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We Look Forward to Seeing You Next Year:

***January 18 - 21, 2021***

# Abstract Guide

**JANUARY 20 - 23, 2020**

**#AMEROUNDUP**



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## Mineral Exploration and Mining in British Columbia, 2019

### Gordon Clarke, B.C. Geological Survey

**Session: Regional Overviews: BC/Yukon/Alaska**

**Time: 10:25 AM – 10:50 AM**

Mineral and coal production for 2019a continued to be a major contributor to the economy of British Columbia. The sector remained robust but the forecast production estimate of C\$8.8 billion was down from the 2018 production estimate of \$9.7 billion. News included Copper Mountain Mining Corporation announcing an updated mine plan increasing mine life by 4.5 years to 31 years.

Throughout the year there was significant investment in British Columbia mines and exploration projects. Newcrest Mining Limited purchased 70% of the Red Chris mine from Imperial Metals Corporation for US\$806.5 million. Ascot Resources Ltd. acquired IDM Mining Ltd., Osisko Gold Royalties Ltd. acquired Barkerville Gold Mines Ltd. for approximately C\$338 million and Avino Gold and Silver Mines Ltd. announced in late November a definitive agreement for its purchase by Talisker Resources Ltd. Newmont Goldcorp Corporation invested \$25.9 million into GT Gold Corp. to advance exploration at the Tatogga project's Saddle North prospect.

While access to venture capital for exploration projects remained difficult, significant programs continued to advance. Kutcho Copper Corp.'s Kutcho project and Barkerville's Cariboo Gold project entered the environmental assessment process. Imperial Metals Corporation drilled at its Ruddock Creek project. Seabridge Gold Inc. continued work on its KSM project and ZincX Resources Corp. reported new drilling results. Telkwa Coal Limited continued to advance its Tenas coal project. Good drilling results were reported for Westhaven Ventures Inc.'s Shovelnose project, Garibaldi Resources Corp.'s Nickel Mountain project, Dolly Varden Silver Corporation's Dolly Varden project, Skeena Resources Ltd.'s Eskay Creek project, Crystal Lake Mining Corporation's Newmont Lake project and Ascot Resources Ltd.'s Premier/Dilworth project.

## Yukon Geology, Exploration and Mining Overview, 2019

### Scott Casselman, Yukon Geological Survey

**Session: Regional Overviews: BC/Yukon/Alaska**

**Time: 10:50 AM – 11:15 AM**

Mineral exploration expenditures in 2019 were down slightly from 2018 levels, ending 2019 at C\$105 million compared to C\$121 million in 2018. Mine development expenditures were also down, C\$240 million as compared to C\$495 million in 2018, but this is because of the completion of construction at Victoria Gold Corp's Eagle gold mine. The number of active exploration projects dropped to half of the 2018 number, a 50 year low!

Victoria Gold completed construction of the Eagle gold mine on September 9, 2019 and poured the first gold bar from the open-pit, heap leach operation on September 17, 2019.

Pembridge Resources PLC was able to complete the purchase of Minto Exploration Ltd. and the Minto mine operation from Capstone Mining Corp. In October they restarted mining and milling operations at Minto after a 1 year hiatus.

Exploration for gold continues to be the driver for exploration activity, with 71% of exploration spending on 45 projects directed to the precious metal. The White Gold district, Rackla gold belt and Dawson Range are the three dominant regions for gold exploration in Yukon. The most advanced gold project is Newmont Goldcorp's Coffee project, which is advancing through the environmental assessment process.

Although the price of zinc is off the highs set in 2018, it remains above the 5 year average, while the London Metal Exchange stockpiles of the metal continue to dwindle. This shortfall bodes well for a continued strong price, which is encouraging for base-metal explorers. BMC Minerals is progressing through the environmental assessment on the Kudz Ze Kayah volcanogenic massive sulphide project. Fireweed Zinc continued work on their Macmillan Pass project, which hosts the Tom and Jason sedimentary exhalative deposits, and they announced a new discovery of higher-grade intervals within previously known low-grade material at the Boundary zone, 15 kilometres west of the Jason deposit. The second largest project in Yukon, by expenditures, was at the North Rackla project of Cantex Mine Development Ltd. In 2018, they announced a new sedimentary-hosted lead-zinc-silver discovery, and in 2019 undertook an extensive drilling campaign with three drills operating well into the winter months.

The Yukon Geological Survey (YGS) is focused on supporting the exploration and mining community. The YGS has been busy compiling exploration data as well as providing the regional geological framework to allow companies continued exploration success.

## Alaska's Mineral Industry Activity in 2019

### Melanie Werdon, Alaska Geological & Geophysical Surveys

**Session: Regional Overviews: BC/Yukon/Alaska**

**Time: 11:15 AM – 11:40 AM**

Alaska's diverse metallogenic provinces, underexplored mineral resource potential, and world-class gold, copper, lead, zinc and coal deposits continue to attract exploration capital. Alaska's estimated total 2019 exploration spending, including near-mine, development-stage and exploration projects, is at least US\$142 million (about C\$189 million), up slightly from 2018. At least 19 non-mine projects spent more than US\$1 million (about C\$1.33 million). In 2019, Alaska had 6 lode metal mines (Red Dog, Fort Knox, Pogo, Kensington, Greens Creek and Dawson), 1 coal mine (Usibelli), about 200 placer mines and 11 advanced-exploration and development-stage projects (7 active; 5 with drill programs).

In 2018, companies in Alaska had numerous exploration successes and discoveries. This continued in 2019, which was another year of strong exploration, with multiple companies exploring for base metals at volcanogenic, carbonate-replacement, and sediment-hosted massive sulphide deposits. Intrusion-related and mesothermal gold exploration and development continued statewide, and Alaska's porphyry Cu-Mo-Au ( $\pm$ Re,  $\pm$ Pd) belt also experienced continued high interest.

Alaska had at least 44 active early-stage exploration projects throughout the state, primarily focused on gold and base metals. Drilling programs to advance exploration and development projects were carried out at the Alaska Range, Arctic, Aktigiruiq/Anarraaq, Bornite, Donlin, Estelle, Golden Summit, Golden

Zone, Goodpaster/Central, Graphite Creek, Healy, Hona, Illinois Creek, Johnson Tract, Northway, Oreo, Palmer, Peak, Pebble, Red Mountain, Round Top, Sam, Shorty Creek, Sunshine, Taurus, Terra, Tibbs and Valdez Creek projects.

The Alaska government encourages resource development by providing geological datasets/maps, airborne geophysical surveys, Alaska Industrial Development and Export Authority partnerships with private entities to finance infrastructure, and permit coordination by the Office of Project Management and Permitting.

## Northwestern B.C.'s 'Golden Triangle': Recurrent Syn- to Post-Subduction Mineralization along Deep Crustal Corridors – Part 1

**Bram van Straaten and JoAnne Nelson of B.C. Geological Survey**

**Session: New Geoscience**

**Time: 1:20 PM to 1:40 PM**

The Golden Triangle's vast metal endowment largely formed during five Mesozoic metallogenic epochs, each with characteristic rock types, mineral deposits and tectonic setting. Episode 1 (Late Triassic, syn-subduction) is characterized by Stuhini Group volcanic rocks, Stikine suite batholiths and calcalkaline porphyry Cu±Au±Mo deposits (Schaft Creek). Episode 2 (latest Triassic, post-subduction) includes small alkalic intrusions, volcanic rocks and silica-undersaturated alkaline porphyry Cu-Au deposits (Galore Creek). Episode 3 (latest Triassic, post-subduction) is related to Tatogga suite intrusions and lower Hazelton Group volcanic rocks near town of Iskut and includes high-K calcalkaline porphyry Cu-Au and related Au deposits (Red Chris). Episode 4 (Early Jurassic, post-subduction) is characterized by Texas Creek suite intrusions and lower Hazelton Group volcanic rocks in a north-south belt from Kitsault-Stewart-Stikine River. It is associated with high-K calcalkaline porphyry Cu-Au and related Au deposits (KSM, Brucejack). Episode 5 (Middle Jurassic, syn-collisional) includes the rift-bound bimodal tholeiitic Iskut River Formation and associated VMS deposits (Eskay Creek).

## Northwestern B.C.'s 'Golden Triangle': Recurrent Syn- to Post-subduction Mineralization along Deep Crustal Corridors – Part 2

**Bram van Straaten and JoAnne Nelson of B.C. Geological Survey**

**Session: New Geoscience**

**Time: 1:40 PM to 2:00 PM**

Throughout its metallogenic history, the Golden Triangle has experienced a variety of tectonic settings, some being ambiguous; however, throughout the entire history northerly and easterly major basement structures have controlled the location and geometry of mineral deposits. Schaft Creek and Galore Creek show strong northerly control by penecontemporaneous faults. The approximately 12 km long northerly KSM porphyry trend lies in the immediate footwall of a north-striking Cretaceous thrust fault, interpreted as a reactivated Early Jurassic syn-mineral lineament. Red Chris is localized along a minor splay of the easterly Pitman fault system, as is the newly discovered Saddle zone at the Tatogga property which, like KSM, lies in the immediate footwall of a later thrust fault. The sets of northerly and easterly lineaments exerted control on some of the oldest intrusive bodies in Stikinia, the Late Devonian Forrest Kerr and More Creek plutons, as well as the youngest post-accretionary overlap unit, the Quaternary–Recent Mt. Edziza volcanic complex. They probably originated as fundamental zones of weakness in the unexposed, unknown pre-Devonian basement of north-central Stikinia.



## Revisiting the Relationships between Paleogene Tectonics and Gold Mineralization in the Cordilleran Orogen

**Luke Ootes, B.C. Geological Survey; Sebastien Castonguay, Geological Survey of Canada**

**Session: New Geoscience**

**Time: 2:00 PM to 2:20 PM**

The Paleogene was a time of change in the North American Cordilleran Orogen, during which late Cretaceous compression and arc construction transitioned to Eocene dextral strike-slip deformation. The tectonic switch appears related to a counterclockwise rotation of the Pacific Plate relative to the North American Plate around ca. 57 Ma. This changed the intersection from relatively orthogonal to moderately oblique, which transitioned the Cordillera into transcurrent deformation. Features that are associated with this switch include: 1) crustal-scale dextral strike-slip faults; 2) a magmatic flux in the Coast Plutonic Complex; 3) voluminous intermediate volcanism in the Intermontane Belt; 3) development of metamorphic core complexes; and; 5) orogenic and epithermal gold and porphyry mineralization.

West of the Coast Plutonic Complex, orogenic gold mineralization occurs within the Juneau gold camp, Alaska, where it is hosted in Paleozoic and Mesozoic metamorphic rocks and related to dextral transpressional deformation. East of the Coast Plutonic Complex, within the Intermontane Belt of British Columbia and Yukon, low-sulphidation epithermal gold mineralization is associated with the development of intermediate volcanic complexes. These volcanic complexes may mark dilatational jogs or pre-existing plate boundaries along crustal-scale dextral strike-slip faults. The volcanic activity progressed southward (from southern Yukon through British Columbia and into northern Washington) and epithermal gold mineralization occurs within several dispersed volcanic complexes. In northern B.C. and southern Yukon, the volcanic complexes formed in a relatively narrow belt, whereas in southern B.C. and northwest United States they are widely distributed and coincide with metamorphic core complexes farther to the east. The coincidence of all of the Paleogene features of the Cordilleran Orogen indicates that diverse gold-forming processes can be related to the same large-scale tectonic process, but the location of resultant mineralized zones/deposits is dictated by local processes.

## Cordilleran Metallogenic Trends and Patterns

**Craig J.R. Hart, MDRU**

**Session: New Geoscience**

**Time: 2:20 PM to 2:40 PM**

Approximately 700 Ma of Cordilleran evolution has developed an architecture upon which the metallogenic framework of ore systems have formed. Most ore systems formed in response to the same processes that built the Cordillera from Neoproterozoic and Paleozoic rifting events, to Paleozoic and Mesozoic accretionary events, and episodic plutonic and volcanic events that span most of its history. It is no surprise then, that there is provinciality in these ore systems. Mineral deposit characteristics reflect

Cordilleran architecture and evolution and record a series of trends and patterns. Although the location of an ore deposit may appear to be controlled by upper crustal geological features, these broader scale trends and patterns clearly indicate the importance of large-scale crustal to lithospheric architecture in controlling the locations of ore systems, and indicate that parts of the crust or lithosphere are much more highly enriched in metals than adjacent blocks.

Understanding the controlling features of Cordilleran metallogenic trend and patterns can be an asset in creative exploration targeting to create opportunities that may not have been previously considered. Cordilleran terrane tectonics have been a revolutionary foundation to understand and explore for ore systems, although researchers increasingly recognize that most terrane boundaries are highly modified and are not lithospheric or even crustal in scale. Much of the Cordilleran terrane framework represents only a 2D view of the 3D architecture that ultimately controls the distribution, trends and patterns of metal enrichment.

### **Scientific Highlights from a Decade of Geological Survey of Canada GEM Research in the Northern Canadian Cordillera**

**Dawn Kellett, Geological Survey of Canada-Atlantic**

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**Session: New Geoscience**

**Time: 2:40 PM – 3:00 PM**

The Geo-mapping for Energy and Minerals (GEM) program has been the flagship bedrock mapping program of the Geological Survey of Canada since 2008 and will come to a close in 2020. During the past 12 years, the GEM Cordillera research group has conducted several research activities across central and southern Yukon and northernmost British Columbia, including acquisition of >130 000 km<sup>2</sup> of aeromagnetic surveys and involving 30 student theses, 6 post-doctoral fellowships, numerous industry collaborations and close collaboration with Yukon and B.C. geological surveys. This is a review of GEM Cordillera research that has led to new concepts for the formation and architecture of the Slide Mountain, Yukon-Tanana, Cache Creek and Stikine/Quesnel terranes, driven by data-rich, multi-disciplinary studies involving mapping, geophysics, structural and metamorphic analysis, geochemistry, geochronology and paleontology. These contributions provide a modern framework for characterizing the mineral endowment of the northern Canadian Cordillera.

## Polyphase Structural History of the Selwyn Fold Belt, Eastern Yukon

David Moynihan, Don Murphy, Maurice Colpron and Rosie Cobbett of Yukon Geological Survey

**Session: New Geoscience**

**Time: 3:00 PM to 3:20 PM**

The Selwyn-Mackenzie fold-thrust belt of the northern Canadian Cordillera underlies a large arcuate region east of the Tintina Trench in eastern Yukon and N.W.T. The arcuate geometry of the belt reflects the presence of an embayment in the ancestral Laurentian margin, which was caused by along-strike variations in rift mechanisms. The fold-thrust belt overprints three main lower Paleozoic paleogeographic domains: from southwest to northeast, these are the McEvoy platform, Selwyn basin and the Mackenzie/Ogilvie platform.

The Selwyn fold belt, which forms the inner part of this region, experienced a polyphase Jura-Cretaceous structural history. Early deformation (Late Jurassic–Early Cretaceous) was restricted to the southwest part of the belt (McEvoy platform and western Selwyn basin areas) and was characterized by northeast-vergent structures. This was followed by a reversal in vergence, which led to ‘backthrusting’ of the Selwyn Basin region over the McEvoy platform to the southwest. This southwest-vergent deformation produced high-amplitude nappe-style folds and was accompanied by amphibolite-facies metamorphism in the Hyland region of southeastern Yukon. New U-Pb data from the Hyland area indicate this deformation and metamorphism was ongoing during the interval 112–106 Ma, and ceased immediately prior to the intrusion of voluminous batholiths of the Hyland River suite. Southwest-vergent deformation was likely coeval with northwest-directed movement on the Tombstone strain zone and was followed by dextral strike-slip faulting ca. 98 Ma. Following, or accompanying, dextral strike-slip faulting there was a return to northeast-vergent thrusting and folding, as southwestern parts of the belt were carried on deeper structures. Northeastward propagation of the thrust belt during the Late Cretaceous–Paleocene led to incorporation of carbonate successions of the Ogilvie and Mackenzie platform, which underlie the mountainous regions in frontal regions of the fold-thrust belt.

## Carlin-type Gold Mineralization in Yukon: Critical Geological Characteristics and Applications to Exploration

**Nicolas Pinet, Patrick Mercier-Langevin, William J. Davis, Duane C. Petts, Josué Jautzy, Omid Haeri-Ardakani, Bram A. Komaromi, Denis Lavoie, Benoit Dubé, Jeanne B. Percival, Simon E. Jackson, Martine M. Savard and Virginia I. Brake of Geological Survey of Canada; Patrick Sack and Maurice Colpron of Yukon Geological Survey**

**Session: New Geoscience**

**Time: 3:20 PM to 3:40 PM**

In central Yukon, sediment-hosted gold prospects have similar characteristics to Carlin-type deposits in Nevada; however, it remains unclear if exploration models applied to the southwestern United States similarly apply to the Canadian Cordillera.

Critical geological features of Carlin-type prospects in Yukon range from regional to nano-scales. Prospects are located close to the Ogilvie platform–Selwyn Basin boundary, a deep-seated structural corridor prone to tectonic reactivation and characterized by slope to base-of-slope sedimentary facies. New LA-ICP-MS U-Pb dating of late-mineralization calcite associated with realgar confirms that Carlin-type gold mineralization in the Nadaleen trend is younger than the main ca. 93 Ma reduced intrusion-related gold event in the northern Selwyn basin. A better understanding of the areal extent and geodynamic framework of the Carlin-type mineralizing event requires further investigation but the authors' initial understanding has the potential to guide exploration.

Neoproterozoic-hosted mineralized intervals in central Yukon are mostly concordant with bedding in complexly shaped anticlines. Sedimentary breccia formed through debris flow and alternating finely laminated limestones and siltstones are the best prospective sedimentary intervals; however, significant ore is also found in other lithologies characterized by pre-mineralization fracture/vein networks that helped channel early acidic fluids and later gold-bearing fluids into favourable strata/traps. Gold is contained within very small (<2 µm) single-stage arsenian pyrite and in the rims of pre-ore pyrite, in decarbonated and silicified rocks. Preliminary data on the temperature of the mineralizing fluids from clumped isotopes and fluid inclusions suggest the Yukon prospects formed in a slightly cooler environment than the giant deposits of Nevada. This difference in temperature perhaps explains the greater abundance of realgar and orpiment believed to represent the late-stage, cooler phase of ore-forming hydrothermal activity in Nevada. This may also mean that larger deposits formed under warmer conditions might exist elsewhere in central Yukon.



## New Method of Mineral Potential Assessments for Land Use Planning in Yukon: Applications for Mineral Prospectivity Mapping

**Warwick Bullen, Yukon Geological Survey**

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**Session: New Geoscience**

**Time: 3:40 PM to 4:00 PM**

Territory-wide mineral potential mapping in Yukon was last conducted 18 years ago. An updated suite of maps for land use planning is, therefore, necessary. Yukon Geological Survey has developed a new GIS-based mapping process for this purpose. Industry-based applications using the new method will be developed going forward.

The approach makes use of mineral system components that potentially contribute to metal accumulations in an area. The method is a hybrid between a classic data-driven probabilistic approach and an expert-driven fuzzy logic approach. It is non-specific in terms of commodity and/or deposit type; however, the claim and assessment report footprint data that is integral to the mapping process capture these important components.

The procedure makes use of block modeling techniques where each block is assigned a prospectivity and bedrock mapping confidence score. Calculations are based on the presence or absence of categorical features within unit cells, and the scores represent the posterior favourability of each cell. Evidential layers are weighted according to buffer distance and/or through the application of knowledge-based factors. Lithology classes are factored using a multiclass weights-of-evidence approach.

Mineral potential and confidence scores are converted to either a 1, 2 or 3 according to a defined mathematical schema. The values are then combined: blocks with scores of 1:1 have the lowest mineral potential and lowest confidence, whereas blocks with scores of 3:3 have the highest mineral potential and highest confidence. Nine possible combinations exist. Mineral potential maps containing measures of both potential and confidence are generated based on the cumulative contrast values.

Potential industry applications include mineral systems exploration targeting supplemented by machine learning; area selection using block standard errors and favourability factors; and property value maximization using a block-driven optimized expenditure approach. Prospectivity as a fractal dimension is currently being examined.

## Systematic Hyperspectral Scanning for Seeing the Unseeable: A New Dance Partner for the Hand Lens

**Kevin Heather, Regulus Resources Inc.**

**Session: 2020 Theme Session: Seeing the Unseeable**

**Time: 9:05 AM – 9:35 AM**

This paper presents the exploration and business case for doing hyperspectral core imaging as part of an advanced-stage exploration program using the AntaKori Cu-Au-Ag porphyry-skarn-epithermal deposit, northern Peru, as a case study. The rationale and vision behind the decision to incorporate hyperspectral scanning as part of the regular systematic workflow at AntaKori is summarized by the following points:

- Identification of some alteration minerals is not obvious to the naked eye (or by hand lens), even to an experienced geologist's eye.
- Consistent identification of complexly mixed and/or overprinted alteration minerals.
- Systematic definition of both textural and temporal relationships of the complex mineral assemblages.
- Determination of detailed chemistry and crystallinity of various silicate, mica and clay mineral species (e.g., chlorite, alunite, epidote, white mica)
- Valuable in determining vectors to mineralization for exploration and resource expansion.
- Systematic mineralogical data (especially clays and micas) that may have important repercussions in downstream activities such as
  - o open-pit mining (blasting and pit slope stability),
  - o underground block cave fracture density and infill mineralogy.
  - o crushing and grinding,
  - o metallurgical processing, and
  - o tailings and waste disposal (acid mine drainage).
- Integration of all geological datasets, including the hyperspectral data and the resource block model into a holistic geo-metallurgical model.

The business case for early-stage application of systematic hyperspectral core scanning for a project like AntaKori is still in progress; although initially thought to be more an exploration targeting/vectoring tool, its true value may lay in the many downstream uses of the data. The future value-adding proposition of incorporating hyperspectral core scanning into the regular workflow of an early- to advanced-stage exploration project is a 'no-brainer' for Regulus Resources Inc. at its AntaKori project in northern Peru.

## Enhancing Kimberlite Diamond Exploration with Multi-geophysical Surveys

**Doug Oldenburg, Seogi Kang, Dominique Fournier, Kris Davis, Sarah Devriese, Thibaut Astic and Lindsey Heagy of University of British Columbia – Earth, Ocean and Atmospheric Sciences**

**Session: 2020 Theme Session: Seeing the Unseeable**

**Time: 9:35 AM – 10:05 AM**

With the development of more sophisticated data acquisition systems and the ability to invert data to recover 3D subsurface models, geophysics has the potential to become a more integral part of the mineral exploration process. In particular, information from multi-geophysical surveys can be combined to generate a 3D geophysical rock model, which can be of great value in understanding a mineral deposit. To illustrate this the authors focused on the DO-27 and DO-18 Tli Kwi Cho kimberlites in the Northwest Territories. Early interpretations using potential field data and drilling information resulted in multiple revisions of the geological model and poorly spotted drill holes. Here we look at how multi-geophysics and 3D modeling could have produced better outcomes. Airborne magnetic, gravity gradiometry, frequency and time domain electromagnetic surveys are inverted to produce 3D images of susceptibility, density, electrical conductivity and chargeability, respectively. These physical properties are clustered to generate a geophysical rock model that has five units. The geophysical units correlate with the geological units obtained from drilling campaigns. Importantly, the authors can distinguish between the hypabyssal, the volcanoclastic and pyroclastic units of the kimberlite and show that the composition of DO-27 is distinct from DO-18. In hindsight, having the geophysical rock model would have greatly aided in spotting the first drill hole. The geological and petrophysical information from that drill hole would then have provided a calibration point for converting the geophysical rock model into a geological model and the data could also have been used to further improve the geophysical inversions.

## Seeing through Cover with Microbes: The Application of Microbial Community-Fingerprinting when Exploring for Concealed Mineral Deposits

**Bianca P. Iulianella Phillips, The University of British Columbia – Earth, Ocean and Atmospheric Sciences**

**Session: 2020 Theme Session: Seeing the Unseeable**

**Time: 10:05 AM – 10:30 AM**

Mineral exploration in northern latitudes is challenging in that undiscovered deposits are likely buried beneath significant glacial overburden. The development of innovative exploration strategies and robust techniques to see through cover is imperative to future discovery success.

Microbial communities are sensitive to subtle environmental fluctuations, reflecting these changes on very short timescales. Shifts in microbial community profiles, induced by chemical differences related to

geology, are detectable and can be used to vector toward discrete geological features. The modernization of genetic sequencing and big data evaluation allows for efficient and cost-effective microbial characterization of soil profiles, with the potential to see through glacial cover.

Results to date have demonstrated the viability of microbial fingerprinting to directly identify the subcrop of mineralization in addition to entrained geochemical signatures in till. Soils above two copper porphyries in British Columbia and two kimberlites in the Northwest Territories have undergone microbial community profiling. These community genome–derived datasets have been integrated with chemistry, mineralogy, surface geology, vegetation type and other environmental variables including Eh and pH. Analyses show significant microbial community shifts correlated with the presence of subsurface mineralization, with a distinct community response at the species level directly over known deposits. The relationship between microbial profiles and mineralization can lead to the application of microbial fingerprinting as a method to accurately delineate geological changes such as the presence of ore deposits in glacially covered terrain.

The integration of microbial community information with soil chemistry and landscape development coupled with geology and geophysics significantly improves the drill/no-drill decision process. There is high potential for application as a field-based technique, as sequencing technology is progressively developed into portable platforms.

## Generating and Advancing Blind Targets Using Hydrogeochemistry: An Integrated and Multi-scale Approach

**James Buskard, Nevada Exploration Inc.**

**Session: 2020 Theme Session: Seeing the Unseeable**

**Time: 10:40 AM – 11:00 AM**

During the last decade explorers have been net value destroyers. Although it is hard to overstate the potential rewards in identifying new prospects in covered regions, as the industry transitions to exploring beneath deeper cover, explorers need new tools that lower costs and increase discovery rates.

In the absence of cost-effective undercover geochemistry tools, explorers have been unable to complete the regional-scale sampling programs that have historically identified new areas for exploration, such as the stream sediment sampling programs in northern B.C. While geophysics provides important information to identify search spaces, explorers still need geochemical tools that can provide direct evidence for and a vector toward mineralization.

Hydrogeochemistry is becoming an important undercover exploration tool because of its ultra-trace detection limits, a growing number of deposit-scale studies, and multiple large sampling programs around the world. As groundwater flows through the subsurface, it retains a hydrogeochemical signature that reflects the lithologies and minerals it encounters, which can produce characteristic footprints in groundwater that are often many times larger than those seen in bedrock.

In terms of its scale of application, the focus to date in the literature and within industry has been at the regional scale, where hydrogeochemistry provides a highly selective and relatively low-cost filter to reduce large covered search regions down to discrete prospects. With tighter sampling density, hydrogeochemistry is also becoming a high-value, prospect-scale tool that can provide an otherwise



missing scale of information to allow explorers to be more targeted in their use of expensive, conventional drilling, based on discrete, high-contrast pathfinder gradients over relatively short distances.

Nevada Exploration Inc. is advancing a portfolio of covered Carlin-type gold projects in Nevada generated based on its regional-scale, hydrogeochemistry-driven exploration program, and is now integrating detailed groundwater borehole sampling to focus drilling at its projects.

## **Insights into Structure and Alteration from 2D Seismic at Bornite Copper, Alaska**

**Greg Turner, HiSeis**

**Session: 2020 Theme Session: Seeing the Unseeable**

**Time: 11:00 AM – 11:20 AM**

In 2018, HiSeis acquired two 6 km lines of 2D seismic data over the Bornite copper deposit in Alaska. The copper mineralization at Bornite has characteristics similar to the Mt. Isa district in Australia and the Tynagh deposit in Ireland, which show syngenetic to early epigenetic characteristics and emplacement. A feasibility study completed 6 months earlier showed that good reflectivity was expected at boundaries between the interbedded phyllite and carbonate layers. Mineralization itself showed some contrast but the ability to directly detect this would depend on its pyrite content, size and geometry.

The 2D seismic reflection data show steep angle faults and thrust faults, which may be significant controls on mineralization emplacement and enrichment. The data also suggest the presence of previously undetected folds, which are supported by geochemical data. It appears that copper mineralization is concentrated within the hinges of these folds. Possible zones of alteration around faults were inferred from low reflectivity zones (indicative of reduced acoustic impedance contrasts between carbonates and phyllites). Subsequent drilling targeting such a zone confirmed the existence of this alteration. Additionally, the understanding of the regional structural framework was improved by the ability to delineate faults in the third dimension and these were linked to surface mapping.

## **Using Cosmic Radiation to Map Underground Density**

**Doug Schouten, HiSeis**

**Session: 2020 Theme Session: Seeing the Unseeable**

**Time: 11:20 AM – 11:40 AM**

Muon geotomography is a novel density measurement technique based on the absorption of cosmic ray muons in the ground. Naturally occurring cosmic ray muons emanating from the upper atmosphere lose energy as they penetrate the Earth at a rate proportional to the density of the material they pass through. Thus, by measuring the flux through muon sensors situated underground, the average density in the overburden above the sensors can be determined. Regions of anomalous density can be inferred from reduced muon flux arriving at the sensors from the surface along any given direction. This presentation

will introduce the concept of muon tomography—including unique capabilities and restrictions—and will summarize field trials led by CRM Geotomography Technologies, Inc. ([www.crmgtm.com](http://www.crmgtm.com)). Finally, the author will present plans regarding HiSeis' borehole instrument capabilities.

## **Hypersonic Impact Drilling and Tunneling 10 Times Faster for Mining and Energy**

**Mark C. Russell, Hypersciences**

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**Session: 2020 Theme Session: Seeing the Unseeable**

**Time: 11:40 AM – 12:00 PM**

Mark will present the development and testing performance of HyperDrill, a novel hypersonic impact drilling technology, and hyper tunnel boring, which uses repetitive hypersonic impact of erodible projectiles to drill 10 times faster in hard, deep rock for conventional and geothermal energy, tunneling and hard-rock resource drilling. HyperDrill field trials have been funded by Shell Game Changers and the Wells group as well as another major resources company.

## Ticking Through the Investment Clock

Joe Mazumdar, Exploration Insights

**Session: Commodities & Financial Markets**

**Time: 1:20 PM – 1:40 PM**

The investment clock ticks through the various stages of an investor's path from seeking opportunities to buying them and eventually selling them.

In the gold sector, investors have observed the shock of a fall in the gold price that led to industry-wide cost reductions, dividend cuts, liquidations and write downs to a more recent stabilization in prices to higher levels leading to a fall in debt levels, stabilizing dividends and costs and a recapitalization of the sector.

A recapitalization of the industry is now occurring, specifically in the junior sector, and some merger and acquisition activity suggesting that this is a 'buying' moment for gold equities.

The author tracks the steps vicariously through the operational and financial results of one major gold company and highlights the mega-merger phenomenon, the broader trend of major cash flowing producers funding the junior explorers as a proxy for their own efforts, and the mergers and acquisitions onslaught of well capitalized Australian producers into the Americas as well as the Chinese state-owned companies.

Major North American-based gold producers are, currently, content to demonstrate an ability to generate free cash flow at lower gold prices (US\$1250/oz), manage their debt levels and issue stable dividends. Divestments were an essential part of the strategy to lower debt levels and fund growth but in an environment of rising gold prices, some have decided to slow that process.

Not many mid-tier producers have generated enough cash flow to fund growth or expansion although they are continually urged to raise their capital market profile even it comes via the acquisition of lower margin assets, which equate to call options on the gold price.

Junior developers, on the other hand, are required to be nimble with respect to funding their project (streaming, off takes and convertible debt, among others) as the traditional sources of financing are not always open to them. Competing with the divestments of operating mines in low-risk jurisdictions like Canada and Australia has also proven to be difficult.

Retail investors, including Eric Sprott, have funded approximately C\$1.4 billion in equity investments in 2019 to support the non-cash-flowing juniors with an emphasis on precious metal explorers in North America.

## **Our Broken Mineral Exploration Capital Markets: Where Do We Go From Here?**

**Michael Gray, Agentis Capital**

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**Session: Commodities & Financial Markets**

**Time: 1:40 PM – 2:00 PM**

There is furious agreement that the capital markets have undergone systematic change, with broker/dealers (globally) no longer profiting from trading equities and an increase in market cap/liquidity requirements from investors. There are many reasons for this, including i) increasing regulation following the global financial crisis; ii) changing institutional investor investment criteria; iii) a regulatory squeeze on many top retail brokers, resulting in their exit as specialists, and iv) robots increasingly dominating trading, with passive exchange-traded funds (ETFs) an investment staple. The result has been the hollowing out of sell-side equity analysts/salespersons/bankers and a systematic decline in broad support for small-cap equities.

In mineral exploration and development, flagrant market cap destruction on the back of flawed assets and/or poor management execution has eroded trust in our sector. With these as significant constraints to accessing new capital, innovation is required to provide the long-term capital that is vital for successful exploration and development of assets in the mineral sector.

## **Lithium and Cobalt: Has the EV Bubble Burst?**

**John Pfahl, SRK Consulting**

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**Session: Commodities & Financial Markets**

**Time: 2:00 PM – 2:20 PM**

The meteoric rise in 'battery metal' prices tied to the hype around electric vehicle (EV) markets (e.g., lithium and cobalt) has just as quickly turned into a subsequent price crash. With the majority of the EV-driven pricing gains now lost, was this price crash the inevitable bursting of the EV bubble or is it just a speedbump for these EV minerals?

This presentation evaluates the state of the current EV market and how potential future demand scenarios for EVs will impact the potential demand for key EV commodities, lithium and cobalt, including supply and prices.



## Commodities – The China Connection Remains Crucial

**Colin Hamilton, BMO Capital Markets**

**Session: Commodities & Financial Markets**

**Time: 2:20 PM – 2:40 PM**

In commodity analysis, getting China right goes a long way. As a country, China is both the marginal buyer and marginal producer of many metals and bulk commodities, and thus has outsized influence in price formation. The author sees China's commodity business model—secure a supply of raw materials, install plentiful process capacity to transform these, and ideally export some of the finished products—as clear and resilient even in the face of current trade concerns. Thus, to create sharp price moves in commodities, the raw material side of the equation is crucial. Moreover, China's influence on the financial side of commodity markets is growing quickly, leading to different trading patterns and short-term dynamics. 2020 will be a big year for Chinese economy, being the year that President Xi's promise to double per capita income over 2010 levels gestates and the fourteenth 5 year plan is released.

## Nickel: Ironing out the Supply-Side Issues

**Gregory Honig and Robert Gray of Resource Capital Funds**

**Session: Commodities & Financial Markets**

**Time: 3:00 PM – 3:20 PM**

Across the industrial metals sector in 2019, one metal stood out—nickel. During the first three quarters, the nickel price on the London Metal Exchange surged +60%, driven by strong stainless-steel demand in Asia and growing nickel demand for electric vehicle batteries. Significant price volatility seen in the fourth quarter has rekindled the debate on the outlook for this commodity.

The 53 million tonne stainless-steel industry remains the bedrock of demand for the nickel industry. The stainless-steel market accounts for approximately 70% of global nickel demand and has grown at a 5.6% compound annual growth rate (CAGR) for the past 50 years, rising to 8.7% CAGR (2017–2019) over the past 3 years. For stainless steel, it does not matter what type of nickel ore is supplied; in fact, ferro-nickel ('FeNi' or Class II nickel) is a preferred input due to the iron credits.

The growing electroplating, nickel alloy and nickel sulphate industries are, however, rapidly changing the current and future outlook for nickel demand. Unlike stainless steel, these demand sources require iron-free or Class I nickel. There are potential new primary sources of Class I nickel, but many are high pressure acid leach (HPAL) projects. Historically, HPAL projects have not met expectations from capital cost, schedule and complexity standpoints and many of the HPAL projects built in the last two decades continue to underperform operationally.

The outlook for nickel is supported by strong demand fundamentals and a dynamic supply-side equation. The key question that must be answered is whether the nickel supply side can iron out the issues and meet the growing demand for iron-free (Class I) nickel in the next few years. The investments have

already started, but how well these investments perform, particularly in Indonesia, will define the nickel market over the next 5–10 years.

## Factors Driving the Bull Market for Precious Metals in 2020

**Craig Hemke, TF Metals Report**

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### **Session: Commodities & Financial Markets**

**Time: 3:20 PM – 3:40 PM**

The year 2019 saw a resumption of the bull market for both gold and silver. After a nearly 7 year period of lower prices and consolidation, the price of gold broke out in June 2019.

This is almost precisely as was forecasted in January 2019. In a blog post titled “2010+9”, TF Metals Report laid out the case for a renewed bull market. Similar to 2010, the year 2019 would include a slowing United States economy and political gridlock with soaring debt and deficits.

This would lead to lower United States interest rates, a surge in global negative-yielding debt, renewed central bank easing and renewed quantitative easing.

The TF Metals Report’s 2019 forecast was for the best annual gains for the precious metals since 2010 and it has been correct. Both metals were up more than 15% year-to-date as of time of writing.

In 2020, interest rates will head even lower and the central banks will institute overt and direct debt monetization programs before year-end. This will lead to a continued surge in demand for precious metals in all their forms: physical metal, futures contracts, exchange-traded funds (ETFs), unallocated accounts and mining shares. The dollar price of gold will first move toward US\$1650/oz; then, once that level is bested, the next target will be US\$1800.

Additionally, as prices of precious metals continue to rise, a surge in the prices of mining shares will follow. Global asset allocation to the sector will increase, leading to more dollars chasing a finite number of investment opportunities.

The presenter will close with an educational section on the history of governmental gold price, including the post-Bretton Woods efforts to maintain the US\$35/oz peg; the United States crisis of 1957–1958, when nearly one-third of United States gold reserves were depleted; the London Gold Pool of 1961–1968 and the move to allow private United States gold ownership in 1974 followed by the creation of gold futures contracts in 1975.

## Outlook for the Price of Gold

**Dr. Martin Murenbeeld, Murenbeeld & Co. Inc.**

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**Session: Commodities & Financial Markets**

**Time: 3:40 PM – 4:00 PM**

This presentation will cover recent developments in the gold market. It will then introduce a number of factors—both bullish and bearish—that the author believes will have a strong bearing on the price of gold over the next 12–18 months. The presentation will conclude with some numerical forecasts of the gold price based on how different economic and financial scenarios might unfold—and our probability of the most likely scenario.

## **Geoscience BC Adds to the Toolbox: New Geophysics for Northern Vancouver Island**

**Todd Ballantyne, in3D Geoscience Inc.; Christa Pellett and Brady Clift of Geoscience BC**

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**Session: Additions to the Geoscience Toolbox**

**Time: 1:15 PM – 1:30 PM**

This session details new public minerals geoscience from Geoscience BC's Vancouver Island North regional project (VIN), which will be published on the morning of January 21<sup>st</sup>, 2020.

Vancouver Island has a long history of mining and mineral exploration. High-quality public geoscience data provide mineral explorers with tools to identify regional geological and structural targets and adds regional perspective.

The VIN project includes regional airborne magnetic and radiometric data for a 6127 km<sup>2</sup> area of northern Vancouver Island, from Tahsis in the southwest to Port McNeill in the northwest and near Sayward in the northeast. The project builds on geophysics and complements geochemistry completed for Geoscience BC's 2012 Northern Vancouver Island project.

For VIN, Precision GeoSurveys collected horizontal-gradient magnetic and radiometric data using a helicopter survey flown at a nominal 80 m terrain-contouring height. Survey lines were spaced 250 m apart for a total survey distance of 26 973.4 line km.

The data and maps from VIN will provide mineral explorers with new high-resolution data from which they can generate both property-level targets and, since the survey is regional in scale, understand their projects in a broader context. Researchers will be able to develop new regional-scale frameworks to understand the geological history of the region and identify metallogenic trends and opportunities. Land-use planners, governments and Indigenous groups will have modern data from which resource management or economic development opportunities can be identified.

Data and maps from the survey will be available on the morning of January 21<sup>st</sup>, 2020, at Geoscience BC's Roundup booth (#217), through the website ([www.geosciencebc.com](http://www.geosciencebc.com)) and Geoscience BC's Earth Science Viewer online mapping application.

## Late Neogene Porphyry Cu-Mo( $\pm$ Au-Ag) Mineralization in British Columbia: the Klaskish Plutonic Suite, Northern Vancouver Island

**Graham Nixon, B.C. Geological Survey; Richard Friedman, The University of British Columbia; Robert Creaser, University of Alberta**

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**Session: Additions to the Geoscience Toolbox**

**Time: 1:30 PM – 1:45 PM**

Late Neogene porphyry Cu-Mo mineralization hosted by the Klaskish Plutonic Suite in northern Vancouver Island occupies a unique position in the forearc of the Cascadia subduction zone. The Klaskish granitoid plutons and Alert Bay volcanic rocks make up the Brooks magmatic suite, which forms a northeast-oriented zone, the Brooks-Haddington tract, extending for 65 km across the island from the Pacific coast to Queen Charlotte Strait in the east. The southern part of the Brooks-Haddington tract is marked by a narrow (10 km) structural corridor, the Brooks Peninsula fault zone, which hosts the mineralized Klaskish intrusions. The northern part of the tract is occupied by eroded edifices of the Alert Bay volcanic suite.

High-precision U-Pb zircon and Re-Os molybdenite dates for mineralized stocks of the Klaskish Plutonic Suite (ca. 7–4.6 Ma) confirm that their emplacement was coeval with older phases of Alert Bay volcanism (8–2.5 Ma), and that porphyry Cu-Mo magmatic-hydrothermal systems are genetically linked to pluton emplacement and crystallization. Neogene plutons associated with porphyry Mo/Cu-Mo mineralization elsewhere in British Columbia are restricted to the Pemberton Arc in the southeastern Coast Mountains, where pluton ages diminish progressively northward.

The late Neogene porphyry Cu-Mo mineralizing systems in the Pemberton Arc and forearc environment of northern Vancouver Island are linked to the plate tectonic evolution of the northern Cascadia subduction zone, notably plate-edge effects generated by subduction of the Juan de Fuca Plate and newly redefined Nootka fault zone in the oceanic crust. The young Cu-Mo porphyry mineralization in northern Vancouver Island forms a well-defined metalotect that is underexplored and rife with opportunities for discovering economic porphyry deposits.

## Northern Vancouver Island Multi-Media Drainage Geochemical and Lead Isotopic Survey

**Alexei S. Rukhlov and Gabe Fortin of B.C. Geological Survey; Gennady N. Kaplenkov, Independent Consultant; Ray E. Lett, B.C. Geological Survey Emeritus; Vivian W.-M. Lai and Dominique Weis of Pacific Centre for Isotopic and Geochemical Research, The University of British Columbia**

**Session: Additions to the Geoscience Toolbox**

**Time: 1:45 PM – 2:00 PM**

Drainage geochemical surveys have been widely used in mineral exploration for decades. Carried out by mining companies since 1950s and later managed by the Geological Survey of Canada, the B.C. Geological Survey and Geoscience BC, regional drainage geochemical survey (RGS) programs in British Columbia have collected and analyzed stream, lake and moss-mat sediments and waters for a wide range of elements. Interpretation of the geochemical data has led to the discovery of numerous world-class precious- and base-metal deposits such as Highland Valley Copper, Northair Gold, Galore Creek, Berg, Huckleberry and Equity Silver.

Proven by centuries of prospecting, panning of stream sediment is the most effective technique to find economic deposits of placer gold, diamonds, tin, tungsten and other commodities. Modern analytical methods determining concentrations of up to 65 elements in different sample media permit evaluation of geochemical resources based on the dispersion of elements in drainage systems. Geochemical zoning of primary and secondary dispersion halos around an orebody, ranked element contrast relative to local background, and drainage productivity are the basis for predicting type, size and level of erosion of a drained deposit.

Geochemical and Pb isotopic surveys on northern Vancouver Island tested stream sediments, heavy mineral concentrates (HMC) and waters draining prospective rocks hosting porphyry Cu-Mo-Au and other styles of mineralization. The authors demonstrate that geochemistry of HMC (200–400 g) recovered by sluicing 11–16 kg of the <2 mm size fraction of alluvium is more representative than that of bulk stream sediment samples (<0.18 mm size fraction). Regional geochemical surveys (RGS) collecting one near-mouth HMC sample per watershed are quick, economic and efficient to delineate prospective basins for a wide range of large-tonnage ore deposits, including non-traditional types that would have been missed by previous RGS programs. The HMC mineralogy, Pb isotopes and hydrochemistry help further refine predicted ore systems in a stream catchment.



## Finding Deeper Porphyry Copper Deposits in the Canadian Cordillera Using Epidote Chemistry

**A. Plouffe, Geological Survey of Canada; I. Kjarsgaard, Mineralogical Consultant; D. Petts, Geological Survey of Canada; and T. Ferbey, B.C. Geological Survey**

**Session: Additions to the Geoscience Toolbox**

**Time: 2:00 PM – 2:15 PM**

The next generation of porphyry copper deposits to be discovered in the Canadian Cordillera is likely to be buried by glacial sediments and located deeper than known deposits. To overcome this 'poor-exposure and depth' challenge, the authors are investigating the composition of epidote, a mineral common in alteration zones that surround porphyry systems, as a means of detecting copper ore at depth. Epidote is a resistant mineral that can be dispersed from its bedrock source by detrital processes. In previous studies, the presenters demonstrated that epidote is more abundant in till near porphyry mineralization compared to surrounding background regions. The distribution patterns of epidote in till result from glacial erosion and dispersal from the porphyry alteration zones; consequently, identification of an epidote anomaly in till could become a means of detecting porphyry copper mineralization covered by glacial sediments. In the Canadian Cordillera, the challenge is then to discriminate between epidote derived from porphyry hydrothermal alteration versus epidote sourced from barren rocks. In the Cordillera, metamorphic epidote commonly occurs within Upper Triassic Nicola volcanic and volcanoclastic rocks. The presenters analyzed the composition of epidote from porphyry alteration zones and Nicola rocks by LA-ICP-MS. In epidote of Nicola rocks, Hf, Th, Sc, Cr and Y occur in higher concentrations compared to epidote from porphyry alteration zones. In addition, the As and Sb content of hydrothermal alteration epidote is higher than in metamorphic epidote. Epidote grains recovered from till in the region of three porphyry deposits have a composition diagnostic of porphyry alteration (i.e., lower Hf, Th, Sc, Cr and Y and higher As and Sb concentrations relative to Nicola epidote). The authors conclude that the composition of epidote in detrital sediments within a prospective geological setting can provide an indication of buried porphyry Cu mineralization.

## Finding New Resources in Old Ground: Digitizing and Modeling Historical Dredging Data to Locate Prospects in the Klondike, Yukon

**Jeffrey Bond, Sydney van Loon and Brett Elliot of Yukon Geological Survey; Laura Grieve, Aspect North**

**Session: Additions to the Geoscience Toolbox**

**Time: 2:15 PM – 2:30 PM**

Yukon Consolidated Gold Corporation (YCGC) largely controlled placer mining in the Klondike from 1923 to 1966. They operated 12 dredges, employed up to 700 people and produced approximately 2 million ounces of gold during this period. This industrious operation required an extensive exploration and development effort that was well documented over the course of four decades of mining.

YCGC maps and reports are stored at the National Archives in Ottawa. Since 2013, Yukon Geological Survey (YGS) has been scanning, cataloguing and digitizing files in an effort to revitalize the data and make it available to claim holders in the Klondike. To date, this effort has processed 854 maps and 225 textual documents containing thousands of pages of information. Common map data include drill information (e.g., depth to bedrock and grade), dredging limits, process volumes and claim boundaries. Textual documents include yearly overviews, production results, reserve inventories, drill data and geological investigations.

Acquisition of this dataset has allowed YGS to digitize more than 12 000 points (drill holes and shafts), 31.4 km<sup>2</sup> of polygons, and footprint 854 maps from 15 drainages. Digital data are released through the YCGC Historic Placer Data web app on the YGS website. Research and prospecting opportunities that result from these data facilitate both placer and hard-rock exploration. Placer application examples include targeting economic deposits marginal to the dredge limits, evaluating dredge efficiency and modeling former pay streak geometry. For hard-rock exploration, concentrations of placer gold can be modeled against bedrock structural interpretations to target potential mineralization.

The effort of previous generations should not be underestimated when exploring in historical mining camps. Incorporating historical data into modern software platforms creates a powerful opportunity for discovery. The YCGC historical data project provides a model for acquiring, managing and digitally releasing vintage data.

## **Remotely Piloted Aircraft Systems: The Newest Addition to a Field Geologist's Toolbox**

**Travis Ferbey and Easton Elia of B.C. Geological Survey**

### **Session: Additions to the Geoscience Toolbox**

**Time: 2:45 PM – 3:00 PM**

Remotely piloted aircraft systems (RPAS) can be used in the field to acquire air photos and produce digital elevation models (DEM), orthomosaics and 3D models. In this study, the researchers examined if field-generated photogrammetric DEMs in a remote, sparsely vegetated mountainous region of north-central British Columbia are of adequate resolution to guide surficial geology mapping. Using a quadcopter RPAS with RTK positioning, more than 150 line km were flown in 16 missions, taking photographs with a visible light RGB digital camera equipped with a 1 in. CMOS sensor and mechanical shutter. Once programmed using flight-planning software, the aircraft flew itself at 4 m/s, at heights <120 m above the ground, and with a line spacing that gave 70% horizontal overlap (side lap) and 80% vertical overlap (end lap). The air photos were then processed in the field using structure from motion (SfM) photogrammetry to create topographic DEMs. With resolutions of <10 cm/pixel, these DEMs, in unvegetated areas, rival those produced using LiDAR. Easy to acquire, affordable and immediately accessible, the DEMs provided details in near-real time about surficial geology map units that field crews would not otherwise have gained. Not only did the DEMs help better define map units, they enabled the gathering of data on glacier movement during the Late Wisconsinan by highlighting landform-scale streamlined features that could not be identified in air photos nor measured on the ground.

## Shovel-Mounted and Belt-Based XRF Sensing for Compositional Data – Empowering Decision-Making at the Digital Mine

**David Turner, Ken Scholey and Maarten Haest of MineSense Technologies Ltd.**

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### **Session: Additions to the Geoscience Toolbox**

**Time: 3:00 PM – 3:15 PM**

Bulk ore sensing and sorting technologies are quickly maturing and being adopted by mines alongside digitalization and automation. Mines are recognizing that sorting improves not only performance and financial metrics, but also environmental metrics. Shovel and belt-based ore sorting provide opportunities to recover ore destined for waste piles and redirect uneconomic or deleterious run-of-mine material at early stages of mining, preventing that material from entering costly and intensive downstream processes.

Bulk data collection by XRF empowers decision-making for operational excellence, but it also imparts changes to material handling and the overall composition of that material, which is relevant based on its original location and forward to its ultimate destination. While shovel and belt-based XRF cannot equal multi-element ICP-MS analyses of diamond drill core, the real-time nature of data collection on operational equipment fills an information void and provides a spatially and geochemically rich dataset that can be leveraged both upstream and downstream.

Upstream, for example, reconciliations can be carried out using the high spatial-temporal resolution shovel-scale (approximately 10–40 m<sup>3</sup>) sensing data from effectively in-situ material against grades measured in drill holes or estimates in resource blocks (approximately 1500 m<sup>3</sup>). Downstream, a ‘cleaned’ mill feed will have inherently improved head grades, and additional short-interval belt sensing can enable further sorting, feed-forward optimized process control and insights into plant challenges. Further upstream or downstream, the data and knowledge generated can potentially facilitate brownfields exploration and resource utilization or more effective management of waste rock.

As more mines embrace bulk ore sensing, the volume (and types) of data will increase dramatically and the use cases for its consumption will grow equally quickly. Simultaneous advances in digitalization within and across mines and the leveraging of cross-disciplinary data will continue to improve operational excellence for all stakeholders. Due to the contextual nature of bulk sensing, geoscientists will play an important role in its interpretation and use.

## Three-Dimensional Magnetotelluric Mineral Exploration, An Overview of Targeted Geoscience Initiative Studies

**Jim Craven, Vicki Tschirhart, Masoud Seyed Ansari and Ernst Schetselaar of Geological Survey of Canada; Eric Roots, Laurentian University; Dwayne Wade, New Gold Inc.**

### **Session: Additions to the Geoscience Toolbox**

**Time: 3:15 PM – 3:30 PM**

The Targeted Geoscience Initiative (TGI) is a program at the Geological Survey of Canada (GSC) providing industry knowledge and innovative techniques to improve their ability to identify deeply buried deposits. The magnetotelluric (MT) group at the GSC, in collaboration with industry and academia, have tested and developed a number of innovative approaches to data analysis and deep target identification. An overview of key results from three project areas will be presented:

- 1) Lalor (VMS) – Following the demonstrable success identifying potential new targets with an improved understanding of a synthetic 3D seismic response at the Lalor VMS mine in northern Manitoba, a similar study was undertaken utilizing MT data. A methodology was developed to build unstructured meshes that more accurately reflect subsurface geometries and electrical rock properties, and have pioneered new finite-element algorithms to calculate the forward MT responses. These innovations increase the confidence to utilize disparities between forward responses and data as a means to identify new targets, or regions where the geological model requires updating.
- 2) New Afton (Cu-Au porphyry) – Preliminary low-resolution modelling of an extensive set of 332 industry MT sites indicated the need for a refined rectilinear mesh to improve target delineation. Mesh rotation was applied to enhance model resolution, and the utility of MT to image both primary and secondary mineralization was demonstrated. A need for wide-aperture MT datasets to address possible regions of anisotropy was also highlighted.
- 3) Patterson Lake Corridor (uranium) – To image both deep and accurately, there is a need for wide-aperture MT surveys that typically extend beyond exploration lease boundaries; therefore, MT data collection was undertaken by the presenters. Comparative 2D and 3D models computed in the cloud and integrated with potential field, along with structural and geochemical data provide key evidence for a new paradigm for uranium exploration in this area.

## B.C. Assessment Report Databases and Digital Data Submissions

**Gabe Fortin, B.C. Geological Survey**

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**Session: Additions to the Geoscience Toolbox**

**Time: 3:30 PM – 3:45 PM**

The B.C. Geological Survey (BCGS) houses more than 37 000 assessment reports, representing more than C\$2.5 billion in mineral exploration expenditures. These reports are made available for download in PDF format. Even though PDF files provide easy access to the reports, extracting data from them is time consuming and expensive.

To improve the usability of assessment report data, the BCGS has begun focused efforts to extract and compile data from these reports, starting with surface sediment geochemical samples (mainly soil samples). The current release (GeoFile 2019-04) contains approximately 40 000 samples with more than 1.6 million analyses. It is provided in a GIS-ready format that can easily be visualized and manipulated. Work is also in progress on a compilation of drill hole data, which will be released in the coming months.

The release of the surface geochemical and drill hole databases is just the beginning of a broader, long-term effort by the BCGS to compile assessment report data as well as encourage the submission of digital data with assessment reports. Digital data associated with assessment reports can now be submitted directly through the BCGS website ([ardata.bcgeologicalsurvey.ca](http://ardata.bcgeologicalsurvey.ca)).

## Structural Tools for Differentiating Archean Orogenic from Intrusion-related Veins

**Bruno Lafrance and Daniel Kontak of Laurentian University; Joycelyn Smith, SRK Consulting; Jordan McDivitt, The University of Western Australia**

**Session: Precious Metals**

**Time: 9:05 AM – 9:30 AM**

Auriferous intrusion-related quartz sulphide veins are spatially associated with intrusions and largely coeval with their emplacement. For intrusions hosted within large corridors of deformation, associated intrusion-related veins may undergo folding, shearing and boudinage and may appear similar to orogenic vein systems that were emplaced during deformation. In the Archean Abitibi-Wawa subprovince, quartz sulphide veins at the Renabie gold deposit in the Michipicoten greenstone belt and the Côté gold deposit in the Swayze greenstone belt were interpreted as orogenic gold vein systems because of their association with shear zones and proximity to large crustal structures, such as the Ridout deformation zone in the southern Swayze greenstone belt. The veins are deformed within shear zones, which overprint the ca. 2740 Ma Chester intrusive complex (Côté) and the ca. 2720 Ma biotite tonalite of the Missinaibe Lake batholith (Renabie). Structural field analysis of the veins and intrusions suggest that they predate the formation of the shear zones, their reactivation and the development of regional fabrics within the greenstone belts. The veins were deposited from mineralizing fluids that were released during the crystallization of intrusions belonging to the Chester intrusive complex. During regional deformation, the veins and their weak phyllic-type alteration halo acted as planar anisotropies that localized the formation of the shear zones. This produced shear zones with deformed, intrusion-related veins similar to orogenic gold systems; however, unlike orogenic gold veins that were emplaced in active shear zones, their orientation and geometry are not consistent with the kinematics of the shear zones hosting them and simple structural tools can be used to interpret their origin.



## **Fosterville Gold Project: Discovery of the High-Grade Swan Zone**

**Troy Fuller, Braden Verity; Simon Hitchman, Wessley Edgar, Ashley Jackson and Nathanael Pittaway of Kirkland Lake Gold**

**Session: Precious Metals**

**Time: 9:30 AM – 9:55 AM**

The Fosterville gold mine is located approximately 20 km east of the city of Bendigo within the historical gold province of Central Victoria, Australia. The deposit is hosted within Ordovician turbidites of the Bendigo zone within the western Lachlan Orogen. The sedimentary sequence has been deformed into north-south-trending folds that are cut by thrust fault systems as a result of episodic and eastward progressing deformation and metamorphism. Mineralization is structurally controlled and is typified by refractory gold occurring in fine-grained arsenopyrite and/or pyrite disseminated in the country rocks as selvages to faults or veins.

The Fosterville gold mine has enjoyed substantial recent success and the future is extremely bright after the transformational discovery of high-grade visible gold 'Swan' mineralization in veins at depth. For the majority of Fosterville's history, cash margins have been small and exploration budgets tight, but persistence and progressive well-planned exploration and definition drilling of down-plunge trends of mineralization has ultimately led to one of the most economic discoveries in recent times.

The discovery has caused geologists and researchers to have to modify their thinking in regards to Central Victorian orogenic gold models. Recent learnings have opened up enormous opportunity for further discovery throughout the region. Kirkland Lake Gold is continually advancing its understanding of these large and complex gold systems, now knowing that exceptionally high grade gold mineralization can be discovered in select geological environments within.

The Fosterville story is a clear demonstration that world-class deposits can be found in existing and historical mining centres. With persistence, commitment and robust exploration strategy great success can be realized. Geological models should continue to be challenged and geologists need to keep an open mind and have the ability to react to observations that do not conform to the status quo.

## **Exploration Strategies for Atypical Gold Deposits in the Meguma Terrane, Nova Scotia**

**Tim Bourque, David Lowe, and Klaus Popelka of Atlantic Gold – St. Barbara Ltd.**

**Session: Precious Metals**

**Time: 9:55 AM – 10:20 AM**

Gold in Nova Scotia was first discovered in the late 1850s, culminating in the further discovery of more than 60 separate gold districts and the production of 1.4 million ounces from 'orogenic-style', vein-hosted deposits in the Cambrian–Ordovician metasedimentary rocks of the Meguma Terrane. Atlantic Gold (a

wholly owned subsidiary of St. Barbara Limited) has been exploring for gold in the Meguma since the early 2000s, successfully uncovering the potential of disseminated mineralization overlooked by past explorers. With advanced insight from the Australian management team, the first open-pit gold mine was put into operation in 2017 and has produced over 150 000 oz from the Touquoy deposit. The 2019-published NI 43-101-compliant resource estimate of Touquoy is 11.26 million tonnes at 1.23 g/t Au for 445 100 oz (cut-off grade 0.3 g/t).

The auriferous Meguma Terrane comprises a lower quartzite (greywacke) sequence—the Goldenville Group—overlain by a sequence of slates (argillites)—the Halifax Group. They are intruded by substantial volumes of granite (Devonian–Carboniferous) and, importantly, uplifted and deformed into a series of tightly folded, subparallel, northeast-trending anticlines and synclines. The basal unit of the Goldenville Group—the Moose River Formation—has been the focus of the exploration efforts yielding the Touquoy deposit and Atlantic Gold’s other three advanced projects; Beaver Dam, Fifteen Mile Stream and Cochrane Hill. Greenfield and brownfield targets have been worked alongside the advancement of the known deposits to further upgrade the reserve potential of Atlantic Gold’s portfolio in the Meguma Terrane.

Conventional exploration efforts were focused on the ‘Meguma-style’ high-grade, narrow-vein mineralization, leading to the overlooked host-rock-disseminated gold that allows for the current low-grade bulk tonnage mining success. Atlantic Gold’s approach looks beyond this typical exploration view with the application of new models and techniques, allowing for a broader targeting approach. Ongoing exploration strategies integrate existing knowledge with new technologies, drilling techniques, assay methods, geochemistry and geophysics.

## **Meliadine Gold Mine, Nunavut: From Exploration to Production, Geology Update**

**Jean-Claude Blais, Agnico Eagle Mines Limited**

**Session: Precious Metals**

**Time: 10:20 AM – 10:45 AM**

The Meliadine gold mine is located in Canada’s low Arctic, approximately 25 km northwest of Rankin Inlet in Nunavut. Mineralization was discovered in the late 1980s. Meliadine’s current mineral resources are part of the Archean Rankin Inlet greenstone belt and include seven banded iron formation–hosted gold deposits along the northwest-trending regional Pyke fault.

The Meliadine gold mine poured its first gold bar on February 21, 2019, with official commercial production starting on May 14, 2019. The current life-of-mine plan projects the mine to produce up to approximately 400 000 oz Au per year by underground and open-pit mining methods over 14 years.

The excellent exploration potential of the project area is one of the key elements that lead to its acquisition by Agnico Eagle Mines Limited in 2010. Since acquisition, focused exploration work and intensive diamond-drilling campaigns have increased the mineral resources by approximately 90% supporting Agnico Eagle’s view on the project’s exploration potential. As of December 2018, Meliadine constitutes Agnico Eagle’s largest asset in terms of total mineral reserves and resources.

The Tiriganiaq deposit is Meliadine's most important mineral resource and contains numerous lodes with challenging geometries. Understanding the geometry and continuity of these lodes is crucial for the success of the project. Tiriganiaq's current 3D model is the result of an evolving geological interpretation based on orebody knowledge gained from early delineation diamond-drilling campaigns, underground development mapping and sampling in ore, and two Master's of Science projects in collaboration with the Institut National de Recherche Scientifique-Eau-Terre-Environnement, the Geological Survey of Canada and the Université du Québec à Montréal. The effectiveness of the updated geological model is being supported by production mining results and exploration at depth below the known portions of the Tiriganiaq deposit.

The Meliadine journey—from first discovery of gold occurrences in the Rankin Inlet area to pouring its first gold bar in 2019—has been filled with challenges, learnings and successes. Agnico Eagle hopes to extend Meliadine's operations well beyond its current mine life with continued exploration by leveraging the high exploration potential of the area and an ongoing commitment toward orebody knowledge.

## **Black Pine Project: A Large, Carlin-style Gold System, Southern Idaho**

**Moira Smith, Liberty Gold Corp.**

**Session: Precious Metals**

**Time: 10:45 AM – 11:10 AM**

The Black Pine gold oxide project is in the Great Basin of southeastern Idaho. In the 1990s approximately 465 000 oz Au were produced from five small pits in a run of mine heap leach operation. Liberty Gold acquired the property in mid-2016 and undertook comprehensive drill permitting, detailed compilation and modeling of over 1800 historical drill holes and thousands of surface samples. The compilation study revealed extensive unmined gold mineralization over an area of 12 km<sup>2</sup>. Liberty Gold commenced drilling in 2019.

Sedimentary rock–hosted gold mineralization occurs in Pennsylvanian to Permian Oquirrh Group carbonates, and calcareous siltstone and sandstone rocks, all of which underwent extensive structural preparation through Sevier (late Cretaceous) folding and thrusting, as well as early Cenozoic normal faulting. Prospective gold-bearing strata form a thrust imbricated package ranging from 100 to more than 300 m thick. Gold-bearing fluids were introduced along a series of moderate-angle normal faults, with the dominant set striking northwest and dipping to the northeast. Gold mineralization is accompanied by elevated arsenic, antimony, thallium, mercury and barium, as is typical of Carlin-style gold systems on the Carlin trend. Alteration includes jasperoidization, weak decalcification, clay alteration, calcite veining and iron oxides. Very minor disseminated pyrite is observed locally.

Drilling in 2019 by Liberty Gold has produced many impressive gold intercepts, including 53.3 m grading 4.39 g/t, 62.5 m grading 3.40 g/t, and 44.2 m grading 3.14 g/t. Weighted average cyanide-soluble assays for these intervals average up to 97% of the fire assay, attesting to the thoroughly oxidized nature of gold mineralization. Liberty Gold believes that historical data and current drilling results support the thesis that a shallow, oxidized, multi-million–ounce gold system exists at Black Pine.

## Clarence Stream New Brunswick – A New and Emerging Gold District

**Michael Sutton, Galway Metals Inc.**

### **Session: Precious Metals**

**Time: 11:10 AM – 11:35 AM**

Located in southern New Brunswick, the Clarence Stream was discovered by a prospector using Government stream sediment and till samples; Freewest Resources Canada Inc. drilled the North and South zones in 2000, and continued expanding both zones until its takeover by Cliffs Natural Resources Inc. Galway now owns 100% of a large, 65 km strike length, land package consisting of 60 000 ha on which there are multiple gold showings and geochemical targets. Additional drilling since 2016 on both deposits has resulted in a high-grade open-pit constrained and underground resource (September 2017) totalling 390 000 oz of gold in the NI 43-101 compliant measured and indicated categories, and 277 000 oz of gold in the inferred category. Galway has since discovered two new deposits that are directly on strike with a third previously known deposit. Visible gold in quartz veins and stockworks is common along all three of these deposits, with drill intersections including 241.5 g/t Au over 4.2 m, 7.3 g/t over 36.7 m and 1.9 g/t over 43.3 m. It is thought that all three deposits, which cover 2.5 km of strike length, are part of the same system. None of these deposits are in the resource. All five deposits are open in all directions.

The project is located near the boundary of the Gander and Avalon terranes of the Canadian Appalachians; the same trend on which Marathon's Valentine Lake project and Oceana's Haile mine are located. Four of the five deposits are located along the Sawyer Brook fault system, which is a major accretionary structure on the Silurian–Ordovician contact. Mineralization is associated with bismuth, silver, arsenic and antimony. Granitic dikes grade laterally into auriferous quartz veins. It is thought that high-temperature chloride complexes and multiple generations of auriferous quartz had their source from intrusions emplaced during at least two time periods. The sediments and gabbro dikes that host mineralization have been folded, resulting in voids and contact areas, and along with secondary structures emanating from the Sawyer Brook fault have combined to create fertile ground for gold deposition. The closest analogies are thought to be the Fort Knox and Pogo deposits.

## Exploring Under Cover for Komatiite-Hosted Nickel Deposits in the Northern Abitibi

**Michael J. Tucker and Darin Wagner of Balmoral Resources Ltd.**

**Session: Base Metals**

**Time: 1:20 PM – 1:40 PM**

Komatiite-related sulphide deposits represent an important source of nickel, copper and platinum group element ore globally. The Abitibi greenstone belt in Canada is the largest known greenstone belt worldwide yet hosts relative few komatiite-hosted nickel deposits, and certainly none that rival the size of those found within greenstone belts of Western Australia. This disparity is likely the result of a combination of many factors; however, the Abitibi in general has not experienced the level of komatiite-related nickel exploration as has Western Australia. This is due in part to the fact that a very large portion of the Abitibi is under deep (>20 m) overburden cover, making exploration exceedingly difficult.

In 2014, the Grasset nickel deposit was discovered by Balmoral Resources in the northern Abitibi greenstone belt. The deposit sits under approximately 80 m of overburden cover and is hosted at the southern end of a 10 km long sequence of komatiitic flows and subvolcanic intrusions (Grasset Ultramafic Complex [GUC]) that is coeval with a rhyolite volcanic assemblage. A 2016 indicated resource estimate for Grasset yielded 3.46 million tonnes at 1.54% Ni, making the Grasset nickel deposit one of the largest komatiite-hosted nickel deposits discovered in the Abitibi. Targeted geophysical techniques and a refined geological and geochemical model produced through the delineation of Grasset aided in the recent discovery of a high-grade basal komatiite contact-style nickel mineralization approximately 7 km northwest of the Grasset deposit. Three discoveries in the span of 4 years (including 2.5 years of no activity as a result of low nickel prices) bodes well for the future exploration potential of the GUC and its potential to evolve into one of the most fertile komatiite belts in the Abitibi. It is also unlikely that the GUC exists in isolation, as the Abitibi is a vast region and in many locations has been sparsely explored, particularly for komatiite-hosted nickel deposits.

## Building Value Through Integrated Geoscience; San Nicolás VHMS Deposit, Zacatecas, Mexico

**Honza Catchpole, Tina Roth and Mario Canela of Teck Resources Limited**

**Session: Base Metals**

**Time: 1:40 PM – 2:00 PM**

Teck Resources Limited (Teck), through its Mexican subsidiaries, owns 100% of the San Nicolás VHMS copper-zinc-gold-silver deposit located in Zacatecas state, Mexico, 60 km southeast of the city of Zacatecas. Teck discovered the deposit in 1997 through mapping, geophysics and drilling. Current mineral resources at San Nicolás include 108.9 million tonnes at 1.17% Cu, 1.62% Zn, 24.5 g/t Ag and 0.43 g/t Au in the measured and indicated categories

The deposit occurs in a Mesozoic bimodal volcanic and sedimentary sequence, unconformably overlain by up to 180 m of post-mineral Tertiary volcanoclastic rocks. Mineralization is hosted by rhyolite lava flows and breccias overlain by mafic lava flows, sills, tuffs and interbedded mudstone. Mineralization occurs as massive to semi-massive sulphides dominated by pyrite with significant sphalerite±galena in the upper zinc-rich zone, transitioning downwards to massive pyrite and chalcopyrite in the copper-rich zone. The deposit is flanked by a northwest-trending syn-volcanic structure.

Key value milestones for the San Nicolás project include the completion of a prefeasibility study (PFS) and environmental studies, currently in progress, for the preparation and submission of an environmental impact statement (Manifestación de Impacto Ambiental [MIA]) (MIA). A fundamental input to both the PFS and MIA is the completion of an integrated geoscience model for the project that is supported by more than 108 km of multi-purpose drilling.

The geoscience model serves as a key platform to 1) complete a well-constrained resource estimate; 2) define geometallurgical domains that optimize metal recovery and maximize paid metal; 3) strengthen the geotechnical engineering parameters; 4) build the hydrogeology model; 5) inform environmental aspects such as waste rock management and 6) design an optimized and robust mine plan and associated production schedule.

The integrated geoscience model provides a solid foundation on which to design a high quality project and has increased confidence in the investment potential of the project.

## **Pine Point: Restarting One of Canada's Most Storied Mines**

**Jeffrey Hussey, Osisko Metals Inc.**

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**Session: Base Metals**

**Time: 2:20 PM – 2:40 PM**

Pine Point remains one of Canada's most storied zinc mines. Operating from 1964 to 1988, Pine Point was an important contributor to the development of the Northwest Territories. During its 24 year life, the mine was among the big three Canadian zinc mines, which included the Brunswick No. 12 Mine and the Faro Mine.

The shut down in 1988 was not Pine Point's swan song. Osisko Metals is diligently advancing substantial exploration initiatives and for the first time, this camp is using modern exploration tools. This has led to the creation of the first site-wide digital compilation that will be complemented by the 2019 airborne gravity survey, and a lineament analysis that includes an airborne LIDAR survey. With the new compilation in hand, Osisko Metals will be testing a range of high-quality targets across the project's 60 km strike length.

Already, Osisko Metals' work has resulted in the publication of two NI 43-101 compliant mineral resource estimates (MRE) over a 12 month period. The latest MRE, published in November 2019, outlined 52.4 million tonnes grading 6.47% Zn Eq of which 47.7 million tonnes are defined as pit constrained. This unique, near-surface mineralization separates Pine Point from other zinc projects and is a key advantage over peers.



In 2020, Osisko Metals will continue to leverage its exploration potential for new discoveries across the camp. Concurrent to these efforts, Osisko Metals will also aim to publish an economic study in the first half of the year. Hydro-electric power and haul roads available on-site, a rail head within 60 km and paved road access to the site form a substantial supportive infrastructure with clear benefits. With all of this combined with the reputation of producing a historically clean, high-grade concentrate, Pine Point is well positioned to be at the forefront of base-metal projects globally.

## **Marimaca: A New Copper Oxide Deposit in Chile's Coastal Belt**

**Sergio L. Rivera, Coro Mining Corporation**

**Session: Base Metals**

**Time: 2:50 PM – 3:10 PM**

The Marimaca copper oxide deposit, located in the very well explored Chilean Coastal Copper Belt, was discovered in 2015, contains close to 620 000 tonnes of Cu, and is one of the most significant discoveries made during the last decade in the country. In many respects, its discovery is a remarkable success considering the unconventional geological nature of the deposit.

Unlike the common, volcanic-hosted, stratiform or 'manto-type' copper deposits typical of the Chilean Coastal Copper Belt, Marimaca is hosted by an extremely fractured and dike-intruded monzodiorite stock. The most remarkable structural feature is a north-trending, east-dipping sheeted system of fractures that can be traced for kilometres in outcrop. At Marimaca, the copper oxide body is largely controlled by this pattern of fractures and by late northeast and west-northwest fault systems. An alteration front limits the extension of mineralization toward the east. Thus, the actual shape of the mineralized body resembles a 'manto' exposed at surface and dipping to the east at roughly 40 to 50 degrees.

Copper mineralization comprises atacamite, brochantite, chrysocolla and copper wad. Remnants of secondary sulphides, chiefly chalcocite and lesser covellite, confirms that the oxide derives from the oxidation of an earlier secondary enrichment blanket. Deeper drill holes encountered hypogene sulphide mineralization that consists mostly of veins and veinlets of massive chalcopyrite with some primary covellite and minor pyrite. Alteration minerals accompanying the primary copper mineralization are chlorite, epidote, actinolite and albite together with magnetite and minor hematite.

The discovery of the 100% outcropping Marimaca copper deposit was made by means of detailed and imaginative fieldwork in an area that had been explored for decades. In this case, the supposed exploration maturity of the Coastal Copper Belt perhaps became a self-fulfilling prophecy that deterred previous explorers from actually going out and exploring.

## Rediscovering the Raska Porphyry and Epithermal District, Serbia

**Fabian Baker, President & CEO**

**Session: Base Metals**

**Time: 3:10 PM – 3:30 PM**

The Raska district is located in southern Serbia, within the Western Tethyan mineral belt, and at the northern extension of a magmatic-hydrothermal district that hosts the former Trepca mining complex and smelter. Trepca included at least six lead-zinc-silver mines and, in the 1980s, is reported to have accounted for more than 70% of Yugoslavia's mineral wealth and employed more than 20 000 people.

The geology includes an Oligocene to Miocene magmatic complex, intruding and overlying serpentinite and carbonate units of the Vardar ophiolite, which was obducted during the closure of the Tethys Ocean. The Raska district hosts lead-zinc-silver vein-type and carbonate replacement deposits, which were the focus of historical exploration and small-scale mining dating back thousands of years. More recent exploration has discovered the potential for copper-gold porphyry mineralization.

Tethyan Resource Corp. has consolidated more than 400 km<sup>2</sup> of exploration licences in the Raska district, covering multiple historical lead-zinc-silver mines and exploration targets that are now recognized to be related and peripheral to at least two recently discovered copper-gold-mineralized porphyry centres also held by Tethyan. Tethyan's ongoing exploration program is advancing on both a district and local scale, using leading remote-sensing geochemical and geophysical methods as well as a focus on mapping in the style pioneered by Anaconda for porphyry exploration. This work has generated a number of exploration targets that have returned some significant copper-gold porphyry and high-grade lead-zinc-silver drill results to date.

## Diverse Mineralization Styles in the Lachlan Fold Belt, Eastern Australia: Exploration Opportunities and Approaches

**Stuart Smith, Inflection Resources Ltd.**

**Session: Base Metals**

**Time: 3:30 PM – 3:50 PM**

The Lachlan fold belt encompasses much of southeastern Australia and constitutes a segment of the larger Neoproterozoic to Mesozoic Tasman Orogen's Gondwana convergent margin.

The fold belt hosts a diverse range of mineral deposits that can typically be related to one of the major arc, thermal or shortening events. Significant orogenic gold deposits occur and include the central Victorian province, which has historically recorded production of approximately 80 million ounces, substantial remaining reserves and exploration potential (e.g., recent Kirkland Lake gold results). Major gold-rich alkalic porphyry (and associated deposits) developed in the late Ordovician to earliest Silurian Macquarie Arc, including the supergiant Cadia (more than 50 million ounces Au, more than 10 million tonnes Cu) and major Northparkes (more than 3 million tonnes Cu, more than 3 million ounces Au)

districts. Important tin-tungsten deposits occur associated with Silurian S-type granites of the Wagga tin belt and a suite of sediment- and volcanic-hosted polymetallic deposits formed in the late Silurian to late Devonian rift basins. These include the controversial deposits of the Cobar Basin (approximately 4.5 million ounces Au and 2 million tonnes Cu plus Zn-Pb-Ag) and more classical volcanic-hosted massive sulphide deposits elsewhere (e.g., Woodlawn, with 21 million tonnes at 11% Zn+Pb, 1.7% Cu, 0.5 g/t Au and 65 g/t Ag). Minor low-sulphidation epithermal, intrusion-related gold and porphyry systems are associated with late Devonian magmatic events.

Exposure in the fold belt is highly variable with the eastern and southern segments well exposed; however, approximately half of the fold belt is covered by Permian to Recent cover. High-quality, publicly available datasets allow targeting beneath these cover sequences and provide a substantial boost to innovative mineral explorers. Opportunities for discoveries must be considered high with so much of the fold belt being covered and therefore having relatively modest levels of exploration. Opportunities exist for innovative explorers who use the public domain data, state of the art interpretation-detection techniques and an extensive drilling.

## **Newcrest – Exploring Beneath Cover**

### **Fraser MacCorquodale, Newcrest Mining Limited**

#### **Session: Base Metals**

**Time: 3:50 PM – 4:10 PM**

Newcrest is known for its strong technical capabilities in exploration, deep underground block caving and metallurgical processing skills. The author will present some of the new technologies and approaches Newcrest is using to explore deep under the traditional search space. He will also review some of the recent successes the Newcrest team has had in the Paterson Province of Western Australia.

The Paterson Province in Western Australia covers about 30 000 km<sup>2</sup> to the east of the Hamersley Basin and southwest of the Canning Basin. It consists of Paleo- to Mesoproterozoic high-grade metamorphic rocks, acid and basic intrusive rocks, shelf sediments and minor younger granite intrusive rocks. The region contains poorly exposed Neoproterozoic sedimentary successions in the northwest Paterson Province, which are host to significant deposits of

- gold-copper (Telfer, Magnum),
- base metal (Nifty, Maroochydore) and
- uranium (Kintyre).

The Havieron project, located 45 km from Newcrest's Telfer mine in the Paterson Province, is operated by Newcrest under a farm-in agreement with Greatland Gold Plc. It is centred on a deep magnetic anomaly with the target overlain by more than 420 m of post-mineral cover. Fraser will discuss the promising drilling results from the Havieron project in 2019.

## Forgotten Silver – The Haldane Silver Project, Keno Hill District, Yukon

**Jason Weber, Alianza Minerals Ltd., and Murray Jones, Equity Exploration Consultants Ltd.**

**Session: BC/Yukon/Alaska**

**Time: 9:05 AM – 9:25 AM**

The Haldane silver project is located at the western end of Yukon's historic Keno Hill silver district, one of the highest grade silver camps in the world and Canada's second largest silver producer. Silver was found on Mt. Haldane in 1918, 15 km west of the original silver discoveries in the Keno Hill district. The mineralization at Haldane is characteristic of the district; complex vein-faults hosted in quartzite, consisting of galena, sphalerite and tetrahedrite in siderite gangue. Underground development at the Middlecoff zone in 1919 produced 24.7 t of hand-sorted ore at 3102 g/t Ag and 59% Pb.

No more significant work was done until the mid-1960s. Trenching exposed new vein-faults along strike from the original showings within a 1.6 km long structural corridor dubbed the Mt. Haldane vein system (MHVS). Subsequently, the MHVS was neglected again until 2010–2013, with the first(!) surface core drilling program on the property. Thirteen holes targeted the MHVS resulting in the identification of new vein-faults such as the West fault (320.0 g/t Ag, 0.67% Pb, 0.86% Zn and 1.118 g/t Au over 2.20 m), demonstrating the continuing potential for new discoveries on the property.

Alianza acquired the Haldane in 2018 realizing the property's patchy exploration history left considerable promise. Initially, Alianza went back to basics with blanket soil geochemical sampling, geological mapping and prospecting. This systematic work detected yet another new target, the Bighorn soil geochemical anomaly, 2.8 km west of the MHVS. In 2019, Alianza's first drill holes tested a combination of the new and the old. A single hole drilled across the Bighorn zone resulted in the discovery of at least four galena-sphalerite mineralized vein-faults, including one that returned 125 g/t Ag and 4.4% Pb over 2.35 m. At Middlecoff, drilling targeted the extensions of high-grade shoots in the historical workings, intersecting multiple vein-faults and returning 455 g/t Ag and 0.39% Pb over 1.0 m of heavily oxidized vein material and, separately, 966 g/t Ag and 28.35% Pb over 0.35 m, signifying the forgotten potential for high-grade silver in the system.

## Silvertip Mine, B.C. – Geological Overview and Exploration Update

**Will Robinson, Coeur Mining, Inc.**

**Session: BC/Yukon/Alaska**

**Time: 9:25 AM – 9:45 AM**

The Silvertip Mine is located in northern British Columbia, just south of the Yukon border, approximately 90 km by air west-southwest of Watson Lake, Yukon.

Silvertip is a silver-lead-zinc carbonate replacement deposit hosted within Middle Devonian rocks of the Cassiar Terrane. Most of the economic mineralization identified to date occurs as mantos along the

stratigraphic contact between the McDame limestone and overlying Earn Group sediments (deep-water black shales and turbidites).

Contacts between the massive sulphides and the host limestone can be remarkably sharp, but transitional zones of alteration (silicification, dolomitization), recrystallization and brecciation are common. The mineralization consists of early formed pyrite, pyrrhotite, sphalerite and lesser galena with a slightly younger, higher temperature sulphosalt-sulphide suite of minerals. The latter contain the main silver-bearing phases including pyrrargyrite-proustite, boulangerite-jamesonite and tetrahedrite (freibergite), as well as silver-rich galena. The mineralizing event is assumed to be Late Cretaceous (70 Ma) based on fluorine ages of quartz-sericite-pyrite (QSP) alteration proximal to felsic intrusions in the region.

Exploration work at Silvertip in 2019 consisted of 1) near-mine resource expansion drilling on the Discovery zone and 2) a regional reconnaissance program designed to discover and prioritize new Silvertip-like targets on the property. The main area of interest defined during the regional program, Tiger Terrace, is located approximately 5 km south of the current Silvertip mine and consists of an 8 km trend of prospective ground that displays multiple overlapping indicators of Silvertip-style Ag-Pb-Zn mineralization. High-priority targets at Tiger Terrace have been defined and are expected to be drill tested in 2020.

## High-Grade Gold Discovery at the Mount Hinton Property, Central Yukon

**Steve Israel, Strategic Metals Ltd.**

**Session: BC/Yukon/Alaska**

**Time: 9:45 AM – 10:05 AM**

The Mount Hinton property is located in central Yukon, about 460 kilometres north of Whitehorse. The property is located 4–15 km southeast of Alexco Resource Corp.'s mill at Keno City, is road accessible, and is 100% owned by Strategic Metals Ltd. A three-phase exploration program in 2019 uncovered several new quartz veins and mineralized zones. Sampling across two of these veins returned 30.5 g/t Au with 53.1 g/t Ag over 1 m and 24 g/t Au with 36.1 g/t Ag over 1.25 m. High-grade grab samples grading up to 2340 g/t Au with 597 g/t Ag and 202 g/t Au with 2020 g/t Ag were found within newly discovered northeast-striking zones of vein and breccia talus.

The Mount Hinton property shares the same tectonic, stratigraphic and structural characteristics as the silver-rich Keno Hill district and is underlain by late Proterozoic to Mississippian meta-siliciclastic rocks of the Selwyn Basin. The Keno Hill quartzite, characterized by quartzite and phyllite with minor sericite schist and meta-carbonate, comprises much of the property. These rocks were deformed and metamorphosed during latest Jurassic to Early Cretaceous thrusting that resulted in isoclinal folds and a strong penetrative foliation developed within the phyllite. Mid-Cretaceous extension is thought to have accommodated intrusion of the Tombstone and Mayo suites and structures related to this extension have been interpreted as pathways for mineralizing fluids.

Mineralization at the Mount Hinton property is hosted in quartz veins formed within northeast-striking, southeast-dipping normal faults and along bedding planes where the faults intersect less competent phyllitic rocks. There appears to be two phases of gold mineralization: an early high-temperature gold-arsenic plus sericite phase, followed by a slightly lower temperature Au-As-Ag-Pb-Sb phase. It is likely both phases are associated with magmatic hydrothermal fluids and differences in metal content reflect

zonation around a cooling pluton.

## Shovelnose Epithermal Gold Project – South Zone and Beyond

**Peter Fischl, Westhaven Ventures**

**Session: BC/Yukon/Alaska**

**Time: 10:25 AM – 10:55 AM**

The Shovelnose project covers 15 000 ha of the Spences Bridge Group, a 110 km long northwest-trending belt of mid-Cretaceous felsic and intermediate volcanic rocks. Historical exploration at Shovelnose since 2006 has uncovered numerous epithermal gold-silver showings that have seen various campaigns of trenching and drilling. Re-evaluation of the project in 2017 led to follow-up ground magnetic surveys and resampling of historical drill core for clay mineralogy (short-wave infrared [SWIR] spectroscopy) to map zones of hydrothermal upflow. Elevated illite crystallinities (higher paleo-temperatures) were identified proximal to several northeast-trending linear magnetic lows. Drilling of one such magnetic low in late 2017 discovered the South zone with the intersection of a vein zone averaging 0.52 g/t Au over 85 m.

Drilling of over 28 000 m since 2017 has defined three subparallel veins zones hosted in a rhyolite dome up to 250 m thick. Zone 1 is a 1000 m long quartz vein zone occurring over a vertical range of 350 m along a northwest-striking, steep southwest-dipping normal fault. Zone 2 is situated 100–150 m to the northeast of Zone 1 and has been traced for 760 m over a vertical range of 260 m. Zone 3, a splay off Zone 2 50–100 m northeast of Zone 2, has been drilled over a strike of 170 m and a vertical range of 130 m.

Vertical zonation of certain mineralogical and textural indicators assisted in the vectoring to higher grade mineralization. Strongest gold mineralization occurs over a 200 m vertical range in a shallow horizon of boiling that features a late phase of banded quartz veins containing adularia, bladed quartz after calcite, ginguero and electrum in centimetre- to metre-scale veins and breccia veins. This phase carries significant gold as seen in hole SN19-01, which intersected 39.3 g/t Au over 12.66 m in Zone 1, and hole SN19-10, which intersected 5.13 g/t Au over 52.1 m in Zone 2. Deeper veining features barren massive to weakly banded quartz with crystalline potassium feldspar.

Geophysical and soil geochemical surveys over the last two seasons on the Shovelnose property have uncovered additional targets. DC resistivity surveys have refined targets within and proximal to the South zone, whereas property-wide soil geochemical surveys and airborne and ground magnetic surveys have uncovered additional targets 4–10 km east and southeast of South zone.



## **Dolly Varden Silver Mining Camp, Northern British Columbia, Canada – One Hundred Years**

**Rob van Egmond and Ben Whiting of Dolly Varden Silver Corporation; Chris Sebert and Michelle McKeough of TerraLogic Exploration Inc.**

**Session: BC/Yukon/Alaska**

**Time: 10:55 AM – 11:15 AM**

Last season saw the historic Dolly Varden silver mining camp reach its 100<sup>th</sup> anniversary since the first mine came into commercial production. The Dolly Varden mine (1919–1921) and Torbrit mine (1949–1959) were past-producing silver-lead-zinc operations located in the Golden Triangle of northwestern British Columbia, Canada. Within the camp, there are multiple silver and base-metal deposits. The 2019 exploration program consisted of 11 836 m of diamond drilling in 44 drill holes, primarily outside of the existing resource blocks.

As well as launching a new resource estimate in 2019, Dolly Varden Silver Corporation conducted a round of metallurgical tests, including cyanide leach and flotation circuit testing. These preliminary tests yielded 88% Ag, 78% Pb and 70% Zn recovery, which are in line with historical production results. Mineralization consists of acanthite, native silver, pyrrargyrite, pyrite, galena and sphalerite.

On July 23, 2019, the company announced hole DV19-165, drilled in the Chance Target area outside of the known resources, which contained 26.5 m (24.9 m estimated true thickness) grading 385 g/t Ag, 0.24% Pb and 0.09% Zn. Within this intercept were 5 m (4.7 m estimated true thickness) grading 1607 g/t Ag, 0.86% Pb and 0.26% Zn.

There are several styles of mineralization, including siliceous exhalative horizons and epithermal quartz veins. The Dolly Varden–Torbrit horizon (DVTH) is marked by a distinctive upper zone of jasper and quartz breccias and stockworks, with bladed barite pseudomorph textures and colloform banding, overlying a lower zone of smoky quartz and sulphides.

Structurally, the deposits are hosted in Jurassic Hazelton Group volcanoclastics in a northward-plunging synform. Locally there are steeply dipping pre-, syn- and post-mineral faults, which offset the horizon. Epithermal veins are often steeply oriented and follow syn-basinal faults.

Overall, the exploration programs illustrate the great potential for further discovery of high-grade silver in this historic Dolly Varden mining camp.

## Exploring the Potential of the High-Grade Johnson Tract Gold-Zinc (Copper) Project, Alaska

**Darwin Green, Ian Cunningham-Dunlop, Brodie Sutherland and Nathan Steeves of HighGold Mining Inc.**

**Session: BC/Yukon/Alaska**

**Time: 11:15 AM – 11:35 AM**

The high-grade Johnson Tract gold-zinc (copper) deposit (JT deposit) is an advanced stage exploration target located 20 km from tidewater and 200 km southwest of Anchorage, Alaska. The 21 000 acre property was acquired by HighGold Mining Inc. through a lease agreement with Cook Inlet Region, Incorporated (CIRI), an Alaska Native regional corporation, and the largest private landowner within the Cook Inlet region.

Mineralization at the JT deposit forms a tabular silicified body that contains a stockwork of quartz sulphide veinlets and brecciation, cutting through and surrounded by a widespread zone of anhydrite alteration. Drillcore resampling by HighGold in 2018 demonstrated excellent reproducibility of historical high-grade gold-zinc-copper results, highlighted by 71.4 m grading 20.70 g/t Au, 4.6% Zn and 0.9% Cu in drill hole JM88-034. Multi-deposit, district-scale potential within the property is supported by the presence of other mineral prospects such as Kona Creek, Easy Creek and, most notably, Difficult Creek, where similar tenor mineralization to the JT deposit is documented.

In 2019, HighGold completed 2246 m of drilling to confirm, better define and expand the JT deposit, which was last drilled between 1982 and 1995. Hole JT19-082 is the first new drill hole completed on this property in 25 years and was designed as a twin of historical drill hole JT93-065 for validation purposes for future resource estimation. The hole improved upon the original by intersecting 107.8 m grading 19.55 g/t gold equivalent (12.42 g/t Au, 7.1% Zn, 0.9% Cu, 1.6% Pb and 8.9 g/t Ag). Data from this new drill program, in combination with historical drill data, will be used to generate the first NI 43-101–compliant mineral resource for the JT deposit.

All drill intercepts reported as core lengths. True width of JT19-082 is approximately 50% of reported width.

## Eskay Creek – Rediscovered

**Paul Geddes, Skeena Resources Limited**

**Session: BC/Yukon/Alaska**

**Time: 11:35 AM – 11:55 AM**

Situated in the Northern Cordillera, in British Columbia's Golden Triangle, the Eskay Creek project has been regarded as one of the highest tenor precious-metal volcanic-hosted massive sulphide (VHMS) deposits globally. Despite possessing characteristics analogous to Noranda-Kuroko-type VHMS systems,

Eskay Creek mineralization diverges from conventional VHMS models in that it possesses a shallow-water, low-temperature epithermal (Hg-As-Sb) signature.

The Eskay Creek deposits are regionally situated in a package of Upper Triassic to Middle Jurassic volcanic and sedimentary lithologies of the Stuhini and Hazelton groups. Mineralization is spatially restricted to a fault-bounded extensional basin within a cyclical, bimodal volcanoclastic succession with subordinate flows and clastic sediments of the Lower to Middle Jurassic Hazelton Group. Post-mineralization Cretaceous deformation is responsible for the deposit's current geometries.

Precious- and base-metal mineralization is heterogeneously distributed throughout three well-defined lithologies at Eskay Creek. A massive to flow-banded, brecciated rhyolite package occurs as a substrate to the exhalative event and is characterized by intense silica-sericite-chlorite-pyrite alteration, with intensity increasing toward synvolcanic feeder structures. Exhalative and extremely high tenor Au-Ag-Cu-Pb-Zn mineralization was formed during a period of quiescence within a transitional rhyolite-mudstone breccia that grades into carbonaceous laminated black mudstone that can range up to 60 m in true thickness. Lastly, an andesitic flow and sill complex with minor interflow sedimentary rocks occurs immediately in the hangingwall opposite to the contact mudstones, with mineralization being restricted to re-activated synvolcanic structures.

Mineralization displays both lateral and vertical zoning throughout the deposit area. Deposit-scale vertical zonation is observed as increasing Au-Ag-Hg-As-Sb tenor up-section whereas lateral zonation is established by epithermal suite enrichment in the south, yielding to base-metal assemblages in the north.

## ALAMOS GOLD INC.

### ISLAND GOLD DEPOSIT, MICHIPICOTEN GREENSTONE BELT, ONTARIO, CANADA

**Chris Rockingham, Alamos Gold Inc; Scott RG Parsons, Alamos Gold Inc; Doug MacMillan, Alamos Gold Inc; Emily Archibald; Alamos Gold Inc.**

In November of 2017, Alamos Gold Inc. acquired Richmond Mines' Island Gold Mine. By the end of 2018, Alamos added over one million ounces of gold across all mineral reserve and resource categories (before mining depletion). Drilling completed in 2019 was successful in extending high grade gold mineralization laterally and down-plunge of the Island Gold Deposit across all three areas of focus including the Main, Western, and Eastern Extensions. In addition, drilling in 2019 intersected high-grade mineralization over a lateral extent of 300 m within a previously untested area between the Eastern and Main Extensions.

A total of \$28 million CAD has been budgeted in 2020 for surface and underground exploration at Island Gold with a focus on continuing to define new near mine Mineral Resources across the two-kilometre long Island Gold Main Zone. The 2020 exploration budget includes 46,000 metres ("m") of surface directional drilling, 30,000 m of underground exploration drilling, and 900 m of underground exploration development to extend drill platforms on the 620, 790, and 840-levels.

A regional exploration program which includes 10,000 m of drilling is also planned in 2020, focused on evaluating and advancing exploration targets outside the main Island Gold Mine area on the 9,750-hectare Island Gold Property.

Intersections on display from drilling at the Island Gold Deposit in 2019 include MH17-04 (40.75 g/t Au (34.01 g/t cut) over 5.15 m), and MH18-05 (102.74 g/t Au (58.62 g/t cut) over 3.94 m).

## ALDEBARAN RESOURCES INC.

### ALTAR CU-AU-MO PORPHYRY PROJECT, SAN JUAN, ARGENTINA

**Kevin B. Heather, Javier Robeto, Raymond Jannas, Mariano Poodts, Tadeo Castaño, Stanford Foy and John Black, Aldebaran Resources Inc.**

The Altar project is a Cu-Au-Ag-Mo porphyry deposit located in San Juan Province, Argentina, approximately 10 km from the Argentina-Chile border and 180 km west of the city of San Juan. Altar consists of multiple porphyry centres that include Altar East, Altar Central, Altar North, Quebrada de la Mina (QDM) and Radio porphyry Cu-Au deposits.

With a NI 43-101 measured + indicated sulphide mineral resource of 2.06 billion tonnes at 0.33% Cu, 0.08 g/t Au and 1.0 g/t Ag and an inferred sulphide mineral resource of 0.56 billion tonnes at 0.28 % Cu, 0.06 g/t Au and 0.9 g/t Ag, the Altar deposit is truly a significant accumulation of copper, gold and molybdenum.

New deeper drilling below all the porphyry centres has confirmed the vertical extensiveness of the copper mineralization. Drilling beneath the shallow QDM gold mineralization (QDM-041) has discovered a new porphyry system within a downthrown fault block relative to the neighbouring, well-mineralized Radio Cu-Au porphyry system.

New geological data strongly suggests that there are higher grade cores to many of the currently known porphyry centres, but that there is also strong evidence to suggest several overprinting porphyry events at Altar that will require further exploration and additional work to test and delineate.

Significant new intersections from the 2018–2019 drilling campaign include

789 m at 0.41% Cu, 0.09 g/t Au and 126 ppm Mo (0.52% CuEq), including 112 m at 0.49% Cu, 0.11 g/t Au and 112 ppm Mo (0.62% CuEq) in porphyry-style mineralization (QDM-041)

1142 m at 0.47% Cu, 0.04 g/t Au and 75 ppm Mo (0.53% CuEq), including 170 m @ 0.71% Cu, 0.02 g/t Au and 126 ppm Mo (0.77% CuEq) in porphyry-style mineralization (ALD-212)

1054 m at 0.49% Cu, 0.15 g/t Au and 28 ppm Mo (0.61% CuEq), including 448 m @ 0.63% Cu, 0.27 g/t Au and 9 ppm Mo (0.84% CuEq) in porphyry-style mineralization (ALD-209)

1075 m at 0.47% Cu, 0.13 g/t Au and 22 ppm Mo (0.57% CuEq), including 212 m at 0.58% Cu, 0.22 g/t Au and 10 ppm Mo (0.75% CuEq) in porphyry-style mineralization (ALD-190)

## ALEXCO RESOURCE CORP.

### GEOLOGY AND EXPLORATION OF THE KENO HILL SILVER DISTRICT, YUKON, CANADA

**A. McOnie (FAusIMM), VP Exploration, Alexco Resource Corp.; S. Iles, Keno District Exploration Manager, Alexco Resource Corp.; L. Stammers (P.Geo.), Project Geologist, Alexco Resource Corp.**

Keno Hill, Yukon, is Canada's second largest historical silver producing district, with 214 million ounces of Ag mined at an average grade of 44 oz/t from over 40 occurrences between 1913 and 1989. As Canada's only primary silver producer, Alexco Resource Corp produced 5.6 million ounces Ag from the underground Bellekeno mine at an average grade of 725 g/t (23.1 oz/t) Ag, 9.5% Pb and 5.1% Zn between 2011 and 2013.

Since 2006, Alexco has conducted multidisciplinary, district-scale exploration for high-grade silver-lead-zinc resources over the 244 km<sup>2</sup> project area and has completed a total of 222 108 m of diamond drilling. The current silver resource base comprises 83 million ounces indicated (including tailings), including 30.5 million ounces reserve and 24 million ounces inferred. The bulk of these resources are located within new blind discoveries made at the Flame & Moth and Birmingham prospects, and are included in the 2019 pre-feasibility study (mine plan (refer to [www.alexcoresource.com](http://www.alexcoresource.com))).

The high-grade silver-lead-zinc mineralization is deposited in narrow, hydrothermal siderite-quartz veining developed in the regionally extensive, competent but highly deformed, Mississippian Keno Hill quartzite formation. Vein formation is fault controlled and analysis of the distribution of mineralization in the Bellekeno mine has led to an understanding of the structural controls of the wider mineral system and provided a tool for effective exploration targeting. Aerial geophysical surveys have guided understanding of the geological framework, with detailed petrology and geochemical study of the deposits providing additional exploration vectors.

The silver minerals associated with galena and sphalerite belong predominantly to the tetrahedrite series, although pyrargyrite and native silver are not uncommon. The mineralization is dated at about 88 Ma and the deposits are spatially associated with the occurrence of the 93 Ma Tombstone intrusive suite related to orogenic gold deposits in the region.

## ALIANZA MINERALS LTD.

### FORGOTTEN SILVER – THE HALDANE SILVER PROJECT, KENO HILL DISTRICT, YUKON

**Jason Weber, Alianza Minerals Ltd., and Murray Jones, Equity Exploration Consultants Ltd**

The Haldane silver project is located at the western end of Yukon's historic Keno Hill silver district, one of the highest grade silver camps in the world and Canada's second largest silver producer. Silver was found on Mt. Haldane in 1918, 15 km west of the original silver discoveries in the Keno Hill district. The mineralization at Haldane is characteristic of the district: complex vein-faults hosted in quartzite, consisting of galena, sphalerite and tetrahedrite in siderite gangue. Underground development at the Middlecoff zone in 1919 produced 24.7 t of hand-sorted ore at 3102 g/t Ag and 59% Pb.

No more significant work was done until the mid-1960s. Trenching exposed new vein-faults along strike from the original showings within a 1.6 km long structural corridor dubbed the Mt Haldane vein system (MHVS). Subsequently, the MHVS was neglected again until 2010–2013, with the first(!) surface core drilling program on the property. Thirteen holes targeted the MHVS, resulting in the identification of new vein-faults, such as the West fault (320.0 g/t Ag, 0.67% Pb, 0.86% Zn and 1.118 g/t Au over 2.20 m), demonstrating the continuing potential for new discoveries on the property.

Alianza acquired the Haldane in 2018, realizing the property's patchy exploration history left considerable promise. Initially, Alianza went back to basics with blanket soil geochemical sampling, geological mapping and prospecting. This systematic work detected yet another new target, the Bighorn soil geochemical anomaly, 2.8 km west of the MHVS. In 2019, Alianza's first drill holes tested a combination of the new and the old. A single hole drilled across the Bighorn zone resulted in the discovery of at least four galena-sphalerite mineralized vein-faults, including one that returned 125 g/t Ag and 4.4% Pb over 2.35 m. At Middlecoff, drilling targeted the extensions of high-grade shoots in the historical workings, intersecting multiple vein-faults and returning 455 g/t Ag and 0.39% Pb over 1.0 m of heavily oxidized vein material and, separately, 966 g/t Ag and 28.35% Pb over 0.35 m, signifying the forgotten potential for high-grade silver in the system.

## AMERICAN CREEK RESOURCES

### DUNWELL MINE

**Kelvin Burton, Investor Relations, American Creek Resources**

The high-grade Dunwell mine is located a mere 8 km (16 minutes by road) from Stewart World Port in Stewart, BC, with Highway 37A and power running through it, giving it the best logistics in the Golden Triangle. It was commercially mined until 1941 (World War II), producing a total of 45 657 t averaging 6.6 g/t Au, 223.9 g/t Ag, 1.83% Pb, 2.43% Zn and 0.056% Cu. Although ore remains in the mine, under the old workings, and in parallel veins, the real potential extends for 3 km along a major fault within the Portland Canal fissure zone, which contains ultrahigh-grade samples including 584 g/t gold over 1.06 m. Numerous surface exposures along this fissure zone and fault yielded ultrahigh-grade ore, which was produced at the mine. Samples of these include

George E: 12 t at 13 g/t Au, 3250 g/t Ag and 23.3% Pb  
Ben Ali: 4500 t at 21.6 g/t Au – other elements not recorded

Lakeview: 60 t at 4.7 g/t Au, 2734 g/t Ag and 11.5% Pb  
 Victoria: 6 t at 20.6 g/t Au, 1028.6 g/t Ag, 35% Pb, and 10% Zn  
 Tyee: 8.2 t at 124.4 g/t Au and 4478.8 g/t Ag

Dunwell's grades are similar to the values being developed on the Silbak Premier mine (9 km west) and Red Mountain gold project (11 km east) scheduled to be taken into production by Ascot Resources. Ascot is one of three companies interested in mill feed from Dunwell to augment their own production. Such a deal could dramatically reduce the time, cost and environmental impact of reopening the mine.

Dunwell's first drill program has been completed and assays are pending. A highly specialized induced polarization survey was recently conducted around the Dunwell mine, which will guide future exploration. The company believes the combination of high-grade polymetallic ore and exceptional logistics makes this one of the most prospective projects in the Golden Triangle.

## **AMEX EXPLORATION INC.**

### **PERRON PROJECT: A NEW GOLD DISCOVERY WITH STRONG ECONOMIC PROSPECTS IN THE NORMÉTAL VOLCANIC BELT OF THE ABITIBI SUBPROVINCE**

**Jérôme Augustin, Laurentia Exploration; Maxime Bouchard, Laurentia Exploration; Jacques Trottier, Amex Exploration; Kelly Malcolm, Amex Exploration**

The Perron project is owned by Amex Exploration Inc. (100%). This project is located in Normétal's volcanic belt in Abitibi's Archean subprovince. Ongoing drilling (100 000 m) led to the discovery of three high-grade gold zones—hosted within a rhyolite sequence—bounded within shear zones and with a mafic intrusion. The gold mineralization is associated with free-milling gold and sulphide within sheared metric quartz veins. The gold system is still open at the property scale, meaning there is potential for further discovery.

## **ASCOT RESOURCES LTD.**

### **PREMIER AND RED MOUNTAIN – HIGH-GRADE GOLD IN THE GOLDEN TRIANGLE OF BRITISH COLUMBIA**

**Lawrence Tsang, Senior Geologist; Lars Beggerow, VP Geoscience and Exploration**

The Premier and Red Mountain properties are located in the southern Golden Triangle, near Stewart, B.C. Ascot's land holdings in the area exceed 25 000 ha. The combined amount of recent and historical drilling from both projects amounts to over 940 000 m.

The Stewart mining camp is underlain by Triassic–Jurassic Stuhini Group and Hazelton Group rocks that formed in an island-arc setting. The major rock types are intermediate to felsic volcanic and volcanoclastic rocks like andesite and dacite with interbedded sedimentary rocks like mudstone and siltstone. Late Triassic calcalkaline intrusions of the Stikine Plutonic Suite in the Red Mountain camp and Early Jurassic calcalkaline intrusions of the Texas Creek Plutonic Suite in the Premier camp represent coeval and subsidiary magma chambers emplaced below the arc. From these intrusions, later stage porphyritic dikes cut up through the volcanic and sedimentary sequences locally called Premier porphyry in the Premier area, and Goldslide porphyry and Hillside porphyry in the Red Mountain area. Eocene intrusions of the Coast Plutonic Complex in the Stewart area are associated with high-grade silver-lead-zinc occurrences



like the mineralization at the Lost Valley in the Red Mountain camp and at the Silver Hill in the Premier camp.

The mineral deposits of the Premier camp are intermediate sulphidation epithermal gold-silver systems with subsidiary base metals. Red Mountain is an intrusive-hosted, sulphide-rich precious-metal system of possibly magmatic-hydrothermal origin. The mineralized bodies at Premier are hosted by quartz breccias and associated stockwork, whereas the mineralization at Red Mountain occurs in pyrite-rich structurally controlled veins, stockwork, and breccia bodies ranging from centimetres to metres in thickness; economic minerals are native gold, native silver and electrum along with accessory pyrite, pyrrhotite, chalcopyrite, galena and sphalerite.

## ATAC RESOURCES LTD.

### INTRUSIVE-RELATED GOLD-COPPER MINERALIZATION AT THE RACKLA GOLD PROPERTY, YUKON

**Adam Coulter, Project Geologist, ATAC Resources Ltd.**

The Rackla gold property encompasses more than 1700 km<sup>2</sup> in east-central Yukon and comprises three 100%-owned project areas: the Rau project, which hosts the Tiger gold deposit and nine other carbonate replacement gold prospects; the Osiris project, which hosts the Conrad, Osiris, Sunrise and Ibis Carlin-type gold deposits, and the Orion project, which hosts a Carlin-type gold prospect.

The 185 km long property covers Neoproterozoic to Permian marine clastics and carbonates deposited along a fault-controlled paleo-continental margin. All discoveries made on the property to date are the result of grass-roots targeting of stream sediment anomalies in a structural and stratigraphic setting similar to northeastern Nevada. Exploration began on the property in 2006 and resulted in the discovery of carbonate replacement style gold mineralization at Tiger. Drilling was completed between 2008 and 2010 delineated an initial resource estimate for Tiger leading to a positive PEA.

On November 13, 2019, ATAC announced that it will commence an updated Tiger deposit PEA, which will include

- 13 step-out and in-fill diamond drill holes, completed in 2017 and 2019;
- updated metallurgical test work demonstrating the upper part of the sulphide facies of the deposit is non-refractory and amenable to direct cyanide leaching and
- an advanced geological model that better captures high-grade structures.

Mineralization at Tiger is most strongly developed along stratigraphic boundaries (i.e., mantos) as seen in hole RAU-17-159 where 51.82 m of 5.66 g/t Au was intersected within a folded series of stacked limestone and volcanoclastic horizons. Gold mineralization occurs within both oxide and sulphide facies.

ATAC completed eight reconnaissance drill holes in 2019 exploring for skarn mineralization closer to the Rackla pluton, approximately 4 km east of Tiger. High-grade prospecting grab samples from the Bobcat skarn target include 41.90 g/t Au with 10.55% Cu and drilling intersected 17.75 g/t Au across 0.51 m in RPP-19-002.

## AURION RESOURCES

### RISTI PROJECT: DISCOVERING NEAR-SURFACE, HIGH-GRADE OROGENIC GOLD IN NORTHERN FINLAND

#### The Aurion Resources Team

Aurion's wholly-owned Risti project covers 16 197 ha in the Central Lapland greenstone belt in northern Finland. It is located 10 km north-northwest of the town of Sodankylä in the Kaarestunturi area, and has well developed infrastructure and excellent access. The geological setting has many similarities to prolific gold-rich orogenic gold belts, specifically the Timmins camp of the Abitibi region of northern Ontario, Canada.

The Geological Survey of Finland explored the area for gold in late 1970s and early 1980s and found up to 10 g/t in conglomerates; the occurrence was interpreted as paleoplacer in origin. Aurion's exploration since 2015 resulted in multiple new gold discoveries including Aamurusko, which became the focus in late 2016 after prospectors discovered 133 high-grade boulders (average 74 g/t Au). Currently more than 1200 boulders (average 25 g/t Au) have been sampled over a 1.3 by 1.7 km area. Aurion has identified two bedrock sources of the boulders via drilling, namely Aamurusko Main and Aamurusko Northwest (NW), and believes there are more.

Aamurusko Main consists of gold-bearing quartz veins occurring near the sheared contact between sediments and a gabbro intrusion, glacially up-ice from high-grade boulders. Drill highlights include 789.06 g/t Au over 2.90 m (including 3510.00 g/t Au over 0.65 m) in drill hole AM18042, 24.50 g/t Au over 4.75 m in AM19081 and 22.63 g/t Au over 3.53 m in AM19114 (DISPLAY).

Aamurusko NW consists of a 10–30 m wide zone of gold-bearing quartz veins within altered and mineralized clastic sediments. Drill highlights include 13.31 g/t Au over 19.54 m in drill hole AM19095 (DISPLAY), 3.51 g/t Au over 31.12 m in AM19094 and 23.41 g/t Au over 11.10 m in AM19106.

Mineralization at Aamurusko Main and NW is hosted within multiple lithologies including clastic sediments, gabbro and mafic volcanics that are variably amounts of fuchsite, sericite, potassium feldspar and iron carbonate altered minerals and the core is clearly hydrothermal. Quartz veins are variably mineralized with iron oxides (after sulphides), pyrite, arsenopyrite, chalcopyrite, galena, sphalerite and locally visible gold. Mineralization remains open to further exploration both laterally and to depth.

## BALMORAL RESOURCES LTD.

### GRASSET ULTRAMAFIC COMPLEX: AN EMERGING KOMATIITE NICKEL DISTRICT IN THE NORTHERN ABITIBI GREENSTONE BELT, QUEBEC, CANADA.

**Michael J. Tucker, Exploration Manager, Balmoral Resources Ltd.; Darin Wagner, President and CEO, Balmoral Resources Ltd.**

Komatiite-related sulphide deposits represent an important source of nickel, copper and platinum group element ore globally. While komatiites are found in the majority of Archean greenstone belts, global komatiite nickel endowment is restricted to only a few regions globally. Economically sized Archean deposits cluster in the Eastern Goldfields Superterrane of the Yilgarn craton of Western Australia, with few large deposits outside of this district. The Abitibi greenstone belt in Canada is the largest known greenstone belt worldwide, yet it is not known to contain any large komatiite-hosted nickel deposits that

rival those of the Eastern Goldfields. In 2014, the Grasset nickel deposit was discovered in the northern portion of the Abitibi greenstone belt. The deposit is hosted at the southern end of a 10 km long sequence of komatiitic flows and subvolcanic intrusions (Grasset Ultramafic Complex) within a dominantly rhyolitic host assemblage. The deposit itself mostly comprises disseminated to net-textured sulphide (pyrrhotite-pentlandite-chalcopyrite) mineralization within olivine mesocumulate that is altered to serpentine and/or talc-carbonate assemblages. Sulphide mineralization sits within the upper portion of what appears to be a subvolcanic intrusion. Favourable lithologies for ore mineralization appear to be those with high MgO contents (>35 wt. % MgO), a common feature of many komatiite-hosted nickel deposits. A 2016 indicated resource estimate on Grasset yielded 3.46 million tonnes at 1.54% Ni; making the Grasset nickel deposit one of the largest komatiite nickel deposits discovered in the Abitibi to date. Recent exploration in the fall of 2018 in the Grasset Ultramafic Complex discovered a new, basal komatiite contact-style nickel occurrence about 7 km away from the Grasset deposit. The presence of another discovery within the complex begins to build the Grasset Ultramafic Complex as a possible new emerging komatiite nickel district outside of the Eastern Goldfields.

## **ELDORADO GOLD CORP.**

### **NEW EXPLORATION RESULTS FROM ELDORADO GOLD'S LAMAQUE PROJECT, VAL D'OR, QUÉBEC**

**Jacques Simoneau; Luc Theberge; Nancy Lafrance; Tim Baker and Peter Lewis, Eldorado Gold Corporation**

Eldorado Gold Corporation's Lamaque operation in Val d'Or, Québec, consists of the recently discovered and developed Triangle gold, located only 2.5 km south of the historical world-class Lamaque and Sigma mines (> 10 million ounces historical production). Triangle is an orogenic deposit characterized by quartz-tourmaline-carbonate veins. These are hosted within a series of subparallel, steeply dipping shear zones ('C' zones) centred on a steeply plunging porphyritic diorite plug that intrudes mafic volcanic rocks. Mineralized shear zones have strongly foliated, sericite-albite-carbonate-pyrite-altered envelopes and gold is contained within both the vein and deformed wallrock. Gold-bearing shear veins and associated alteration are on average 4–5 m thick and extend 500–700 m horizontally and vertically with an average grade of about 7 g/t Au.

The current mine plan at Triangle is focused on the upper shear zones (C1–C5), whereas recent exploration has targeted new mineralized structures below C5 (about 800–1800 m below surface). Mineralized shear zones in the lower deposit are similar in character to the upper shear zones, occurring within and adjacent to the diorite plug and including C6, C7, C8, C8b, C9, C9b and C10. The lower shear zones steepen with depth and are accompanied by an increase in density of mineralized secondary splays and extensional vein networks, which combined represent potential bulk mining targets similar to stockwork areas exploited historically at the Lamaque mine.

Recent drilling results from the lower Triangle deposit capped at 40.0 g/t Au include: 3.85 m at 19.33 g/t Au (C7; TM-16-191M01); 9.30 m at 10.72 g/t Au (C7; TM-18-327W02); 5.30 m at 12.22 g/t Au (C9b; TM-18-327W01) and 64.50 m at 3.00 g/t Au in large stockwork zones below C9 (TM-15-020W03M01).

A new zone of gold mineralization called P5 Flats located approximately 1.5 km north of Triangle was discovered earlier this year. Mineralized intercepts were found within wide arrays (10–35 m) of sub-horizontal quartz-tourmaline-carbonate extensional veins associated with a vertical shear zone.

## ERO COPPER CORP

### COPPER AND NICKEL MINERALIZATION IN THE CURAÇÁ VALLEY, BAHIA STATE, BRAZIL

**Mike Richard; Pablo Mejia-Herrera; Filipe Porto, ERO Copper Corp**

The Curaçá Valley's mafic-ultramafic complex is located within the Curaçá high-grade metamorphic gneissic terrane in the São Francisco craton. The mining and exploration projects located within the Mineração Caraíba S/A (MCSA) Mining Complex lie within a Trans-Amazonian belt bordered on the west by volcanosedimentary rocks and on the east by intrusive syenite rocks.

The Cu (Ni) deposits are hosted by irregular-shaped intrusive bodies of pyroxenite (hypersthene) and minor gabbro-norite that have been intruded into granulite facies gneiss and migmatite at the northern margin of the São Francisco craton. The intrusions have been interpreted as either deformed sill-like bodies or irregular-shaped intrusions into an anastomosing ductile shear zone, or more recently as later intrusions injected into deformed gneiss.

Mineralization is composed mainly of copper sulphides in the form of chalcopyrite, bornite and rarely chalcocite that occur as disseminations, veins and massive sulphide breccias. Pentlandite may occur either as flames in pyrrhotite or as massive concentrations within the massive breccia lenses. Other minerals commonly associated with the ore include phlogopite, pyrite, magnetite and chromite.

Mineralized intrusive bodies are commonly affected by various alteration assemblages including potassic (phlogopite and K-feldspar) and calcsilicate (diopside) as well as epidote and lesser garnet and serpentine. Following the emplacement of the pyroxenite, several pulses of alteration overprint the pyroxenite dikes and the older deformed rock units.

## FIREWEED ZINC LTD.

### INNOVATION, ORE SORTING AND A NEW LOOK AT FIREWEED ZINC'S BOUNDARY ZONE ZINC DEPOSIT

**G. Dessureau, V.P. Exploration, Fireweed Zinc Ltd; Jack Milton, Chief Geologist, Fireweed Zinc Ltd; Moira Cruickshanks, Senior Geologist, Fireweed Zinc Ltd.**

In 2018, Fireweed Zinc acquired the 73.93 km<sup>2</sup> Nidd property, located in Yukon adjacent to and along strike with Fireweed's 100%-owned Tom and Jason shale-hosted zinc-lead-silver deposits, and with current mineral resources and a PEA economic study (11.21 million tonnes indicated at 9.61% ZnEq or 6.59% Zn, 2.48% Pb and 21.33 g/t Ag and 39.47 million tonnes inferred at 10.00% ZnEq or 5.84% Zn, 3.14% Pb and 38.15 g/t Ag).

The Nidd property covers the 200 by 800 m Boundary zone, which consists of significant vein-hosted, stockwork, disseminated and replacement-style zinc mineralization that crosscuts mafic tuff and flows, breccias and diamictite, carbonaceous mudstone, and conglomerates of the Macmillan Pass member within a sub-basin of the Devonian Earn Group. Mineralization is dominantly sphalerite-siderite-pyrite with minor galena deeper in the system and occurs at surface, extending up to 285 m down dip. The Boundary zone contains both high-grade and wide, low-grade zones as demonstrated in the 2019 drilling: NB19-001 intersected 250 m of 3.44% Zn, 0.10% Pb and 5.6 g/t Ag, including 23.3 m of 16.35% Zn and 4.85 m

of 31.96% Zn. NB19-002 intersected 230 m of 4.14% Zn from surface including 100 m of 7.94% Zn and 6.4 m of 42.49% Zn.

In 2019, Fireweed announced positive results from an initial pre-concentration test using state-of-the-art X-ray fluorescence ore sorting technology on samples from the Boundary zone. These test results showed that it was possible to reject 50–70% of the barren material (30–50% mass pull) while retaining up to 80–85% of the zinc, showing a potential upgrade to mill feed material from approximately 2.5% Zn to 5% Zn from the material tested. These results show that the Boundary zone has the potential to significantly affect the overall economics of the Macmillan Pass project, and further detailed studies are underway.

## **FIRST COBALT CORP.**

### **IRON CREEK COBALT-COPPER RESOURCE, IDAHO**

**Frank Santaguیدا, First Cobalt Corp.**

The Iron Creek cobalt-copper project in central Idaho occurs within the Mesoproterozoic Idaho cobalt belt (ICB), a prolific mining district containing several historical operations and undeveloped cobalt-copper±gold resources.

Actively explored from 1967 to 1971, the property was essentially dormant for the past 40 years. First Cobalt has been actively exploring since 2017. In 2018, a maiden NI 43-101-compliant inferred resource was calculated. Subsequent drilling in 2018–2019 increased the total number of diamond drill holes to 105 for over 28 500 m, prompting an updated resource estimate of 4.83 million tonnes at 0.24% Co and 0.68% Cu using a cutoff grade of 0.18% Co equivalent for an underground mining scenario. Approximately 45% of the resource is calculated to indicated category. Mineralization remains open along strike and down dip.

Mineralization is largely stratabound, contained within siltite-rich metasedimentary rocks mantled by quartzite-rich units. Thin, centimetre-scale quartzite layers are prominent within the main mineralized zones. Metamorphism is lower greenschist grade; sedimentary structures are well preserved. Ore metal mineralogy is relatively simple; cobalt occurs primarily as pyrite and copper as chalcopyrite. Pyrite lenses are interlayered with the host siltite rocks, but locally transcend bedding. In places, pyrite is semi-massive and over 15 m in true thickness. Chalcopyrite is disseminated, but also occurs as stringers cutting the pyrite lenses and is well developed in the siltite hangingwall in the western portion of the resource. Local breccia and shear zones contain higher grades of cobalt mineralization, but overall deformation is not significant within the area currently drilled.

The various deposits and prospects within the ICB are important primary cobalt global resources for the emerging demand in North America. The genesis for Co-Cu mineralization in the district remains enigmatic, but prospectivity for new discoveries is still high.

## **FIRST MINING GOLD CORP.**

### **MILLER PROSPECT PROFILED: EXPLORATION TARGET ON THE GOLDLUND PROPERTY IN ONTARIO, CANADA**

**Miro Mytny, P.Geo., Exploration Manager, First Mining Gold; Hazel Mullin, P.Geo., Director, Data Management & Technical Services, First Mining Gold Corp.**

Miller is one of several exploration targets identified on First Mining Gold's 100%-owned Goldlund property, an exploration-stage gold deposit located in northwestern Ontario, Canada. Goldlund is an Archean lode-style deposit located in the western Wabigoon subprovince of the Superior Province. Mineralization is typically hosted by a suite of tonalite dikes/sills ('granodiorite' in mine terminology), which intrude close to contacts between tuffs and lava packages. Gold is associated with quartz-carbonate veining and alteration zones alongside of veining and occurs both as fine disseminations in quartz vein stockworks and as larger grains associated with pyrite in the quartz veins.

Miller is located 10 km northeast and along strike of the current resource area at Goldlund and was drilled by First Mining in 2018 and 2019. The Miller target does not currently have a defined resource. The 2018 and 2019 drill programs at Miller total 40 holes and more than 7000 m of drilling. The 2019 drill program included step-out holes to test the southwest extent of the mineralized zone, along with holes to the northeast to test additional geophysical targets, plus additional infill holes in the core Miller area. Drilling has been completed on approximate 25 m spacing. Drill core presented from Miller displays typical 'Goldlund-style' alteration and mineralization within granodiorite units, which consists of cross-cutting quartz, quartz-ankerite and quartz-carbonate veinlets with silicic and potassic alteration halos. Mineralization includes fine- to coarse-grained sulphides (pyrite and pyrrhotite), gold (including visible gold) and tellurides.

First Mining Gold is working toward defining what it believes is an underexplored regional district with potential for multiple gold deposits along the 50 km of strike length at the project—Miller being one of these potential targets. Goldlund is located off Highway 72, about 40 km north of Dryden, Ontario, in an area of excellent infrastructure.

## **FORUM ENERGY METALS**

### **JANICE LAKE SEDIMENTARY COPPER PROJECT IN NORTHERN SASKATCHEWAN 2019 UPDATE**

**Ken Wheatley, Vice President, Forum Energy Metals; Rick Mazur, President and CEO, Forum Energy Metals**

The Janice Lake project, located in north-central Saskatchewan, was drilled by Forum Energy Metals in 2018, with the first hole returning 50.5 m of 0.45% Cu starting at a depth of 27 m. This caught the interest of Rio Tinto Exploration Canada (RTEC) at the 2019 AME Roundup and in May of 2019, RTEC signed a deal with Forum. In summer 2019, as part of the earn-in process (RTEC can gain up to 80% of the project by spending C\$30 million in exploration over the next 6 years), RTEC flew a detailed high-resolution airborne magnetic survey over the project (23 claims for 38 250 ha and over 52 km long) followed by a 5209 m drill program of 21 diamond drill holes.



Three of the eighteen known showing areas were tested by the drilling: nine holes at Jansem, nine at Janice and three at Kaz. Mineralization consisting of copper and silver, with lead at the interpreted geochemical boundaries, was intersected at the first two showings starting from surface and continuing in a series of layers to a depth of 358 m down hole; the deepest hole drilled on this program was 363 m. The mineralization consisted of mainly chalcocite with subordinate native copper and bornite and was intersected in multiple layers up to 63 m thick within the metasediments of the eastern Wollaston domain.

The metasediments that host the mineralization consist of conglomerates, psammities and psammo-pelitic rocks, which have been metamorphosed to a schist–gneiss grade. These are overlain by barren calcsilicates and underlain by a weakly silicified metaconglomerate, possibly acting as an aquitard. Strontium sulphates are present with the copper mineralization, suggesting the historical presence of evaporites in the system.

## **GALORE CREEK MINING CORPORATION**

### **GALORE CREEK CU-AU-AG PORPHYRY PROJECT, BRITISH COLUMBIA, CANADA**

**Leif Bailey, Galore Creek Mining Corporation; Nils Peterson, Galore Creek Mining Corporation**

Galore Creek is one of the largest and highest grade undeveloped copper-gold-silver porphyry deposits in North America, with a measured and indicated resource of 1.104 billion tonnes at 0.47% Cu, 0.26 g/t Au and 4.2 g/t. The project is operated by Galore Creek Mining Corporation (GCMC), a 50:50 partnership between Newmont Goldcorp Corporation and Teck Resources Limited. The project is located within northwestern British Columbia in the traditional territory of the Tahltan Nation.

Galore is an end member of the silica-undersaturated class of alkalic porphyry copper-gold deposits, characterized by distinctive hydrothermal alteration facies and a lack of hydrothermal quartz. The deposit is associated with a cluster of syn-mineral syenite intrusions (about 205 Ma) that were emplaced into the Late Triassic Stuhini Group. These intrusions were accompanied by formation of syn-mineral hydrothermal and igneous breccias.

Mineralization is developed at several hydrothermal centres in an area of 4 × 3 km, within a larger zone of alteration and sulphides extending ~10x~15km. These mineralized centres are spatially associated with structural boundaries, intrusive contacts and favourable volcanic lithologies. Mineralization is disseminated, replacement and breccia hosted; sulphides are zoned from a central bornite core to chalcopyrite an outer to pyrite shell. Hydrothermal alteration assemblages include garnet-diopside, biotite-orthoclase-magnetite and biotite-garnet. Gold, copper and silver are generally correlated, but gold-dominant and copper-dominant zones also occur.

With the renewed partnership, GCMC has embarked on a multi-year program to complete an updated prefeasibility study to advance the social, environmental, regulatory and techno-economic components of the project. A substantial 2019 field program included 24 600 m of drilling focused on geometallurgical, geotechnical and hydrogeological objectives, as well as exploration drilling that identified extensions of mineralization between two previously known zones in the Galore Creek valley, suggesting additional upside potential in an already very large system.



## GALWAY METALS

### CLARENCE STREAM NEW BRUNSWICK: A NEW EMERGING GOLD CAMP

**Michael Sutton, VP Exploration, Galway Metals**

Located in southern New Brunswick, the Clarence Stream was discovered by a prospector using Government stream sediment and till samples; Freewest Resources Canada Inc. drilled the North and South Zones in 2000, and continued expanding both zones until its take-over by Cliffs Natural Resources Inc. Galway now owns 100% of a large 65 km strike length land package consisting of 60,000 hectares on which there are multiple gold showings and geochemical targets. Additional drilling since 2016 on both deposits has resulted in a high-grade open pit constrained and underground resource (September, 2017) totalling 390,000 ounces of gold in the Measured & Indicated categories, and 277,000 ounces of gold in the Inferred category. Galway has since discovered two new deposits that are directly on strike with a third previously-known deposit. Visible gold in quartz veins and stockworks is common along all three of these deposits, with drill intersections such as 241.5 g/t over 4.2 m, 7.3 g/t over 36.7 m, and 1.9 g/t over 43.3 m. It is thought that all three deposits, which cover 2.5 km of strike length, are part of the same system. None of these deposits are in the resource. All five deposits are open in all directions.

The project is located near the boundary of the Gander and Avalon terranes of the Canadian Appalachians; the same trend on which Marathon's Valentine Lake project and Oceana's Haile mine are located. Four of the five deposits are located along the Sawyer Brook Fault System, which is a major accretionary structure on the Silurian-Ordovician contact, that continues along the east coast. Mineralization is associated with bismuth, silver, arsenic, and antimony (correlation coefficients in order). Granitic dykes grade laterally into auriferous quartz veins. It is thought that high temperature chloride complexes and multiple generations of auriferous quartz had their source from intrusions emplaced during at least two time periods. The sediments and gabbro dykes that host mineralization have been folded, resulting in voids and contact areas, and along with secondary structures emanating from the Sawyer Brook fault, have combined to create fertile ground for gold deposition. The closest analogies are thought to be Fort Knox and Pogo deposits.

Galway and Freewest have primarily used soil sampling of the B horizon, with a confluence of till, boulder and chip sample gold anomalies combined with linear magnetic lows to do exploration drilling.

## GOLDPLAY EXPLORATION LTD.

### SAN MARCIAL – AN ADVANCED SILVER RESOURCE WITH EMERGING GOLD POTENTIAL IN MEXICO

**Marcio Fonseca, President and CEO, Goldplay Exploration Limited ("Goldplay"); Trevor Woolfe, VP Corporate Development and Exploration, Goldplay Exploration Limited ("Goldplay")**

The San Marcial Ag (Au) project is located in the prolific Rosario mining district, Sinaloa State, Mexico, famous for its historical production of gold and silver. Goldplay acquired the project in May 2018 and immediately commenced investigations to update the historical resource estimate for the project. In February 2019, Goldplay announced its maiden NI 43-101 indicated & inferred resource estimate for San Marcial, containing 40 moz million ounces of silver, a substantial 67% increase over the historical resource.

San Marcial is situated along the western edge of the Sierra Madre Occidental geological province, within the Tertiary lower volcanic unit of this extensive belt. The deposit is a low-sulphidation silver-lead-zinc epithermal that is, hosted by a 10–50 m thick hydrothermal breccia. The Hydrothermal breccia has been traced, continuously for at least 500 m along a northwest-southeast–trending structure, and is open along strike and down dip.

Recent exploration by Goldplay has identified a potential dacite dome-style gold mineralized system in the footwall of the silver deposit. This theory was tested in the recent drill program, which successfully intersected 1 m at 204.6 g/t Au. In addition to this exciting discovery, the new gold focus at San Marcial is enhanced by recent surface exploration at the Nava target, 1.5 km west of the high-grade gold interval, where channel sampling identified up to 24 m at 2.11 g/t Au. This low-sulphidation, epithermal-style quartz vein and stockwork mineralization also returned visible gold in panned samples from shallow underground artisanal workings.

Goldplay continues to apply systematic exploration methods at the San Marcial project to both a) expand the existing advanced silver resource with drilling along strike and down dip and b) assess the eight additional targets thus far identified by soil and lithogeochemical sampling, mapping and trenching in the underexplored areas within the 1 250 ha concession.

## **GOLD STANDARD VENTURES CORP.**

### **DARK STAR GOLD DEPOSIT, RAILROAD MINING DISTRICT, ELKO COUNTY, NEVADA**

**Steven R. Koehler, Donald A. Harris, Melanie N. Newton and Mark A. Laffoon; Gold Standard Ventures Corp., Elko, Nevada, USA**

Dark Star is a Carlin-type gold deposit located on the southeast end of the Carlin trend of north-central Nevada. Gold Standard Ventures (GSV) consolidated Dark Star and associated exploration opportunities under single control in December 2014.

Following the initial NI 43-101–compliant inferred mineral resource estimate of 23.11 million tonnes grading 0.51 g/t Au, totaling 375 000 oz Au, GSV initiated systematic exploration in the greater Dark Star area. Work included Anaconda-style geological mapping, soil and rock sampling, drill hole relogging, gravity surveys, controlled-source audio-frequency magnetotelluric surveys and drilling. As a result of this work, reverse circulation drill hole DS15-10 intersected 149.4 m of 1.38 g/t Au approximately 500 m north of the Dark Star initial resource. Additional exploration drilling in 2016 and 2017 continued to expand this new oxide gold discovery. Infill and development drilling in 2017 and 2018 reduced drill spacing to approximately 30 m in advance of a prefeasibility study. The South Railroad prefeasibility study (September 2019) has proven and probable Dark Star mineral reserves of 29 456 000 t at 0.93 g/t Au for 884 000 oz Au. Dark Star is the first reserve hosted in Pennsylvanian–Permian carbonate rocks on the Carlin trend.

On the north end of the deposit, higher-grade oxide gold mineralization is developed near the current topographic surface, and plunges steeply to depths exceeding 350 m. This part of the deposit is controlled by the high-angle, north-striking, east-dipping Ridgeline and IDK normal faults along with, and by west-northwest–striking faults. Fluidized hydrothermal breccias and quartz feldspar rhyolite porphyry dikes are developed locally. Deep drilling results confirm a gold-bearing, sooty pyrite-hosted gold zone at depth below the oxide zone.

On the south end of the deposit, gold mineralization begins at the current topographic surface and is stratigraphically controlled within a west-dipping section of Pennsylvanian–Permian debris flow conglomerate, in the footwall of the north-striking, west-dipping West fault.

## GREAT BEAR RESOURCES LTD.

### CONTINUED SUCCESS AT FINDING HIGH-GRADE GOLD ON THE DIXIE PROJECT

**R. Bob Singh P.Geo., Vice President Exploration, Great Bear Resources Ltd.; Andrea Diakow P.Geo., Exploration Manager, Great Bear Resources Ltd.**

Great Bear's 100%-owned Dixie project is a high-grade, near-surface gold discovery located 15 km southeast of Red Lake, Ontario. The land package is over 22 km in length and has undergone mineral exploration since the 1940s. Since acquisition in 2016, Great Bear re-logged, sampled and surveyed historical drill core and began drilling in 2017. More than 80 000 m of drilling has been conducted to date and several new high-grade gold discoveries have been made within the Dixie Limb, Hinge and LP Deformation zones.

Gold in the Hinge zone is associated with red-brown biotite hydrothermal alteration halos, hosted in quartz veins within a calcalkaline basalt (also near a contact with metasediments). The Hinge zone is also located near a major D2 fold hinge and associated with a steeply plunging lineation hosted within a high-Fe tholeiite basalt and a calcalkaline basalt. Drill results from this zone include 51.39 g/t Au over 5.05 m (DHZ-003) and 68.76 g/t Au over 5.80 m (DHZ-004).

The LP Deformation zone is a large-scale deformation zone up to 500 m wide and interpreted to extend for approximately 18 km through the property. This deformation zone has now been drill tested for over 4 km of strike length and has been found to be proximal to both felsic-mafic and felsic-metasediment contacts. Gold is developed along foliation surfaces and in broken and transposed quartz veins, hosted near major contacts in rocks that have undergone varying degrees of silica, albite and sericite alteration. To date, felsic rocks are the best host for gold mineralization demonstrated by higher grade gold within a wider spread, lower grade, mineralization halo. The discovery hole for this zone was DNW-011, drilled in March 2019, which assayed 12.33 g/t Au over 14 m. More recent results include 5.14 g/t Au over 37.40 m including 10.32 g/t Au over 18.20 m in BR-036 as well as 16.60 g/t Au over 6.00 m and 5.60 g/t Au over 25.25 m in BR-037, both of which were drilled 2 km to the southeast of DNW-011.

## GROUP TEN METALS

### PLATINUM GROUP ELEMENTS, NICKEL, COPPER AND COBALT MINERALIZATION WITHIN THE LOWER STRATIGRAPHY OF THE STILLWATER COMPLEX: NEW TARGETS DISCOVERED AND OLD TARGETS REVISITED

**Craig Bow, Chief Geologist, Group Ten Metals; Mike Ostenson II, Project Geologist, Group Ten Metals; Justin Modroo, Project Geophysicist, Group Ten Metals; Michael Rowley, President and CEO, Group Ten Metals**

Group Ten Metals is exploring for palladium, platinum, rhodium (PGE), nickel, copper and cobalt within the Stillwater Complex, a 2.7 Ga layered mafic–ultramafic intrusion, host to the world-class Sibanye-Stillwater PGE mines in Montana. Group Ten controls approximately 25 strike km of prospective mafic and ultramafic rocks, including multiple target types and individual prospects.

Systematic analysis of 50 years of historical exploration data with respect to different commodity focus, land positions, analytical menus and deployed petrogenetic models has defined a series of high-quality exploration targets in the Iron Mountain, Camp zone and Chrome Mountain areas, providing the initial focus for our programs.

In 2019, Group Ten implemented a six-hole, 1 600 m diamond drilling program in the Iron Mountain and Camp zone areas. Primary targets were the 'contact-type' PGE-Ni-Cu-magmatic sulphides originally drilled by AMAX half a century earlier, with the objectives of confirming their base-metal results and establishing the PGE tenor of sulphides. In addition, drill holes penetrated basement rock rafts, which conceal mineralized ultramafic rocks beneath. Secondary targets included the PGE-enriched 'B' chromitite package, which rests stratigraphically above the basal sulphides.

At Chrome Mountain, exploration conducted by predecessor companies during the 2007 and 2008 field seasons resulted in discovery of a previously unrecognized style of disseminated PGE occurrence, well within the ultramafic series. Re-logging of surviving drill core splits demonstrates that broad intervals of highly anomalous levels of Pt+Pd (e.g., 1.02 g/t Au+Pd+Pt over 116.7 m) are associated with disseminated and schlieren-type chromite. Hostrocks are complexly textured mixes of pyroxene-cumulate and olivine-cumulate rocks, which have provisionally been binned together as hitherto unrecognized magmatic breccias.

Group Ten's land package combines properties formerly divided among other companies, enabling unprecedented integration of targets, databases and geological thinking. The purpose of this core shack presentation is to present results from the 2019 drilling program, within the context of historical exploration of this iconic district.

## **GT GOLD CORP.**

### **GT GOLD'S SADDLE NORTH CU-AU PORPHYRY DISCOVERY – AN EMERGING TOP TIER ASSET IN THE GOLDEN TRIANGLE OF NORTHWEST B.C.**

**Charles J. Greig, Vice President Exploration, GT Gold Corp.**

The Saddle North porphyry Cu-Au system, discovered during a 10-hole, 8000 m campaign in August 2018, is now defined by 33 000 m of drilling in 46 drill holes. The discovery has attracted attention globally for its excellent infrastructure, development optionality, project scale and grades, which stand out amongst peers.

Saddle North consists of a high-grade core zone surrounded by a well-mineralized envelope. The core measures 1200–1600 m down plunge and 200–400 m along strike, and is 40–450 m thick, whereas the mineralized envelope measures 1400–1600 m down plunge and about 700 m along strike, and is 200–560 m thick.

Mineralization occurs as stockwork-sheeted vein zones, largely comprising millimetre- to centimetre-scale carbonate-quartz-magnetite-pyrite-chalcopyrite veins, earlier magnetite (hematite)-chalcopyrite veinlets and later pyrite-only and quartz-pyrite veinlets, as well as associated disseminated pyrite, magnetite and chalcopyrite.

The mineralized system is centred on intensely altered latest Triassic or earliest Jurassic hornblende feldspar diorite porphyries emplaced into Upper Triassic tuffaceous volcanic and volcanoclastic rocks that are overlain unconformably by Lower Jurassic volcanoclastic and volcanic rocks. Dating indicates that the

copper-gold mineralizing event closely followed emplacement of the intrusive hostrocks, which are part of a regional east-west-trending, high-K, calcalkaline metallogenic event that includes nearby intrusions and mineralization at the Red Chris mine and the North Rok and Castle properties.

The Saddle system and its hostrocks were deformed, uplifted and eroded prior to the deposition of overlying Lower Jurassic rocks, which dip gently to the north; both were further deformed in the mid-Cretaceous, during development of the Skeena fold belt. All Triassic and Jurassic rocks host a steeply south-southwest-dipping foliation that parallels both nearby fold axial surfaces in the belt, as well as a prominent footwall fault, which locally truncates the Saddle North mineralizing system. The fault juxtaposes the mineralized intrusive rocks with generally barren argillically to propylitically altered rocks in its footwall.

## **HIGHGOLD MINING INC.**

### **EXPLORING THE POTENTIAL OF THE HIGH-GRADE JOHNSON TRACT GOLD-ZINC (COPPER) PROJECT, ALASKA**

**Darwin Green, HighGold Mining Inc.; Ian Cunningham-Dunlop, HighGold Mining Inc.; Brodie Sutherland, HighGold Mining Inc.; Nathan Steeves, HighGold Mining Inc.**

The high-grade Johnson Tract gold-zinc (copper) deposit (JT deposit) is an advanced stage exploration target, located 20 km from tidewater and 200 km southwest of Anchorage, Alaska. The 21 000 acre property was acquired by HighGold Mining Inc. through a lease agreement with Cook Inlet Region, Incorporated (CIRI), an Alaska Native regional corporation, and the largest private landowner within the Cook Inlet region.

Mineralization at the JT deposit forms a tabular, silicified body that contains a stockwork of quartz sulphide veinlets and brecciation, cutting through and surrounded by a widespread zone of anhydrite alteration. Drill core resampling by HighGold in 2018 demonstrated excellent reproducibility of historical high-grade gold-zinc-copper results, highlighted by 71.4 m grading 20.70 g/t Au, 4.6% Zn and 0.9% Cu in drill hole JM88-034. Multi-deposit, district-scale potential within the property is supported by the presence of other mineral prospects such as Kona Creek, Easy Creek and, most notably, Difficult Creek, where similar tenor mineralization to the JT deposit is documented.

In 2019, HighGold completed 2246 m of drilling to confirm, better define and expand the JT deposit, which was last drilled between 1982 and 1995. Hole JT19-082 is the first new drill hole completed on this property in 25 years and was designed as a twin of historical drill hole JT93-065 for validation purposes for future resource estimation. The hole improved upon the original by intersecting 107.8 m grading 19.55 g/t Au equivalent (12.42 g/t Au, 7.1% Zn, 0.9% Cu, 1.6% Pb and 8.9 g/t Ag). Data from this new drill program, in combination with historical drill data, will be used to generate the first NI 43-101-compliant mineral resource for the JT deposit.

All drill intercepts reported as core lengths. True width of JT19-082 is approximately 50% of reported width.

## **IAMGOLD/VANSTAR (JV)**

### **NELLIGAN PROJECT: A NEW DISCOVERY OF A LARGE AURIFEROUS HYDROTHERMAL SYSTEM IN A SEDIMENTARY SEQUENCE, CHAPAIS-CHIBOUGAMAU MINING DISTRICT, ABITIBI, QUEBEC.**

**Coraline Crozier, P.Geo., IAMGOLD Corporation; Marie-France Bugnon, P.Geo., IAMGOLD Corporation**

Located 60 km southwest of Chibougamau, Quebec, the project is underlain by a portion of the Caopatina segment belonging to the North Volcanic zone of the Abitibi Belt of the Superior Province. The property is centred on synformally deformed metasediments of the Caopatina Formation, bounded to the north and to the south by volcanic rocks of the Obatogamau Formation and locally intruded by tonalites. The project is transected by several regional and local structural trends, including the Guercheville deformation zone, which are important in the localization of gold mineralization.

Following the 2016 discovery of the Renard zone, which built on initial discoveries made by Vanstar Mining, an initial mineral resource estimate was completed, which on a 100% basis, indicates a pit-constrained inferred resource totalling 96 990 000 t averaging 1.02 g/t Au for 3 193 900 oz of contained Au at a 0.5 g/t Au cutoff grade (effective October 2, 2019). Mineralization is hosted in a wide (approximately 900 m) hydrothermal alteration system that is characterized by variable carbonate, sericite and phlogopite with pervasive silicification and disseminated pyrite, over a strike length of more than 1 km. The resource estimate includes four mineralized zones: Dan, Liam, Zone 36 and Renard, from south to north.

The Nelligan project is a 51:49 exploration joint venture between IAMGOLD and Vanstar, with IAMGOLD as the project operator. IAMGOLD holds an option to earn up to an 80% interest in the project.

## **INDEPENDENCE GOLD CORP.**

### **3TS PROJECT – EPITHERMAL GOLD IN CENTRAL BC**

**Connor Malek, Independence Gold Corp.; Krisztina Pandur, Independence Gold Corp.**

The 3Ts project is located 130 km southwest of Vanderhoof and consists of 15 mineral claims totaling about 5200 ha. The project was acquired during a staking rush in early 1994 after Larry Diakow (B.C. Geological Survey) discovered a mineralized vein that assayed 3.74 g/t Au while mapping near Tommy Lake. Exploration work in the area has continued since that time.

The mineralized quartz-calcite veins within the 3Ts project strike north-northwesterly and have subvertical dips. These veins formed by open space filling along faults. Vein breccia fragments, crustiform banding and comb structures indicate that the mineralized veins have an epithermal character and formed at a shallow depth. Independence reported an inferred mineral resource using a 1.0 g/t Au grade cutoff. The current combined NI 43-101 inferred resource estimate for the Tommy, Ted and Mint veins is 5 452 000 t grading 2.52 g/t Au and 71.5 g/t Ag for 441 000 contained oz Au and 12 540 000 contained oz Ag.

The mineralized Ted and Mint vein structures are both open at depth below a cross-cutting microdiorite sill. The Tommy vein is also open along strike to the north. With further drilling, the potential exists to expand the resource at the Tommy, Ted and Mint veins and thereby expand the total gold and silver resource on the 3Ts project.



Recent work on the 3Ts project in 2019 included an extensive historical data review and compilation, 3D geological modeling of the epithermal vein system based on surface and historical drilling data, a detailed TerraSpec alteration mapping program and a 286 line km drone-based magnetic survey. The resulting magnetic interpretation and a 3D magnetic inversion model, together with the observed alteration features, highlighted numerous areas of interest for follow-up work and assisted in refining several new drill targets.

## INTEGRA RESOURCES CORP.

### DELAMAR GOLD AND SILVER PROJECT: LOW-SULPHIDATION EPITHERMAL AU-AG-SE MINERALIZATION IN SOUTHWESTERN IDAHO.

**E. Max Baker, Mitch Collins, Joe Kizis**

The DeLamar–Florida Mountain–Silver City district in Idaho comprises three separate low-sulphidation epithermal centres, spaced about 5 km apart. Initial mining began in 1863 on high-grade veins with approximately 1 million ounces Au and over 25 million ounces Ag produced from the district from start of production through 1914. Open-pit mining from the late 1970s to 1998 produced a further 0.75 million ounces Au and 47.6 million ounces Ag from disseminated/stockwork mineralization peripheral to the high-grade veins. Recent drilling by Integra Resources has defined an NI 43-101 resource estimate of 2.3 million ounces Au and 116 million ounces Ag (measured and indicated).

The mineralization is spatially and temporally associated with the mid-Miocene bimodal Columbia River basalt, with mineralization being localized within and around rhyolite flow domes emplaced along regional north-northwest structures. Ore mineralogy consists primarily of native silver and gold, acanthite, proustite, pyrrargyrite, polybasite, miargyrite and naumannite associated with gangue chalcedony/quartz, adularia with up to several percent pyrite and or marcasite. The DeLamar mineralization is hosted within a rhyolite flow-dome complex comprising four north-northwest–trending vein zones associated with a complex clay-illite-pyrite-adularia alteration assemblage. Florida Mountain comprises a 1 500 m long, near-vertical, north-northwest–trending vein system with a vertical extent of over 400 m. The bulk of historical mining at Florida Mountain occurred on a high-grade vein hosted in the basement Cretaceous Idaho batholith.

Integra’s ongoing exploration drill program will focus on extending mineralization peripheral to the 3.9 million ounce AuEq (measured and indicated) resource at Florida Mountain and DeLamar and greenfield exploration at War Eagle Mountain and the Blacksheep district. War Eagle Mountain was subject to high-grade mining in the early 1900s and modern drilling in the late 1980s that returned multiple high-grade results above the granodiorite. Exploration will also focus on Blacksheep, a separate epithermal district 5 km northwest of DeLamar. This high-level epithermal system is complete with sinters, opaline silica and hydrothermal eruption breccias. Soil sampling, and IP and geological mapping in the area has identified multiple drill targets.



## **IRVING RESOURCES INC.**

### **HIGH-GRADE GOLD-SILVER EPITHERMAL VEIN DISCOVERY, OMU, HOKKAIDO, JAPAN**

**Akiko Levinson, Irving Resources Inc.; Quinton Hennigh, Irving Resources Inc.; Hidetoshi Takaoka, Irving Resources Inc.; Haruo Harada, Irving Resources Inc.; Takeshi Uemoto, Irving Resources Inc.**

Irving's Omu high-grade gold-silver epithermal vein project, Hokkaido, Japan is host to an extensive network of paleo-hot springs associated with an approximate 200 km<sup>2</sup> mid-Miocene intermediate to felsic volcanic centre. To date, four large target areas have been identified: Omui mine site, Omu Sinter, Hokuryu mine site and Maruyama.

At Omui mine site, approximately 1 t of gold was mined from the shallow high-grade Honpi vein during the late 1920s. In spite of its the high grade, little subsequent exploration was conducted over surrounding areas. Through surface soil and rock sampling as well as extensive geophysical surveys, including controlled-source audio magnetotellurics (CSAMT), gravity and magnetics, Irving has identified several high-priority targets within a 1 km radius of Honpi and is currently testing these by diamond drilling.

At Omu Sinter, approximately 10 km north of Omui mine site, Irving's geologists discovered an extensive silica sinter terrace in 2016. Magnetic and gravity data collected in 2017 helped guide the first round of diamond drilling here in 2019. Of the initial eight holes that tested this 2 km long north-south-trending target, seven encountered high-grade vein mineralization including 1.33 m of 30 g/t Au and 576 g/t Ag in hole 19OMS-002, 2.03 m of 13 g/t Au and 44 g/t Ag in hole 19OMS-005 and 3.00 m of 3 g/t Au and 1570 g/t Ag in hole 19OMS-006. Irving recently conducted a CSAMT survey over Omu Sinter to help guide upcoming follow-up drilling at this exciting target.

In 2019, Irving conducted extensive geological mapping, soil sampling and geophysical surveys at Hokuryu mine site and Maruyama, approximately 7 km west and 8 km west-northwest of Omui mine site, respectively. Irving plans to undertake its first diamond drill program at these two targets in mid-2020.

## **JADE LEADER CORP.**

### **NORTH AMERICA'S JADE POTENTIAL: RECENT WASHINGTON AND WYOMING DISCOVERIES BY JADE LEADER CORP.**

**Jean-Pierre Jutras, B.Sc. Hons Geol, P.Geol., Jade Leader Corp.**

Jade Leader Corp. is currently the only publicly-traded mineral exploration company whose exclusive mandate is the discovery and definition of new nephrite jade deposits in the Western world.

The rise of China, as it is regaining its place as one of the world's largest economies, has had a recognizable impact in the resource sector. China has often needed to look outward to secure long-term supplies of strategic commodities necessary for its growing industrial base and infrastructure.

While this has been followed closely by the resource industry, what has gone essentially unnoticed has been a tremendous parallel resurgence of the arts, especially Chinese traditional jade carving, which requires natural stone. This has led to a multiple-fold increase in demand reflected in the increased price of raw materials, as more than 250 000 new carvers have reportedly re-entered the industry over the last

20 years. In a space best described as a nano-space in the years prior, this has put tremendous pressure on historically known supplies in an underexplored, and still largely artisanal, sector.

Jade Leader's Core Shack displays HQ jade cores from the first ever known diamond drilled jade occurrence in Washington State, United States. Surface and trench samples of nephrite jade from its Wyoming properties, where the company has secured rights to five distinct project areas, are also on display. All of Jade Leader's projects contain nephrite jade occurrences, which have been documented through fieldwork over the last 2 years.

## **K92 MINING INC.**

### **KORA GOLD-COPPER DEPOSIT, KAINANTU GOLD MINE, EASTERN HIGHLANDS PROVINCE, PAPUA NEW GUINEA**

**Chris Muller, Vice President – Exploration, K92 Mining Inc.; John Lewins, Chief Executive Officer and Director, K92 Mining Inc.; David Medilek, Vice President Business Development and Investor Relations, K92 Mining Inc.**

The Kora gold-copper deposit is located in the eastern Papuan mobile belt of mainland Papua New Guinea. Quartz-sulphide gold-copper veins at Kora extend laterally over 2.5 km and are typically 3–5 m wide. The mineralization style is of the 'intrusion-related, intermediate sulphidation quartz-sulphide gold-copper vein system' type. The Papuan mobile belt hosts a number of world class epithermal Au (e.g., Porgera) and porphyry Cu-Au (e.g., Ok Tedi, Frieda River, Wafi/Golpu) orebodies.

In May 2017, a northern extension to the 1.65 million ounce AuEq inferred Kora deposit was discovered, called Kora North. By October 2018, Kora North had increased combined Kora–Kora North resources by more than 60%, having defined a measured and indicated resource of almost 400 000 oz AuEq and inferred resource of almost 750 000 oz AuEq. Kora North is a near-mine infrastructure discovery that has rapidly transformed the Kainantu mine with mining commencing in October 2017, commercial production declared on February 1, 2018, 2018 production of 47 237 oz AuEq, upgraded 2019 guidance of 72–80 000 oz AuEq and 2020 outlook of 115 000 to 125 000 oz AuEq. As of the latest resource (October 2018), the Kainantu mine had a measured and indicated resource of 560 000 oz AuEq and inferred resource of 2.4 million ounces, with combined average grades of over 12 g/t AuEq.

The Kora and Kora North deposits are open to depth and along strike (to the south), and have been connected via recent drilling. An aggressive exploration program is underway with five drill rigs operating. The program has returned exciting results, particularly recently (reported October 7, 2019), with two of the deepest holes to date intersecting significant mineralization, including KMDD0143: 7.40 m at 23.72 g/t Au, 26 g/t Ag and 1.71% Cu (26.67 g/t AuEq) plus 2.00 m at 5.09 g/t Au, 24 g/t Ag and 4.16% Cu (11.77 g/t AuEq). These intersections are about 300 m below our existing underground development.

## **KOOTENAY SILVER INC.**

### **COLUMBA SILVER PROJECT**

**Dr. Tom Richards, Vice President, Exploration; Luis Moya, Gustavo Gallego, Roberto Jordan, Rafa Gutierrez and Jim McDonald, President & CEO, Kootenay Silver Inc.**

Columba, in the state of Chihuahua, Mexico, is a classic low sulphidation epithermal vein system that provides a rare glimpse into the vertical zonation of these deposit types because of minimal erosion.

Surface exposures transition from banded veining (up to 6 m wide and Ag grades to 699 g/t) to narrow, less than 50 cm wide, siliceous, open space, matrix-supported breccia with 1 to 3 g/t Ag 100 m higher in elevation. Further, historical mining and recent drilling confirms grades continue to increase with depth, with values exceeding 1000 g/t Ag.

Regionally, Columba is located within the terrane boundary of the western margin of the Jura-Cretaceous Chihuahua basin and the eastern margin of the Eocene–Oligocene Sierra Madre rhyolites, a structural corridor that is host to numerous Ag mines including Cinco de Mayo, Fresnillo and Parral.

Mineralization is found within low sulphidation, epithermal quartz-calcite, quartz-barite, quartz-calcite-barite, calcite and manganiferous calcite veins, stockworks, breccias and disseminations within a 5 km diameter rhyodacitic caldera intruded by a coeval syenomonzonite to diorite stock 800 m in diameter.

The caldera is underlain by thick-bedded felsic breccias, pyroclastics, breccia/conglomerate and lacustrine/fluvial tuffaceous sediments defining the upper facies of a diatreme setting intruded by flow-banded rhyolite dikes, felsic dikes, domes and intrusive breccias. All intrusive, volcanic and volcanoclastic rocks hosting mineralization have undergone pervasive early to strong argillic alteration associated with disseminated pyrite within a broad regional propylitic alteration peripherally.

Vein mineralization occurs in both intrusive and extrusive rocks with breccia, stockwork and disseminated mineralization more common in extrusive rocks.

Vein textures observed are crustiform, cockade, coxcombs, breccia and stockwork. There are several principal veins and individual veins can be traced for more than 2 km with widths at surface exceeding 6 m. Stockworks with breccias can be in the order of 10–50 m wide. Vein mineralogy includes sphalerite, galena, acanthite and probable Ag sulphosalts in a fine-grained gangue of quartz, chalcedony, barite, amethyst, calcite and manganiferous calcite with pyrite as disseminations and fracture coatings; Sb, Cu and As are weakly anomalous.

The property underwent two periods of mining: circa 1910–1920 and again 1958–1960. Now-flooded underground workings include two principal shafts (90 and 200 m) and six levels of drifts measuring over 1 000 m in length (100 kt estimated production). Plan maps from these workings indicate average grades across 1–3 m widths of 390 to over 800 g/t Ag.

Some 2019 drill results: CDH 19-9: 2.9 m of 516 g/t Ag, including 0.9 m of 1070 g/t Ag, in a hangingwall vein; CDH 19-7: 1.68 m of 417 g/t Ag, also 1.55 m of 693 g/t Ag; CDH 19-8: 33.5 m of 112 g/t Ag, including 4.85 m of 408 g/t Ag, 0.58 m of 707 g/t Ag, 1.17 m of 366 g/t Ag and 1.3 m with 509 g/t Ag; CDH 19-12: three hangingwall veins 1.35 m of 113 g/t Ag, 2.1 m of 699 g/t Ag and 0.6 m of 113g/t Ag; F vein with 11 m of 184 g/t Ag, including 3.15 m of 476 g/t Ag and 1.75 m of 755 g/t Ag; CDH 19-18: 54.13 m with 32 g/t Ag including 0.54 m of 357 g/t Ag in the I vein.

## **LIBERTY GOLD CORP.**

### **BLACK PINE PROJECT: A LARGE, CARLIN-STYLE GOLD SYSTEM, SOUTHERN IDAHO**

**Will Lepore, Liberty Gold Corp.; April Barrios, Liberty Gold Corp.; Peter Shabestari, Liberty Gold Corp.; Moira Smith, Liberty Gold Corp.**

The Black Pine gold oxide project is located in the Great Basin in southeastern Idaho. Approximately 465 000 oz of Au were produced from five small pits in a run of mine heap leach operation in the 1990s.

Liberty Gold has operated the property since mid-2016. Prior to the commencement of drilling in 2019, Liberty Gold undertook comprehensive drill permitting and detailed compilation and modeling of more than 1800 historical drill holes and thousands of surface samples. Extensive unmined gold mineralization was documented in historical drill holes and surface samples over a 12 km<sup>2</sup> area.

Sedimentary rock–hosted gold mineralization occurs in Pennsylvanian to Permian Oquirrh Group carbonate rocks, calcareous siltstone and sandstone, which underwent extensive structural preparation through Sevier (late Cretaceous) folding and thrusting, as well as early Cenozoic normal faulting. Prospective gold-bearing strata form a thrust-imbricated package ranging from 100 to more than 300 m thick. Gold-bearing fluids were introduced along a series of moderate-angle normal faults, with the dominant set striking northwest and dipping to the northeast. Gold mineralization is accompanied by elevated arsenic, antimony, thallium, mercury and barium, as is typical of Carlin-style gold systems on the Carlin trend. Alteration includes jasperoidization, weak decalcification, clay alteration, calcite veining and iron oxides. Very minor disseminated pyrite is observed locally.

Drilling by Liberty Gold to date in 2019 has produced a number of impressive intercepts, including 53.3 m grading 4.39 g/t Au, 62.5 m grading 3.40 g/t Au, and 44.2 m grading 3.14 g/t Au. Weighted average cyanide-soluble assays for these intervals average up to 97% of the fire assay, attesting to the thoroughly oxidized nature of gold mineralization. Liberty Gold believes that the historical data and current drilling support the thesis that a shallow, oxidized, multi-million-ounce gold system exists at Black Pine.

## LION ONE METALS LIMITED

### TUVATU, FIJI: ALKALINE GOLD IN THE SOUTH PACIFIC

**Stephen Mann, P.Geo., Managing Director, Lion One Metals Limited**

Lion One Metals Limited (TSX-V LIO; ASX LOL: LOLMF OTCQX) is the 100% owner of the Tuvatu gold project in Fiji, and is currently transitioning from explorer to gold miner.

The company's core asset is the Tuvatu gold project, located 17 km from the Nadi International Airport on the island of Vitu Levu, Fiji. Lion One has tenure totalling 140 km<sup>2</sup> over the Navilawa caldera, one of a number of mineralized, 4.8 Ma volcanic centres aligned along the 250 km long, northeast-southwest–striking Vitu Levu lineament.

The Tuvatu gold deposit consists of a series of north-south, east-west and northwest-southeast steeply dipping mineralized lodes and a series of relatively flat east-dipping lodes, hosted in an alkaline suite of rocks, dominated by a large monzonitic intrusion. To date, the company has delineated a NI 43-101– and JORC-compliant inferred and indicated mineral resource of 4 965 000 t at 5.71 g/t Au for 911 300 oz Au, but expects further exploration to significantly increase that figure.

As part of its endeavour to demonstrate that this highly mineralized field hosts multi-millions of ounces of gold, Lion One is undertaking detailed exploration programs including deep diamond drilling, regional BLEG sampling, CSAMT geophysical surveys and detailed mapping, trenching, benching and surface geochemistry to identify further resources both at depth and elsewhere in the caldera.

Following the approval of the environmental impact report in 2013 and the grant of the mining lease and surface lease in 2016, the company constructed a world-class geochemical and metallurgical laboratory and purchased drilling assets to ensure the continuation of low-cost and efficient mineral exploration, while developing the mining operation targeted to be operational in 2021.

## LUMINA GOLD CORP.

### CANGREJOS AU-CU PROJECT, ECUADOR

**L Hathaway, Sn VP, Lumina Gold; A Carstensen, VP Expl, Lumina Gold; G Wells; A Soful, Lumina Gold**

The Cangrejos advanced exploration project is located in southern Ecuador, 30 km southeast of the port city of Machala. In 1992, Odin Mining carried out a stream sediment sampling program to try and locate the source of the 69,000 ounce Birón alluvial gold deposit that the company was mining. A number of highly anomalous gold stream sediment samples were identified and mineral concessions covering them were acquired. In 1994, Odin formed a joint venture with Newmont and carried out extensive geological, geochemical and airborne magnetic surveys on the project. A large sub-circular gold-copper soil anomaly with a diameter of approximately 2.7 km was discovered. Subsequent drilling discovered two zones of porphyry style gold-copper mineralization: Cangrejos and Gran Bestia. In 2001, Newmont withdrew from the joint venture and Odin continued to explore the property. In 2014, Lumina acquired control of Odin Mining and the company was renamed Lumina Gold in November 2016.

Since acquiring the project, Lumina has defined an Indicate Resource of 10.4 million ounces of gold and another 6.3 million ounces of gold in Inferred Resources at Cangrejos. (Indicated: 568.2 Million tonnes at 0.57 g/t Au, 0.11% Cu, Inferred: 476.0 Million tonnes at 0.41 g/t Au, 0.08% Cu, November 2019).

Gold-copper porphyry style mineralization is associated with Miocene quartz diorite intrusions and adjacent breccias. Finely disseminated chalcopyrite, pyrite and minor bornite, molybdenite and pyrrhotite are associated with potassic and late stage calcic-sodic alteration.

## MAWSON RESOURCES

### RAJAPALOT GOLD-COBALT PROJECT, LAPLAND, FINLAND

**Nick Cook, President, Mawson Resources**

The Rajapalot project forms the eastern part of a 10 km by 10 km, 100%-owned area comprising three resource bodies plus two new discovery areas within a 4 km by 3 km area in Northern Finland.

In late 2018, a pit and underground maiden constrained inferred mineral resource of 424 000 oz Au at 3.1 g/t AuEq (4.3 million tonnes at 2.3 g/t Au, 430 ppm Co) at 0.37 g/t AuEq cutoff open-pit and 2 g/t AuEq underground was calculated, within a combined unconstrained inferred mineral inventory for the Palokas and Raja prospects of 482 000 oz AuEq at a grade of 2.4 g/t AuEq (6.2 million tonnes at 1.7 g/t Au, 410 ppm Co) at 0.4 g/t AuEq cutoff.

A 15 km drill program completed during early 2019 doubled volumes below the 2018 maiden inferred resource to create a substantial exploration target. Best results from the 2019 drill program below the 2018 resource areas were:

- Raja: PAL0188: 31.3 m at 4.3 g/t Au and 1030 ppm Co from 298.3 m and
- Palokas: PAL0194: 15.2 m at 4.3 g/t Au and 2566 ppm Co from 418.7 m, a 275 m down-plunge step-out.

Drilling recently recommenced, with a 15 km program ongoing to April 2020. This drill program will infill and aim to extend resource areas. Drill targets for the program are well constrained, given the continuity of the linear high-grade gold mineralization within electromagnetic (EM) conductors. Fixed-loop EM surveys aid in defining further blind mineralized bodies and downhole EM will be used to refine precise drill targets. A resource upgrade is planned for late second quarter 2020.

Gold and cobalt are free milling, which auger well for a conventional and simple metallurgical flowsheet.

## MCEWEN MINING INC.

### EXPLORATION DRILLING RESULTS FROM GREY FOX AND STOCK – BLACK FOX COMPLEX, TIMMINS, CANADA

**Sylvain Guerard, Senior VP of Exploration, McEwen Mining Inc.; Ken Tylee, Exploration Manager, McEwen Mining Inc.**

Surface drilling at Grey Fox highlights the potential for additional mineralization across the 1 km<sup>2</sup> area, confirms the continuity of the main mineralized shoot at 147NE and shows new mineralization at South Zone and Whiskey Jack.

- South Zone: 10.9 g/t Au over 18.8 m, including 15.9 g/t Au over 10 m
- Whiskey Jack: 14.1 g/t Au over 8.4 m, including 59.1 g/t Au over 1.3 m
- 147NE: 12.3 g/t Au over 4.4 m, including 19.2 g/t Au over 2.2 m

Drilling on the Stock property revealed gold values at two strongly mineralized gold systems: At Stock West the favourable hostrock is a coarse-grained, magnesite-fuchsite-dolomite-carbonate-altered ultramafic unit. The well-mineralized intersections assay consistently across intervals, with gold present in both veinlets and within the ultramafic unit.

- 6.7 g/t Au over 39 m
- 5.6 g/t Au over 30 m, including 9.1 g/t Au over 13 m
- 5.6 g/t Au over 29.1 m, including 15.0 g/t Au over 5.1 m

This new mineralization, intersected 390–510 m below surface, remains open at depth and along strike. Similar coarse-grained ultramafic host appears at Stock Deep and the potential for connecting with Stock West over a 600 m gap will be tested.

In addition, a pyrite-rich felsic dike occurring next to the ultramafic intrusive and carrying visible gold throughout was intersected, returning 13.2 g/tAu over 5.4 m. These styles of mineralization differ from most others in the Black Fox complex.

Recent drilling at Stock East encountered significant grades from approximately 290 m vertical depth:

- 34.7 g/t Au over 5.9 m, including 74.1 g/t Au over 2.7 m
- 83.5 g/t Au over 5.6 m, including 417 g/t Au over 1.1 m

Assessing the occurrence of higher-grade shoots within the wider and lower grade at Stock East generated some of the highest-grade intersections to date.



## **MINAURUM GOLD INC.**

### **ALAMOS SILVER PROJECT: EXPLORATION BRINGS A HISTORICAL MINING DISTRICT BACK TO LIFE**

**Steve Maynard, VP Exploration, Minaurum Gold Inc.**

Minaurum Gold's 37 317 ha Alamos project in Sonora, Mexico, covers the Alamos mining district, which produced a minimum 120 million ounces Ag from 1680 until 1930, and is 15 km south of Cobre del Mayo's Piedras Verdes 50 000 tpd open-pit and 4500 tpd underground copper-silver mine. No systematic modern exploration was conducted in the district until Minaurum's entry in 2016. Minaurum's exploration program consists of geological mapping, rock-chip sampling, and drilling.

Minaurum has documented 25 vein zones with strike lengths ranging from 0.5–3.4 km over a defined mineralized footprint measuring 10 km in strike length and 5.5 km wide. The first hole drilled into the Europa-Guadalupe zone, hole AL17-007, intersected 8.25 m grading 1760 g/t (57 oz/t) Ag, 1.6% Cu, 1.5% Pb and 2.6% Zn, including 2.2 m grading 5098 g/t (164 oz/t) Ag, 2.76% Cu, 0.5% Pb and 1.18% Zn. 'Blind' veins were intersected in drill holes AL17-007 and AL17-008, confirming the 'piano key' model. Hole AL19-025 intersected 3.80 m of 415 g/t Ag, 2.68 g/t Au, 1.37% Cu, 6.20% Pb and 9.19% Zn, or 1 430 g/t AgEq, including 0.95 m of 1566 g/t Ag, 6.72 g/t Au, 4.48% Cu, 9.27% Pb and 10.08% Zn, or 3321 g/t AgEq.

The Alamos vein system occupies a 10 km by 5.5 km 'footprint' in a complex set of north-northeast–south-southwest–trending horsts and grabens cutting limestone, batholithic granodiorite and andesitic and rhyolitic volcanics. Silver- and base-metal–bearing epithermal veins are controlled by graben-bounding faults. Additionally, blind veins may be present in down-dropped blocks with little or no surface expression. The 'piano key' model refers to this series of parallel elongated fault blocks that are alternately up-and down-thrown. Veins in and on the margins of the high-standing blocks were eroded to expose mineralization. Mineralized levels in veins in the down-thrown blocks were protected from erosion so that only high-level stringer veins are exposed. Stringer veins on surface in down-thrown blocks potentially indicate intact economic veins at depth.

Minaurum will show mineralized core and surface samples from the Alamos project at its display booth.

## **NEW PACIFIC METALS CORP.**

### **SILVER SAND: POTENTIAL FOR WORLD-CLASS SILVER DEPOSIT**

**Cain Saint Merat, New Pacific Metals Corp.; Gloria Feng, New Pacific Metals Corp.**

New Pacific Metal Corp.'s Silver Sand project is 25 km northeast of Cerro Rico, situated within a tier one, tin-silver mining belt. San Cristóbal, San Vincente, Chocaya, Illapa, Sinchi Wagra and Cerro Rico are current producing mines in the area.

The stratigraphy consists first of reddish siltstone and mudstone units of Cretaceous Tarapaya Formation followed by massive silver-mineralized whitish sandstones of the Cretaceous La Puerta Formation, which were bleached white due to sericite alteration of the original reddish sandstones. The drill hole generally ends with fresh red sandstones.



The mineralized structures strike northwest-southeast and are geometrically characterized by a subvertical dipping brittle fracture network and accompanied with thin but densely distributed veinlet and breccia structures hosting high-grade silver mineralization. The mineralization is mostly hosted in fractures developed in the bleached sandstone of La Puerta Formation within 150 m of the overlying red mudstone and siltstone of the Tarapaya Formation, making shallow and subhorizontal zones with an average depth of about 120 m (minimum of 1.7 m using a >30 g/t Ag cutoff).

Silver Sand mineralization primarily consists of freibergite, miargyrite, polybasite and andorite with other accessory sulphosalt minerals.

Initial metallurgical testing is encouraging, indicating amenable soft-medium grindable, low-medium abrasion, rough scavenger floatation recovery of 92%, 86.6% and 96% for oxide, transition and sulphide rock, respectively.

Mineralization involves a multi-phased fluid paraenesis within a structurally controlled oxidation system to depths of about 200 m. This type of mid-Miocene magmatic hydrothermal model has considerable district-wide and scalable exploration potential given the presence of both historical workings and current mine producers.

## **NORTHISLE COPPER AND GOLD INC.**

### **CHANGES IN ALTERATION AND MINERALIZATION WITH EROSIONAL LEVELS IN PORPHYRY COPPER GOLD DEPOSITS AT THE NORTH ISLAND PROJECT, BRITISH COLUMBIA.**

**John McClintock, President and CEO, Northisle Copper and Gold Inc.**

The North Island property occurs at the north end of Vancouver Island in British Columbia, Canada. Geographic coordinates are 50°40.5'N and 127°51' W. The property includes the Hushamu and the Red Dog porphyry copper-gold-molybdenum deposits and a number of other porphyry-type occurrences including NW Expo and Pemberton Hills. The Hushamu and Red Dog deposits were the subject of a preliminary economic evaluation completed in 2017.

Northisle Copper and Gold Inc.'s tenures cover a 50 km length of the Jurassic Bonanza volcanic arc. The Bonanza Group consists of intermediate volcanic and volcanoclastic rocks likely derived from a series of volcanic centres along the length of the belt. The intruding Island intrusions include diorite, quartz diorite and granodiorites. The known porphyry copper-gold-molybdenite deposits and occurrences are hosted in andesite and intruding Jurassic Island intrusions.

The Bonanza volcanic arc is unusual for both the number of deposits and occurrences within its 60 km length as well as the variation in exposure level of the porphyry copper-gold-molybdenum mineralization systems. The level of erosion of the porphyry systems range from potassic alteration at Island Copper (not on Northisle's tenures), intermediate argillic and advanced argillic at the Hushamu and very high level lithocap alteration at NW Expo and Pemberton, where potential for a porphyry deposit at depth remains. At the Red Dog deposit, the copper- and gold-mineralized quartz magnetite breccia is fault bounded by advanced argillic alteration. The relationship of this magnetite breccia to its position in the porphyry system remains enigmatic. All of the deposits along the belt contain significant amounts of rhenium ranging from 0.3 to 0.5 ppm.

Core on display shows the change in alteration and mineralization from the intermediate argillic level to clay and silica alteration of the lithocap.

## **RADISSON MINING RESOURCES**

### **O'BRIEN GOLD PROJECT: CREATING VALUE ALONG THE WORLD-RENOWNED LARDER-LAKE-CADILLAC BREAK**

**Richard Nieminen, P.Geo Exploration Manager, Radisson Mining Resources; Kenneth Williamson, M.Sc., P.Geo, Kenneth Williamson 3DGeo-Solution.**

The O'Brien project is located in the Bousquet-Cadillac mining camp along the Larder Lake–Cadillac Break in Abitibi, Quebec. The Bousquet-Cadillac mining camp has produced over 21 million ounces of gold over the last 100 years. The project hosts the former O'Brien mine, considered to have been the Abitibi greenstone belt's highest-grade gold producer during its production (1 197 147 tons at 15.25 g/t Au for 587 121 oz of Au from 1926 to 1957).

In 2019, a new structural interpretation was based on current and historical drill holes and highlighted a strong compatibility with the historical data and geometry of the old O'Brien mine, where 90% of gold production came from three veins at the crossing of a conjugated system (Sauvé et Trudel, 1989). Three preferential mineralized orientations are observed: east-northeast, east-southeast and east-west. The regional Lac Imau fault, a deep-seated fault corridor, splays off the Cadillac break at the O'Brien property. This fault is trending east-southeast and is one of the main mineralized controlling structures.

Steep eastward-plunging gold enrichment vectors are identified on F, 36E, Kewagama and Vintage zones. These vectors occur where mineralized structures intersect each other or lithological contacts, and/or along the axes of asymmetrically folded gold-bearing quartz veins. In the current resource area, the vertical extension of the known mineralized shoots was defined by drilling to a depth of 550 m. A 20 000 m drill program is underway at the O'Brien gold project.

Using a 5.00 g/t Au cutoff grade, the current mineral resource estimate as of July 2019 reports

- indicated resources of 949 700 t at 9.48 g/t Au, for a total of 289 400 oz Au
- inferred resources of 617 400 t at 7.31 g/t Au, for a total of 145 000 oz Au

## **REGULUS RESOURCES INC.**

### **ANTAKORI COPPER-GOLD-SILVER SKARN-PORPHYRY-HIGH-SULPHIDATION EPITHERMAL PROJECT, CAJAMARCA, NORTHERN PERU**

**Kevin B. Heather, Regulus Resources Inc.; Hubert Gamarra, Regulus Resources Inc.; John Black, Regulus Resources Inc.; Peru Exploration Staff, Regulus Resources Inc.**

The AntaKori project, Cajamarca Province, Peru, continued to deliver outstanding drill results during the 2019 drill campaign, with a NI 43-101 indicated sulphide mineral resource of 250 million tonnes at 0.48% Cu, 0.29 g/t Au and 7.5 g/t Ag and an inferred sulphide mineral resource of 267 million tonnes at 0.41% Cu, 0.26 g/t Au and 7.8 g/t Ag.

The project is located within the world-class Au-Cu-Ag belt of northern Peru. It is adjacent to the Tantahuatay high-sulphidation epithermal (HS) Cu-Au mine (Compañía Minera Coimolache,

Buenaventura, Southern Peru), which has an indicated sulphide resource of 488.5 million tonnes at 0.76% Cu and 0.20 g/t Au and an inferred resource of 455.0 million tonnes at 0.68% Cu and 0.1 g/t Au (BVN Annual Report 2016 & Webpage); 7 km northwest of the Cerro Corona porphyry Cu-Au mine (Gold Fields); and 32 km northwest of the Yanacocha HS Au-Cu mine (Newmont-Buenaventura).

AntaKori is characterized by prograde and retrograde exoskarn, calcic-skarn and porphyry-related Cu-Au-Ag mineralization (low As) overprinted by high-sulphidation Cu-Au-Ag mineralization (high As), and by carbonate–base metal–Au-Ag-Pb-Zn-Cu mineralization (low As). Skarn mineralization is dominated by magnetite-chalcopryite-pyrite. The Cretaceous rocks are locally overlain and crosscut by middle Miocene (13.2–12.7 Ma) intermediate to felsic volcanic and subvolcanic rocks of the Tantahuatay centre of the Calipuy Formation, which hosts HS Au-Ag-Cu mineralization with enargite-tennantite-pyrite.

Recent drilling on various magnetic highs and lows, located to the north of AntaKori, has led to the discovery of significant low-As-bearing skarn-, porphyry- and breccia-hosted Cu-Au mineralization, which is collectively called the AntaNorte discovery. Significant intersections at AntaKori and AntaNorte from the 2019 drill program include

610.20 m at 0.84% Cu, 1.02 g/t Au and 10.3 g/t Ag (1.66% CuEq in both HS and skarn mineralization; AK-19-031; AntaKori);

819.90 m at 0.53% Cu, 0.24 g/t Au and 7.8 g/t Ag (0.77% CuEq) in skarn, porphyry and lesser high-sulphidation mineralization (AK-19-034; AntaNorte);

473.20 m at 1.16% Cu, 0.21 g/t Au and 8.4 g/t Ag (1.39% CuEq) in breccia mineralization (AK-18-026; AntaNorte).

## **ROCKHAVEN RESOURCES LTD.**

### **KLAZA PROJECT – HIGH-GRADE GOLD AND SILVER IN CANADA’S YUKON**

**Matt Turner, President and CEO, Rockhaven Resources Ltd.**

The Klaza property is 100% owned by Rockhaven Resources Ltd. and covers an area of 28,700 hectares. It is favourably located within Yukon's Mount Nansen Gold Belt (MNGB), an area that hosts an historical gold mine, rich placer gold deposits and key infrastructure such as road access. Rockhaven's exploration to date has included 100,000 m of diamond drilling, 24,000 m excavator trenching, extensive soil geochemical surveys, and airborne and ground geophysical surveys.

Drilling at the Klaza property has identified mineralized zones and numerous subsidiary structures, which are part of an epithermal to porphyry system. The majority of these zones are hosted within a 2.5 km long and 1.8 km wide structural corridor hosted by mid-Cretaceous granitoids.

The property hosts an indicated resources of 4.5 Mt containing 686,000 oz gold and 14,071,000 oz silver at grades of 4.8 g/t gold and 98 g/t silver, and inferred resources of 5.7 Mt containing 507,000 oz gold and 13,901,000 oz silver at grades of 2.8 g/t gold and 76 g/t silver (see Klaza Property Technical Report dated August 2, 2018). A preliminary economic analysis, announced in March 2016 and completed on the December 2015 resource estimate, yielded encouraging results with a Pre-Tax NPV(5%) of \$150 million and 20% IRR.

The Klaza mineral resources lie within the northern part of the MNGB, a northwest elongated structural belt that hosts more than 30 known mineral occurrences. Gold and silver-rich veins within the MNGB

dominantly occur in northwesterly trending structures. The hydrothermal system associated with mineral occurrences in the MNGB is cored by weak porphyry copper-molybdenum centres, and transitions outwards to anastomosing sheeted veins and more distally to cohesive base and precious metal veins. The mineralizing events within the MNGB are interpreted to be related to the emplacement of the Late Cretaceous, Casino Suite intrusive centres.

The majority of Rockhaven's exploration activities, including 2019 work, have been focused on the discovery and delineation of vein mineralization, which lies in distal part of the local hydrothermal system where copper-deficient, precious metal rich veins predominate.

## **RUDDOCK CREEK MINING CORPORATION (AN IMPERIAL METALS COMPANY)**

### **RUDDOCK CREEK PROJECT**

**Jim Miller-Tait, Vice-President of Exploration, Imperial Metals Corporation; Bill Fischer, M.Sc., Exploration Geologist and Doctoral Candidate, Imperial Metals Corporation and Simon Fraser University.**

Ruddock Creek is a high-grade, rift-related sedimentary exhalative (SEDEX) Zn-Pb-Ag deposit, hosted within the Neoproterozoic Windermere Supergroup. The property is located 155 km northeast of Kamloops, British Columbia. Rocks of the Windermere Supergroup host massive sulphide mineralization and consist of amphibolite-grade metasedimentary rocks, calcsilicate-altered rocks, marbleized carbonate rocks and Late Cretaceous pegmatitic granitoids. Significant deformation during the Late Cretaceous resulted in dynamic folding and displacement of the massive sulphide horizons.

Massive sulphide horizons at Ruddock Creek have an indicated strike length of roughly 5 km. Throughout the strike length, district-scale faults have dismembered the sulphide horizon into several different zones of mineralization. Ore textures are identical between the zones, but can have varying orientations and degrees of deformation. Mineralization at the V zone is the most exciting property wide due to its 70° dip to the north, the predictability of the massive sulphide horizon and high Zn-Pb concentrations.

In summer 2018, 21.7 m (true thickness 21.5 m) grading 16.99% Zn, 3.44% Pb and 2.41 g/t Ag was intercepted approximately 300 m below the deepest mineralization previously known. Mineralization was encountered at a drill hole depth of 750 m (predicted depth: 751.5 m) and, until 2019, was the highest grade encountered at the V zone.

In summer 2019, an extensive drilling program was implemented to provide further continuity to V zone mineralization. Drill hole RD-19-V54 intersected mineralization 52 m above the mineralization defined in 2018, confirming the presence of a wide, high-grade massive sulphide horizon. The hole assayed 16.83% Zn, 3.46% Pb and 4.74 g/t Ag over a width of 40.9 m (true thickness of 36.8 m). The continuity, thickness and steeper dip of the V zone should have a lower mining cost than the shallower dipping zones, thus greatly improving the economics of the project as a whole.

## SABINA GOLD & SILVER CORP.

### EXPLORATION SUCCESSES AT THE BACK RIVER GOLD PROJECT, NUNAVUT, CANADA

**Stacie Jones, Sabina Gold & Silver Corp.; Angus Campbell, Sabina Gold & Silver Corp.**

The Back River gold project is an approximately 7.2 million ounce iron formation–hosted gold district in advanced exploration and early stage development that is located in the Kitikmeot region of Nunavut, Canada, approximately 520 km northeast of Yellowknife, Northwest Territories, and is 100%-owned by Sabina Gold & Silver Corp.

During 2019, structural field mapping, trenching and 7 065 m of exploration diamond drilling was completed at the Goose property, with a focus of advancing high-impact resource opportunities in parallel with continued study of the deposit(s) paragenesis including an increased understanding of the structural history. Highlights from 2019 include drilling at the Nuvuyak, Llama Extension and Vault zones supplemented by a 50 m by 20 m trench over the Goose Main deposit.

The continued expansion of the Nuvuyak target, a geologically driven discovery, is a strong success story in the growth potential for additional new discoveries at the Back River project, with the significant results from 2019 including 9.25 m grading 14.7 g/t Au and 8.60 m grading 10.52 g/t Au in drill hole 19GSR566W2. The current strike length of the Nuvuyak mineral zone is 370 m and remains open in all directions.

At Umwelt underground the definition and expansion of a thickened, high-grade corridor of mineralization, initially identified at the Vault zone and more recently traced in the up-plunge direction presents a near-term opportunity to enhance project economics. Significant results from 2019 include 21.75 m at 14.97 g/t Au from drill hole 19GSE569.

Sabina has made considerable progress in demonstrating the potential for continued resource growth and plans to continue the development of the Llama Extension and Nuvuyak zones. Additionally, optimization of the Umwelt underground resource through further definition of the high-grade structure newly identified within the deposit trends up-plunge from the Vault zone will also be a priority.

See [www.sabinagoldsilver.com](http://www.sabinagoldsilver.com) for additional updates from 2019 and information on mineral resource estimates.

## SILVERCREST METALS

### LAS CHISPAS PROJECT

**N. Eric Fier, CPG, P.Eng. CEO and Director, SilverCrest Metals; Stephany “Rosy” Fier, CPG, Vice President, Exploration & Technical Services, SilverCrest Metals**

The Las Chispas district in Sonora, Mexico, is split into the Las Chispas area and the Babicanora area, which together currently consist of 36 epithermal veins. Of the 36 veins, SilverCrest has included 10 in their current resource. Drilling in each vein has intercepted high-grade (greater than 150 g/t AgEq) mineralization in all veins with more than 75 intercepts of >5000 g/t AgEq. The veins and stockwork within the Las Chispas vein consist of fine- to medium-grained, subhedral to euhedral, interlocking quartz with minor cavities lined by comb quartz (typically crystals are 5–10 mm in length). Vein emplacement and

form are structurally and lithologically controlled. The rheology of the host rock plays an important role in structural preparation and emplacement of the mineralization. Within the fine-grained welded tuff, veining is narrow and chaotic. Veins and breccia emplacement in the more competent medium-grained lapilli tuffs are wider and focused along the main structure with denser veining in the adjacent fault-damaged zone. The two types of breccias associated with mineralization at Las Chispas, hydrothermal breccia and recemented mechanical breccia, are hosted differently. Argentite and electrum are the principal silver and gold minerals in association with acanthite, polybasite, stephanite, pyrrargyrite, native silver and native gold. Silver and gold values have a strong correlation with one another and are likely precipitated together during the crystallization of quartz. Base metals and trace elements are generally low and do not negatively impact metallurgy.

## **SKEENA RESOURCES**

### **ESKAY CREEK: THE LEGEND CONTINUES**

**Kelly Earle, VP Communications, Skeena Resources; Katie MacKenzie, Investor Relations, Skeena Resources**

The Golden Triangle of B.C. has been regaining its former popularity. One of the most famous, high-grade past producers that triggered the region's mining fame is Eskay Creek. Skeena optioned Eskay Creek from Barrick in 2017 and released a combined indicated and inferred 4 million ounce, 4.5 g/t AuEq, open-pit resource in February 2019. The company also recently completed a preliminary economic assessment on Eskay, which has highlights of an after-tax net present value 5% of C\$638 million, 51% internal rate of return and 1.2 year payback. Skeena drilled 7000 m in 2018 and commenced a 15 000 m drill program at Eskay Creek in August 2019. Results from the 2019 drill program include a newly discovered high-grade hydrothermal vent grading 18.13 g/t AuEq over 22.65 m. The company also intersected 314.07 g/t AuEq over 2.21 m in a Lower Mudstone horizon. The Lower Mudstone horizon holds significant exploration potential as it can be traced over 5 000 m along strike. It sits 100 m stratigraphically below the more familiar high-grade Contact Mudstone. The complexity of the Eskay core and anomalous high grades make it a one of a kind VMS-style deposit.

## **SSR MINING**

### **NEW RESOURCE DISCOVERY AT THE GAP HANGINGWALL ZONE, SANTOY DEPOSIT**

**David Gale, Corporate Exploration Manager; Jeff Kulas, Manager Geology; Anders Carlson, Exploration Manager, SSR Mining**

The Seabee-Santoy mine property is located within the Glennie domain in the Reindeer zone of the Trans-Hudson Orogen in central Saskatchewan. The Reindeer zone is a roughly 500 km wide collage of Paleoproterozoic (1.92–1.83 Ga) arc volcanic rocks, volcanogenic sediments and plutons. The Glennie domain comprises relatively narrow belts of supracrustal rocks separated by large granitoid gneisses and plutons, all of which have been subjected to amphibolite facies metamorphism that peaked ca. 1810 Ma. The Glennie domain is bound to the west and north by the Stanley shear zone and the La Ronge domain, and to the east by the Tabbernor fault and the Kissynew domain. The Santoy mine complex lies along a high-strain, crustal-scale structure interpreted as a northwesterly splay off the Tabbernor fault.



The geology of the Santoy mine complex is dominated by fine- and coarse-grained mafic volcanics associated with pelitic interflow sediments along the moderately to highly strained western limb of the Carruthers Lake synform. Hangingwall rocks to the Santoy gold deposits include conformable gabbroic and granodiorite sills to the surrounding mafic volcanic rocks. The Gap HW zone occurs 200 m to the northeast (in the hangingwall) of the main Santoy deposit and comprises three stacked zones of quartz veining hosted within a Z-folded granodiorite sill. An inaugural 87 000 oz resource grading 6.07 g/t Au was defined in 2018. Extensive drilling in 2019 has defined a zone with 900 m of down-plunge extent that remains open at depth and along strike to the east. The Gap HW zone is one of a number of targets that will be aggressively tested in 2020 as the Seabee gold operation approaches the 3 million ounce produced + resource mark.

## SUN METALS

### STARDUST: A MODERN APPROACH TO EXPLORATION AT A HISTORICAL SKARN/CARBONATE REPLACEMENT DEPOSIT IN NORTHERN BRITISH COLUMBIA

**Steve Robertson, President, Sun Metals; Ian Neill, VP Exploration, Sun Metals; Tyler Caswell, Project Manager, Sun Metals**

The Stardust project, located in northern British Columbia, has a long history of exploration dating back to the initial discovery in the 1940s. Hosted in the Cache Creek Terrane directly west of the Pinchi fault, the project consists of a full suite of carbonate-replacement-style mineralization located proximal to the Eocene Glover stock.

Historical exploration traced distal epithermal-style vein mineralization along trend to lead-zinc manto-style mineralization before the Canyon Creek skarn zone was discovered within interbedded phyllites and limestones directly east of the Glover stock. This work has left a rich history of exploration data to build upon.

In 2018, Sun Metals conducted an initial exploration program at Stardust, which comprised an integrated geological, geochemical and geophysical effort to identify 'new discovery' areas and 'zone expansion' areas. This work led to the targeting of DDH18-SD-421, Sun Metals' best intersection from the 2018 program, which returned grades of 4.99% Cu equivalent over 100 m within skarn-altered limestone beneath the phyllitic package.

In 2019, Sun Metals continued this work, expanding on mineralization within the '421 zone' aided by the use of directional drilling to trace mineralization along plunge of an interpreted fold hinge. Core displayed is from two holes drilled during the 2019 program, drillhole DDH19-SD-429 and drillhole DDH19-SD-441, both showing examples of the mineralized skarn assemblage.

## TECK RESOURCES LIMITED

### SAN NICOLÁS VHMS DEPOSIT, ZACATECAS, MEXICO

**Tina Roth, Teck Resources Limited; Mario Canela, Teck Resources Limited; Honza Catchpole, Teck Resources Limited**

Teck Resources Limited (Teck), through its Mexican subsidiaries, owns 100% of the San Nicolás VHMS copper-zinc-gold-silver deposit located approximately 60 km southeast of Zacatecas city in Zacatecas



state, central México. Teck discovered the deposit in 1997 through a combination of geological mapping, geophysical surveys and drilling. Current mineral resources at San Nicolás include 108.9 million tonnes at 1.17% Cu, 1.62% Zn, 24.5 g/t Ag and 0.43 g/t Au in the measured and indicated categories.

The deposit occurs in a Mesozoic bimodal volcanic and sedimentary sequence. Mineralization is hosted by rhyolite lava flows and breccias overlain by mafic lava flows, sills, tuffs and interbedded mudstone. Tertiary volcanoclastic rocks unconformably overlie the Mesozoic sequence. Mineralization occurs as massive to semi-massive sulphides dominated by pyrite with significant sphalerite±galena and trace tetrahedrite/tennantite in the upper zinc-rich zone, transitioning downward to massive pyrite and chalcopyrite in the copper-rich zone. Massive to semi-massive textures transition sharply to sulphide stringers in the lower and lateral parts of the deposit. Within the copper zone, alteration facies and distribution consist of intense chlorite grading out to sericite away from the core of the deposit; sericite and carbonate are common within the zinc-rich portion. The deposit flanks a northwest-trending, southwest-dipping syn-volcanic structure.

Detailed metallurgical studies have defined four geometallurgical units (GMUs) for copper based on chalcopyrite phase-specific surface area (PSSA), determined using a mineral liberation analyzer. PSSA is a proxy for grain size and mineral liberation. Recovery equations for copper were developed within each GMU based on estimates of multi-element data. Zinc recovery is based on a single multi-element equation that includes PSSA values of sphalerite.

Teck continues to advance the project through execution of multidisciplinary field programs. A prefeasibility study and Mexican environmental impact assessment are in preparation.

## TERANGA GOLD CORPORATION

### GOLDEN HILL PROJECT, BURKINA FASO

#### David Mallo, Teranga Gold Corporation

Golden Hill is Teranga Gold Corporation's most advanced exploration project, comprising three adjacent exploration permits covering 468 km<sup>2</sup> in southwest Burkina Faso. It is centrally located within the highly mineralized Houndé greenstone belt, host to several high-grade gold discoveries including the Houndé, Siou and Yaramoko deposits.

In just 3 years, Teranga has identified more than a dozen moderate- to high-grade, near-surface prospects and deposits, all located within 10.0 km of a central point. Of these advanced drill prospects, the most extensively explored and drilled to date is the Ma structural complex, hosting the largest resource outlined to date. In February 2019, Teranga announced an early-stage initial mineral resource estimate for Golden Hill's most advanced prospects with indicated mineral resources of 6.40 million tonnes averaging 2.02 g/t Au for 415 000 oz and inferred mineral resources of 11.95 million tonnes averaging 1.68 g/t Au for 644 000 oz (as at November 30, 2018).

Gold mineralization throughout all known prospects at Golden Hill is influenced and controlled by structure and less so by hosting geology. Mineralization is both volcanic hosted and intrusive hosted. Researchers commonly observe the same mineralized structures crosscutting both stratigraphic hosts while displaying excellent continuity and correlation within and extensional to both. Many of the mineralized structures observed tend to have a brecciated component centrally located within the broader altered and mineralized host structures.

Of further exploration interest are oblique crossing structures propagating from the primary northeast regional trend. Teranga observes these crossing structures throughout and focuses ongoing evaluations at areas of structural intersections.

Technical studies are currently underway in support of a preliminary economic estimate as the company is advancing the project toward the feasibility stage. Based on encouraging drill results to date and the positive initial resource estimation, confidence continues to increase that Golden Hill could be Teranga's third gold mine.

## TINKA RESOURCES

### AYAWILCA ZINC CARBONATE REPLACEMENT DEPOSIT, PERU

**Dr. Graham Carman, Tinka Resources ; Alvaro Fernandez-Baca, Tinka Resources**

Ayawilca is located 200 km northeast of Lima in the central Peruvian Andes. Zinc mineralization occurs at depths of 120–400 m as flat-lying sulphide 'mantos', typically 5–30 m thick. At West and South Ayawilca, mantos are stacked and can be mineralized continuously over vertical thicknesses up to 150 m. Zinc occurs in sulphide form as high-iron sphalerite (marmatite) with lesser low-iron sphalerite accompanied by pyrite, pyrrhotite and/or magnetite with minor galena, arsenopyrite and chalcopyrite.

Zinc mineralization is predominantly hosted by Pucará Group limestone, a Triassic–Jurassic formation. The Pucara limestone is overlain by 120–400 m of flat-lying, Cretaceous Goyllarisguizga sandstone that acted as an impermeable seal during mineralization. The sandstone can be mineralized at or near the contact with limestone and also hosts steep zinc-rich veins. Mineralization is interpreted as Miocene (15–10 Ma), associated with an unidentified intrusion at depth. Ayawilca has similarities to other large carbonate replacement deposits in central Peru hosted by the Pucará Group, including Cerro de Pasco and Morococha.

In July 2019, Tinka published a positive PEA based on an indicated resource of 11.7 million tonnes grading 6.9% Zn, 0.16% Pb and 15 g/t Ag and an inferred resource of 45.0 million tonnes grading 5.6% Zn, 0.23% Pb and 17 g/t Ag. Additional drilling, totaling approximately 4000 m, was conducted at Ayawilca in 2019 and is not reflected in the resource estimate. In addition to drilling high-grade zinc intercepts at South Ayawilca, the 2019 drill program identified a new mineralized area with high-grade silver that remains open.

Ayawilca also has a separate tin resource (14.5 million tonnes inferred grading 0.63% Sn with 0.21% Cu and 18 g/t Ag) and a separate silver oxide resource (2.9 million tonnes indicated at 112 g/t Ag and 2.2 million tonnes inferred at 105 g/t Ag).

## TRIUMPH GOLD CORP.

### DEEP WAU: OBSERVE THE HIGH-GRADE TRANSITION FROM EPITHERMAL TO PORPHYRY MINERALIZATION IN A SINGLE DRILL HOLE

**Tony Barresi, President, Triumph Gold Corp.**

In 2018, Triumph Gold Corp. discovered two high-grade, gold-rich, breccia bodies on their 100%-owned, 200 km<sup>2</sup>, road-accessible, Freegold Mountain property in Yukon. The Blue Sky porphyry breccia, and the WAu breccia yielded some of the longest intersections of >1% copper-equivalent, porphyry-related

mineralization ever made in Yukon (e.g., drill hole RVD18-19 intersected 316 m grading 1.1 g/t Au, 5.0 g/t Ag, 0.27% Cu and 0.02% Mo, including 79.75 m grading 2.5 g/t Au, 6.9 g/t Ag, 0.38% Cu and 0.02% Mo).

Triumph's 2019 exploration program included seven deep drill holes, which tested a newly developed geological model that explains the high-grade breccias in terms of a large, mostly buried, porphyry system. Results to date from the WAu breccia demonstrate: 1) that the cupola of a porphyry system exists at depth beneath the breccia, and 2) it contains high-grade mineralization. Drill hole RVD19-02, which tested the WAu breccia to depth, intersected multiple zones of high-grade mineralization over a 851.50 m length. The uppermost high-grade intersection (77.52–478.00 m) is 400.48 m of 0.73 g/t Au, 6.9 g/t Ag, 0.23% Cu and 0.03% Mo. A deeper high-grade intersection (560.50–663.00 m) is 102.50 m of 0.73 g/t Au, 1.5 g/t Ag, 0.18% Cu and 0.06% Mo. The upper intersection doubled the known depth of the WAu breccia, and comprises low-temperature, epithermal style mineralization and alteration. The deeper intersection comprises high-temperature, magnetite-chalcopyrite breccia hosted in intensely potassic-altered granite. The stark difference between the upper and lower high-grade intersections demonstrates increasing proximity to a causative porphyry intrusion, the source for heat, hydrothermal fluids and metals, which generate the porphyry mineralization system. Observing the upper and lower intersection side by side is pleasing both in terms of geological significance, and the pure amount of metal present.

## VICTORIA GOLD

### RAVEN: A NEW DISCOVERY ON THE DUBLIN GULCH CLAIM BLOCK

**Helena Kuikka; Steven Wozniak; Paul Gray**

Victoria Gold's Dublin Gulch gold property is situated in central Yukon, Canada, approximately 375 km north of the capital city of Whitehorse and approximately 85 km from the town of Mayo. The property covers an area of approximately 555 km<sup>2</sup>, and is the site of the company's operating Eagle gold mine.

The Nugget zone, inclusive of the Raven target, represents the second largest Cretaceous granodiorite intrusive body on the Dublin Gulch property (second only to the Dublin Gulch stock that hosts the Eagle gold mine) and consists of a 2.2 km by 1.2 km, medium- to coarse-grained granodiorite stock of the Cretaceous Tombstone Plutonic Suite. The Nugget stock is hosted in the Earn Group and the Keno Hill quartzite. Coincident arsenic and gold in soil anomalies occur along the contact margins of the Nugget stock. This intrusive plug is akin to the Eagle deposit and has been the subject of limited historical exploration work due to the previous inaccessibility of the area.

The Raven target was tested during the 2019 exploration program with nine diamond drillholes, totaling almost 1617 m, over 5400 m of mapped and sampled surface trenches and approximately 3900 soil samples.

Raven is centred in a large 1800 m long by 900 m wide soil anomaly that remains open to the south and east. The 2019 Raven trenches covered an area of over 800 m<sup>2</sup> and returned multiple scorodite-, bismuth- and siderite-related sulphide vein exposures throughout the trenches. Structural control of the mineralization is evident within the trenches and drill core and points to a potentially large dilatational fracture zone at Raven.

## **WALLBRIDGE MINING COMPANY LTD.**

### **FENELON GOLD: DISCOVERY AND DEVELOPMENT ALONG THE DETOUR LAKE BELT, NORTHERN ABITIBI'S EMERGING GOLD CAMP**

**Attila Péntek, Vice President Exploration, Wallbridge Mining Company Ltd.; Evan Slater, Senior Project Geologist, Wallbridge Mining Company Ltd.**

Wallbridge's 100%-owned Fenelon gold property is located proximal to the Sunday Lake deformation zone, an emerging gold belt in northwestern Quebec. This major east-west structure in the northern Abitibi greenstone belt hosts the Detour Lake mine and is very similar to other breaks controlling world-class gold camps in the southern Abitibi, yet it remains underexplored due to thick overburden cover.

At Fenelon, secondary splays of the Sunday Lake deformation zone have controlled the emplacement of a significant gold system along the Jeremie pluton. Historically, exploration has focused on high-grade shear zones hosted in the Main Gabbro, and this is where Wallbridge has completed a bulk sample of 33 500 t grading 18.49 g/t Au. The Main Gabbro was the only known hostrock for significant gold mineralization on the property and exploration was limited to a vertical depth extent of 200 m.

In late 2018, exploration drilling discovered a new geological setting with extensive vein network gold mineralization hosted within the Jeremie pluton itself, and named it Area 51. The ongoing 70 000–80 000 m 2019 drill program is proving the connectivity of Area 51 through the newly discovered sediment-hosted Tabasco and Cayenne zones to the Main Gabbro and is continuing to expand the footprint and depth extent of the combined Fenelon gold system.

The Tabasco and Cayenne zone discoveries have yielded numerous high-grade intersections in 2019 at 400–700 m vertical depths, including 27.00 g/t Au over 38.39 m in FA-19-086 and 17.58 g/t Au over 11.04 m in FA-19-059.

In Area 51, drilling has demonstrated good continuities of several zones within the Andromeda and Orion corridors with broad mineralization surrounding more focused higher grade intervals: 0.98 g/t Au over 191.90 m, including 2.42 g/t Au over 42.80 m (which includes 5.00 g/t Au over 12.71 m).

## **WESDOME GOLD MINES LTD.**

### **KIENA GOLD MINE COMPLEX, ABITIBI GREENSTONE BELT, VAL D'OR, QUEBEC**

**Lindsay Carpenter Dunlop, Vice President, Investor Relations, Wesdome Gold Mines Ltd.; Michael Michaud, Vice President, Exploration, Wesdome Gold Mines Ltd.**

The Kiena gold mine complex is located in northwestern Quebec, straddling the southern boundary of the Abitibi greenstone belt that is host to numerous orogenic gold deposits. The Kiena mine complex is a fully permitted, integrated mining and milling infrastructure that includes a 930 m production shaft and 2000 t/day capacity mill. From 1981 to 2013 the mine produced 1.75 million ounces of gold from 12.5 million tonnes at a grade of 4.5 g/t of Au.

The bulk of this production came from the S50 zone between depths of 100 and 1000 m. Historical mining was characterized by a series of quartz, carbonate, albite and pyrite veins, and stockworks or breccia lenses hosted within altered tholeiitic basalt, komatiite or talc-chlorite schist. Gold mineralization is

typically concentrated where there is a marked competency contrast between more competent mafic rocks and the adjacent deformed komatiite or chlorite-talc schists.

In contrast, the recently discovered Kiena Deep A zone is characterized by very high grade, visible gold within quartz veins having very little associated sulphide mineralization, and may represent a new style of gold mineralization in this area. The Kiena Deep A zone is divided into three main lenses that occur along an isoclinal fold associated with a contact between mafic volcanics and komatiite that are variably altered to chlorite, carbonate and amphibole. The zone comprises laminated quartz veins interpreted to be associated with second or third order connecting structures. This high-grade zone may represent a transition from the previously mined, more brecciated and sulphide-rich deposit near surface, to a more discrete structure with visible gold and less sulphide at depth. The gold mineralization plunges approximately 45° to the southeast and now extends over 700 m and remains open up and down plunge.

## **WESTERN COPPER AND GOLD CORP.**

### **CASINO PROJECT, YUKON**

**Partial excerpts from Form 43-101F1 Technical Report Feasibility Study, prepared by M3 Mining Consultants in 2013**

Located in west-central Yukon, the Casino deposit is centred on an Upper Cretaceous, east-west–elongated porphyry stock, the Patton porphyry, which intrudes Mesozoic granitoids of the Dawson Range batholith and Paleozoic schists and gneisses of the Yukon Crystalline Complex. Intrusion of the Patton porphyry into the older rocks caused brecciation of both the intrusive and the surrounding country rocks along the northern, southern and eastern contact of the stock. Brecciation is best developed in the eastern end of the stock, where the breccia can be up to 400 m wide in plan view. To the west, along the north and south contact, the breccias narrow gradually to less than 100 m.

Primary copper, gold and molybdenum mineralization was deposited from hydrothermal fluids that exploited the contact breccias and fractured wallrocks. Better grades occur in the breccias and gradually decrease outward away from the contact zone both toward the centre of the stock and outward into the granitoids and schists.

The main mineralization types (listed in descending order of depth) are

- Leached cap – gold-enriched and copper depleted.
- Supergene oxide – copper-enriched, with trace molybdenite; where present it can average 10 m thick and contain chalcantite, malachite and brochantite, with minor azurite, tenorite, cuprite and neotocite.
- Supergene sulphide – grades vary widely, but are highest in fractured and highly pyritic zones, due to their ability to promote leaching and chalcocite precipitation.
- Hypogene – occurs throughout the various alteration zones of the Casino porphyry deposit, as mineralized stockwork veins and breccias. Significant Cu-Mo mineralization is related to the potassically altered breccia surrounding the core Patton porphyry, as well as in the adjacent phyllically altered hostrocks of the Dawson Range batholith. The pyrite halo in this mineralization is host to the highest Cu values on the property.

## WESTHAVEN VENTURES INC.

### SHOVELNOSE EPITHERMAL GOLD PROJECT – SOUTH ZONE AND BEYOND

**Peter Fischl, Exploration Manager, Westhaven Ventures Inc.**

The Shovelnose project covers 15 000ha of the Spences Bridge Group, comprising mid-Cretaceous felsic and intermediate volcanics situated in a 110 km long, northwest-trending belt that is prospective for epithermal gold mineralization. Historical exploration at Shovelnose since 2006 had uncovered a number of epithermal gold-silver showings (Mik, Line 6, Brookmere, Tower and Alpine) that have seen various campaigns of trenching and drilling. A re-evaluation of the project in 2017 led to the completion of follow-up ground magnetic surveys and resampling of historical drill core for clay mineralogy (short-wave infrared [SWIR] spectroscopy) to map zones of hydrothermal up-flow. The discovery of South zone is a direct result of this work. Clay sampling identified elevated illite crystallinities (higher paleo-temperatures) in historical drill core proximal to several northeast-trending linear magnetic low anomalies. Drilling of one such magnetic low in late 2017 discovered the South zone with the intersection of a vein zone averaging 0.52 g/t Au over 85 m. This is considered a 'blind discovery' because any surficial expression of South zone is now obscured by 40–100 m of glacial till.

Drilling of over 28 000 m since then has defined three subparallel vein zones hosted in a rhyolite dome up to 250 m thick. Zone 1 consists of a zone of quartz veining traced over a strike length of 1.3 km and a vertical range of 350 m along a northwest-striking, steep southwest-dipping normal fault. Zone 2 is situated 100–150 m to the northeast of Zone 1 and has been traced for 760 m over a vertical range of 260 m. Zone 3, a splay off Zone 2 50–100 m northeast of Zone 2, has been drilled over a strike of 170 m and a vertical range of 130 m.

Vertical zonation of certain mineralogical and textural indicators assisted in the vectoring to higher grade mineralization. Strongest gold mineralization occurs over a 200 m vertical range in a shallow horizon (1100–1300 m elevation) of boiling that features colloform-crustiform-banded quartz veins containing adularia bands and selvages, bladed quartz after calcite, ginguero and electrum. Deeper veining (below 1100 m elevation) features barren massive to weakly banded quartz with crystalline potassium feldspar.

Pathfinders associated with gold and silver include arsenic (pyrite, marcasite), molybdenum (ginguro, pyrite, marcasite) selenium (naumannite–silver selenide) and copper (chalcopyrite).

Multiple phases of veining and brecciation are evident at South zone. The first phase consists of a hydrothermal breccia healed by a dark silica-pyrite matrix. This is followed by brown-grey to black variably pyritic chalcedony, occurring in centimetre- to metre-scale veins that are quite common in Vein Zone 2. This chalcedony is cut by pale-grey cryptocrystalline, commonly colloform-crustiform-banded quartz±adularia±pyrite/marcasite±ginguro, in centimetre- to metre-scale veins and breccia veins. This third phase carries significant gold mineralization. Examples of this include hole SN19-01, which intersected 39.3 g/t Au over 12.66 m in Zone 1, and hole SN19-10, which intersected 5.13 g/t Au over 52.1 m in Zone 2.

Geophysical and soil geochemical surveys over the last two seasons on the Shovelnose property have uncovered additional targets. DC resistivity surveys have refined targets within and proximal to South zone, whereas property-wide soil geochemical and airborne and ground magnetic surveys have uncovered additional targets 4–10 km east and southeast of South zone.



## WHITE GOLD CORP.

### VERTIGO GOLD PROJECT

**Josh Forrester, White Gold Corp.; Andrew Hamilton, White Gold Corp.**

The Vertigo gold project is located on the JP Ross property, part of White Gold's large ground position in Yukon's White Gold district, south of Dawson City. The Vertigo gold project lies 35 km to the northwest of the company's flagship White Gold property, which hosts gold resources of 1 039 600 oz indicated at 2.26 g/t Au and 508 700 oz inferred at 1.48 g/t Au.

Gold mineralization on the Vertigo is hosted within a series of high-angle, south-dipping structures associated with multiple phases of quartz-sericite-carbonate alteration with quartz veining and brecciation. Disseminated to semi-massive arsenopyrite-galena-pyrite and, locally, visible gold occurs within the mineralized zones with additional strong correlations to Ag and Bi.

The mineralized structures transect three lithological packages consisting of an upper package of fine-grained biotite-quartz-feldspar gneiss (felsic gneiss) and amphibolite gneiss; a middle package of mafic schist, amphibolite, muscovite schist and banded quartz biotite gneiss; and a lower unit of medium- to coarse-grained biotite-quartz-feldspar gneiss. Mineralization appears preferential to the upper felsic gneiss package with the highest grade portions at or near lithological contacts. Distinct marker beds occur within the middle package and highlight localized offset of the lithology along the mineralized structures, indicating normal motion along the structures in an extensional environment.

The structural zones have been traced from surface up to 250 m down dip and along strike for about 300 m. The envelope of alteration and mineralization along the structures varies down dip and ranges from 0.5–30 m in thickness. Narrower, northerly dipping zones (<0.25 m) are also recognized to occur in hangingwall of most mineralized structures, up to 20 m away from the core zones. The grade profile varies down dip and along strike, as is common in high-grade, structurally controlled gold deposits.

Significant drill intersections in 2019 include 9.61 g/t Au over 4.15 m, including 94.2 g/t Au over 0.32 m, in hole JPRVER19D005, and 0.42 m of 141 g/t Au within a broader zone of 11.64 g/t Au over 5.34 m in hole JPRVER19D0015.

## YAMANA GOLD

### CERRO MORO MINE, SANTA CRUZ, ARGENTINA: GEOLOGY AND NEW DISCOVERIES

**Henry Marsden, Yamana Gold; Andre Oliveira, Yamana Gold; Walter Munizaga, Yamana Gold; Juan Di Caro, Yamana Gold**

The Cerro Moro mine area is underlain by Jurassic volcanic and volcano-sedimentary rocks. These rocks are typically attributed to the Chon Aike and La Maltide formations of the Desado Massif, an extensive Jurassic felsic volcanic province. The sequence consists of welded pyroclastic rocks and flow dome and pyroclastic rocks of felsic composition overlain by a sequence of reworked volcano-sedimentary rocks and local andesite flows and intrusive rock. The distribution of these rocks is controlled by block faults that strike northwest, east-west and northeast. Mineralization at Cerro Moro is hosted in low- to intermediate-sulphidation epithermal veins. Limited Ar-Ar dating of adularia has demonstrated a long-lived system spanning 11 million years from 182–171 Ma. There is a close correlation between mineralizing



events and periodic felsic volcanism. The older veins are typical epithermal white quartz veins with local adularia, base-metal sulphides and gold-silver mineralization, whereas the youngest mineralizing episode is a distinctive high-grade gold-silver event with exceptionally high gold-silver grades and a polymetallic chemistry with high molybdenum contents. The high-grade veins are localized within and adjacent to a major northwest– to east-west–striking block fault with significant displacement that hosts high-grade segments (Zoe, Martina, Escondida Far East, Central, West and Far West) along 3.5 km of strike. Several older typical low-sulphidation veins also host significant mineralization including the Nini-Esperanza, Gabriela, Deborah and Michelle vein systems. Systematic exploration since 2017 using soil geochemistry, spectrometry to define alteration patterns, geophysics, mapping and rock sampling is driving new discoveries throughout the large mineralized area surrounding the mine including the new Naty discovery in late 2018.

## CORE SHACK SCHEDULE

Company Name	Project Name	Commodity(ies)	Location	Exhibit Days
Alamos Gold Inc.	Island Gold	Au	ON	Wed/Thurs
Aldebaran Resources Inc.	Altar	Cu, Au, Mo	Argentina	Wed/Thurs
Alexco Resource Corp.	Keno Hill	Ag, Pb, Zn	YT	Mon/Tues
Alianza Minerals Ltd.	Haldane	Ag	YK	Wed/Thurs
American Creek Resources	Dunwell Mine	Au, Ag, Pb, Zn, Cu	BC	Wed/Thurs
AMEX Exploration Inc.	Perron	Au	QC	Mon/Tues
Ascot Resources Ltd.	Premier and Red Mountain	Au, Ag	BC	Mon/Tues
ATAC Resources Ltd.	Rau Project	Au	YT	Mon/Tues
Aurion Resources	Risti / Launi	Au	Finland	Mon/Tues
Balmoral Resources Ltd.	Grasset Central	Ni, Cu, Co, PGE	QC	Wed/Thurs
Eldorado Gold Corp.	Lamaque	Au	QC	Mon/Tues
Ero Copper Corp.	Siriema and Vermelhos	Cu	Brazil	Wed/Thurs
Fireweed Zinc Ltd.	Boundary Zone	Zn, Pb, Ag	YT	Mon/Tues
First Cobalt Corp.	Iron Creek	Co, Cu	ID, USA	Wed/Thurs
First Mining Gold Corp.	Miller Target, Goldlund	Au	ON	Wed/Thurs
Forum Energy Metals	Janice Lake	Cu, Ag	SK	Mon/Tues
Galore Creek Mining Corporation	Galore Creek	Cu, Ag, Au	BC	Mon/Tues
Galway Metals Inc.	Clarence Stream Gold	Au	NB	Wed/Thurs
Gold Standard Ventures Corp.	Railroad Pinion	Au	NV, USA	Wed/Thurs
Goldplay Exploration Ltd.	San Marcial	Ag, Au	Mexico	Mon/Tues
Great Bear Resources Ltd.	Dixie Project	Au	ON	Mon/Tues
Group Ten Metals	Stillwater West PGE-Ni-Cu	Pd, Pt, Ni, Cu, Co	MT, USA	Mon/Tues
GT Gold Corp.	Tatogga	Au, Cu	BC	Mon/Tues
HighGold Mining	Johnson Tract	Au, Zn, Cu	AK, USA	Mon/Tues
IAMGold / Vanstar (JV)	Nelligan	Au	QC	Wed/Thurs
Independence Gold Corp.	3Ts	Au, Ag, Cu	BC	Wed/Thurs

Company Name	Project Name	Commodity(ies)	Location	Exhibit Days
Integra Resources Corp.	DeLamar	Au, Ag	ID, USA	Mon/Tues
Irving Resources Inc.	Omu	Au	Japan	Mon/Tues
Jade Leader Corp.	DJ	Jade	WA, USA	Mon/Tues
K92 Mining Inc.	Kainantu	Au	Papua New Guinea	Mon/Tues
Kootenay Silver Inc.	Columba	Ag	Mexico	Wed/Thurs
Liberty Gold Corp.	Black Pine	Au	ID, USA	Wed/Thurs
Lion One Metals Ltd.	Tuvatu	Au	Fiji	Wed/Thurs
Lumina Gold Corp.	Cangrejos	Au, Cu, Ag, Mo	Ecuador	Mon/Tues
Mawson Resources Limited	Rompas-Rajapalot	Au	Finland	Wed/Thurs
McEwen Mining	Grey Fox and Stock	Au	ON	Wed/Thurs
Minaurum Gold Inc.	Alamos	Ag	Mexico	Mon/Tues
New Pacific Metals Corp.	Silver Sands	Ag	Bolivia	Wed/Thurs
Northisle Copper and Gold	North Island	Cu, Au	BC	Wed/Thurs
Radisson Mining Resources Inc.	O'Brien	Au	QC	Wed/Thurs
Regulus Resources Inc.	AntaKori - AntaNorte	Cu, Au, Ag	Peru	Wed/Thurs
Rockhaven Resources Ltd.	Klaza	Au, Ag, Pb, Zn	YT	Wed/Thurs
Ruddock Creek Mining Corporation (an Imperial Metals company)	Ruddock Creek	Zn, Pb, Ag	BC	Mon/Tues
Sabina Gold & Silver Corp.	Back River Gold	Au	NU	Wed/Thurs
SilverCrest Metals Inc.	Las Chispas	Au, Ag	Mexico	Mon/Tues
Skeena Resources Limited	Eskay Creek	Au, Ag	BC	Wed/Thurs
SSR Mining	Santoy Gap Hanging Wall	Au	SK	Mon/Tues
Sun Metals Corp.	Stardust	Cu, Au, Ag, Zn	BC	Mon/Tues
Talisker Resources Ltd.	Bralorne	Au	BC	Wed/Thurs
Teck Resources Limited	San Nicolás	Cu, Zn	Mexico	Mon/Tues
Teranga Gold Corp.	Golden Hill	Au	Burkina Faso	Wed/Thurs\

Company Name	Project Name	Commodity(ies)	Location	Exhibit Days
Tinka Resources Limited	Ayawilca	Zn, Ag, Pb, Sn	Peru	Mon/Tues
Triumph Gold Corp.	Freegold Mountain	Au, Ag, Cu, Mo	YT	Wed/Thurs
Victoria Gold	Raven/ Nugget	Au	YT	Mon/Tues
Wallbridge Mining Company Ltd.	Fenelon Gold	Au	QC	Wed/Thurs
Wesdome	Kiena	Au	QC	Mon/Tues
Western Copper and Gold Corp.	Casino	Cu, Au	YT	Mon/Tues
Westhaven Ventures Inc.	Westhaven	Au	BC	Wed/Thurs
White Gold Corp.	Vertigo	Au	YT	Mon/Tues
Yamana Gold Inc.	Cerro Morro & East Gouldie / Jacobina	Au	Argentina & QC	Wed/Thurs