

# Summary of Yukon Geological Survey 2018–19 activities

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Relf, C., 2019. Summary of Yukon Geological Survey 2018–19 activities. *In: Yukon Exploration and Geology Overview 2018*, K.E. MacFarlane (ed.), Yukon Geological Survey, p. 1–16.

## 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](mailto: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<sup>1</sup> 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

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<sup>1</sup> 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).

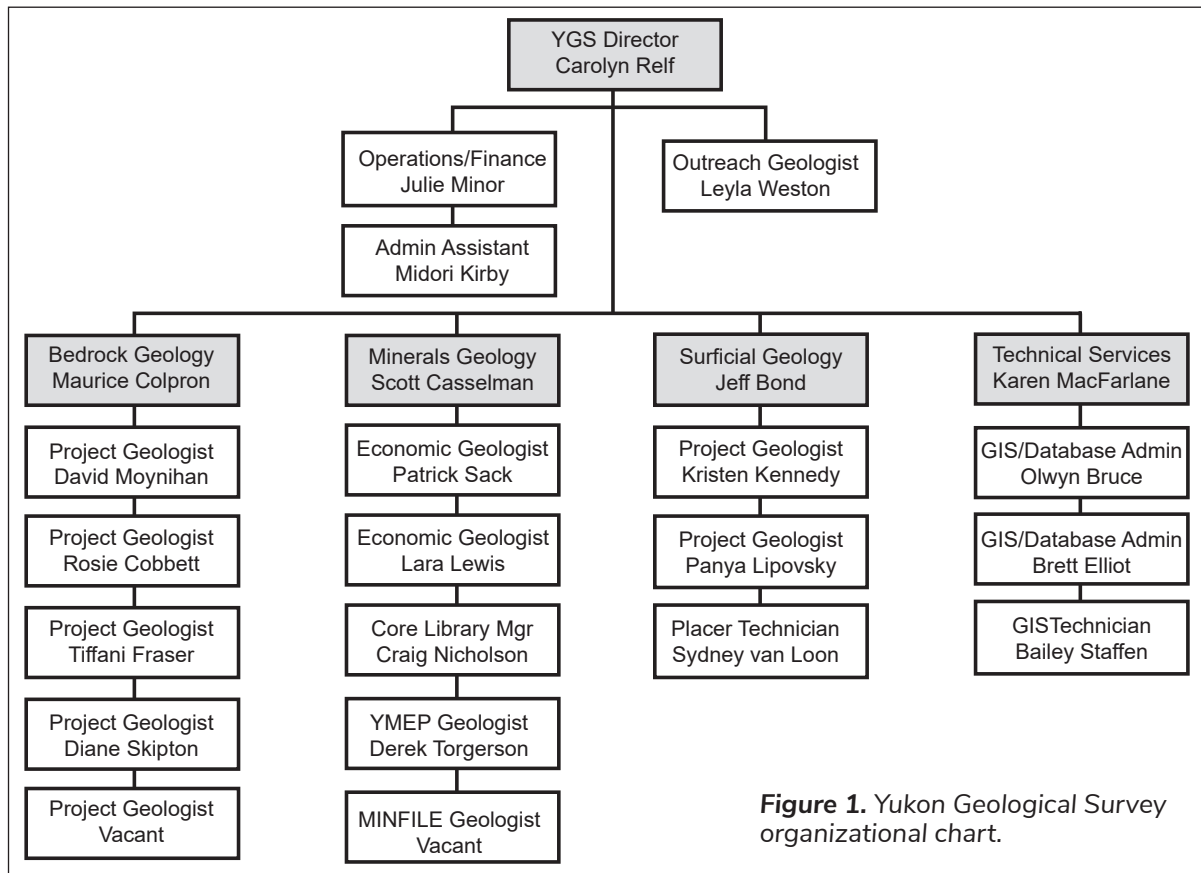


Figure 1. Yukon Geological Survey organizational chart.

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

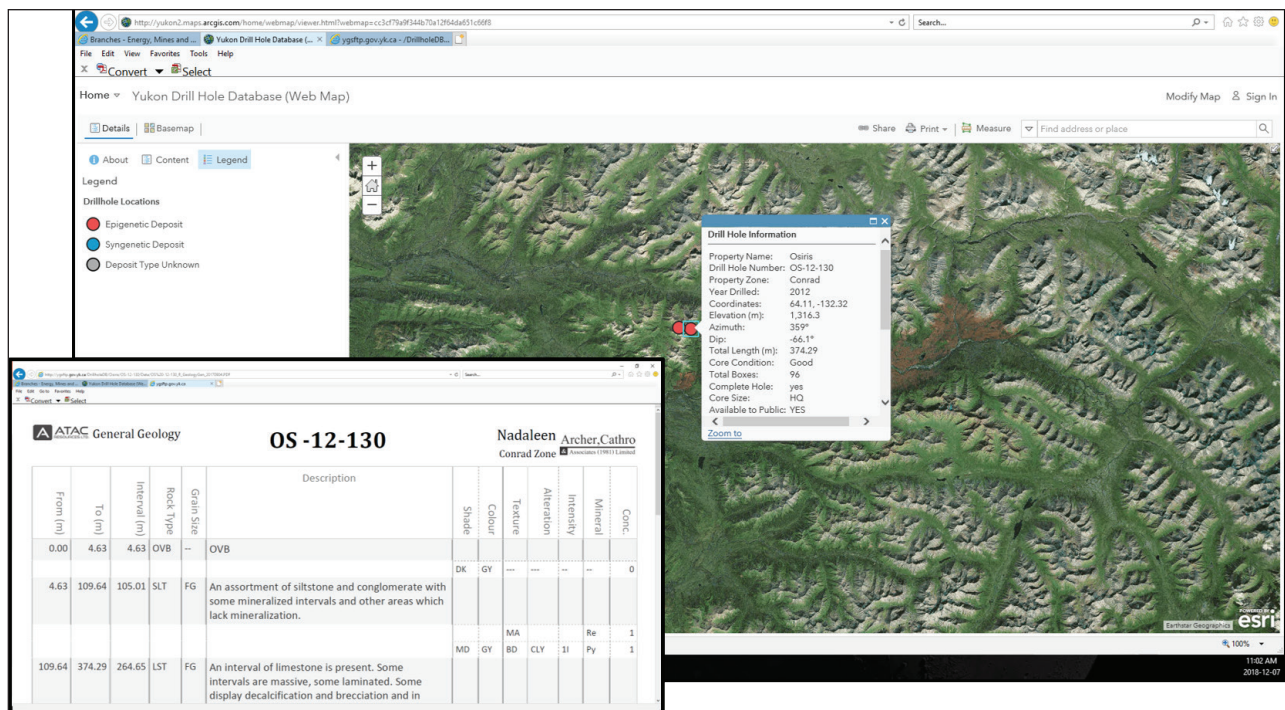


Figure 2. Screen grab of Drill Core web map application. Users can view core in YGS’ collection and query the database for information on the core, including logs and assays where available.

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,  $^{40}\text{Ar}/^{39}\text{Ar}$ , 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](http://www.geology.gov.yk.ca/core_library.html)).

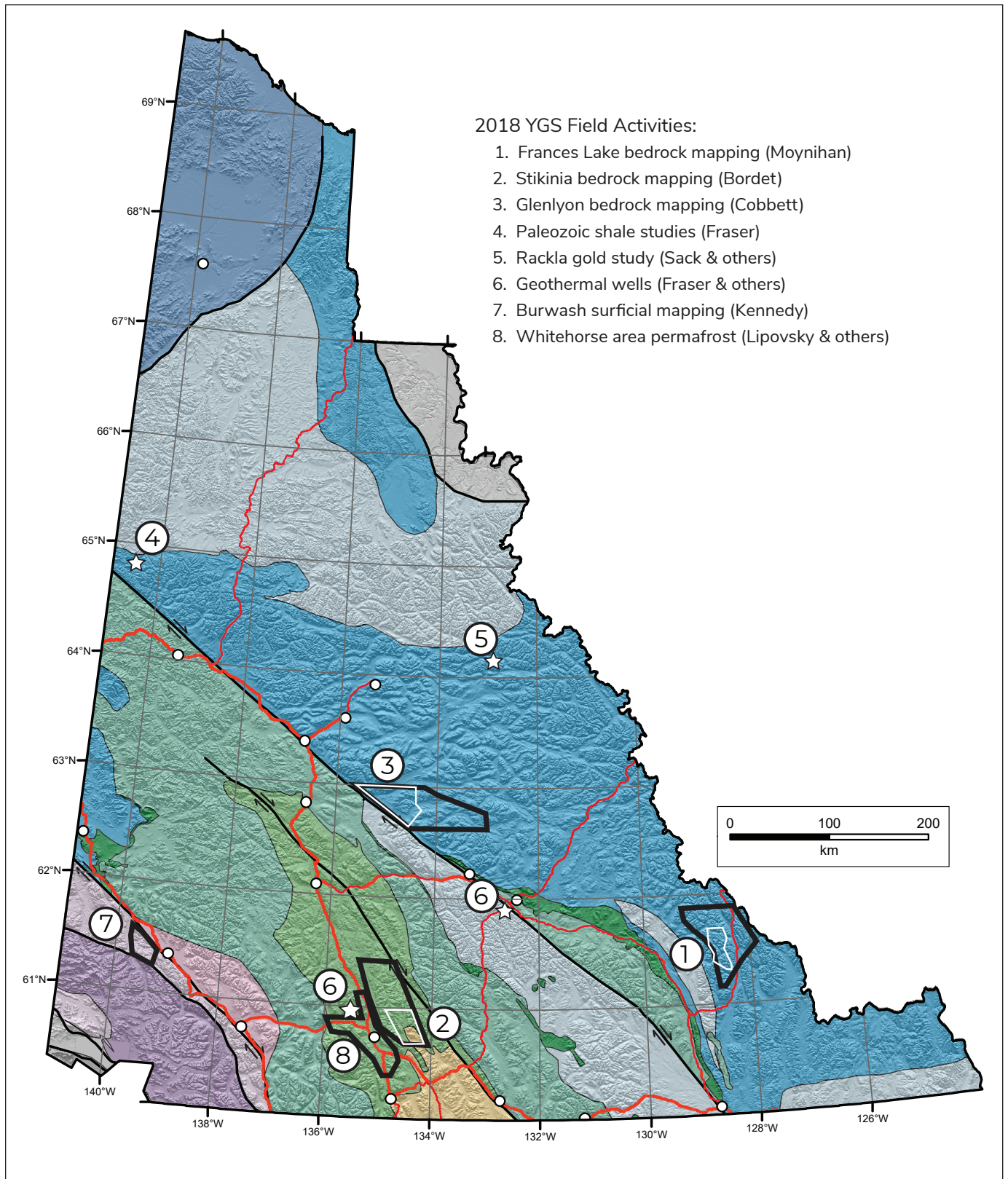
## Social Media

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.



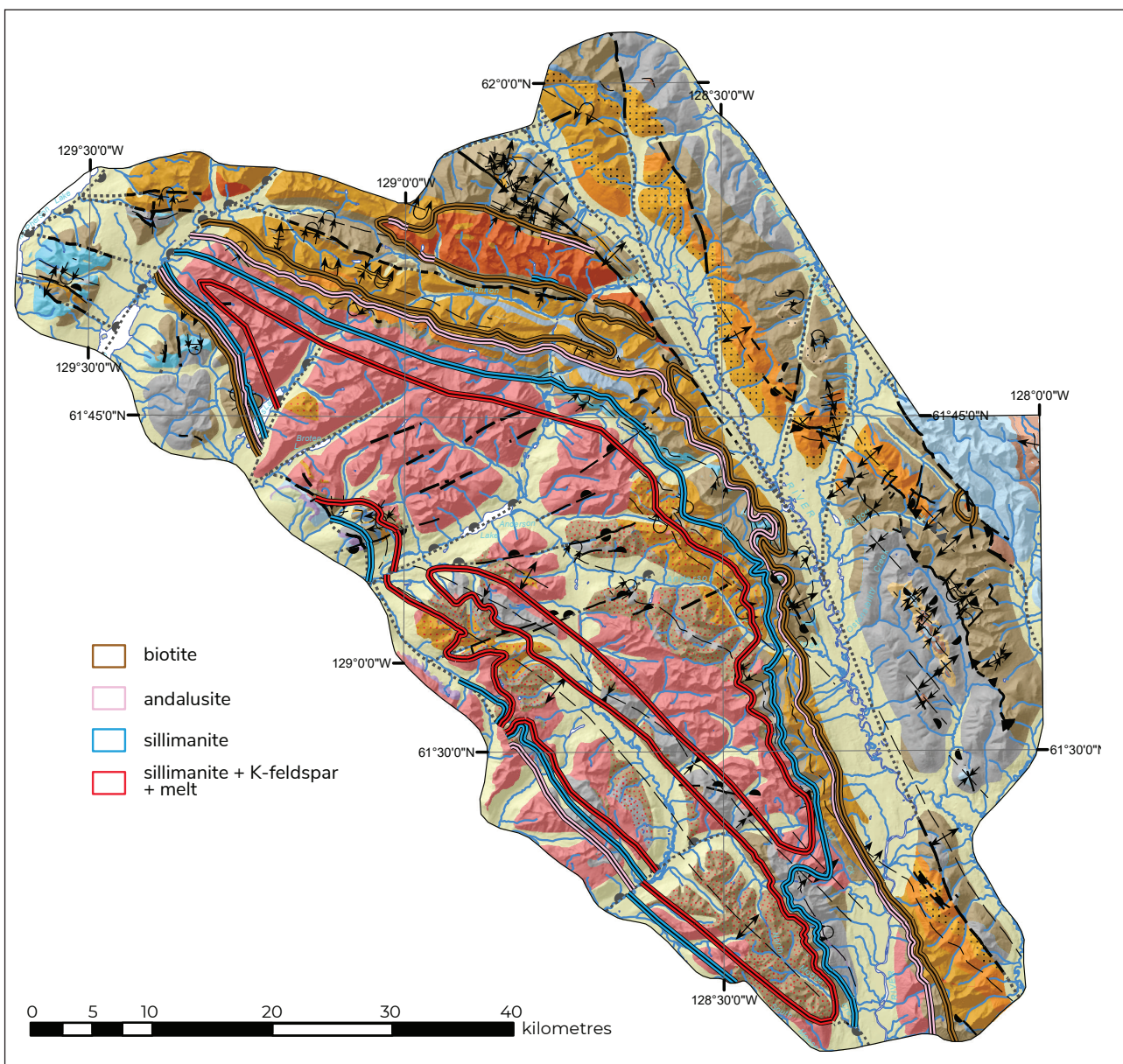
**Figure 3.** Locations of 2018 field projects. Bedrock mapping projects (1–3) include areas mapped in 2018 (white outline) as well as full project areas (black outline).

### 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.



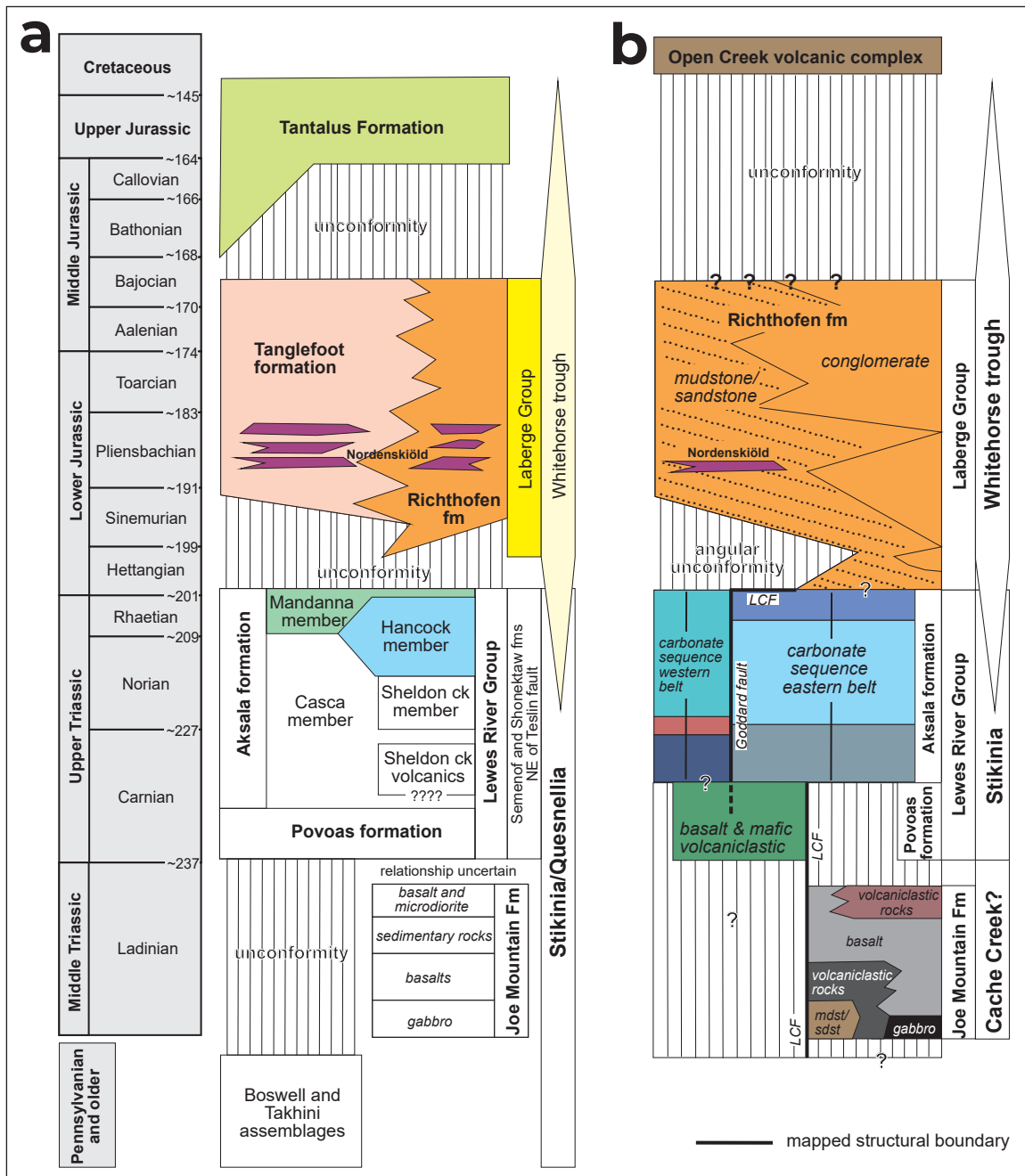
**Figure 4.** Simplified geology map of the Frances Lake map area, showing distribution of isograds. Highest grade rocks are centred on the Cretaceous batholith (pink unit) exposed in the core of a regional antiform.

**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. Lithochemical 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 lithochemical,  $\delta^{13}\text{C}$  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.

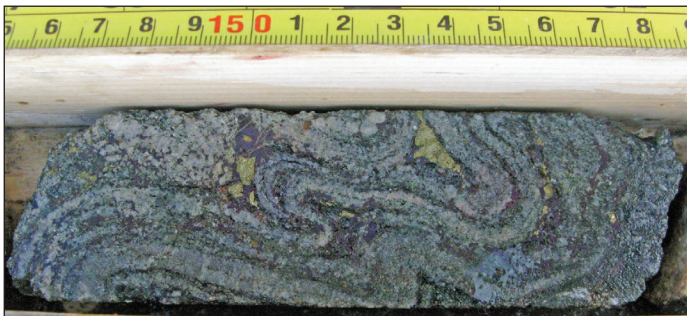
Over the winter, Sack will continue the collaborative work he began in 2017 with Emerita Professor Jean Cline from the University of Nevada in Las Vegas. Analytical work will include imaging of gold-bearing

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 ( $\leq 10$  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 migmatized 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.

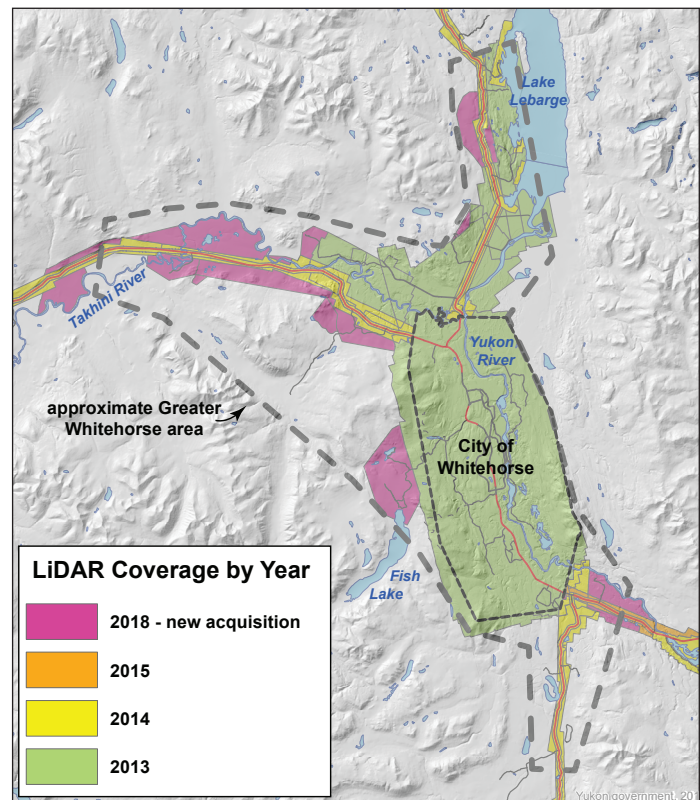
Kennedy presented highlights of the three year project at the Yukon Geoscience Forum in November. An Open File report and new surficial geology map are in production and will be released in 2019.

#### ***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<sup>2</sup> 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](mailto: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](mailto:carolyn.relf@gov.yk.ca)).

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