500 oz Au at an average grade of 9.47 g/t Au (4.73M tonnes) and an Inferred Resource of 515,700 oz Au at an average grade of 8.85 g/t Au (1.81M tonnes)

The veins are terminated by shear contacts: to the west by a metasedimentary unit and to the east by gneiss (Fig 3), but are open for extension at depth and there is LiDAR evidence of potential additional sub-parallel structures “continuing the pattern” to the north and south in between the shear contacts.

Development Strategy:

The area around the deposit in the Herbert River Valley is a popular area for outdoor recreation. Multiple hiking trails are in the area, including a popular path on the opposite side of

the Herbert River from the project site which provides views of the Herbert Glacier further up the valley. Downstream is the Eagle Beach State Park campground and picnic area. The project must therefore utilize a development strategy with an extremely small, unobtrusive footprint to maintain local social license and facilitate the environmental review and permitting process.

The way to achieve this is via development of a direct-ship operation (DSO). An underground mine utilizing selective longhole stoping methods would extract ore which would then be subjected to a sensor-based ore sorting process (Fig. 4). This ore would then be containerized and hauled up Glacier Highway to a site called Cascade Point (Fig. 1), where a barge dock would be constructed. The sorted ore would then be transported to an offsite third-party facility for processing.

This avoids the need for use of any ore processing reagents and eliminates the need for an onsite tailings facility, dramatically reducing the acreage of land impacted (by approximately 85%) and minimizing the mine's environmental footprint. Furthermore, all development waste rock would be returned underground as backfill, avoiding the need for any permanent stockpiles left on surface after closure.

Fig. 1. Location of the New Amalga project relative to Glacier Highway, the City of Juneau, the proposed Cascade Point ore dock, and nearby existing mines



Fig. 2: Example of New Amalga Drill Core

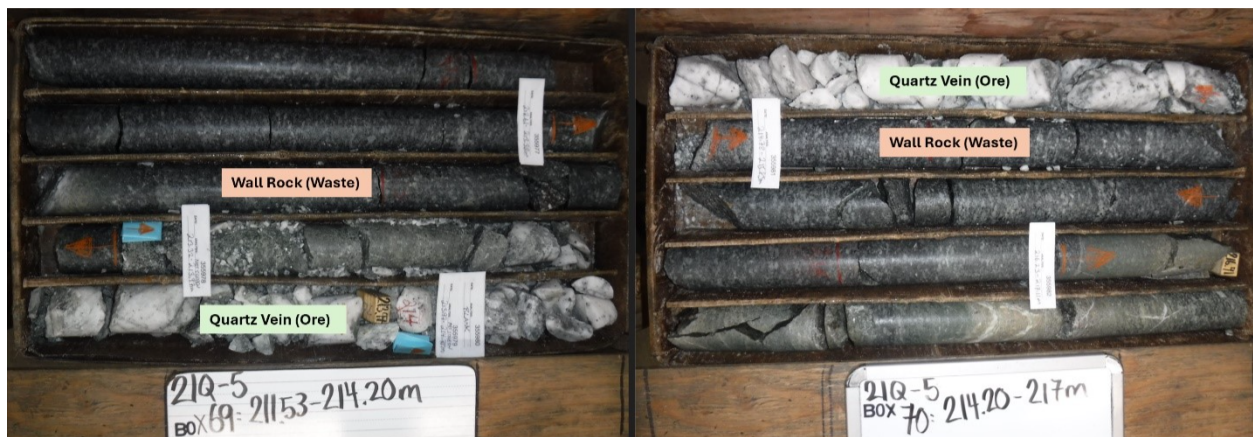


Fig. 3. Arrangement of Vein Structures and Shear Zone Contacts at the New Amalga Deposit

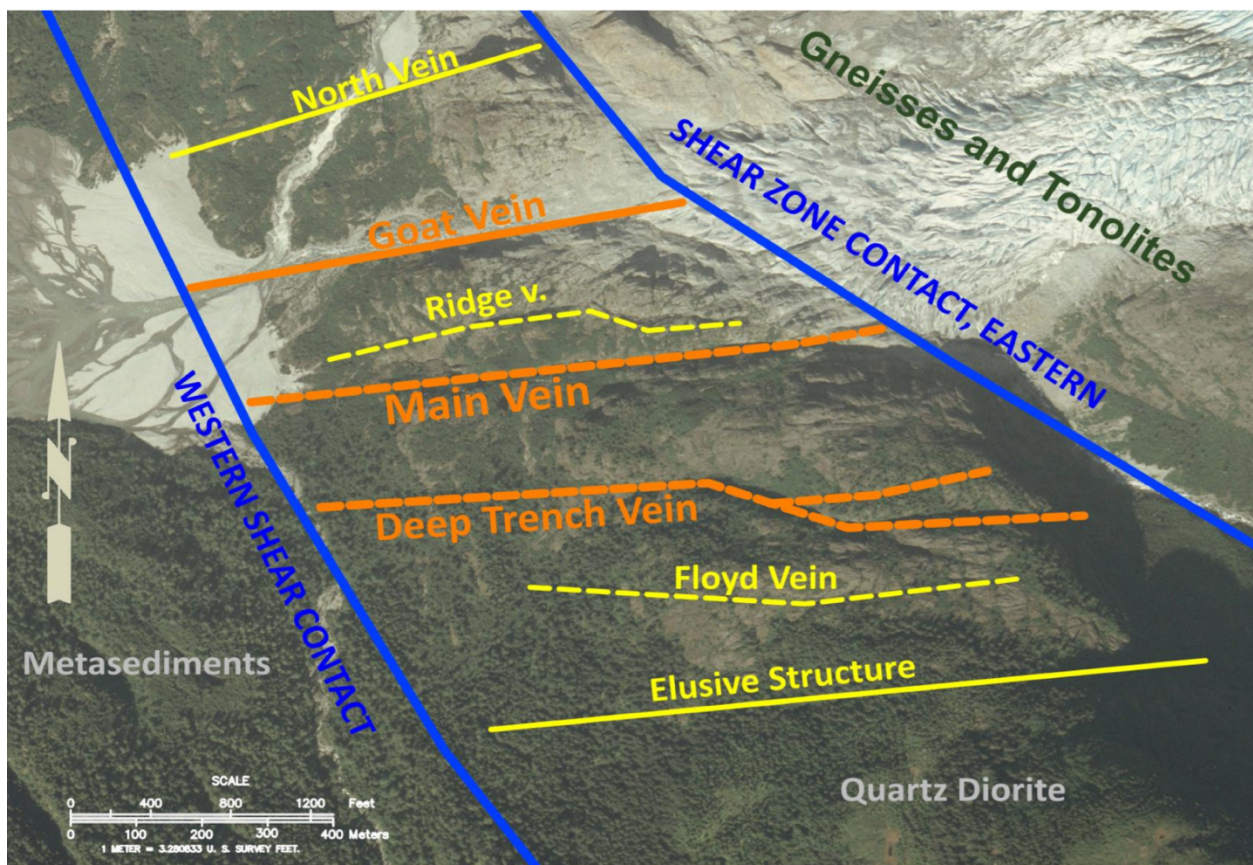
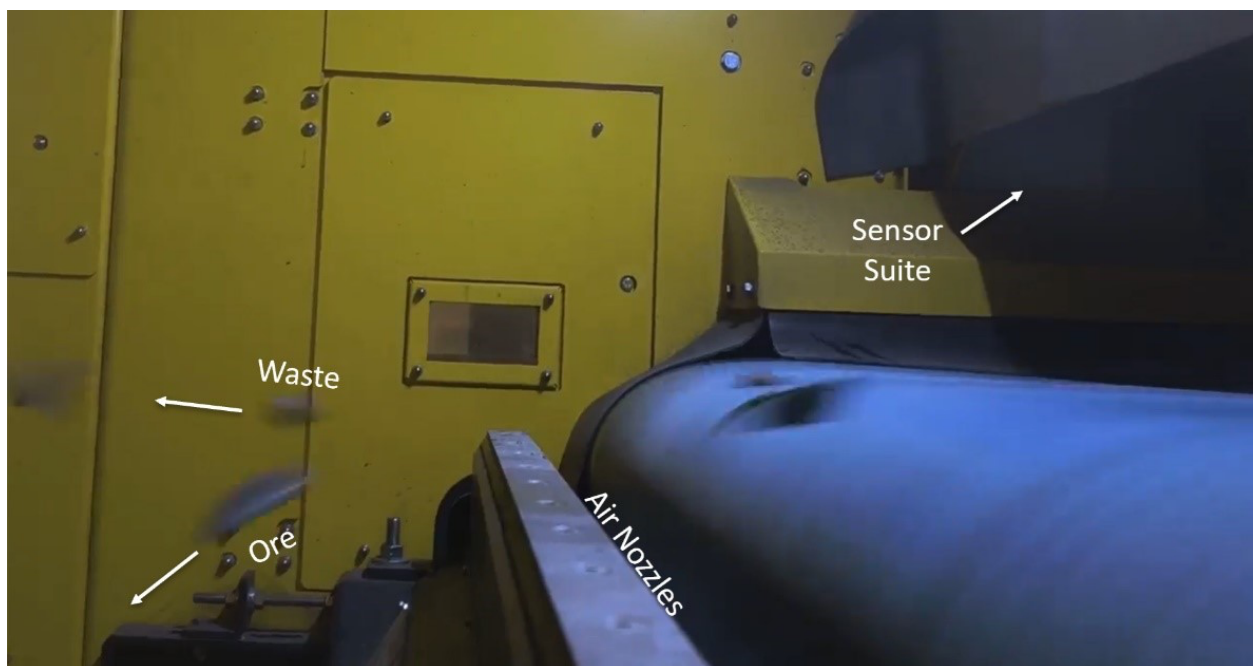


Fig. 4: Image of XRD Sensor-Based Ore Sorting Testwork Being Conducted on New Amalga Samples

The crushed rock is placed on a conveyor belt and then passed in front of the sensor, which rapidly analyzes the individual pieces of rock. When a piece of rock is identified as waste, a puff of compressed air redirects it to a “reject” bin. The remaining pieces of rock are sent to the accepted “product” stockpile.

Testwork on a composite sample of New Amalga ore and waste material assayed at 5.9g/t resulted in 43% of sample mass sent to “product” stockpile, which subsequently assayed at 12.9g/t. Meanwhile 57% of sample mass was sent to the “reject” bin, which subsequently assayed at 0.6 g/t. This test showed a gold recovery of 94% and a grade increase of 120%.



What does it take to mine and process in Alaska?

Author: John Shively, Pebble Limited Partnership

Known as one of the most promising mining prospects in the world, the Pebble Project has faced significant political challenges from an overreaching Environmental Protection Agency over the last 15 years. The Pebble team is actively contesting the EPA in federal court and engaging in conversations with the new administration in DC to get the project back into permitting. Longtime PLP CEO John Shively will provide an update about the company's latest efforts along with a discussion of the importance of increasing domestic mineral processing. He will also discuss the potential of hydromet processing technology and its potential for Alaska.

Integrating Proven Technologies to Optimize the Definition of the Aktigiruaq Deposit Resource

Author: E. Fejes, Senior Geologist, Teck Resources Limited

The Aktigiruaq and Anarraaq Exploration drill program was designed to extend and increase the resource confidence of high grade, undeveloped zinc-lead deposits located approximately eight miles northwest of the Red Dog zinc-lead mine in Alaska's Brooks Range. Red Dog Operations was developed through an innovative operating agreement between the operator Teck Alaska Incorporated, a subsidiary of Teck Resources Limited (Teck) and the land-owner NANA, a Regional Alaska Native corporation owned by the Iñupiat of northwest Alaska. The mine and concentrator properties are leased from, and were developed under the agreement with NANA.

The world class Aktigiruaq and Anarraaq deposits are located on State Lands with Anarraaq hosting Inferred Mineral Resources of 16.3Mt @14.3% Zn, 4% Pb and 80.4 g/t Ag and Aktigiruaq hosting Indicated Mineral Resources of 32.7Mt @16.2% Zn and 4.2% Pb and Inferred Mineral Resources of 26.6Mt @13.7% Zn and 3.5% Pb. Both deposits represent a significant opportunity to extend the Red Dog Operations mine life and as such, over the last few years, significant effort was dedicated to advance their definition using cost-effective and reliable proven technologies.

The 2019 Aktigiruaq resource definition drill program initiated the use of directional drilling technology that resulted in optimizing the program efficiency by reducing the amount of drill core meters needed to intersect mineralization whilst reducing the environmental footprint and ground disturbance by consolidating what would have been multiple drill holes to a single drill pad.

In 2022, the program implemented core scanning technology which included the collection of XRF and hyperspectral data for all the resource drill holes.

An additional critical component to optimize the definition of the resource was a drill hole spacing study completed in 2023; the integration of data generated through strategically and intentionally spaced directional holes and continuous core scanning data facilitated the development of dynamic spacing and dynamic grade modelling capabilities which has driven methodological improvements in both the planning and execution of the Aktigiruaq resource program.

The application of directional drilling, scanning technology and drill hole spacing studies has allowed for the overall optimization of the Aktigiruaq drilling programs and to significantly extend and increase the resource base and confidence. These technologies greatly enhanced the speed and quality of data collection while minimizing disturbance to the environment. As Aktigiruaq advances, Teck continues to explore new opportunities to derive value from scanning data. This includes investigating the potential to define geochemical proxies to predict key environmental and geotechnical parameters such as static acid-base accounting (ABA) and rock quality designation (RQD) respectively.

ALASKA DATA AT RISK

Alaska Data at Risk

Author: Rob Retherford

Abstract: Outline of the Problem

1. Past Recording of Work completed on State of Alaska Claims has allowed industry to provide only limited information often not including Geochem results or Assays of drill core.
2. A significant amount of important data has therefore been retained in private industry files and not forwarded to the State of Alaska
3. Many of those private industry files are from long ago projects and have since passed through many hands. The current owners of this data are, in many cases, struggling with how that data should be preserved.
4. For the future, the State should require the mineral industry to provide ALL important data at the time the work is completed. Clarification of the statutes may be necessary.
5. For the present, there are several ways in which private industry data can be passed back to the State.
6. Much of the data will need to be organized and digitized before it can be added to public files.

Fueling Discoveries: How Alaska can turbocharge the Discovery & Development of its Mineral Resources: Improving Open-File Reporting, Data Access, and Discovery Outcomes

Author: Russ Eley, Chief Geologist, MDF Global

The availability of historical exploration data is a major catalyst for new discoveries around the globe, and is expected to play an even larger role as companies leverage new tools & workflows to help them make sense vast amounts of data. This presentation compares the public reporting and data access systems that underpin mineral exploration in Australia and Alaska, highlighting how differences in regulatory frameworks, data management, and government investment directly influence discovery rates.

In Australia, mineral exploration data are treated as a public resource. State and territory mining acts require companies to submit detailed exploration reports—including drilling, geochemical, and geophysical results—to the relevant Geological Survey. After a confidentiality period (typically one to five years), these reports become “open file” and are released through public digital systems such as WAMEX in Western Australia, the GSQ Open Data Portal in Queensland, and SARIG in South Australia. Each report is georeferenced, standardized, and linked to metadata templates that allow seamless integration into geoscientific databases. The result is a vast, continuously growing national dataset encompassing millions of drillholes and surface samples—an ecosystem that underpins both academic research and industry-driven exploration targeting.

By contrast, Alaska lacks statutory open-file reporting requirements for mineral exploration data. Claim holders are required to submit annual “labor affidavits” or “assessment work statements” to maintain tenure, but these filings record only the value and type of work undertaken—not the technical data itself. Although the Alaska Division of Geological & Geophysical Surveys (DGGS) produces world-class regional mapping and geophysical datasets, and the Geologic Materials Center (GMC) curates physical core samples, these programs cannot substitute for the ongoing release of company-generated data. Consequently, the state’s collective exploration knowledge base grows slowly and unevenly, and much of the valuable technical information gathered by private explorers remains locked in corporate archives.

The implications for discovery rates are significant. In Australia, open-file reporting has supported a steady stream of globally significant mineral discoveries since 2000—such as Prominent Hill, Tropicana, Nova-Bollinger, Gruyere, Winu, Havieron, Hemi, and Julimar. These finds often emerged in mature terrains, guided by reinterpretation of existing public data. In Alaska over the same period, fewer new discoveries have been publicly documented, and those that have—such as Livengood, Graphite Creek, Goodpaster, and Palmer—are less well defined in terms of discovery chronology and data lineage, reflecting the lack of consistent open-file documentation.

Several practical measures could be adopted to strengthen Alaska’s exploration ecosystem. First, adopt statutory open-file reporting for mineral exploration, requiring digital submission of all technical data with a defined confidentiality period prior to release. Second, establish an “Alaska

Open Data Portal”—a unified online platform integrating DGGs datasets, GMC archives, and company submissions in machine-readable formats. Third, link incentives such as tax credits or grants to timely data reporting, ensuring public benefit from state-supported exploration. Finally, standardize digital templates and metadata to align with international best practices, lowering barriers for data reuse and integration.

The message is simple: open data drives discovery. Australia’s experience demonstrates that systematic reporting and public data access shorten exploration cycles, reduce duplication, and attract investment. By adopting similar frameworks, Alaska could unlock its full mineral potential—transforming isolated private datasets into a shared foundation for the next generation of discoveries.

Digitalization and Preservation of Legacy Geologic Information

Author: Kurt Johnson, Curator, Alaska Geologic Materials Center, Div. of Geological & Geophysical Surveys

Summary: Preservation and digitization of both legacy and current metadata, datasets, and samples are formidable challenges for the geological sciences. Curator Kurt Johnson with the Alaska Geologic Materials Center will review IT architecture utilized by the Division of Geological & Geophysical Surveys to preserve data and apply up-to-date work processes to digitized information. The presentation will examine sample preservation, databases, software, and archival methods utilized by this agency.

Abstract: The Alaska Geologic Materials Center (GMC), managed by the Alaska Division of Geological & Geophysical Surveys (DGGS), stores extensive geologic data related to energy, minerals, and more, valued at more than \$35 billion. It provides various users, including industry professionals, government officials, researchers, and the public, with access to samples that help identify new resource opportunities and enhance geologic understanding in Alaska. The GMC aims to curate its collections, improve global access to materials, and stimulate exploration of Alaska's resources through new scanning equipment. GMC collections are accessed frequently by global industry and academic researchers whose interests span the gamut from lithium, REE, and other critical mineral exploration to novel concepts such as carbon capture and hydrogen generation in ultramafic rock suites.

To assist client visits the GMC features a database and web inventory interface that allows users to easily access a real-time inventory of nearly 780,000 public sample items. Our minerals collection includes drill core from 292 prospects, containing 2,426 boreholes, that adds up to more than 43,000 core boxes. Basic metadata such as drill logs, geochemical analyses, and drill collar locations with inclination and azimuth are also accommodated by the database.

Automation is key to GMC archival operations, with systems for sorting, indexing, and searching data, along with AI for categorizing information. We use advanced OCR technology to scan old maps and reports, including poor handwriting. The GMC has a clean room for archiving legacy media formats, comprising old 9-track tapes, diskettes, CDs, DVDs, DAT tapes and QIC tapes. We may be the only facility in Alaska with the ability to read and archive these old formats. Over a five-year period, a \$64,000 investment in GMC storage servers will replace comparable cloud services costing more than \$200,000. All IT systems are developed and maintained by DGGS staff.

Gathering essential geologic information across wide and remote regions of Alaska is difficult and very expensive. Experience repeatedly shows that over time even valuable data evaporates into nothingness. To mitigate this risk takes planning, infrastructure, and significant effort. Both DGGS and the GMC apply enormous priority and energy to develop and maintain systems to hold and distribute Alaska geologic information. The GMC is a world-class geologic repository that can house and preserve critical resource industry information and samples. DGGS stands ready to assist organizations to retain its legacy geologic data and samples. We welcome inquiries from the Alaska

minerals exploration community to learn more about our agency's mission and digitalization capabilities. Community input from the minerals sector can assist in metadata research on legacy boreholes.

RED DOG: A LEGACY OF RESPONSIBILITY AND FUTURE OPPORTUNITY

Western Arctic Caribou, Red Dog Operations, and the Biodiversity Mitigation Hierarchy

Author: Johanna Salatas, Biologist, Red Dog Mine, Teck Alaska

The Western Arctic Caribou herd, one of Alaska's largest, migration covers a vast territory of approximately 157,000 acres through Arctic tundra habitat. Although subject to natural cycles, the population has declined to its lowest in four decades, dropping from 500,000 in 2003 to 152,000 animals in 2023. This decline is driven by a combination of stressors including climate change, predator and hunter pressures, northward expansion of diseases, food availability changes and human activity. Teck Alaska has operated Red Dog Mine since 1989 under an innovative operating agreement between NANA, an Alaska Native corporation, land owner and operating partner, with subsistence protection as a key priority. Teck works collaboratively with the Red Dog Subsistence Committee, NANA, community leadership, Alaska Department of Fish and Game, and National Park Service. The Community Reporter Program employs local stakeholders from Kivalina and Noatak to monitor caribou during migration and winter, and to advise road closures which have lasted multiple days. Biologists work together with community reporters to document caribou behavior in relation to hunters, predators, infrastructure and equipment. The integration of Traditional Ecological Knowledge with western science has led RDO to adopt a range of initiatives to better understand and protect caribou. These include a radar system, thermal imaging cameras on haul trucks, camera-based studies, lichen growth research, and predator studies to clarify the relationship between wolves and caribou. Tissue metals monitoring occurs with the support of the community hunters and vegetation monitoring tracks changes in landscape and flora. The caribou monitoring and research efforts support Teck's application of the biodiversity mitigation hierarchy—avoidance, minimization, and rehabilitation. Insights from these initiatives are being integrated into Red Dog Operations' reclamation and closure plan, ensuring alignment with NANA's End Land Use Plan and Teck's Sustainability Commitments.

Working Together: NANA Regional Corporation, Teck Alaska Incorporated and Native Village of Kivalina

Panelists: Native Village of Kivalina: Millie Hawley millie.hawley@kivaliniq.org

Teck Alaska Incorporated: Wayne Hall Wayne.Hall@teck.com

NANA Regional Corporation: Jennifer Todd jennifer.todd@nana.com

Panel Co-chair: Clayton Gooden Clayton.Gooden@nana.com

The Siñgagmiut Working Group (SWG) involves the direct participation of Teck Alaska Incorporated, NANA Regional Corporation and Native Village of Kivalina. This organization was formed in 2017 to collaborate on issues that emerge as the Red Dog Mine operates in the region, such as health matters, water quality, emergency response, education, employment, and cultural revitalization. The panel will bring a speaker from each of the three parties to talk about the benefits of collaboration, our strengths working together, the challenges we have faced over the years, lessons learned, and share wise practices.

Since 2017, our programs and their reach have increased in the community. We have created unique programs to support cultural continuity, employability, and monitoring in the community. In doing so, we have built trust and partnerships along the way, and we will continue to work with the same determination until the life of the mine. Finally, the panel speakers will each reflect on their hope for the future of the relationships we have built over the years that go beyond SWG.

Anchoring Closure in Community Values: End Land Use Planning at Red Dog

Authors: Chloe Crossley (Teck Alaska), Lance Miller (NANA), Clayton Gooden (NANA)

Contact: Chloe.Crossley@teck.com; Lance.Miller@nana.com; Clayton.Gooden@nana.com

End land use planning (ELUP) is reshaping how the mining industry approaches closure, moving beyond technical remediation to post-mining solutions that are meaningful, sustainable, and community-driven. At Red Dog Mine, this shift is being advanced through a proactive partnership between Teck's Red Dog Operations (RDO) and the landowner, NANA. From the outset, both parties aligned on the ELUP's purpose, priorities, and expectations. This collaboration established shared objectives, including a commitment to a participatory process centered on landowner values. While NANA leads the project with a consultant completing technical delivery and assisting in community engagement, RDO remains engaged to keep the work coordinated and complementary to other closure planning efforts.

As early as 2006, Teck and NANA convened major stakeholder closure planning workshops that brought together the NANA Board, Subsistence Committee, communities, state agencies, NGOs, and technical experts to evaluate closure pathways and tailings options. These efforts set a benchmark for inclusive closure dialogue, highlighting that social planning and engagement must begin well before the end of mine life.

The current ELUP process began in 2023 with a consultant launching a multi-phase process in 2024. Initial efforts focused on socializing the concept, defining scope, and securing buy-in from NANA stakeholders. Early 2025, NANA hosted a Red Dog End Land Use workshop with broad participation, including local communities, the Northwest Arctic Borough, state regulators, and RDO technical experts. Current phases include community visits and youth engagement to capture voices, aspirations, and values that will guide community-led initiatives and integration with broader closure planning. This phased approach enables early dialogue and progressively deeper collaboration and alignment.

Traditional closure planning has often emphasized technical safety. In contrast, ELUP places equal weight on shared values, cultural continuity, and regional aspirations. Though still in progress, the NANA ELUP process is breaking down limiting beliefs and establishing a community-anchored closure vision. By embedding landowner leadership and partnership into closure planning, NANA and RDO are again setting an industry benchmark for sustainable legacies in mining.

MINES AND ADVANCED PROJECTS

From faces to tailings: Driving innovation at Coeur Alaska's Kensington Mine

Author: Rae Keim, Technical Services Manager, Coeur Alaska, Kensington Mine

At Coeur Alaska's Kensington Mine, we have recently deployed two innovative technologies that are advancing efficiency, safety, and accuracy in both underground operations and tailings management.

The first, Mine Vision Systems (MVS), is a tablet-based platform that integrates camera, LiDAR, and lighting to capture georeferenced imagery and 3D spatial data of underground headings in real time. Since February 2025, our Mine Geologists have used MVS to scan and map every sampled face and drift rib with accuracy within one foot of survey data. This capability enables round-by-round geo-steering, faster turnaround of geological information, and the generation of higher-resolution models to support engineering design.

The second, a customized AutoTremie system, adapts dredging technology for controlled placement of tailings within our Tailings Treatment Facility (TTF). Currently operating in semi-automated mode, the system senses tailings depth and adjusts positions as necessary, with full autonomy in development. This innovation delivers safer and more uniform deposition, maximizes storage capacity, and eliminates the need for manual line movement on the water.

Together, these projects highlight how tailored technological solutions can enhance precision, safety, and sustainability in modern mining operations.

Operations and Production Geology Update – the Dawson Mine

Authors: Robert Fithian email@robertf@dawsonmine.com; Kris Alvarez, Sundance Mining, LLC email: kris@dawsonmine.com

2025 brought significant enhancements to the Dawson Mine Project. Acquisition of contiguous strike length claim group expanded the existing mine life 50 years to 30252075. Included within this acquisition are several historic producing mines. Mining continues with several horizontal rubber-tired development headings followed by room and pillar production. The Dawson Mine gravity only mill was refurbished in a 21-day period during July. Grinding circuit change included replacement of the ball mill with a rod mill. The former ball mill had a recirculating load requirement of 600 percent to achieve optimal grind for gravity only recovery. This high recirculating load also created excessive -200 mesh slimes which harbored the highest percentage of gold loss. The new rod mill increased production by sixty percent without any recirculating load. Additionally, it produces an optimum grind for gravity only recovery from the Dawson Mine ore. Substantial crusher labor and wear cost benefits were also realized with the rod mill as fine ore feed size was able to be increased to .75 from .375 inch. This change reduced crushing time by 40 percent. Additionally, the complete initial spirals recovery circuit was replaced with a new design of enhanced overflow and underflow spirals and the final recovery circuit of hi-gravity-force separation was replaced with new special designed fine gold recovery spirals.

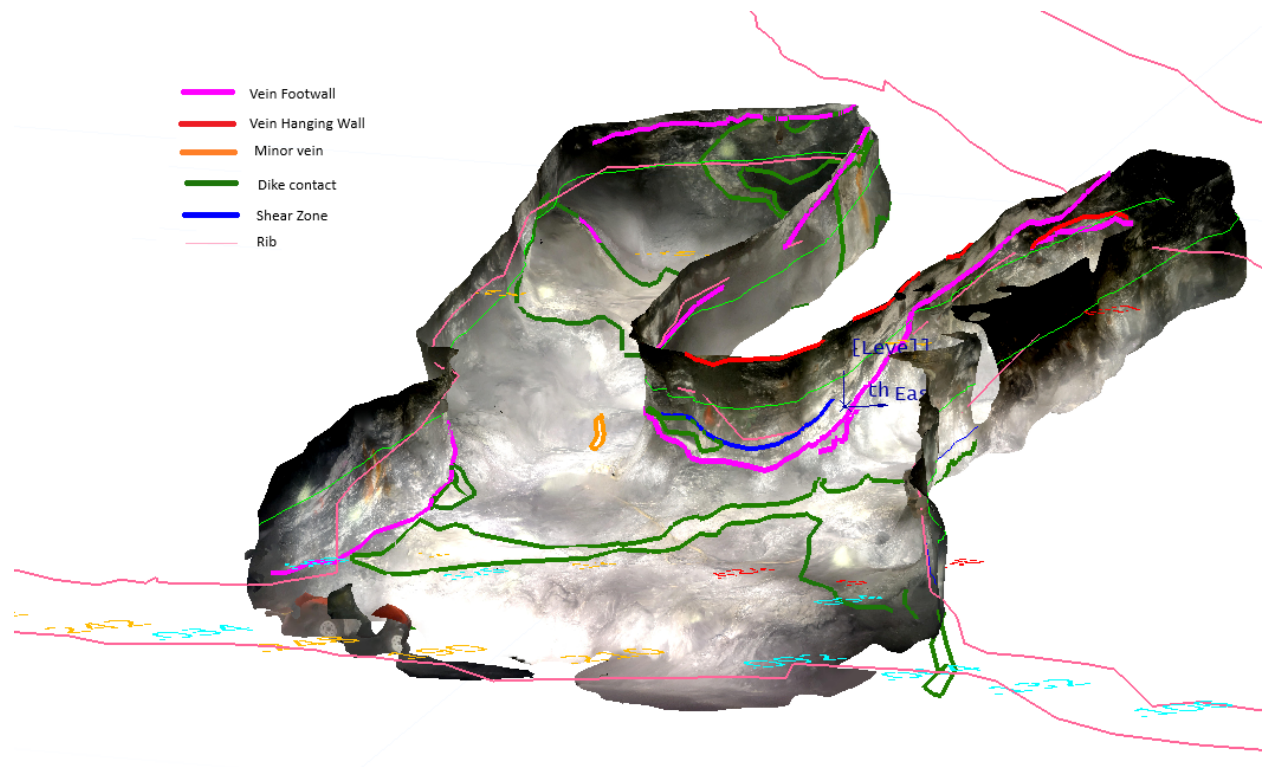
The rapid convergence of technologies and the lower cost and high ease of use of lidars, tablets, and databases has removed barriers for smaller operators to upgrade production geology procedures. Mineralization at the mine can be complex and difficult to map in 2D and geologic controls of gold grades in ore shoots remain poorly understood due to incomplete mapping. A workflow using MySQL, Rockmapper©, CloudCompare, and Polycam has been developed at the Dawson Mine to assist with face sampling and mapping and to facilitate better geologic modeling and projections. Georeferenced imagery (analogous to core log photos) is also preserved for future re-interpretations. Future compilation and interpretation of this data is hoped to lead to a better understanding of geological controls of higher-grade mineralization.

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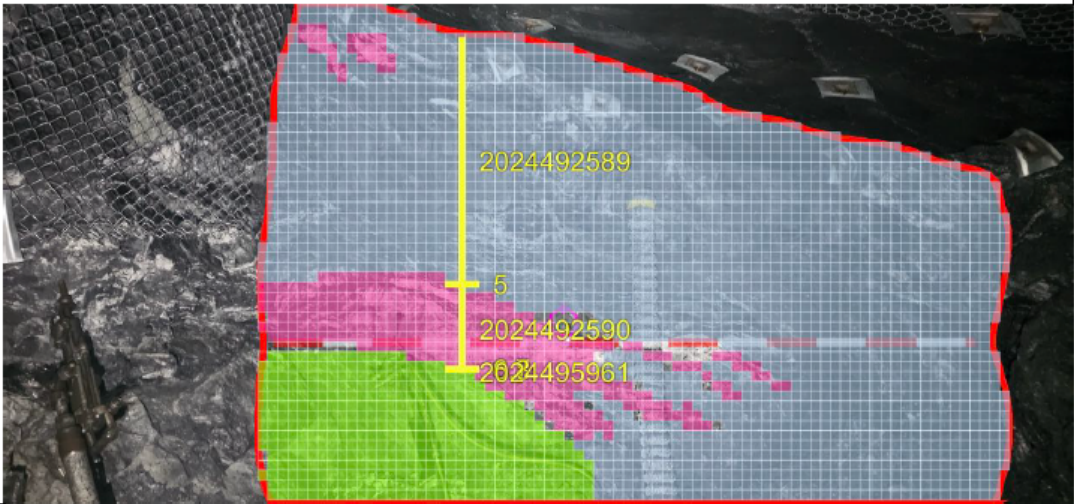
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A Polycam lidar scan of the 410 Scrams 11 and 12 with geologic contacts.

Sampling Report

Level: 492	Region: South Decline	Face Number: 10	Date: 08 Sep 2025	Time: 12:34
Author: Kris Alvarez	Face Area: 126.4sqft	Face Heading: NA	Mag Decl: +17.5°	Mine Grid Rot: +0°



Scale bar length: 14.2ft
Grid size: 0.2ft

Domains (Total Area %, Filled Area %)

QVN (11%, 11%)	QRS (74%, 75%)	Andesitic Dike (13%, 13%)
Unknown (2%, 2%)		

Georeferencing

ID: Sp237

X / Easting: 2,885,650.884
Y / Northing: 1,330,923.601
Z / RL: 486.181
Azimuth: 192.87
Plunge: 0
Distance to Laser Station: 101.63ft

Projected Laser Point:

X / Easting: 2,885,628.247
Y / Northing: 1,330,824.524
Z / RL: 486.181

Example of a face report with a chip channel sample

Looking Forward with Usibelli Coal Mine

Author: Ethan Trickey, P.E., Senior Mine Engineer Usibelli Coal Mine

Usibelli Coal Mine, Alaska's longest-running major mine at over 83 years, is focused on managing costs, adopting new technology, and improving infrastructure. This presentation covers Usibelli's work at Jumbo Dome Mine, final reclamation in Hoseanna Valley, and the exciting plans to use the "Ace in the Hole" Dragline for future mining.

Fort Knox, Gil and Manh Choh Mine Geology Update – Current Interpretations of Blasthole Assay Results and Oriented Core Structural Measurements

Authors: Bryan Babb, Jeff Cox, Chris Van Treeck

Blasthole assay results offer high density information on gold grade distribution. High gold grade zones, as well as offsets in high gold grade, illuminate the structural framework of the ore deposit. Modeling ore controlling features from high data density blasthole assay results to low data density subsurface resources areas provides robust exploration targets. The structural measurements oriented core can provide are essential for testing the geometry of ore controlling faults modeled from blasthole data and increasing confidence in the exploration model. We will be sharing our current geologic interpretations, based on recent contributions to the large volume of historic observations and investigations of Kinross Alaska's three gold mines.

Fort Knox, a type locality for the Reduced Intrusion Related Gold deposit model, displays multiple high gold grade corridors corresponding with mid to high-angle faults. These faults funneled hydrothermal fluids, through the granodiorite host, localizing sericite $\pm$ pyrite $\pm$ quartz and kaolinite alteration, accompanied by gold-quartz $\pm$ bismuth $\pm$ molybdenite mineralization. The Fort Knox granodiorite stock displays an E-W oriented elongate shape bisected by the near vertical, northeast trending, Monte Cristo fault of ¹Newberry et al. Mineralized faults on the east side of the pit vary in orientation from those on the west side of the pit indicating differing stress regimes divided along the mineralized Monte Cristo left-lateral normal fault.

At the Gil a series of north dipping reverse faults create a thickened package of mafic and calcareous schists, with variable calc-silicate alteration. Apparent offsets in the mafic/calcareous package indicate additional high angle northeast and southwest dipping normal faults. Hydrothermal fluids exploited both the reverse faults and cross cutting normal faults to deposit gold-pyrite-arsenopyrite $\pm$ bismuth $\pm$ molybdenite mineralization with associated sericite $\pm$ pyrite $\pm$ quartz or silica alteration. In the main Gil pit, abundant mafic/calcareous lithologies localized strain and rupture within that relatively ductile unit; as a result the north dipping reverse faults are the main ore control. Outside the main Gil pit, the northeast and southwest dipping normal faults appear to be the main ore control, with loci of high gold grade at the intersections of normal and reverse faults especially in intersections hosted in the chemically reactive mafic/calcareous lithologies.

Complex recumbent folding (sheath folding) significantly thickened the southwest dipping calcareous schist which hosts the Manh Choh gold deposit. Sub-parallel, northwest trending high angle faults bisect the long dimension of this fold thickened calcareous schist package, providing conduits for hydrothermal fluids which deposited the gold and silver rich (arsenopyrite $\pm$ bismuth),

pyrrhotite dominant, Fe-Cu massive sulfide amphibole skarn. Additional high-angle northwest and southeast dipping normal faults act as a secondary control on gold grade distribution, localizing fluid flow and creating offsets in the calcareous host lithology.

¹Newberry, R.J., Bundtzen, T.K., Clautice, K.H., Combellick, R.A., Douglas, Tom, Laird, G.M., Liss, S.A., Pinney, D.S., Reifenhuth, R.R., and Solie, D.N., 1996, Preliminary geologic map of the Fairbanks mining district, Alaska: Alaska Division of Geological & Geophysical Surveys Public Data File 96-16, 17 p., 2 sheets, scale 1:63,360.

Pogo Growth: 2025 Future Planning

Author: Zachary McLeay – Mining Manager, Northern Star Resources, Pogo Underground Gold Mine

As Northern Star Resources advances its long-term growth strategy at the Pogo Underground Gold Mine, 2025 marks a pivotal year of expansion and modernization. Two new portals are being developed to provide access to the emerging northern orebodies, including the Central Lodes and Goodpaster, while drilling and mine planning are underway for the Southern Star orebody, where access mining is set to commence this month.

Significant infrastructure upgrades are underway to support this growth, including the commissioning of an Orica ORBS centralized blasting system over a new fiber-optic network, implementation of Sandvik Multi-Lite for remote loader operation, and major ventilation enhancements such as new portals, fans, and telemetry-based monitoring systems. Complementary projects include new underground explosives magazines, process plant upgrades, and scoping for expanded mine water treatment capacity.

To deliver this expansion, Pogo has strengthened its workforce and fleet—adding a dedicated underground projects team, transitioning to a new diamond drilling contractor, introducing a seventh jumbo, a modern Epiroc haulage fleet, and additional loaders. Together, these initiatives position Pogo to sustainably grow production beyond 1.7 Mtpa while improving safety, efficiency, and long-term resource access.

CORE SHACK AND PROSPECTORS TENT

High-Grade Exploration at Kensington Mine

Sam Kilfoyle and Trevor Nelson, Coeur Alaska - Kensington Mine

Coeur Alaska's Kensington Mine is located approximately 45 miles north-northwest of Juneau, Alaska. The property sits within the Berners Bay Mining District, at the northern-most edge of the Juneau Gold Belt. The Juneau Gold Belt is a 120-mile-long, 10-mile-wide structural zone hosting several major gold producers. Coeur Alaska has mined over 1,400,000 ounces from the property since beginning commercial production at Kensington in 2010.

The property lies to the west of the Coastal Megalinalment, situated between the Wrangellia terrane and the Treadwell formation of the Gravina belt. The deposits are modeled as low-sulfide, mesothermal, gold-quartz veins with strict structural controls. The deposits have reportedly been restricted to a Cretaceous diorite intrusion, known as the Jualin diorite, which intrudes the Triassic basalts of the Wrangellia terrane and lies unconformably against the Gravina belt.

The Kensington Mine consists of multiple deposits including the Kensington, Elmira, Raven, Johnson, and numerous other prospective vein zones. The vein systems are generally shear hosted veins or vein packages composed of extensional vein arrays, sheeted extensional veins, and stacked, en-echelon, shear veins. The main deposits of the Kensington Mine strike to the north-northwest and dip moderately to the east. The mineralogy of the deposits varies between gold tellurides, most commonly calavarite (AuTe_2) and petzite (Ag_3AuTe_2), associated with pyrite-rich zones at Kensington, and coarse free gold (Au) commonly associated with galena, sphalerite, tennantite, and pyrite at Jualin.

In the upper area of the Kensington deposit, recent drilling has returned high grades over significant widths across the eastern veins Zone 30 and 30B. Drilling of Zone 10A, located on the west side of the vein system, has also yielded positive results. This zone represents a significant recent expansion at Kensington given its proximity to near-term planned production.

In the lower area of the Kensington deposit, recent drilling has targeted Zone 50, 10, and 10 HW from new exploration development. Intercepts confirm the continuity of mineralized zones previously identified and highlight continued mineralization at depth and in parallel zones.

The Elmira vein system shares similar vein style and mineralization characteristics with the Kensington deposit, lying 2,500 feet east of Kensington. Recent drilling has confirmed continuity across the upper portions of both the Main and South zones across substantial strike length. The Johnson vein system, lying 500 feet east of Elmira, remains a drill target with potential for future resource conversion.

Ongoing exploration is built upon previous drill programs, surface and underground geochemistry, surface and underground mapping, geophysical surveys, oriented core, and compilation of historic data. The program is focused on developing a stronger geological interpretation of the district and maintaining current mine life. This approach drives new interest in known prospects and positions scout drilling to build a pipeline of targets for future growth.

Vein Mineralization and Structural Controls at the Donlin Gold Deposit

Stephanie Mrozek, Chief Geologist; Graham Ellsworth, Project Geologist; Matt Matko, Project Geologist; Preston Weeks, Geologist; Michelle Deal, Exploration Project Manager

Donlin Gold LLC, 2525 C St, Suite 450, Anchorage AK 99503

The Donlin project in southwestern Alaska hosts one of the world's largest undeveloped gold resources, with Proven and Probable Reserves of 33.8 Moz, 504.8 Mt at 2.09 g/t Au and Measured and Indicated Resources of 39.0 Moz, 541.3 Mt at 2.24 g/t Au (100% basis, inclusive of Mineral Reserves)¹. The intrusion-related gold deposit is hosted in Cretaceous rhyodacites and Kuskokwim Group sedimentary rocks. The project is jointly owned by NovaGold Resources (60%) and Paulson Advisors (40%), following a June 2025 transaction in which Barrick Gold divested its 50% interest. Since this transition, the Donlin team has accelerated technical programs, including the 2025 resource conversion drilling campaign.

Our 2025 AMA Core Shack highlights mineralized intercepts from three new drill holes – DC25-2232, DC25-2245, and DC25-2270 – selected to illustrate vein-style mineralization across multiple host lithologies.

- **DC25-2232** intersects RDX (crowded porphyry) and siltstone, both cut by quartz-sulfide veins with gold up to 19.9 ppm and arsenic exceeding 1.0%.
- **DC25-2245** features quartz-sulfide veins overprinting RDA (aphanitic porphyry), with gold up to 12.8 ppm and arsenic from ~3,000 ppm to more than 1.0%.
- **DC25-2270** displays V3 veins of orpiment, realgar, and native arsenic overprinting earlier quartz-sulfide veins.

Downhole televiewer data from DC22-2270 defines vein, fault, and contact orientations, with a display figure showing their correspondence with core observations, improving structural continuity. Na/Al molar ratios serve as proxies for clay alteration intensity and mineralogy (e.g., NH₄-illite, illite, kaolinite). Higher gold grades correlate with increased veining and Na/Al <0.013, indicative of NH₄-illite alteration.

Together, these results contribute to refining Donlin's geologic and structural models, advancing resource classification, and guiding future project development under the new ownership. Visitors are invited to examine representative core, review geologic and televiewer logs, and discuss integration of legacy and new data into Donlin's evolving deposit model.

References

¹NI 43-101 Technical Report on the Donlin Gold project, Alaska, USA with an effective date of June 1, 2021, S-K 1300 Technical Report Summary on the Donlin Gold Project, Alaska, USA dated November 30, 2021, <https://novagold.com/donlin-gold/reserves-resources/>

Kinross Alaska Core Shack Exhibit

Selected core and rock sample displays to characterize host rock, alteration, and mineralization of the three Kinross Alaska Mines.

- **Fort Knox:** accompanying plan and long sections of the deposit, and project timeline. Shawn Colburn and David Poole, 2018
- **Gil – Sourdough:** interpretive cross sections of the Main and North Deposits. Bryan Babb, 2021
- **Manh Choh:** interpretive cross sections of the Main and North Deposits. Shawn Colburn, 2022

Fort Knox

Pit is 1.6 mi E-W, 1 mile N-S, 1900 ft deep.

9.5 Moz produced.

Mine ~250,000 tons/day using 36, 240-ton trucks, 4 shovels and two loaders; drill ~350 holes a day.

1996-2022: 1,300,000,000 tons mined; 372,000,000 tons milled; 294,000,000 tons on Walter Creek Heap Leach (2.3 Moz); over 147,000,000 tons on Barnes Creek Heap Leach (0.9Moz) another 87 MT (.60Moz) to end of P10); the mill can push up to 40K tons a day. 815,000,000 tons waste moved (33 Mt more). Another 527,000 left in P10.

Gil

14-mile haul to Fort Knox

Gil:

24.6 M tons mined

7.3 Mtons A ore 184 koz

2 M tons C with 22.3 koz

15.2 M tons waste

Fort Knox/Gil-Sourdough

- 2022 Production – 221,248 oz Fort Knox; ~70,000 oz Gil
- 1.9 Moz P&P Reserves, including 0.145 Moz Gil
- 1.1 Moz M&I Resources, including 0.233 Moz Gil
- 2023 H1 Production – 134,825 oz / \$1,166 oz
- ~12.5% of Kinross' global production

Manh Choh

At the 70%-owned Manh Choh project and it is expected to add approximately 640,000 attributable Au eq. oz. to the Company's production profile over its approximately 4.5-year life-of-mine.

- 0.7 Moz Au, 1.2 Moz Ag P&P Reserves
- 0.05 Moz Au, 0.1 Moz Ag M&I Resources
- Avg. dug/day: ~25k tons (this is average of moved over 2024-2025 present)
- Ore shipped: ~ 1.26 million tons
- Avg. Au opt: ~ 0.237 (since you exploration folks insist on metric ~ 8 g/t)
- Poured and recoverable we are at ~ 259k ounces
- 3.6 Mt and 714 koz (70%)

Including Manh Choh, the Company expects to produce an average of approximately 400,000 attributable Au eq. oz. per year, ~19% of Kinross' global production, from 2024 to 2027 from its Alaskan assets.

The Lost River and Kougarok Rare Metal (Li, Sn, W, F, Ta, Nb) Granite Deposits of the Seward Peninsula, Alaska - Lost River Mining Inc.

Robert Selwood, Micah Claypoole, Liam Doyle, Odin Christensen, Steve Ristorcelli, and John Odden.

The Lost River and Kougarok deposits occur on the Seward Peninsula of Alaska (figure 1). These deposits, centered on granite intrusions host resources of Li, Sn, W, F, Ta, and Nb constituting a substantial source of critical minerals. Mineralization occurs at both deposits in granite, greisen, and breccia. Additional mineralization is hosted in skarn at Lost River and fractured schist at Kougarok. Exploration by Lost River Mining Inc. (LRM) between 2022 and 2025 has built on historical datasets to define new resource models for Li, Sn, W, and F at Lost River and Li, Sn, Ta, and Nb at Kougarok.

Substantial historical exploration has been completed at Lost River after the discovery of Sn in 1903, followed by production of tin from 1952 to 1955 by the U.S Tin Corp. supported by the Defense Production Act of 1950. The United States Geological Survey (USGS), United States Bureau of Mines (USBM), and three companies explored Lost River and the wider district in the 1950s and 1960s, with Lost River Mining Corp. (LMRC) completing a bankable feasibility study in 1973. LRM gained control of the property along with Kougarok in 2022 and has since completed 3 campaigns of drilling at Lost River for 98 core holes totaling 23,200m.

Tin mineralization at Kougarok was discovered by USGS geologists in 1972 and later staked by the Anaconda Minerals Company (Anaconda) in 1979. Anaconda drilled 61 holes totaling 9,333m of core, defining significant Sn, Ta, and Nb targets. A brief program of exploration was completed by two companies in 2001 and 2002. Since 2022, LRM has re-assayed 7,078m of historical drill core and drilled 10 core holes totaling 3,434m that infilled and expanded mineralization defined by Anaconda.

Mineralization at Lost River and Kougarok is centered on highly differentiated multiphase Cretaceous granites intruded into sedimentary and metamorphic rocks of the York and Seward terranes, respectively. Magmatic and hydrothermal processes concentrated Li, Sn, W, F, Ta, and Nb into the upper roof zones of the granites and overlying rocks. At Lost River the granite intruded into limestone and shale forming an asymmetric intrusion with Li, Sn, and W dominantly concentrated in Li-bearing micas (zinnwaldite, lepidolite, muscovite) cassiterite, and wolframite in the roof zone and flanks of the granite (figure 2). Overlying the granite a complex sequence of skarn and hydrothermal breccias that, in addition to Li and Sn, contain significant concentrations of F, W, and Be in fluorite, scheelite, and chrysoberyl.

At Kougarok the granite intrusion forms a sub-horizontal lenticular body intruded into schist. Li and Ta-Nb mineralization occurs in lepidolite - zinnwaldite and niobates, respectively, and increases in concentration towards the roof of the granite (figure 2). Tin mineralization is associated with the Sn-enriched granite and intense greisen alteration concentrating cassiterite at the roof of the granite, along dikes and granite plugs along with in intense brecciation, as well as fracture-controlled and disseminated tin in surrounding schists.

Ongoing work at both projects includes finalizing SK-1300 resource reports, metallurgical beneficiation and refining bench-scale studies, mining and processing trade-off studies, and planning for future resource development and exploration drill campaigns.



Figure 1) Location map of the Lost River and Kougarok critical metal projects within the Seward Peninsula,

Alaska.

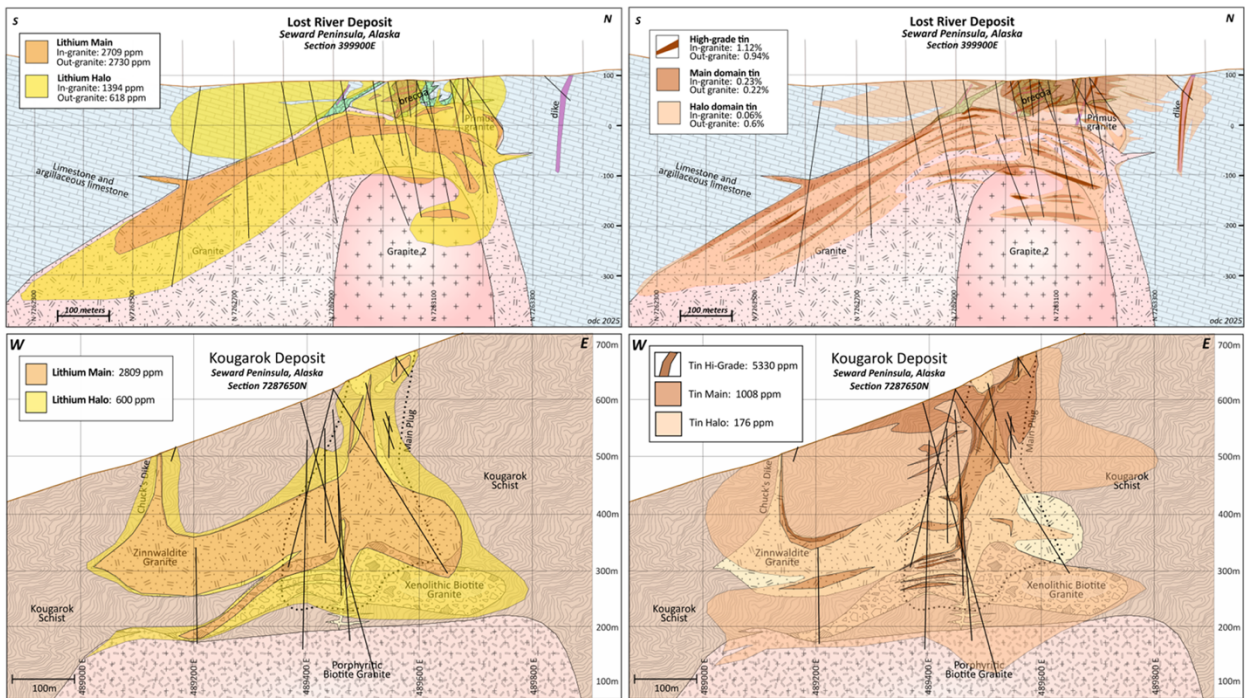


Figure 2. Cross sections for the Lost River and Kougarok deposits showing the geology, lithium, and tin domains of the 2025 resource models with mean grades for section lines 399900E and 7287650N, respectively.

The Oreo Mountain Porphyry Cu-Mo-Ag-Au Prospect, East-Central Alaska – 2025 Synopsis

David A. Hedderly-Smith, Ph.D., P.G., QP, D.A. Hedderly-Smith & Associates

The Oreo Mountain porphyry copper-molybdenum-silver-gold prospect is located in the Yukon-Tanana Uplands, about 40 miles east of Tok AK and 15 miles north of the Alaska Highway. The Oreo Mountain prospect is enormous - it has the largest, strongest copper-molybdenum-lead-silver soil geochemical anomaly (see below) that I've seen in over 50 years of geological work in the Yukon-Tanana terrain in both Alaska and the Yukon; the strong soil anomaly covers an area of about 8 km E-W by 1 to 2 km N-S – about 1,200 hectares.

The prospect has all of the hallmarks of being another Casino – same geology, same rocks, same age, same tectonics, same magnetics – except that Oreo's geochemical footprint (with values to is significantly larger than Casino's.

Oreo Mountain presents a substantially underexplored, very large Cu-Mo-Ag-Au porphyry system in a recognized porphyry copper-silver-gold terrain known to host giant ore deposits. Work to date has identified multiple drill targets. Additional work should help refine those targets at a minimal cost.

The property has excellent logistics and local infrastructure and is situated in a stable, mining supportive jurisdiction (Alaska) on State of Alaska owned land. It has the potential to become a truly world-class copper resource. My company, Tubutulik Mining Company LLC, is the sole owner of the claims; there are no underlying interests.

The soil geochemical work by Kennecott Exploration in 2018 (which returned values of up to 749 ppm Cu, 301 ppm Mo, 504 ppm Pb & 1.36 ppm Ag) and the State of Alaska aeromagnetic surveying (Burns *et al.*, 2011, and Burns *et al.*, 2020) identify an area with coincident geochemical anomalies and resistivity lows within a strong aeromagnetic low inside a regional aeromagnetic high – the classic “donut.” The strong aeromagnetic low also corresponds to a strong analytic signal high. The State's reconnaissance geologic mapping (Twelker, *ed.*, 2021) suggests that the area of the analytic signal is underlain by a unique intrusive body some 10 km E-W by 3 km N-S.

The property has seen no prospect-level geologic mapping, no high-definition aeromagnetic surveying, and no ground geophysics. While outcrop is absent and even float and colluvium are rare, portions of the property were preliminarily mapped in 1976 shortly after discovery, and that historic mapping correlates reasonably well to the state's 2021 mapping effort. Recommendations include a drone high-definition aeromagnetic survey and IP/resistivity surveys and with concurrent

prospect-level geologic mapping and prospecting over key areas during that work to better refine targets for two or three 500-meter holes, perhaps to be drilled in a second field season.

The Yukon-Tanana terrain in eastern Alaska is unglaciated and the Oreo Mountain area is totally leached. If Oreo Mountain does indeed host a major porphyry system, it could be covered by a significant supergene blanket, and that blanket could be relatively shallow (within 100 or 200 meters of the surface?).

Oreo Mountain presents an excellent opportunity for a mining/exploration company to pick up and discover a very significant mineral deposit to either build their own future or to develop alongside an existing major copper producer.

The Tubutulik Mining Company LLC is the 100% landowner, and there are no underlying interests. The property is held with State of Alaska mining claims and is on 100% patented state-owned land, about 15 miles north of the Alaska Highway. The community of Tok, Alaska (population ~1500), is located 40 miles to the west of Oreo Mountain and 100 miles in from the Yukon border and is the first major community one comes to in Alaska along the Alaska Highway. Tok has most major services. An access road to a mine at Oreo would be mostly along an existing, regularly used “winter trail” RS2477 right-of-way over a low ridge just north of the Alaska Highway and down along the headwaters of the Ladue River; it would be about 20 miles long overall to the property. Valdez, Alaska, the likely shipping port for future ore concentrates, is another 300 miles to the south over all-season, paved highways.

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Boulder Creek Uranium Deposit, Seward Peninsula, Alaska

David A. Hedderly-Smith, Ph.D., P.G., QP, D.A. Hedderly-Smith & Associates

The Boulder Creek uranium deposit, the largest known uranium deposit in Alaska, is located in the Boulder Creek basin at the southern end of Death Valley on the southeastern Seward Peninsula, Alaska. Known resources on the property are contained within 11 grandfathered unpatented federal mining claims in a township tentatively approved for selection by the State of Alaska. Another 140 160-acre State of Alaska MTRSC claims cover the federal claims and the projected trend of mineralization from Boulder Creek, along the western side of the Death Valley Basin, to the Fireweed prospect, 13 miles to the north-northeast. The total land package is currently 22,400 acres (9,065 hectares). The Tubutulik Mining Company LLC is the 100% landowner of all claims, and there are no underlying interests.

Access to the property is by air from Nome, Alaska, 100 miles to the west-southwest of Boulder Creek. An 1,800-foot dirt and natural airstrip and a campsite are located on a ridge two miles east of the property. A rough foot trail and a 4-wheeler trail lead from the camp to the deposit. A 3,400-foot gravel airstrip is available at Elim, an Eskimo village 35 miles southwest of the deposit. Elim has daily scheduled flight service from Nome. Nome and Elim are both accessible seasonally by barge, greatly reducing costs of shipping large loads and heavy equipment to the area.

The Boulder Creek uranium deposit is an epigenetic sandstone-type uranium deposit. Uranium has been leached from a Late Cretaceous alkalic quartz monzonite and deposited in a likely roll-front mode in a reducing environment of Paleocene, arkosic, carbonaceous sandstones, siltstones and conglomerates of the Boulder Creek basin (Dickenson *et al.*, 1987).

Over 11,000 feet (3,350 meters) of diamond core drilling in 52 holes and about 200 feet (60 meters) of surficial split-tube sampling in 21 holes by Houston Oil and Minerals (HOM) in the latest 1970s and early 1980s outlined a minimum historic resource of 1 million pounds with an average grade of U₃O₈ of 0.27% and an average thickness of 9.9 feet (3 meters). These historical resources are included in an area 300 X 3,000 feet (90 X 900 meters) located immediately east of Boulder Creek, a tributary of the Tubutulik River, at depths from the surface to 350 feet (110 meters) along a north-northwest trending mineralized zone. The vast majority of the resources are within 200 feet (60 meters) of the surface.

An additional nearly 7,000 feet (2,130 meters) of core drilling by Triex Minerals (Triex) between 2006 and 2008 confirmed the HOM results and identified a thick (+200-foot [+60-meter]) coal

seam at the prospect. Triex also discovered a new prospect, the Fireweed prospect, in northeastern Death Valley some 13 miles (21 km) north-northeast of Boulder Creek and drilled 5 short holes totaling 876 feet (267 meters) at Fireweed. While only preliminarily studied, the Fireweed prospect appears to not have any affinity with sedimentary rocks but to be hard-rock related.

In 2024 Boulder Creek was optioned to Panther Minerals, who commissioned a comprehensive technical report on the project, summarizing all available data. A draft copy of that report, which contains a compilation of detailed data on Boulder Creek and Fireweed and data from research into historical government and private-sector studies that identified several historical showings and prospects in the general area, is available for review by interested parties, subject to a confidentiality agreement. All original data provided to the Tubutulik Mining Company LLC from the previous work by Houston Oil and Minerals and Triex Minerals is also available for review, some in hard paper form but much in electronic form.

While the Boulder Creek sandstone-type deposit is the only discovery with established uranium resources in the Death Valley Basin, the 2007 discovery of the Fireweed prospect along with numerous mineralized occurrences associated with alkalic igneous rocks identified by the U.S.G.S. and others in the general area suggests there is excellent potential for additional discoveries in the southeastern Seward Peninsula area. The author believes that the southeastern Seward Peninsula of Alaska, including the Death Valley Basin, the eastern McCarthy's Marsh Basin and the surrounding mountains, may be an emerging significant uranium province on American soil.

Reference

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Silver47 – Red Mountain

The Red Mountain Property is prospective for volcanogenic massive sulphide ("VMS") mineralization occurring in the Bonnilfield District, located in the western extension of the Yukon Tanana terrane. Two advanced VMS prospects (Dry Creek and West Tundra Flats) have been the focus of exploration and drilling at the Property, in addition to at least 20 other early-stage exploration VMS prospects, and at least one prospect (Sheep Creek prospect) considered to be a sedimentary-hosted exhalative ("SEDEX") base metals deposit type. The regional geology consists of an east-west trending schist belt of Precambrian and Palaeozoic metasedimentary and volcanic rocks. The schist is intruded by Cretaceous granitic rocks along with Tertiary dikes and plugs of intermediate to mafic composition. Tertiary and Quaternary sedimentary rocks with coal bearing horizons cover portions of the older rocks. The VMS mineralization is most commonly located in the upper portions of the Totatlanika Schist which is of Mississippian to Devonian age. The Totatlanika Schist forms the core of a roughly NW-SE trending syncline (the Bonnilfield East Syncline) within the Red Mountain Property. The Dry Creek (DC) North Horizon occurs within the Mississippian-Devonian portion of the Totatlanika Schist, can be traced for 4,500 metres and hosts the majority of mineralization defined to date. Zones of mineralization dip steeply to the north. The central 1,400 metres (on the flanks of Red Mountain) host the Fosters and Discovery lenses of VMS mineralization. At the West Tundra Flats prospect (located approximately 5 km to the northeast of Dry Creek) the mineralized zone occurs at the base of a black chloritic schist unit that is at the base of the sedimentary tuffaceous phyllite unit (MDph) and at the very top of the metarhyolite unit (MDr). The zone extends at least 1,000 metres northwest-southeast along strike and 1,600 m down dip to the southwest. The horizon dips about 10° to the southwest, is 0.3 to 4.4 m thick and remains open down dip. Massive sulphide mineralization is localized in several generally narrow exhalative units distinguished by semi-massive and massive sulphides including pyrite, sphalerite and galena. The massive sulphides are commonly rich in silver with erratic gold.

Elliott Creek Prospect 2025

Nick Begich Sr.

Wrangell Saint Elias at Elliott Creek Incorporated

Email: drnick@alaska.net Phone: 1-907-854-9912

The Property consists of 802 acres of **patented federal** mining claims. There is about 3000 feet of underground constructed from previous ore blocking and intersect efforts during the early 1900's. We are seeking partners that have an interest in creating a project that includes additional exploration and development of a production plan for a small-scale ore concentration circuit for shipping grade copper/silver sulfides.

This year we spun out 10 acres of the property for other uses including a permanent camp. The access road and driveways are being constructed to the property with completion funded and planned for 2026/27. We have strong working relationships and access agreements with our boundary neighbors. WSEECI has consolidated the properties within the Elliott Creek valley, bringing together all privately held land under two entities with an exploration/mining emphasis in one and the other focused on camp construction and other land uses.

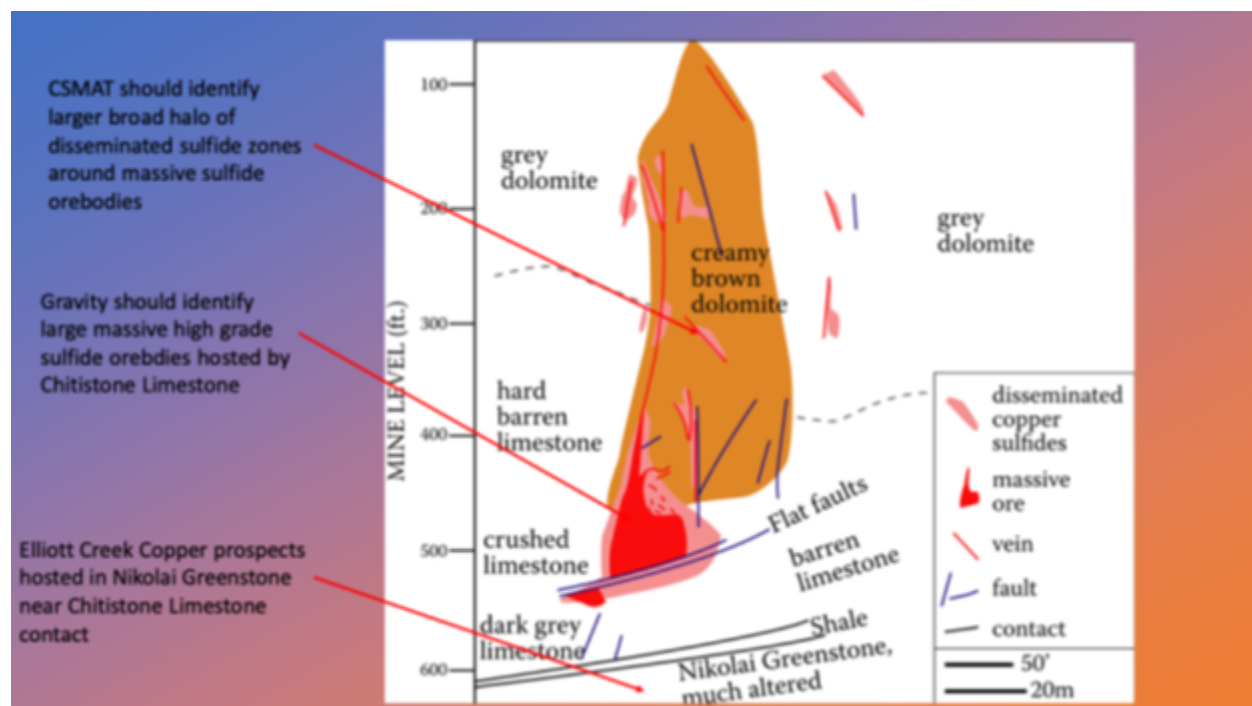
Assays and Field Work. Preliminary investigation of the WSEECI property was conducted by SRK in 2009, and additional sampling since. An additional report was prepared by others in 2022. As part of its continuing work on the property original monuments have been located along with trenches, tunnels and other workings. Approximately 1,500 feet of the underground development have been explored with as much remaining to be examined. Over 200 grab samples and continuous chip samples have been collected by WSEECI since 2008, yielding assay results of **between 2% and 18% copper** with additional **silver**, and **gold** as further CuEq drivers.

Geology. The mineralization at Elliot Creek has been identified as basaltic, hydrothermal copper. These deposits include native Cu-Ag and copper-sulfide mineralization occurring as veins and disseminations in amygdaloidal flows, tuffs, breccias, conglomerates and in places sandstones. Mineralization is found in the Nikolai Greenstone below the Chitistone Limestone. Mineralization is described by Moffet et al., (1923) as structurally controlled occurring along fracture planes and faults. Copper minerals also occur as disseminations proximal to fractures and faults. Copper minerals include bornite, chalcopyrite, cuprite, covellite and chalcocite. The geology of Elliott Creek provides the ingredients for a remarkably environmentally friendly mining operation, should one be engaged. Extensive limestone deposits as well as concomitant calcite complement an ore profile exceptionally low in deleterious elements.

2025 Highlights. The company continued constructing the access road into the property. Ten and a half miles of an existing 17b easement continued to be improved for access by standard vehicles. Five miles of additional new road was completed as a part of a private easement. The remainder of road and driveway construction into the property is planned for 2026/27. Ten acres was spun out of the property and Elliott Development LLC was formed for the purpose of building a permanent camp and lodge facility to accommodate up to 24 people to facilitate tourism and the other activities on the property. An initial historic reclamation project has been planned, outlined and funding for preservation is being pursued prior to any industrial activities removing these in advance of permits to avoid project delays.

Next Steps include completion of the preliminary access road and driveways to prospects in 2026/27. Continue to advance the infrastructure to support all future permanent camp related activities for the property through the spun-out LLC. Initial construction is scheduled for 2026 and two building were prefabricated in 2025 for this purpose.

WSEECI is seeking partners capable of contributing toward efforts advancing these holdings to their highest and best use. WSEECI is moving forward with surface estate improvements including road construction, driveways, camp structures, historical artifacts preservation and property sampling.



The Flat Gold Project: The Perspective in 2025

Peter Kleespies, Trent Newkirk, Varina Zinno; Tectonic Metals Inc.

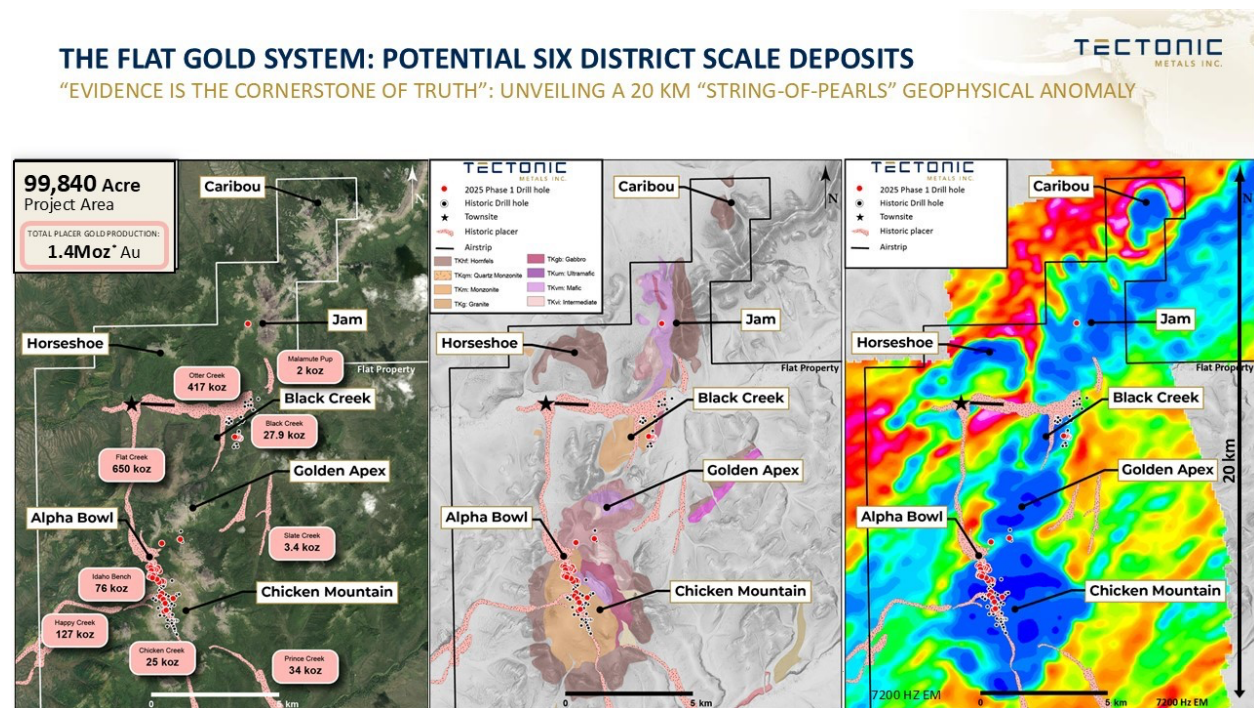
The Flat Gold Project is located in southwestern Alaska, just 40km north of the Donlin Gold Project within the Iditarod Quadrangle. It covers 99,840 acres of primarily Doyon, Limited owned land within the Kuskokwim Mineral Belt of the Tintina Gold Province. The Flat property hosts intrusion-related gold mineralization analogous to that found at the Fort Knox (Alaska) and Eagle (Yukon) gold mines and consists of a multiphase Cretaceous age (68.3 to 73.2 Ma) Chicken Mountain igneous complex (CMIC). The CMIC intruded into the Kuskokwim sedimentary and volcanic sequences north of the right-lateral Nixon Fork-Iditarod Fault, which generated a long history of placer mining, producing an estimated 1.4 million ounces of alluvial gold since 1908.

Since initiating exploration in 2022, Tectonic Metals Inc. has advanced Flat through ~22,000 m of combined diamond-core and reverse-circulation drilling, two phases of metallurgical testing, petrography, reprocessing and geophysical inversion work of regional magnetic data, and a high-resolution drone magnetic survey. In 2024, reverse circulation drilling beneath extensive historic placer spoils north of Chicken Mountain at the Alpha Bowl target identified gold mineralization hosted within coarse-grained biotite-pyroxene, which returned 1.20 g/t Au over 65.5 m. Subsequent Phase 1 sectional drilling through the Alpha Bowl in 2025 demonstrated that the coarse-grained intrusion is continuous with the main Chicken Mountain body and that gold mineralization persists northward along at least 1200 m of strike length beyond the historically defined Chicken Mountain zone.

Gold mineralization occurs primarily as sheeted “productive” quartz-vein arrays within the biotite monzonite to quartz monzonite phases, associated with sericite-altered rocks. At Chicken Mountain, the productive quartz/sulphide veins trend NNE to NNW with steep moderate westerly dips and host Au+Bi+Te +/-As mineralization. “High-level” epithermal textured veins hosting Au+Sb+/-As+/-Hg+/-W mineralization have been observed in cross-cutting and discrete spatial settings suggestive of a protracted, multi-episodic mineralizing event. Late-stage WNW orientation white clay and calcite veins do not host significant gold mineralization and are observed to crosscut and offset the earlier productive quartz bearing assemblages.

Magnetic inversion modelling of regional data has revealed that low-susceptibility to very low-susceptibility domains coincide with drilled mineralization, implying a close relationship between reduced, magnetite-poor intrusions and gold deposition. Tectonic completed a high-resolution drone magnetic survey during 2025, and ongoing 3D inversions and development of magnetic based exploration vectoring will refine exploration targeting.

Flat's 2025 Phase 2 drilling focused upon the historic Chicken mineralization zone with section-based drilling as the initial step towards an inaugural inferred mineral resource estimate. Drilling was conducted along ~1500 m of mineralized strike, with additional infill and resource delineation drilling slated for 2026. Significant exploration and discovery potential remains on the project, particularly on additional blind-to-surface targets in the Golden Apex and Black Creek target areas, as well the northern regions of the Flat Volcano-Plutonic Complex lying north of Otter Creek, which has seen very limited modern exploration.



POSTER SESSION

Examining the Economic and Environmental Sustainability of Lubricants Supply in the Mining Industry of Ghana — A Focus on Equipment Reliability, Performance, and Health Considerations

Ackah Albert Miezah, University of Alaska Fairbanks

The mining industry plays a significant role in Ghana's economic development. However, this sector's extraction and processing activities are often associated with substantial environmental challenges. One critical aspect of sustainable mining operations is the use of lubricants, which are essential for machinery and equipment reliability. This study aimed to examine the economic and environmental sustainability of lubricant supply in the mining industry of Ghana, with a focus on equipment reliability, performance, and health considerations post-use of conventional non-biodegradable oils. To achieve the study objectives, a triangulation mixed-methods approach combining qualitative and quantitative research methods was employed. A purposive nonprobability sample technique, open-ended survey questionnaires were designed and distributed among thirty (30) experienced key stakeholders, including mining industry technical experts and environmental agency professionals. An extensive literature review was conducted on global standard best practices and regulations regarding spent oil management and embracing the circular economy in the mining industry as an environmental sustainability approach.

The quantitative phase focused on the economic sustainability, assessing mining companies with condition-monitoring and tribological (the study of friction, wear, and lubrication) reliability maintenance. A laboratory experiment was conducted to investigate the presence of heavy metals in spent oils and their effect on the environment.

The findings of this study show a 16.6% total annual lubricant cost saving for the mining companies on strategic condition-based reliability maintenance practices.

This strategic condition-based reliability maintenance practice improved mine machinery reliability and optimization performance indicators, such as Mean Time Between Failures (MTBF), Planned Maintenance Percent (PMP), downtime percent, and Overall Equipment Effectiveness (OEE).

The lab experiment confirmed the presence of heavy metals in petroleum-based spent oils at unacceptable levels in reference to the WHO maximum permissible limits in water. The experimental results showed heavy metals such as Chromium (Cr), Copper (Cu), Lead (Pb), and Nickel (Ni) were present in spent oil with average concentration levels of 1.75ppm, 2.25ppm, 1.25ppm, and 1ppm, respectively for 20 samples of different grades of oils were all found to be higher than WHO

maximum permissible limits (Cu-2ppm, Pb-0.01ppm, Cr-0.05ppm, Ni0.07ppm of in water). The concentration of Chromium was also found to be higher than the WHO acceptable concentration of 1.6ppm in soil and for plants.

In the literature review, it was asserted that 33% of the energy required for moving vehicles is lost to friction. This is mainly due to poor lubrication, premature oil degradation due to heat, loss in oil viscosity, and contamination.

This means that to optimize lubricant use, there is a need to adopt strategies such as conditionbased maintenance through oil analyses, oil dialyses, and improved offline and online filtration systems, which can increase oil life potency beyond often-recommended drain hour intervals by OEMs (0-250 hours and 250-500 hours on average for most equipment).

Statistics from research show that 53.3% of respondents confirm not being aware of sustainable lubricants. Hence, a recommendation to the above statistic is to propose Biodegradable or Biobased lubricants as good substitutes for conventional petroleum-based lubricants because they are made from organic and renewable resources. These lubricants are environmentally sustainable and have no harm to the environment as they decompose naturally.

A recommendation is for government and mining regulators to revise the hazardous waste disposal procedure to adopt a circular economy model (recycling and reuse of spent oils), as well as increasing compliance. This will reduce the risk of heavy metals from reckless or accidental disposal of spent oil into the environment.

A recommendation is for all mining companies, not yet following condition-based reliability maintenance, to adopt this cost-saving model, as well as reduce mine machinery downtime due to the friction losses, and optimize energy use. The study's outcomes serve as a basis for policy development, industry guidelines, and strategic decision-making aimed at promoting the circular economy and use of sustainable lubricants in the mining industry.

The study's outcomes serve as a basis for policy development, industry guidelines, and strategic decision-making aimed at promoting the circular economy and use of sustainable lubricants in the mining industry.

AFM-Based Characterization of Thermally Activated Evolution of Surface Morphology and Nanomechanical Properties in Fault Gouge Materials

Dickson Nguu and Long Fan, Department of Mining and Mineral Engineering, University of Alaska, Fairbanks, USA

Atomic force microscopy (AFM) in novel Peakforce Quantitative Nanomechanical Mapping (PFQNM) mode was used to qualitatively investigate the morphology and nanoscale mechanical response of granite, shale, and sandstone over a temperature range of 80 - 450 °C. The height and modulus channels data, corrected for tilt, bowing, artifacts and distortions, revealed distinct mineralogical and structural dependent responses. Granite exhibited a progressive increase in surface roughness up to 250 °C, followed by partial smoothing at higher temperatures, along with relatively uniform modulus distributions, reflecting the inherent rigidity of its crystalline framework. Sandstone exhibited a similar roughness trend, along with a progressive increase in modulus with temperature, likely resulting from microstructural transformations driven by mechanisms such as phase boundary stiffening, viscous flow and lattice diffusion. For shale surface roughness decreased significantly at higher temperatures, indicating dehydration and compaction, but exhibited pronounced heterogeneity and locally elevated modulus values, influenced by its foliated structure, mineral transformation and microstructural anisotropy. These findings reveal that thermally induced microstructural transformations strongly influence how stress is distributed and released within geomaterials and can lead to the development of localized stress concentrations that act as initiation points for thermally driven seismic events. The study also demonstrates the effectiveness of AFM in capturing nanoscale mechanical responses and estimating elastic properties under varying temperature conditions. Nevertheless, meaningful interpretation requires rigorous calibration, tip characterization, and model-based corrections to account for mineral heterogeneity and anisotropy. By linking nanoscale mechanical behavior to macroscopic stress evolution, this research advances understanding of how thermal processes in geothermal reservoirs can initiate or intensify induced seismicity.

In-Processing Plant Recovery of Gold from Waste Activated Carbon Using a Designed Novel Reactor

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1,2 University of Mines and Technology

3 Golden Star Wassa Limited

4 University of Alaska Fairbanks

Waste Activated Carbon (WAC) refers to the fine, brittle particles of activated carbon generated during gold recovery processes, such as carbon-in-leach (CIL) and carbon-in-pulp (CIP) methods. These particles, although highly active and gold-laden, are typically lost to tailings due to their inability to be retained by inter-tank screens, resulting in significant gold losses and an economic impact on gold processing plants. This study presents the development and evaluation of a novel reactor designed for the on-site treatment of WAC at gold processing plants. Representative WAC samples were characterized and subjected to optimized combustion in the reactor, resulting in the production of ash with a concentrated gold content. Results show that combustion of the carbon fraction of WAC achieves a gold enrichment ratio of 8.5–9.6 (over 730%) compared to the feed, with gold recoveries of up to 96% using cyanidation at 1000 ppm. Economic analysis indicates that the process can generate approximately US\$57,000 per tonne of ashed WAC with reasonable operational and fabrication costs. By providing an efficient, plant-integrated method for recovering gold from WAC, this research offers a practical solution to minimize gold losses, enhance operational profitability, and improve resource utilization and sustainability of gold mining operations.

A Review on REE Extraction from Coal Gangue: Enhancing Leachability through Grinding and Alkali Roasting Methods

Gopal Fosu Oppong Wiafe and Professor Tathagata Ghosh, University of Alaska Fairbanks, USA.

Mineral encapsulation and chemical inertness impose limitations on the effective extraction and recovery of rare earth elements (REEs) from coal gangue. The focus of this review is on two crucial pretreatment methods that enhance acid leaching: selective grinding and alkali roasting. Previous studies have reported that physical separation methods are not effective and efficient in the extraction and recovery of REEs from coal gangue, despite some recoveries being made. This review examines selective grinding as a pretreatment step to enhance particle size distribution, minimize grind size, reduce grind time, and increase mineral exposure while liberating REEbearing phases. Whereas the alkali roasting pretreatment step alters the physicochemical properties of the coal gangue, an increase in pore size and surface area enhances leachant penetration. This is achieved through the roasting of gangue samples, usually with Na_2CO_3 or NaCl , at temperatures ranging from 700 to 900 °C. Findings highlights combining these pretreatments lowers acid consumption while increasing REE leachability. Mineral transformation mechanisms, reaction kinetics and selectivity in extracting REEs from coal gangue requires more studies and attention. Limited insitu analysis and sustainable assessment hinders practical application. Future studies should emphasize advanced characterization, ecofriendly leaching, combined activation and techno economic evaluations for a sustainable large-scale metal recovery.

Keyword: coal gangue, selective grinding, alkali roasting, acid leaching, rare earth elements

Experimental and Scanning Electron Microscope Characterization of Hydrogen Storage in Coal

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The global push toward net-zero CO₂ emissions has elevated hydrogen's role as a clean energy source, especially in Alaska. However, a significant challenge lies in ensuring a stable year-round energy supply. Large-scale hydrogen storage, crucial for this transition, is most cost-effectively achieved in underground geological formations. While surface storage in compressed tanks is costly (\$400–\$700/kg of H₂), underground storage in formations like aquifers, salt caverns, coal seams, and depleted oil/gas reservoirs could reduce costs significantly to \$35–\$38/ kg of H₂. Research on utilizing depleted oil and gas reservoirs, salt caverns, and aquifers has been extensively discussed in the literature, but studies on coal seams are still in their early stage. Prior studies have shown that coal seams can store substantial amounts of hydrogen, and the storage potential depends on the rank of coal. However, the factors accounting for the differences in adsorption capacity are unclear and debatable. This work underscores the importance of understanding the mechanism of sorption capacity, flow behavior during hydrogen storage in coal ranks, and factors accounting for the adsorption capacities. The experimental setup included a reference cell to control gas flow to two sample cells containing coal samples. A syringe pump delivered gases and monitored pressure using three transducers (0–35 MPa range, 10 Pa accuracy). Temperature was maintained with a water bath, and data were collected with a data acquisition system. Tests were conducted on 50g of Anthracite and Bituminous coals, pulverized to 250–177 microns and oven-dried for 24 hours at 105°C. Before testing hydrogen adsorption, helium was introduced to determine the sample cell matrix volume exposed to hydrogen. The adsorption capacity of the coal samples was tested at a constant temperature of 30 °C with a pressure range from 0.76 MPa to 15.17 MPa. The manometric method was adopted, whereby the adsorption or desorption of gas is determined by simply monitoring the pressure drop. Regarding the Ideal Gas Law, the difference in moles was used to determine the amount of gas adsorbed at each pressure increment. The isotherms for the different coal ranks were acquired and fitted with the Langmuir models. For the coal ranks tested, the hydrogen adsorption capacity for Bituminous Coal is higher, with an adsorption capacity of 1.33 mmol/g, than that of Anthracite Coal, which is 0.20 mmol/g. The coal samples were analyzed under an SEM to understand the difference better. The SEM revealed more visible striations or lamellae in the Bituminous coal than in the Anthracite Coal. The surface of Bituminous coal looks rougher with visible pores, which may provide more pathways for hydrogen to interact. A High Percentage of Si and Al in Anthracite from the XRF data shows a higher possibility of quartz inclusion.

Petrology, geochemistry, and geochronology of the Tofty Ridge carbonatite: insights into petrogenesis

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The Tofty Ridge carbonatite of Interior Alaska preserves a polyphase mineralization history of late-stage magmatic niobium mineralization and later hydrothermal alteration. We present the results of petrography and whole rock x-ray diffraction analysis to determine carbonatite mineralogy, electron probe microanalysis to characterize niobium and REE-bearing mineral phases, and laser ablation split stream inductively coupled plasma mass spectrometry (LASS-ICP-MS) to determine U-Pb ages of carbonatite emplacement and Nb-REE mineralization.

Niobium enrichment occurs in magnetite- and apatite-rich dolomitic carbonatite sills. Rutile and ilmenite with Nb-enriched cores and depleted rims are disseminated through the carbonatite. Monazite, although limited in extent and modal abundance, is disseminated through the carbonatite in breccias, and as a secondary product after apatite dissolution. In-situ LASS-ICP-MS analysis of zircon grains yield a $^{206}\text{Pb}/^{238}\text{U}$ weighted mean age of 215.4 ± 2.4 Ma, interpreted to reflect crystallization of zircon from the carbonatite magma. Monazite petrochronology yields a $^{208}\text{Pb}/^{232}\text{Th}$ weighted mean age of 118.1 ± 1.1 Ma, interpreted to reflect secondary hydrothermal alteration. REE-bearing monazite was thus post-magmatic, formed or remobilized in a regional hydrothermal event. Rutile and ilmenite cores, meanwhile, show partial replacement by rims of a Nb-poor TiO_2 phase suggestive of an alteration event, but relict Nb-rich cores are interpreted to have crystallized directly from the carbonatite melt.

Magmatic Source and Controls on Plutonic Hydrothermal Mineralization in the Western Yukon Tanana Uplands, Alaska

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The western Yukon Tanana Uplands (YTU) hosts several significant precious and base metal deposits, including the producing Fort Knox and Pogo mines. The origin of the Fort Knox deposit and related systems is magmatic-hydrothermal, manifesting as intrusion-hosted sheeted veins and disseminated deposits, proximal skarns and veins, and distal veins and replacement deposits. In contrast, the Pogo deposit is disputed, with some workers proposing an orogenic origin with no clear relationship between magmatism and mineralization. Outside of the main areas of Pogo and Fairbanks, minimal historic hardrock metal production is recorded. However, previous studies, Alaska Resource Data Files, and placer production in the region suggest there are additional significant precious and base metal mineralization, including gold, silver, antimony, tungsten, tin, uranium, and REE, all of which have varying associations with plutonism. Magmatism ranges from syn-late regional metamorphism to post-tectonic from ~113 Ma to ~55 Ma, with emplacement of the main pulses at ~110 Ma to 100 Ma, ~95 Ma to ~89 Ma, ~72 to 66 Ma, and ~60 Ma to ~55 Ma. Although the Igneous Related Gold model posits that magmatic oxidation state is important to the genesis of these gold deposits, the degree to which melt protolith exerts a control on fertility and oxygen fugacity remains enigmatic.

The Mineral Section of the Alaska Division of Geological and Geophysical Surveys is conducting ongoing bedrock geologic mapping funded by the United States Geological Survey Earth Mineral Resources Initiative. We aim to classify and determine the origin of significant periods of plutonic activity and assess the prospectivity for specific metal associations. In addition to previously published data, samples were collected during bedrock geologic mapping in the summers of 2022 to 2025. Select samples were analyzed for major and minor element concentrations, U-Pb zircon geochronology, zircon hafnium isotope analysis, and rare earth element analysis in zircon.

Major and minor element analyses will aid in (1) differentiating the plutonic units observed in the field, (2) understanding the petrogenesis of the igneous suites, and (3) understanding processes driving compositional diversification across YTU. U-Pb zircon geochronology via LA-ICP-MS will define the crystallization ages of individual plutons in addition to defining the duration of significant periods of magmatism and magmatic lulls. Zircon trace element analysis of rare earth elements via LA-ICP-MS will provide insight into oxygen fugacity during crystallization, magmatic fluid content, and potential resource fertility. Hafnium isotope systematics are a powerful petrogenetic tracer

widely used to determine the source melt of selected intrusions. When synthesized, these integrated data will enable the classification of intrusive units into plutonic suites based on temporal and geochemical similarities. Ultimately, data compilation will facilitate analysis using the ArcPro GIS program to quantify spatial relationships and trends, providing insight into the framework of regional geology.

Recovery of Rare Earth Elements (REEs) from Coal Ash Using Acid Leaching: A Review of Leaching Conditions and Efficiencies

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Rare earth elements (REEs) are the set of 17 elements, 15 elements of the lanthanide series (57- 71), including Scandium (21) and Yttrium. The demand for the REEs is increasing consistently due to their wide range of applications, from defense technologies, EV batteries, permanent magnets in wind turbines to motors in EVs, metal catalysts, and light-emitting diodes. Since the 1990's, China is dominating in REE mining being the largest supplier and becoming the major consumer. US has been relying on China to fulfill its REE demand. With the growing demand of REEs and its limited economically viable primary source, coal ash generated from the coal combustion power plant has been identified as the reliable secondary source to reduce the dependence on China. Coal ash with no economic significance, but creating a significant environmental hazard, could be a prominent source of REEs. Due to the minerology of coal ash, acid leaching has been identified as the suitable method of extracting REEs from coal ash, enhanced by prior physical beneficiation techniques based on the feedstock. This research focuses on reviewing and identifying the suitable acid leaching conditions and leaching recoveries of three different acids i.e., H_2SO_4 , HCl , and HNO_3 on coal ash sample from different regions of the world at various concentration of acids, leaching temperature and durations. Acid leaching of coal ash has come up as a promising method, as nearly 100% of leaching efficiency can be obtained. However, it requires further studies to characterize coal of different regions and develop an optimized process for economically recovering REEs in industry scale.

Keywords: Rare earth elements; Coal Ash; Minerology; Acid Leaching

Supercritical CO₂ Solubility in TBP–HNO₃ Complexes: Thermodynamic Insights and Implications for Rare Earth Element Extraction Efficiency

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Understanding the solubility behavior of supercritical carbon dioxide (SC-CO₂) in mixed solvent systems is essential for the proper design and optimization of rare earth element (REE) extraction operations from coal byproducts (coal ash) from organic deposits (coal). This work carefully investigated the thermodynamic solubility of CO₂ in tri-n-butyl phosphate (TBP)-nitric acid (HNO₃) complexes at three molar ratios (2:1, 1:1, and 1:2), temperatures ranging from 40 to 60 degrees Celsius, and a maximum pressure of 12 MPa. This study employed a static high-pressure equilibrium cell in conjunction with mole balance calculations to quantify solubility. Furthermore, Fourier Transform infrared spectroscopy (FTIR) was utilized to elucidate the molecular interactions prevailing inside the solvent system. This study's findings indicate a strong positive link between pressure and carbon dioxide solubility, with a significant increase noted beyond the critical pressure of CO₂ (about 7.38 MPa). Conversely, temperature and CO₂ solubility exhibited an inverse relationship; for the 1:2 TBP: HNO₃ complex, the peak CO₂ absorption was consistently seen at 40 degrees Celsius across the examined pressure range. Consequential spectral shifts in the phosphorylation (P=O) and nitrate (N-O) regions were revealed and detected by Fourier Transform infrared (FTIR) spectroscopy, substantiated by hydrogen bonding interactions and a reorganization of the solvent structure upon CO₂ dissolution. Generally, the observed CO₂ solubility behavior gives important mechanistic insight into the solvent-CO₂ interactions essential for efficient ligand delivery and complexation in SC- CO₂ mediated REE separation processes. Additionally, preliminary extraction experimental runs were conducted to validate solubility studies. Results from ICP-MS report confirmed that high solubility favors effective REE extraction, especially Cerium and Neodymium, and a complex ratio of 2:1 resulted in higher yield of extraction. These research findings reveal that solubility is a crucial mechanism for good extraction performance and have provided valuable thermodynamic understanding that can inform the future development of more environmentally benign and solvent-efficient extraction technologies.

Keywords: supercritical CO₂, solubility, rare earth extraction efficiency, thermodynamics, pressure