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2022 AMA Annual
Convention & Trade Show
Nov. 7-10, 2022

ABSTRACTS

Alaska Miners Association
2022 Annual Convention

November 7-10, 2022
Dena'ina Civic and Convention Center, Anchorage

ALASKA MINERS ASSOCIATION

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ALASKA MINERS ASSOCIATION
2022 ANNUAL CONVENTION

TRACK ONE

GEOSCIENCE INVESTIGATIONS

Mapping mineral systems to relate primary commodities to critical mineral prospectivity in Alaska
Doug Kreiner, USGS

Critical minerals are presently defined as non-fuel mineral or mineral material essential to the economic or national security of the U.S. and which has a supply chain vulnerable to disruption (https://www.federalregister.gov/documents/2022/02/24/2022-04027/2022-final-list-of-critical-minerals). These metals are essential to meet modern mandates for zero-emission vehicles and transition to a low-carbon, green economy. The U.S. Geological Survey's Earth Mapping Resources Initiative (Earth MRI) program was developed to acquire new high-quality datasets (geological, geophysical, geochemical, and topographic) over areas that are favorable for containing critical mineral deposits. Initially, ~$1M/year was provided to Alaska Division of Geological & Geophysical Surveys to support new data collection, and that investment has increased to more than $6.5M in the current year to bolster data collection. The state of Alaska has also prioritized critical minerals exploration and production in Alaska through the establishment of the Office of Energy and Innovation.

Currently, zinc is the only commodity listed on the U.S. critical mineral list that is produced from hard rock mining in Alaska. Germanium is also present in the zinc concentrate produced at Red Dog, and unreported amounts are recovered during refining out of state. Zn and Au constitute >80% of metal production in Alaska with lesser amounts of Ag and Pb (Twelker et al., 2022). Approximately 95% of exploration dollars spent in the state are targeting Au, Cu, Pb, Zn, and Ag. A small fraction of exploration dollars is focused on critical minerals, primarily graphite and REE. Alaska, however, does have by- or co-product resources defined for Co and Zn (Ambler district) and Pd (Pebble) in addition to the produced zinc at Red Dog and Greens Creek.

The mineral systems concept provides a holistic framework connecting the geologic factors that may lead to critical mineral enrichments to the major mineral commodities that drive the economics of a particular district or deposit. Mapping mineral systems and their host geologic terranes provides essential insights into the potential formation and distribution of deposits to predict which critical minerals may also be enriched as by- and co-products. Processes that occur over large time

and space scales have a profound influence on the enrichment of metals in ore deposits. Focusing on the mineral system rather than the any individual deposit provides a more complete and integrated understanding for sources and sinks of critical minerals. For example, critical minerals such as As, Sb, Bi, W, Sn, and Te are mobile in similar fluid compositions and settings as Au. However, knowing where those metals may be sourced and trapped is critical to effective exploration and development of Alaska's mineral resources.

We have developed a mineral systems framework for Alaska that relies on a process-based approach to relating individual deposits and mineral districts to the geologic environments that host them. We have mapped the general extent of 17 distinct mineral systems that are known or suspected to exist within Alaska, and we delineated more than 100 associated focus areas known or suspected to include most of the commodities that are presently listed as critical (Kreiner and Jones, 2020; Kreiner et al., 2022). Our mapping was guided by publicly available geologic, geochemical, geophysical, and mineral occurrence datasets that cover most of the state. Mineral resource prospectivity models published by the U.S. Geological Survey for Alaska in recent years provided guidance for evaluating the footprints of mineral systems. The Yukon-Tanana upland of eastern interior AK was selected as the first priority region for new data collection under the USGS Earth MRI program because it has the most overlap of different mineral systems. Other regions of interest such as the Kuskokwim Mountains and Seward Peninsula in southwestern and western Alaska, respectively, will be the focus of new data collection in the future. Our mapping of mineral systems and critical mineral prospectivity and the resulting focus areas provide a strategic framework for prioritizing new research and data collection in Alaska to advance our understanding of domestic critical mineral potential.

DGGS Completes Yukon-Tanana Upland Earth MRI Airborne Geophysics Program, and Planning Underway for CY2023 Magnetic, Radiometric, and Electromagnetic Data-Acquisition

Abraham M. Emond and Evan Twelker, ADGGS

The Alaska Division of Geological & Geophysical Surveys (DGGS), using funds from the U.S. Geological Survey's Earth Mapping Resources Initiative (Earth MRI), State of Alaska, Bureau of Land Management, and industry partners has completed our geophysics program for the Yukon Tanana Upland focus area in eastern Interior Alaska, excluding Yukon-Charlie Rivers National Preserve (fig. 1). Approximately 60,000 square kilometers of new magnetic and radiometric data were collected during 2020, 2021, and 2022. These data are primarily 400-meter line spacing, 300-meter ground clearance ("Tier II") fixed wing surveys and lesser helicopter-based surveys. All new data will be available for download from the DGGS website by year-end 2022. These data are sure to provide valuable insights into the region's geology and mineral potential.

In calendar year 2023, DGGS will be leveraging expanded Earth MRI funding opportunities to collect new surveys in the Kuskokwim River region and the Seward Peninsula. In the Kuskokwim River region, DGGS will be collecting approximately 40,000 to 50,000 square kilometers of 400-meter line spacing magnetic and radiometric data using both fixed wing and helicopter platforms (fig. 2). Data collection will begin in May 2023. On the Seward Peninsula, DGGS will be collecting 1,000 to 3,000 square kilometers of electromagnetic data, most likely with a mid-depth time domain system, to support the USGS's graphite assessment (fig 3). For both survey areas DGGS is actively seeking partners to expand data coverage and/or increase data density.

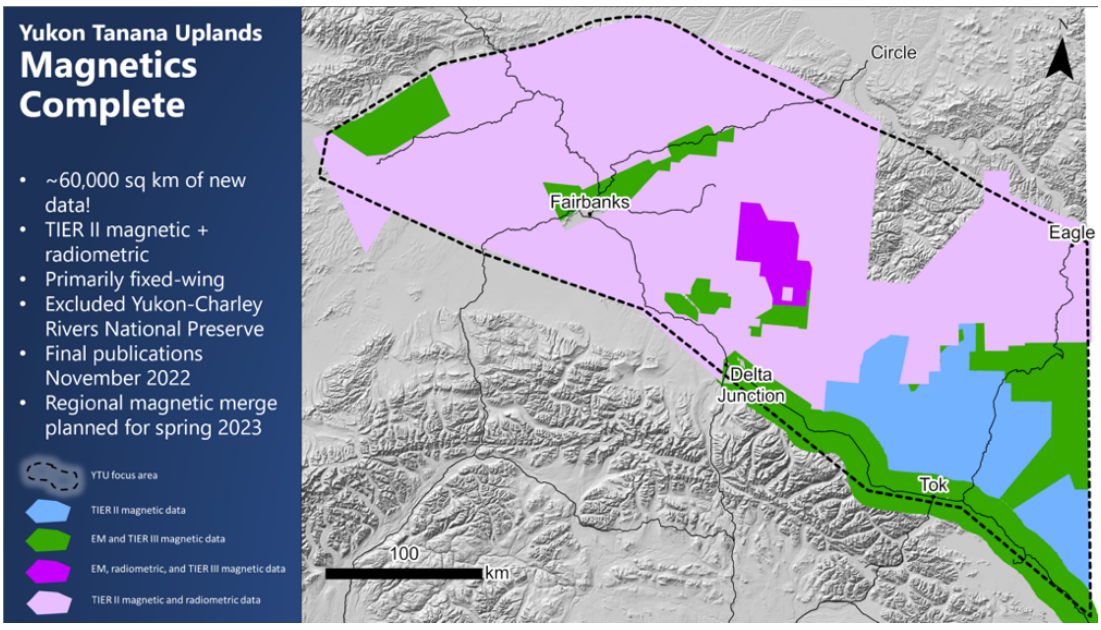


Figure 1. Yukon Tanana Uplands magnetic

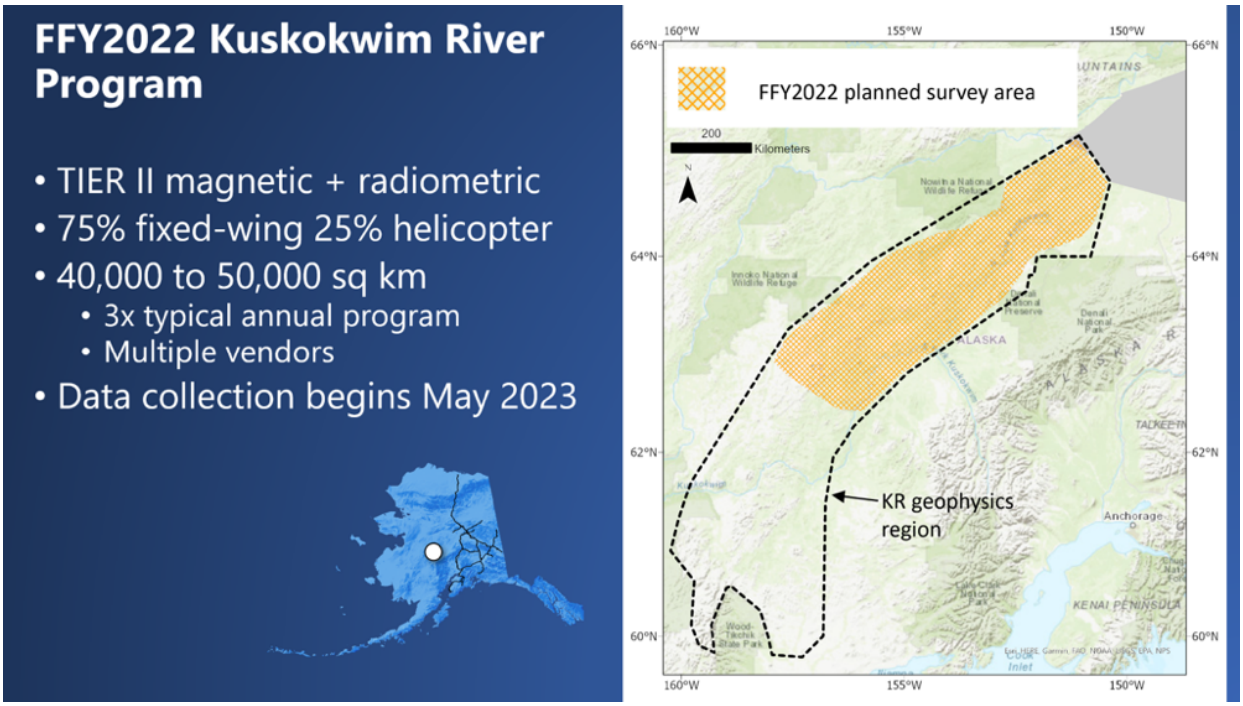


Figure 2. Kuskokwim river FY2022 Program data coverage. Want to see data, come to the talk!

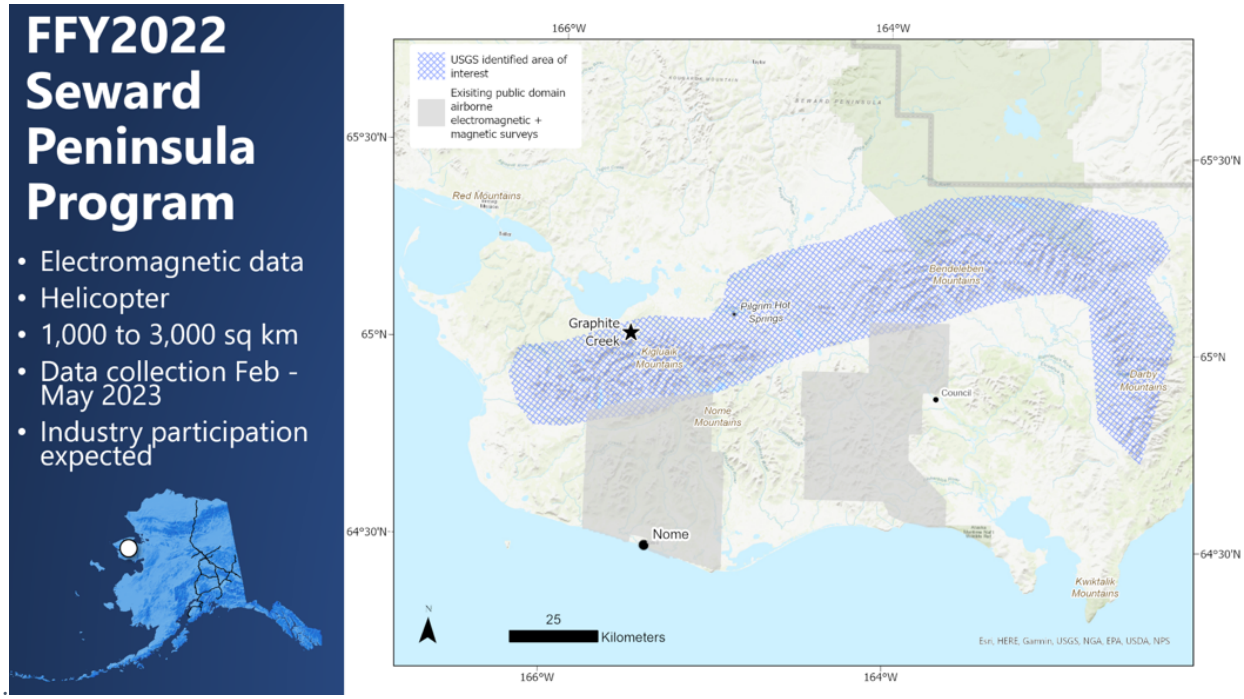


Figure 2. Seward Peninsula FFY2022 program.

Graphite mineral potential in the United States: An Alaskan perspective
George Case, USGS

Crystalline graphite – commercially known as either flake graphite or lump and chip graphite – is a critical mineral commodity used for energy storage systems in a carbon-neutral economy. Understanding the geologic characteristics of crystalline graphite deposits is crucial for identifying domestic mineral potential and reducing the risk of future supply chain disruption of this commodity, of which the United States is currently 100% import reliant. To this end, the U.S. Geological Survey collaborated with the University of Alaska Fairbanks to investigate the largest-known crystalline flake graphite deposit in the United States: the Graphite Creek deposit, Seward Peninsula, Alaska (~103 Mt; 8% graphitic carbon, Cg). Graphite Creek is hosted in granulite-facies rocks of the Kigluaik Mountains. Our research shows that Graphite Creek, like many other flake deposits, formed during high-temperature metamorphism of carbonaceous sedimentary rocks. However, Graphite Creek is unusual in that partial melting (anatexis) during this event formed localized, very high-grade (up to 50% Cg) enrichments in the orebody. Regionally, the Kigluaik Mountains and geologically similar rocks in the Bendeleben Mountains are considered favorable for this style of mineralization.

The insights gained from studying Graphite Creek have helped to guide a recently initiated national mineral resource assessment of graphite in collaboration with the Geological Survey of Alabama. In the conterminous United States, granulite-facies rocks of the Adirondack Mountains are the most geologically comparable setting to that of Graphite Creek. The Adirondack Mountains historically produced graphite (including for the famous Dixon Ticonderoga pencils), but deposits of a size comparable to Graphite Creek have not yet been discovered. The Appalachian orogen contains belts of high-temperature metasedimentary (HTMS) rocks, variably exposed from Maine to Alabama, that are favorable for flake graphite deposits. Numerous graphite occurrences and historic mines are documented along the Appalachian orogen, and the Coosa deposit (~80 Mt, 2.5% Cg) in the Alabama Graphite Belt has economic potential for flake graphite and associated vanadium – another critical mineral. Other isolated packages of HTMS rocks with flake graphite potential and historic production, related to Proterozoic orogens, have been identified in Michigan, Wisconsin, Minnesota, and Texas.

In contrast, lump and chip crystalline graphite deposits are characterized by sets of < 3 m wide hydrothermal veins that contain coarse (> 4 cm long) graphite aggregates. These vein sets are generally very high-grade (> 90% Cg), but small (< 1 Mt) and usually sub-economic. Vein occurrences are documented in the Ruby Range, Montana, and in the Appalachian Mountains of New Hampshire, where they are hosted in granites or amphibolite- to granulite-facies metasedimentary rocks. Although they are small, the growing demand for graphite has renewed exploration interest for lump and chip graphite veins.

To date, our assessment reveals potential for multiple types of crystalline graphite deposits throughout the United States and highlights substantial differences in the size and metal associations among flake graphite deposits. Ongoing research will

illuminate more about the geologic processes that influence the grade and quality of crystalline graphite as well as vanadium and other critical mineral potential in these deposits.

Updates on DGGS geologic mapping efforts in eastern Interior Alaska
Travis Naibert, ADGGS

During the 2020 through 2022 field seasons, geologists from the Alaska Division of Geological & Geophysical Surveys (DGGS) conducted 1:100,000-scale mapping and sampling of areas totaling about 5,700 square miles in the Tanacross, Eagle, Mount Hayes, and Big Delta quadrangles (fig. 1). All three map areas are within the Yukon-Tanana Uplands between Tok and Salcha and were previously mapped at 1:250,000 scale by the USGS during the 1960s. These projects aim to produce more detailed geologic maps and supporting data to promote mineral discovery in Interior Alaska. Here we present the results of geochemical and geochronological sampling, our preliminary 1:100,000-scale geologic maps for the areas mapped in 2021, a summary of our field observations from the 2022 field season, and regional observations based on our on-going mapping in interior Alaska.

The Yukon-Tanana Uplands are underlain by two major geologic terranes: the parautochthonous margin of North America (pNA) and the allochthonous Yukon-Tanana Terrane (YTT). Metamorphic units within pNA include the Lake George assemblage and the Divide Mountain augen gneiss. Metamorphic units within YTT include the Fortymile River assemblage, the Chicken assemblage, the Klondike Schist, and the Ladue River unit.

A north-dipping extensional detachment between the underlying Lake George assemblage and the overlying Fortymile River assemblage was mapped in detail by DGGS in the Northeastern Tanacross map (Wypych and others, 2021). 2021 mapping efforts identified a similar structure along the southern boundary of the Taylor Mountain batholith where the detachment is concealed by unmetamorphosed Cretaceous to Tertiary sedimentary rocks and minor felsic volcanics. North dipping shear zones along several ridges on the south and west margins of Mosquito Flats are interpreted to be continuations of the same detachment, extensively crosscut by later high-angle faults. The presence of Jurassic plutons, which are only found within YTT elsewhere in eastern Alaska, support mapping the Fortymile River assemblage on the west side of Mosquito Flats. Previously published argon thermochronology in interior Alaska suggests that exhumation of the Fortymile River assemblage occurred during collision of the YTT with pNA in the Early Jurassic. The pNA units in eastern Interior Alaska were apparently exhumed during the mid-Cretaceous. Thermochronology samples are currently being analyzed to confirm the location of the detachment in the recent map areas.

The Chicken assemblage was mapped along the northern boundary of the Taylor Mountain Batholith and appears to lie structurally above the Fortymile River assemblage. The contact between these units is mapped as a high-angle normal fault that down-drops the lower-grade Chicken complex. The fault is cut by a small pluton interpreted to be mid-Cretaceous.

We have identified multiple piercing points along the northeast-striking Sixtymile-Pika, Mount Harper-Kechumstuk, and Shaw Creek fault systems that suggest that faults in this orientation can have both left-lateral, right-lateral, and possible vertical

offsets. Using these offsets, we have attempted to trace the extension of the older, northwest-striking Big Creek fault system from Yukon into Alaska. This fault system may play an important role in Cretaceous magmatism and mineralization.

The Western Tanacross map area and adjacent parts of the Taylor Mountain map areas contain mid-Cretaceous felsic volcanic rocks. Preservation of these volcanics, along with plutons of comparable age suggest complicated uplift and exhumation of the landscape since the mid-Cretaceous. Locally present late Cretaceous and Paleogene-Eocene volcanics and porphyritic intrusives are often mapped near high-angle faults, suggesting a genetic link may exist between faulting and magmatism.

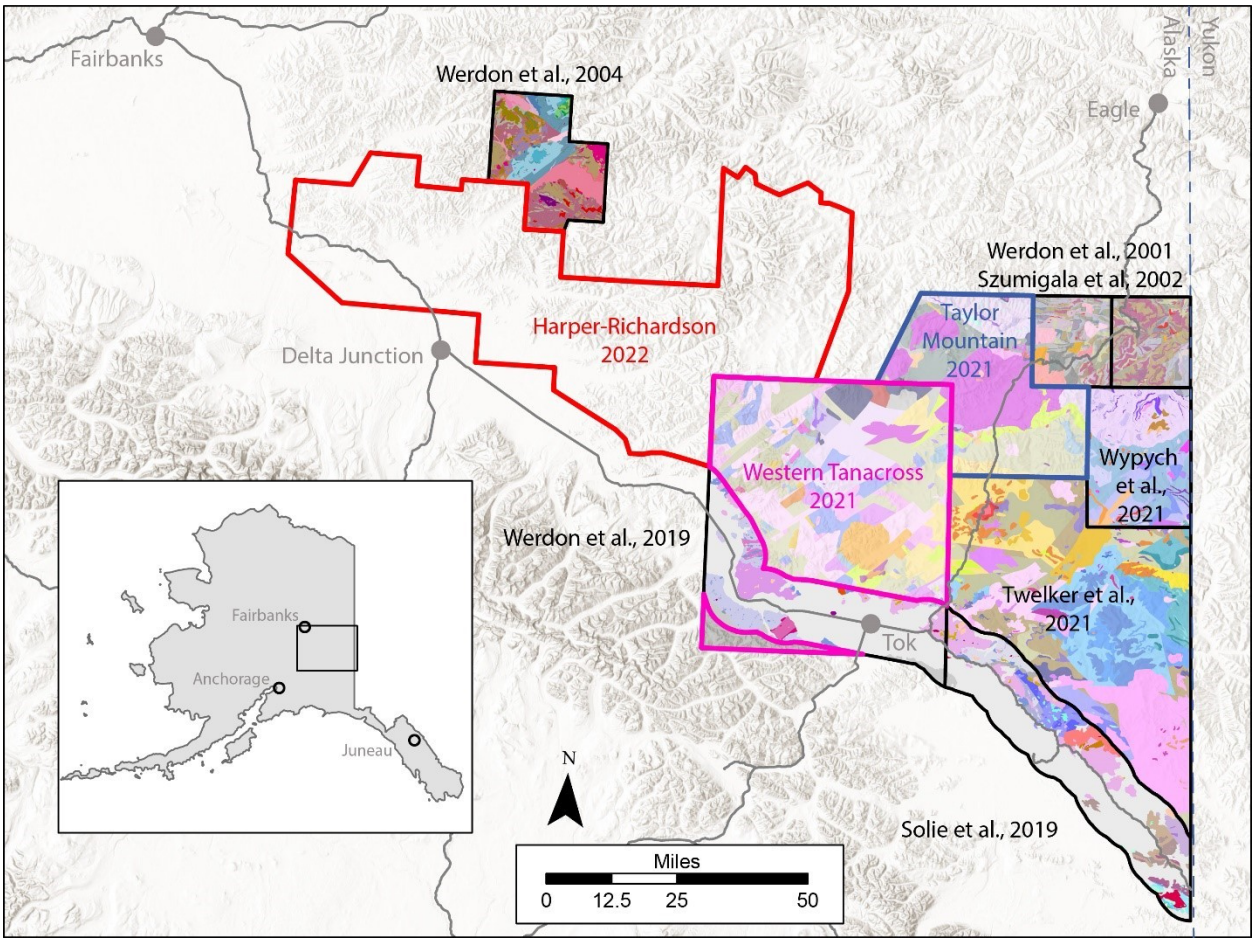


Figure 1Map showing the location of 2021 and 2022 geologic mapping projects in relation to previously published DGGS geologic maps in eastern Interior Alaska

Inverted Barrovian metamorphic field gradient and gold mineralization along the insular-intermontane boundary, Clearwater Mountains, AK.
Sean Regan, UAF

The Valdez Creek catchment located in the western Clearwater Mountains has been a significant placer gold district for over 100 years. The catchment is situated near the boundary of the intermontane-derived Maclaren schist and insular-derived Clearwater metasedimentary units, traditionally referred to as the Maclaren Glacier metamorphic belt. The bedrock geology across the catchment preserves a classic inverted Barrovian metamorphic field gradient developed across the Valdez Creek shear zone (VCsz), a north-dipping thrust-sense shear zone that juxtaposed amphibolite-facies Maclaren schist structurally on top of low greenschist-facies Clearwater metasedimentary rocks. Detailed in-situ monazite petrochronology show that deformation within the VCsz decreases in age structurally downward with decreasing metamorphic grade, and ranges from 67-56 Ma. The base of the shear zone is marked by the transition from phyllite to slate, and contains local mineralized m-scale thrust faults with geometries compatible with top-to-the-south deformation, consistent with kinematics of the overlaying shear zone.

Known lode deposits are located within one km of the phyllite-slate contact, and are often spatially associated with granitoid stocks and sills. We performed $^{40}Ar/^{39}Ar$ on white mica from quartz-calcite-ankerite ± gold veins, preliminary detrital zircon geochronology from the placer system, EPMA analysis of placer gold and lode gold, and U-Pb zircon geochronology from stocks and sills from the base of the VCsz. Detrital zircon analysis from the placer system indicates that the provenance is entirely composed of insular-belt units (i.e., recycled Clearwater metasediments) with large influx of ca. 90 Ma grains within the placer-rich gravels. Bedrock zircon U-Pb zircon analysis of granitoids within the reworked footwall yield consistent ca. 88 Ma ages. White mica $^{40}Ar/^{39}Ar$ step heating experiments from gold-bearing veins yield a range of ages from 65-58 Ma, all of which yielded flat step-heating profiles inconsistent with partial resetting. Lastly, placer and lode gold have similar compositions with only slight chemical variations that are consistent with fluvial transport, suggesting a genetic relationship. Collectively, our data indicate that gold mineralization within the Valdez Creek catchment occurred during contractional deformation within the VCsz, where fluids were pushed southward along discrete thrusts and trapped within and near rigid ca. 80 Ma plutonic rocks. The style of mineralization and geologic framework indicate that the Valdez Creek area is the northern extension of the Tatshenshini shear zone in the Yukon and western metamorphic belt of the Coast Mountains Complex in southeast AK and BC that has been dismembered by significant margin-parallel translation along Denali and Chatham Straight Faults.

EXPLORATION PROJECT HIGHLIGHTS

Contango - Developing Alaska's Next Gold Mines: Manh Choh and the Lucky Shot

Rick Van Nieuwenhuyse, Contango Ore Inc.

Contango Ore discovered a high quality skarn deposit on land owned by the Tetlin Alaska Native Tribe in 2012. After more than ten years it is finally being developed in partnership with Kinross Alaska and the Tetlin Tribe. In September 2020 Contango entered into a 70/30 joint venture agreement with Kinross as majority owner and manager, with a plan to develop the Manh Choh ore body and truck the run-of-mine ore to the Fort Knox mill for processing. Construction has started and Kinross plans to have the mine operational and producing gold in 2024. Meanwhile, with Kinross doing all the heavy lifting at Manh Choh, Contango is busy exploring our Lucky Shot mine from underground. The mine was a historic producer from the late 1920s up until 1942 when President Roosevelt used the War Act to shut down all gold mining in the United States by Executive Order. Prior to closing the mine had produced 250,000 ounces of gold averaging 40g/t (1.6oz/ton). Previous underground workings have been refurbished and extended, and exploration drilling is underway to defining new resources down-dip from the historically mined areas. Both Manh Choh and the Lucky Shot project have excellent exploration opportunities.

The Flat Gold Project

Peter Kleespies, Tectonic Metals Inc.

Flat is located in southwestern Alaska, just 40km north of the Donlin Gold Project. in the Kuskokwim Mineral Belt. The project consists of 92,160 acres of Native-owned land belonging to Doyon, Limited, one of Alaska's largest Alaska Native Regional Corporations and private landholders. The property hosts intrusion-related gold mineralization similar to that found at the Fort Knox (Alaska) and Eagle (Yukon) gold mines. Since 1908, when gold was first discovered at Flat, the immediate vicinity has been notable as an area of significant placer gold mining activity with an estimated 1.4 million ounces of placer gold produced from streams draining the Chicken Mountain – Black Creek complex.

The Flat Gold Project occurs within the Iditarod Quadrangle where the dominant structural feature is the regionally extensive right-lateral, strike-slip Iditarod-Nixon Fork Fault, which extends from the southwest to northeast corners of the quadrangle.

North of the fault-zoned multiphase stocks of Chicken Mountain, Black Creek (68.3 to 73.2 Ma) and Swinging Dome (59.4 to 63.4 Ma) intrude Kuskokwim sediments and are genetically related to accumulations of intermediate and felsic volcanics. Hornfelsing occurs within both the sedimentary and volcanic rocks adjacent to the intrusion margins. At Chicken Mountain three major compositional phases are present: monzodiorite and gabbro comprise the outer margin and initial phases, biotite monzonite forms a relatively homogeneous central transitional phase and leucocratic quartz monzonite forms the central phase.

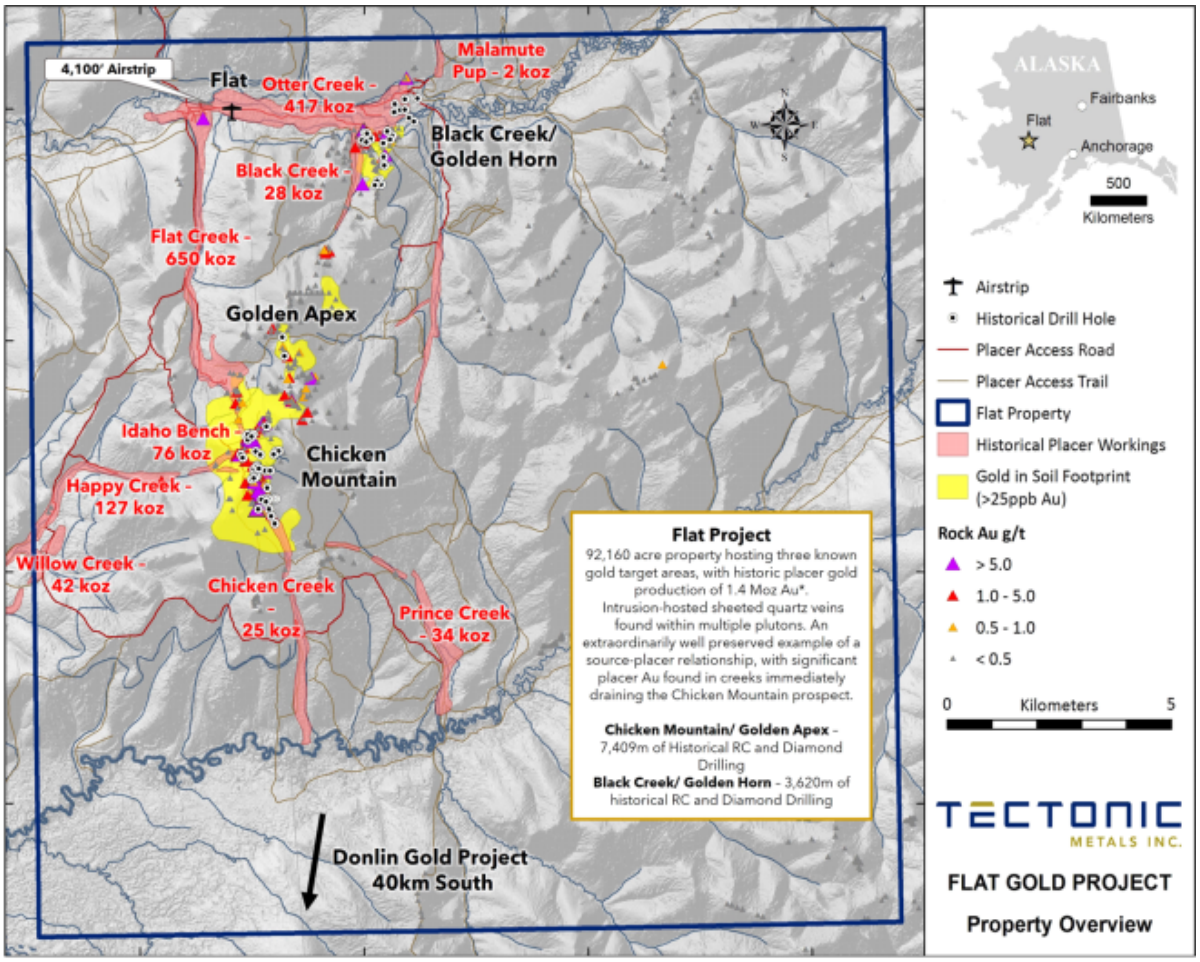
Bedrock gold mineralization at Flat has been recognized in at least two geological settings.

1. Low-grade intrusion related within altered, fractured and veined late-stage phases in the Chicken Mountain- Black Creek stocks. Notably, the most significant gold mineralization is hosted within the late-stage quartz monzonite at Chicken Mountain.

2. Contact-related vein and disseminated bulk tonnage mineralization hosted within sedimentary and volcanic rocks. Most notable are the Golden Apex zone which occurs between the Chicken Mountain and Black Creek Stocks and Golden Hornfels zone which occurs along the eastern contact of the Black Creek stock.

Historic exploration work between 1977 and 2003 including 87 core and reverse circulation drillholes for 11,040 metres, resulted in an extensive surface and subsurface geochemical database on the project. Significant surficial gold in soil and rock anomalies generated by the historic exploration efforts remain untested by drilling.

Initial exploration efforts by Tectonic are focused on the central portion of the Chicken Mountain stock where gold occurs as veinlet and fracture-controlled gold mineralization in the pervasively altered, late stage leucocratic quartz monzonite, which appears to have been a major source of the placer gold in the Flat district



* Placer production figures from "Mineral Occurrence and Development Potential Report, Locatable and Salable Minerals, Bering Sea-Western Interior Resource Management Plan, BLM-Alaska Technical Report 60", prepared by the U.S. Department of the Interior, Bureau of Land Management, November 2010"

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Welcome to Valhalla – A New Focus for the Sun Deposit, Ambler Mining District, Alaska

Bonnie Broman, Sorin Posescu, Valhalla Metals Inc.

Mineralization was discovered at the Sun deposit over 50 years ago, and since that time the project has gone through several periods of intense exploration followed by periods of dormancy – the most recent of which ended when Valhalla Metals Inc. acquired 100% ownership of the Sun deposit in 2018. In September 2022, the project took another significant step forward when Valhalla began trading on the Toronto Stock Exchange (TSX) and raised over $C10 million to advance the project and welcome Marubeni, a well-established Japanese copper producer, as a strategic investor.

Sun is the eastern-most deposit known within the highly prospective Ambler Mining District and is characterized as a volcanogenic massive sulfide (VMS) deposit containing high grade zinc, copper, lead, silver and gold mineralization. On a worldwide comparison basis, Sun ranks in the second quartile for size and the second quartile for metal value.

Valhalla completed an updated Canadian NI 43-101 compliant resource on October 1, 2021 with Sun estimated to contain an Indicated resource of **1.71 million tonnes** (MT) grading **4.32% Zn, 1.48% Cu, 1.11% Pb, 60.0 g/t Ag, and 0.21 g/t Au (4.09% CuEq)**; and an Inferred resource grading **9.02 MT of 4.18% Zn, 1.21% Cu, 1.46% Pb, 81.7 g/t Ag, and 0.25 g/t Au (4.10% CuEq)***. A total of 97 holes (19,123m) have been drilled since the deposit was first discovered in 1966 and are used to define the current resources at Sun and SW Sun. These holes have only been extended to ~200m below surface within the Main Sun prospect, so the potential to upgrade and increase the overall size of Sun is highly prospective down-dip and along strike. Mineralization at Sun is hosted by at least two polymetallic massive and semi-massive sulfide horizons containing primarily pyrite, sphalerite, chalcopyrite, galena, and tetrahedrite-tennantite with other accessory sulfide minerals.

Helicopter VTEM and magnetic surveys were completed in 2019 with detailed conductive plate modeling done in 2022. Comprehensive 2D and 3D modelling confirms the known Sun resources and further defines believed mineralization along strike and down-dip to greater depths at Sun, SW Sun, and Picnic Creek. Several other previously untested VTEM anomalies were also identified, including a large 2km circular shaped anomaly referred to as the Western Anomaly. A soil geochemical program was completed in 2021 over the Western Anomaly showing coincident anomalous metals in soils. This detailed modeling demonstrates there are several exciting new targets to explore across the property in addition to expanding mineralization down-dip and along strike of Sun, SW Sun, and Picnic Creek.

Forward progress is being made on the Ambler Mining District Industrial Access Project (AMDIAP) with the BLM currently working on a supplemental EIS. Valhalla intends to advance the Sun deposit by drilling down dip and along strike of the current resource area to confirm, upgrade and expand the existing resource base, as

well as to obtain representative samples for metallurgical testing. In addition, exploration efforts including drilling and downhole geophysics in other areas of the property will continue, both to further refine existing prospects and to generate new ones.

Note: *The following metal prices were used to calculate CuEq: copper - $3.00/lb; zinc - $1.10/lb; lead - $1.00/lb; silver - $18/oz; and gold - $1,300/oz

The Oreo Mountain Porphyry Cu-Mo-Ag-Au Prospect, East-Central Alaska, including comparisons to the giant Casino porphyry in the Western Yukon

David A. Hedderly-Smith, D.A. Hedderly-Smith and Associates

Introduction & Location

The Oreo Mountain prospect in the Tanacross quadrangle of east-central Alaska was first discovered in 1975 by Cities Service Minerals Corporation (the then mineral subsidiary of CITGO Petroleum Corporation) and has seen minor sporadic exploration work since.

The prospect is located on State of Alaska land on the southern side of the upper Ladue River at elevations ranging from about 600 to 950 meters (2000 feet to 3000 feet), about 25 kilometers (15 miles) northeast of Midway Lake on the Alaska Highway (Alaska Highway 2) and about 55 kilometers (35 miles) east of Tok, Alaska, the major commercial center in Alaska's eastern interior with virtually all services. A road to the property down the upper Ladue River from the Alaska Highway would be about 32 kilometers (20 miles) long, mostly along an existing right-of-way that is currently used for winter access to other prospects in the area. The project is 100% on State of Alaska owned land and is held with state mining claims.

Regional Exploration Background

The discovery of the large porphyry copper-molybdenum-silver-gold porphyry Casino deposit in the Yukon Territory in 1969 led to the Yukon-Tanana Uplands being suspected to be a significant porphyry copper province. In 1970 the U.S. Geological Survey published a 1:250,000-scale reconnaissance geologic map of the Tanacross Quadrangle (Foster, 1970). Continued exploration in the Yukon and adjacent east-central Alaska and led to the discovery of several porphyry copper prospects on both sides of the border over the next few years.

Continued development of the Casino deposit over the past 50 years has shown it to be a true giant system with contained metal resources of over 1 billion tons of measured and indicated resources containing some $60 billion of copper and gold and another $40+ billion of metal in inferred resources, supergene-hypogene-oxide resources and heap leach resources. Casino is about 320 kilometers (200 miles) southeast of the Tanacross quadrangle on geologic trend.

Government and agency work in the area over the past 15 years has included 21st-Century airborne geophysical survey data from magnetic and electromagnetic surveys by the Alaska DGGS in the area (Burns *et al.*, 2006, Burns *et al.,* 2011 and Emond *et al.,* 2015), a metallogenic/lineament analysis focusing on the generation of porphyry deposits by the Mineral Deposit Research unit of the University of British Columbia (Sanchez *et al.,* 2014) and ADDGS RI 2021-5, *Geologic Investigations of the Ladue River-Mount Fairplay Area, Eastern Alaska* (Twelker ed., 2021), which study area is essentially centered on the Oreo Mountain prospect and which contained a vastly improved 1:100,000-scale geologic map and greatly updated the geologic understanding of the area.

Oreo Mountain Prospect History

The Oreo Mountain deposit was initially discovered in 1975 through reconnaissance soil sampling by Cities Service Minerals Corporation. Efforts since have included work by Full Metal Minerals and j-v partner BHP-Billiton in 2007-2012 which identified an area of anomalous soils ranging up to 398 ppm Cu that was about 5 kilometers (3 miles) east-west and up to 2 kilometers (1.5 miles) north-south.

In September of 2017, thirty-two 160-acre State of Alaska MTRSC mining claims were located on the Oreo Mountain prospect on behalf of Tubutulik Mining Company LLC. In April of 2018, the property was optioned to Kennecott Exploration Company (Rio Tinto) and later that spring another 106 160-acre claims were staked, bringing the total to 138 160-acre claims (~22,080 acres or 8,935 hectares), covering the aeromagnetic high that included the anomalous soil area. In a three-week project in September 2018, Kennecott established several helipads at Oreo Mountain and conducted soil sampling and trenching on the prospect. The soil work (374 auger samples) extended the footprint of the soil anomaly to over 8 kilometers (5 miles) in length east-west and 1 to 2 kilometers (1.5 miles) in width north-south while the trenching identified some local altered and mineralized rocks. Soil samples collected by Kennecott contained up to 749 ppm Cu, 301 ppm Mo, 504 ppm Pb & 1.36 ppm Ag. In August & September of 2019 Kennecott drilled six HQ core holes stretching across 5 kilometers (3 miles) totaling 1061 meters (3481 feet) with the deepest T-D'd at 187 meters (618 feet). The holes were located largely by copper soil geochemistry as Kennecott did not attempt any significant geologic mapping at Oreo and performed no geophysical work on the prospect during their tenure with it. Copper and molybdenite mineralization and porphyry-type alteration were encountered in all six holes, but values were not overly impressive.

Oreo vs. Casino

Oreo is located about 320 kilometers (200 miles) northwest of Casino is very similar terrain. Both Casino and Oreo Mountain sit astride strong, large local aeromagnetic highs which are part of a distinct northwesterly trend of the aeromagnetics through the Yukon-Tanana uplands (Oneschuk *et al*., 2019). Both are also associated with strong northwesterly trending regional lineaments/faults identified in the metallogenic study of Sanchez *et al.* (2014).

Geologically the two deposits are not surprisingly quite similar. Both deposits are associated with similar late Cretaceous calc-alkaline intrusions. The mineralizing intrusion at Casino is the 72.4 ma Patton Porphyry. It a porphyritic mega-crystic granodiorite/tonalite, intruded into mid-Cretaceous (104 ma) Dawson Range diorite and granodiorites, which are themselves intruded into the Paleozoic Yukon Metamorphic Complex. At Oreo Mountain the identified late Cretaceous intrusions include a 71.4 to 72.1 ma granodiorite and a (post mineral?) 68.8 ma mega-crystic monzogranite porphyry, all intrusive into similar Paleozoic metamorphic rocks as those at Casino.

The soil geochemistry of the two deposits is also very similar. While the soil surveys were conducted 50 years apart, both were sampled with hand augers. And

although analytical techniques were different, anomaly levels are similar. While the anomaly levels are slightly higher at Casino, the Oreo Mountain soil anomaly area is twice as large. Casino has a good gold soil anomaly which Oreo largely lacks (to date). Other elements are similar.

Both deposits sit astride large strong magnetic highs adjacent to local magnetic low embayments. And both appear to be located slightly south of the northwesterly trending Big Creek-Tanacross North lineament as identified by Sanchez *et al*. (2014) near ostensibly important northeasterly-striking couple.

Oreo Exploration Potential

Kennecott spent limited portions of two field seasons (about 10 weeks total) on their work at Oreo. Their six 2019 drill holes were sited based on soil geochemistry without any geologic mapping by Kennecott or any ground geophysics (including IP/resistivity). Only after Kennecott left the property were the results of the State of Alaska's geologic studies and mapping released.

A 6-kilometer (3.7 mile) E-W by ¾-kilometer (1/2-mile) N-S strong aeromagnetic low (Burns *et al*., 2011) has been interpreted by the state to be underlain by the 68.8 ma post-mineral(?) mega-crystic monzogranite porphyry (Twelker ed., 2021). However, magnetic susceptibility measurements by both the state and Kennecott suggest that such an intrusion should not result in a magnetic low.

Possibly the magnetic low is not a feature resulting from lithology but rather a large feature resulting from hydrothermal alteration of the underlying (intrusive?) rock. The DGGS surface work only included two traverses across portions of this large area. The soil geochemistry displays good to strong anomalies in this area, including some of the strongest lead anomalies on the prospect. Continued exploration – probably starting with prospect-level geologic mapping and prospecting and an IP/resistivity survey – is needed in this large area as this geophysical anomaly could hint a very large mineral deposit.

Other areas of the claim block also offer excellent exploration potential.

Summary

In summary, Oreo Mountain is a substantially underexplored very large Cu-Mo-Ag-Au porphyry system in a recognized porphyry Cu-Mo-Ag-Au terrain. The prospect has the potential to become a world-class copper resource. It also has excellent logistics and local infrastructure and is situated in a very favorable jurisdiction for development.

Exploring for multi-million ounce gold discoveries in the world-class Fairbanks gold mining district

Dave Larimer, Felix Gold

Felix Gold is a “built for purpose” minerals exploration company. Founding parent company, Mine Discovery Fund (MDF) from Australia, conducted a global review to find the highest probability towards discovery of Tier 1 ore bodies. This review highlighted Alaska and the Tintina Gold Province. Felix Gold was established as a privately held exploration company incorporated in Alaska in 2021. Felix Gold was named after Felix Pedro (Felice Pedroni) who initially discovered gold near Fairbanks, Alaska in 1902. In January 2022, Felix gold successfully conducted an Initial Public Offering, listing on the Australian Stock Exchange (ASX) with incorporation in Alaska and Flagship operational headquarters established in Fairbanks, Alaska.

Felix Gold has key landholdings in the world-class gold province that cover over 392 Km2 in a + 16Moz gold production of the Fairbanks Mining District. Projects are adjacent to Kinross’ operating Fort Knox Gold Mine and in the same trend as Freegold’s Golden Summit Project. Flagship projects are within 20 Km of traditional gold mining hub of Fairbanks, AK. Surrounded by existing infrastructure, services support and skilled work force supporting multiple future development pathways.

In 2022, Felix Gold executed decisive gold exploration across its 4 projects: Grant-Ester, NE Fairbanks, Liberty Bell, and Treasure Creek (See fig. 1). Reprocessing and reinterpretation of geophysical data combined with 3-dimensional geologic modeling advanced exploration targets strongly supported by multi-kilometer soil anomalies. Exploration targets were tested utilizing shallow Reverse Circulation (RC) and Diamond Core drilling totaling 17,700 meters in 187 holes. At time of submittal of this abstract.... many assays are still pending.

Felix’s initial program at Treasure Creek drill tested large-scale high-grade (+100 ppb Au) soil geochem anomalies across multiple target zones for near surface Au mineralization. Returned assays to date have been published in press releases (all press releases can be found on the Felix Gold website = www.felixgold.com.au) with more to follow.

Results to date support discovery of significant gold mineralization zones in Felix Gold’s Treasure Creek target areas of North West Array Southern Zone and Eastgate-Scrafford. Highlighted significant intercepts (previously reported) from North West Array Southern Zone include: 29.0m @ 1.53g/t Au from 24.4m (22TCRC002), 33.5m @ 1.63 g/t Au from 1.5m (22TCRC005), 89.9m @ 1.20g/t Au from 32m (22TCRC008), 38m @ 1.09g/t Au from 1.5m (22TCRC071), 35.1m @ 1.81g/t Au from 16.8m (22TCRC075), 89.9m @ 0.97g/t Au from 45.7m, and 24.4m @ 1.08g/t Au from 51.8m.

These initial results released to date from the 2022 drill program demonstrates broad zones of bulk tonnage gold mineralization and within these larger zones substantial thickness of high-grade Au mineralization. Data from the 2022 drill program will be supplemented by detailed structural observations from the diamond drilling program and recent geophysical surveys.

This presentation looks to expand on the above highlighted results more results are expected.

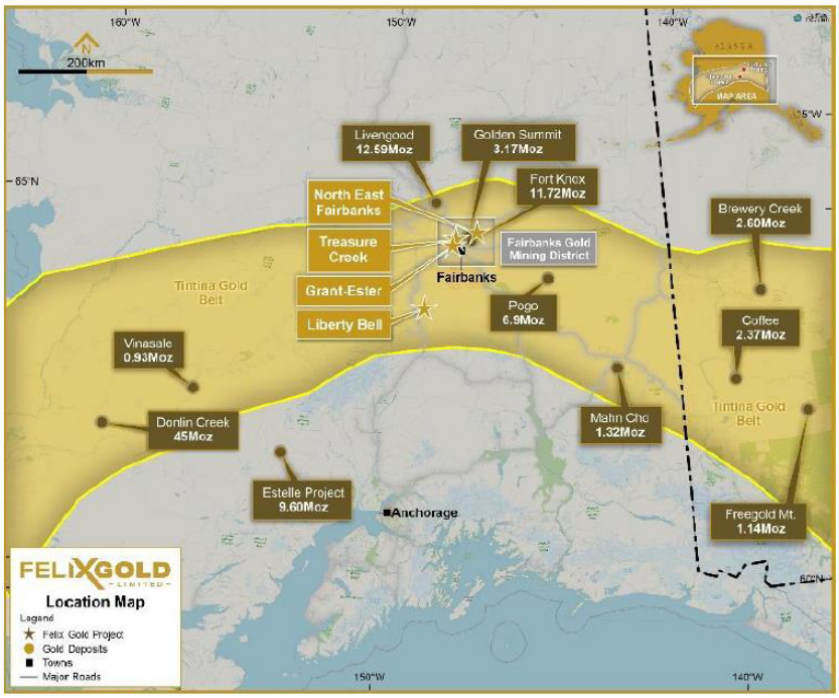


Fig 1 – Felix Fold Project areas within the Tintina Gold Province.

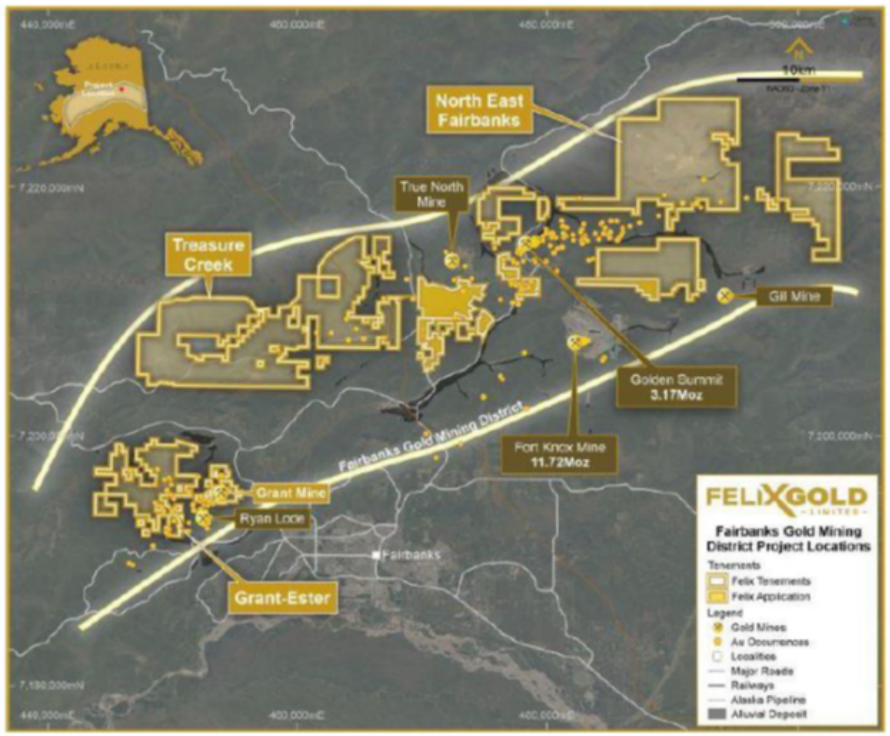


Fig 2 – Felix Gold Tenure in the Fairbanks Mining District

The Ni-Cu-Co-PGE Eureka Zone: Unlocking Alaska's Critical and Strategic Minerals for America's Future

Gabe Graf, Millrock Resource Inc.

The Nikolai Project (formerly known as the MAN Project) is located within Alaska's Delta Mining District, approximately 130 kilometers by road south of Delta Junction and approximately 280 kilometers southeast of Fairbanks (Figure 1). The Eureka zone consists of disseminated Ni-Cu-Co-PGE mineralization initially discovered by a subsidiary of INCO, and further expanded by Pure Nickel Inc. as reported in their press releases ranging between 2007-2014. Historical drillhole assay results reported by Pure Nickel Inc. (TSX-V: GGO) (Pure Nickel Inc., News Release, October 29th, 2013), indicate an area of mineralization with an estimated true width ranging from 94.8 to 320 meters, and grades ranging from 0.20 to 0.25% nickel, 0.05 to 0.15% copper, 0.016 to 0.019% cobalt, 39 to 96 ppb platinum, 62 to 156 ppb palladium and 11 to 31 ppb Au, with a calculated nickel equivalent (NiEq) ranging from 0.33% to 0.47%.

Millrock has recently resampled historical core and the new assay results confirm the existence of low-grade Ni-Cu-Co-PGE mineralization immediately below and adjacent to the Core Eureka Zone ("CEZ"). The new zone is named the Lower Eureka Zone ("LEZ"). Along with the Upper Eureka Zone ("UEZ"), hole FL-003 intersected 346 meters of nickel mineralization representing an approximate true width of 275 meters (Figure 2). The LEZ mineralized zone assay results returned 135.6 meters grading 0.20% Ni, 0.05% Cu, 0.016% Co, 0.062 ppm Pd, 0.026 ppm Pt, and 0.014 ppm Au (including eight historical intervals), providing evidence for a significant amount of mineralized tonnage below the CEZ.

Initial nickel and copper deportment studies completed by Millrock indicate very encouraging results for the recoveries and processing of the nickel-sulfide mineralization. In these low-grade nickel sulfide deposits, it is extremely important for the economics to fully understand the distribution and recoverability of nickel and copper. Nickel sulfide and nickel alloys accounted for ~94% of the total nickel within the CEZ composite sample (only 5.1% of total nickel in silicates). Pentlandite was the principal nickel bearing sulfide and carried ~92% of the total nickel in the CEZ composite. Interlocking between pentlandite and pyrrhotite was rarely observed, which will be favorable to the pentlandite separation from pyrrhotite. Nickel sulfide and nickel alloys accounted for ~80% of the total nickel within the UEZ composite sample (18.9% of total nickel in silicates). Pentlandite was the principal nickel bearing sulfide and carried ~64% of the total nickel in the UEZ composite. The remaining potentially recoverable nickel was in the form of nickel alloy and nickel metal, which accounted for ~16%.

Copper sulfides accounted for ~71% to 75% of the total copper within the CEZ and UEZ composites. Chalcopyrite is the dominant copper sulfide and accounts for ~67% to 71% of the copper in the composite samples. Bornite, chalcocite, cuprite, malachite, and azurite were also present, in the composite samples. The remainder of the copper (~24% to 28%) was present in valleriite (Cu-Fe-Mg sulphate). An

additional composite sample of the newly defined LEZ has been submitted for additional deportment studies.

Based on the historical data currently available to Millrock a clear exploration target has been established with a potential block of mineralized rock measuring 400 meters by 300 meters by 400 meters. Drill density is not presently sufficient to calculate an Inferred Resource. However, it is estimated that the exploration target contains between 140 million tonnes and 211 million tonnes, with grades ranging from 0.28% NiEq to 0.42% NiEq. Additionally, significant upside potential exists, as historical geophysical reports indicated a VTEM anomaly ~3.5 km in length and 400-600m in width in this part of the Eureka Zone. The developed exploration target accounts for only 12% of the length of the VTEM anomaly.

An exploration drill program has been designed consisting of seven holes totaling approximately 2750 meters. If successful, the program would, along with historical drill hole information, provide a drill density on 200-meter centers. This drill hole density is believed to be adequate to allow calculation of an Inferred Resource, given the apparent relative continuity and homogeneity of the mineralized zone. The grade and scale of the potential mineralized Eureka Zone appears to be comparable to Canada Nickel's Crawford Main Zone (606Mt @ 0.26% Ni), Gigametals Turnagain deposit (1073Mt @ 0.22% Ni) and Stillwater Critical Minerals Stillwater West Deposit (157Mt @ 0.20% Ni). Millrock believes these low-grade Ni-Cu-Co-PGE deposits will be the future for nickel production. Options to fund the initial exploration drill program are currently being explored, with the plan for drill rigs to be turning on the project next summer.

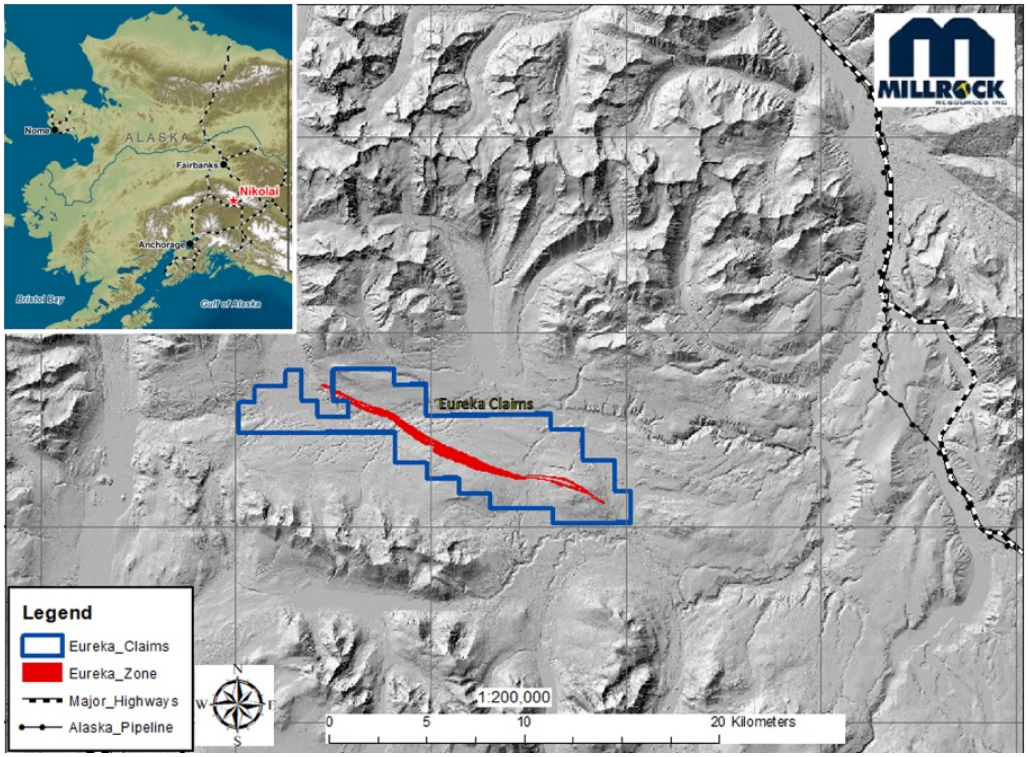


Figure 1. Location of the Ni-Cu-Co-PGE Eureka Zone

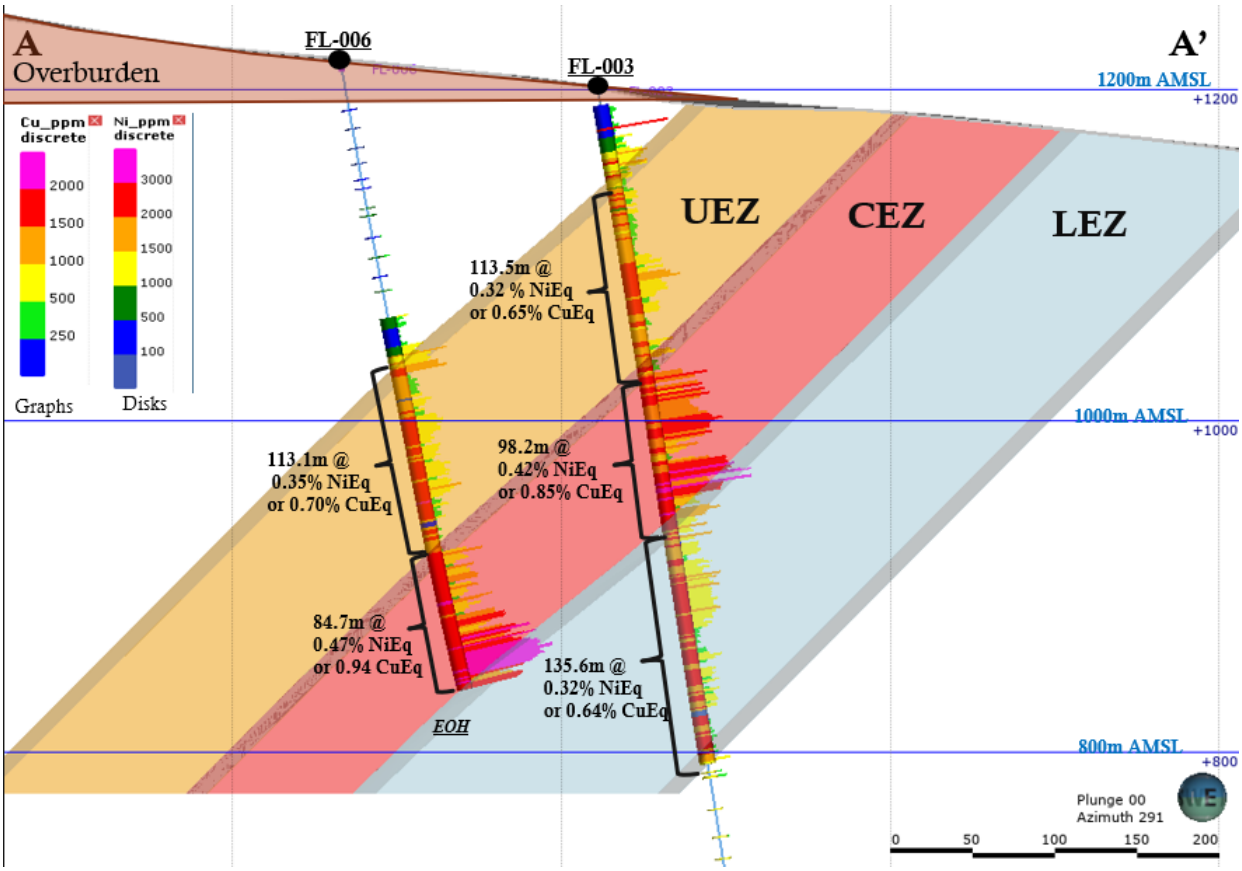


Figure 2. Cross Sectional view of INCO drillholes FL-003 and FL-006 through the Upper, Core and Lower Eureka Zone

Drilling up Grinder - Icy Cape Gold and Industrial Heavy Minerals Project

Dr. Karsten Eden, Trust Land Office

The Icy Cape Gold and Industrial Heavy Minerals Project is a unique and extraordinarily large volume placer gold and industrial minerals sands exploration project in the Gulf of Alaska. The Project Property is located in the Gulf of Alaska near Icy Bay about 75 miles northwest of Yakutat and encompasses about 48,000 acres (75 sq. mi.) of which about half is underlain by glacial and nearshore marine placer-heavy-mineral-bearing sediments. These sediments extend to depths of over 200 feet throughout the Property whereas rock basement is shallow (tens of feet) near Cape Yakataga in the west.

The Project is managed and operated by the Trust Land Office (TLO) and is the TLO's flagship exploration project. Since 2015 the Project has focused on gold extraction with garnet, and other heavy minerals as co-products. Incrementally, the Project collected stratigraphic framework and resources assessment drill-core samples, and in two recent field exploration seasons, the TLO identified four main prospects for follow-up exploratory drilling.

Per the Project's findings Hatch, a leading international consulting firm specializing in mining, mineral and metals industries, recommended that the Project further develop economic parameters and resource information so that returns to the TLO are maximized. Specifically, Hatch recommended exploration and development work to advance the mineral resource estimates of at least one prospect to an indicated resources level and subsequently, a pre-feasibility study.

The Grinder Prospect was selected for further development and resource definition drilling. The TLO set up a 24-person camp on site and an additional sample processing facility built and equipped with state-of-the-art hydrogravimetric core sample processing equipment. The Grinder drill hole plan was designed based on interpretation of newly acquired innovative 3-dimensional aeromagnetic gradient exploration survey data to maximize the effectiveness of resource development drill hole locations.

Over a 3-month span during the 2022 field exploration season the camp hosted a staff that included geologists, drillers, geologic field technicians, camp maintenance personnel, mechanics, and cooks, along with leading industry consultants working on the Icy Cape Project. The principal objective of the 2022 field work was to collect and process densely spaced drill-core samples from the Grinder Prospect in order to upgrade its gold and garnet resource estimate to a NI43-101-compliant indicated resource status. Resource definition drilling will continue in 2023 and bulk samples will be collected for metallurgical testing.

Stratigraphic and sediment texture information collected in 2022 supports previous drill-core observations indicative of a significant placer gold resource potential in sediments of the Grinder Prospect.

Western Alaska Minerals: Waterpump Creek and Illinois Creek Drilling Update

Zach Mahaffey, Western Alaska Minerals

The intercept of high-grade Pb-Zn-Ag sulfide mineralization at Waterpump Creek from the 2021 drilling campaign (Table 1) confirmed the carbonate replacement deposit (CRD) sulfide occurrence within the Illinois Creek District (Fig. 1). The 2022 program aimed to expand the Waterpump Creek mineralization, while further developing the district scale zonation of the CRD system. Western Alaska Minerals successfully drilled 32 holes, totaling 8,842.9 meters; expanding the Waterpump Creek sulfide zone (Table 1) and testing the Last Hurrah and Illinois Creek prospects (assays pending).

Following up on the 2021 (WPC21-09) high-grade sulfide intercept, Western Alaska Minerals (WAM) completed an additional 28 holes in the Waterpump Creek prospect totaling 7,157.7 meters of drilling during the 2022 program. Sulfide intercepts confirm the manto style mineralization forming a 30 to 40 meter wide and 400 meter long body which remains open to the south (Table 1; Fig. 2). Intercepts indicate multiple stages of sulfide mineralization characterized by alternating zinc-dominant sphalerite rich and lead-silver dominant galena rich zones (Table 1). The 102.7 meter intercept of sulfide in WPC22-18 suggests the discovery of a chimney feeder zone near the intersection with the Illinois Creek Structure (Fig. 2). To better understand the trend and continuity of mineralization seen at Waterpump Creek a four-drill hole profile with 20-40 meter spacing was completed 50 meters south of the thick intercept in WPC22-18. WPC22-20, -21, and -22 drilled along the profile all intersected significant sulfide mineralization; totaling 32.1 meters, 4.0 meters, and 67.3 meters, respectively. Drilling at Waterpump Creek moved 200 meters south to avoid a wide swath of wetlands. Significant alteration was identified in these southern holes and can be used as a vector towards the sulfide trend seen further north (Fig. 3).

In conjunction with the 2022 drilling program WAM completed a system-wide controlled source audio-magnetotellurics (CSAMT) survey (Fig. 1). The CSAMT program covered approximately seven kilometers between Illinois Creek oxide mineralization, the Last Hurrah prospect, and the Waterpump Creek sulfide target. Preliminary inversions highlight pre-mineral thrusting and high-angle syn-mineral faults. Notably, the Waterpump Creek structure (ore control for Waterpump Creek mineralization) is apparent over six kilometers of strike within the CSAMT sections. The Illinois Creek permissive stratigraphy consisting of 200 meters of interbedded quartzite and carbonate overlaying 200 meters of dolomite lies immediately under a large greenstone sill and a graphitic schist between 20 to 50 meters thick. This stratigraphy is down dropped on the west side of Wade's Fault, another high angle NNE structure subparallel to the Waterpump Creek structure (Fig.1).

Interpretations of the preliminary CSAMT inversions showed numerous targets along the Illinois Creek and Warm Springs fault trends, specifically testing areas of intersections with other high angle structures that could produce mineralization like

that seen in WPC22-18. Initial drilling at Illinois Creek testing Wade's Fault (IC22-01) intersected 50 plus meters of intense silicification, brecciation and massive pyrite mineralization with anomalous XRF base metal values below the greenstone sill. A second hole (IC22-02) designed to test the permissive stratigraphy hosting the East Illinois Creek Manto continuation south of the Warm Springs Fault intersected major silicification and brecciation with lesser but still significant pyrite component. A third hole (IC22-03) targeted the intersection of Wade's Fault and the Warm Springs Fault; notable alteration was observed on the east side of Wade's Fault in the up thrown dolomite before intercepting the greenstone sill, which apparently thickens as it rolls over into Wade's Fault.

The successful drilling at Waterpump Creek and Illinois Creek in conjunction with preliminary inversions from the CSAMT program continues to confirm the presence of a major CRD system with potential for additional discoveries and the continued expansion of the high-grade Waterpump Creek mineralization.

Table 1: Assay results for major intercepts at Waterpump Creek.

Drill Hole	From (m)	To (m)	Thickness (m)	Ag (g/t)	Zn %	Pb %	Ag Eq* (g/t)
WPC21-09	109.4	210.9	10.5	522	22.5	14.5	1886
WPC22-07	136.4	142.5	5.1	459	12.1	14.8	1340
WPC22-07	150.1	164.4	14.3	54	10.3	1.9	504
WPC22-08	114.6	125.5	10.9	157	9.9	6.4	720
WPC22-11	139.1	150.6	11.5	337	16.7	10	1259
WPC22-11	152.7	156.3	3.6	151	22.3	5.1	1130
WPC22-13	150.1	152.9	2.8	1304	2.5	37.1	2434
WPC22-13	158.4	160.8	2.4	820	15	13	2041
WPC22-17	125.5	174.3	48.8	144	9	5.5	680
WPC22-17	125.5	135.3	9.8	428	15.9	14.1	1512
WPC22-17	160.6	164.7	4.1	417	14.8	18.3	1587
WPC22-18	147.2	248.9	101.7	160	5.4	5.3	544
WPC22-18	158.6	165.8	7.2	349	7.3	9.7	947
WPC22-18	191.7	195	3.3	358	7.2	10.6	980
WPC22-18	223.8	242.3	18.5	335	2.2	13.5	798

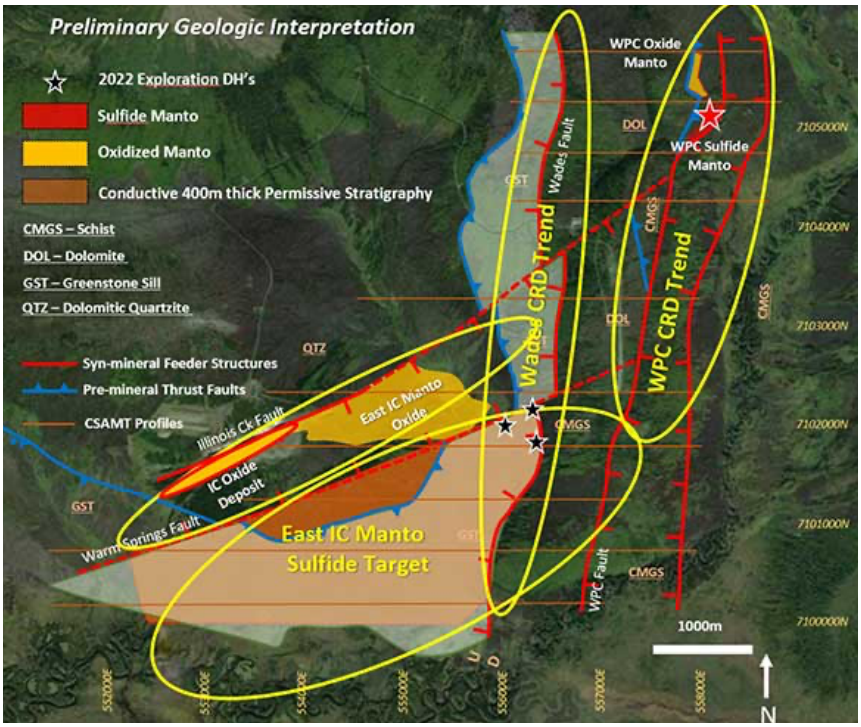


Figure 1: Preliminary geologic interpretations and targets defined by 2022 CSAMT program.

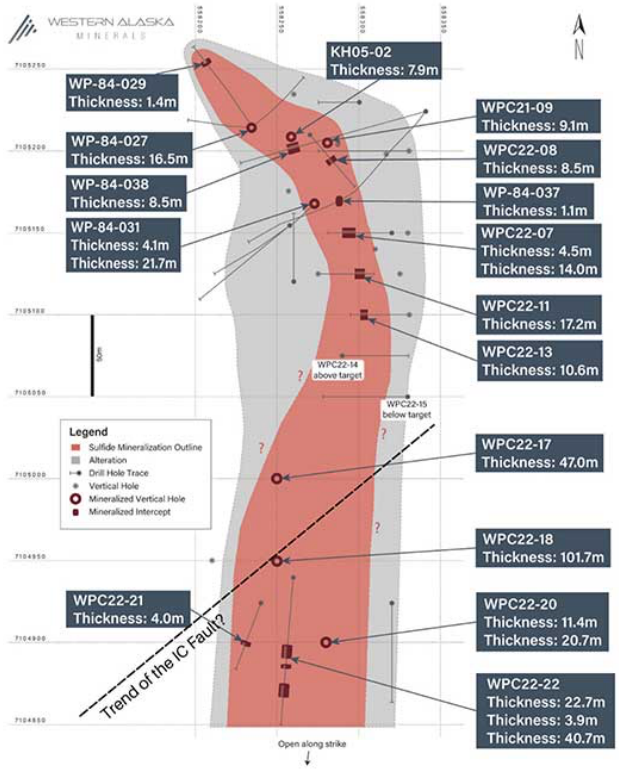


Figure 2: Pierce point map showing Waterpump Creek Manto.

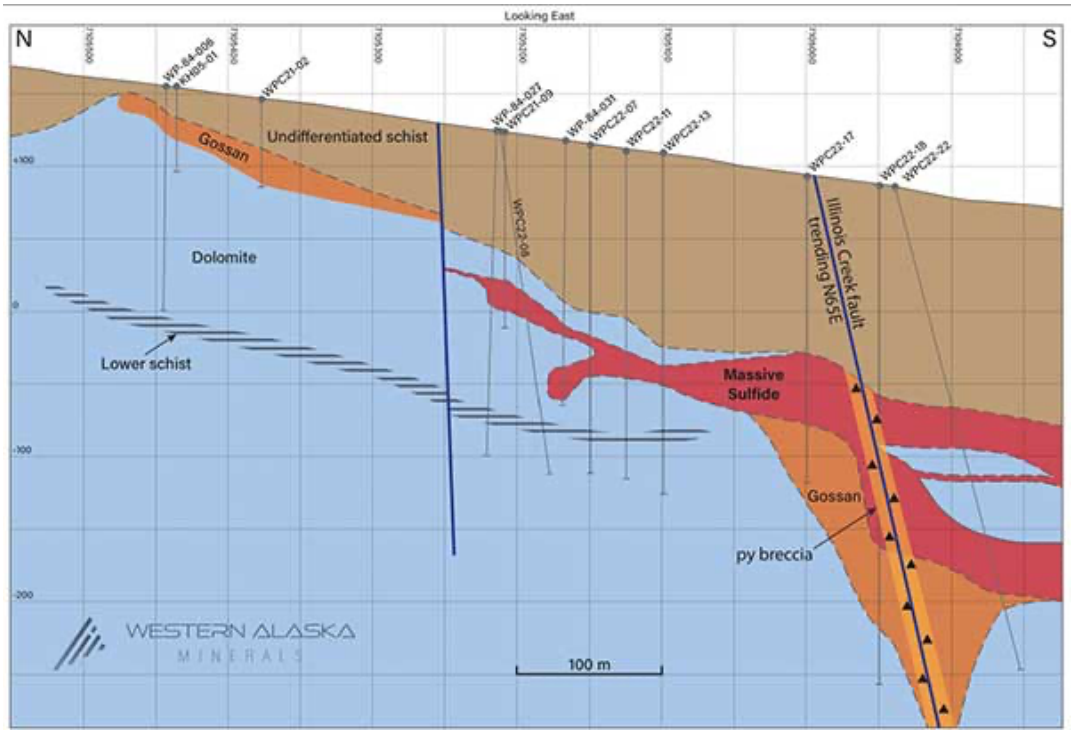


Figure 3: Longitudinal cross section down the access of the Waterpump Creek manto (N-S).

MINING AND THE ENVIRONMENT

Environmental Permitting Services – Early Steps

Ben Veach, Stantec

This talk will focus on the successful traits of a permitting process that flows in an efficient and transparent manner.

State and federal permitting requirements continue to increase in all phases of mining. Changes in the federal administration, the interpretation of rules, and agency turnover leave potholes in the road to successful permitting for both exploration and mining. With these changes come increasingly steep costs and inevitable delays in the permitting process. Exploration, mining, and reclamation each have costs tied to complex interdependent schedules that require a comprehensive approach to effectively manage. Time is money.

Good mine planning is the single-most important opportunity to control permitting delays and costs. It is essential to begin with an ending in mind, meaning that an understanding of the orebody, and what one will do with it, is essential. A well-thought-out project description can resolve many issues. Once a boundary is set, and the process to be used on the ore is known, permitting can begin in an organized and methodical process.

Permitting is project-specific and needs to address all elements for exploration and mining. There is no “one size fits all.” If there is a need for additional power, a road improvement, or a monitoring well, this must be included in the project description and permit.

When the project description is ready, the assessment of impacts can begin and the understanding of how best to deal with those impacts can be weighed with respect to the resource and the permitting requirements of relevant regulatory agencies. These agencies have a responsibility to meet their statutory requirements, as well as to consult with a wide array of other public agencies and special interest groups. A good plan will support the regulatory process from beginning to end.

Rain, snow, and ice – Hydrogeology at the Palmer Project

Steve Teller, Tundra Consulting, LLC

The Palmer Project, located 60 kilometers (37 miles) east of Haines, Alaska, is an advanced stage exploration project. It is unique from a hydrogeology perspective: it is located in the northern temperate rainforest, in an area of heavy snow fall, and it has considerable glacial ice coverage in the project area. But all projects are unique in some aspects. Therefore, hydrogeologic studies are important part of the environmental work in all exploration projects. These studies typically begin around the time of the preliminary economic assessment (PEA), continue through pre-feasibility and feasibility, and are an integral part of mine operations. They provide baseline information and impact estimates necessary for permitting, and provide water quantity estimates required for design of water handling, treatment, and disposal systems. This paper presents studies completed to estimate the potential quantity of water that may be discharged from an exploration adit and entire underground mine planned at the Palmer Project. The mine plan is based on the Palmer PEA.

A system of water level monitoring points, usually starting as exploration drillholes, has been established, with new points added each year as exploration, and the hydrogeology studies, progress (Figure 1). These monitoring points are principally used for hydraulic testing and water level monitoring. The principal hydraulic test method in bedrock holes is packer isolated testing which allows tests at multiple discrete intervals per hole. Other methods included flow/shut-in tests (flowing artesian holes), air-lift tests, and slug tests. Hydraulic conductivity of bedrock ranges from 5.56×10^{-6} to 6.4 meters/day (m/day) and is primarily a function of faulting and fracturing.

Pressure transducers are installed to measure water depth and seasonal variation in water depth. Water depth at the Palmer Project varies 20 to 30 m seasonally, depending on location. The groundwater rises rapidly in May due to snowmelt, stays relatively high during the summer, often peaks again in October, and after freeze-up shows a long decline through the winter.

Stream flow monitoring is challenging in Glacier Creek a relatively steep, high flow, mountain stream. The headwater are currently glaciated. Regional hydrologic analysis suggests that long term glacial melting (“glacial retreat”) may contribute almost 50% excess water to the stream compared to similar drainages with no glacial ice.

The hydrologic data and geologic understanding are used to develop a conceptual hydrogeologic model. A component of the model, the hydrogeologic units are shown in Figure 1 and the hydraulic conductivity of those units is shown in Figure 2.

The conceptual hydrogeologic model, climate model, and hydrologic analysis are used to build a numeric groundwater flow model and define variation in recharge to the groundwater system. The model is calibrated to the observed water level

seasonal variations, and stream baseflow data. The model is then used to estimate the mining and post-mining effects on the groundwater and surface-water system.

The model predicts a base-case groundwater inflow of 360 gallons per minute (gpm) to the exploration adit when it crosses the permeable Kudo Fault Zone in Year 2 (Figure 3). The maximum predicted mine discharge reaches 790 gpm in Year 5 with considerable seasonal variation. These potential inflows do not consider control measures, such as grouting, that may reduce inflow. The model predictions indicate that the area affected by dewatering will not extend to Glacier Creek and therefore the creek will be unaffected. Sensitivity analysis were run to evaluate hydrogeological uncertainties to be addressed during the feasibility study.

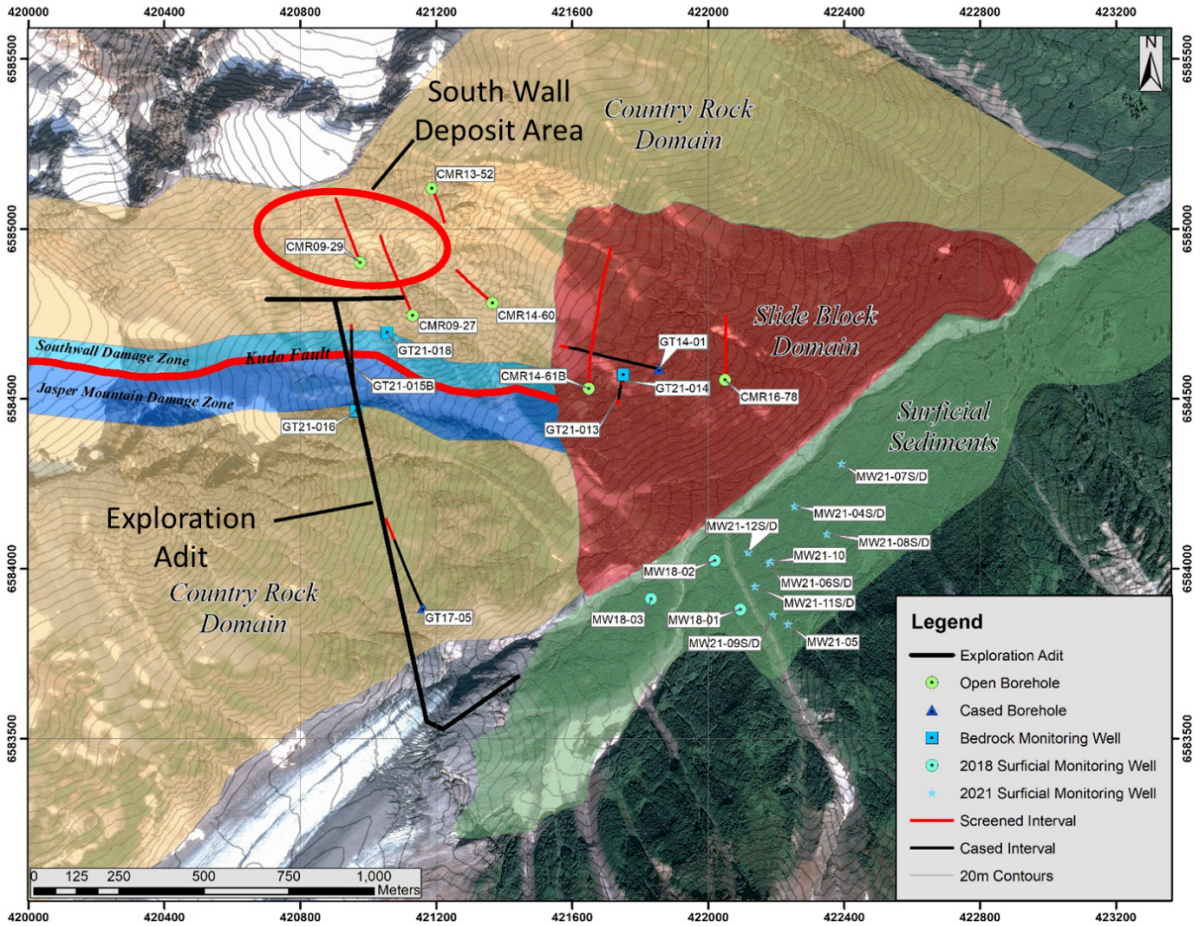


Figure 1. Palmer Project hydrogeologic unit

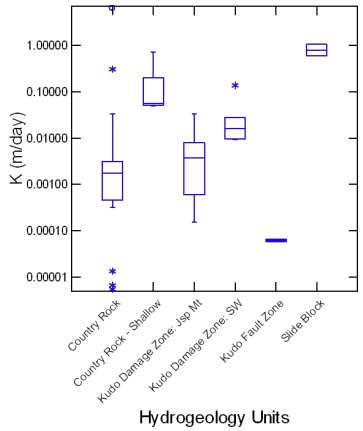


Figure 2. Box plots showing hydraulic conductivity of hydrogeologic units

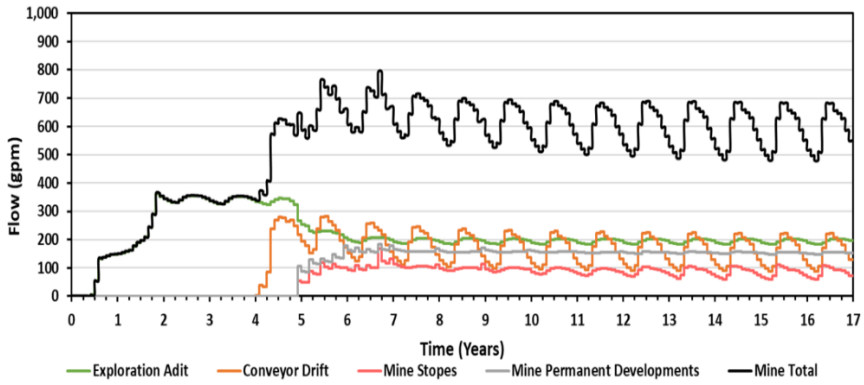


Figure 3. Base case - estimated mine discharge over time

Environmental baseline program at the Donlin Gold Project
Enrich Fernandez, Donlin Gold LLC

Donlin Gold LLC. (Donlin) has proposed the development of an open pit gold mine is southwest Alaska (Project), approximately 10 miles north of the village of Crooked Creek, on lands owned by Calista Corporation and The Kuskokwim Corporation. The Project includes three components: the mine; a natural gas pipeline; and a transportation system. Permitting for the project started in 2012 with the submission of an application for a Department of the Army (DA) permit pursuant to Section 404 and Section 10 of the Clean Water Act to the U.S. Army Corps of Engineers (USACE); and a pipeline right-of-way (ROW) application to the Bureau of Land Management (BLM). The USACE and BLM led the preparation of an Environmental Impact Statement (EIS) which concluded with the issuance of a Joint Record of Decision in 2018, DA permit and BLM ROW Grant. The environmental analysis completed by the USACE, and BLM was supported by an extensive environmental dataset collected for the Project which took years to build.

The collection of environmental baseline data started in 1996, during the early stages of the mining exploration phase. Resources and topics in the baseline study program were selected based on the needs of engineering design, community feedback, permitting and Donlin's goal of developing a sustainable project, including air quality, cultural resources, fish and aquatic resources, geochemistry, geotechnical, surface and groundwater quality and quantity, wetlands, wildlife, etc.

The collection of environmental data faced many challenges, not just logistical due to the remoteness of the Project, but also because of the changes to the Project infrastructure over time. Many studies were initially centered around the immediate vicinity of the mine site and had to be expanded beyond to match up with changing infrastructure plans to what eventually became the proposed Project. Water quality monitoring stations expanded and contracted over time; and the study area for wetland delineation seemed to continuously expand. The wetlands delineation for the project included more than 300,000 acres.

Donlin's investment in the environmental baseline program paid off during the preparation of the EIS. While data gaps were identified, few of those required the collection of additional field data, and most were resolved through analysis or modeling using existing data.

Today, the collection of environmental data is still ongoing, and will continue for the foreseeable future. However, the focus of the studies has been reduced to that required to detect the potential future environmental effects of the Project.

Greens Creek – A Mine on an Island

Marty Stearns, Hecla Greens Creek Mine

Summary

Hecla Greens Creek Mining is celebrating 33 years of production in 2022. This presentation will discuss the mine's history and challenges it has faced in permitting and into production as well as continuing challenges encountered daily. It's a mine on an island, in a coastal rain forest, on a National Monument, with a dry stack tailings storage facility, surrounded by brown bears eating salmon and skunk cabbage.

Abstract

The Hecla Greens Creek Mine is a polymetallic underground mine located 18 miles southwest of Juneau, Alaska on the northwest side of Admiralty Island. Major facilities at the Mine include the mill and mine portal facilities, tailings disposal facility, waste rock storage facilities, roads, and Hawk Inlet port facility. The land comprising the Mine consists of both public and privately-owned land. The Mine area includes 440 unpatented lode mining claims, 58 unpatented mill site claims, 17 patented lode claims, one patented mill site and other private (fee) lands, notably the Hawk Inlet Facility. The Mine permitted surface area includes Tongass National Forest, Admiralty Island National Monument, and the aforementioned private surface. Reconnaissance mineral exploration in the area began in 1973 and the mine began ore production in 1989. Production at the mine was suspended from 1993 to 1996 due to low metal prices.

Greens Creek faces the same operational, economic and environmental challenges that any other mine faces to permit and maintain it's "License to Mine". The additional challenges Greens Creek faces include:

- Maintaining operations on an island where all materials needed to conduct daily operations and products and by-products must either be brought to or taken from the site by boat or plane.
- Maintaining operations on a National Monument and minimizing required surface disturbance.
- Maintaining operations on a National Forest.
- Maintaining operations of a dry-stack tailings storage facility in a coastal rain forest.
- Maintaining operations on an island that has one of the highest concentrations of Alaska Brown Bears in the world. (Almost 3 per square mile)
- Maintaining operations within a watershed that supports anadromous fish habitat.

The ability to meet these challenges under regulatory and public oversight is a priority. Developing positive relationships with regulators and all stakeholders is always advantageous for maintaining a mine's "License to Operate", regardless of it's location.

Considering Permitting as part of Environmental Baseline Studies for Mineral Projects in Alaska

Kyle Moselle, Alaska Department of Natural Resources and Office of Project Management and Permitting

Advancing a mineral project from discovery to production is a complex process that requires collecting vast amounts of data to inform countless decisions along the way. Environmental baseline studies are used to gather statistically valid data related to the physical, chemical, biological, and socio-economic characteristics of a project at various spatial and temporal scales. This presentation discusses why a robust environmental baseline monitoring program may benefit from considering regulatory permitting processes.

Developing a hard rock mine in Alaska requires numerous individual permits and other approvals from state, federal, and local government agencies. In simple terms, a permit is confirmation that a proposed activity complies with applicable laws, regulations, and policies. However, for certain permits, issuance by a regulatory agency represents the culmination of extensive technical evaluations, due diligence, and public engagement. All permitting decisions benefit from high-quality, relevant information. Therefore, considering informational needs of key permitting processes when designing and implementing environmental baseline studies will better ensure that the collected data will be accepted by regulatory agencies, informative to decisionmakers, and trusted by the public.

ALASKA ADVANCED EXPLORATION PROJECTS

HighGold Mining's High-Grade Johnson Tract Au-Zn (Cu-Ag-Pb) Project, Alaska and the new Ellis Zone Discovery at Difficult Creek

Darwin Green, Nathan Steeves Ian Cunningham-Dunlop and Devin den Boer, HighGold Mining

The high-grade gold-zinc (copper-silver-lead) JT Deposit is an advanced-stage exploration target within the Johnson Tract Project ("Johnson Tract"), located 12 miles (20 km) from tidewater and 125 miles (200 km) southwest of Anchorage, Alaska. The 20,942-acre (8,513-hectare) property includes at least nine other high-potential mineral prospects over a 12-kilometre strike length, including the recent Ellis Zone discovery at the Difficult Creek ("DC") prospect.

The JT Deposit hosts an updated Indicated Resource of 3.49 Mt grading 9.39 g/t gold equivalent ("AuEq") for 1.05 Moz AuEq (5.33 g/t Au, 6.0 g/t Ag, 0.56% Cu, 0.67% Pb and 5.21% Zn) and an Inferred Resource of 0.71 Mt grading 4.76 g/t AuEq for 0.11 Moz (1.36 g/t Au, 9.1 g/t Ag, 0.59% Cu, 0.30% Pb, and 4.18% Zn)*. The indicated resource is subvertical and averages 40-m horizontal width: ideal geometry for low-cost mining. Metallurgical tests indicate that locked cycle flotation yields very high-quality copper, zinc, lead, and gold concentrates produced at a coarse primary grind with very good metal recoveries (97% gold recovery), low impurities, and negligible penalty elements.

The district-scale potential of Johnson Tract was confirmed in 2021 and 2022 with results from the newly defined 'Ellis Zone' at the DC prospect, 4 km northeast of the JT Deposit. Highlights for the Ellis Zone include 10.1 g/t Au and 6.0% Zn over 14.8 m *(DC22-046*), 21.7 g/t Au and 4.2% Zn over 11.9 m *(DC22-043)*, and 578 g/t Au and 2,203 g/t Ag over 6.4m *(DC21-010)*. The Ellis Zone has been defined over a strike length of approximately 150 m, to a depth of 100 m and is open in all directions.

Mineralization at both the JT Deposit and Ellis Zone occurs primarily as a stockwork of crustiform, cockade, and/or massive polyphase quartz-sulfide ± chlorite ± anhydrite ± carbonate veinlets and breccia in quartz, sericite, and nodular to pervasive anhydrite altered dacitic to andesitic volcaniclastic rocks of the Jurassic Talkeetna Formation. The deposit has characteristics of both intermediate sulfidation epithermal and VMS models.
The 2022 field program included over 10,000 m of diamond drilling at DC, JT Deposit, and other district prospects, ongoing surface mapping and prospecting, airborne magnetic surveys, and the initiation of preliminary environmental baseline and engineering studies to support future planning.

**See report titled "Updated Mineral Resource Estimate and NI 43-101 Technical Report for the Johnson Tract Project, Alaska," dated August 25, 2022. Gold equivalent "AuEq" = Au g/t + Ag g/t × 0.01 + Cu% × 1.27 + Pb% × 0.31 + Zn% × 0.59. Assumed prices of USD $1650/oz Au, $20/oz Ag, $3.50/lb Cu, $1/lb Pb, $1.50/lb Zn and assumed payable metal recoveries of 97% Au, 85% Ag, 85% Cu, 72% Pb, 92% Zn.*

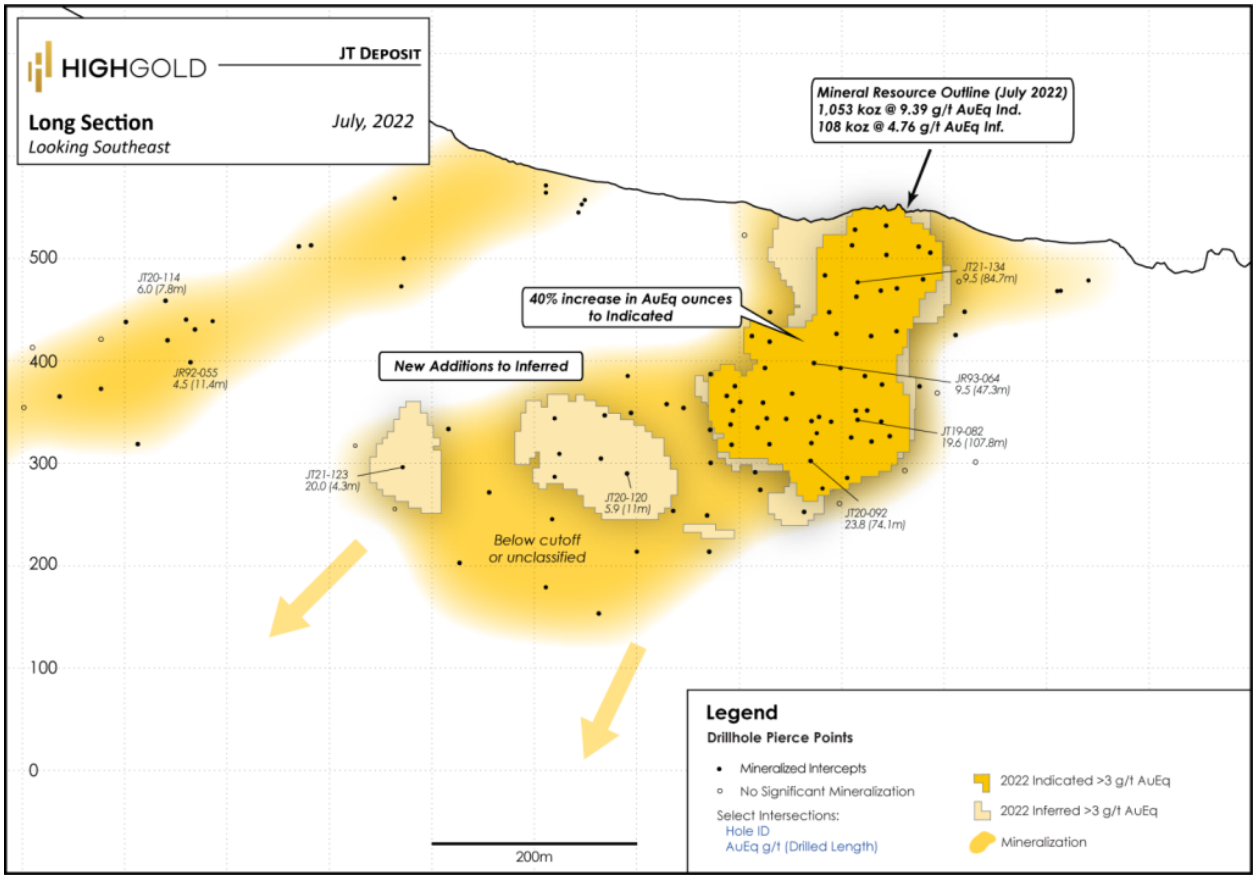


Figure 1. *Longitudinal Section showing the JT Deposit mineral resource, Johnson Tract Project, AK*

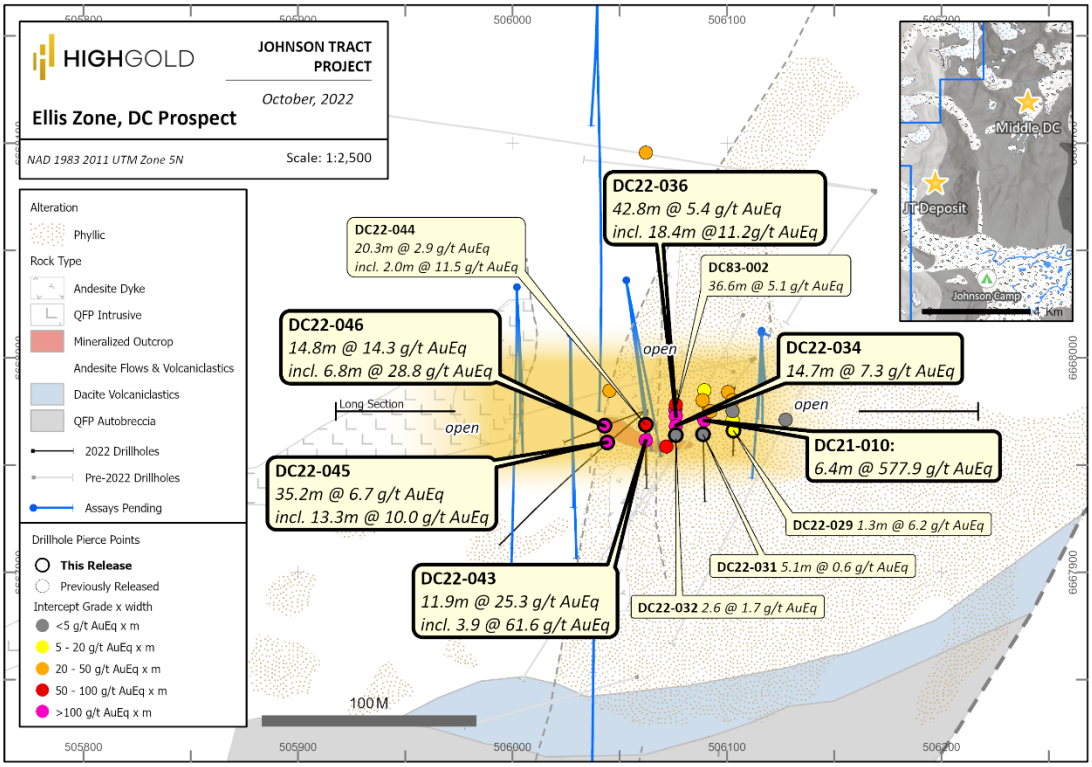


Figure 2. *Plan Map of the Ellis Zone, DC Prospect, Johnson Tract Project, AK*

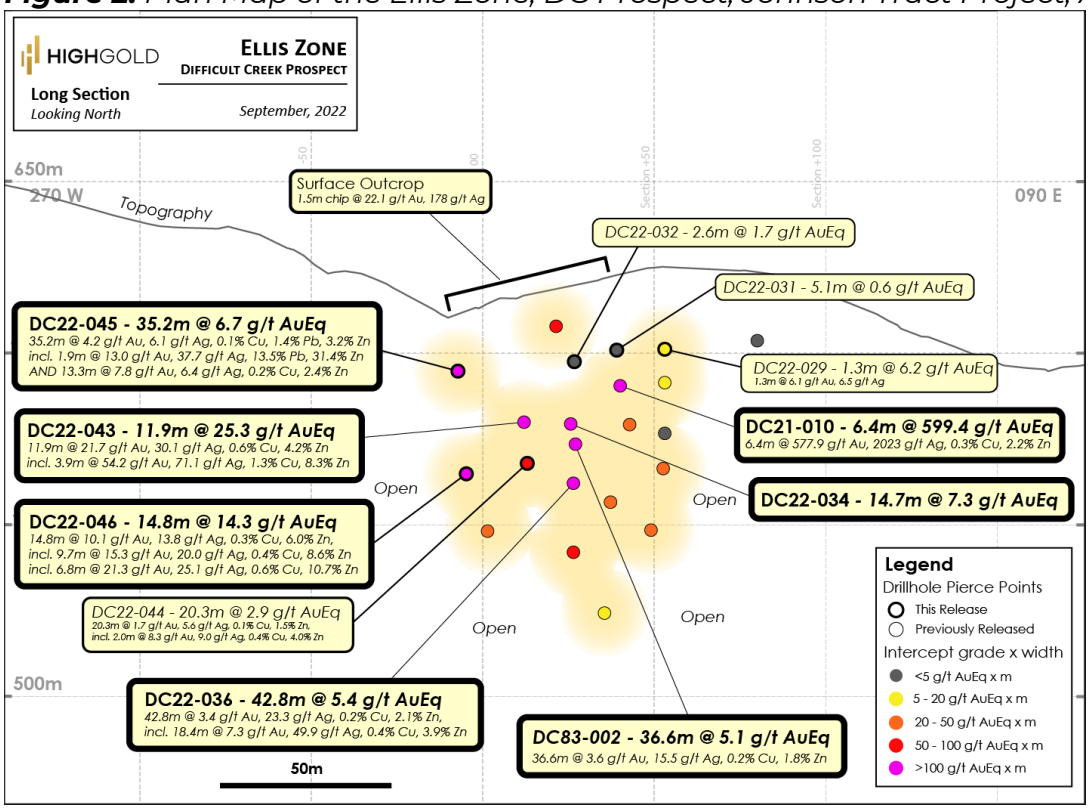


Figure 3. *Longitudinal Section of the Ellis Zone, DC Prospect, Johnson Tract Project, AK*

Ambler Metals advancing the Upper Kobuk Mineral Projects

Andy West and Kirsten Fristad, Ambler Metals

Ambler Metals LLC is an Alaska-based private joint venture company with Trilogy Metals Inc. and South32 Limited each owning 50%. Ambler Metals formed in February 2020 as the culmination of a 3-year exploration agreement between Trilogy Metals, who had been advancing the Upper Kobuk Mineral Projects (UKMP) in Northwest Alaska since 2004, and South32. The UKMP is a prospective district consisting of the Arctic and Bornite deposits, Ambler Volcanic-hosted Massive Sulfide (VMS) belt, and the Cosmos Hills Carbonated-hosted Cu Belt. Our +10-year exploration partnership with NANA Regional Corporation, Inc., our Alaska Native Corporation partner, remains in place to focus efforts on community engagement and workforce development strategies. Our vision is to develop the UKMP mining district into a premier North American metal producer.

Ambler Metals actively explored in the UKMP in 2021 and 2022, with the 2021 program being the first since the formation of Ambler Metals. Exploration activities included diamond drilling and advanced studies at the Arctic Deposit to move it along the development path and soil sampling, geologic mapping, and drill testing on numerous prospects with the Ambler VMS belt, and the Cosmos Hills Carbonate-hosted Cu Belt.

The drilling programs at Arctic, the most advanced deposit in the Ambler VMS Belt, were designed to move Arctic along the development and permitting path following Trilogy's Feasibility Study in 2020. The 2021 drill program completed 18 diamond drill holes totaling 4,131 meters designed to convert a portion of the mineral resources from the "indicated" category to the "measured" category, provide material for metallurgical testing, and obtain geotechnical data for the open pit design. The 2022 drill program completed 47 holes totaling 8,376 meters that will further progress the conversion of the mineral resources to the measured category and provided additional geotechnical data for the pit design.

Exploration in the Ambler VMS Belt spanned the Alaska state claim block in 2021 and 2022 and focused on understanding and expanding upon the previous 5 decades of work in the region. The 2019 VTEM and ZTEM aerial surveys provided an exciting new data layer to focus exploration.

In 2021, Ambler Belt exploration drill targets were tested at Arctic East, Southeast Arctic, and Snow for a total of 2,325 meters in 6 holes. In addition to the drill program, geologists carried out geological mapping and soil sampling. Traverses were completed at the Center of the Universe prospect, DH, JA Creek, the Bud-Sunshine-East Sunshine cluster, Dead Creek, Pipe, and the Nora prospects. Soil sampling focused on the JA Creek, Dead Creek, and East Sunshine prospects and several VTEM anomalies.

The 2022 program comprised of drilling at near-Arctic prospects, 98-9 and East Dead Creek. Four holes totaling 1,399 meters at the 98-9 prospect tested the associated VTEM anomaly and mineralization observed on surface. The East Dead Creek VTEM

and a shallow stratigraphic target was tested with one hole totaling 245 meters. The mapping, recon, and soil sampling program was the largest in recent history with 4 mappers and 13 soil samplers covering ground at over 20 prospects and targets including Tom Tom, Z, East Dead Creek, Arctic East, Nani, Luk, Cynbad, and numerous VTEM anomalies.

Exploration was also active in the Cosmos Hills in 2021 and 2022, extending outside of the existing Bornite Cu-Co resource. The work included large scale soil grids covering most of the exposed carbonate stratigraphy, detailed geologic mapping, and diamond drilling within the Ambler Lowlands, West Bornite, and Pardner Hill.

The lithostratigraphy, lithogeochemistry, and tectonic setting of the AG volcanogenic massive sulfide (VMS) deposit, Haines Alaska

Kei Quinn, Constantine Mining LLC

The Palmer project is an advanced stage, Cu-Zn-Au-Ag volcanogenic massive sulphide (VMS) exploration project located within the Alexander Triassic metallogenic belt (ATMB) near Haines, Alaska. The ATMB hosts the supergiant (~300 Mt) Cu-Co Windy Craggy deposit, the Ag-rich Greens Creek deposit, and the polymetallic (Zn-Cu-Pb-Ag-Au-Ba) Palmer deposit. The recently discovered AG VMS deposit is located 3 km from the 10 million tonne Palmer deposit and is composed of both exhalative- and replacement-style, barite-rich VMS mineralization with an inferred resource of 4.3 Mt grading 4.64% Zn, 0.12% Cu, 0.96% Pb, 119.5 g/t Ag, 0.53 g/t Au and 34.8% $BaSO_4$.

Constantine Mining LLC has provided financial support to Palmer project Exploration Manager, Kei Quinn, in her pursuit of a Master of Science (MSc). The research integrates observations from geologic field mapping, core logging, petrography, lithogeochemistry, and U-Pb zircon geochronology to reconstruct the AG volcanic architecture and improve our understanding of the relationships between the magmatic, tectonic, and hydrothermal processes that formed the AG VMS deposit.

The AG volcanic sequence includes: (1) tholeiitic pillow basalts with enriched mid ocean ridge basalt (EMORB)-like geochemical signatures, (2) coherent to volcaniclastic, Fe-rich, intermediate to felsic rocks with weak “arc-like” signatures including rhyolites derived from high-temperature melts (i.e., FIIIa rhyolites), (3) effusive to pyroclastic, EMORB-like, FeTi-rich tholeiitic basalts, (4) heterolithic breccias that locally contain massive sulphide clasts, and (5) FIIIb high-silica alkali rhyolites (HSAR) with extreme rare earth element (REE) and high-field strength element(HFSE) enrichment.

One important synvolcanic fault is interpreted based on the presence of localized deposits of heterolithic breccias, the distribution of felsic intrusive and extrusive rocks, and sharp lateral changes in the thicknesses and facies of units. VMS-style mineralization is localized along this primary rift-basin feature and is synchronous with the emplacement of FIIIa ferro-rhyolitic lapilli tuffs, heterolithic breccias, and FeTi-rich basalts.

Litho- and chemo-stratigraphic reconstruction of the volcanic environment suggests the rocks hosting the AG VMS deposit formed in an intraoceanic back-arc rift associated with high-temperature, shallow magmatism where rifting, the development of synvolcanic structures, and basaltic underplating were important processes. These tectono-magmatic processes were important for initiating and sustaining the hydrothermal convection required for VMS formation and are both physically and chemically reflected in the AG volcanic sequence.

The lithostratigraphic and geochemical features of the AG host volcanic rocks can be used to identify VMS-favourable successions and guide exploration at the property- to belt-scale, and in similar intraoceanic back-arc rift settings globally.

Manh Choh: A new approach to modern mining
Anna Atchison, Kinross Alaska

Kinross is the majority owner and operator of this joint venture with Contango. We're excited to introduce you to this project, which is truly a direct partnership with the Native Village of Tetlin. Manh Choh is located about 10 miles south of Tok and 12 miles west of Tetlin. The project is accessed off the Tetlin village road, which connects to the Alaska Highway. The project is entirely on land owned and controlled by Tetlin, which owns the fee-simple surface and sub-surface mineral rights.

The Manh Choh project plan includes small open pit mining near Tetlin from which ore will be trucked about 240 miles one-way for processing at the existing Kinross Fort Knox mine, located about 25 road miles northeast of Fairbanks. Ore processing will occur within existing permitted facilities at Fort Knox, eliminating the need for a mill or tailings facilities at Manh Choh. The mine is estimated to start production in mid-2024 with a mine life of 4-5 years.

Manh Choh will bring significant, generational opportunities to the region and will create 400-600 well-paying year-round jobs.

Golden Summit Project, Alaska – Continuing to Grow

Kristina Walcott, Freegold Ventures Limited

Gold mineralization on the Golden Summit property occurs in three main forms, including 1) intrusive hosted sulfide-quartz stockwork veinlets (such as the Dolphin), 2) auriferous sulfide-quartz veins (exploited by historic underground mines), and 3) shear-hosted gold-bearing veinlets. All three types are considered to be part of a large-scale intrusive-related gold system on the property.

The Dolphin gold deposit is hosted in the Dolphin stock and the surrounding metasediments. The stock consists largely of granodiorite and tonalite, similar to the Pedro Dome pluton. The Dolphin stock has been dated at 89-90 million years, approximately the same age as the nearby Fort Knox pluton, which hosts Kinross Gold's Fort Knox gold mine. Freegold made the initial discovery of widespread low grade gold mineralization in the Dolphin stock during the initial drilling campaign on the prospect in 1995; however resource definition drilling only commenced in 2011. Since drilling re-commenced in 2020 approximately 70,000 metres have been drilled, focusing on expansion and infill drilling

In 2019, following an extensive data review of past drilling and in conjunction with the resource model and block model level plans, Freegold identified what it believed to be the potential for a higher-grade corridor of mineralization extending from the area of the old Cleary Hill mine workings towards the Dolphin Intrusive. Based on this interpretation a drill program was initiated on the project in February 2020. Hole GSDL2001 was the initial test of this hypothesis and returned 188 metres grading 3.69 g/t Au. More recently drill hole GS 2221 intersected 155.5 metres grading 2.57 g/t Au including 73.1 metres grading 4.26 g/t Au.

Drilling remains ongoing on the project. A resource update is expected in the fourth quarter of 2022 and an updated PEA will follow in 2023.

Graphite Creek – Project Update
Mike Schaffner, Graphite One Inc.

There has never been a greater need for critical minerals in the United States. Recent geopolitical events highlight the increasing risk to America's national security from reliance on foreign suppliers of critical minerals. Additionally, America's ability to meet environmental targets for carbon dioxide emissions lie out of our control. Fortunately, Alaska has the resources to supply many of these critical minerals. 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 country's growing graphite needs for many generations to come.

The Graphite Creek Project will develop an open pit mine and processing facility at Graphite Creek located 40 miles North of Nome. The mine will produce a graphite concentrate which will be shipped to a secondary treatment plant in Washington. The secondary treatment plant will further purify the graphite so it can be used for many products, not the least of which includes anodes for electric car batteries. This presentation discusses the current timeline and work associated with bringing Graphite Creek into production.

ANCSA After 50 Years

ANCSA after 50 years: Responsible mineral development and helping to solve the minerals crisis

Lance Miller, NANA Regional Corporation

Alaska Native Corporations (ANCs) have over 50 years of responsible mineral exploration and development that has contributed to local, regional, and statewide economies. Under the Alaska Native Claims Settlement Act of 1971, 12 regional corporations and over 200 village corporations were created with 44 million acres of land. Along with priorities for subsistence, much of the land was selected for the mineral potential to help in self-determination and economic sustainability. The talk will explore the current state and future opportunities related to mineral potential related to ANC subsurface lands.

Shareholder and Workforce Development

Brenda Pacarro, Calista Corporation

Shareholder and workforce development programs and initiatives are vital components of success in Rural Alaska, especially for Alaska Native Corporations. With over 35,000 Shareholders, Calista Corporation will present how they have carefully crafted internal and external programs through strategic partners to help create a healthy workforce for today and future generations.

MINES AND ADVANCED PROJECTS

Greens Creek – Automation

Tim Brueggeman, Hecla Greens Creek Mining Company

Summary

Hecla Greens Creek Mining is celebrating 33 years of production in 2022. This presentation will discuss the mine's trials (and errors) with automation technology.

Abstract

The Hecla Greens Creek Mine is a polymetallic underground mine located 18 miles southwest of Juneau, Alaska on the northwest side of Admiralty Island. Major facilities at the Mine include the mill and mine portal facilities, tailings disposal facility, waste rock storage facilities, roads, and Hawk Inlet port facility. The land comprising the Mine consists of both public and privately-owned land. The Mine area includes 440 unpatented lode mining claims, 58 unpatented mill site claims, 17 patented lode claims, one patented mill site and other private (fee) lands, notably the Hawk Inlet Facility. The Mine permitted surface area includes Tongass National Forest, Admiralty Island National Monument, and the aforementioned private surface. Reconnaissance mineral exploration in the area began in 1973 and the mine began ore production in 1989. Production at the mine was suspended from 1993 to 1996 due to low metal prices.

Greens Creek faces the same operational, economic and safety challenges that any other mine faces today. The additional challenges Greens Creek faces include:

- Sustaining production requirements to support the need of the metal and technology industries.
- Advancing mining technology closer to other industry standards.
- Changing methods and practices to suit younger work forces.
- Maintaining safe operations with new technology.

Sulfate Reduction at Kensington Mine

Ben Holtz, Coeur Alaska, Kensington

Increasing levels of dissolved sulfate in Kensington Mine's tailings impoundment have been a growing concern. To combat this, Kensington sought a tailings water pre-treat strategy. Most solutions evaluated would generate a sulfate rich brine or precipitate needing disposal. Kensington elected to trial adding this sulfate rich brine to its underground paste backfill as a means of disposal, locking the sulfates in cemented tailings underground.

A reverse osmosis system was installed at the paste plant. Sulfates and other dissolved constituents are removed from the paste/mill/tailings process water loop. Clean water is pumped back into the mill and tailings impoundment; the removed sulfates form a brine. This brine supplements the water used in paste backfill.
To assure no adverse effects, paste strength, leaching, and In-situ monitoring are ongoing, as well as overall effectiveness at removing sulfate mass from the tailings impoundment. The project implementation, testing, and findings are detailed here. This project has potential to increase control of the tailings facility and significantly reduce treatment costs during production and reclamation.

Critical Minerals and Rare Earth Elements Extraction from Alaska's Coal and Coal Ash

Justin Seavey, Usibelli Coal Mine

Usibelli Coal Mine is working to identify the critical minerals and rare earth elements that can be extracted from Alaska's coal and coal ash.

The US Department of Energy (DOE) has identified numerous minerals that the country is wholly or mostly dependent on from foreign nations, and in some cases unstable nations, with national security implications. These minerals are referred to as Critical Minerals (CM) and include elements of the periodic table referred to as Rare Earth Elements (REE).

Usibelli is studying which CM exist in Alaskan coal and coal by products, and how they might be processed for economic recovery. Usibelli is focusing on waste streams of its mining operation, such as low-grade zones within coal seams that are not suitable for customer use, as well as coal ash from power plants.

This summary of UCM's activities to date will share how the state's only operating coal mine is supporting the larger national effort in support of continued responsible use of State resources to the benefit of Alaska, its economy, and national security.

Optimization of Fort Knox – Gil Mining and Processing
Aaron Debrah, Kinross Fort Knox

The Kinross Fort Knox mine is an open pit operation, located near Fairbanks, Alaska. Fort Knox poured its first commercial ounces in December of 1996. The mill operation processes approximately 40,000 tons per day of low grade free milling gold ore. The mill operation consists of crushing, grinding, gravity concentration, agitated cyanide leaching, carbon-in-pulp, carbon stripping/elution in closed circuit with electrowinning cells, and a refinery. In September of 2021 Fort Knox began receiving ore from the Gil satellite mine located 9 miles east by utilizing private roads. Gil celebrated its first ounces poured in October of 2021.

This presentation will review a few of the innovations embarked on by the Fort Knox team to address operational challenges to optimize gold production. This is a follow up to the 2019 AMA Convention talk “Industrial Scale Autogenous Milling Trial at the Fort Knox Gold Mine”. The focus will be on primary crusher feed blend strategy for Fort Knox and Gil pit ores, grinding, carbon stripping/elution and gold recovery from spent electrowinning cathodes.

North to 300: The Pogo Journey

Michael Eckert, Northern Star Resources

The Pogo Gold Mine is located approximately 90 miles southeast of Fairbanks, Alaska and is situated in the Tintina Gold Province. The operation, which commenced production in 2006, has significant underground workings, a Carbon-in-pulp processing plant and dry-stack tailings storage facility. Pogo has poured over 4.5 million ounces of gold to date and controls some 42,200 acres of mining and exploration leases.

Northern Star acquired the Pogo Mine in September 2018. At that time, the operation had aging infrastructure, decreasing production profile, decreasing reserve base, increasing operating costs and declining mine life. Over the subsequent 4 years, Northern Star has undergone a significant refurbishment and expansion of the operation. This involved replacement of the mining fleet, transitioning mining methods to high-speed jumbo development and Longhole open stoping, expanding the mill to 1.45M ton per annum, and numerous infrastructure upgrades to support the expanded operation. Pogo now has ~600 Northern Star employees plus contractors, a 7.3Moz Mineral Resource and 1.8Moz Ore Reserve, and is set up for production into the next decade. This case study presents the technical and operational challenges of undertaking this mine refurbishment and expansion, whilst introducing a new operating model into an existing operation.

TRACK TWO

REGULATORY AND POLICY UPDATES

Interagency Working Group on Hardrock Mining Laws, Regulations and Permitting

Ron Rimelman, NOVAGOLD

In the first half of 2022, in response to Congressional direction to enhance permitting of domestic critical and strategic mineral projects, the Biden Administration formed an Interagency Working Group (IWG) to evaluate existing laws, regulations, and guidance and recommend changes to help advance such projects. The IWG includes representatives from the White House (Council on Environmental Quality and National Economic Council), DOI, EPA, USDA (Forest Service), the State Department, and DOD. Over the summer, the IWG solicited public input in 12 broad areas ranging from Mining Law Reform to NEPA and permitting programs to Tribal engagement to data needs regarding mineral resources to international standards and guidelines. AMA submitted detailed comments to the IWG that were state-specific and consistent with exhaustive national association comments provided by NMA and AEMA. Throughout the process, organizations have had frequent and intensive follow-up discussions with the IWG members to further advance our positions. A particular IWG emphasis has been on the perception that existing programs do not adequately solicit and respect Tribal views. Limited initial recommendations are expected from the IWG to Congress in November with more detailed reporting to follow. This talk will summarize the status of the IWG's work and industry's efforts to inform and influence the process.

Alaska DNR's New Mineral Tenure Regulations

Steve Buckley, AKDNR

Senate Bill 155 was enacted in 2020: **"An Act relating to exploration and mining rights; relating to annual labor requirements with respect to mining claims and related leases; relating to statements of annual labor; defining "labor"; and providing for an effective date."** Regulations related to this bill became effective on October 28, 2022. These changes are now implemented and outlined below.

Qualifications (AS 38.05.190)

- Qualifications to hold mineral rights: The new statute specifically includes Limited Liability Companies (LLC) and Trusts (when a Trustee is otherwise qualified).

Mining Claims (AS 38.05.195)

- A "valid MTRSC location establishes rights to deposits of minerals in or on all state land that within the quarter or quarter-quarter section that is open to claim staking at the time of location;"
- A location on State-selected land on an active federal claim can only be filed by the federal claim holder or with their permission.

Annual Labor (AS 38.05.210 and AS 38.05.240):

- Labor can be applied from adjacent federal or private mineral interests.
- The statement must include the information set out in Statute:

  If there is a deficiency on an annual statement of labor the DNR will provide written notice giving the owner of the mining claim 90 days to correct the deficiency or the mining claim will be declared invalid and the land open to mineral entry.

- During the 90-day notice period the area will remain closed to mineral entry.
- "Labor" is defined and includes environmental studies, permitting activities and transportation.

Abandonment (AS 38.05.268)

- Eliminated the phrase "A statement of annual labor that does not accurately set out the essential facts is void and of no effect".
- Claims are abandoned if the following is not done timely:
  - Labor performed (During the Mining Year: Sept 1-August 31)
  - Cash in lieu of labor paid (by Sept 1 of new mining year)
  - Statement of Annual Labor recorded (by Nov 30th)
  - Rental paid (by Nov 30th)
  - Production royalties paid (on May 1st)

Abandonment vs Invalidation

- When a mining claim is abandoned, per AS 38.05.268 the claim holder must wait a year to post a new claim over the previous claim's area.
- When a mining claim is invalidated, the claim is closed but there is no restriction on when the original claim holder can post a new claim in the area.

Department Review (AS 38.05.880)

- The DNR is not required to determine whether an owner of a mining claim, leasehold location, or mining lease is in compliance with this chapter or the regulations adopted under this chapter.

Extracting the Next Generation
Leslie Olmstead, Teck American & Adam Hawkins, Global External

This segment will feature a conversation about the state of mining industry when it comes to new hires, maintaining and growing talent from within, as well as making sure that the industry has what it takes to attract young professionals. The panelists will reflect on decades of experience, what attracted them to the industry, and explore a number of new initiatives to attract new talent. While neither panelist is a HR professional, both have unique experience with having to beg, borrow, and (downright) steal younger professionals from other industries and passionate about the most important resource in mining: people.

Attendees should expect a robust conversation between the panelists and audience participation, with an eye on developing some fresh ideas.

PANEL: BREAKING DOWN BARRIERS TO BUILD A SUCCESSFUL WORKFORCE

Breaking down barriers to build a successful workforce
Beki Toussaint, Alaska Resource Education

Stop asking "what do you want to be when you grow up?" Start igniting interest in students.
Everyone knows there is labor shortage, a skills gap, an aging workforce, and a lack of interest for new people to join the workforce. What can each of us to do help? In order to be successful, we need to start breaking down barriers, stop working in silos, and create an actionable plan to help move more people towards the workforce in a meaningful way. This plan needs to include students, parents, high school educators, counselors, all post-secondary programs, AND industry.

This session will examine the state of education today, especially in a post-Covid world, identify hurdles in the educational system, celebrate successes, and incorporate meaningful dialogue of how industry and education need to partner and work together to meet our workforce needs.

This track will consist of two panels – the first will set the stage with current and past students discussing their view of education and career development, and parents' perspective of education today. The second panel will address the three main career pathways and the state of secondary and post-secondary education across Alaska. This panel will consist of secondary representatives: rural and urban Career and Technical Education (CTE) directors, the ASD counselor coordinator, as well as post-secondary representatives from 4-year degree programs, 2-year certification programs, and technical programs. This combination of powerful leaders has the power to move the needle towards helping more students successfully graduate from high school to follow career paths THEY are passionate about.

Join us to have a voice in the conversation and gain a better understanding of how industry can have an effective role in the process.

CORE SHACK

Geology and Mineralization of Three Interior Alaska Gold Deposits, Explored, Operated, and Under-Construction
Kinross Gold and Peak Gold, LLC

Fort Knox Mine, Northeast Fairbanks Mining District

Selected core and rock samples to characterize host rock, alteration, and mineralization of the Fort Knox Gold Mine, with accompanying plan and long sections, as well as a project timeline. Shawn Colburn and David Poole, 2018.

The Fort Knox Gold Deposit, 30 Years of Sustainable Discovery, Exploration, and Mining, Northeast Fairbanks Mining District Interior Alaska USA, David Poole, Akira Rattenbury, and Shawn Colburn, April 2022, Poster presented at Kinross Exploration 2022 Technical Conference, Reno Nevada. 68x42 inch.

Gil – Sourdough Mine, Northeast Fairbanks Mining District

Core samples of archive drillholes to characterize host rock, alteration, and mineralization of the Main Deposit, with interpretive cross sections. Bryan Babb, 2021.

Manh Choh Project, Tetlin Alaska

Core samples of archive drillholes, drilled normal to the Main and North Deposits with interpretive cross sections, Shawn Colburn, 2022.

The Flat Gold Project

Peter Kleespies, Tectonic Metals Inc

Flat is located in southwestern Alaska, just 40km north of the Donlin Gold Project. in the Kuskokwim Mineral Belt. The project consists of 92,160 acres of Native-owned land belonging to Doyon, Limited, one of Alaska's largest Alaska Native Regional Corporations and private landholders. The property hosts intrusion-related gold mineralization similar to that found at the Fort Knox (Alaska) and Eagle (Yukon) gold mines. Since 1908, when gold was first discovered at Flat, the immediate vicinity has been notable as an area of significant placer gold mining activity with an estimated 1.4 million ounces of placer gold produced from streams draining the Chicken Mountain – Black Creek complex.

The Flat Gold Project occurs within the Iditarod Quadrangle where the dominant structural feature is the regionally extensive right-lateral, strike-slip Iditarod-Nixon Fork Fault, which extends from the southwest to northeast corners of the quadrangle.

North of the fault-zoned multiphase stocks of Chicken Mountain, Black Creek (68.3 to 73.2 Ma) and Swinging Dome (59.4 to 63.4 Ma) intrude Kuskokwim sediments and are genetically related to accumulations of intermediate and felsic volcanics. Hornfelsing occurs within both the sedimentary and volcanic rocks adjacent to the intrusion margins. At Chicken Mountain three major compositional phases are present: monzodiorite and gabbro comprise the outer margin and initial phases, biotite monzonite forms a relatively homogeneous central transitional phase and leucocratic quartz monzonite forms the central phase.

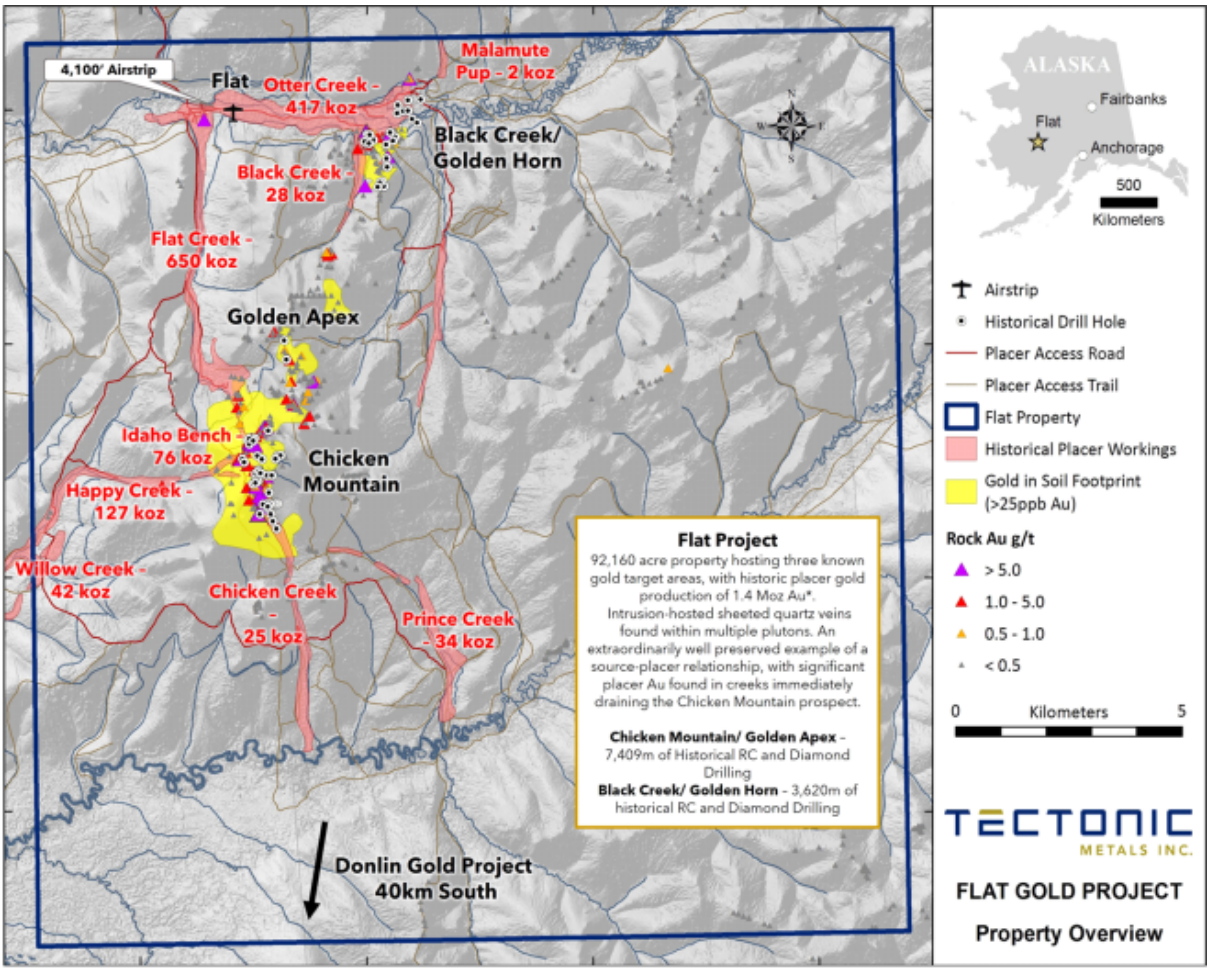
Bedrock gold mineralization at Flat has been recognized in at least two geological settings.

2. Low-grade intrusion related within altered, fractured and veined late-stage phases in the Chicken Mountain- Black Creek stocks. Notably, the most significant gold mineralization is hosted within the late-stage quartz monzonite at Chicken Mountain.

3. Contact-related vein and disseminated bulk tonnage mineralization hosted within sedimentary and volcanic rocks. Most notable are the Golden Apex zone which occurs between the Chicken Mountain and Black Creek Stocks and Golden Hornfels zone which occurs along the eastern contact of the Black Creek stock.

Historic exploration work between 1977 and 2003 including 87 core and reverse circulation drillholes for 11,040 metres, resulted in an extensive surface and subsurface geochemical database on the project. Significant surficial gold in soil and rock anomalies generated by the historic exploration efforts remain untested by drilling.

Initial exploration efforts by Tectonic are focused on the central portion of the Chicken Mountain stock where gold occurs as veinlet and fracture-controlled gold mineralization in the pervasively altered, late stage leucocratic quartz monzonite, which appears to have been a major source of the placer gold in the Flat district



* Placer production figures from "Mineral Occurrence and Development Potential Report, Locatable and Salable Minerals, Bering Sea-Western Interior Resource Management Plan, BLM-Alaska Technical Report 60", prepared by the U.S. Department of the Interior, Bureau of Land Management, November 2010"

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Advancing Near-Mine Exploration Prospects at Kensington Mine

Robert Callaghan, Richard Halvorsen, Sam Kilfoyle, Trevor Nelson, and Alejandro Razo, Coeur Alaska - Kensington Mine

Coeur Alaska's Kensington Mine is located approximately 45 miles 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 1,000,000 ounces from the property since beginning commercial production at Kensington in 2010. The Kensington Mine is currently producing from two deposits: Kensington and Jualin. Recent drilling and development on the Elmira deposit continues to be encouraging with initial production planned before the end of this year. Drilling continues to focus on expanding Kensington and Elmira resources to the south, and on the Johnson prospect to the east of Elmira. These successes demonstrate the continuing exploration potential to advance additional deposits within the district.

The property lies to the west of the Coastal Megalinament, 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 vein systems are generally shear hosted veins or vein packages comprised 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.

The Elmira vein system shares similar vein style and mineralization characteristics with the Kensington deposit, lying 2,500 feet east of Kensington. Coeur Alaska's exploration team is expected to complete this year's planned drilling targeting Elmira, to further define the deposit. The Johnson vein system, lying 500 feet east of Elmira, continues to be intercepted, adding extension along strike to the south, and feeding the model. Planned drilling targeting Johnson will continue throughout the second half of 2022. Other near-mine prospects drill targeted this year include Jennifer, Eureka, Valentine/Fremming, Hoggatt, Jualin Vein #1, and Comet.

Recent drilling of these prospects builds upon previous drill programs, surface geochemistry, surface and underground mapping, and compilation of historic data. The programs focused on developing a stronger structural interpretation of the district and outlining potentially economic zones. This rigorous approach is driving new interest in known prospects and is focused on driving the additional discovery necessary to unlock the potential of underexplored areas of the Berners Bay Mining district.

The Palmer Zinc-Copper-Silver-Gold Jv Project
Constantine Mining LLC

The Palmer Project is an advanced stage, high-grade volcanogenic massive sulphide (VMS) project that is found within the Alexander Triassic Metallogenic Belt that includes the Greens Creek and Windy Craggy VMS deposits. The project is located in a very accessible part of coastal Southeast Alaska, with road access to the property and within 60 kilometers of the year-round deep-sea port of Haines. The Palmer Project is being advanced through a joint venture between Constantine Metal Resources Ltd* ("Constantine") and Dowa Metals & Mining Co, Ltd.("Dowa").

American Pacific Mining Corp is the process of acquiring Constantine Metal Resources Ltd and its subsidiary Constantine North Inc. which hold an interest (~44%) in the Palmer Project with Dowa holding the remaining interest. This transaction is expected to be completed by the end of October 2022.

Exploration work at Palmer has outlined two deposits (Palmer and AG) with a combined resource of **4.68 million tonnes** of indicated resource grading 5.23 % zinc,1.49 % copper, 30.0 g/t silver, 0.30 g/t gold and **9.6 million tonnes** of inferred resources grading 4.95 % zinc, 0.59 % copper, 69.3 g/t silver, 0.39 g/t gold. VMS deposits are known to occur in clusters, and with at least twenty-five separate base metal and/or barite occurrences and prospects on the Palmer Project, there is abundant potential for discovery of multiple deposits.

In 2019, a positive Preliminary Economic Assessment ("2019 PEA") was completed on the Palmer Project with a post-tax $NPV_{7\%}$ of US$266 million. The 2019 PEA was amended, and replaced by, a technical report on March 7, 2022 (the "Amended PEA"). The Amended PEA outlined the potential for a low capex, low operating cost, high margin underground mining operation with attractive environmental attributes. Metal prices used for were copper at $2.82/lb, zinc at $1.22/lb, silver at $16.26/oz, gold at $1,296/oz, and barite at $220/tonne.

The Joint Venture is focussed on continued exploration and bringing the conceptual aspects of the Preliminary Economic Analysis, with its guidelines for further work, into a mine feasibility study.

The Amended PEA is preliminary in nature and includes inferred mineral resources that are considered too speculative geologically to have economic considerations applied to them that would enable them to be categorized as mineral reserves. There is no certainty that Amended PEA results will be realized. Mineral resources that are not mineral reserves do not have demonstrated economic viability.

Donlin Gold – A Geologic Profile

Catherine Kim, Lead Geologist; Stefan Krogseng, Field Geologist, Stephanie Mrozek, Sr. Project Geologist; Michelle Deal, Exploration Manager and Dan Graham, General Manager, Donlin Gold LLC

The Donlin Gold deposit, in the historic Kuskokwim Gold Belt of southwestern Alaska, is located approximately 270 miles west of Anchorage and 10 miles north of Crooked Creek. The project is situated on land owned by The Kuskokwim Corporation (TKC) and Calista Corporation (Calista) with subsurface mineral rights leased to Donlin Gold LLC by Calista. Donlin Gold LLC is co-owned by NOVAGOLD and Barrick in a 50/50 partnership. Gold mining in the region dates to the early 1900's with placer work in the Snow Gulch area. The mid-1980's saw increased hard rock exploration and by the mid-2000's several mineralization centers had been recognized at Lewis, ACMA, Rocheleau and 400.

The Donlin deposit is hosted in a series of rhyolite to rhyodacite volcano-plutonic complexes intruded into folded sedimentary units within the Kuskokwim flysch basin. The system has been identified as a Cretaceous-aged hydrothermal deposit with measured and indicated resources of 39.0 million ounces of gold. Mineralization occurs within structural corridors trending north-northeast with vein sets dipping southeast and presents as broad disseminated sulfide zones throughout the intrusive body and discretely in vein networks. Gold is often accompanied by very fine-grained arsenic sulfides and oxides, such as native arsenic, stibnite, pyrite, and trace sphalerite. Associated alteration is dominantly argillic with lesser sericite and assorted clays.

The 2022 field program was the largest undertaking since 2006, consisting of over 42,000 meters of drilling designed to meet a wide variety of objectives, including resource spacing studies, deep exploration, expanding structural framework understanding, and advancing geotechnical studies. In addition to the drill program, Donlin completed the excavation of two 60 x 60-meter trenches for a detailed mapping effort and on-going geological studies. This year Donlin will present a summary of the exploration field program completed in 2022, with a detailed look at the best (man-made) outcrops that Western Alaska has to offer.

Pogo Mine
Northern Star Resources Limited

On display is diamond drill core from the Goodpaster gold deposit near Pogo Mine. In June of this year Northern Star announced a maiden inferred gold resource of 1.1Moz at 10.3 gpt Au with MSOP parameters. This deposit is an intrusion-related quartz-gold-bismuth-telluride-bearing group of lodes hosted in amphibolite-grade paragneiss. Goodpaster deposit is intruded by and spatially-related to felsic to intermediate intrusions along the margin of the Goodpaster Batholith outcropping northeast of the lodes. These lodes are stacked on various thrust sheets that ride above the basal, barren Goodpaster Shear. Post-mineral faults have affected the orientations and the positions of parts of this deposit.

Drilling continues this year at Pogo; various lodes are open in three directions.

Core is also displayed from the North Zone deposit above the main Liese mine and lodes. North Zone is currently being developed by Northern Star production personnel. High-value, near-surface, oxide core, rare at the Pogo Project, is also on display.

The company's website is: www.nsrltd.com

Northern Star Resources Ltd. is an Australian-based company with operations in Australia and Alaska, USA. Northern Star operates the Kalgoorlie Superpit and Jundee Mine in Western Australia as well as the underground Pogo Gold Mine east of Fairbanks, Alaska. Additional Australian operations are pictured on our website.

Graphite Creek Project

B Flanigan, C Gierymski, J Kase, J Wyse, M Bethe, J Anderson and E Faulkner-Monks

The Graphite Creek Property is located on the north flank of the Kigluaik Mountains about 1.6 miles (3 km) from intertidal water of the Imuruk Basin, and approximately 37 miles (60 km) north of Nome, Alaska. The property consists of 176 State of Alaska ¼-section (160 acre) mining claims.

The graphite-bearing schists are well-exposed and coherent for a strike length of at least 3.1 miles (5 km) along the north flank of the Kigluaik Mountains gneiss dome, south of the range-bounding Kigluaik fault. The metamorphic stratigraphy strikes roughly parallel to the flank of the Kigluaik Mountains and locally forms a dip slope. Incised creek drainages crosscut the metamorphic stratigraphy and provide good exposure of bedrock. The schists dip north between 25° and 75°. Ore-grade graphite occurs as high-grade massive to semi-massive segregations and as disseminations in quartz-biotite-garnet-sillimanite schist, and mostly as lower grade disseminations within other lithologies, within a package of granulite facies metamorphic rocks. The graphitic rocks are coincident with a > 9.9 mile (16 km) long electromagnetic anomaly. As of 2022, the trend is drill tested to a 4.2 mile (6.8 km) strike length.

In 2021, a 24-person remote camp was established on the alluvial plain adjacent to Graphite Creek, approximately a kilometer northwest of the proposed pit indicated resource area. A staging area at 28-mile on the Kougarok Road was used to stage fuel and drill supplies. A new core logging, core cutting, core storage, and prep lab facility were established in two leased structures at Satellite Field in Nome.

The 2021 program had several goals including; improving the quality of the resource calculation through in-fill drilling, collecting structural data from oriented core to inform the geological model, establish monitoring wells and instrumented boreholes to provide data to begin building a hydrological model, continue geotechnical drilling in the proposed pit, start a geotechnical drilling and pit digging program in the infrastructure areas, graphite ore for materials testing and product development, and to continue PAG, environmental, and road engineering studies.

In 2021 a total of 11 HQ3-size drill holes were completed, comprising 5561 ft (1695m) of core drilling.

In 2022, the Graphite Creek camp was expanded from 24-person capacity to 60-person capacity and an additional 24-person camp was established in Nome where the core logging and sample processing facilities were established in 2021.

The 2022 Field Program included infill and step-out core drilling in the resource area. Additional core and sonic drilling were completed for geotechnical data collection at the proposed mill site, planned dry tailings/waste rock storage areas and the access route.

Excluding the access route, a total of 7,052 ft (2,150 meters) were drilled during the 2022 Field Program, of which 6,363 ft (1,940 meters) was resource, including infill drilling and exploration drilling on the geophysical anomaly. Core drilling in the deposit area continued to encounter visible graphitic mineralization over wide intervals consistent with previous drilling. To date, 40,590 ft (12,375 meters) of resource drilling has been conducted, spanning a lateral distance of 4.2 miles (6.8 km).

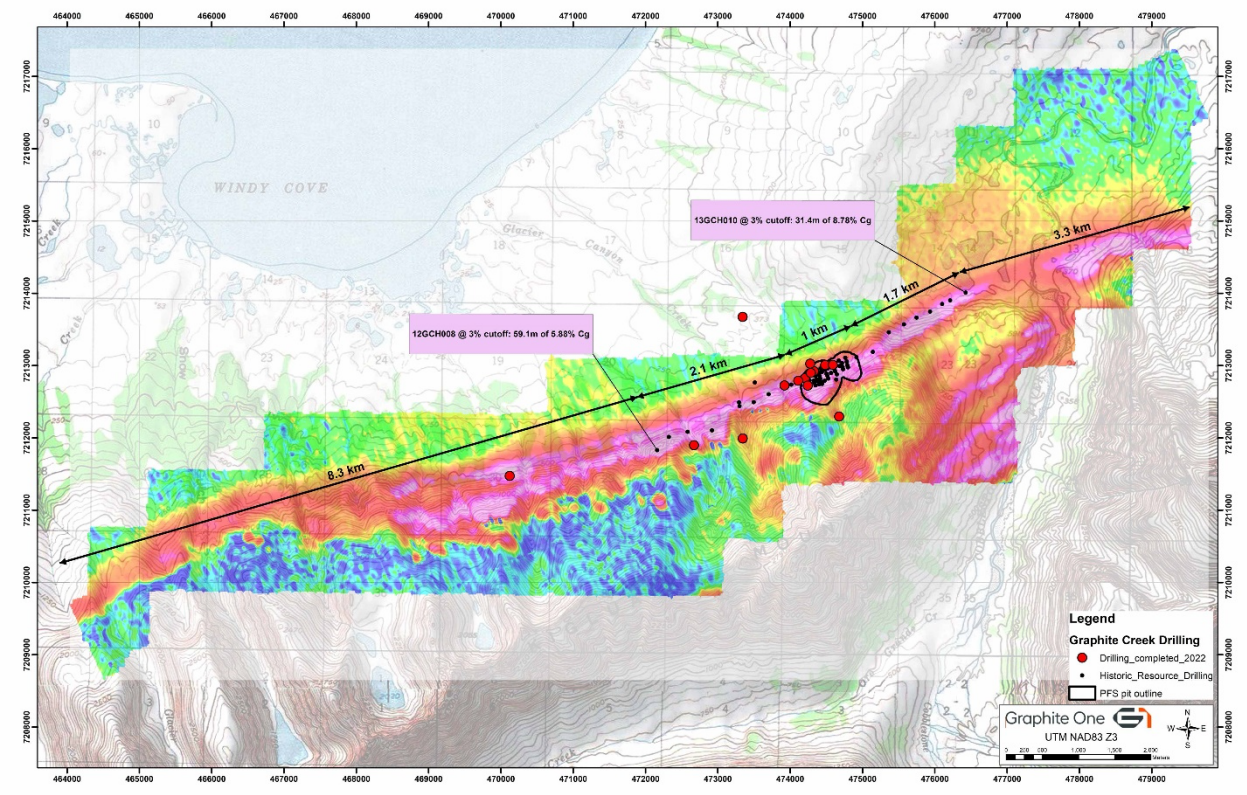

Figure 1: Showing the >9.9 mile (16 km) geophysical anomaly, PFS pit outline, 2022 infill, expansion and exploration drilling along with historical drilling.

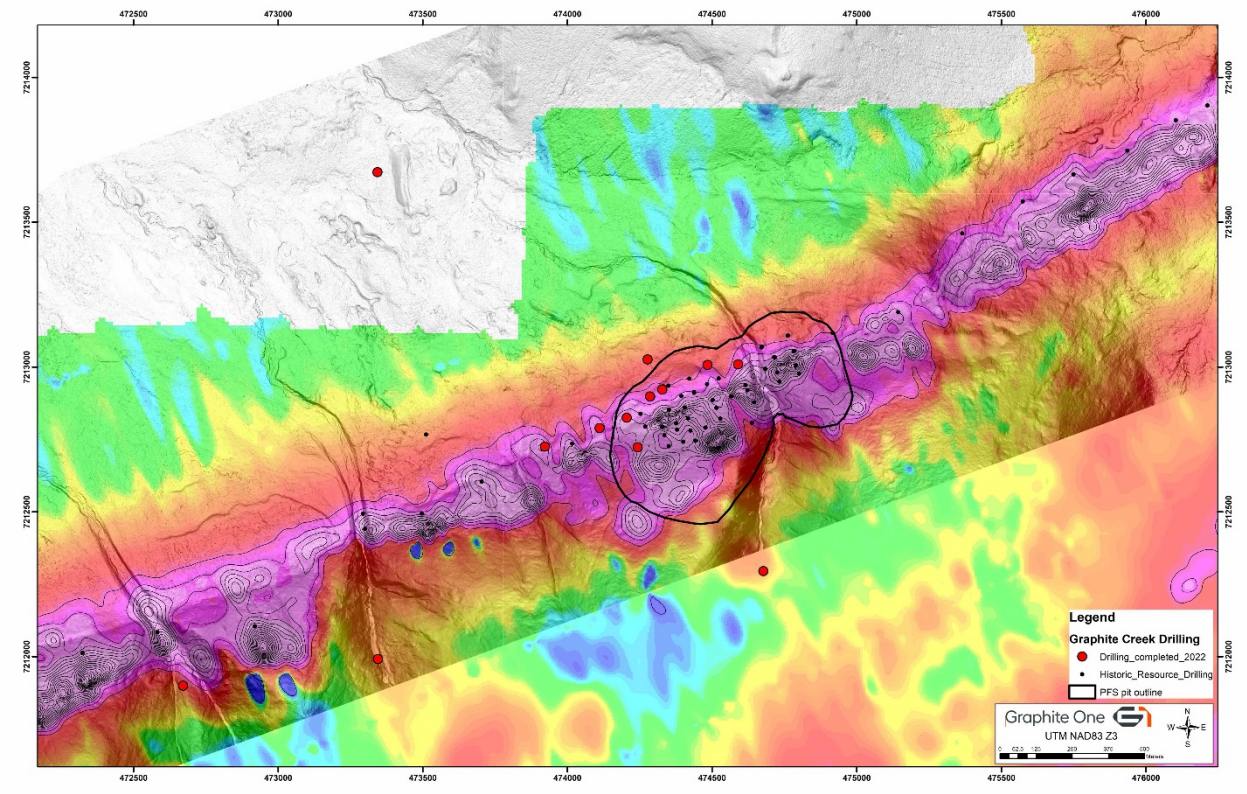

Figure 2: Showing the detailed geophysical anomaly, 2022 PFS pit outline, 2022 infill and expansion drilling along with historical drilling.

PROSPECTORS TENT

The Oreo Mountain Porphyry Cu-Mo-Ag-Au Prospect, East-Central Alaska, including comparisons to the giant Casino porphyry in the Western Yukon

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

Introduction & Location

The Oreo Mountain prospect in the Tanacross quadrangle of east-central Alaska was first discovered in 1975 by Cities Service Minerals Corporation (the then mineral subsidiary of CITGO Petroleum Corporation) and has seen minor sporadic exploration work since.

The prospect is located on State of Alaska land on the southern side of the upper Ladue River at elevations ranging from about 600 to 950 meters (2000 feet to 3000 feet), about 25 kilometers (15 miles) northeast of Midway Lake on the Alaska Highway (Alaska Highway 2) and about 55 kilometers (35 miles) east of Tok, Alaska, the major commercial center in Alaska's eastern interior with virtually all services. A road to the property down the upper Ladue River from the Alaska Highway would be about 32 kilometers (20 miles) long, mostly along an existing right-of-way that is currently used for winter access to other prospects in the area. The project is 100% on State of Alaska owned land and is held with state mining claims.

Regional Exploration Background

The discovery of the large porphyry copper-molybdenum-silver-gold porphyry Casino deposit in the Yukon Territory in 1969 led to the Yukon-Tanana Uplands being suspected to be a significant porphyry copper province. In 1970 the U.S. Geological Survey published a 1:250,000-scale reconnaissance geologic map of the Tanacross Quadrangle (Foster, 1970). Continued exploration in the Yukon and adjacent east-central Alaska and led to the discovery of several porphyry copper prospects on both sides of the border over the next few years.

Continued development of the Casino deposit over the past 50 years has shown it to be a true giant system with contained metal resources of over 1 billion tons of measured and indicated resources containing some $60 billion of copper and gold and another $40+ billion of metal in inferred resources, supergene-hypogene-oxide resources and heap leach resources. Casino is about 320 kilometers (200 miles) southeast of the Tanacross quadrangle on geologic trend.

Government and agency work in the area over the past 15 years has included 21st-Century airborne geophysical survey data from magnetic and electromagnetic surveys by the Alaska DGGS in the area (Burns *et al.*, 2006, Burns *et al.,* 2011 and Emond *et al.,* 2015), a metallogenic/lineament analysis focusing on the generation of porphyry deposits by the Mineral Deposit Research unit of the University of British Columbia (Sanchez *et al.,* 2014) and ADDGS RI 2021-5, *Geologic Investigations of the Ladue River-Mount Fairplay Area, Eastern Alaska* (Twelker ed., 2021), which study area is essentially centered on the Oreo Mountain prospect and which contained a

vastly improved 1:100,000-scale geologic map and greatly updated the geologic understanding of the area.

Oreo Mountain Prospect History

The Oreo Mountain deposit was initially discovered in 1975 through reconnaissance soil sampling by Cities Service Minerals Corporation. Efforts since have included work by Full Metal Minerals and j-v partner BHP-Billiton in 2007-2012 which identified an area of anomalous soils ranging up to 398 ppm Cu that was about 5 kilometers (3 miles) east-west and up to 2 kilometers (1.5 miles) north-south.

In September of 2017, thirty-two 160-acre State of Alaska MTRSC mining claims were located on the Oreo Mountain prospect on behalf of Tubutulik Mining Company LLC. In April of 2018, the property was optioned to Kennecott Exploration Company (Rio Tinto) and later that spring another 106 160-acre claims were staked, bringing the total to 138 160-acre claims (~22,080 acres or 8,935 hectares), covering the aeromagnetic high that included the anomalous soil area. In a three-week project in September 2018, Kennecott established several helipads at Oreo Mountain and conducted soil sampling and trenching on the prospect. The soil work (374 auger samples) extended the footprint of the soil anomaly to over 8 kilometers (5 miles) in length east-west and 1 to 2 kilometers (1.5 miles) in width north-south while the trenching identified some local altered and mineralized rocks. Soil samples collected by Kennecott contained up to 749 ppm Cu, 301 ppm Mo, 504 ppm Pb & 1.36 ppm Ag. In August & September of 2019 Kennecott drilled six HQ core holes stretching across 5 kilometers (3 miles) totaling 1061 meters (3481 feet) with the deepest T-D'd at 187 meters (618 feet). The holes were located largely by copper soil geochemistry as Kennecott did not attempt any significant geologic mapping at Oreo and performed no geophysical work on the prospect during their tenure with it. Copper and molybdenite mineralization and porphyry-type alteration were encountered in all six holes, but values were not overly impressive.

Oreo vs. Casino

Oreo is located about 320 kilometers (200 miles) northwest of Casino is very similar terrain. Both Casino and Oreo Mountain sit astride strong, large local aeromagnetic highs which are part of a distinct northwesterly trend of the aeromagnetics through the Yukon-Tanana uplands (Oneschuk *et al*., 2019). Both are also associated with strong northwesterly trending regional lineaments/faults identified in the metallogenic study of Sanchez *et al.* (2014).

Geologically the two deposits are not surprisingly quite similar. Both deposits are associated with similar late Cretaceous calc-alkaline intrusions. The mineralizing intrusion at Casino is the 72.4 ma Patton Porphyry. It a porphyritic mega-crystic granodiorite/tonalite, intruded into mid-Cretaceous (104 ma) Dawson Range diorite and granodiorites, which are themselves intruded into the Paleozoic Yukon Metamorphic Complex. At Oreo Mountain the identified late Cretaceous intrusions include a 71.4 to 72.1 ma granodiorite and a (post mineral?) 68.8 ma mega-crystic monzogranite porphyry, all intrusive into similar Paleozoic metamorphic rocks as those at Casino.

The soil geochemistry of the two deposits is also very similar. While the soil surveys were conducted 50 years apart, both were sampled with hand augers. And

although analytical techniques were different, anomaly levels are similar. While the anomaly levels are slightly higher at Casino, the Oreo Mountain soil anomaly area is twice as large. Casino has a good gold soil anomaly which Oreo largely lacks (to date). Other elements are similar.

Both deposits sit astride large strong magnetic highs adjacent to local magnetic low embayments. And both appear to be located slightly south of the northwesterly trending Big Creek-Tanacross North lineament as identified by Sanchez *et al*. (2014) near ostensibly important northeasterly-striking couple.

Oreo Exploration Potential

Kennecott spent limited portions of two field seasons (about 10 weeks total) on their work at Oreo. Their six 2019 drill holes were sited based on soil geochemistry without any geologic mapping by Kennecott or any ground geophysics (including IP/resistivity). Only after Kennecott left the property were the results of the State of Alaska's geologic studies and mapping released.

A 6-kilometer (3.7 mile) E-W by ¾-kilometer (1/2-mile) N-S strong aeromagnetic low (Burns *et al*., 2011) has been interpreted by the state to be underlain by the 68.8 ma post-mineral(?) mega-crystic monzogranite porphyry (Twelker ed., 2021). However, magnetic susceptibility measurements by both the state and Kennecott suggest that such an intrusion should not result in a magnetic low.

Possibly the magnetic low is not a feature resulting from lithology but rather a large feature resulting from hydrothermal alteration of the underlying (intrusive?) rock. The DGGS surface work only included two traverses across portions of this large area. The soil geochemistry displays good to strong anomalies in this area, including some of the strongest lead anomalies on the prospect. Continued exploration – probably starting with prospect-level geologic mapping and prospecting and an IP/resistivity survey – is needed in this large area as this geophysical anomaly could hint a very large mineral deposit.

Other areas of the claim block also offer excellent exploration potential.

Summary

In summary, Oreo Mountain is a substantially underexplored very large Cu-Mo-Ag-Au porphyry system in a recognized porphyry Cu-Mo-Ag-Au terrain. The prospect has the potential to become a world-class copper resource. It also has excellent logistics and local infrastructure and is situated in a very favorable jurisdiction for development.

Elliott Creek Prospect

Nick Begich Sr., Wrangell Saint Elias at Elliott Creek Incorporated

The Property

Wrangell Saint Elias at Elliott Creek Incorporated (WSEECI) holds, in fee, 812 acres of patented federal land inclusive of the mineral and surface estate, extralateral rights, water rights, and timber rights, among others. We are seeking partners that have an interest in creating a development that may include mining, tourism, hydroelectric or other opportunities as will optimally leverage the historic, geologic or other natural aspects of the property.

WSEECI has consolidated the properties within the Elliott Creek valley, bringing together all privately held land under a single entity. Property history is referenced throughout public literature, inventoried by the National Park Service, and supplemented by many additional original documents held by WSEECI.

Assays and Field Work

Preliminary investigation of the WSEECI property was conducted by SRK in 2009, and additional sampling has been conducted by the owners through the summer of 2021. As part of its continuing work on the property original monuments have been located along with trenches, tunnels and adits. Approximately 1,500 feet of underground workings have been explored with as much remaining to be examined.

Over 150 grab samples and continuous chip samples have been collected by WSEECI since 2008, and have assayed **up to 18% copper** with additional **silver**, **palladium**, **platinum**, 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 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.

Next Steps

WSEECI is developing a strategy to optimize the value its property holdings. These possibilities include mining, tourism, and other land use strategies. In addition to a number of agency permits and clearances, the company has engaged with the National Park Service and gained the necessary approvals to advance surficial

infrastructure improvement. As a next step, WSEECI is seeking partners capable of contributing toward efforts advancing these holdings to their highest and best use.

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Mr. Nicolas J. Begich
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Anchorage, AK 99520

Date Received 11/07/2016
Date Reported 12/12/2016

ANALYTICAL REPORT

CSAL ID	Client ID	Gold ppm	Silver ppm	Cu %
1116-172156	NT 16 - 1N	0.337	7.3	6.02
1116-172157	UT 16 - 1u	0.101	7.9	6.62
1116-172158	UT 16 - 2u	0.842	6.0	5.14
1116-172159	UT 16 - 3u	0.269	9.7	10.99
1116-172160	UT 16 - 4u	0.135	6.1	5.45
1116-172161	UT 16 - 5u	0.168	16.0	14.14
1116-172162	UT 16 - 6u	0.236	20.1	18.82
1116-172163	UT 16 - 7u	0.168	13.4	6.77
1116-172164	UT 16 - 8u	0.168	13.0	9.68
1116-172165	LT 16 - 1 L	0.168	5.8	9.41
1116-172166	LT 16 - 2 L	0.269	8.3	8.37
1116-172167	LT 16 - 3 L	0.202	8.3	5.90
1116-172168	LT 16 - 4 L	0.202	10.5	10.27
1116-172169	LT 16 - 5 L	0.135	13.0	8.23
1116-172170	LT 16 - 6 L	0.135	7.9	5.31
1116-172171	LT 16 - 7 L	0.135	14.9	5.44
1116-172172	LT 16 - 8 L	0.135	11.6	7.99
1116-172173	LT 16 - 9 L	0.135	5.8	5.61
1116-172174	LT 16 - 10L	0.101	1.1	0.167

REGISTERED ASSAYER CERTIFICATE NO. 8888 Dnyanendra Amrutlal Shah DATE SIGNED ARIZONA U.S.A

12/12/16

Reported By_____ 12/12/2016
D.A. Shah / Laboratory Director

President: D.A. Shah Parle1940@aol.com ★ Lab Manager: Andrew Shah Andrew@prescottlab.com
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Page 1 of 1

POSTER SESSION

Testing Hyperspectral Spatial Resolution for Different Flight Altitudes and Mapping Alteration Minerals over Mount Elephant, Alaska

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Airborne spectral imagery provides high-resolution hyperspectral data that may be used to map different mineral species associated with alteration and mineralization. This technique is valuable in places like Alaska where the mineral potential is high but access to those areas is challenging. In spite of its great potential for mineral detection and exploration, there is still a great need to test and refine methodologies for airborne spectral imaging. In order to analyze the effect of flight altitude on the spatial resolution of the HySpex hyperspectral camera, we flew 18 flight lines with altitudes ranging from 3500–7500 feet above the ground, over the low-relief, well-exposed porphyry copper prospect at Elephant Mountain. The study area—between Minto and Manley Hot Springs, AK—is readily accessible from Fairbanks. We flew on a clear day in mid-September 2021, using the NEO HySpex hyperspectral imaging system which has two sensors for visible, near-infrared (VNIR) and shortwave–infrared (SWIR). The VNIR has 182 bands (410–984nm) with a sampling rate of 3.169 nm per band. The SWIR sensor has 288 bands covering a wavelength range of 949–2509 nm with a sampling rate of 5.434 nm per band. Hyperspectral image processing involves the conversion of raw data to radiance. Achieving high resolutions is a compromise between the resolution of the underlying DEM and the elevation of the flight lines. We started with 5-meter IFSAR DEMs, the highest-resolution for Alaska, and resampled these to 1 and 0.5-meter spatial resolution using cubic interpolation. The processed hyperspectral data is draped over the DEM, and the higher the resolution of the DEM, the higher the resolution of the orthorectified reflectance data. Spectral resampling and binning of atmospherically corrected data, using the ENVI program, reduces whatever noise remains. I used the ENVI plugin “PRISM,” which was developed by the U.S. Geological Survey, to classify the hyperspectral data and produce mineral classification maps. The spectra from each pixel of input data is then matched to the MICA spectral library published by the USGS.

We found in this study that flight altitude and the type of sensor affect the final map resolution. A 50-cm spatial resolution is unattainable for flight lines of >4500 feet above the ground surface in the SWIR region—above this altitude, multiple data gaps were seen. However, there were no data gaps with the VNIR-1800 sensor at the 50-cm spatial resolution altitudes up to 7500 feet. This indicates that the SWIR sensor is more sensitive to elevation. Understanding the tradeoffs of data acquisition will help us better design and apply optimized flight paths. These findings will guide our data

collection for summer 2022 & 2023, which we intend to do for Mount Hajdukovich in the eastern Alaska Range.

Alaska's story of radon challenges in a big, Arctic, far-flung U.S. State

Jennifer Athey[1], Art Nash[2], Sam Knapp[1]

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[2]University of Alaska Fairbanks, Cooperative Extension Service
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Radon is a naturally occurring radioactive gas and progeny in the uranium-238 decay chain. When radon is liberated from rocks and soils, the gas can migrate to the surface, enter buildings through their foundation, and concentrate inside. The odorless, colorless gas is the second leading cause of lung cancer after smoking and causes more than 21,000 deaths per year in the U.S. Fortunately, tests that measure radon concentrations in buildings are inexpensive and easy to conduct, and most homes can be fixed inexpensively.

Alaska is unique among U.S. states in size, remoteness, and climate. Alaska's radon program (https://dggs.alaska.gov/hazards/radon.html), therefore, has unique, interesting challenges to overcome to increase awareness of the hazard of radon. The typical programmatic challenges become "supersized" due to the variety of communities, cultures, and distances between them: outreach and education for multiple audiences, expensive logistics, effective radon testing for fly-in villages, mapping statewide radon potential with a low data density, etc. Alaska's radon resistant construction and mitigation techniques often differ from the rest of the country due to its cold climate, thawing permafrost, high-priced materials and fuels, economically disadvantaged residents, few regulations, and absent radon service providers.

The Alaska Radon Program is meeting these challenges by (1) working with relevant industries, organizations, and the public to increase radon awareness and education in Alaska, and (2) prompting homeowners to test to determine the concentration of radon in their homes and reduce exposure to radon through mitigation when necessary. The ultimate goal of this work is to decrease lung cancer deaths in the state. All Alaskans should consider testing the buildings in which they spend significant amounts of time.

Sulfate Brine Disposal In Paste Backfill

Ben Holtz[1]

Increasing levels of dissolved sulfate in Kensington Mine's tailings impoundment have been a growing concern. To combat this, Kensington sought a tailings water pre-treat strategy. Most solutions evaluated would generate a sulfate rich brine or precipitate needing disposal. Kensington elected to trial adding this sulfate rich brine to its underground paste backfill as a means of disposal, locking the sulfates in cemented tailings underground.
A reverse osmosis system was installed at the paste plant. Sulfates and other dissolved constituents are removed from the paste/mill/tailings process water loop. Clean water is pumped back into the mill and tailings impoundment; the removed sulfates form a brine. This brine supplements the water used in paste backfill.
To assure no adverse effects, paste strength, leaching, and in-situ monitoring are ongoing, as well as overall effectiveness at removing sulfate mass from the tailings impoundment. The project implementation, testing, and findings are detailed here. This project has potential to increase control of the tailings facility and significantly reduce treatment costs during production and reclamation.

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Stratigraphic and structural implications of new data from a traverse across strike from the Graphite Creek deposit in the Kigluaik Mountains, Seward Peninsula, Alaska

Karl, Susan[1], Case, George[1], and O'Sullivan, Paul[2]

The Graphite Creek deposit, located on the north flank of the Kigluaik Mountains on the Seward Peninsula, Alaska, is the largest and highest-grade flake graphite deposit known in North America. The deposit is hosted in granulite facies metamorphic rocks consisting of meter-scale alternating layers of coarse-grained graphitic garnet-sillimanite-quartz-biotite gneiss and massive, homogenous, fine-grained quartz-biotite (± graphite ± garnet ± sillimanite ± pyrrhotite) granulite. Fine-grained graphite is disseminated in the massive fine-grained granulite. A belt of interlayered massive gneiss and coarse-grained paragneiss that contains cm- to meter-thick lenses of coarse-crystalline graphite extends along strike for ~18 km. Late Cretaceous quartz-feldspar (± tourmaline) pegmatite dikes contain xenocrystic garnet and graphite; hornblende-biotite granitic dikes that have margin-parallel foliation textures intrude the gneiss and graphite lenses and post-date formation of the graphite lenses.

The paragneiss and orthogneiss form a gneiss dome that is cored by Late Cretaceous granodiorite, inferred to be the heat source for the high temperature metamorphism. On the south side of the gneiss dome paragneiss is intruded by granitic orthogneiss that has U-Pb zircon crystallization ages of 565 and 555 Ma and is thus inferred to be Neoproterozic in age; the age of the paragneiss protolith at Graphite Creek on the north side of the dome is not constrained by an intrusive orthogneiss age. The gneiss dome is rimmed by telescoped second sillimanite (sillimanite + K-feldspar) to biotite Barrovian isograds on three sides; the isograds are truncated on the north side by the steep Kigluaik normal fault. The Graphite Creek deposit occurs in second sillimanite grade paragneiss adjacent to the Kigluaik fault. On the south margin of the gneiss dome, biotite grade greenstone and marble are intruded by orthogneiss that has a U-Pb zircon crystallization age of 678 Ma. Thus metamorphic grade is not indictive of protolith age.

On the north flank of the gneiss dome, the gneiss fabric is moderately north-dipping. We conducted a ~5 km traverse across strike in consistently north-dipping gneiss, southward from Graphite Creek. The longest drill core at the Graphite Creek deposit extends ~400 m across strike. Drill cores intersect graphitic sillimanite-garnet-biotite-quartz gneiss, granite, and pegmatite. Structurally below these rocks on the ridge south of the deposit we encountered lenses of marble up to 20 m thick, and a layer of quartzite ~100 m thick. Continuing southward and structurally below the thick marble and quartzite layers, we found a few cm-scale layers of quartzite and sparse marble up to several meters thick in graphitic sillimanite-garnet-biotite paragneiss. On this traverse we did not find any lithologic or structural evidence for repetition of section, either by folding or by fault imbrication.

New detrital zircon ages from Graphite Creek core and our traverse consistently have robust U-Pb zircon age peak populations that are Triassic and Late to Early Paleozoic in age, in addition to Neoproterozoic and Mesoproterozic populations similar to

those of previously published detrital zircons from gneiss in the Kigluaik gneiss dome. The Triassic detrital zircon ages indicate the protoliths on the north flank of the gneiss dome are younger than the protoliths intruded by Neoproterozic orthogneiss on the south margin of the dome and argue against an anticlinal structure coring the dome. The Triassic zircon population is consistent with a "Permian-Triassic, probable Triassic" conodont age from the Nome Complex on the western Seward Peninsula (Till et al., 2011), suggesting rocks of this age may be more extensive on the Seward Peninsula than was previously known. The Nome Complex is correlated with Paleozoic rocks of the southern Brooks Range, which are overlain by highly carbonaceous Triassic rocks that may correspond to the graphitic rocks at Graphite Creek.

Till, A.B., Dumoulin, J.A., Werdon, M.B., and Bleick, H.A., 2011, Bedrock geologic map of the Seward Peninsula, Alaska, and accompanying conodont data: U.S. Geological Survey Scientific Investigations Map 3131, 75 p., 2 sheets, scale 1:500,000, https://doi.org/10.3133/sim3131.

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The Economic Potential of Alaska's Mining Industry

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This research paper, published by ISER on March 8, 2022 and available at https://iseralaska.org/publications/?id=1856, describes potential growth or contraction of the mining industry in the next 20 years. It does not predict an expected outcome; rather, it considers what may happen in favorable, status quo, and unfavorable policy and economic scenarios. Using an innovative methodology, the study finds that over the next two decades employment and production value could approximately double in the favorable scenario or fall by a third in the unfavorable scenario. It also describes the potential for the industry to produce critical and energy minerals needed by the U.S. economy, the potential changes in revenue to the state, and potential regional impacts.