Yukon
Exploration & Geology Overview
2018

- Yukon Geological Survey Activities
- Yukon Mineral Exploration Program
- Hard Rock Mining, Development & Exploration
- Placer Mining Development
- Yukon Geological Survey Outreach
- YGS Publications

Yukon Geological Survey staff

Standing (left to right): Scott Casselman, Derek Torgerson, Tiffani Fraser, Patrick Sack, Maurice Colpron, Brett Elliot, Karen MacFarlane, Jeffrey Bond, Kristen Kennedy, Rosie Cobbett, Julie Minor, Olwyn Bruce, Panya Lipovsky, David Moynihan

Kneeling (left to right): Carolyn Relf, Lara Lewis, Leyla Weston, Sydney van Loon, Midori Kirby

Missing from photo: Bailey Staffen, Craig Nicholson

Yukon

Yukon Exploration & Geology Overview 2018

Edited by

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Yukon Geological Survey

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Front cover photograph: Heading northeast on Kalzas Range on a smokey morning en route to a forested traverse. Photo by Halley Keevil, Yukon Geological Survey.

Preface

Yukon Exploration and Geology (YEG) papers and the Yukon Exploration and Geology Overview are two of the main publications of the Yukon Geological Survey (Energy, Mines and Resources, Government of Yukon). Individual YEG papers, with colour images, are available in digital format and can be downloaded from our website. The YEG Overview is available in digital format and in a limited colour print run.

YEG 2018 contains up-to-date information on mining and mineral exploration activity, studies by industry, and results of recent geological field studies. Information in this volume comes from prospectors, exploration and government geologists, mining companies, and students, all of whom are willing to contribute to public geoscience for the benefit of the scientific community, general public and mineral and petroleum industries of Yukon. Their work is appreciated.

Colleagues at the Yukon Geological Survey are thanked for their involvement in authoring and reviewing YEG papers.

Sherry Tyrner of the Queen's Printer ensured that the printing process went smoothly.

We welcome any input or suggestions that you may have to improve future YEG publications. Please contact me at (867) 667-8519, or by email at karen.macfarlane@gov.yk.ca.

Karen MacFarlane

Yukon Exploration and Geology Overview 2018

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Introduction

This report provides a summary of Yukon Geological Survey (YGS) activities undertaken in 2018, including field work, outreach activities, publications and web services. Elsewhere in this volume are overviews of hard rock exploration and development (Lewis and Casselman, 2019) and placer development highlights (Bond and van Loon, 2019), as well as a report on projects supported under the Yukon Mineral Exploration Program (Torgerson, 2019). The accompanying Yukon Exploration and Geology volume includes papers on several YGS-supported projects; results of other projects will be presented elsewhere.

Early in 2019, YGS will be preparing to host its sixth five-year planning workshop. The session is planned for April 3–4, and the survey will be reaching out to clients to participate and provide input on their current and anticipated future geoscience information needs. The format for the workshop is still under development and the agenda is not expected to be finalized until early March. Readers interested in participating can contact the survey at geology@gov.yk.ca.

Yukon Geological Survey Program Funding

Yukon Geological Survey's operating budget for fiscal year 2018–19 totaled $3,099,513. This includes $1,265,000 in core O&M funding, $1,600,000 for the Yukon Mineral Exploration Program (YMEP), $158,658 from the Canadian Northern Economic Development Agency's (CanNor) Strategic Investments in Northern Economic Development (SINED) program, and $75,855 from Indigenous and Northern Affairs Canada's Climate Change Preparedness in the North Program. The allocation of these funds is described briefly below.

YMEP funds are intended to support early-stage hard rock and placer exploration activities and are allocated as grants on a competitive basis. This year, all eligible applications[1] were funded and at the time of writing the program anticipates lapsing about $20,000. Funds under the Climate Change Preparedness program are flowed through YGS to Yukon College's Northern Climate Exchange (NCE) to support a joint YGS–NCE study of permafrost in the greater Whitehorse area. The project is described in more detail below. YGS' O&M funds are used to deliver YGS' core geoscience program activities (~80%), and to cover administrative costs (building maintenance, software, equipment maintenance, etc.: ~20%). SINED funds were renewed this year for a two-year

[1] Eligible applications are those which meet a minimum score of 33 out of 50 possible points.

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period (2018–2020) and will be invested primarily in desk-top studies and planning for new projects beyond 2020, should federal funding for geoscience extend beyond 2020. Four areas of investment have been identified for the current round of funding: database/ web tools, geothermal studies, geophysics data management and community engagement. Approval for the proposed SINED projects was received in early December; consequently, there is very little to report on at the time of writing. However, initial deliverables, including updates to MINFILE data and a new radiogenic heat map for Yukon are anticipated early in 2019.

Yukon Geological Survey Organizational Overview

Yukon Geological Survey saw a number of staff changes over the past year (Fig. 1). In April, Steve Israel left YGS to join Archer Cathro and Associates. His legacy includes more than fifteen years of mapping in southwestern Yukon; his work has significantly advanced our understanding of the area's tectonic framework and mineral deposit settings. In late December Esther Bordet left the survey to pursue her dual interests of art and geology. She plans to do some geological consulting, while exploring opportunities to advance her artistic talents.

Rob Deklerk, YGS' MINFILE geologist, retired in October after twenty-seven years managing the database and tracking mineral discoveries. MINFILE, which is one of Canada's oldest mineral occurrence databases, has had many iterations over the years, and has grown under Rob's management to include more than 2600 occurrences.

I would like to take this opportunity to thank Rob, Esther and Steve for all their hard work and commitment to the geological survey.

In addition to departures, I am pleased to welcome Diane Skipton to YGS. Diane recently completed a Post Doctorate Fellowship at the Geological Survey of Canada, where she led a mapping team on northern Baffin Island as part of the GSC's Geo-mapping for Energy and Minerals (GEM) Program. She will be joining YGS in mid-February (2019).

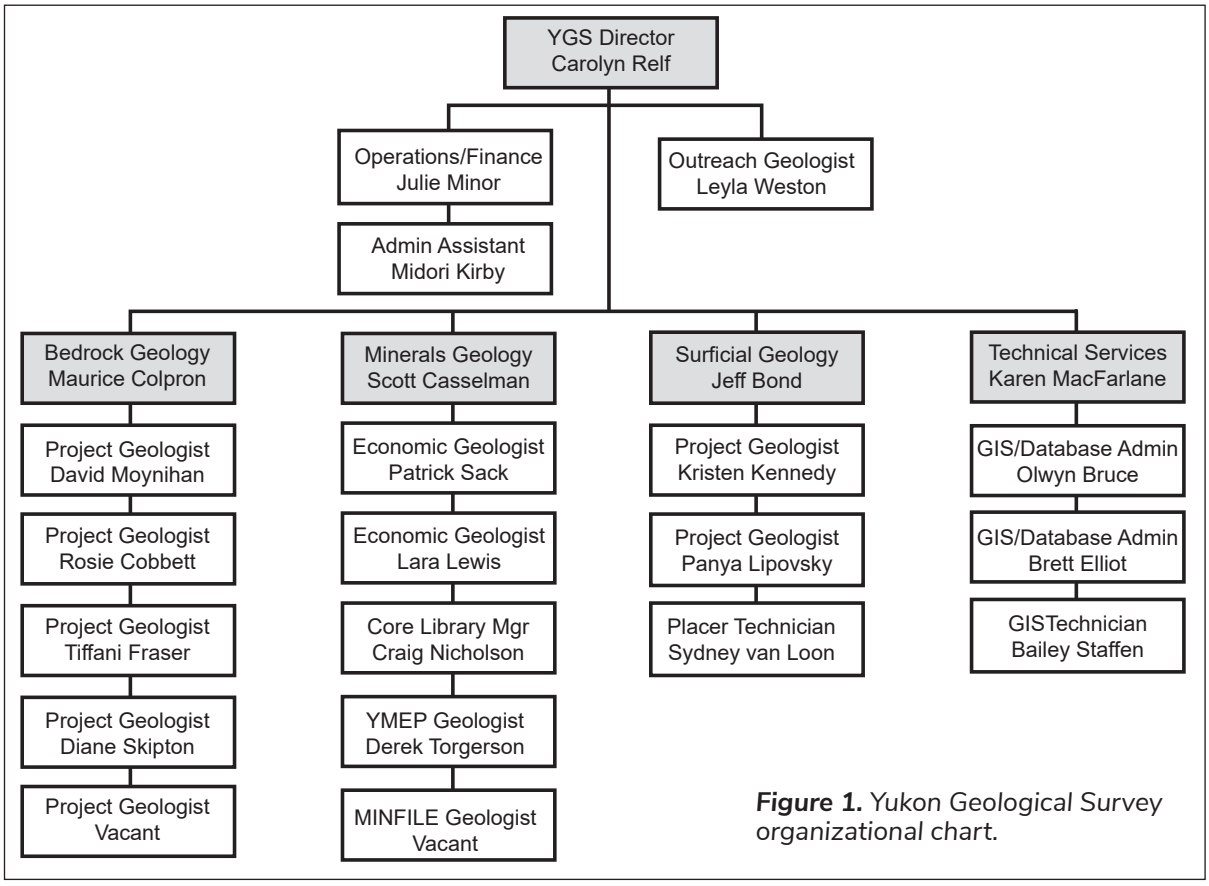

Figure 1. *Yukon Geological Survey organizational chart.*

Finally, following a year's maternity leave, Bailey Staffen returned to work in September, filling the gap she left in our Technical Services group a year ago. She has resumed management of our website and Facebook pages, and is providing GIS and map production support to staff.

Information Services

Publications

In 2018, forty-one publications were released by YGS, including twenty Open Files, an updated Mineral Deposits Summary and the 2015–2017 Yukon Placer Industry Report. In addition to YGS publications, staff authored or co-authored seven papers in refereed journals. A list of all publications is appended at the end of this volume.

Web Services

YGS added two new web maps to its online Map Gallery in 2018. YGS' diamond drill core collection, including photographs, core logs, assays and cross sections (where available) are displayed on one map (Fig. 2). Users can query drill core by commodity, location, and other criteria, then view and download core data. The other map displays digitized Yukon Consolidated Gold Corporation (YCGC) historic data. Four key data sets are captured for this application: historic drill holes, dredged areas, historic map index and placer claims. Users can filter the information, view data, link to records and download files. Data are still being added to the drill core database and digitizing of YCGC files is ongoing: as these data sets grow, the new information will be made available via the respective web maps.

The existing "Footprints" web map was updated in 2018 to include placer and YMEP reports, along with the most recently-released assessment reports. Currently, a total of 4643 industry reports can be accessed using the Footprints application. At the 2018 Exploration Roundup, Brett Elliot presented a talk on the survey's newest applications, highlighting the new web applications in the YGS Map Gallery.

Over the summer, Olwyn Bruce generated forty-three 1:250 000 bedrock geology map "tiles" from YGS' most recent bedrock compilation data. The tiles are saved as georeferenced *.pdf files, and can be downloaded for free from YGS' Bedrock Geology page or from

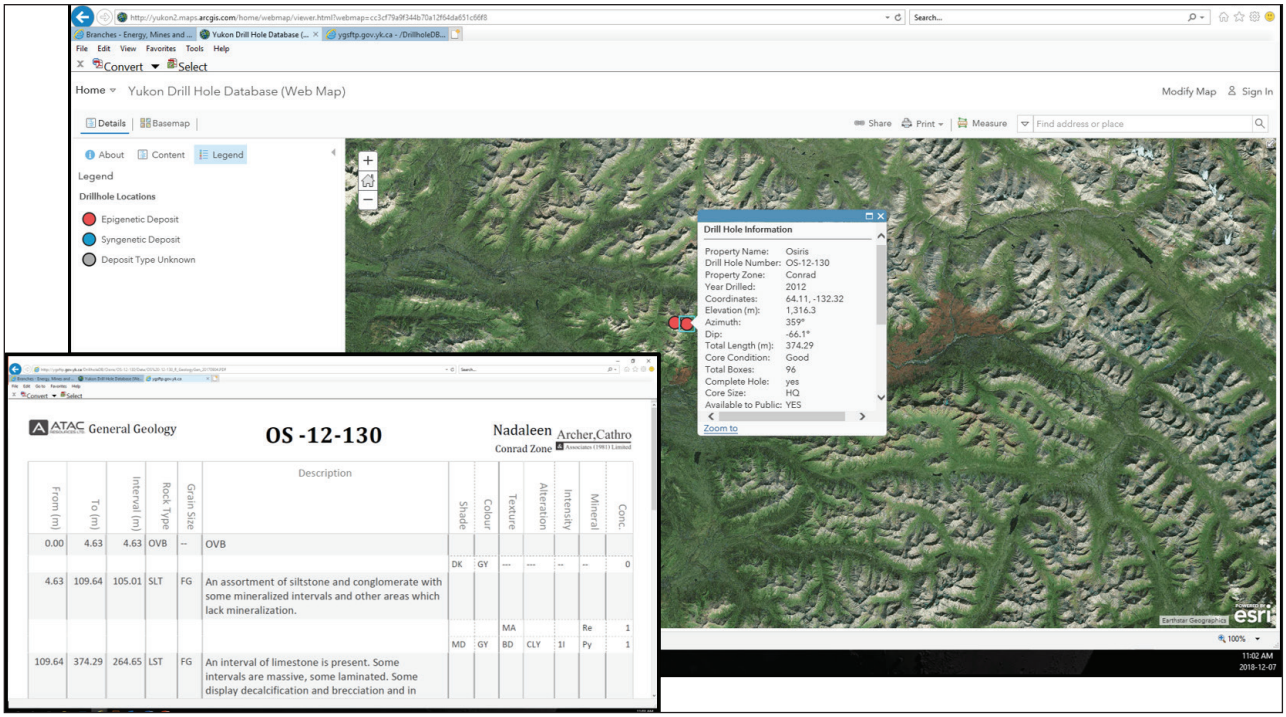

Figure 2. *Screen grab of Drill Core web map application. Users can view core in YGS' collection and query the database for information on the core, including logs and assays where available.*

the Avenza Maps store (https://www.avenzamaps.com/maps/) for use on a GIS-enabled Ipad, tablet or cellphone running Avenza software. Each map tile includes a geological legend and selected radiometric dates.

Data Compilations

The bedrock geology compilation was updated in spring 2018 to include new geological mapping from the Frances Lake, Mount Freegold and eastern Lake Laberge areas, and revisions were made to parts the Tintina and Denali faults to capture recent mapping. In addition to new bedrock information, an updated isotopic ages geodatabase was added in summer 2018. The geochronology layer includes published, and some unpublished, radiometric dates (U/Pb, $^{40}Ar/^{39}Ar$, K/Ar, Re/Os, etc.), basic information on samples and analytical results, some age plots and source information. Further enhancements will include available data tables and regular additions of new ages to the database.

A compilation of whole rock geochemical data was initiated in 2018. Most data from plutonic and volcanic rocks in YGS' sample collection have been captured and verified, and GSC data collected over the past ~fifteen years will be added to the database early in 2019. Web-enabling of the data will follow. Work continued on the Yukon Mineral Exploration database, which captures information on exploration activities and expenditures. Currently, data for 2017 and 2018 can be viewed online, and YGS staff are focusing on capturing historic (pre-2017) data.

A new project capturing physical rock property data was initiated in 2018. The idea for the project was proposed by YGS' Minerals Technical Liaison Committee, who noted that rock property measurements from different lithological units would be valuable for interpreting regional and property-scale geophysical surveys. To enable data collection, a space was created at the Core Library to house a magnetic susceptibility meter and a high resolution scale-and-dunk tank for measuring specific gravity. The collection of physical rock property data is not a high priority project; rather, it will be done opportunistically on an ongoing basis as time and capacity allow. Over the summer, students captured data from the archived sample collections of Steve Israel (covering parts the Kluane Lake, Aishihik Lake and Dezadeash map sheets), and Lee Pigage (Coal River and Anvil district). Release of the data via the web will wait until a more significant volume of data are captured and some quality assurance/quality control has been undertaken; in the meantime, clients can contact the Survey to request a copy of the data compiled to date.

In addition to magnetic and specific gravity instruments, a Sample Core IP tester has been acquired to collect resistivity properties and IP response of core samples. Data acquisition from YGS samples has not yet begun, but the instrument is available for clients wishing to test samples to assess whether a field IP survey would yield useful results. Information on how to access the Rock Properties lab can be found on the YGS website (http://www.geology.gov.yk.ca/core_library.html).

Social Media

YGS' Facebook site continued to see regular postings in 2018. With 1300 followers, posts are often shared (for example, the video announcement about the launch of a web map featuring historic placer information reached more than 5000 people). Content focuses on notifications of public outreach events, photographs of field activities, new publications and geological information of broad general interest. As the survey increases its focus on community outreach, it is anticipated that Facebook will become an increasingly important tool for sharing information on topics and issues of interest to communities and the general public.

2018 YGS Field Activities

Bedrock Geology Projects

Field work on four multi-year bedrock projects was wrapped up in 2018: three involved bedrock mapping and the fourth was a geothermal study. Final map compilations and accompanying reports are currently being prepared for the mapping projects, and new data will be incorporated into the Yukon digital bedrock compilation in 2019. A fifth field project, studying Paleozoic shales across Selwyn basin, continued this year in the Monster Creek area. Locations of 2018 field activities are shown in Fig. 3.

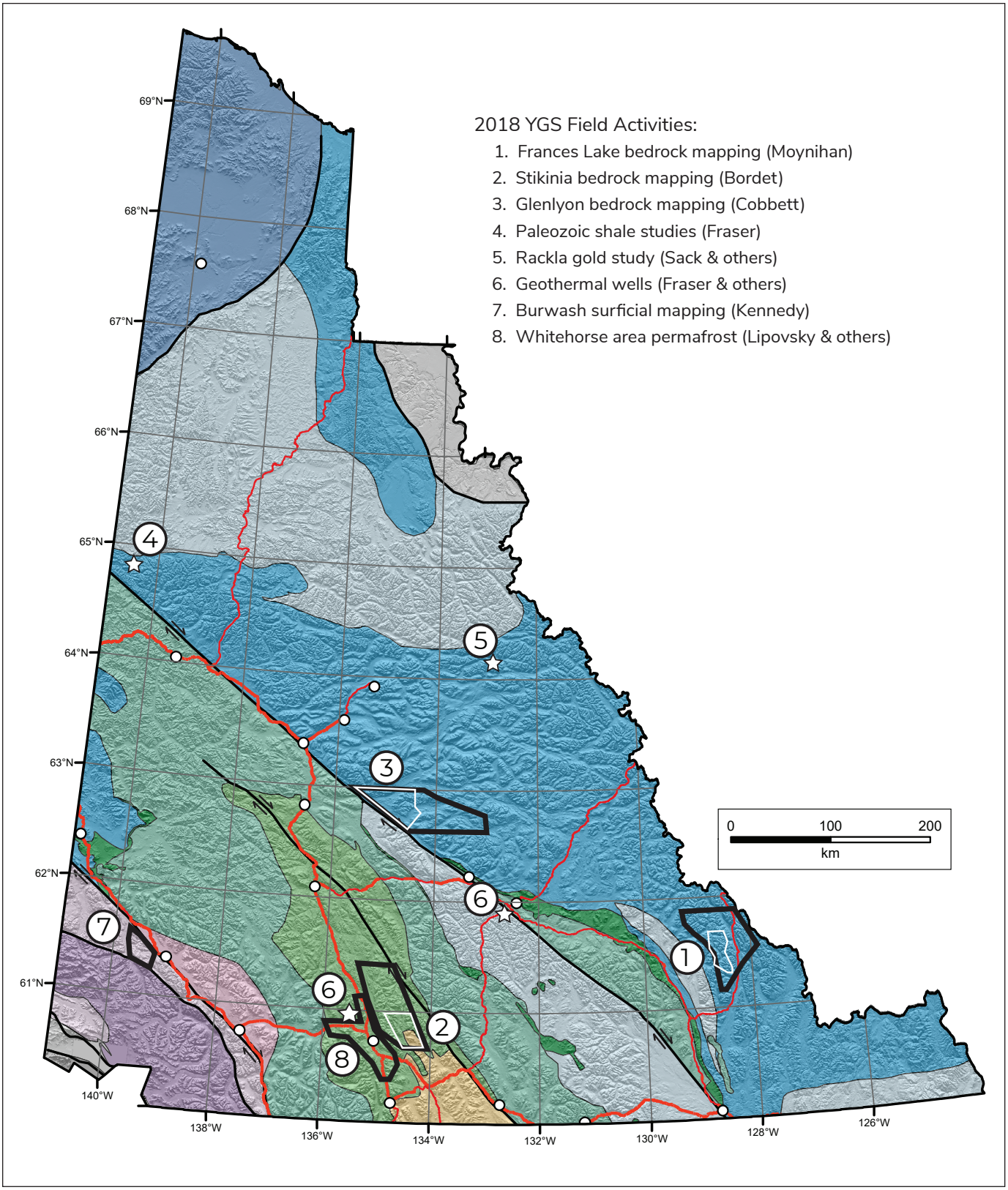

Figure 3. *Locations of 2018 field projects. Bedrock mapping projects (1–3) include areas mapped in 2018 (white outline) as well as full project areas (black outline).*

Frances Lake area bedrock mapping

David Moynihan completed a final year of mapping in the east-central part of Frances Lake map area in 2018. Most of the map area is underlain by penetratively-deformed Neoproterozoic to Cambrian rocks of the Hyland Group. They define a northwest-trending structural culmination that is intruded by mid-Cretaceous plutons in the western part of the map area (Fig. 4). Pelitic rocks of the Hyland Group preserve mineral assemblages that record a prograde transition from greenschist facies in the northeast to upper amphibolite facies (sillimanite + Kspar + melt) in the southwest, in the plutonic core of the culmination. On the southwestern side of the structural culmination, Ordovician to Silurian rocks of the Rabbitkettle and Road River formations are in fault contact with amphibolite grade Hyland Group rocks.

A final Geoscience Map and associated Bulletin are currently in progress and are anticipated for release some time in 2019.

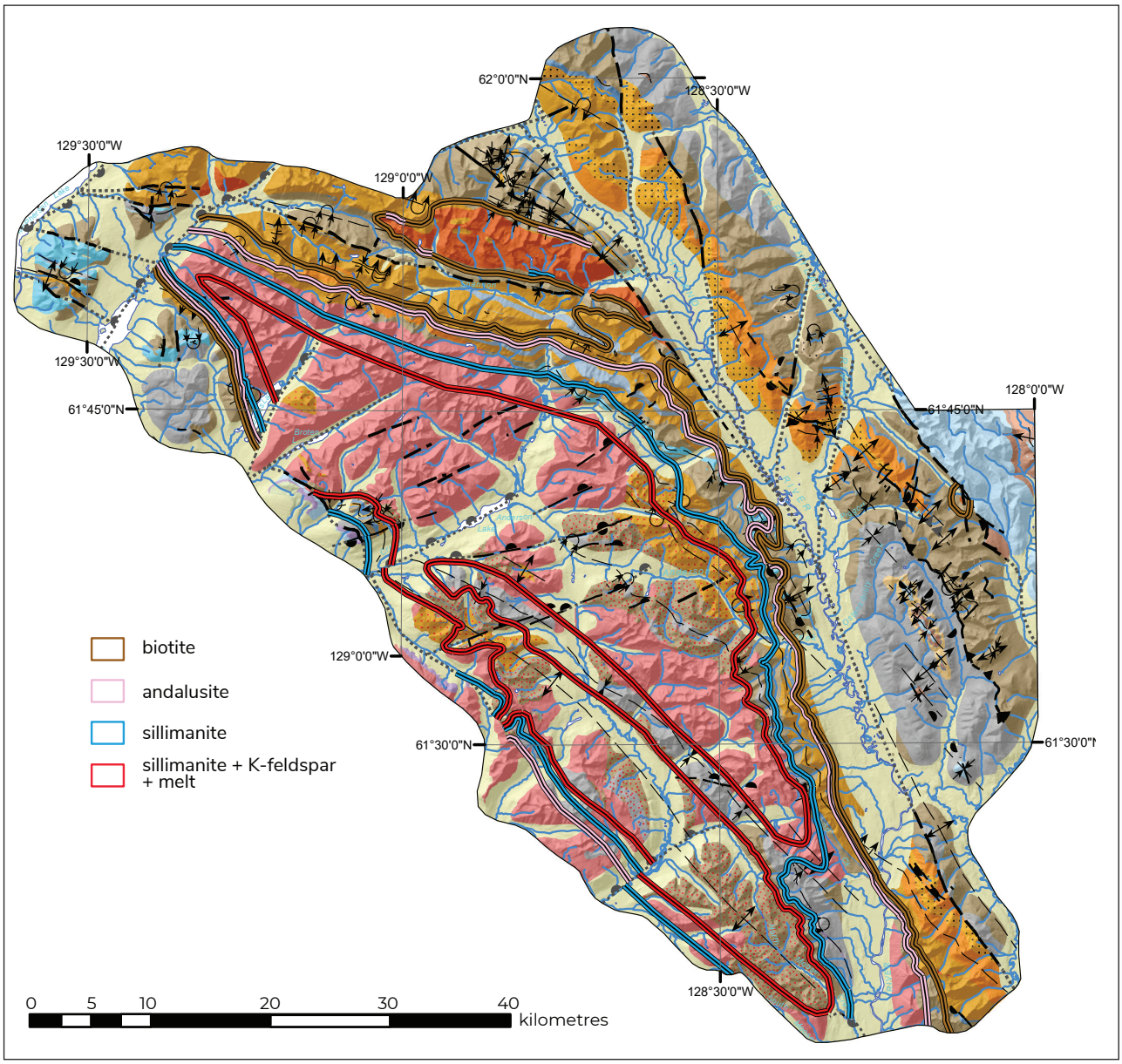

Figure 4. *Simplified geology map of the Frances Lake map area, showing distribution of isograds. Highest grade rocks are centred on the Cretaceous batholith (pink unit) exposed in the core of a regional antiform.*

Stikinia bedrock mapping

Esther Bordet completed a fourth and final year of mapping in 2018 in rocks of Stikinia terrane in the area east of Lake Laberge (Fig. 3). Results of her field work were presented at the Yukon Geoscience Forum in November. A recently-released aeromagnetic survey by the Geological Survey of Canada (Kiss and Boulanger, 2018a,b) enabled Bordet to refine contacts and interpolate geology through areas with few outcrops. These revisions are reflected in the final Geoscience Map and Open File report (Bordet, 2019, Bordet et *al.*, 2019).

Bordet's 2018 field work corroborated stratigraphic reinterpretations reported from her previous mapping in the area (Fig. 5; Bordet, 2018), including the tentative correlation of Joe Mountain Formation with the Cache

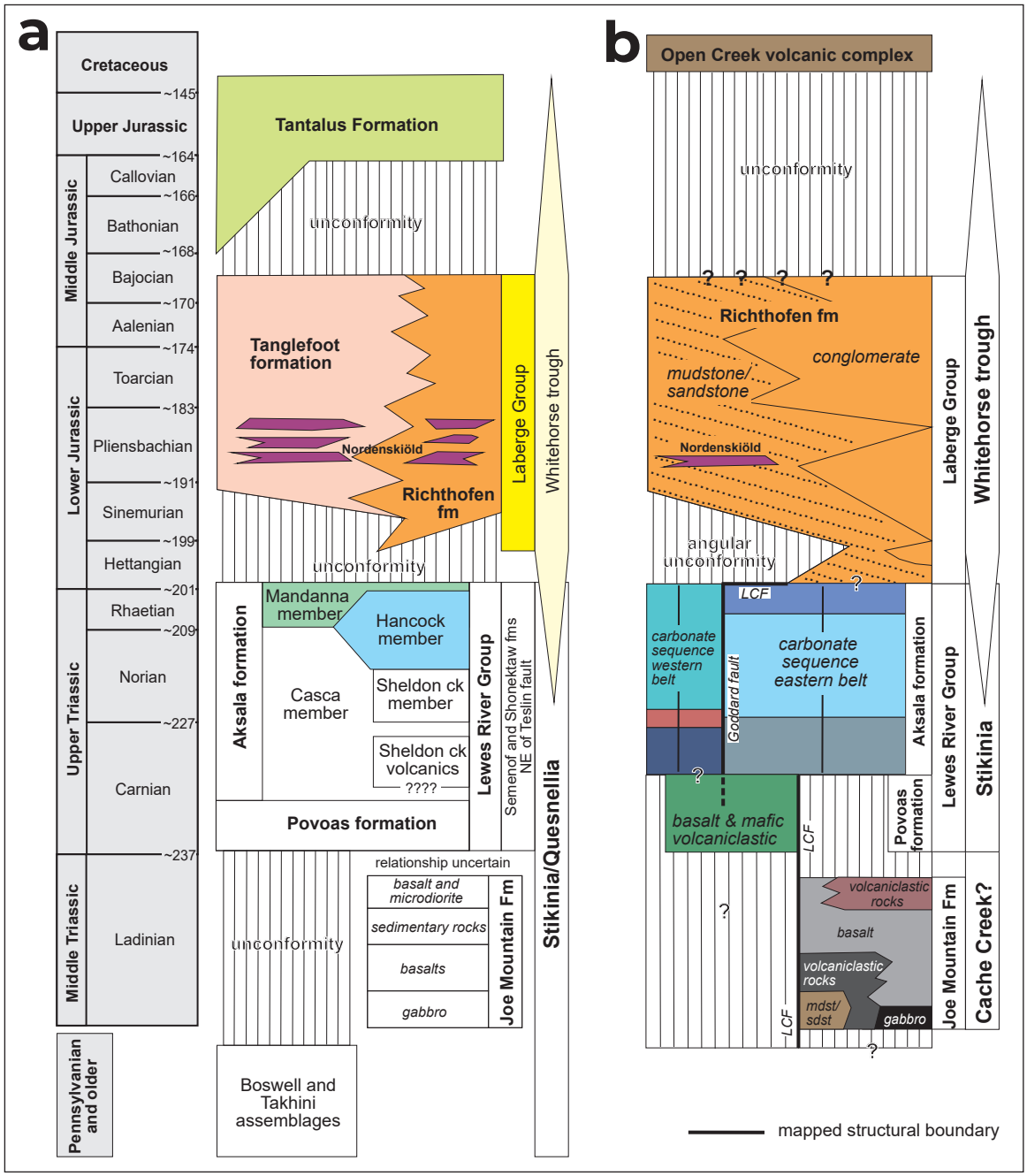

Figure 5. *Stratigraphic correlations between (**a**) Whitehorse trough and (**b**) eastern Lake Laberge area, based on recent mapping by Bordet (2019a,b).*

Creek terrane. Lithogeochemical and Nd-Hf isotopic data reveal that both sequences are primitive volcanic suites (ocean island arc, back-arc or mid-ocean ridge environment), although the Late Triassic Povoas flows have a more primitive signature. An angular unconformity mapped below the Laberge Group suggests a previously undocumented Late Triassic deformation event. New detrital zircon ages from basal Laberge Group rocks help to constrain the timing of this deformation event.

In addition to stratigraphic revisions, Bordet's mapping identified four Cretaceous magmatic suites in the study area. They range from Early to Late Cretaceous in age and the youngest have both intrusive and volcanic components. Bordet examined a number of mineral occurrences in the Joe Mountain area in 2018 to collect samples of host rock, mineralized veins and spatially-associated dikes. Data on the age and chemistry of the samples will help characterize the relationship between magmatism and mineralization.

Glenlyon area bedrock mapping

Rosie Cobbett wrapped up a final field season of mapping in the northeastern Glenlyon area in 2018 (Fig. 3). Her work focused on delineating the trace of the Twopete thrust fault in the MacMillan River area. The fault juxtaposes an early Paleozoic package of Selwyn basin sedimentary and volcanic rocks over mid to late Paleozoic, predominantly clastic sedimentary rocks. New fossil ages have led to the reinterpretation of earlier stratigraphic correlations, and new isotopic dating has revealed that late Devonian plutonism was more widespread in Selwyn basin than previously recognized.

Highlights of 2018 mapping were presented at the Geoscience Forum and are summarized in this volume (Cobbett, 2019). A final Geoscience Map and Bulletin are currently in progress; Cobbett will incorporate data from archived Cypress Anvil files into the map compilation.

Paleozoic shale studies

As a contribution to the GSC's Target Geoscience Initiative on understanding the genesis of hyper-enriched black shale occurrences, Tiffani Fraser continued her work documenting the stratigraphic setting of the Ni-Mo-rich massive sulphide layer. In June 2018, she visited outcrops in the Monster River area northwest of Dawson City to investigate reported occurrences of the "Ni-Mo" horizon. She and a colleague from Dartmouth College measured detailed sections from the Upper Road River Group into the overlying Canol Formation. They documented a thin unit (3–7 cm) of massive sulphides above an interval of siliceous shale with large dolomite concretions; features that are characteristic of the Ni-Mo horizon elsewhere in Selwyn basin and Richardson trough. The section was sampled for lithogeochemistry, $\delta^{13}C$ isotopes and Total Organic Carbon to determine an age, depositional environment and enable regional correlation with other parts of the Paleozoic basin.

As a result of scheduling conflicts, Fraser's field work did not overlap with her GSC colleagues, who visited the outcrops later in the summer to examine the Ni-Mo horizon in detail. Results of the work she did with GSC in 2017 will be released shortly via a GSC publication (Gadd *et al.*, *in press*). A peer-reviewed journal paper is also in progress.

Metallogeny Studies

YGS had two metallogeny studies underway in 2018: one on gold in the Rackla belt and the other on the metallogeny of Jurassic plutons.

Carlin-style gold of the Rackla belt

Patrick Sack continued collaborations with colleagues from the GSC on a study of Carlin-type gold in the Rackla belt. The study is part of GSC's Targeted Geoscience Initiative program. Sack and Nicolas Pinet (GSC) spent time at Atac Resource's Nadaleen property, logging and sampling sections through the Osiris, Sunrise and Conrad deposits. Sack's work is focused on documenting host lithology, alteration and mineralization at each deposit via sample "transects" along the core.

Over the winter, Sack will continue the collaborative work he began in 2017 with Emerita Professor Jean Cline from the University of Nevada in Las Vegas. Analytical work will include imaging of gold-bearing

pyrite (via scanning electron microscopy), followed by electron probe micro-analysis of pre-ore and ore pyrite. The intent of this study is to understand the behavior of gold in these deposits; this knowledge has implications for exploration and metallurgy.

Jurassic pluton metallogeny

Patrick Sack and Maurice Colpron continued writing up results of their study of Late Triassic to Middle Jurassic plutons (anticipated for release in 2019). Differences in age and bulk composition have allowed the plutons to be divided into nine distinct suites. Geochronologic, isotopic and thermobarometric studies reveal a complex, dynamic crustal setting into which the suites were emplaced.

Between ca. 200 and 175 Ma the plutons record a progressive increase in crustal contamination that coincides with progressively shallower depths of emplacement (from >25 km at ca. 200 Ma to about 10 km at ca. 175 Ma). The two oldest suites of plutons (ca. 220–210 Ma) overlapped with, and are likely related to, the Lewes River arc. Their emplacement depths (≤10 km) and geochemistry suggest they are prospective copper porphyry targets. They are likely related to Late Triassic mineralization at the Minto and Carmacks Copper deposits, where ore occurs as partially digested rafts of Upper Triassic metavolcanic rocks within Jurassic plutons (Fig. 6).

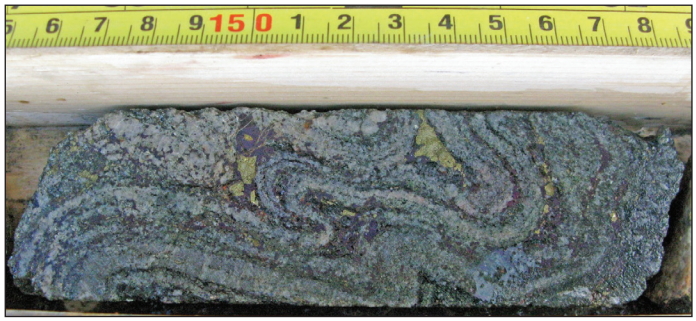

Figure 6. *Photo of chalcopyrite and bornite-rich ore from Minto Mine (North Deposit, ~81 m depth). Sulphides are concentrated in Late Triassic, ptygmatically-folded layers that have been migmitized and partially digested by Early Jurassic granodiorite. Photo credit: Geological Survey of Canada.*

Geothermal Energy Research

Work continued in 2018 on a multi-disciplinary geothermal research project. The multi-year study, led by Tiffani Fraser, included modeling of Curie point depths to generate a heat flow map for the lower crust in Yukon (Witter and Miller, 2017), calculation of the potential radiogenic heat generated from Cretaceous and younger granitic rocks (Friend and Colpron, 2017), and the drilling and instrumenting of two 500 m deep temperature gradient wells (Fig. 7). One well is located in the Whitehorse area near the Takhini Hot Spring, and the second well is located in the Tintina Trench about 10 km southwest of Ross River.

Figure 7. *Photo of rig drilling the ground temperature monitoring well in the Tintina Trench near Ross River.*

In the spring, the thermistor cables from both temperature gradient wells were removed and final temperature profiles were generated. Logging of drill core from the Ross River area well was completed in the fall, and samples were collected and shipped to the University of Alberta, where researcher Jonathan Banks will measure rock properties such as thermal conductivity and permeability/porosity for selected units. Palynology samples were also collected from organic-rich layers; these samples are currently still at YGS. Logging of the Takhini core is planned for spring, 2019. A final decision on where to release the core logs (e.g., journal paper, open file, etc.) has not been made; at a minimum, the drill core metadata will be added to YGS' Drill Core Database.

Over the summer, Colpron updated the radiogenic heat map, incorporating unpublished whole rock geochemical data collected by the Geological Survey of Canada. Incorporation of these data filled a number of gaps in the earlier map. The updated map will be published early in 2019, following the release by GSC of the geochemical data set.

Preliminary results of the project were presented at the annual Geoscience Research Council meeting in Reno in October (Fraser *et al.*, 2018). Results were also presented by Fraser at the Yukon and Yellowknife Geoscience Forums in November, 2018, and are summarized in this volume (Fraser *et al.*, 2019).

Surficial Geology Projects

YGS surficial geologists carried out work on two field projects in 2018 (Fig. 3), and made progress on a Bulletin on the surficial geology of the Stevenson Ridge area.

Burwash Uplands surficial mapping

Kristen Kennedy completed a surficial mapping project in the Burwash Uplands area in 2018. Mapping in 2018 focused on the west side of the Donjek River between Cement and Steele creeks, where the terrain is dominated by steeply incised glacial meltwater channels and numerous landslides. The abundance of landslides in this area is attributed to poorly-consolidated bedrock that has been extensively excavated by glaciers in a seismically active area.

Kennedy presented highlights of the three year project at the Yukon Geoscience Forum in November. An Open File report and new surficial geology map are in production and will be released in 2019.

Greater Whitehorse area surficial geology mapping and permafrost studies

This project entails 1:25 000 scale surficial geology mapping, documentation of geological hazards, and identification of aggregate resources (led by Panya Lipovsky at YGS), and characterization of permafrost (led by Yukon College researchers) in the greater Whitehorse area. Indigenous and Northern Affairs Canada is funding the permafrost characterization work over a four-year period (2017–2021) under its Climate Change Preparedness in the North program. The key drivers of the project are to support climate change adaptation planning and minimize risks to infrastructure in this heavily populated region.

In 2018, YGS acquired 182 km^2 of new LiDAR data for parts of the study area, which, coupled with pre-existing data, provide high resolution DEM imagery for most of the study area (Fig. 8). The new data will be made publicly available in spring 2019; the older data are currently available through Geomatics Yukon (http://mapservices.gov.yk.ca/GeoYukon/). Lipovsky is currently using these images to refine and reinterpret surficial geology map units, identify potential aggregate resources, and map landforms related to deglaciation (e.g., paleo-shorelines, moraines, and meltwater channels). The past summer was her first of three field seasons targeted toward validating the new mapping by examining surficial materials exposed in road cuts, river banks, gravel pits and hand-dug pits.

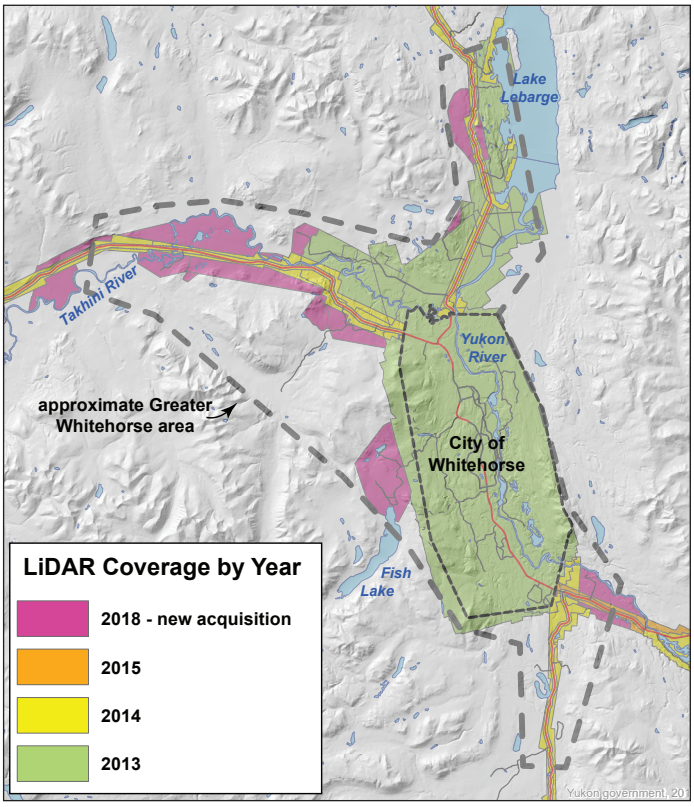

Figure 8. *Map showing the location of the greater Whitehorse area study and the footprint of publicly-available LiDAR imagery.*

Two shallow (~20 m) boreholes are scheduled to be drilled this winter to characterize permafrost properties and establish long term ground temperature monitoring stations. A set of YGS publications will be released in spring 2019 describing the results of the work performed east of these permafrost case study sites.

The new knowledge generated over the next three years will support municipal development, land planning (e.g., for agricultural and country-residential use), and highway infrastructure maintenance.

Student Thesis Projects

YGS provided support for three graduate student projects in 2018. In addition to the three projects underway, two theses are in the final write-up stages. MSc student Leigh van Drecht (Memorial University) is completing a study of the stratigraphy, sedimentology and depositional environment of the Laberge Group in the upper Whitehorse trough (van Drecht and Beranek, 2018), and MSc student Derek Cronmiller (Simon Fraser University), is writing up research on the glacial history and setting of placer deposits in Gladstone Creek (Cronmiller *et al.*, 2019).

Colin Paget completed a second and final year of mapping and data collection for a PhD thesis in the Hyland River area in 2018. Working under the supervision of Dave Pattison (University of Calgary) and David Moynihan (YGS), Paget is continuing his study of lower crustal and mantle xenoliths that were recovered from Cenozoic dikes in the area. He is also undertaking a study of sulphide minerals (pyrite, pyrrhotite) in pelitic rocks of the Hyland area, funded by the Geological Survey of Canada under their Targeted Geoscience Initiative program. The aim of this work is to determine the role that metamorphism plays in the generation of gold-bearing fluids, in particular during the recrystallization of pyrite to pyrrhotite with increasing temperature.

Melissa Friend (MSc student at University of British Columbia) completed a second (final) year of field work in central Yukon. Her research is examining the links between Cretaceous metallogeny and magmatic fertility in southwestern Yukon. Fieldwork in 2018 expanded the focus of the study beyond the Mount Freegold/Prospector Mountain area to include the Sixtymile/Klondike and the Southern Lakes regions. Samples of early Late Cretaceous and late Late Cretaceous plutonic rocks were collected to evaluate the geochemical and petrogenetic attributes that contribute to their fertility (Fig. 9). The study is being supervised by Craig Hart at the Mineral Deposits Research Unit (UBC). Results of her work to date were presented at the Geoscience Forum in November.

Matt Manor is a PhD candidate at Memorial University working under Steve Piercey's supervision. He is examining the stratigraphy, petrology and age of host rocks to the Kudz Ze Kayah, Wolverine and Fyre Lake VMS deposits in the Finlayson district of Yukon. Preliminary results of his research were presented in Manor and Piercey (2018) and an update on this work is included in this volume (Manor and Piercey, 2019).

Figure 9. *Melissa Friend examining granite rubble near the Revenue deposit. Big Creek valley in the background.*

Desktop Studies

Ongoing Capture of Yukon Consolidated Gold Corporation File Data

Under Sydney van Loon's direction, a contractor continued geo-referencing placer exploration data from Yukon Consolidated Gold Corporation (YCGC) files in 2018. To date, 330 maps have been digitized. In the fall, van Loon compiled historic drill data in the lower Hunker Creek/Klondike River valley. The compilation indicated the presence of a pay channel along the lower left limit of Hunker Creek. Results of the study were presented at the Yukon Placer Forum and are described in this volume (van Loon, 2019).

Over the next year, YGS will consider whether to continue generating creek-by-creek compilations of YCGC data, or to simply allow clients to view and download data in areas of interest using the YCGC web application described above (see Information Services). In the meantime, van Loon will focus on digitizing data and undertaking quality control as digitized files are added to the web map.

Mineral Potential Mapping

In 2018, Yukon government and Tr'ondëk Hwëch'in First Nation initiated a call to re-establish the Dawson Land Use Planning Commission. At the time of writing, Commission members have been identified and an announcement is pending. It is anticipated that the planning process will get underway early in 2019. In addition to the Dawson plan, a planning process for the Beaver River watershed has started in partnership with the First Nation of Na-cho Nyäk Dun, to mitigate impacts of a tote road between Mayo and Atac Resources' Tiger gold deposit.

YGS has met with the Beaver River working group to understand the key values identified for protection and their approach to planning. At the same time, the survey was able to share information about existing geoscience data in the planning area and discuss ideas about targeted data collection to address critical gaps in order to support decision-making.

YGS anticipates hiring a Mineral Assessment Geologist early in 2019, who will take the lead on providing mineral potential information to both land use planning processes.

Geoscience Outreach

YGS continues to be committed to public engagement and geoscience education. Under Leyla Weston's leadership the survey has an active geoscience outreach program that runs year-round. Events include Mining and Discovery Day Camp (in May) and Yukon Geoscience Forum (November), which attract hundreds of students; and Tombstone Park's Weekend on the Rocks (in August), which draws both Yukoners and out-of-territory tourists.

Other annual events include local and community school visits and field trips, as well as workshops and interpretive hikes for educators. An overview of 2018 outreach highlights is presented in this volume by Weston (2019).

In addition to geoscience education, Weston liaised between YGS geologists and Yukon First Nation governments to share information on planned YGS field activities. YGS is working to build strong relationships with First Nations so that communities are aware of the work YGS does and they have access to the information the survey generates. YGS met with nine First Nations in 2018 to seek input on project plans, share results of field work, and gather information on community information needs.

Ongoing YGS Activities

Mineral Industry Liaison

Scott Casselman, Lara Lewis, Patrick Sack and Derek Torgerson visited twenty-seven mineral exploration properties in 2018, including four currently-funded and three previously-funded YMEP hard rock projects (Fig. 10). Information gathered on these site visits was captured in YGS' Hard Rock Mineral exploration database. Among the property visits was a trip to Mount Nansen to ensure historic drill core was not destroyed during the site remediation work underway and to recover core from a couple of representative drill holes. Highlights of the 2018 exploration season are summarized elsewhere in this volume (Lewis and Casselman, 2019) and were presented at the annual Geoscience Forum in November. An updated overview will be the subject of a talk by Casselman at Roundup in January 2019.

In August, YGS held a two and a half day "Carmacks Rocks" field workshop. The event featured an afternoon community open house, evening lectures on Jurassic metallogeny, and a two-day field trip to the Carmacks Copper and Minto copper deposits. The 2018 field trip underscored similarities and differences between the two deposits and showcased recent research by Colpron and Sack (Jurassic metallogeny study) and Nikolett Kovacs (Kovacs, 2018).

Figure 10. *Photo of Lara Lewis examining core at the JC tin occurrence east of Teslin.*

YGS participated in a number of events coordinated by the Yukon Mining Alliance (YMA) in 2018. These included a presentations at the Vancouver Resource Investment Conference (January) and a Yukon Mining Investment Forum in Toronto (May). Survey staff (Colpron, Casselman, Relf) also led a four-day regional tour for investors of selected YMA member projects in June, providing information on property geology and exploration history.

In November, the Minerals Geology unit organized a short course on Carlin-style gold deposits in conjunction with the Geoscience Forum. The course compared the geology and ore characteristics of several Carlin deposits with those of the Rackla belt in central Yukon. Patrick Sack and Maurice Colpron were among the presenters at the course, along with Jean Cline (University of Nevada/Las Vegas) and Julia Lane (Atac Resources). YGS would like to thank Atac Resources for allowing researchers working on their property to present results of their work and for sharing drill core with course participants.

Placer Industry Liaison

Jeff Bond and Sydney van Loon visited 95 placer operations in 2018, collecting information on the geology of the creeks and documenting data on mining methods and gold distribution (Fig. 11). Highlights of 2018 placer industry activities are presented in this volume (Bond and van Loon, 2019).

Figure 11. *Photo of Sydney van Loon discussing placer processing equipment with Z. Bidrman on Scroggie Creek during a 2018 site visit.*

At the 2018 Gold Show in May, Bond and van Loon released the 2015-2017 Yukon Placer Industry Report (Bond and van Loon, 2018). The report is the most comprehensive Placer Industry Report produced to date by YGS. It includes an overview of staking activity, gold production, and commodity prices for gold and diesel for the period between 1989 and 2017; this information provides a backdrop for the work history and production statistics presented in the volume. The report also includes detailed descriptions of surficial geology and stratigraphy, including characteristics of the pay gravels. The report is currently in its third printing, and can be ordered online from geology@gov.yk.ca.

In September, the Canadian International Resource Development Institute brought a contingent of placer miners and government regulators from Peru, Ecuador, Guyana, Ghana and Ethiopia to Yukon to meet regulators and learn about the placer mining industry in Canada (https://cirdi.ca/cirdi-hosts-yukon-asm-fellowship/). Bond and van Loon participated in a one day workshop with the group in Whitehorse, and coordinated a two day field trip in the Klondike, where representatives had an opportunity to learn about Yukon placer mining methods, including mercury-free gold clean-up options.

Permafrost Monitoring

Panya Lipovsky continued to coordinate ongoing maintenance of YGS' long term permafrost monitoring stations near Dawson, Faro, Ross River, Watson Lake and Beaver Creek. The survey purchased additional borehole thermistors in 2018 in anticipation of increasing its monitoring network in the upcoming years.

Seismic Monitoring

In 2015, YGS installed four teleseismic stations in the Liard basin area (southeastern Yukon/northeastern BC). These instruments contribute data to both the US Array network and the BC seismic consortium, which monitors natural and induced seismicity in the region. In 2018, the survey had a technician visit two of the sites when the instruments stopped transmitting data. Both sites are now back online, but will require new batteries to perform optimally; this work is tentatively scheduled for spring 2019.

Over the next two years as the US Array network project winds down, YGS will assess whether to keep the stations operating in the Liard basin area or to re-deploy them to other locations where they might support other Yukon priorities.

Summary

Highlights of 2018 accomplishments include the addition of two new web applications to the online Map Gallery, completion of four mapping projects (three bedrock, one surficial), and the wrap-up of the geothermal research project. In addition to these, progress continued on several ongoing projects, and a new study of permafrost and surficial geology in the Whitehorse area was initiated.

Survey staff continued to liaise closely with industry clients from the hard rock and placer sectors, and a record number of Yukoners were reached through community meetings and public events.

YGS has started planning for its next five-year geoscience planning workshop: the dates for the event are April 3–4, 2019. The workshop will provide an opportunity for clients and partners to identify gaps in Yukon's geoscience knowledge base, examine issues facing Yukon that are linked to geology, and exchange ideas about potential future projects the survey could take on. Preliminary information on the agenda will be posted on YGS' website in February; readers interested in participating should contact the author (carolyn.relf@gov.yk.ca).

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Yukon placer mining 2018 development overview

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Bond, J.D. and van Loon, S., 2019. Yukon placer mining 2018 development overview. *In:* Yukon Exploration and Geology Overview 2018, K.E. MacFarlane (ed.), Yukon Geological Survey, p. 17–24.

Introduction

The placer mining industry was strong in 2018, bolstered by a successful year in 2017. Gold prices were favourable and the number of sluicing operations was comparable to previous years. Placer gold production, according to royalty reporting, indicates that 2018 will yield a return similar to 2017, once the winter reporting season concludes in April. Strong production numbers were filed for the main stems of the Indian River, Sixtymile River, Quartz Creek and Bonanza Creek. Once again the Indian River drainage accounted for the majority of the placer gold produced with 54% of the total Yukon production.

Climate for Mining

The sluicing season began early in Dawson and Mayo due to favourable temperatures. The average daily high reported from Dawson for May was 18.9°C; a high of 24°C was reported on May 10. Precipitation was variable during the month, and 13 rain days were reported in Mayo and zero rain days reported in Haines Junction. This precipitation trend continued through the summer with only 33 mm of rain falling in Haines Junction in July and August, whereas 110 mm fell in Mayo in June. The Klondike experienced little precipitation in July as only 9 mm were reported. Scarce rainfall in the southwestern part of the territory forced the closure of at least one high-elevation operation in the Ruby Range. Temperatures were warm in most districts through July with the average daily high temperature reaching 24.5°C in Dawson. Fall sluicing temperatures were favourable through September and Dawson City had an average high of 12°C and average low of -2.3°C. Similar temperatures were also experienced in Mayo. Early October temperatures cooled rapidly in Dawson and Mayo and recovered during the middle of the month allowing miners to wrap up their season.

Gold Production and Value Summary

Placer gold production, according to royalty reporting, indicates that 2018 is on track for a similar year to 2017. The final reporting numbers for 2017 totaled 74,400 crude ounces, valued at $96.5M CDN. This was the highest value since 1989 when taking into account inflation, and the highest production total since 2004. As of December 7, a total of 66,200 crude ounces have been reported, which is about 1600 crude ounces less than this time last year (Fig. 1). Factors affecting profit margins include a minor reduction in gold price and increased diesel costs. The average gold price fell by 3% from last year and 8% from 2016, whereas the diesel price climbed by 20% from

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the previous year according to retail prices in Whitehorse (NRC, 2018). Fuel bills account for approximately 30% of the production cost and therefore this kind of price increase greatly impacts the industry.

The distribution of production from the various regions did not vary considerably in 2018. Overall the unglaciated terrain produced 90% of the gold, and the glaciated terrain produced 10%. This ratio has remained consistent for many years. Within the unglaciated terrain, Indian River production accounted for 54% of the total, which was up by 1% from last year. Production from the West Yukon increased from 8 to 10% of the total, largely due to activity in the Sixtymile River. Production from the lower Stewart River area fell by 4%.

Development Highlights

Indian River Drainage

Production from the main stem of the Indian River increased to more than 18,000 crude ounces in 2018, an increase of more than 4000 crude ounces from 2017. This was largely driven by an increase in production from the Little Flake Mine and a focus by Fine Gold Resources to develop their left limit claims above the mouth of Eureka Creek. In addition, mining on the Gimlex claims above the mouth of Quartz Creek resumed under an option agreement with Gold Rush's Rick Ness. Overall, production from the drainage remained consistent with nearly 35,000 crude ounces reported (Fig. 2).

Large scale operations by Schmidt Mining continued on the right limit bench of Quartz Creek. A number of cuts were in various stages of development throughout the course of the season as they extended upstream into Little Blanche Creek. A zone of thrusted bedrock blocks were encountered in the bench cut, which uplift the pay gravel by 6 to 8 m. The thrusts occurred prior to deposition of the upper White Channel gravel and therefore there is no surface evidence of the tectonic disturbance.

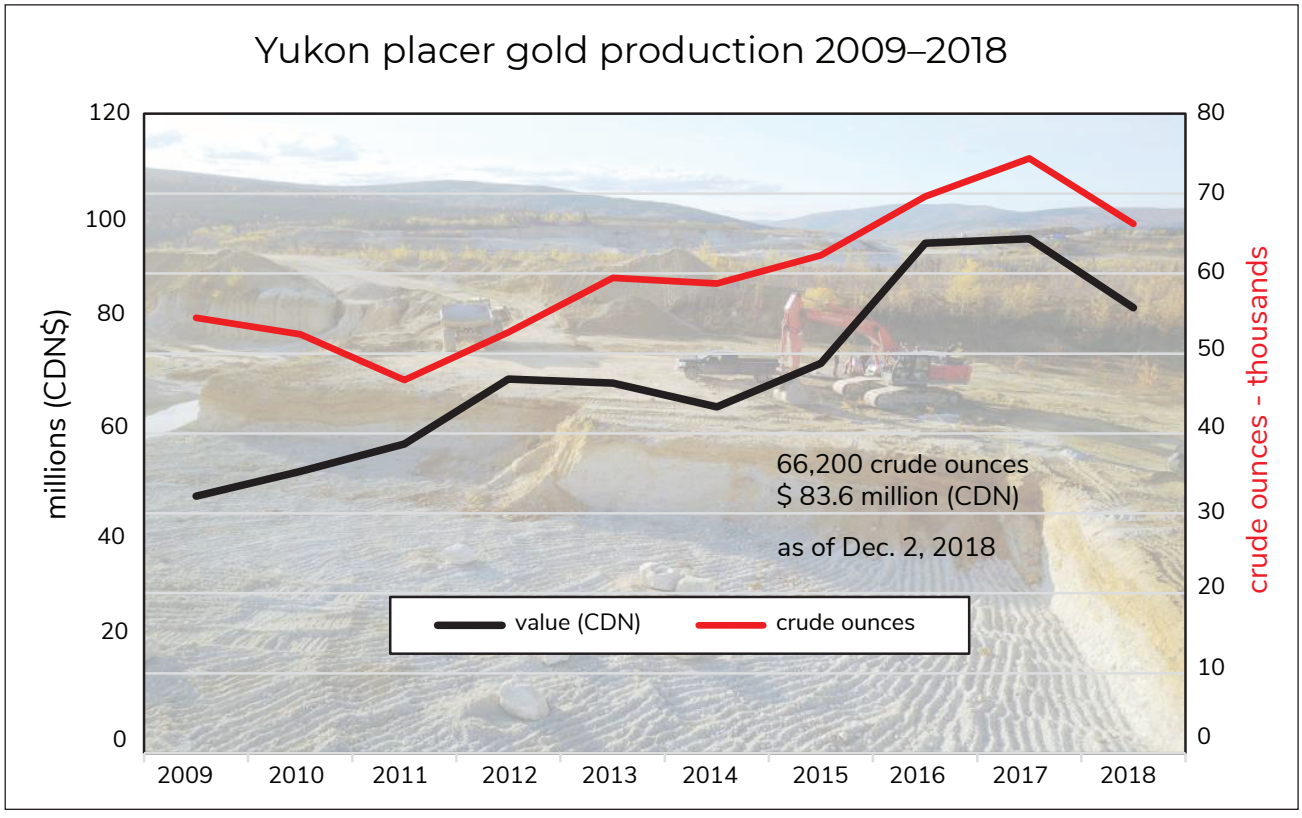

Figure 1. *Yukon placer gold production according to export tax reporting for the last ten years. The 2018 reporting season has yet to conclude and will likely reach levels similar to those in 2017.*

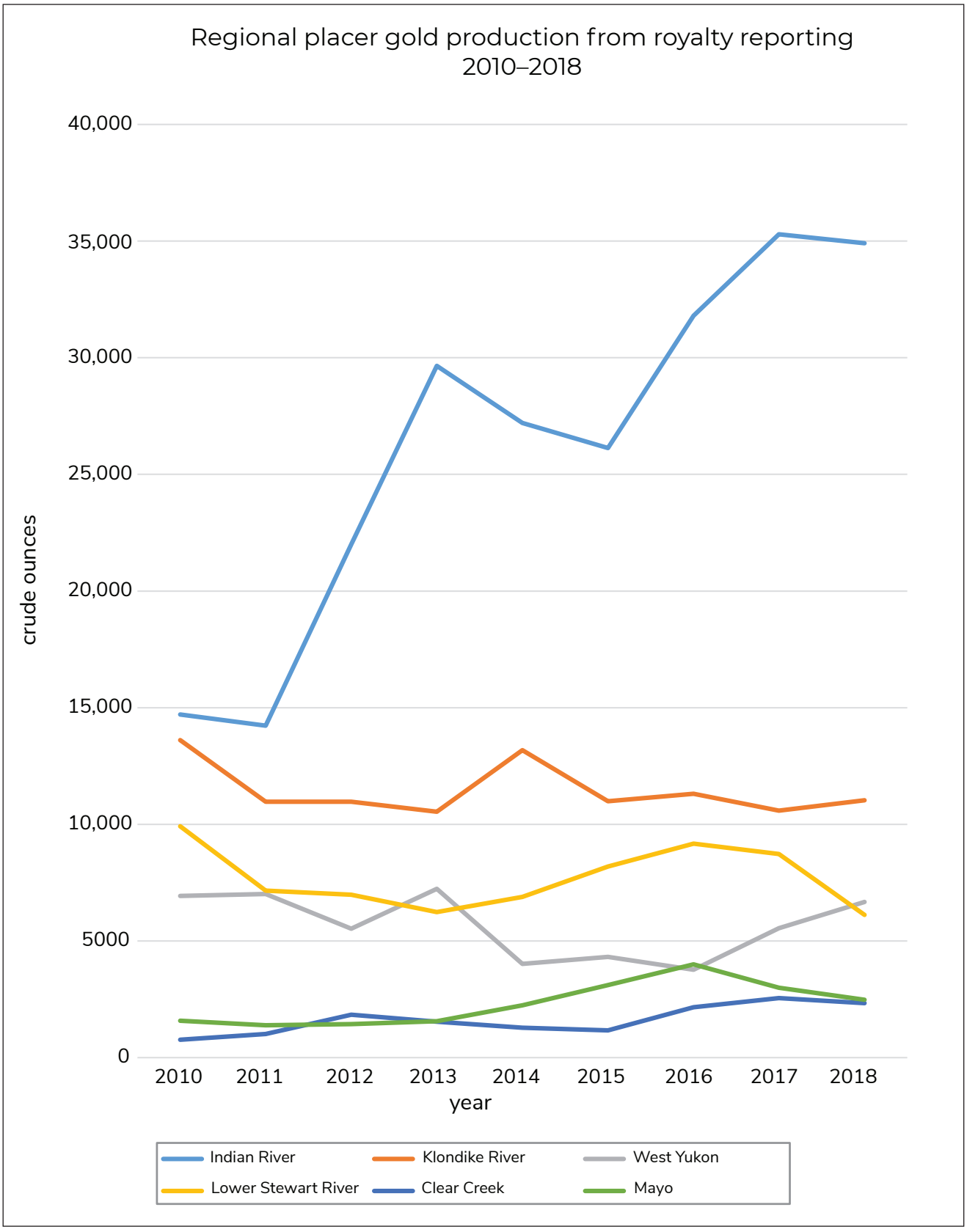

Figure 2. *Placer gold production from the various mining regions in Yukon from 2010 to 2018. Values are tabulated according to royalty reporting data as of December 2, 2018.*

A new operation, Yukon Heliski, commenced work on Sulphur Creek, targeting left limit side pay previously drilled by the Yukon Consolidated Gold Corporation (Fig. 3). With the help of Yukon Geological Survey historic data compilation efforts, the mine was able to quickly locate an area of economic pay and make their first season a success. Additional work completed on the claims includes resistivity geophysics and drilling that was co-funded by the Yukon Mineral Exploration Program.

Following the Dawson City Gold Show in May, the Yukon Geological Survey organized a field trip to Adrian Hollis' mine to learn about conveyor mining methods. More than 30 participants attended and were given detailed explanations on the construction, engineering, operating costs, capacity and limitations to employing excavator-mounted conveyors at a mine site. This low-cost method of earth moving is ideal for both stripping and transporting pay in many situations. In addition, the technique is conducive for material segregation, which facilitates reclamation top-coating.

Klondike Drainage

Production from the Klondike River drainage was split between Bonanza and Hunker creeks. In addition, there was an increase in production from the Klondike River main stem with the re-starting of Tatra Ventures mine.

Figure 3. *A view looking upstream on Sulphur Creek at Yukon Heliski's operation. In the 2018 cut, miners extracted pay gravel from under a unit of loess (silt) and massive ice overburden.*

Overall production from the Klondike drainage was slightly higher than 2017 with 11,029 crude ounces reported (Fig. 2). This accounts for 17% of the total Yukon production.

Tatra Ventures operated one of the largest placer mines in the drainage, located on the Klondike River floodplain upstream from Bear Creek subdivision. Proximity to the Klondike River makes groundwater management challenging, and upwards of seven diesel powered pumps are required to dewater the pit. They have two years of mining left on this ground, and are considering a conversion to hydro-electricity to meet next seasons pumping requirements. This will greatly reduce emissions associated with the operation.

Production from Favron Enterprises' Dago Hill property, a left limit White Channel gravel on Hunker Creek, was steady with mining activity occurring at a number of locations. A significant hydraulic monitoring effort occurred near Dago Gulch below the north slope of Dago Hill. This site is well located in-line with the White Channel paystreak that is concentrated on a low-level Hunker Creek bench and onto the colluvial slope of the hill (rim). Exploration on the property consisted of five sonic drill holes completed on the left limit, high-level bench of Last Chance Creek.

A stretch of historic ground was mined on Hunker Creek immediately upstream from Gold Bottom Creek. The "Hunker Narrows" is a section of the valley that could not be dredged due to the limited width of the valley bottom (Fig. 4). Old-timer underground workings and some mechanized mining has occurred on the property, but it had never been fully opened up. Work by Coulee Resources, in partnership with D. Millar, focused on the left limit below Delhi Hill where Hunker Creek gravel is overlain by coarse weathered bedrock and White Channel tailings off the bench rim.

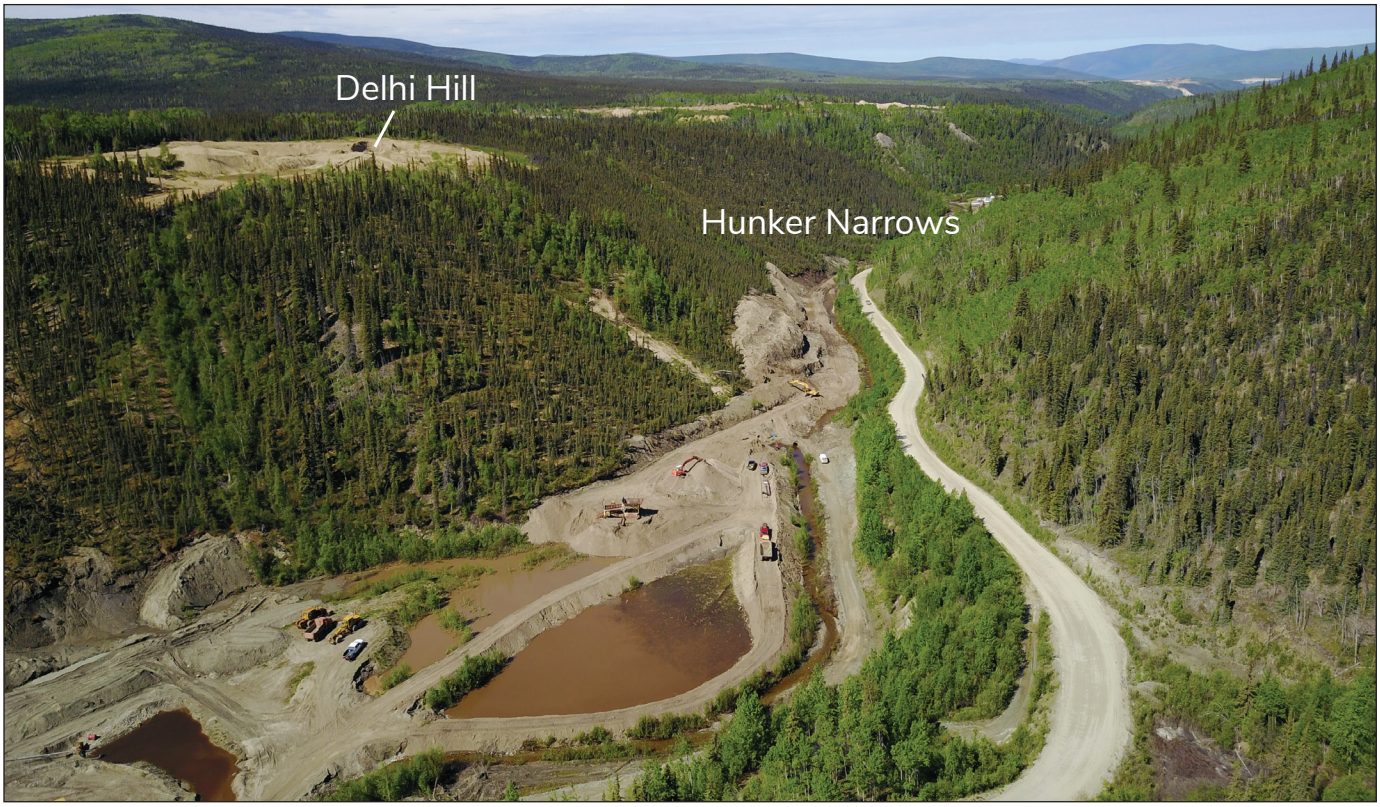

Figure 4. *A view looking downstream on Hunker Creek toward the Hunker Narrows. The former White Channel gravel pay streak was only partially left on Delhi Hill. The remainder was eroded onto the rim of the hill and into the valley bottom.*

West Yukon

Production from West Yukon continued to increase in 2018, largely due to activity along the Sixtymile River. A total of 6671 crude ounces were reported with more than 5500 crude ounces mined out of the Sixtymile River valley (Fig. 2). This included production from M2 Gold Mines, Hawk Mining and K-1 Mining.

M2 Gold Mines expanded operations on Sixtymile River with a crew of 12, running two plants. A variety of settings were mined including the high-level bench and modern point bars adjacent to the river. Their New Zealand-style mining method is ideally suited for the shallow deposits along the modern bars, and allows for systematic production (Fig. 5).

Spere Exploration has been actively prospecting Swede Creek, a left limit tributary to the Yukon River near Dawson City, for the past five years. This work has been completed utilizing the Yukon Mineral Exploration Program, and included geophysics, drilling, hand shafting and test pitting. In 2018, a 300 m³ bulk test was completed and had very encouraging results returning 403 g of coarse gold. This equates to a value of $45/m³ or $5/feet² in ground only 4 m (13 feet) deep.

Figure 5. *M2 Gold Mines operation on the Sixtymile River. After a thin layer of uneconomic gravel is stripped off, a single excavator can handle the bulk of the mining operation. In this cut, the excavator digs pay and feeds the plant. As the excavator moves along the mining face it drags the trommel in order to maintain the appropriate feed spacing.*

Lower Stewart River and Dawson Range

The main producing drainages in the lower Stewart River include Henderson, Kirkman, Scroggie, Black Hills and Maisy May creeks. Total production reporting is more than 6000 crude ounces, a reduction of nearly 1500 crude ounces from 2017 (Fig. 2). The main highlight from the district includes a late season staking rush in small tributaries to Henderson Creek.

In the Dawson Range, a significant exploration program was conducted by Ryanwood Exploration near the Coffee Gold project. This included 193 rotary air blast drill holes, 30 km of ground geophysics and 160 km of LiDAR. The program was completed using helicopters that minimized surface disturbance. Their work was primarily focused in Shovel, Boulevard, Excelsior and Sunshine creeks, all tributaries to the Yukon River. This is likely the largest placer exploration project in Yukon since the 1980s program on the Ladue River.

Clear Creek and Mayo

Production, according to royalties from Mayo, dropped for the second year in a row, largely due to reductions from Granite and Duncan creeks. Nearly 5000 crude ounces was reported from the two areas in 2018 (Fig. 2). The reduction is expected to turn around in 2019 with new mines coming on stream in the Clear Creek district.

On lower Clear Creek, Wolfhead Discovery and Mining LLC moved closer to full-scale production with the construction of a new 400 yd^3/hr Tyler 1100 T-class screen deck plant fitted with six sluice boxes (Fig. 6). More than 1500 feet of conveyors were moved onto the property to assist with feeding pay gravel to the plant. Exploration also continued with 78 auger drill holes and a LiDAR survey flown over the property.

On Big Creek, a tributary to the Little South Klondike River, Schmidt Mining continued exploration test pitting. A late season discovery was made that will help guide pay streak delineation in 2019. This property is anticipated to move into a development phase next year.

Figure 6. *A view of the new wash plant and feeder being installed on Wolfhead Discovery and Mining's operation on lower Clear Creek.*

Yukon Artisinal and Small-Scale Mining Fellowship

The Yukon Geological Survey participated in a fellowship program organized by the Canadian International Resource and Development Institute (CIRDI) that is based in Vancouver, BC. One of CIRDI's goals is to connect developing nations with Canadian expertise in the fields of resource extraction. In September, thirteen representatives from five nations, comprising Peru, Ecuador, Guyana, Ghana and Ethiopia, visited Yukon to learn about Yukon's placer mining regulations and methods (Fig. 7). Participants included both mining regulators and industry representatives. YGS organized two days of mine site tours in the Klondike that included visits to a diverse number of geologic settings: Gold Hill (Dulac Mining), Canyon Creek (L. Cail and Schmidt Mining), Quartz Creek (Schmidt Mining), Dominion Creek (A. Hollis and Dominion Gold Resources) and Sulphur Creek (Yukon Heliski). The purpose of the mine site tours was to learn about the geology, mine engineering, processing equipment and concentrate clean-up. The tour members were particularly interested in learning about mercury-free gold recovery techniques that they could communicate back to their respective countries. The fellowship was a success and highlighted Yukon's global position as a leader in placer mining technology, progressive regulations and security.

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Figure 7. *Delegates from the Yukon Artisanal and Small-Scale Mining Fellowship observe a clean-up at Marcel Dulac's property on Gold Hill.*

Yukon Mineral Exploration Program 2018 update

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Torgerson, D., 2019. Yukon Mineral Exploration Program 2018 update. *In*: Yukon Exploration and Geology Overview 2018, K.E. MacFarlane (ed.), Yukon Geological Survey, p. 25–36.

Program Summary

The Yukon Mineral Exploration Program (YMEP) is a funding program, administered by the Yukon Geological Survey (YGS), and is designed to support individual prospectors, partnerships and companies by providing a portion of the risk capital required to locate, explore and develop mineral occurrences in Yukon (Table 1). YMEP funding has consistently demonstrated its impact as an effective economic incentive by supporting exploration work that has led to numerous discoveries, which in turn, have provided significant long term economic benefits to the territory.

YMEP funding supports placer and hard rock exploration projects by reimbursing a percentage of approved exploration expenditures. Funding is merit-based; a panel of geologists evaluate submissions using a ranking system designed to score a range of criteria, quantifying the quality of the target, the proposal, the work plan, and the applicant's previous YMEP performance. This scoring system is available from our website at http://www.geology.gov.yk.ca/ymep.html.

Table 1. *Summary highlights of YMEP program guidelines. For more detailed information please reference the YMEP guidebook or* www.geology.gov.yk.ca/ymep.html.

	Grassroots	Focused Regional	Target Evaluation	Placer
Funding	max $15,000	max $25,000	max $40,000	max $40,000
Reimbursement rate	up to 100% of eligible expenses	up to 75% of eligible expenses	up to 50% of eligible expenses	up to 50% of eligible expenses
Scope of work	to generate new targets and advance existing ones	to generate new targets	to evaluate and advance already known targets	to evaluate and advance new and existing placer targets
Who is it for	individual prospectors only (no companies nor anyone working on behalf of a company)	prospectors, companies, partnerships	prospectors, companies, partnerships; projects with total exploration expenditures less than $300,000	
Report requirements	daily log and final technical report	final technical report		
Reporting deadlines	Project proposal: March 31, Status Report: September 30, Final Financial Report and Final Summary/ Technical report and release of funds: January 31 of following calendar year			
Confidentiality	reports will be kept confidential for 5 years	reports will be kept confidential for 2 years		
Eligible expenses (See Rate Schedule for details)	conventional exploration work, travel within Yukon (truck, helicopter, etc.; up to 25% of eligible claim), assays, shipping, wages (applicant not eligible in grassroots module), WCB, contracts, equipment rental, daily field expenses, fuel, claim staking (up to 20% of eligible claim), reclamation, limited physical work			
Compliance	applicants must ensure that proper permitting is in place and that their work programs satisfy existing laws and regulations			

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Update for 2018

Recognizing that economic conditions in 2018 would likely continue to be challenging for the exploration sector, the Government of Yukon maintained an enhanced level of YMEP funding at $1.6M. Interest in the 2018 program was strong, and the YGS received 74 applications seeking more than $2.2M.

Sixty-two applicants were offered funding in 2018. Forty of the funded applications are for hard rock exploration projects (eight are focused regional, two are grassroots, and thirty are target evaluation); and twenty-two placer applications were funded. The success rate for funding over the last seven years is shown in Table 2; the enhanced funding for this year allowed a higher than average success rate of 84%.

Hard rock projects account for 64% of the successful applications and placer projects account for the remaining 36%. Individual prospectors and private companies secured 66% of available funds, while public junior mining/exploration companies received 34% of the funds. The breakdown between the different modules and the demographics of the applicants over the past six years are outlined in Table 3. Over this period, the funding split between placer and hard rock sectors has been fairly consistent. The biggest change has been the increase in the share granted to placer projects, from a historical average of approximately 25% to 36.5% this year.

Table 2. *Summary of YMEP funding.*

Historical funding	2012-13	2013-14	2014-15	2015-16	2016-17	2017-18	2018-19
Available funding	$570,000	$1.17M	$1.4M	$1.4M	$1.4M	$1.6M	$1.6M
No. of applications	79	81	111	103	100	78	74
Approved projects	29	55	51	62	57	59	62
Max funding level grassroots	$15,000	$15,000	$15,000	$15,000	$15,000	$15,000	$15,000
Max funding level focused regional	$15,000	$15,000	$25,000	$25,000	$25,000	$25,000	$25,000
Max funding level target evaluation	$25,000	$25,000	$50,000	$40,000	$40,000	$40,000	$40,000
Max funding level placer	$0	$0	$0	$0	$0	$40,000	$40,000

Table 3. *YMEP fund allocation for the last 6 years.*

	2013-14		2014-15		2015-16		2016-17		2017-18		2018-2019	
	No. of projects	% of funding	No. of projects	% of funding	No. of projects	% of funding	No. of projects	% of funding	No. of projects	% of funding	No. of projects	% of funding
Placer	7	15%	14	22%	15	28%	15	26%	21	35%	22	36%
Hard rock	48	85%	29	78%	47	72%	34	74%	38	65%	40	64%
Total projects	**55**		**51**		**62**		**57**		**59**		**62**	
Prospectors/ individuals	28	36%	20	30%	24	34%	24	39%	18	29%	30	48%
Private companies	16	33%	12	29%	21	32%	16	30%	22	26%	15	24%
Public companies	13	31%	19	41%	17	34%	17	31%	19	45%	17	28%

The locations of funded YMEP projects are illustrated in Figure 1. The majority of placer projects (eleven) are centered in the Klondike placer district, two projects are in the Mayo/Keno area, three are in the Clear Creek area, two are in the Dawson Range, and individual placer projects are located in the Mt Nansen and Marsh Lake areas of Yukon. A single placer aggregate project is located in the Heather Lake area near Whitehorse. Hard rock projects are fairly evenly distributed throughout the territory. Gold is the most sought-after commodity with twenty-six proponents exploring for structurally-controlled, epithermal, Carlin style, intrusion related, or orogenic gold. Other targets include vein-hosted silver (three), porphyry copper (five), VMS style mineralization (one), jade (one), aggregate (one), cobalt (one), tin (two), and magmatic massive sulphide copper/nickel/PGE prospects (one).

Twenty-six exploration projects focused on soil and silt sampling, prospecting and geological mapping; eight undertook ground-based or airborne geophysical surveys; twenty three involved drilling and/or trenching; and five undertook hand shafting.

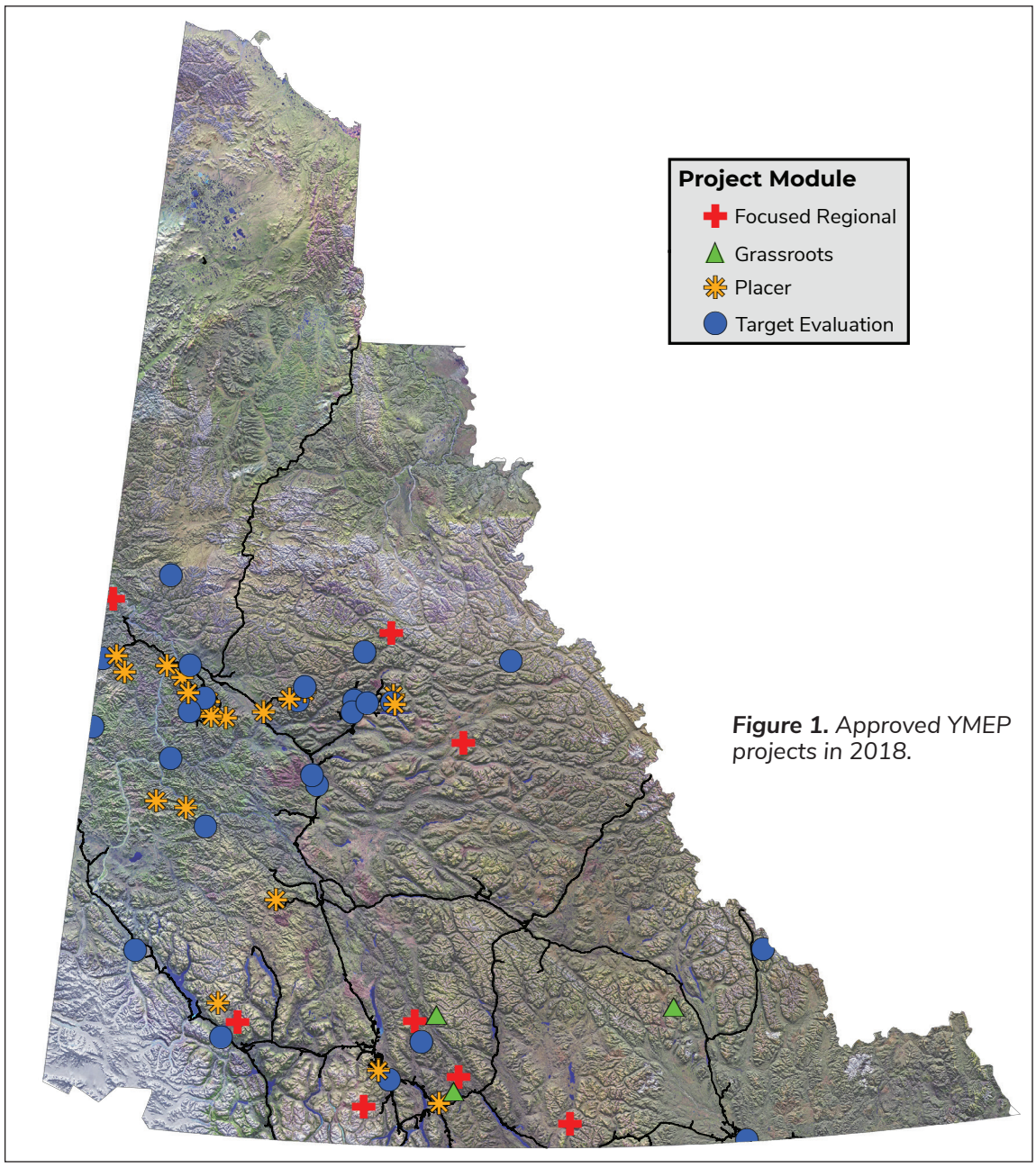

Figure 1. *Approved YMEP projects in 2018.*

YMEP Footprints

The Yukon Geological Survey has recently completed the digitizing of all YMEP technical report footprints as part of the Assessment Report Footprints project. There are currently 1170 reports that have been added to the web app. Of these reports, 318 are placer projects, 852 are hard rock; 54 are currently closed.

YMEP reports are confidential/closed for two years for target evaluation, focused regional and placer programs, and five years for grassroots projects; whereas, reports filed for assessment are confidential for five years. The web-based map now contains the spatial footprints with a link to download all open reports, as well as information such as project expenditures, work program details and NTS location. The interactive webmap (Fig. 2) also contains layers such as assessment report footprints and drillhole locations and can be found on the YGS website (http://yukon2.maps.arcgis.com/apps/webappviewer/index.html?id=5a7c8f1658514ddc8107c8a190b74799). This online app has been well received. When YMEP footprints are plotted on a map in conjunction with advanced and significant exploration projects it is apparent that many of these projects have been able to utilize YMEP funding to advance their programs and leverage additional expenditures (Fig. 3)

As of mid-December, most YMEP projects have been successfully completed and preliminary results suggest there are several potentially significant discoveries resulting from the work.

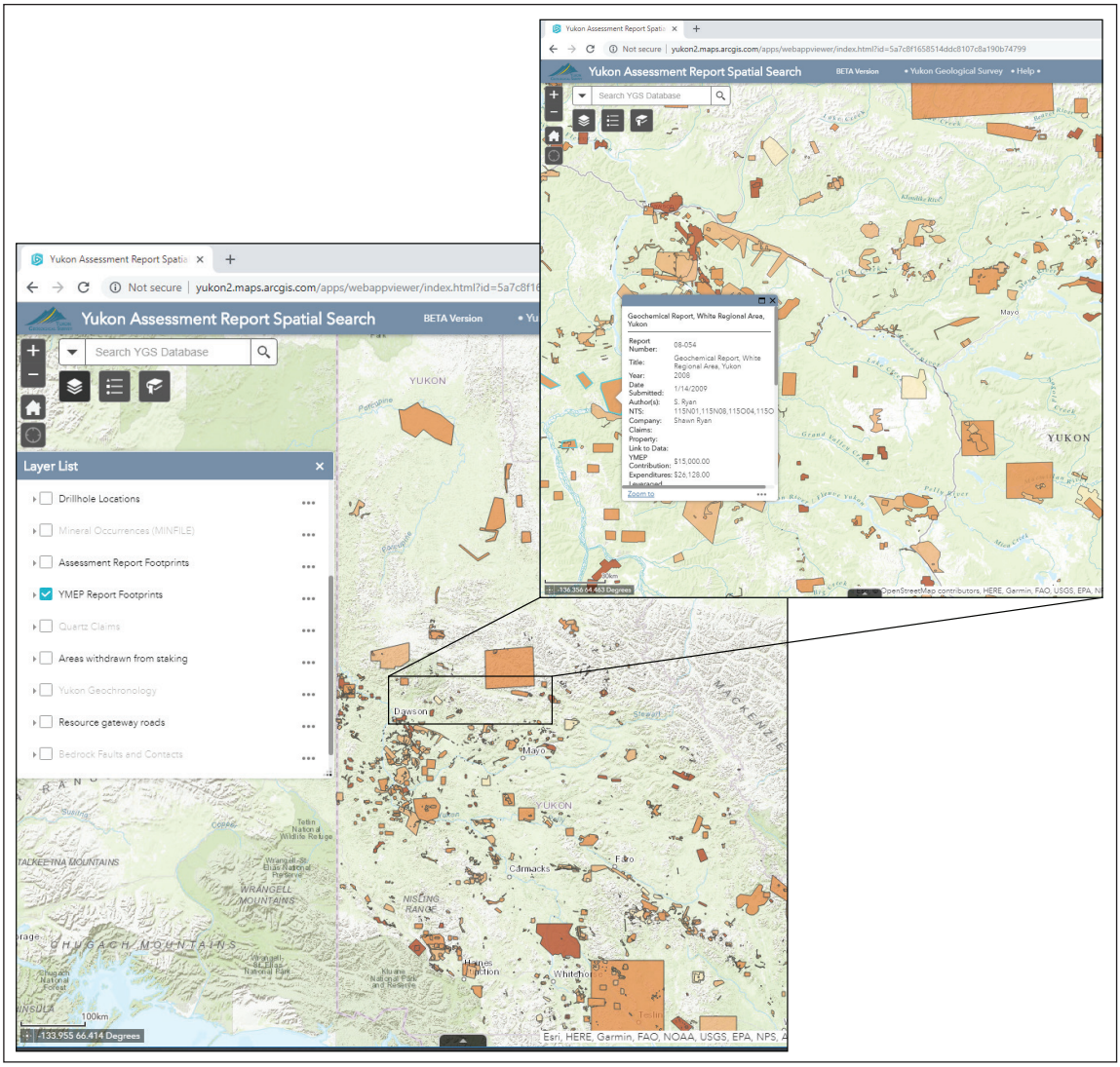

Figure 2. *YMEP footprints.*

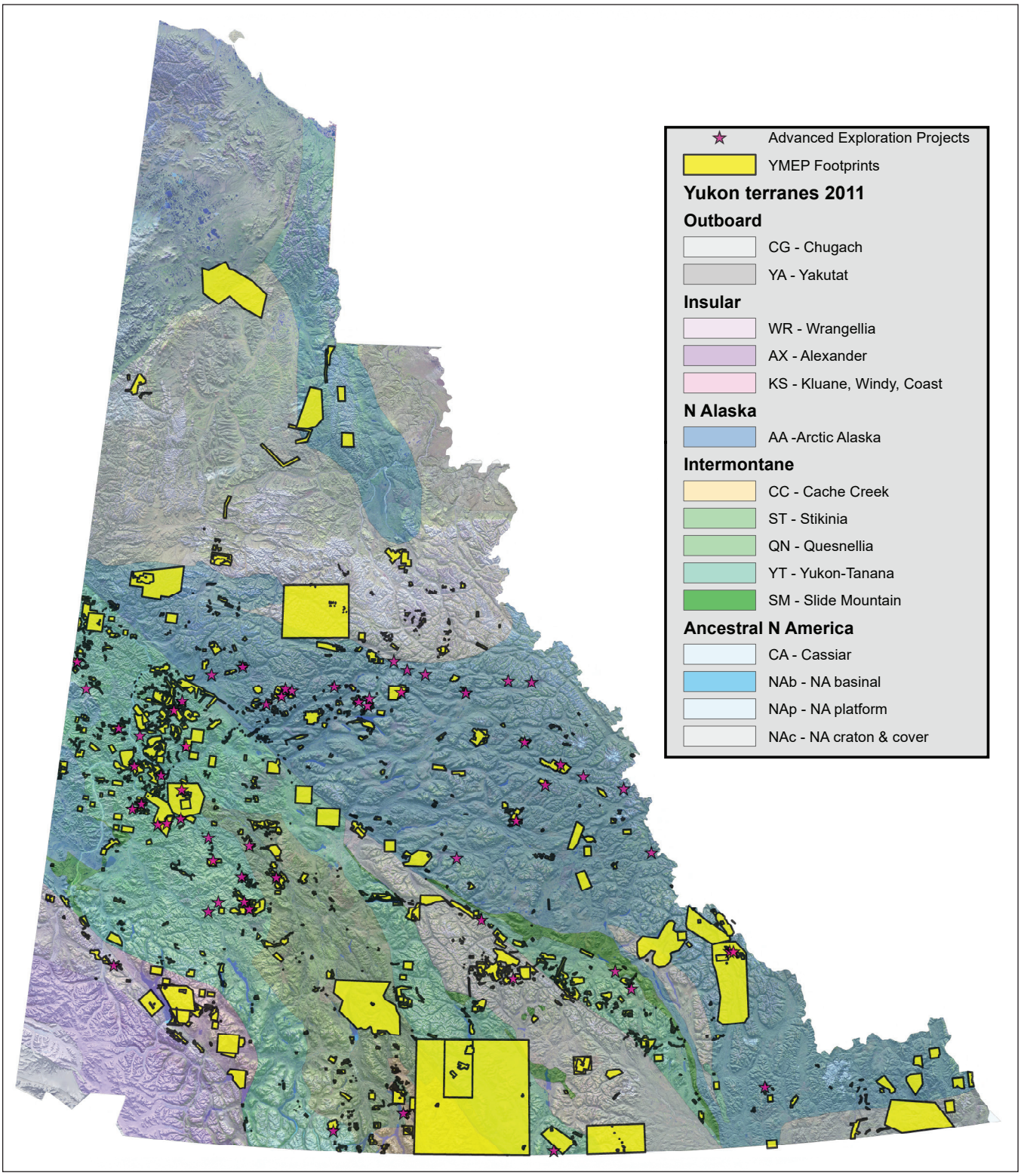

Figure 3. *YMEP footprints plotted in conjunction with advanced and significant projects.*

2018 Highlights

Mt. Hinton – Strategic Metals

The 2018 exploration program at the Mount Hinton property focused on the Granite Creek drainage where recent placer mining has yielded large gold nuggets and wire gold (Fig. 4), indicating a nearby bedrock source. The work program consisted of geological mapping, prospecting and soil sampling.

Figure 4. *Placer gold from Granite Creek.*

Soil sampling extended the geochemical anomaly an additional three kilometres to the southeast. This extension outlines some of the strongest geochemistry on the property; numerous samples returned values greater than 1 g/t gold-in-soil. A continuous chip sample across Vein 12 returned assay values of 8.82 g/t gold, 63.48 g/t silver, and 2.34% lead across 1.95 m. A zone of quartz vein and stockwork, 7 to 11 m wide, was discovered in subcrop. Rock samples from this zone returned assay values of 9.5 g/t gold and 5.02 g/t silver, 9.15 g/t gold and 5.17 g/t silver, and 2.91 g/t gold and 1.94 g/t silver. Float samples from newly discovered areas of mineralization on the east side of Granite Creek yielded 17.25 g/t gold, 225 g/t silver and 2.01% lead, and 14.75 g/t gold, 633 g/t silver and 2.22% lead.

Monster – Go Cobalt

In 2018 Go Cobalt utilized YMEP funding for an exploration program on its Monster property. The work program consisted of prospecting, geological mapping, soil sampling, claim staking, detailed airborne magnetic and radiometric surveys, inversion modelling, and spectral analysis.

As a result, multiple unexplored coincident geochemical, geophysical and spectral anomalies, and several large high-priority “bullseye” targets were defined. Widespread erythrite (cobalt bloom), cobaltite and copper, silver and gold mineralization has been identified on the property (Fig. 5). Assays from sampling the Bloom target returned results of 9.61% cobalt, 3.19% copper, 11.31 g/t silver and 1.16 g/t gold. The program led to the identification of the Arena area and Cobalt Cirque showing. Assays from these occurrences returned values of 2.96% cobalt, 3.81% copper, 53.52 g/t silver and 0.49 g/t gold.

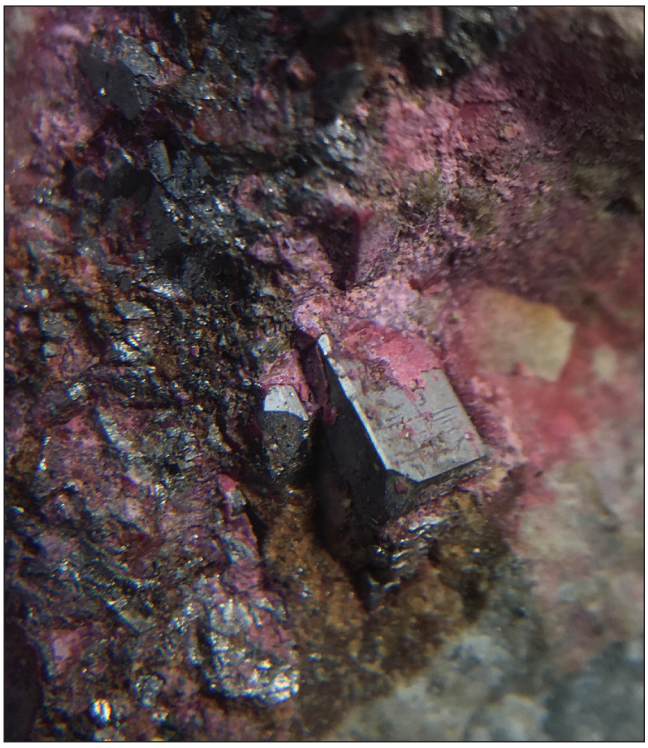

Figure 5. *Cobaltite crystal with erythrite coating; sample collected from the East Cu-Co zone.*

Swede Ck – Morgan Fraughton

In 2018 Morgan Fraughton conducted a placer exploration program consisting of road brushing, shafting, claim staking, test pitting, bulk sampling and reclamation on his Swede Creek property. Test pitting of bench claims was successful (Fig. 6) at determining the northern edge of the fluvial deposits and determined that the bench gravel above Swede Creek is deep and extensive. The bulk sample returned extremely encouraging results; the 4 m deep by 15 m wide by 20 m long pit (the top 3 m of the pit was treated as overburden) produced 300 m^3 of pay yielding 402 g of gold. The project will now move through the permitting process as these results make mine development the next logical step.

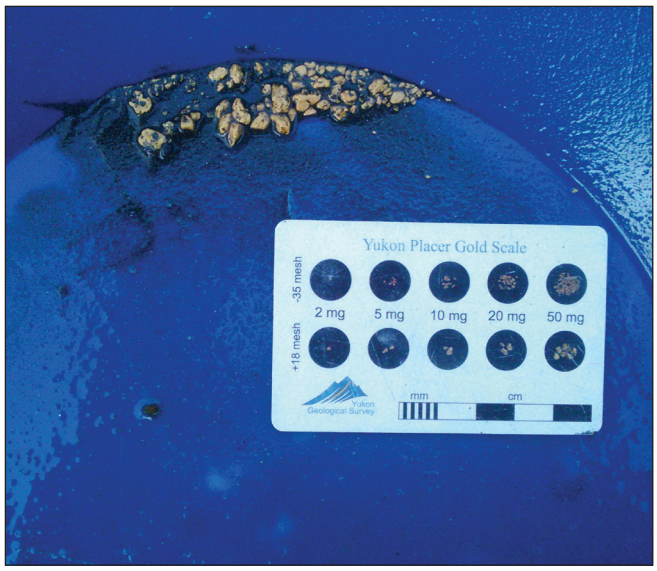

Figure 6. *Gold recovered (8 g) from 1 m^3 test on bedrock.*

Dominion Mountain – Bernie Kreft

This 65 claim (1300 ha), road accessible orogenic gold target, is located southeast of Dawson City in the Klondike goldfields. Fieldwork consisted of prospecting, soil sampling, and excavator trenching, designed to locate sources for the placer gold deposits found within creeks draining the property.

The work led to the identification of 13 mineralized zones, showings or significant soil anomalies along a 4.0 km northwest-trend. Channel sampling of a 1 m wide quartz-pyrite-galena vein returned values of 106.2 g/t gold and 656 g/t silver. A sample of heavily iron-carbonate altered and weakly pyritic schist with an absence of quartz veining assayed 50.17 g/t gold (Fig. 7). Gold values appear to be associated with a prominent northwest-trending fault (visible on FVD aeromagnetic data) especially at intersections with presumed northeast and east-west trending structures. Further soil sampling, prospecting and trenching is planned for remaining untested areas on the property; results will provide a guide to preliminary drill testing of the property.

Figure 7. *Iron-carbonate altered schist containg trace disseminated pyrite.*

YMEP Success Stories

The YMEP plays a very important role in helping to advance grass roots programs, to de-risk early stage exploration and to support exploration in financially lean years. The mandate of the YMEP is to keep a variety of projects at various stages of advancement operating in Yukon. A number of projects have progressed through the YMEP and have advanced beyond the intended scope of the program. Three projects that now have deposit resource estimates are the Coffee, Andrew and Red Mountain. These projects standout as having stimulated significant investment beyond their initial YMEP-funded expenditures. The projects collectively represent development and exploration expenditures

in excess of $276M; combined they have resources of 7.14 Moz gold, 990 Mlb zinc and 238 Mlb lead, and a contained value in excess of $12.1B. The total YMEP investment in these projects was $396K, corresponding to a leveraging ratio of 697:1.

A number of high profile projects have recently benefitted from YMEP investment, and have now generated enough success and momentum to secure financing on equity markets. These projects include the 3 Aces, Plateau and Wellesley Lake.

Golden Predator: 3 Aces project

The 3 Aces project of Golden Predator (http://www.goldenpredator.com/) received YMEP funding between 2001 and 2014 (grant numbers 2001-017, 2010-118, 2014-010). Work included prospecting, geological mapping, soil sampling, airborne geophysics, and bulk sampling. In 2010, chip sampling at the Main zone returned extremely high gold values of up to 1013 g/t Au and 50.19 g/t Ag across 1.1 m. Chip sampling on the Sleeping Giant zone returned numerous high grade gold values up to 11.34 g/t Au across 6.0 m. In 2010, Golden Predator Mining initiated and completed metallurgical tests on three large volume samples collected from the Sleeping Giant vein zone (600–800 kg). The program was designed to help understand the coarse gold in the vein system. Results from the 2014 program provided very important data regarding appropriate assay techniques, gold recoverability, and detailed mineralogy of the free gold grains. Results to date from subsequent drilling and sampling programs has yielded numerous high grade gold discoveries throughout the 3 Aces claim package.

Since the 2014 YMEP program Golden Predator has invested in excess of $20M for exploration on the 3 Aces property. In 2017 Golden Predator completed a $17.25M financing to continue to advance the project towards commercial production.

Goldstrike Resources: Plateau property

GoldstrikeResources(https://www.goldstrikeresources.com/) received a YMEP grant (2014-014) for its Plateau property in 2014 to conduct 3-D resistivity and chargeability surveys, and to gather samples from the VG, Ben and SW zones for rock physics measurements. Results of the fieldwork indicated that the resistivity structure in the near-surface zone consists of a strong NW-SE lineament defined by alternating bands of conductive and resistive rock. A crosscutting secondary structure was observed to offset the lineament. Chargeability was generally low in the upper zone but areas of moderate chargeability correlated strongly with anomalous geochemistry. It was concluded that zones of gold and arsenic corresponded to high resistivity, and low to moderate chargeability and low magnetic susceptibility.

Since the 2014 YMEP grant the Plateau project has seen exploration expenditures in excess of $16.7M. In March of 2017, Goldstrike announced that it had formed a strategic alliance with Newmont Mining to acquire the Plateau property in a deal worth $53M. In 2018, Newmont's exploration program consisted of a 26 hole (7753 m) diamond drill program, 310 rock grab samples, 1377 geochemical soil samples, 5 km of ground geophysical surveying (IP) and extensive property-wide mapping and prospecting. Drilling focused on geologic and geophysical targets and ten of the holes successfully intersected gold mineralization of >0.5 g/t, with intercepts up to 7.17 g/t over 0.85 m.

K2Gold : Wellesley Lake Gold

K2Gold (http://k2gold.com/) received YMEP funding for the Wellesley Lake project between 2011 and 2015 (grant numbers 2011-046, 2012-024, 2014-006, 2015-083). During this time YMEP helped to fund programs of soil sampling, prospecting, geological mapping, airborne geophysics, trenching and diamond drilling. The first pass of this work outlined a 1250 by 200 m east-trending gold + arsenic + antimony + silver + tungsten in soil anomaly with values ranging from 34.6 to 3082 ppb Au. Follow-up trenching and prospecting returned grab samples values up to 149.5 g/t Au and trench samples values of 9.15 g/t Au over 40.5 m. The first diamond drilling campaign on the property was completed in 2015. Significant results included 97.5 m of 0.76 g/t Au, including 3.11 g/t Au over 19.5 m and 5.71 g/t Au over 9 m. In 2016 the project was optioned to West Melville Metals which would become K2Gold. In 2018 K2 Gold conducted a $1.0M exploration program which included 2400 ha of unmanned (UAV) coverage,

16.5 line kilometres of ground magnetics, 840 VLF readings, prospecting and property wide Lidar coverage. Significant results from 2018 include the locating of additional gold bearing quartz vein float returning 43 g/t gold and the discovery of numerous untested geophysical anomalies that will require follow-up in 2019.

YMEP Review

Placer

In fall 2018, YGS undertook a client survey of placer applicants to measure how we could determine metrics showing the overall impact of the new placer module. The survey consisted of 6 questions:

> Did you discover new targets? (*i.e.*, potential resources)
>
> Did you define new resources?
>
> Is additional exploration needed or has a development decision been made?
>
> Have you started developing YMEP targets/ resources?
>
> If it has been mined, can you estimate how much gold (how many oz) you have recovered?
>
> Other comments about YMEP

Many of those who responded indicated that YMEP funding allowed them to discover new targets and define these new resources. Proponents have been able to make the decision to develop their properties. A few of the comments reflect what recipients feel about the module:

> "In 2018 the YMEP grant led to a bulk sample that proved Swede Creek hosts economic placer gold and should be mined (400 g gold in 300 m^3 of dirt washed). In addition the 2018 work showed that the high level bench gravels contain gold and are another target to be evaluated on a larger scale. As a result mining is planned to start in 2019 and will no doubt produce many ounces of gold over the years to come."

"As for the Placer YMEP it has been a great program in my mind. I have used this component of the YMEP for the last two years. I used the program one year to run a geophysical survey and drill in 2017 and followed up with my own dollars in 2018 and delineated about 4000 feet of economic pay. I used the program on 2 project's this year and outlined 2 more potential creeks with some nice drill hits, I am planning on following up on these targets next spring with a shafting program. I am using the placer module a lot like the hard rock module wherein the program has helped me to start the prospecting and discoveries are been made. Larger private dollar programs are being put in for follow up. I figure I have personally invested roughly $600,000 in the last 2 years and hopefully uncovered 4 to 5 million worth of placer gold, all back of the napkin calculations, point is the placer module is working to uncover new areas"

"The YMEP placer module is great program to allow individuals and companies to afford placer exploration. This is crucial for new comers to the industry who lack funding to conduct placer work. It is an incentive to explore new areas and to use new innovative technologies that otherwise would not have a budget for. It is an added security when exploring new placers which is a high risk investment as there is no guarantee for success. The 2018 Hidden Gold exploration program that was in part funded by the YMEP, aided in the completion of a bulk sample which has proven the project is economically feasible. The program discovered the presence of coarse placer gold in a brand new area! An area which is already road accessible and only 40 minutes from Whitehorse. Operating conditions are excellent as there is no permafrost and on average 5 feet of overburden. Upper gravels are payable based on hand and mechanical testing. From approximately 100 yd^3 test over one ounce of coarse gold was recovered and 2 ounces in fine gold as of yet, some fine heavies are still being separated."

> "As an example of the economic benefits flowing from a placer discovery, a total YMEP investment of approximately $25,000 has led to a deposit capable of supporting a moderate sized operation for approximately 8 years. The estimated cost per month to operate this operation will be about $50,000; so for a $25,000 investment there will be direct expenditures of approximately $2,400,000 over mine life with approximately 40% spent at Dawson area businesses (restaurants, service and supply etc.), and 60% to wages for workers living in Whitehorse. YMEP plays a major role in helping keep the Yukon vital and current with outside investors due to the excitement that comes from having a steady stream of grassroots discoveries."

Hard Rock

In order to demonstrate the profound impact this program on hard rock and placer exploration, the YGS compiled statistics on the YMEP. The compilation covers the last seventeen years, which is the period for which robust statistics exist. Since 2000, YMEP has invested $17.63M in 907 projects leveraging $40.9M of additional exploration expenditures in the year the grants were awarded.

The YMEP is designed to meet the needs of users of the program and to act as an engine for stimulating economic development. Significant effort has been expended to improve the program for clients. Development of the Placer module, creation of the YMEP footprints app and the redesign of YMEP forms and guidebooks was all done to improve the client experience.

Success can be measured by a number of indicators, such as dollars leveraged, new discoveries and option agreements entered (Table 4). In 2018, YMEP recipients committed ~$5.1 M in exploration investment, corresponding to a leveraging ratio of 3.2:1. While easily measured, leveraging ratios are relatively modest indicators of success. The greater impacts are linked to the discoveries made and the further investments they trigger in the medium to long term. The discoveries in 2018 will continue to stimulate exploration expenditures in the years ahead and enable the discovery of the mines of the future.

YGS intends to carry out further analysis of the YMEP data over the next year to determine whether there are potential adjustments that could improve the program. Updated application forms, scoring criteria and hard rock and placer program guidelines are available for download at http://www.geology.gov.yk.ca/ymep.html.

Table 4. *Successful YMEP options from 2000 to 2018.*

YMEP#	Property Name	Total YMEP Contribution(s)	Optioned by	Company investment or work commitment
01-011 and 15-030	Ice/Red Mountain	$52 500	AM Gold	~$7.7M
03-079	White Gold	$10 000	White Gold Corp. Kinross Gold	~$42M
04-072 and 05-043	Blende	$30 000	Blind Creek Resources	$5.2M
05-058	Andrew	$14 400	Overland Resources	~$16M
09-046, 09-062, 10-008, 11-019 and 12-049	Golden Culvert	$117 000	Stratabound Minerals	~$0.77M
04-041 and 07-043	Coffee	$35 000	Gold Corp. Kaminak Gold Corp.	~$273M
07-056, 08-012 and 09-112	Toni/Sixty Mile	$33 000	Radius Gold	~$4.5M
03-023, 06-033 and 09-137	Scheelite/Gold Dome	$75 000	Golden Predator	~$1.4M
09-015	Clear Creek	$10 450	Golden Predator	~$4.1M
09-016 and 017	Ten Mile Creek	$25 600	Radius Gold	~$0.63M
09-158	Prospector Mountain	$30 750	Silverquest Resources	~$3.85M
09-116	Cynthia	$15 350	Golden Predator	~$1.7M
10-118 and 14-010	3 ACES	$93 130	Northern Tiger Golden Predator	~$31M
10-097	Portland	$14 320	Taku Gold	~$1.25M
00-069, 06-005, 06-006 and 15-014	Mariposa	$76 000	Pacific Ridge	~$4.9M

Yukon hard rock mining, development and exploration overview 2018

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Lewis, L.L. and Casselman, S., 2019. Yukon Hard Rock Mining, Development and Exploration Overview 2018. *In:* Yukon Exploration and Geology 2018, K.E. MacFarlane (ed.), Yukon Geological Survey, p. 37–52.

Introduction

Mineral exploration remained strong in 2018. More than 110 exploration projects were active (Fig. 1); 28% of these were drilled (Fig. 2). Gold continues to be the most sought-after commodity, with 65% of projects and 81% of the exploration funding targeting gold. The remainder of projects were focused on lead-zinc, copper, silver, and nickel-PGEs, and to a lesser extent, tin, cobalt, and jade. Exploration expenditures were almost $CAN115 million (Fig. 3). Development expenditures are estimated at $CAN410 million, primarily for the development of Victoria Gold Corp.'s Eagle Mine in central Yukon, as well as the advancement of Goldcorp Inc.'s Coffee gold project in western Yukon.

Funding for the Yukon Mineral Exploration Program (YMEP), a grant program that helps companies offset exploration costs, was maintained at $CAN1.6 million for 2018/19. YMEP funds were distributed to 40 hard rock and 22 placer exploration projects (see Torgerson, 2018 in this volume for more information).

The number of hard rock claims staked in 2018 remained low at 5405, but the number of claims active and in good standing only dipped slightly to 185,036 (Fig. 4).

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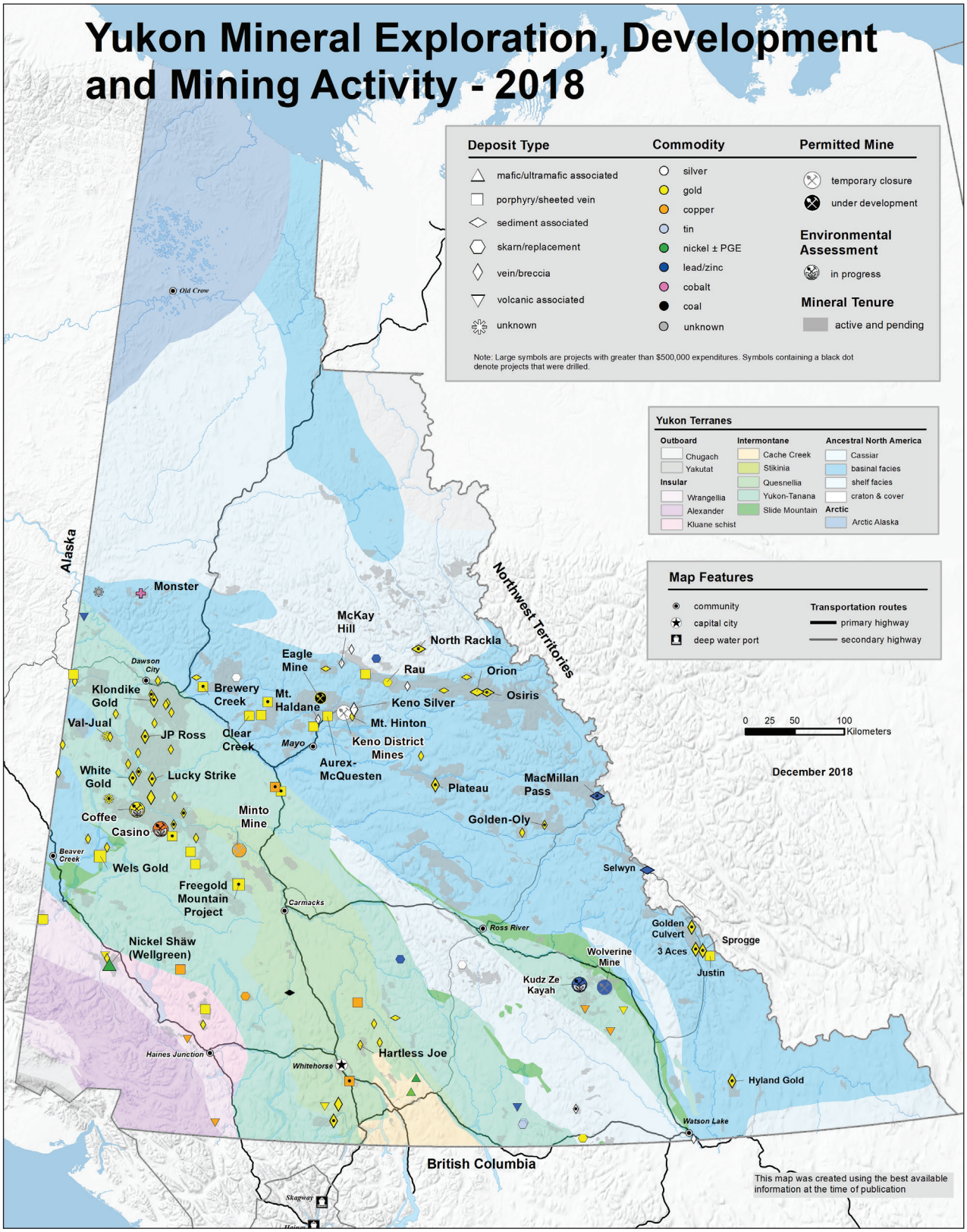

Figure 1. *Yukon exploration, development and mining projects, 2018. Large symbols represent projects having estimated expenditures ≥$500 000; small symbols having expenditures <$500 000. Black dot in the centre of a symbol indicates that drilling constituted part of the exploration activities.*

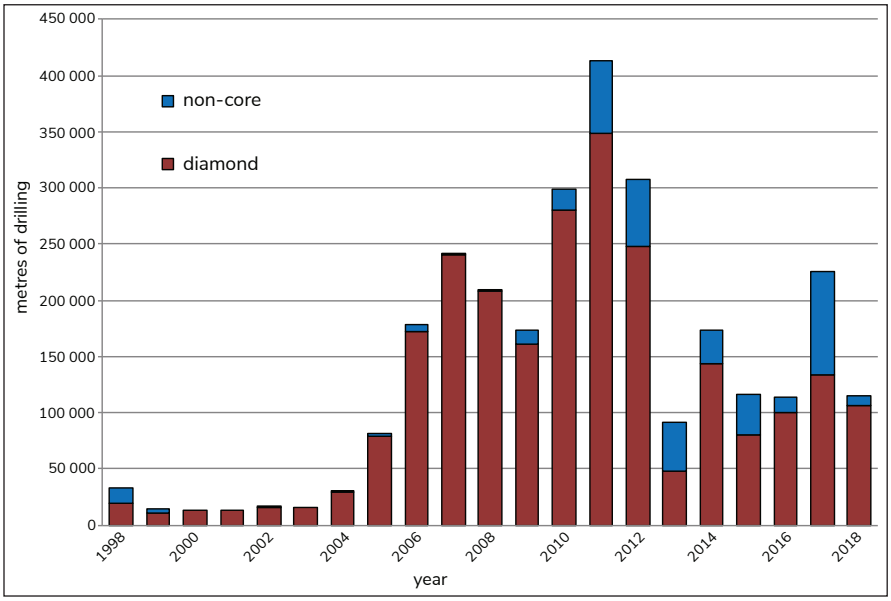

Figure 2. *Diamond drilling and reverse circulation or rotary air blast drilling, 1998–2018.*

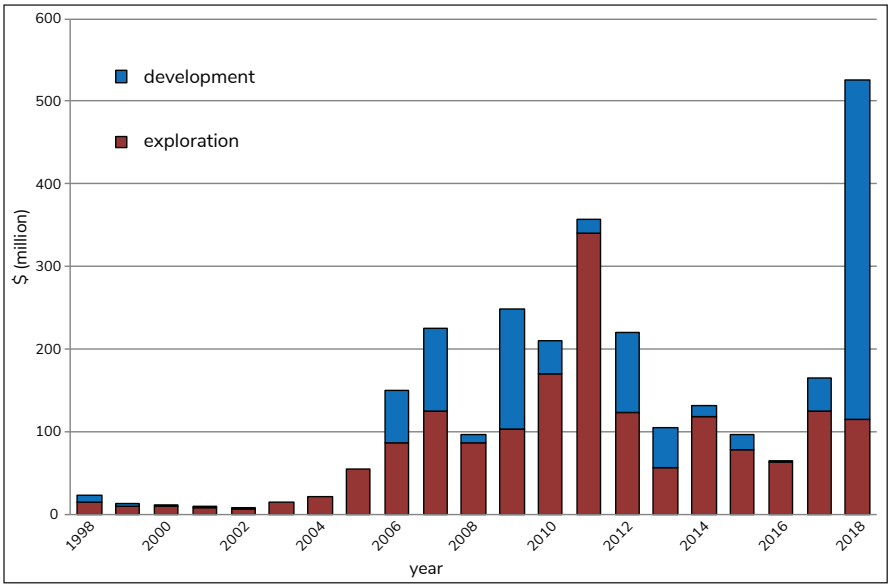

Figure 3. *Estimated exploration and development expenditures on hard rock projects, 1998–2018.*

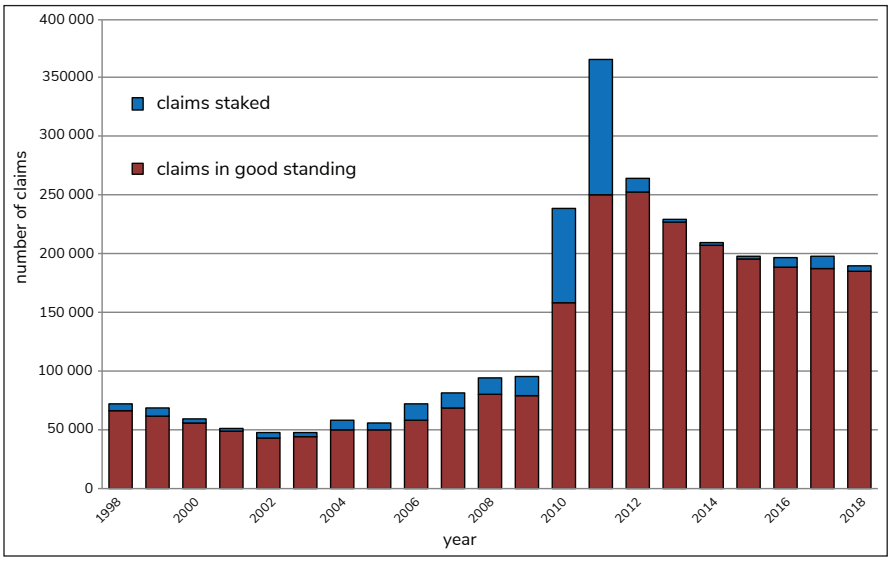

Figure 4. *Hard rock claims staked and in good standing, 1998–2018.*

Mining and Development

Hard Rock Mining

The territory's only hard rock mine (Minto copper-gold-silver) was on track to change ownership in 2018. In February, Capstone Mining Corp. (www.capstonemining.com) announced an agreement to sell the Minto Mine to Pembridge Resources plc for $CAN37.5 million plus 9.9% of Pembridge shares. Difficult market conditions through the summer prevented Pembridge from closing the financing. In October, Capstone terminated the agreement and announced that mining operations would cease and the site would be placed on temporary care and maintenance. Pembridge remains interested in the operation and, while they have lost exclusivity, are working towards renegotiating the acquisition terms. In the first nine months of 2018, Minto produced 9421 tonnes of copper, 7812 ounces of gold and 89,000 ounces of silver.

Victoria Gold Corp. (www.vitgoldcorp.com) began mine construction at its Eagle intrusion-related gold deposit in central Yukon (Fig. 5). Capital expenditures are estimated at $CAN369 million. The company is on target to pour its first gold in Q2 2019, and once in full production, plans to produce 200,000 ounces of gold per year from the open pit operation. Late in 2018, Victoria Gold announced an increase of the mineral resource by 450,000 ounces of gold (Table 1). In tandem with mine development, the company continued to explore the larger Dublin Gulch property outside the Eagle deposit with 5395 m of diamond drilling (29 holes), trenching, mapping and soil sampling. Drilling on the untested Nugget zone, 12 km east of the Eagle deposit, demonstrated the prospectivity outside the development area: diamond drill hole NG18-006C intersected 101.5 m of 0.57 g/t Au from near surface at Nugget.

Figure 5. *Aerial view of Victoria Gold Corp's Eagle gold project.*

Table 1. *Updated mineral resource for Victoria Gold Corp.'s Dublin Gulch property.*

Zone	Category	Tonnage	Au (g/t)	Contained Au (oz)	Ag (g/t)	Contained Ag (oz)
Eagle	Measured	36,061,386	0.715	828,978		
	Indicated	162,658,881	0.622	3,252,840		
	Inferred	12,780,597	0.498	204,633		
	Total	**211,500,864**		**4,286,450**		
Olive	Measured	2,000,000	1.19	76,519	2.31	148,538
	Indicated	7,500,000	1.05	253,189	2.06	496,733
	Inferred	7,300,000	0.89	208,885	1.70	398,994
	Total	**16,800,000**		**538,594**		**1,044,264**

Goldcorp Inc. (www.goldcorp.com) submitted its application for permitting of the Coffee gold property to the Yukon Environmental and Socioeconomic Assessment Board (YESAB) in the spring of 2017. The 2.16 million ounce (proven & probable reserve) gold property is envisioned as an open pit/heap leach operation. Permitting and detailed engineering are expected to be completed in 2020. Commercial production is targeted for 2021. The company continued exploring the property with a $35 million drill program to upgrade the resource and define additional oxide resources. Drill results have not been released.

Although not actively mining, Alexco Resources Ltd. (www.alexcoresource.com) is advancing the Bermingham and the Flame & Moth deposits in the Keno Hill silver district. Underground work continued at the Flame & Moth decline and underground drilling at Bermingham intersected spectacular grades including 4.29 m grading 3605 g/t Ag in the Bear vein; 3.96 m grading 3348 g/t Ag in the Bermingham Footwall vein; and, 4.10 m grading 1575 g/t Ag in the Bermingham Main vein. As a result of exploration work conducted in 2017 and 2018, the Bermingham indicated mineral resource has expanded from 17.3 million ounces to 33.3 million ounces of contained silver at an average silver grade of 628 g/t, while inferred mineral resources have increased from 5.5 million ounces to 10.4 million ounces of contained silver at an average silver grade of 526 g/t. A pre-feasibility study for the Bermingham and Flame & Moth is expected in the first quarter of 2019.

BMC Minerals Ltd. (http://bmcminerals.com), a private company, advanced its Kudz Ze Kayah volcanogenic massive sulphide (VMS) copper-zinc-lead property in east-central Yukon. An application to develop the ABM deposit (Fig. 6) on the property was submitted to YESAB in March 2017 and entered the screening stage in January 2018. A positive pre-feasibility study for the ABM deposit in 2017 envisioned an open pit and small underground mine processing 2 million tonnes per year with a nine year mine life. Total capital requirements over the life of the mine are calculated at $CAN530 million. The company continued to explore the property with 4055 m of diamond drilling in 22 holes, an electromagnetic survey, soil geochemical sampling and mapping in 2018. Results have yet to be released.

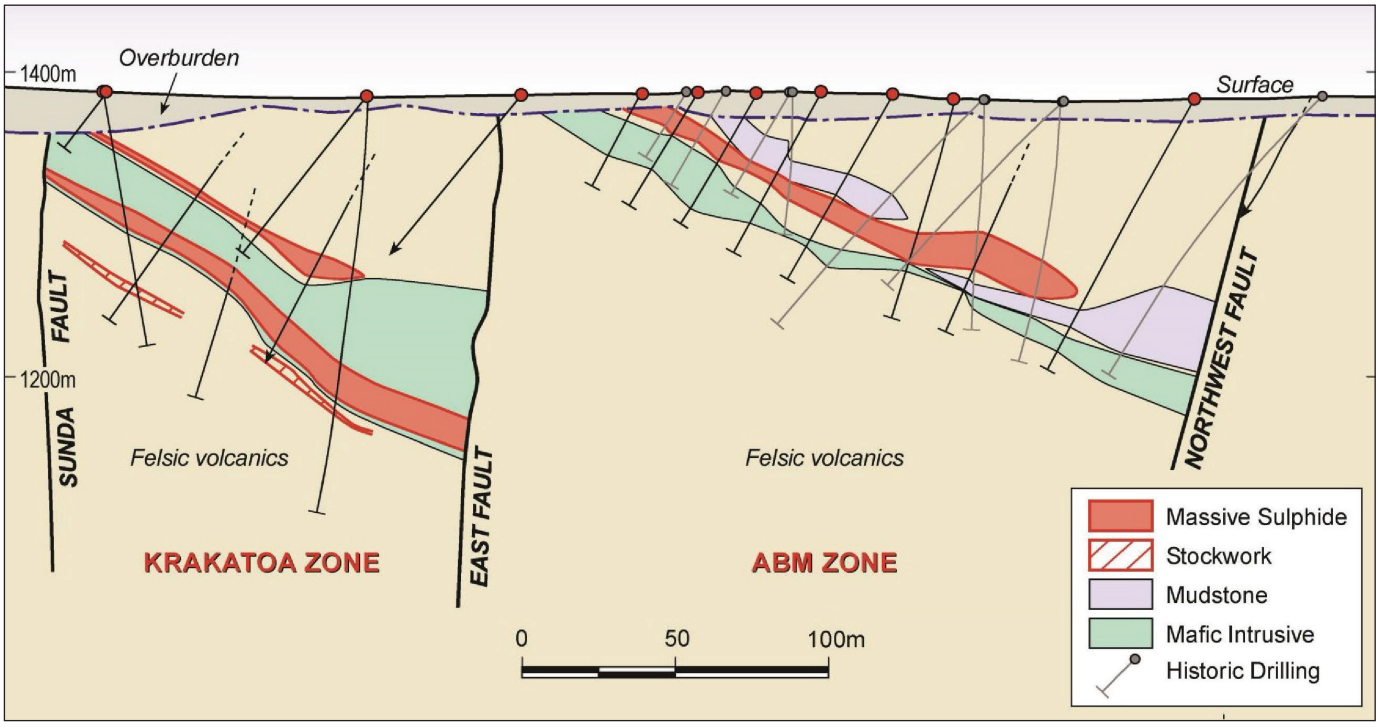

Figure 6. *Sketch showing a cross section of BMC Minerals' ABM deposit.*

Western Copper and Gold Corporation (www.westerncopperandgold.com) is undertaking adequacy work to complete its application to YESAB for panel review of its Casino porphyry copper-gold-molybdenum project in western Yukon. In November, 2018, the company completed a Best Available Tailing Technology Study for Tailings and Waste Rock Management at the site.

Yukon Zinc Corp.'s (www.yukonzinc.com) volcanogenic massive sulphide Wolverine Mine in eastern Yukon has been in temporary closure since 2015. In October, 2018, the Yukon government announced the mine had been sold to a new owner. No further details on the sale have been disclosed.

Significant Exploration Projects–Precious Metals

Atac Resources Ltd. (www.atacresources.com) explored its extensive Rackla Gold Project in north-central Yukon. The western part of the property, the Rau Trend, includes the Tiger carbonate replacement gold deposit (5.68 Mt @ 2.66 g/t Au, totaling 490,000 contained ounces of gold). A positive recommendation from YESAB for an access road to the site was made, but final approval for road construction is pending. The 2018 program focused on mapping, prospecting and hand trenching at the newly discovered Bobcat Au-Cu skarn target. Hand-pitting at Bobcat returned samples up to 6.07 g/t Au and 7.41% Cu.

Atac Resources optioned the central part of its Rackla Gold property (Orion) to Barrick Gold Corp. (www.barrick.com) in April 2017. The 7410 m (16 holes) diamond drill program in 2018 was designed to test the mineralized Anubis fault corridor; geochemical and geophysical anomalies; and, fault intersections of geochemically anomalous structures. High-grade gold was intersected in four step-out holes along the Anubis fault, e.g., BDO-017 intersected 7.61 m of 10.48 g/t Au 380 m down dip from the Anubis discovery outcrop. Despite the drilling success, Barrick terminated the option for the property in late 2018.

Atac Resources' eastern portion of the Rackla belt is the Osiris project, which hosts the Conrad, Osiris, Sunrise and Ibis Carlin-style gold zones. An initial resource on the Osiris Deposit was announced in June 2018: 12.38 Mt @ 4.24 g/t Au, for a total of 1.7 million ounces of gold. The company budgeted for 10 000 m of diamond drilling within the trend and had great drilling success. Drilling at the Sunrise zone returned one of the highest grade intervals to date: 26.70 m of 12.95 g/t Au in hole OS-18-273. At the Conrad zone, drill hole OS-18-266, intersected two main faults and demonstrated the importance of structural control on mineralization, assaying 2.83 g/t Au across 52.91 m.

Triumph Gold Corp. (www.triumphgoldcorp.com) explored its Freegold Mountain project with 17 566 m in 74 diamond drill holes (Fig. 7). Other work included magnetic and IP surveys, soil sampling, trenching, prospecting and mapping. The discovery of the Blue Sky porphyry on the property shifted focus away from the Revenue breccia toward this significant higher grade target. Diamond drill hole RVD18-19 intersected 1.10 g/t Au and 0.27% Cu across 316 m at Blue Sky. Drilling success was also achieved at other targets on the property: Nucleus drill hole DDH N18-17 returned 1.184 g/t Au across 59.5 m; Granger drilling returned 0.98 g/t Au across 18.39 m in drill hole RVD18-33; WAu Breccia drill hole RVD18-08 returned 0.639 g/t Au, 0.17% Cu over 128.00 m.

Figure 7. *Exploration roads at the Blue Sky Zone on Triumph Gold Corp.'s Freegold Mountain project.*

White Gold Corp. (WGC; www.whitegoldcorp.ca) continued to explore its large portfolio of properties in western Yukon. The biggest programs were at White Gold and JP Ross. Overall, the 2018 exploration program comprised 16 176 m of diamond drilling, 2397 m of reverse circulation drilling, 100 holes of rotary air blast (RAB) drilling, IP surveys, airborne magnetic and DIGHEM surveys, drone surveys, rock and soil sampling, and mapping over 18 properties. At the White Gold property, step-out drilling hit substantial gold mineralization at the new Golden Saddle West target: 2.32 g/t Au across 115.61 m in hole WHTGS18D0194. At the Ryan's Showing, high-grade gold mineralization was intersected in discovery hole WHTRYN18RC0001: 20.64 g/t Au across 6.10 m. WGC's program at JP Ross resulted in the discovery of the Vertigo target, a 1.5 km long gold mineralized trend. RAB drilling at Vertigo identified several mineralized intersections including 23.44 g/t Au and 145 g/t Ag across 24.38 m, starting at surface.

Klondike Gold Corp. (www.klondikegoldcorp.com) explored its Klondike Gold property south of Dawson City. The recent recognition of disseminated gold in schist between mineralized quartz veins led the company to resample historic drill core. At the Nugget zone, resampling of diamond drill hole EC15-15 returned 58.10 m of 1.03 g/t Au (the original assay was 1.8 m of 3.7 g/t Au). A total of 9511.93 m of new diamond drilling was completed in 2018 (87 drill holes). Drilling tested near-surface mineralization at the Lone Star, Nugget, Gold Run, French and Glacier targets. At Lone Star, diamond drill hole LS18-201 intersected a wide interval of gold mineralization: 91.0 m of 1.02 g/t Au.

Goldstrike Resources Ltd. (www.goldstrikeresources.com) struck a deal with Newmont Mining in March of 2017 for investment in its flagship Plateau Property, east of Mayo. The 2018 exploration program included 7753 m of drilling in 26 holes, sampling, and ground geophysical surveys. Ten of the drill holes were successful in intersecting gold mineralization of >0.5 g/t Au, with intercepts of up to 7.17 g/t Au across 0.85 m at Gold Dome.

Golden Predator Mining Corp. (www.goldenpredator.com) explored its 3 Aces orogenic gold project in southeastern Yukon with 4772 m of diamond drilling, 392 m of RC drilling and geological mapping (Fig. 8). One of the better intersections was at the Sprogge area, which has been interpreted as a blind intrusion-related target, younger than the orogenic system. Diamond drill hole 3A18-335 intersected 16.86 m of 1.35 g/t Au at Sprogge.

Figure 8. *Geologists examine a gold-bearing quartz vein at the Jack of Spades showing of Golden Predator Mining Corp.'s 3 Aces property.*

Golden Predator also conducted a small drill program for a metallurgical study at its Brewery Creek gold project in central Yukon. Highlights of the 1628 m program include 5.05 g/t Au across 8.5 m at the Lucky zone (DDH BC-18-604) and 21.0 g/t Au across 2.0 m (DDH BC-18-605) at the Lone Star zone.

In western Yukon, Lucky Strike Resources (www.luckystrikeres.com) built upon the discovery drilling of 2017 at its Lucky Strike gold property. Drilling was focused on the Monte Carlo zone (1359.7 m in 11 diamond drill holes). Diamond drill hole DDLS-18-06 returned 1.16 g/t Au across 8.3 m in the upper part of the zone and 4.55 g/t Au across 7.6 m in the lower gold-sulphide zone, which is coincident with a strong 1.8 km long IP chargeability anomaly. The company also carried out trenching along the 10 km Lucky Strike corridor which delineated new drill targets at the Maverick and Belmont zones.

Stratabound Minerals Corp. (www.stratabound.ca) optioned the Golden Culvert project in southeastern Yukon and drilled the very first holes on the property, completing 1350 m of diamond drilling in 8 holes (Fig. 9). In addition, the company soil sampled, prospected, mapped and trenched. Significant drill intersections include 2.53 g/t Au across 33.1 m in DDH GC1803.

Banyan Gold Corp.'s (www.banyangold.com) main project in Yukon is Hyland Gold in the southeastern part of the territory. A modest program of 1360 m diamond drilling in 11 holes was carried out. One of the better intersections assayed 0.73 g/t Au and 5.61 g/t Ag across 85.0 m in diamond drill hole HY18-077. Banyan also explored its newly acquired Aurex property in the Keno area with 1414 m of diamond drilling (12 holes), trenching and soil sampling. Drill highlights include 113.0 m of 0.74 g/t Au in DDH MQ-18-34.

Strategic Metals Ltd. (www.strategicmetalsltd.com) explored its Mt. Hinton gold project with soil sampling and prospecting. The soil anomaly on the property has been extended to 3 km in length, with numerous soils returning greater than 1 g/t Au. Chip sampling of vein 12 returned 8.82 g/t Au, 63.48 g/t Ag and 2.34% Pb across 1.95 m. Float samples have returned up to 17.25 g/t Au and 633 g/t Ag. Strategic also revisited its Hartless Joe property and completed a grassroots program of soil sampling, hand trenching and

Figure 9. *Stratabound Minerals Corp.'s exploration camp on the Golden Culvert property.*

prospecting. Trenching at Grumpy returned 9.57 g/t Au across 2 m. Rock samples yielded up to 49.8 g/t Au and 365 g/t Ag. Strategic completed small programs at 18 of its projects, scattered throughout Yukon.

K2 Gold Corp. (www.K2gold.com) continued work at the Wels intrusion-related gold property in southwestern Yukon. LiDAR, and ground magnetic and VLF-EM surveys helped the company identify major structures on the property. Prospecting these structures returned significant assays including 4.07 g/t Au at the Pekoe target from a quartz-carbonate gabbro sample. At the Saddle Area, quartz vein float assayed 43.0 g/t Au. The mineralized footprint has been expanded to 4 by 2 km wide.

Aben Resources Ltd. (www.abenresources.com) focused efforts on a new gold-bearing zone discovered in 2017 at the Justin property in southeastern Yukon (Fig. 10). This Lost Ace zone is characterized by visible gold in quartz veins, similar to mineralization at the neighbouring 3 Aces project of Golden Predator. The exploration program included trenching, channel sampling and prospecting. Results are pending.

Kestrel Gold Inc. (www.kestrelgold.com) explored the Clear Creek property west of the Eagle Mine development. The 2018 field program focused on the Saddle zone. Assay results include a peak value of 3613 ppb Au from soil samples, up to 25.1 g/t Au from mineralized sedimentary rocks, and up to 11.8 g/t Au

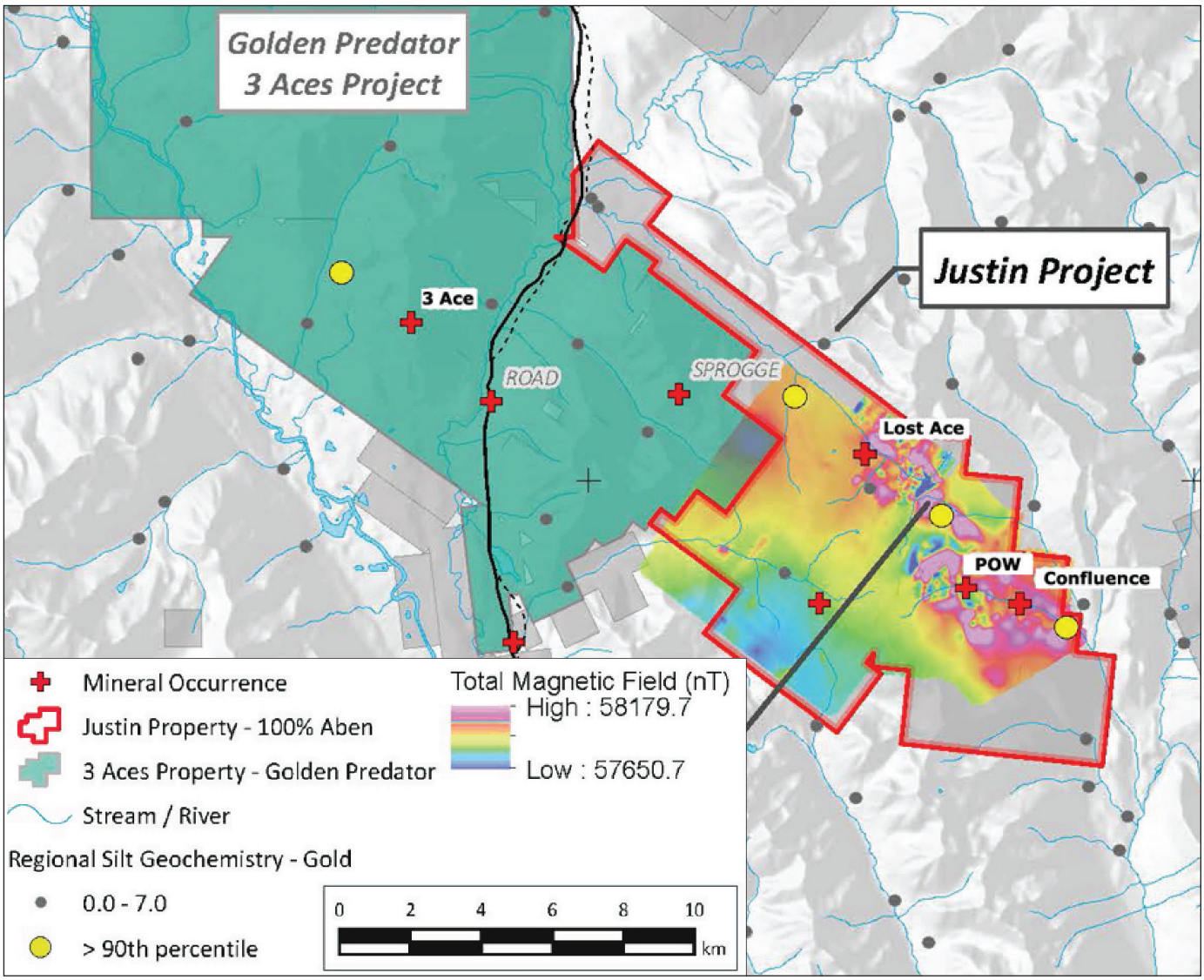

Figure 10. *Aben Resources' Justin gold property, modified from website image [accessed Dec. 12, 2018].*

from intrusive rocks cut by sheeted quartz veining. The Saddle zone is an approximately 300 x 950 m east-trending gold zone. Gold correlation with anomalous bismuth, tungsten and arsenic values suggests a fit with the intrusion-related gold deposit model.

Kestrel also worked the Val-Jual property in the White Gold district with a soil sampling program. The program expanded two anomalous zones, Teckphel and Cupid East, with values up to 12 400 ppb Au. The anomalies appear to be coincident with northwest and east-west trending magnetic linear features. Historic trenching has returned up to 11.1 g/t Au across 3 m and 1.0 g/t Au across 19 m, while historic drilling has returned 0.34 g/t Au across 54 m and 0.931 g/t Au across 13.71 m.

Strikepoint Gold Inc. (www.strikepointgold.com) worked its Golden-Oly project off the North Canol road with a 1000 m diamond drill program at the Colossus target. Gold is hosted in quartz-arsenopyrite sheeted veins. Results are pending.

Metallic Minerals Corp. (www.metallic-minerals.com) explored its Keno Silver Project in the historic Keno Hill silver district with drilling at the Formo, Homestake and Caribou targets. Drill results are pending. The company carried out drone-based geophysics, soil sampling, detailed stratigraphic mapping and trenching on 20 targets in the district. The company also explored its McKay Hill prospect north of Keno, expanding the silver-in-soil anomaly and uncovering multiple new high-grade silver veins.

Significant Exploration Projects–Base Metals

Base metal exploration continues to bring impressive results from the historic Tom and Jason (MacMillan Pass) sedimentary exhalative lead-zinc deposits. Fireweed Zinc Ltd. (www.fireweedzinc.com) drilled some of the highest-grade intercepts at the Tom East occurrence: 21.1% Zn, 13.5% Pb and 243 g/t Ag across 16.41 m in DDH TS18-004. The comprehensive exploration program included 5497 m of diamond drilling (20 holes), mapping, sampling and ground gravity. Drilling at the under-explored End zone target, northwest of Jason, returned significant intersections, e.g., 4.78% Zn, 10.17% Pb and 87 g/t Ag across 11.08 m in DDH EZ18-002. Fireweed Zinc released an updated resource for the Tom and Jason deposits in 2018: 50.68 million tonnes grading 6.01% Zn, 2.99% Pb and 34.43 g/t Ag (indicated and inferred).

Cantex Mine Development Corp. (www.cantex.ca) explored its North Rackla property in central Yukon with a modest diamond drilling program (7 drill holes; Fig. 11). The company made a new discovery, with massive sulphide mineralization containing galena and sphalerite encountered in drilling. Diamond drill hole YKDD18-12 intersected 13.00 m of 150.6 g/t Ag, 7.85% Pb and 15.86% Zn and a slightly deeper intersection of 7.00 m grading 22.0 g/t Ag, 1.23% Pb and 8.27% Zn. The lead and zinc assays for this hole, as well as several other holes, were over-limit and required re-assaying.

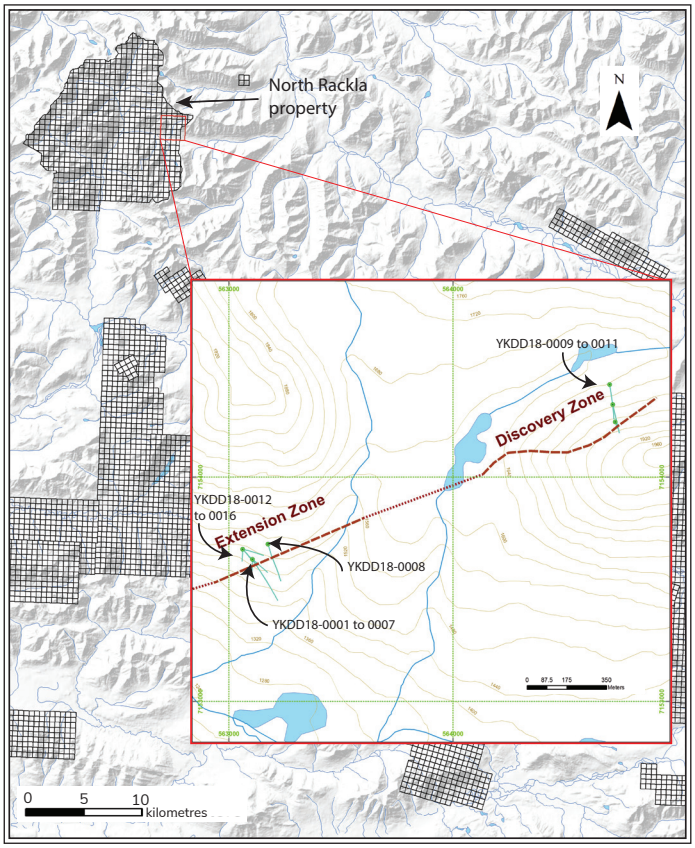

Figure 11. *Drill collar locations at the North Rackla property of Cantex Mine Development.*

In 2018, Nickel Creek Platinum Corp. (www.nickelcreekplatinum.com) conducted geological mapping and IP geophysical surveys on underexplored targets at its Nickel Shäw project (formerly Wellgreen) in southwestern Yukon. Results are pending. The company also released an updated mineral resource: 323 million tonnes containing 1.9 billion lbs Ni, 1.1 billion lbs Cu, 107 million lbs Co and 5.8 million oz PGM + Au (measured & indicated). The new resource was re-calculated after metallurgical tests demonstrated a strong correlation between higher total sulphide content and higher nickel recovery.

The Mt. Haldane property in the Keno area saw renewed activity in 2018 with a small sampling program by Alianza Minerals Ltd (www.alianzaminerals.com). The program was successful in identifying two new soil anomalies and expanding two known soil anomalies. The Ross soil anomaly is 600 m long with values greater than 1000 ppm Zn and up to 1455 ppm Pb. The strike potential of the Mt. Haldane Vein system is underpinned by a soil anomaly that has been extended to 3.5 km in length.

Selwyn Chihong Mining Ltd. (www.selwynchihong.com) continued to do work at its sedimentary exhalative Selwyn property in eastern Yukon. In 2018, work included site reclamation, baseline environmental research, permitting for the Howards Pass Access Road, as well as engineering work.

At least one company was exploring for cobalt in Yukon. Go Cobalt Mining Corp. (www.gocobalt.ca) worked its Monster property within a Proterozoic inlier north of Dawson City with prospecting, sampling, mapping and trenching. Rock assay highlights from this early stage project include 2.96% Co and 2.96% Cu from the Arena target and 9.61% Co and 3.19% Cu from the Bloom Target.

For further up-to-date information on all 2018 projects, please see the online Exploration Activity ArcGIS map at https://apps.ynet.gov.yk.ca/expdb/f?p=200:1:3987141858328:::::

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Appendix 1. Exploration projects 2018.

Project	Owner/Optioner	Yukon MINFILE	Commodity	Deposit type	Level of Advancement
3 Aces	Golden Predator Mining Corp.	105H 066	Gold	vein/breccia	diamond drilled
All-In	Richards, Gord	-	Copper	porphyry/sheeted vein	grassroots - never drilled
Aurex-McQuesten	Banyan Gold Corp.	105M 060	Gold	porphyry/sheeted vein	diamond drilled
Ball	Bluebird Battery Metals Inc.	115A 005	Copper	volcanic associated	grassroots - never drilled
Bermingham	Alexco Resource Corp.	105M 086	Silver	vein/breccia	NI 43-101 defined resource
Betty	White Gold Corp.	115J 074	Gold	vein/breccia	R/C drilled
Black Fox	White Gold Corp.	115O 169	Gold	vein/breccia	diamond drilled
Black Hills	White Gold Corp.	-	Gold	vein/breccia	R/C drilled
Blende	Blind Creek Resources Ltd.	106D 064	Zinc-Lead	Mississippi Valley-type	NI 43-101 defined resource
Bonanza	White Gold Corp.	-	Gold	vein/breccia	R/C drilled
Brewery Creek	Golden Predator Mining Corp.	116B 160	Gold	porphyry/sheeted vein	NI 43-101 defined resource
Byng	Strategic Metals Ltd.	105D 184	Gold	vein/breccia	grassroots - never drilled
Carcross	Prior, Glen	-	Gold	volcanic associated	grassroots - never drilled
Carlin Gold	Carlincore Resources Ltd.	-	Gold	sediment associated	grassroots - never drilled
Casino	Western Copper and Gold Corp.	115J 028	Copper	porphyry/sheeted vein	in permitting
CD	Strategic Metals Ltd.	-	Gold	-	grassroots - never drilled
Clear Creek	Kestrel Gold Inc.	-	Gold	porphyry/sheeted vein	diamond drilled
Coffee Project	Goldcorp Inc.	115J 110	Gold	vein/breccia	in permitting
Convert	Strategic Metals Ltd.	105B 143	Zinc-Lead	volcanic associated	diamond drilled
Cowley Park (Lobo)	Lobo Del Norte Ltd.	-	Copper	porphyry/sheeted vein	diamond drilled
Crag East	Strategic Metals Ltd.	106C 106	Gold	sediment associated	diamond drilled
Dabb	Strategic Metals Ltd.	105E 033	Zinc-Lead	skarn/replacement	grassroots - never drilled
Division Mountain	2560344 Ontario Inc.	115H 013	Coal	sediment associated	NI 43-101 defined resource
Dixie Creek	Blackwater Minerals Inc.	-	Gold	vein/breccia	grassroots - never drilled
Dublin Gulch (Eagle)	Victoria Gold Corp.	106D 025	Gold	porphyry/sheeted vein	mine development
Ellen	Group Ten Metals Inc.	-	Copper	volcanic associated	diamond drilled
Flame & Moth	Alexco Resource Corp.	105M 087	Silver	vein/breccia	NI 43-101 defined resource
Flume/Storck	K2 Gold Corp.	115N 110	Gold	vein/breccia	diamond drilled
Four Corners	Strategic Metals Ltd.	105G 146	Copper	volcanic associated	grassroots - never drilled
Freegold Mountain	Triumph Gold Corp.	115I 107	Gold	porphyry/sheeted vein	NI 43-101 defined resource
Fyre Lake	BMC Minerals	105G 034	Copper	volcanic associated	NI 43-101 defined resource

Appendix 1 (continued). Exploration projects 2018.

Project	Owner/Optioner	Yukon MINFILE	Commodity	Deposit type	Level of Advancement
Gold Cap	Pacific Ridge Exploration Ltd.	115O 175	Gold	vein/breccia	R/C drilled
Golden Culvert	Stratabound Minerals Corp.	105H 067	Gold	vein/breccia	diamond drilled
Golden-Oly	Strikepoint Gold Inc.	-	Gold	vein/breccia	diamond drilled
Grabben Gold	Kreft, Bernie	115O 054	Gold	vein/breccia	grassroots - never drilled
Groundhog	Strategic Metals Ltd.	105F 029	Silver	skarn/replacement	historical resource
Hartless Joe	Strategic Metals Ltd.	105D 203	Gold	vein/breccia	grassroots - never drilled
Hat	Strategic Metals Ltd.	-	Unknown	Unknown	grassroots - never drilled
Hayes	White Gold Corp.	115J 012	Gold	vein/breccia	grassroots - never drilled
Hen	White Gold Corp.	115O 168	Gold	vein/breccia	grassroots - never drilled
Hopper	Strategic Metals Ltd.	115H 019	Copper	skarn/replacement	diamond drilled
Hotspot	Goldstrike Resources Ltd.	115N 101	Gold	vein/breccia	grassroots - never drilled
Hunker	White Gold Corp.	115O 083	Gold	vein/breccia	grassroots - never drilled
Hyland Gold	Banyan Gold Corp.	095D 011	Gold	vein/breccia	NI 43-101 defined resource
Jaycee Regional	Huber, Marty	-	Tin	skarn/replacement	grassroots - never drilled
JP Ross	White Gold Corp.	115O 160	Gold	vein/breccia	diamond drilled
Justin	Aben Resources Ltd.	105H 035	Gold	porphyry/sheeted vein	diamond drilled
Kelli Claim	Gutrath, Gordon	115G 102	Gold	volcanic associated	diamond drilled
Keno	Metallic Minerals Corp.	105M 011	Silver	vein/breccia	diamond drilled
King Solomon Project	Kestrel Gold Inc.	-	Gold	vein/breccia	diamond drilled
Klondike District Property	Klondike Gold Corp.	115O 072	Gold	vein/breccia	NI 43-101 defined resource
Klondike Valley	Diamond Tooth Resources Inc.	116B 009	Gold	vein/breccia	grassroots - never drilled
Kryptos	Mieras, Jeff	-	Gold	porphyry/sheeted vein	R/C drilled
Kudz Ze Kayah	BMC Minerals	105G 117	Copper	volcanic associated	in permitting
Line	White Gold Corp.	-	Gold	vein/breccia	grassroots - never drilled
Logjam	CMC Metals Ltd.	105B 038	Silver	vein/breccia	historical resource
Lucky Strike	Lucky Strikes Resources Ltd.	115O 170	Gold	vein/breccia	diamond drilled
MAGA	Mann, Bill	-	Zinc-Lead	volcanic associated	grassroots - never drilled
Mariposa	Four Nines Gold Inc.	115O 075	Gold	vein/breccia	diamond drilled
Mars	Strategic Metals Ltd.	105E 002	Copper	porphyry/sheeted vein	diamond drilled
McKay Hill	Metallic Minerals Corp.	106D 038	Silver	vein/breccia	grassroots - never drilled
Meloy	Strategic Metals Ltd.	115G 070	Copper	porphyry/sheeted vein	grassroots - never drilled

Appendix 1 (continued). Exploration projects 2018.

Project	Owner/Optioner	Yukon MINFILE	Commodity	Deposit type	Level of Advancement
Michie Formation Ultramafics	Brodie McCrory	-	Jade	mafic/ultramafic associated	grassroots - never drilled
Midas	Kreft, Bernie	-	Gold	vein/breccia	grassroots - never drilled
Mint	Strategic Metals Ltd.	115F 087	Gold	porphyry/sheeted vein	diamond drilled
Minto	Capstone Mining Corp.	115I 021	Copper	porphyry/sheeted vein	mine in temporary closure
Monster	Go Cobalt Mining Corp.	116B 102	Industrial Minerals	Wernecke Breccia	grassroots - never drilled
Mount Anderson	Apex Resources Inc.	105D 029	Gold	vein/breccia	grassroots - never drilled
Mount Hinton	Strategic Metals Ltd.	105M 052	Gold	vein/breccia	diamond drilled
Mt. Haldane	Alianza Minerals Ltd.	105M 032	Silver	vein/breccia	diamond drilled
Nickel Shäw (Wellgreen)	Nickel Creek Platinum Corp.	115G 024	Nickel-PGE	mafic/ultramafic associated	NI 43-101 defined resource
No Name Target	StrataGold Corp.	-	Gold	sediment associated	grassroots - never drilled
North Rackla	Cantex Mine Development Corp.	106C 088	Gold	sediment associated	diamond drilled
Orion	Barrick Gold Corp.	106C 099	Gold	sediment associated	NI 43-101 defined resource
Osiris	ATAC Resources Ltd.	106C 045	Gold	sediment associated	NI 43-101 defined resource
PDM	Strikepoint Gold Inc.	105J 010	Gold	vein/breccia	grassroots - never drilled
Pedlar	White Gold Corp.	-	Gold	vein/breccia	grassroots - never drilled
Pilot	White Gold Corp.	115K 109	Gold	vein/breccia	grassroots - never drilled
Plateau	Newmont Mining Corp.	105N 036	Gold	vein/breccia	diamond drilled
Rawgeef	Bachynski, Ryan	-	Zinc-Lead	sediment associated	grassroots - never drilled
RC	Pacific Ridge Exploration Ltd.	-	Gold	porphyry/sheeted vein	grassroots - never drilled
Red Ridge	Apex Resources Inc.	105D 100	Gold	vein/breccia	grassroots - never drilled
RJ	Coe, Ryan	-	Gold	porphyry/sheeted vein	grassroots - never drilled
Roam	Shearer, Johan	-	Silver	vein/breccia	grassroots - never drilled
Rod	Strategic Metals Ltd.	106C 087	Silver	vein/breccia	diamond drilled
Rude Creek Gold	0890763 B.C. Ltd.	115J 022	Gold	porphyry/sheeted vein	grassroots - never drilled
Salloon	Strategic Metals Ltd.	105E 003	Copper	-	diamond drilled
Sawbuck	Strategic Metals Ltd.	-	Silver	skarn/replacement	grassroots - never drilled
Selwyn Project	Selwyn-Chihong	105I 037	Zinc-Lead	sediment associated	NI 43-101 defined resource
Silver Hill Area	Metallic Minerals Corp.	-	Silver	vein/breccia	grassroots - never drilled
Sixtymile	Kreft, Bernie	116C 146	Gold	porphyry/sheeted vein	grassroots - never drilled
SM	Strategic Metals Ltd.	115N 123	Gold	vein/breccia	grassroots - never drilled
Sprogge	Golden Predator Mining Corp.	105H 103	Gold	vein/breccia	diamond drilled

Appendix 1 (continued). Exploration projects 2018.

Project	Owner/Optioner	Yukon MINFILE	Commodity	Deposit type	Level of Advancement
Squalin	Heon, Daniele	-	Nickel-PGE	mafic/ultramafic associated	grassroots - never drilled
Staff	Strategic Metals Ltd.	-	Gold	porphyry/sheeted vein	grassroots - never drilled
Stew	Mann, Bill	-	Gold	vein/breccia	grassroots - never drilled
Teslin Mountain	Hulstein, Roger	-	Gold	vein/breccia	grassroots - never drilled
Tom/Jason (MacMillan Pass)	Fireweed Zinc Ltd.	105O 001	Zinc-Lead	sediment associated	NI 43-101 defined resource
Toonie	White Gold Corp.	-	Gold	vein/breccia	R/C drilled
Trail-Minto	Mayo Lake Minerals	-	Gold	porphyry/sheeted vein	grassroots - never drilled
Val-Jual	Kestrel Gold Inc.	-	Gold	Unknown	diamond drilled
Van Gogh East	Van Krichbaum, Everett	-	Gold	volcanic associated	grassroots - never drilled
Vault	Strategic Metals Ltd.	115G 027	Gold	vein/breccia	grassroots - never drilled
VIP	Generic Gold Corp.	-	Gold	Unknown	grassroots - never drilled
Wells	White Gold Corp.	-	Gold	vein/breccia	grassroots - never drilled
Wels Gold	K2 Gold Corp.	115J 039	Gold	porphyry/sheeted vein	diamond drilled
White Gold	White Gold Corp.	115O 165	Gold	vein/breccia	NI 43-101 defined resource
Yellow	White Gold Corp.	-	Gold	vein/breccia	grassroots - never drilled

Appendix 2. Drilling statistics by project, 2018.

Property	Optioner/Owner	# of drill holes	# of metres
Diamond Drilling			
3 Aces	Golden Predator Mining Corp.	35	4772
Bermingham	Alexco Resource Corp.	36	8582
Brewery Creek	Golden Predator Mining Corp.	22	828
Dublin Gulch (Eagle)	Victoria Gold Corp.	29	5395
Freegold Mountain	Triumph Gold Corp.	74	17 566
Golden Culvert	Stratabound Minerals Corp.	8	1350
Golden-Oly	Strikepoint Gold Inc.	3	682
Hyland Gold	Banyan Gold Corp.	11	1294
Kudz Ze Kayah	BMC Minerals Ltd.	22	4055
Lone Star	Klondike Gold Corp.	87	9512
Lucky Strike	Lucky Strikes Resources Ltd.	11	1360
Mount Anderson	Apex Resources Inc.	9	1400
Osiris	ATAC Resources Ltd.	16	7410
Plateau	Newmont Mining Corp.	26	7753
Sprogge	Golden Predator Mining Corp.	27	2169
Tom/Jason (MacMillan Pass)	Fireweed Zinc Ltd.	20	5497
White Gold	White Gold Corp.	46	16 176
Rotary Air Blast/Reverse Circulation			
3 Aces	Golden Predator Mining Corp.	10	392
Division Mountain	2560344 Ontario Inc.	4	125
JP Ross	White Gold Corp.	69	4764
Rude Creek Gold	0890763 B.C. Ltd.	2	197
VIP	Generic Gold Corp.	11	1090
White Gold	White Gold Corp.	14	2397

Yukon Geological Survey's Outreach Program: Bringing earth science to all Yukoners

Leyla Weston
Yukon Geological Survey

Weston, L., 2019. Yukon Geological Survey's Outreach Program: Bringing earth science to all Yukoners. *In:* Yukon Exploration and Geology Overview 2018, K.E. MacFarlane (ed.), Yukon Geological Survey, p. 53–64.

Introduction

With a staff of more than 20, Yukon Geological Survey (YGS) generates a significant amount of geoscience information annually in the form of bedrock and surficial maps, targeted geoscience studies and publications, permafrost research, community hazards maps, and more. This information can be highly complex and technical, posing a challenge when communicating this science to a non-technical audience. YGS recognizes that educating the public and providing them with some basic knowledge of Earth science is essential to meeting the environmental and resource challenges that we are facing today.

Since the inception of YGS, more than 25 years ago, outreach geology, in terms of education and awareness, has always been included in the organization's program activities. In 2011, a permanent Outreach Geologist position was created to meet the growing needs of the program, as well as provide a dedicated point-person to fulfill First Nation's engagement with respect to YGS' program activities. While the author is the lead on most outreach activities, YGS staff also participate in public lectures, interpretive hikes and other outreach activities.

This paper provides a broad overview of the types of outreach and education activities in which YGS engages.

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Classroom Visits and Core Library Tours

Yukon schools follow the British Columbia curriculum (including some Yukon-specific adaptations), which was recently redesigned. Concepts of Earth science are introduced as early as grade three, or eight years of age. YGS designs geoscience outreach and education in the classroom in a way that enhances the school curriculum by providing hands-on activities (Fig. 1). These activities will vary from the introduction to the rock cycle with rock and mineral identification, to the processes and stages of mining whereby students finish off their activity with a delicious cookie! Rock specimens that are brought into the classroom are carefully selected to always include local samples that the students are likely to come across during their outdoor adventures. Classroom visits to Yukon schools are by request and direct invitation from a teacher, and typically last one class period (approximately 50–90 minutes). Over the years, the number of teacher contacts has grown as the teachers see the value in having experts in specific fields of science visit the classroom.

Figure 1. *Leyla Weston of Yukon Geological Survey demonstrates specific rock properties with grade 4/5 students, Golden Horn Elementary School, Whitehorse.*

In recent years, teachers from Whitehorse area schools have been bringing their classes for tours of the H.S. Bostock Core Library. Included in the core library tour are a number of activities: (1) a topography lesson with the Augmented Reality (AR) Sandbox; (2) rock properties and identification; (3) introduction to core logging; (4) training on the use of lapidary slab saws (Fig. 2); and (5) an introduction to optical mineralogy and the petrographic microscope. The H.S. Bostock Core Library also houses a collection of more than 200 Yukon rock and mineral specimens that students can view. Taking the students out of the classroom and giving them access to real-life tools used by both research and exploration geologists has been highly valuable in engaging Yukon students. In 2018, the author completed 10 core library tours and 7 classroom visits.

Figure 2. *Ms. Jane Londero, grade 12 geology teacher at Vanier Catholic Secondary, teaches her student how to use a rock saw.*

Field Trips

There is no better way to teach a natural science, such as geology, than by getting outside the classroom and into the field. Whitehorse is uniquely situated adjacent to the Whitehorse Copper Belt, which includes a linear belt of more than 30 copper-skarn deposits and mineral occurrences. The old mine site, which has been reclaimed, offers a vast area where students can collect samples containing minerals such as bornite, chalcopyrite, yellow serpentine, magnetite, garnet and much more (Fig. 3). Furthermore, there are several road-accessible sites just a few kilometres from Whitehorse, where students can make field observations at outcrop exposures, which encourages critical thinking and long-term retention. Field trips help students to develop a positive attitude towards science and a greater appreciation for nature.

Figure 3. *Grade 12 geology students from Vanier Catholic Secondary collect samples of mineralized rock from the Whitehorse Copper Belt.*

YGS conducts, on average, 15–20 field trips to the Whitehorse Copper Belt annually. Field trips can be easily catered to participants of all ages. The area offers more than just interesting geology, but also a rich history that few local residents know anything about, namely that Whitehorse had an operating mine in their backyard. Exploring the Whitehorse Copper Belt not only exposes students and the public to the fascinating world of geology, but it also gives them a deeper connection to their community (Fig. 4). In 2018, the author led 15 tours through the Copper Belt, three through Miles Canyon, and one field trip that examined exposures of outcrop along the Alaska Highway in the Ibex Valley.

Figure 4. *More than 25 participants attended the Whitehorse Copper Belt evening field trip as part of Mining & Geology Week 2018.*

Events

Every year, YGS participates and/or facilitates several geological events for Yukon students and the public that showcase all aspects of earth science.

Mining week

Mining and Geology Week takes place every year during the first week of May. The Yukon Chamber of Mines, in partnership with the Government of Yukon hosts the event, which celebrates the role that mining and geology plays in our society. The week includes an evening field trip for the public (see Fig. 4) and

culminates with a one day, outdoor event—Mining & Geology Discovery Day Camp at the S.S. Klondike National Historic Site in downtown Whitehorse. Mining is the largest private industry in Yukon, and this event provides an opportunity to educate all Yukoners about what the industry brings to the territory. Participating companies, which include mining and exploration companies, environmental firms, as well as other government organizations, are set up in wall tents with geology and mining displays and activities (Fig. 5). YGS' main role during Mining & Geology Discovery Day Camp is to organize student tours; these include hands-on activities such as rock and mineral identification, mapping, and demonstrations that simulate a volcanic eruption. The event, with its central location, attracts more and more people every year. In May 2018, more than 400 students and Yukoners visited and learned about the sustainable and responsible mining and exploration industry in Yukon.

Junior Rural Experiential Model (REM)

Figure 5. *Students from a Whitehorse Elementary School enjoy gold panning at McBride Museum's exhibitor tent at Mining & Discovery Day Camp 2018. Photo courtesy of Yukon Chamber of Mines.*

The Rural Experiential Model or REM offers hands-on learning experiences to rural students of Yukon. Junior REM brings together more than 120 grade 7 and 8 students from the communities of Watson Lake, Teslin, Carcross, Haines Junction, Carmacks, Pelly Crossing, Dawson City, Mayo, Old Crow, Faro and Ross River. REM is a two-day event that is held in a different community every year; this year students gathered in Tets'elūgé' (Watson Lake). The Junior REM is a unique experiential approach that integrates traditional ways of knowing and thinking with modern-day teaching and learning. It is designed to connect students with their heritage, culture and traditions while strengthening their emotional, mental and physical well-being. This event also enables students from Yukon communities to come together and connect with their peers (Fig. 6). Students participate in six daytime sessions and register for two sessions from each of the following three main themes: Yukon Culture Sessions (e.g., beading, trapping, traditional foods, etc.); Personal Wellness Sessions (e.g., climbing, introduction to First Aid, mental wellness, etc.); and Technology/Applied Skills/Fine Arts Sessions (e.g., carpentry, mini-med school, crime lab, etc.). YGS provided a 'Rock On' session in 2018 that included both an indoor and outdoor component. Hands-on activities helped students understand how Earth's processes have shaped the land beneath their feet and created all the natural resources that they rely on in their everyday lives.

Weekend on the Rocks

Figure 6. *Students enjoy evening games at Junior REM in Watson Lake.*

The Tombstone Interpretive Centre, situated in Tombstone Territorial Park, offers a variety of programming throughout the summer that exposes visitors to the dynamic and rich ecosystem of the Park. YGS facilitates 'Weekend on the Rocks', one of several theme weekends, which takes place every year during the month of August. Weekend on the Rocks was formalized in 2012 and was an initiative that began with the late Charlie Roots, a former YGS geologist with an incredible passion for geology and the outdoors, but more importantly, he was highly dedicated to geoscience outreach and sharing his knowledge with people of all ages (Fig. 7). Charlie's initiative has proven successful and Weekend on the Rocks has seen an increase in the number of participants every year. YGS provides a weekend of activities including two evening talks and three interpretive hikes. Visitors learn about the geology, tectonic history, as well as the processes of glaciation—all that has shaped the rugged topography that we see today. This year saw a record number of participants. The evening talks were standing-room only with upwards of 60 people and despite the cool rainy weather, an average of 25 individuals participated in the interpretive hikes (Fig. 8). Special thanks goes to YGS Emeritus Geologist Don Murphy for taking time out of a busy retirement in order to give a talk and lead three guided hikes.

Figure 7. *The late Charlie Roots discusses the geology of Tombstone Park, Weekend on the Rocks, 2013.*

Figure 8. *Emeritus YGS geologist Don Murphy guides an interpretive geology hike at Weekend on the Rocks, 2018.*

Figure 9. *Jason Davison of Mining Matters, teaches mineral properties to children of Whitehorse at Family Day, Yukon Geoscience Forum & Tradeshow. Photo courtesy of Yukon Chamber of Mines.*

Yukon Geoscience Forum

This year's Yukon Geoscience Forum and Trade Show drew 700 delegates, nearly double the numbers from five years ago. This event, organized by the Yukon Chamber of Mines and jointly funded by the Government of Yukon, provides the greatest opportunity to engage students early and inform them about the benefits of the resource industry. The main outreach elements of the forum are Family Day and student tours, which both take place in the trade show area. The trade show is free and open to the public for 4 days during the forum and includes 75 exhibitors from all sectors of the industry. During Family Day, the public can learn about the mining and exploration activities that are occurring around the territory, or try their hand at gold panning with staff from the MacBride Museum. YGS is also committed to Family Day and exhibits the augmented reality (AR) sandbox, and provides hands-on geology activities with their partners at Mining Matters—a charitable organization based out of Toronto that is dedicated to bringing knowledge and awareness about Canada's geology and mineral resources to students, educators and the public (Fig. 9). This year, Family Day attracted more than 200 people of all ages.

Along with Family Day, YGS facilitates student tours in the trade show area over the last two days of the forum. Students spend the first part of their tour at the AR sandbox (Fig. 10) and Mining Matters' activities table. Here, they learn about topography and 3-D spatial thinking, as well as the specific uses of minerals in our everyday lives. For the second part of the tour, students are issued a 'Trade Show Passport' or booklet that includes questions that are prepared by eight participating exhibitors/companies. Students engage with the companies to answer the questions and in doing so, they learn about the modern technology applied to the discovery of mineral resources. Furthermore, they gain a better understanding of the global nature of the mining industry, discover the wealth of career opportunities, and learn about the industry's social responsibilities to the environment and our communities. More than 320 students from 14 schools participated in the student tours: 11 Whitehorse schools and the Del Van Gorder School (Faro), the Ghùch Tlâ Community School (Carcross), and the St. Elias Elementary School (Haines Junction).

Figure 10. *Whitehorse students learn about topography and 3-D spatial thinking with YGS' augmented reality (AR) sandbox. Photo courtesy of Cathie Archbould.*

Training

Teacher Workshop

For the past three years, YGS and Mining Matters have offered a teacher workshop following Yukon Geoscience Forum. The workshop is hosted at the YGS Core Library, where participants can tour the lapidary facilities and see some of the survey's sample collections. Teachers from Whitehorse schools participate in a 2-hour workshop that is designed to give educators tools to develop their students' knowledge of Earth science, Canada's minerals industry and the diverse job opportunities available. Upon completion of the workshop, attendees have access to a 'teacher resource kit' that contains dozens of lesson plans, information bulletins, learning activities, rock and mineral samples, equipment, career information and additional resources (Fig. 11). YGS enhances the kit by providing access to hundreds of Yukon rock and mineral samples.

Figure 11. *Allison Cunningham of Golden Horn Elementary, and Sharon Nehring-Willson of Jack Hulland Elementary try their hands at geotechnical engineering at a teacher workshop hosted by YGS and Mining Matters.*

Parks and Museum Interpretive Staff

Another component of outreach that YGS offers is training to parks and museum interpretive staff by providing expertise in both bedrock and surficial geology of Yukon. Every spring, YGS surficial geologists participate in annual training for Beringia Centre interpretive staff. This includes presentations on current research pertaining to the Pleistocene geology of Yukon. Yukon Conservation Society also calls upon YGS to train their summer staff on the geological history of Miles Canyon in preparation for their summer programming of free guided hikes and "Kids' Ed-Ventures" in the canyon.

Kluane National Park in southwestern Yukon receives hundreds of visitors annually due to its spectacular mountains, wildlife and glacier systems. This year, three YGS staff (Panya Lipovsky, Rosie Cobbett and Leyla Weston) spent a day in Kluane National Park with 12 interpretive staff discussing the geologic history of the area; special emphasis was made on the tectonic evolution and structural geology of the Park, and the recent diversion of the Slims River (Fig. 12). Since the May 2016 piracy of the Slims River by the Alsek River, there has been an increased interest on the future impacts to the local ecosystem and Kluane Lake by First Nations and other residents of the area.

Figure 12. *Panya Lipovsky of YGS explains the glacial history of the Kluane area to interpretive staff of Kluane National Park. View is to the southeast looking upstream on Vulcan Creek, southwestern Yukon.*

Public Talks

During the winter months, when Yukon Geological Survey staff aren't busy with interpreting data, compiling their maps and writing papers, they may be giving public lectures and talks. YGS is actively involved with the Yukon Science Institute public lecture series, which is an excellent platform to inform the public on the most current scientific research in the territory. Yukon is geologically highly complex and richly dynamic as was shown by the reversal of the Slims River in May 2016, and the May 1, 2017 earthquake that jolted Whitehorse residents from their sleep. Geological events such as these have a direct and measurable impact on lives of Yukoners, whether it be damage to private property through an earthquake or loss of habitat for fish stocks due to a drop in lake level. As such, it is important to keep the public informed and provide accurate scientific data on current events. Last winter, two YGS staff gave public lectures as part of the Yukon Science Institute talk series. Panya Lipovsky spoke about the rapid landscape changes that are being observed in the St. Elias Mountains since the last glaciation, and Maurice Colpron presented on the basic concepts of plate tectonics, the geology of the Northern Cordilleran mountain range, and the factors leading to seismic hazards in northwestern North America.

Along with outreach, YGS staff are always available for 'in-reach' services, or providing their geoscience expertise to other Government of Yukon branches. Last winter, Leyla Weston of YGS was invited to speak in Dawson City at a Community Open House facilitated by Community Services (Fig. 13). The City of Dawson recently partnered with Yukon government to replace old sewer and water mains which required a large-scale communications effort. When the original infrastructure was installed decades ago, the trenches were back-filled with rock that contained naturally occurring asbestos. In her talk, Weston focused on the local geology of Dawson City, where one might expect to find naturally occurring asbestos, and the health risks associated with exposure to asbestiform minerals. Weston assured residents of Dawson that the concentration of asbestiform minerals in the rock is known to be very low (<1%), furthermore, if the rock or contaminated soil is not disturbed, it poses no health risk.

Figure 13. *Leyla Weston of YGS describes to residents of Dawson City the diagnostic characteristics of serpentine and how to identify asbestiform minerals.*

First Nations Engagement

Yukon Geological Survey is committed to engaging with Yukon First Nations with respect to our program activities. In order to build trusting and meaningful relationships with Yukon's First Nation governments, YGS is striving to increase communication and seek input from First Nations (FN) early on in the planning stages of projects. Routine engagement includes spring notification letters to all affected FNs with respect to our program activities, meetings with Lands and Resources staff of the FN governments, and fall follow-up letters detailing summer work. Additionally, when YGS hosts industry events in a community, e.g., Carmacks Rocks, an afternoon of geoscience education and outreach is always provided (Fig. 14).

This year, YGS is taking on a new initiative to be more proactive at informing FN citizens at the community level. YGS proposes to undertake a series of community-based workshops in order to raise the awareness of the importance of geoscience research, as well as enhance YGS' visibility and the support that we can offer to communities. For the next year, YGS will focus on eight FN communities—four that are most likely to be impacted by mineral exploration and development

Figure 14. *Scott Casselman of YGS demonstrates copper plating to children of Carmacks at a community open house as part of Carmacks Rocks.*

over the next 5 to 10 years, and four communities that are most prospective for geothermal development. To date, YGS has met with representatives from four out of the eight FN governments; YGS plans to complete two community workshops before fiscal year-end or March 2019.

Publications

Yukon Geological Survey produces dozens of publications annually in the form of maps, internal reports and external scientific journals—all of which are highly technical. In recent years, it has become apparent that there is a need to provide simplified and relevant geoscience brochures that are designed for public consumption. YGS has started an Educational Series of brochures that is intended to target those areas of Earth science that are least understood or perhaps even misunderstood by Yukoners. One topic in particular involves the many uses of geological maps, in other words, they are not simply treasure maps to hidden mineral deposits. In May of 2018, YGS published "Geology Matters" (http://data.geology.gov.yk.ca/Reference/DownloadProduct/53085), a brochure that explains the benefits of having geoscience knowledge and more importantly, why we should care about geology (Fig. 15a). Another educational series brochure that was recently published titled "Geothermal Energy Yukon" (http://data.geology.gov.yk.ca/Reference/DownloadProduct/53086) defines the basic concepts of geothermal energy and presents those areas in Yukon that are believed to have geothermal potential (Fig. 15b). YGS is planning a third brochure in the new year that will describe permafrost in Yukon and potential hazards related to thawing permafrost.

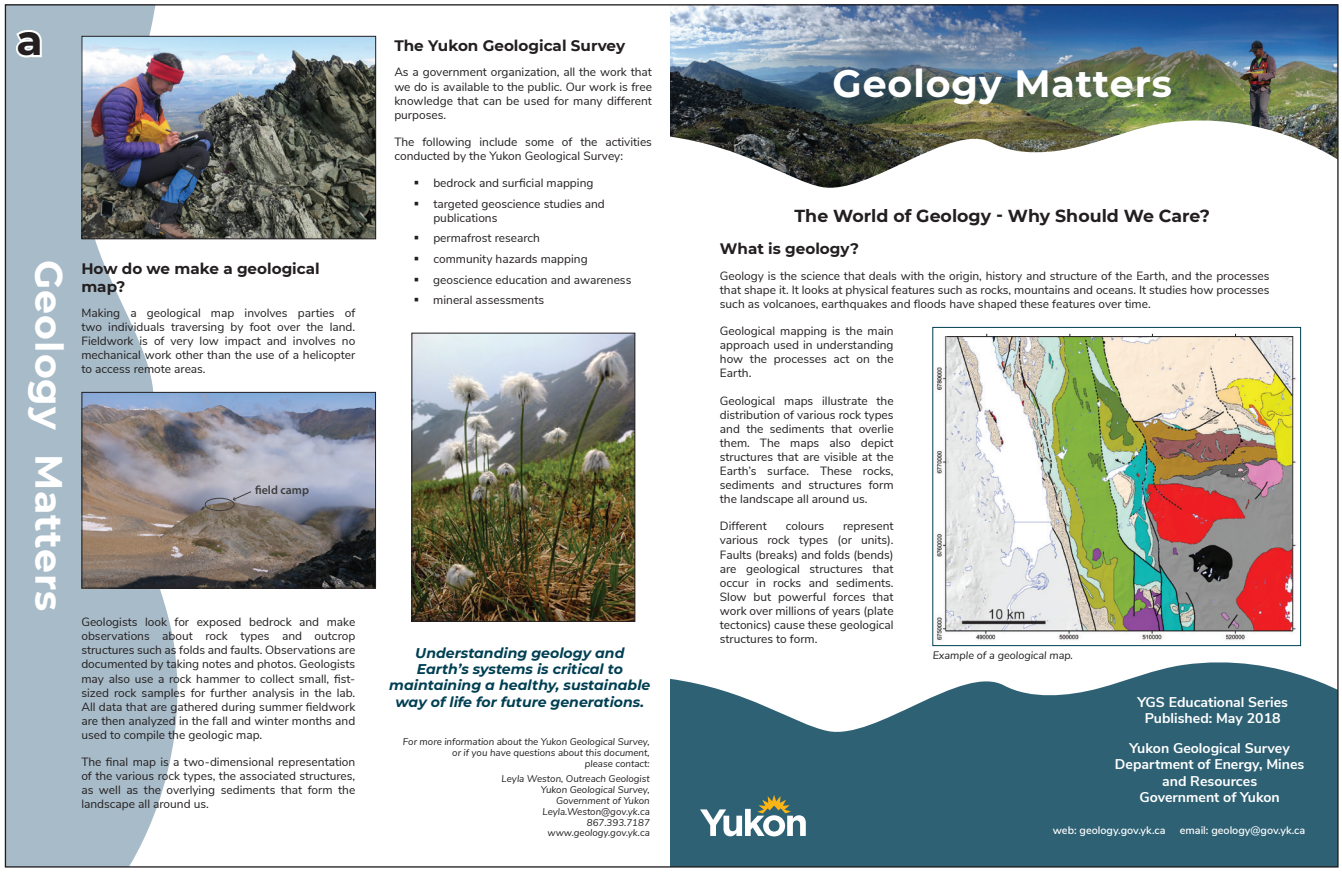

Figure 15. *Yukon Geological Survey builds on their Educational Series of publications in order to inform Yukoners on* **(a)** *the importance of geoscience knowledge and* **(b)** *present the geothermal energy potential in Yukon.*

Conclusion

As humans, we rely on natural resources in our everyday lives from recreation, to agriculture, manufacturing and building. Having geoscience knowledge is critical to maintaining a healthy, sustainable way of life for future generations. The Yukon Geological Survey is committed to continuing its outreach and providing all Yukoners and Yukon First Nations accurate geological information that will help our communities move toward greater sustainability.

Robert E. Leckie Awards

Kathy Sutherland
Mining Lands, Energy, Mines and Resources

Sutherland, K., 2019. Robert E. Leckie Awards. *In:* Yukon Exploration and Geology Overview 2018, K.E. MacFarlane (ed.), Yukon Geological Survey p. 65–68.

Excellence in Environmental Stewardship in Quartz Mining: Selwyn Chihong Mining Ltd.

The Selwyn Project, owned and operated by Selwyn Chihong Mining Ltd. (SCML) is host to one of the largest undeveloped zinc/lead deposits in the world. The project straddles the Yukon and Northwest Territories border, approximately 350 km northeast of Whitehorse. Remediation work began in 2016 and has focused on drill pads, trails and waste accumulating on the site since the 1980s; approximately 438 800 m^2 has been seeded since 2016. The efforts to recontour and establish vegetation on disturbed areas has proven to be successful, and the regrowth is almost indistinguishable from the natural surroundings. A significant amount of waste has been removed from the site including several barrels that were buried by a previous company operating in the same area. Soil testing was completed to ensure the soil was not contaminated from the historic barrels.

The company developed and implemented “An Elder in Camp” initiative to assist and advise the company in achieving a full culturally integrated work place. A student/worker shadow program was also established to allow students to get a firsthand experience for the various positions.

This dedication to site reclamation exceeds expectations and demonstrates exemplary environmental stewardship, benefitting the environment and setting an example for others to follow.

View of trails two years after seeding.

Excellence in Environmental Stewardship in Placer Mining: Simon and Lil Hambrook

Simon and Lil Hambrook have been mining on Black Hills Creek, a tributary of the Stewart River, since 2009. Progressive reclamation began early in the mining program, resulting in quick revegetation. Most land based reclamation and the final diversion channel construction was done in the fall of 2017 and summer of 2018. Mined areas were contoured flat or into low relief hills and covered with overburden. Trees were left to act as seed sources for future revegetation.

The creek channel was rip-rapped for added stability on bends in the creek and overburden was bulldozed right up to the Black Hills Creek diversion. These activities were proven beneficial by the results of previous progressive reclamation downstream.

The reclamation work that was completed is of high quality and demonstrates outstanding environmental stewardship and reclamation standards.

Looking downstream at a part of restored Black Hills creek channel.

Responsible and Innovative Exploration and Mining Practices: Dominion Gold Resources Ltd.

Dominion Gold Resources Ltd.'s placer mine is one of the largest placer mining properties in Yukon. They acquired the property in 2013 and began the renovation process in 2014; it had been left to the elements for eight years prior and was neglected and rundown. The mine is located 55 km from Dawson City.

Camp structures were repaired and rebuilt, including houses, support buildings, workshops and facilities. Oil burning furnaces and hot water tanks were converted to propane, and equipment was modernized.

The company invested in an environmentally friendly conveying system designed and built to move dirt more efficiently and cost-effectively, and an experimental prototype ore crushing machine to increase productivity. They are currently building a state of the art water treatment plant for drinking water at the camp. They also have advanced medical equipment on site, including an ambulance and certified paramedic. Both the vehicle and paramedic are volunteered to nearby camps.

Since 2013 the property has been rehabilitated and has become a shining example on Dominion Creek.

View of the renovated camp.

Yukon Exploration and Geology 2018 abstracts

The following abstracts are from the Yukon Exploration and Geology 2018 volume. Full versions of the individual papers are available from the Yukon Geological Survey website, www.geology.gov.yk.ca.

Analyses of regional wetland distribution using predictive ecosystem mapping data sets for west-central Yukon and east-central Alaska

J.D. Bond

Predictive ecosystem mapping (PEM) in west-central Yukon and east-central Alaska effectively defines the location of larger, contiguous wetlands; however, it does not provide an accurate estimate of area. A quality control comparison between detailed mapping in the Indian River drainage and a regional PEM data set indicates that wetland area is underestimated by approximately two thirds within the PEM data set. Despite this, the PEM is useful at locating areas of wetland abundance from a regional perspective. Within the Tr'ondëk Hwëch'in traditional territory, the Ogilvie Mountains and Tintina Trench contain the largest concentrations of wetlands, whereas the Klondike Plateau has approximately 50% less wetland density due to topographic characteristics. When analyzing wetland distribution for the Klondike Plateau ecoregion that spans the border between Yukon and Alaska, the largest wetlands are located distal to the Yukon River in valleys that have not been affected by Pleistocene base level change. Overall average wetland coverage, for all study areas, is estimated to be upwards of 10% of the landscape. Their abundance is attributed to a combination of suitable terrain, Pleistocene aeolian sedimentation, periglacial processes and a climate supporting extensive discontinuous permafrost. Understanding regional wetland distribution through PEM can help frame significance when considering land management decisions that weight the placer mining economy and environment.

Preliminary observations of the Bouvette Formation at Nadaleen Mountain, Yukon (NTS 106C/2,3)

J.F. Busch, J.V. Strauss, M.H. Saylor, T.J. Allen, K. Faehnrich and J.F. Taylor

The Cambrian–Devonian Bouvette Formation outcrops over large parts of central Yukon. Despite its broad lateral and temporal extent, relatively little is known about its age range, facies distribution, depositional history, and significance for early Paleozoic paleogeographic reconstructions of northwestern Laurentia. At Nadaleen Mountain (NTS 106C/2, 3) in east-central Yukon, the Bouvette Formation is remarkably well exposed and provides new insight into the transition between the southeastern Ogilvie platform and northern Selwyn basin. Here, we present preliminary field data collected from this region during 2017 and 2018, including measured stratigraphic sections, biostratigraphy, and detailed imagery acquired from Unmanned Aerial Vehicles (UAVs), in order to test the hypothesis that the Bouvette Formation locally preserves a platform margin reef and forereef succession. These observations not only provide an important new contribution to Yukon's early Paleozoic depositional history, but also identify an exceptional location to study carbonate platform–margin depositional environments.

Preliminary observations on the geology of the northeastern Glenlyon area (parts of NTS 105L/10, 14, 15), central Yukon

R. Cobbett

Regional bedrock mapping has revised structural and stratigraphic relationships in the northeast corner of the Glenlyon map sheet (NTS 105L). Three structural panels that, separated by south and southwest dipping thrust faults, subdivide the area. Cambrian(?) to Ordovician metasedimentary and volcanic rocks underlie the southwest panel and include all exposures southwest of the Duo fault. Ordovician to Silurian(?) siliciclastic and carbonate strata and phyllite units that are intruded by Late Devonian porphyritic rocks underlie the central panel. Silurian(?) to Triassic siliciclastic and carbonate strata in the northern panel occur to the north, and in the footwall of, the Twopete fault. Mid-Cretaceous granitic rocks that crop out near Kalzas Mountain and occur below the surface near Dromedary Mountain intrude the central and northern panels. Northeast-verging folds and thrust faults deform layered rocks in the northeastern Glenlyon area and are offset by by north-south oriented, steeply dipping structures with both normal and strike-slip motion.

Upper Devonian Earn Group strata host layered sulphide bodies and polymetallic veins that contain lead, zinc, and silver. This mineralization occurs in the footwall of the Twopete fault, a regional structure that originally developed as a Late Devonian synsedimentary fault.

Ordovician and Silurian (?) quartz-rich clastic rocks are unlike coeval basinal facies rocks mapped elsewhere within the Selwyn basin in Yukon. These rocks represent slope facies deposits that mark a transition from basin to platform that is the northern extension of the McEvoy platform–Selwyn basin boundary.

Constraints on the evolution of placer gold at Gladstone Creek, Yukon (NTS 115G/7, 8)

D. Cronmiller, B.C. Ward, J.D. Bond and D. Layton-Matthews

Gladstone Creek has been glaciated at least three times and hosts a productive placer mine. Glaciations eroded bedrock and reworked surficial materials, depositing thick sequences of sediment in Gladstone valley which were subsequently fluvially incised during deglaciation and non-glacial intervals. Fluvial incision and reworking concentrated detrital gold in coarse gravels, commonly overlying bedrock and false-bedrock surfaces. Identifying false-bedrock units in stratigraphy may help placer miners target economical gold deposits perched above the valley bottom.

Gold grain samples were collected from four gravel units on Gladstone Creek. Characterization of gold grain morphology and laser ablation ICP-MS analysis indicates multiple sources of lode mineralization. Based on regional ice flow directions and the stratigraphic and geographic locations of the gold samples, gold is likely sourced from epithermal and gold-rich porphyry deposits associated with the Ruby Range batholith, and orogenic mineralization in the Kluane schist.

Evaluating geothermal potential in Yukon through temperature gradient drilling

T. Fraser, M. Colpron and C. Relf

As part of the Canadian government's commitment to establishing clean energy in the North, the Yukon Geological Survey is collecting subsurface temperature data near communities in the southern part of the territory. The research is a collaborative effort among federal and territorial geoscientists, universities, First Nation governments, and geothermal consultants. A major goal of the project is to determine whether ground temperatures warrant further geothermal exploration in the territory. The study also presents an opportunity for Yukon Geological Survey to educate the public about geothermal energy. This paper summarizes the methods and results of the drilling of two ~500 m geothermal temperature gradient wells. The first was drilled in the fall of 2017 in the Whitehorse area, near Takhini Hot Springs, where a surface water seep measures 46°C. A second well was drilled in winter 2018 in the Tintina fault system, near Ross River. Results to date suggest warm fluids and possible permeable rocks in the Takhini well between 450 and 500 m from surface, and a higher than average geothermal gradient of ~31°C/km in the Tintina trench near Ross River. The results do not indicate temperatures for power generation at economic depths, however, they are encouraging enough to warrant further geothermal studies in southern Yukon.

Geochemistry of Devono–Mississippian volcanic and intrusive rocks of the Finlayson Lake district, Yukon-Tanana terrane, Yukon

M.J. Manor and S.J. Piercey

The Finlayson Lake district in southeastern Yukon is a remnant of a Late Paleozoic arc–back-arc system that consists of metamorphosed volcanic, plutonic, and sedimentary rocks of the Yukon-Tanana and Slide Mountain terranes. These rocks host more than 40 Mt of polymetallic resources in numerous occurrences and styles of volcanogenic massive sulphide (VMS) mineralization. Geochemical data from these rocks support previous interpretations that volcanism and plutonism occurred in arc–marginal arc (e.g., Fire Lake formation) and continental back-arc basin environments (e.g., Kudz Ze Kayah formation, Wind Lake formation, and Wolverine Lake group) where felsic magmatism formed from varying mixtures of crust and mantle-derived material. The rocks have elevated high field strength element (HFSE) and rare earth element (REE) concentrations in VMS-proximal stratigraphy relative to VMS-barren assemblages, suggesting that the petrogenetic conditions that generated felsic rocks likely played a role in the localization of VMS mineralization. Future work aims to constrain magmatic processes and outline prospectivity criteria for delineating productive VMS assemblages within the district, and in similar geodynamic settings globally.

Analyzing historic drilling data to investigate gold distribution on lower Hunker Creek and Klondike River

S. van Loon

The Yukon Consolidated Gold Corporation (YCGC) tested, mined, and documented placer gold resources in the Dawson region from 1923 to 1965. The company was established to acquire the holdings of other dredging operations and smaller companies in the Klondike, and during the time it was active in Yukon, YCGC produced a robust collection of maps and textual documents including drilling results, dredge reserves, thawing and stripping layouts, and dredging limits.

This paper uses historic YCGC data to summarize gold distribution characteristics in Hunker Creek and builds upon previously published summaries of YCGC data. Attributes of 1005 YCGC drillholes and shafts along lower Hunker Creek and a short section of the Klondike River were digitized, compiled, and analyzed in a Geographical Information System (GIS). A raster analysis of the digitized data allows for interpretation and examination of surficial material thicknesses and gold distribution in the project area and identifies potential prospects for further exploration.

Stratigraphy of the Faro Peak formation, central Yukon: New field observations of Jurassic synorogenic sedimentation along the Yukon-Tanana–Slide Mountain terrane boundary

A.C. Wiest and L.P. Beranek

The Faro Peak formation is a Lower Jurassic(?) unit assigned to the Yukon-Tanana terrane in the southern Tay River map area (NTS 105K). A two-year project was initiated in 2018 to investigate the Faro Peak formation and constrain its stratigraphy, age, and significance to Cordilleran tectonic evolution. The exposed base of the Faro Peak formation includes argillite and organized to disorganized sandstone units that crop out southwest of the Yukon-Tanana–Slide Mountain terrane boundary near Faro. Lower Faro Peak formation units have mafic-intermediate volcanic provenance and were deposited by concentrated density flows or turbidity currents. The upper Faro Peak formation contains massive, disorganized conglomerate and sandstone units that were sourced from the Yukon-Tanana and Slide Mountain terranes and deposited by non-turbulent debris or density flows. The Faro Peak formation is likely the remnant of a synorogenic basin that formed as a result of Intermontane belt exhumation in central Yukon.

YGS list of publications and maps for 2018

YGS released 25 publications in 2018: 3 Annual Reports, 20 Open Files, 1 Brochure and 1 Educational Series pamphlet.

Open Files

Bordet, E., 2018. Bedrock geology map of the Teslin Mountain and East Lake Laberge areas, parts of NTS 105E/2, 3, 6. Yukon Geological Survey, **Open File 2018-1**, 2 sheets, scale 1:50 000.

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