

# Summary of Yukon Geological Survey 2017-18 Activities

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## INTRODUCTION

The mandate of the Yukon Geological Survey (YGS) is to provide the geoscience information required to support resource and land management decisions for the benefit of Yukoners. The projects delivered each year by the survey help to increase our understanding of Yukon's geologic framework (in particular its mineral endowment) and to identify geohazards which could impact buildings and infrastructure. This information is disseminated in a variety of formats, including maps, reports, raw data, public lectures and school visits, in order to meet the different needs of YGS clients.

In 2017, YGS staff undertook or supported nineteen field-based projects and six graduate student thesis studies, and worked on five data mining/information management projects. Sixty-six YGS publications and five papers in refereed journals were released. This paper provides an overview of 2017 project highlights; more detailed reports on many of these projects are presented in the accompanying 2017 Yukon Exploration and Geology volume; other projects will be summarized in stand-alone publications.

YGS tracked 2017 hard rock and placer exploration and mining activities and provided support to industry clients through the provision of data, advice and access to YGS' drill core collection. Highlights of hard rock exploration and placer operations are reported on separately (see Lewis and Casselman, 2018 and Bond and van Loon, 2018, respectively). YGS administered fifty-nine grants totaling \$1.6M under the Yukon Mineral Exploration Program (YMEP) in 2017. An overview of YMEP projects is presented in Torgerson (2018).

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## YUKON GEOLOGICAL SURVEY PROGRAM FUNDING

Yukon Geological Survey’s budget for fiscal year 2017-18 totals \$4 027 724. This includes \$1 265 000 in core O&M funding, \$1 600 000 for the Yukon Mineral Exploration Program, \$1 100 000 from the Canadian Northern Economic Development Agency’s (CanNor’s) Strategic Investments in Northern Economic Development (SINED) Program, and \$62 724 from Indigenous and Northern Affairs Canada’s Climate Change Preparedness in the North Program.

YMEP funds are allocated entirely to support early-stage hard rock and placer exploration activities and the Climate Change funding is committed to a project that will be delivered in collaboration with Yukon College (the funds are being transferred to the college to support permafrost research in the greater Whitehorse area). SINED and YGS’ O&M funds have varying degrees of discretion with respect to how they are spent: 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 are applied to projects that have potential to stimulate exploration investment and/or support

infrastructure development decisions. In the following sections, the activities described are funded by YGS’ core O&M budget unless otherwise indicated.

The allocation of funds is influenced by client input (including the advice provided each year by YGS’ Technical Liaison Committee), opportunities to leverage partnered funding through collaborations (e.g., with universities or the Geological Survey of Canada), and the strategic priorities of the Department of Energy, Mines and Resources.

## YUKON GEOLOGICAL SURVEY ORGANIZATIONAL OVERVIEW

Yukon Geological Survey’s organization chart is shown in Figure 1. The chart reflects a few staff changes since last year. In April, Sydney van Loon was hired on a two-year term as a Placer Geology Technician. She enhances the Surficial Geology unit’s capacity to visit placer operations and track placer exploration and production statistics.

Following ten month’s education leave to earn a teaching degree, Outreach Geologist Sarah Laxton tendered her resignation in July to pursue a career in teaching. Leyla Weston was hired as YGS’ new Outreach Geologist in December.

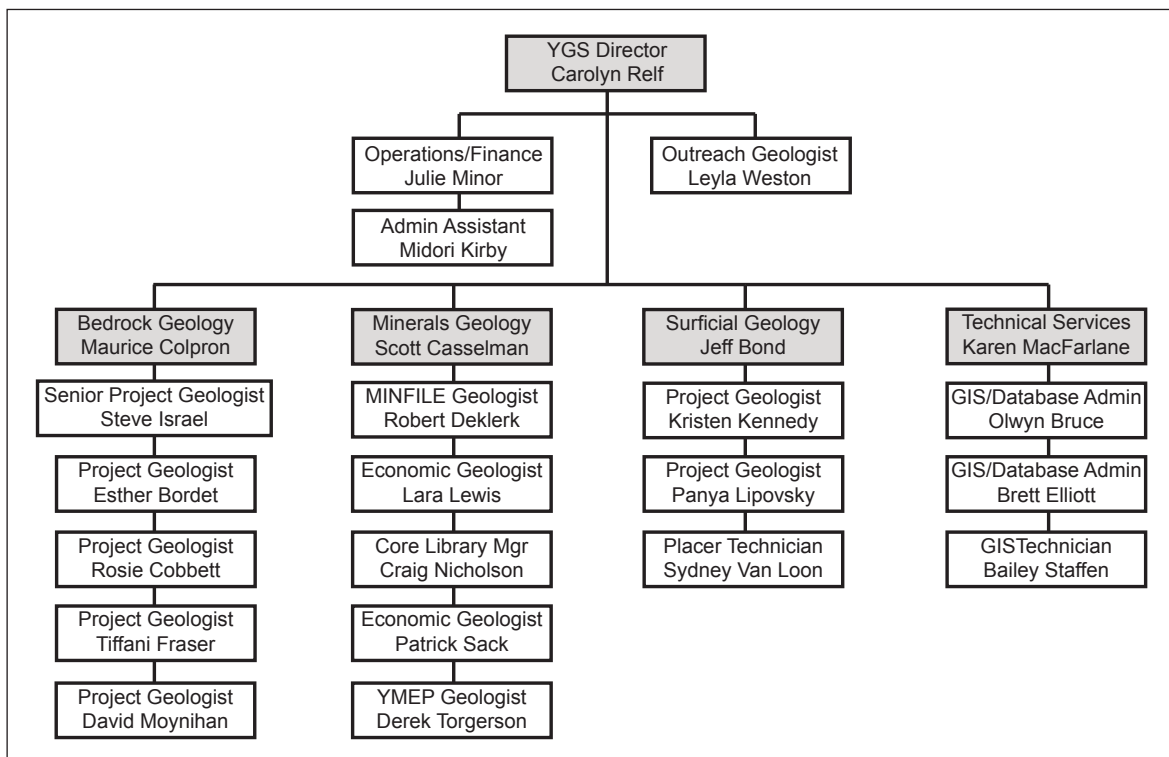


Figure 1. Yukon Geological Survey organizational chart.

Bailey Staffen started a year's maternity leave in August, and in November, Rosie Cobbett returned from maternity leave, suggesting that perhaps the law of conservation of energy has a maternity-leave counterpart.

The survey would like to thank Sarah for the contributions she made to YGS' outreach program during her five years with the survey, and wish her luck in her new career. I would also like to take this opportunity to say welcome to Sydney and Leyla, welcome back to Rosie, and congratulations to Bailey on the birth of her daughter.

## INFORMATION SERVICES

The impacts of YGS' investments in geoscience knowledge are only realized if the data are made publicly available, and therefore a significant effort is made each year to disseminate the information YGS collects. In 2017, sixty-six publications were released (see the appended publication list at the end of this volume), and staff co-authored five papers in referred journals. The 2017 Yukon Exploration & Geology volume, to be released early in 2018, contains overviews of hard rock and placer exploration and development activities, as well as eleven technical papers describing 2017 project highlights.

A number of changes were made to the YGS website over the past year, and more significant changes will be coming early in 2018. Among the recent changes, field activities are now presented in an ESRI Story Map format, enabling users to see where field projects are located and read brief narratives on each study. The Facebook site initiated in 2016 continues to see regular postings; it is turning out to be an effective way to communicate with Yukon teachers and to share information of general interest to the public, such as the location and setting of the earthquakes felt across the territory in early May.

The "Footprints" web application, launched last year, was expanded beyond assessment reports to include YMEP and Placer reports. The database behind the application captures metadata such as claim owner, year and type of work, exploration expenditures and the physical footprint of work carried out, and the web application allows users to filter, query and discover information about exploration work using a map interface. The database currently contains 8777 reports, with roughly 160 Placer

reports remaining to be captured. It is anticipated that the remaining placer reports will be online by spring. This work is supported in part with SINED funds.

Work on the MINFILE database included the addition of fifteen new mineral occurrences and updates to the work history and reference sections of sixty existing occurrences. YGS recognizes that there is thematic overlap between the MINFILE database and the information presented via the Footprints application, and discussions are underway on how to merge the databases to allow a single map-based interface to serve all mineral occurrence-related information.

YGS continues to make improvements to the digital bedrock geology geodatabase. The next update is scheduled for January 2018 and will include the incorporation of recently-compiled mapping in southeastern Yukon, revisions to Selwyn basin geology, new mapping in the Lake Laberge area, and detailed mapping in the Mount Freegold area. In addition, a number of minor errors will be corrected in the next update. YGS will also be releasing an updated and improved Yukon geochronology database in 2018. The new database is based on the model for the bedrock geology map, which allows for regular updates as/when new data are available.

In addition to the initiatives above, the Technical Services unit launched the YGS Map Gallery in 2017. The Gallery is a series of online maps that allow users to view, query (and in some cases, download) YGS' geoscience information. The different maps in the Gallery are intended to be user-friendly, enabling clients to learn about Yukon geology and access a variety of information based on their needs and interests.

## 2017 YGS FIELD ACTIVITIES

### BEDROCK GEOLOGY PROJECTS

Bedrock Geology staff carried out field work on three projects in 2017 and undertook reconnaissance work to identify potential areas for future mapping. Locations of field activities are shown in Figure 2.

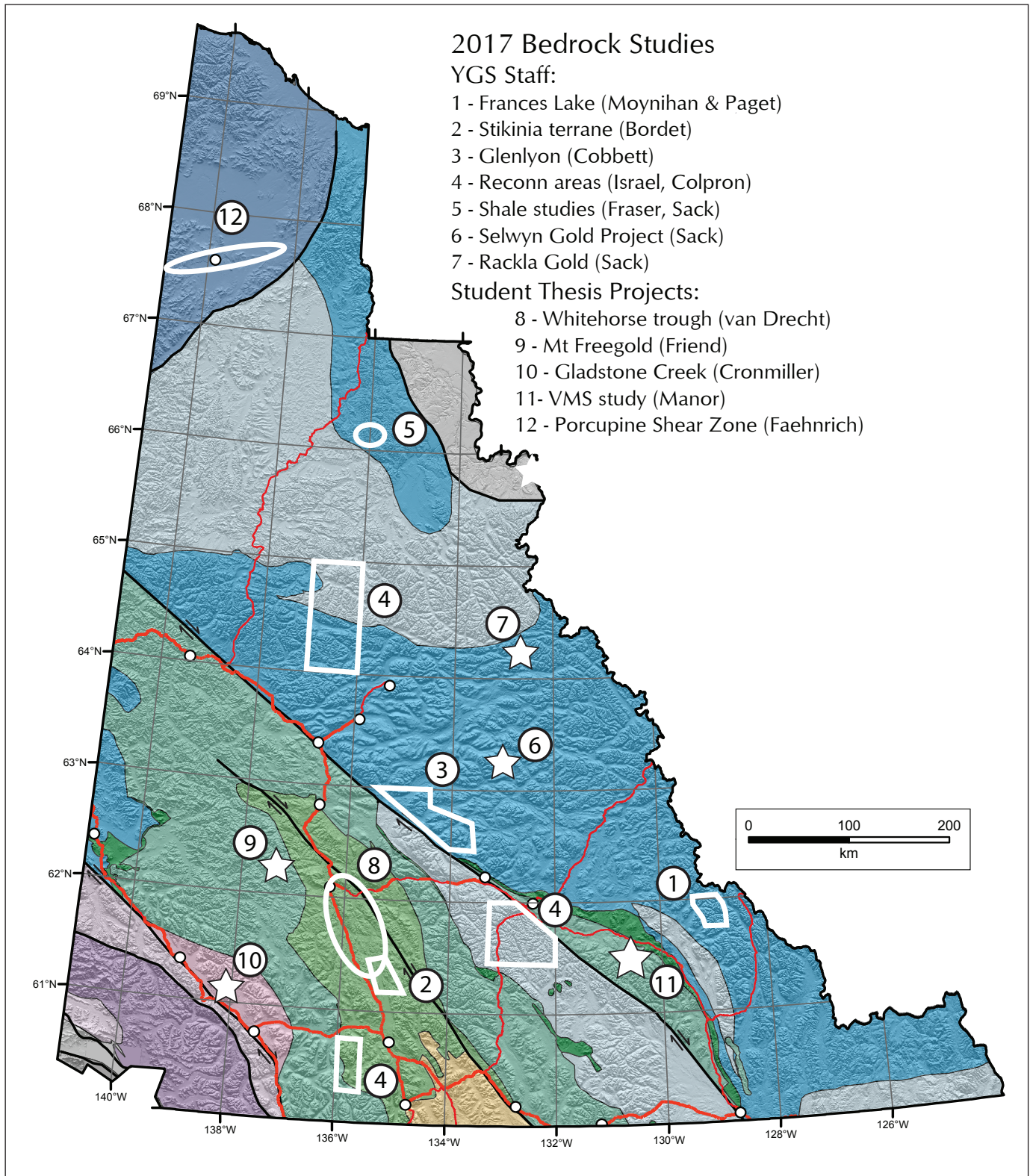


Figure 2. Locations of 2017 bedrock geology and graduate student field projects.

### ***Frances Lake bedrock mapping***

For the 2017 field season Geological Survey of Canada (GSC) and YGS planned a collaborative mapping project in the Frances Lake area under the GSC's Geo-mapping for Energy and Minerals (GEM) Program. The intent of the field project was to expand on the mapping that has been completed to date by Moynihan (2017) and resolve questions regarding the nature of the contact between Hyland Group rocks and lower Paleozoic strata of the McEvoy platform, a potential offset equivalent to Cassiar platform northeast of Tintina fault.

The planned project was to involve a field crew of ten mappers and a support crew (cook, camp manager, helicopter crew). During the YESAA assessment of the proposed camp, Ross River Dena Council and Liard First Nation expressed concerns with the project, noting that Frances Lake has significant cultural and spiritual values to both communities. Further consultation led to a decision to defer the project to 2018, allowing time to find an alternate campsite(s) and to engage the community more fully on the nature and impacts of the project.

In the interim, YGS undertook 2017 field work from two-person fly camps around the Anderson batholith, extending coverage westward from mapping previously completed in the upper Hyland River area (Moynihan, 2016; 2017). Mapping was carried out by David Moynihan and graduate student Colin Paget (University of Calgary). Their work identified the stratigraphic position and age of upper amphibolite facies rocks mapped in 2016, and documented connections between Neoproterozoic rocks of the underlying McEvoy and Cassiar platforms (Ingenika Group) and autochthonous Hyland Group strata of Selwyn basin. Details of the mapping results are presented in Moynihan (2018).

### ***Stikinia bedrock mapping***

Esther Bordet completed a third year of mapping in rocks of Stikinia east of Lake Laberge in 2017 (Fig. 2). Her work focused on stratigraphic revisions to Triassic units, dating of Cretaceous intrusive and volcanic overlap assemblages, and documenting structures in the map area.

New mapping has resulted in the subdivision of the Middle Triassic Joe Mountain Formation into five distinct units and a reinterpretation of the depositional sequence of units northwest of Teslin Mountain. The Upper Triassic Lewes River Group has been subdivided into nine units, and a sequence of clastic sedimentary rocks previously

mapped as part of the Lewes River Group has been re-interpreted to be Middle Triassic in age and re-assigned to the Joe Mountain Formation.

Bordet has distinguished five post-accretionary plutonic suites in the map area that range in age from Middle Jurassic to Late Cretaceous, as well as a number of dike sets that transect the area (Fig. 3). In addition to intrusive rocks, detailed mapping of the Upper Cretaceous Open Creek volcanic complex was undertaken to characterize its volcanic setting and determine its relationship to the Teslin Mountain pluton. Preliminary geochronological and petrological data from these overlap sequences are presented in Bordet (2018).



**Figure 3.** Image of a 10 m wide Cretaceous rhyolite dike cutting pale grey massive limestone of the Upper Triassic Lewes River Group.

### ***Richardson trough shale studies***

Tiffani Fraser completed a final field season in 2017 working with a team of colleagues (from St. Francis Xavier, Dartmouth and Stanford universities) studying shale of the Road River Group in the Peel River region (Fig. 2). The group has been studying a section that preserves a unique, near-continuous stratigraphic record from the late Cambrian to the Middle Devonian. Bio and chemostratigraphic data, coupled with U-Pb ages from ash beds, will enhance our understanding of Yukon's early Paleozoic history and paleoenvironment.

Based on her knowledge of early Paleozoic shale, Fraser was invited to participate in a new collaborative YGS-GSC project examining the contact between Road River Group and overlying Middle to Upper Devonian shale (Canol Formation in Richardson trough; Earn Group in Selwyn basin). Of particular interest to the group is the thin, Ni and Mo-enriched pyritic layer marking the contact between the two units known as the "Ni-Mo" horizon (Fig. 4).

The Ni-Mo horizon is currently the subject of a study by the GSC (under their Targeted Geoscience Initiative program) and YGS (see below), and Fraser's work is providing a sequence stratigraphic framework for the study.

A summary of both studies is presented in Fraser *et al.* (2018).

### ***Reconnaissance for new mapping***

Steve Israel and Maurice Colpron spent a few days conducting reconnaissance for potential future mapping projects (Fig. 2). One of the areas examined was east of Kusawa Lake (NTS 115A). Exposures there may provide an opportunity to resolve some uncertainties regarding the relationship between Yukon-Tanana and Stikinia terranes. Based on observations made in the area this summer, it is likely that Israel will map there in 2018 and seek answers to some of these outstanding questions.

In addition to the Kusawa Lake area, Israel and Colpron examined outcrops in the eastern Larsen Creek area (NTS 116A) northeast of Dawson City. The most structurally-complex (and therefore most interesting) geology lies in the northern part of the map sheet which is inside the Peel Watershed, making it a lower priority for mapping.



**Figure 4.** Tiffani Fraser collecting a sample from the Ni-Mo horizon above the Road River Group.

Quiet Lake area (NTS 105F) is also being considered for new mapping, although before new mapping projects are planned in Ross River Dena Council's Traditional Territory a clearer understanding of the community's interest and support will be needed.

## METALLOGENY STUDIES

YGS has four metallogeny projects underway, three of which saw field work this summer (Fig. 2).

### *Metallogeny of Jurassic plutons*

Patrick Sack and Maurice Colpron have initiated the final write-up of their atlas of Late Triassic to Jurassic plutons in south-central Yukon. The report, expected to be released in 2018, will provide comprehensive descriptions of the rocks, including their chemical characteristics, ages, petrology, depth of emplacement, physical rock properties, and metallogeny. An accompanying journal article is in preparation and will focus on the tectonic evolution of the Intermontane terranes during intrusion of these Jurassic plutons.

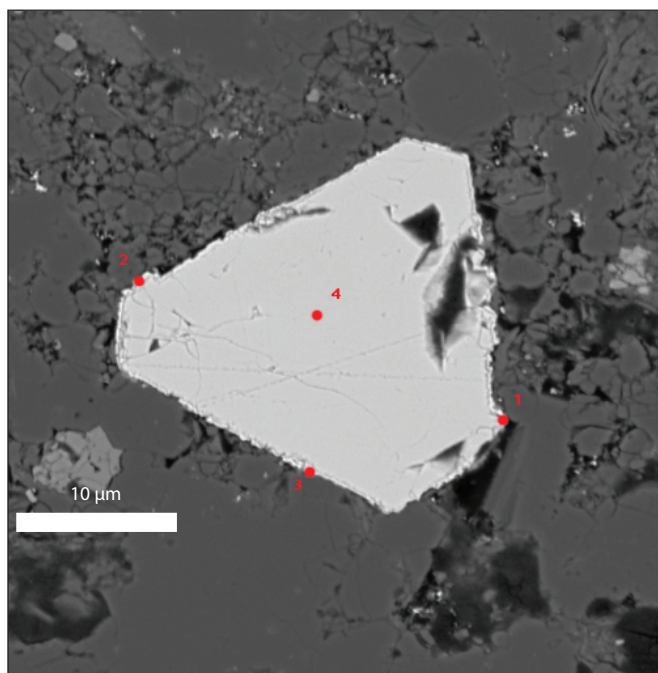
### *Selwyn Gold Project*

Patrick Sack continued his Selwyn gold study, collecting samples from the Plateau South property (Fig. 2) to understand the paragenesis of gold-bearing quartz veins. The veins occur both as discrete quartz + carbonate + muscovite + albite veins, and as breccia infill; gold is associated with arsenopyrite + pyrite ± galena ± chalcopyrite in both settings. The veins are interpreted to have formed during a late extensional event that followed Mesozoic folding and thrusting. Work over the winter will include  $^{40}\text{Ar}/^{39}\text{Ar}$  dating of muscovite (to bracket the timing of deformation and quartz vein formation); Pb isotope analysis of galena in gold-bearing quartz veins (to identify potential source(s) of metals); U-Pb zircon ages from plutonic rocks in the region; and petrography of mineralized veins. Preliminary results of the study will be presented at the Mineral Exploration Roundup in January 2018.

### *Carlin-style gold of the Rackla belt*

In addition to the Selwyn gold project, Sack spent a week with GSC colleagues examining drill core and collecting samples as part of a GSC-led study of Carlin-style gold occurrences in the Rackla belt (under GSC's Targeted Geoscience Initiative; Fig. 2). Sack's contribution to the study involves characterizing ore-stage pyrite chemistry

at Rackla and comparing it with ore-stage pyrite from the Carlin trend in Nevada. In the fall he spent two days working with Dr. Jean Cline at the University of Nevada in Las Vegas (UNLV), where he did reconnaissance analysis of ore samples from several gold occurrences in advance of undertaking more detailed microanalytical work this spring at the GSC's lab. The ore textures are relatively simple (Fig. 5) and bear a striking resemblance to pyrites from the Carlin trend; preliminary results of the project will be presented at Roundup 2018.



**Figure 5.** Backscatter image of diagenetic pyrite from the Osiris/Sunrise gold occurrence (Rackla belt) with an  $\sim 0.5\mu\text{m}$  wide hydrothermal overgrowth of gold and arsenic-rich pyrite. Rim contains up to 3.34% As and 1960 ppm Au (based on three spot analyses). Numbered points indicate sites where quantitative analyses were taken using UNLV's electron microprobe.

### *Ni-Mo horizon*

The fourth metallogeny study involves re-examination of the pyrite-rich, Ni and Mo-enriched "Ni-Mo" horizon that characterizes the top of the Road River Group in the Richardson trough (Fig. 2). The project has a number of components. Tiffani Fraser is providing contextual information on the stratigraphic and sedimentological setting of the Ni-Mo horizon (see above) and Sack is working with a colleague at the University of Tasmania examining trace element compositions of syngenetic and early diagenetic pyrite from the Ni-Mo horizon.

The pyrite composition is being evaluated as a potential proxy for seawater chemistry (see Large *et al.*, 2017). At the same time, GSC colleagues are undertaking more traditional whole rock geochemical, chemostratigraphic and lithostratigraphic studies that will provide information on paleo-ocean conditions. The latter study is part of the GSC's Targeted Geoscience Initiative program.

## GEOHERMAL ENERGY RESEARCH

### *Radiogenic heat potential study*

In 2016, YGS initiated a study to advance understanding of the potential for geothermal energy development in southern Yukon. Early in the 2017-18 fiscal year, a map and accompanying database documenting the heat-generating potential of Cretaceous and younger plutons was released by the survey (Friend and Colpron, 2017). The study used existing whole rock geochemical data to calculate the potential radiogenic heat production from the decay of naturally occurring radioactive elements (U, Th, K). The information is displayed on a map that shows the locations of plutons and their associated radiogenic heat potential.

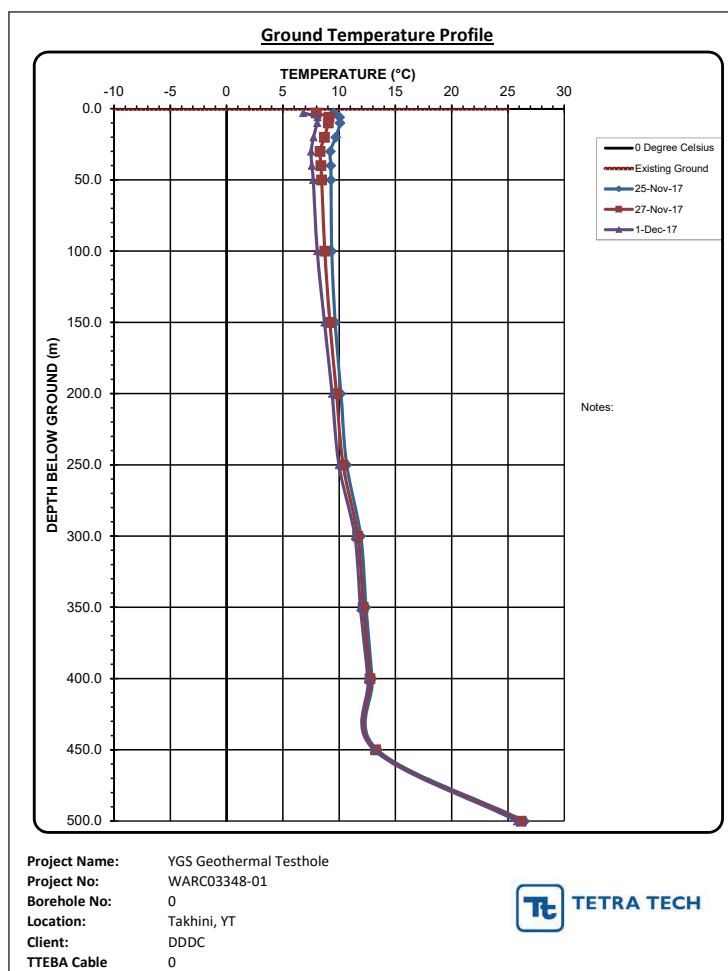
### *Ground temperature monitoring*

Over the summer, YGS established a partnership with Da Daghay Development Corporation (DDDC) to drill Yukon's first deep ground temperature monitoring well. The site selected is on a Ta'an Kwäch'än Council (TKC) Category A land parcel west of the Takhini Hot Spring. The 500 m deep well was drilled in November and is currently instrumented with a thermistor string that is generating a temperature profile (Fig. 6). The project is a first step in helping TKC determine whether business opportunities such as district heating or energy production are viable. SINED funds were used for this project.

Upon completion of the well, YGS initiated discussions with Ross River Dena Council about the possibility of drilling one or more geothermal targets in the Tintina trench near Ross River. This work, which will also be funded under the SINED program, is planned for winter/spring 2018.

## SURFICIAL GEOLOGY PROJECTS

Staff from YGS' Surficial Geology unit undertook four field-based surficial geology studies in 2017 (Fig. 7) and initiated consultations for a fifth project (to start in 2018). In addition to field studies, Panya Lipovsky is working on a YGS Bulletin on the surficial geology of Stevenson Ridge map sheet, synthesizing the results of previously-released 1:50 000 maps (Bond and Lipovsky, 2015a,b; Lipovsky and Bond, 2012a-e, 2013a-f). The bulletin is anticipated to be released by late spring 2018.



**Figure 6.** Preliminary ground temperature profile from the well near Takhini Hot Spring. Profile shows data collected between November 25 and December 1, 2017.

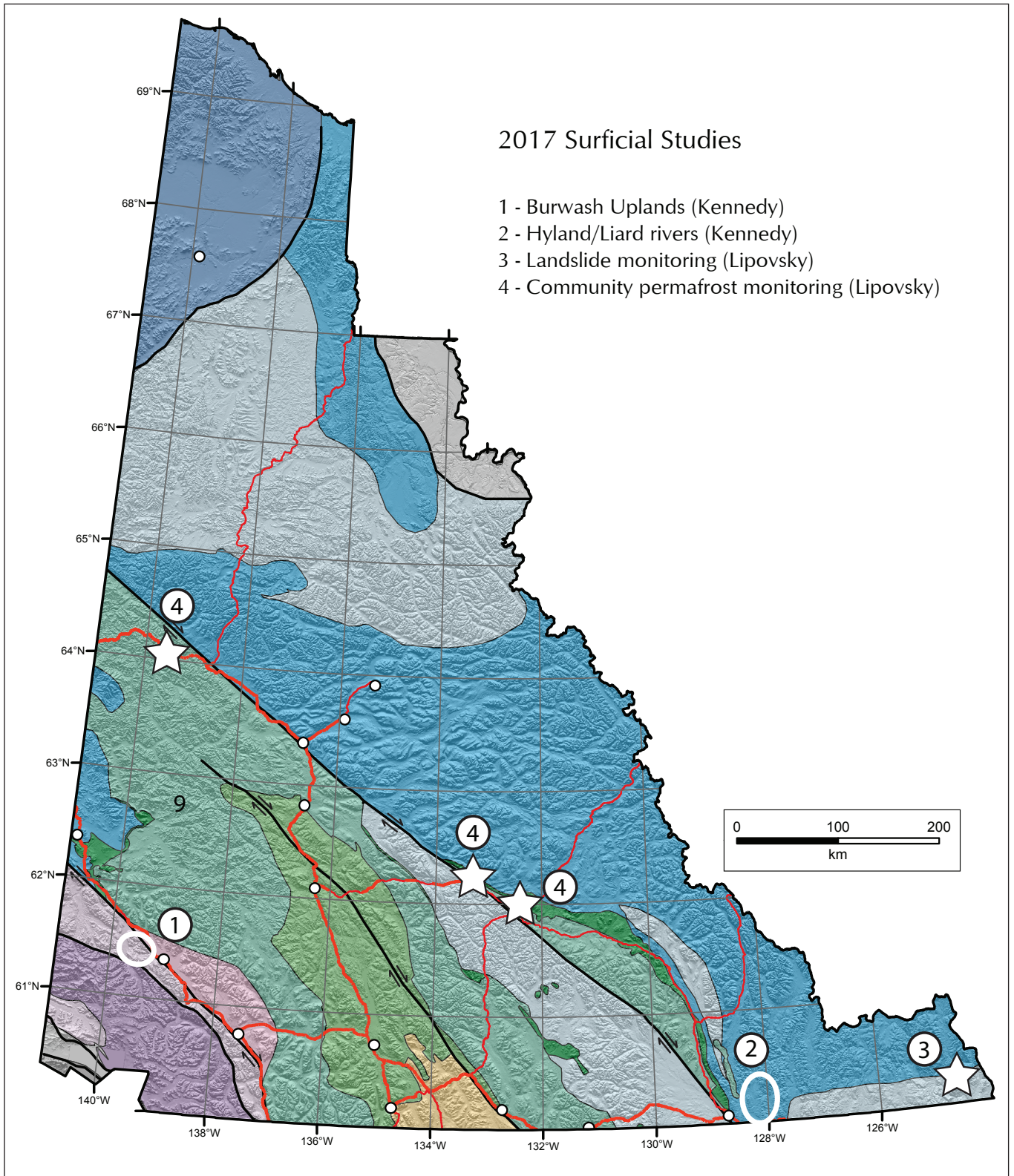


Figure 7. Locations of 2017 surficial geology field projects.

### ***Burwash Uplands surficial mapping***

Kristen Kennedy spent a month mapping surficial geology in the northern Kluane Range focusing on the Quill, Arch, Maple and Wade creeks drainages (Fig. 7). The purpose of the study was to characterize the area's glacial history and improve understanding of the placer potential of creeks in the area (Fig. 8). Mapping revealed that glacial incursion into the mountains in this area was much more restricted than previously thought. This has important implications for sampling strategies for mineral exploration, as much of the area is unglaciated. Preliminary results of the project are presented in Kennedy (2018).

Kluane First Nation is actively exploring their Category A Settlement Land in the Burwash Uplands area, and ongoing collaboration with Kennedy will continue to support their work as mapping moves into the Burwash Creek-Duke River area in 2018.

### ***Liard River gravel study***

Kristen Kennedy collaborated with Alberto Reyes and Britta Jansen (University of Alberta) and Nick Roberts (Simon Fraser University) in the Liard River area near Watson Lake in 2017 (Fig. 7). This is the second year of a study focused

on a section of preglacial quartz pebble-rich gravels and overlying glacial sediments. The research involves Eocene climate reconstructions, as well as paleogeographic studies and glacial chronology. Preliminary data on the latter subject is presented by Ellis (2018) in this volume.

The preglacial gravels bear a striking resemblance to the White Channel gravels in the Dawson area, although to date their placer potential remains largely untested.

### ***Landslide monitoring in Liard basin area***

In 2016, Panya Lipovsky initiated a multi-year landslide-monitoring program in Liard basin at the site of the Kotaneelee gas field. The area is of interest because remediation is underway and roughly 25% of the area is overlain with relict landslide cover. An understanding of the risk of future slides is important for ensuring the abandoned wells will not be impacted by future ground movement.

In 2017 Lipovsky spent two days re-surveying the monuments that were installed in 2016. Differential GPS measurements revealed no ground movement has occurred at the sites in the last year. Paramount Resources provided logistical support for the field work.



**Figure 8.** Kristen Kennedy examining a section of Amphi theatre Formation in the Burwash Uplands area.

### **Permafrost Monitoring**

Panya Lipovsky and Leyla Weston visited Dawson City, Faro and Ross River in September to collect data from, and undertake maintenance on, permafrost monitoring stations that were installed in the communities in 2007. While in the communities they visited schools to present information on permafrost and earthquakes as part of YGS' outreach program.

In addition to the permanent installations in communities, US Array personnel installed short-term permafrost monitoring stations at eight sites in northern Yukon this summer. The US Array project currently has 45 seismic stations deployed across Yukon as part of a broader array covering the northern Cordillera of Alaska-Yukon-NWT (see below). YGS provided instrumentation and built housings for the permafrost instruments; these installations will enable permafrost data to be collected for the next two to three years (until the seismic stations are removed), filling gaps in existing coverage.

### **Greater Whitehorse area permafrost study**

In the spring of 2017, Lipovsky submitted an application for funding to Yukon's Climate Change Secretariat for a multi-year study of permafrost in the greater Whitehorse area. The funds are part of Indigenous and Northern Affairs Canada's 2017-2021 Climate Change Preparedness in the North Program, and YGS was successful in securing \$243 176 over four years. Engagement of local residents will begin over the winter.

The intent of the greater Whitehorse area study is to document and characterize the geological environments where permafrost exists in order to identify areas at risk from permafrost degradation and support infrastructure development planning. The bulk of the funding will be transferred to the Northern Climate Exchange (Yukon College) to enable stakeholder engagement, field investigations and data compilation. Lipovsky's contribution to the project will be to map the surficial geology of the area and generate a geohazard map to underpin the study. Field work will be initiated in 2018.

### **STUDENT THESIS PROJECTS**

In any given year, YGS provides logistical and financial support for one or more graduate student thesis projects. The studies add value to YGS' program by contributing analytical data and access to university-based expertise; they also give the survey a chance to contribute to the training of next-generation geoscientists. This year, YGS is supporting five graduate students who are working independently (Fig. 2), as well as a student from the University of Calgary (MSc candidate Colin Paget) who is working with David Moynihan in the Frances Lake area (see above).

Leigh van Drecht completed the second and final season of field work in 2017 for her MSc thesis on the stratigraphy and sedimentology of the upper part of the Whitehorse trough. Her thesis focuses on the provenance, depositional environment and stratigraphy of the lower Laberge Group. The study is being undertaken at Memorial University under the supervision of Luke Beranek. Results of her field work are reported in van Drecht and Beranek, 2018.

A second MSc student, Melissa Friend, carried out her first summer of field mapping and sampling in Mount Freegold district, where more than two million ounces of gold have been discovered to date. Her thesis will focus on the links between Cretaceous metallogeny and magma fertility. The study is being supervised by Murray Allan at the Mineral Deposits Research Unit at the University of British Columbia (Fig. 9). Results of 2017 field work are described in Friend *et al.*, 2018.



**Figure 9.** Murray Allan examining mineralized granitic outcrop near Mount Freegold.

A third MSc student, Derek Cronmiller, is studying the interaction between the Cordilleran Ice Sheet and local montane glaciers in the Gladstone Creek area of the Ruby Range (Fig. 10). The study involves surficial mapping and stratigraphic studies, including an examination of placer deposits in Gladstone Creek. Brent Ward (Simon Fraser University) is supervising the study. Results of the fieldwork were presented at the Placer Forum in November and will be featured on a poster at the Exploration Roundup in January.

Matt Manor, a PhD candidate at Memorial University, 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. He is working under the supervision of Steve Piercey at Memorial University. Preliminary results of his research are presented in Manor and Piercey, 2018.

YGS contributed SINED funds to cover field and/or analytical expenses to the above four projects.

Karol Faehnrich, a PhD student at Dartmouth College, is studying the kinematics and displacement history of the Porcupine Shear Zone in the Old Crow area. The shear zone juxtaposes rocks of the North Slope terrane with the Yukon stable block. Maurice Colpron and Steve Israel spent five days in the area this summer, mapping with researchers from Dartmouth College and the University of Iowa and providing helicopter support to the field project.

## DESKTOP STUDIES

### *Yukon digital bedrock geology map*

Following the release of the Yukon digital bedrock geology map two years ago (Colpron *et al.*, 2016), Maurice Colpron has worked to generate regular updates



**Figure 10.** Derek Cronmiller examining a surficial section in the Gladstone Creek area.

for online release. The first update was released in January 2017, and a second update is planned for January 2018 (at the Exploration Roundup). The update will capture new geology compiled by YGS and GSC mappers since 2017 and will be available as shape files and in \*.pdf format.

### *Compilation of southwest Yukon bedrock geology*

Steve Israel spent much of 2017 writing up final reports and papers related to the Kluane Ranges, the Bear Creek assemblage (in collaboration with Joel Cubley at Yukon College) and Paleocene magmatic rocks. A Kluane Ranges Bulletin is expected to be released sometime in the spring of 2018 and two or more journal articles will be submitted over the next few months.

Two MSc students co-supervised by Israel defended their theses at Simon Fraser University in 2017. Andy Clark investigated the structural and metamorphic history of the Aishihik Lake region and Lianna Vice studied the metamorphic, structural and detrital zircon characteristics of the Blanchard River area. Both of these theses are available at the EMR Library.

### *Glenlyon map area*

In November, Rosie Cobbett resumed work on the Glenlyon mapping project following her maternity leave. Over the winter, she will finish compiling the geology of the Tay River and Glenlyon map sheets; this map will integrate the field work that she completed between 2013 and 2016 with geological data captured from YGS' collection of Cypress Anvil files.

Cobbett is planning one final summer mapping in the area; she will hold off releasing a final compilation map until her 2018 field data can be incorporated into the map. In the meantime, the geology she has compiled to date will be captured in the January 2018 update of the Yukon digital bedrock geology map.

In addition to the map, Cobbett plans to publish a paper describing Earn Group stratigraphy that will include new age data and its stratigraphic implications.

### *Dempster Highway Aggregate mapping*

At the request of Yukon's Department of Highways and Public Works, Lipovsky completed a desktop study and generated an aggregate potential map for a portion of the Dempster Highway (Km 174-240; Fig. 11). This map will support ongoing maintenance efforts by the department, and is available to the public on request.

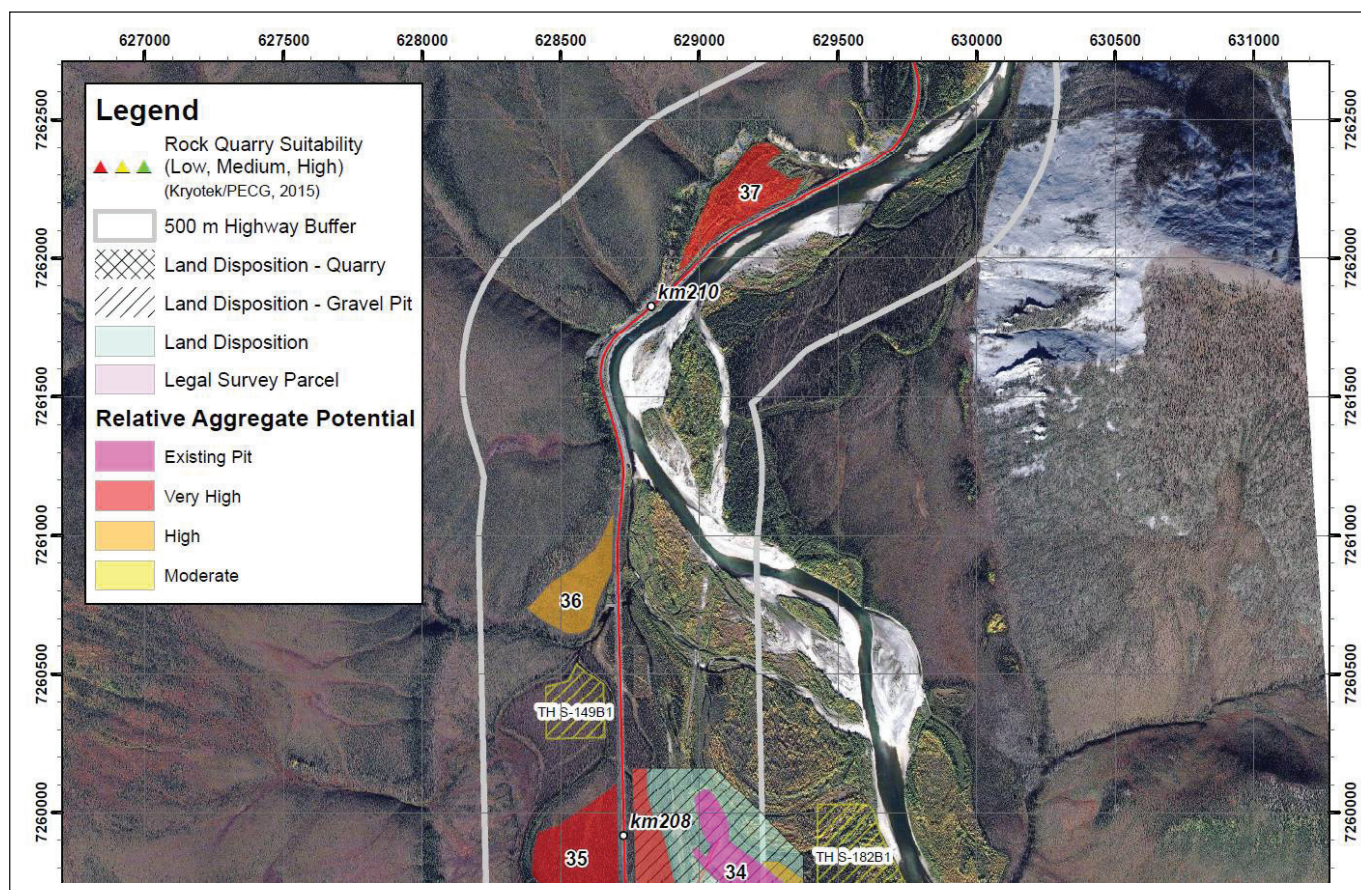


Figure 11. Map showing locations of potential aggregate resources along the Dempster Highway between Km174 and 240.

### 1:250 000 Magnetic map tiles

Last year YGS initiated a project to re-process the regional magnetic data from the Alaska-Yukon magnetic compilation map (Miles *et al.*, 2015). The project involved generating four derivative maps (residual total magnetic field; reduced-to-pole magnetic field; first vertical derivative reduced-to-pole magnetic field; and tilt derivative reduced-to-pole magnetic field) for each 1:250 000 map sheet in Yukon. The individual “tile” maps were re-leveled for each map sheet, revealing subtle magnetic features that are not immediately apparent on the regional compilation.

The contract to re-process the data was funded under the SINED program last fiscal year and the maps were released in July 2017. Each Open File includes Geosoft grid files, geotiffs and \*.pdf files (Aurora Geosciences Limited and Bruce, 2017: YGS Open Files 2017-5 through 2017-59).

### Ongoing capture of Yukon Consolidate Gold Corporation file data

Over the past couple of years, Sydney van Loon has generated maps and profiles across selected Klondike creeks, displaying data from the collection of Yukon Consolidated Gold Corporation (YCGC) files (van Loon, 2016; 2017). She will not be compiling any YCGC data this year, given the time commitment required to complete the Yukon Placer Industry Report (see below). However, YGS plans to work on geo-referencing data from the files this spring (e.g., locations of shafts, gold grade data, etc.). This will provide her with digital data she can work with next winter, generating grade maps and cross sections from one or more creeks in 2018-19.

### ***Mineral potential mapping***

Following the ruling of the Federal Supreme Court on the Peel Land Use Plan, Yukon government has renewed its commitment to re-starting the land use planning process. YGS' role in this process will be to provide the mineral potential maps that will help to inform the Planning Commissions. While regional mineral potential maps exist for Yukon (Bradshaw and VanRanden, 2003), recent mineral discoveries and new geoscience research have rendered the assessments outdated for some parts of the territory. The time and resources required to update these assessments will depend on the areas identified for planning and the timelines set for the development of land use plans.

In anticipation of this work, YGS has invested time examining mineral potential mapping methodologies and expects to ramp up this work over the next year or so. To date, a few "trial" maps have been generated that assign mineral potential values for deposit types based on geologic attributes (such as lithology, age, structure, etc.) coupled with knowledge derived from MINFILE occurrences and stream sediment geochemical data. The maps incorporate both mineral potential values and "confidence" designations, which allow users to recognize the uncertainties associated with mineral potential values. The confidence values also serve to highlight areas that require additional research to ensure decisions are based on sound evidence.

### ***Monitoring seismicity***

In 2017, YGS provided logistical support for the deployment of several portable seismometers as part of the US Array project. There are now 45 passive seismometers installed across Yukon, collecting data that will enable imaging of the northern Cordillera's lower crust and lithosphere and enhance our understanding of earthquake hazards.

In addition to the US Array instruments, YGS retained four seismometers in the Liard basin area (southeastern Yukon). These instruments contribute data to both the US Array network and the BC seismic consortium, which monitors natural and induced seismicity in the region.

## **GEOSCIENCE OUTREACH**

YGS continued to fulfill its commitment to public engagement and geoscience education this year. Leyla Weston led several Whitehorse-based classes on day trips to the Whitehorse Copper Belt and Miles Canyon, and

brought hands-on activities to classes in Whitehorse and outlying communities (Haines Junction, Destruction Bay, Dawson City, Faro, Ross River and Watson Lake).

Weston also coordinated YGS' participation in student tours and activities for Mining and Geology Week in early May. The event attracted over 400 students from Whitehorse schools. In early August YGS hosted its 6<sup>th</sup> annual "Weekend on the Rocks" in Tombstone Park; a public event organized by Yukon Parks and Friends of Dempster Country. Weston and retired YGS geologist Don Murphy led interpretive hikes in the park (Fig. 12) and presented an evening lecture to participants. In November, YGS teamed up with the Prospectors and Developers Association of Canada to bring Mining Matters to the Geoscience Forum in November. The week included class tours and hands-on activities, including YGS' Augmented Reality sandbox. Following the Geoscience Forum Weston organized a geology workshop for Yukon teachers.

In addition to geoscience education initiatives, Weston spent time liaising between YGS geologists and First Nation governments in the Traditional Territories where YGS is carrying out research. Liaison efforts ensure that communities are aware of and understand the work YGS does, and that they have access to the information YGS generates.



**Figure 12.** Don Murphy describing local geologic features to participants in the "Weekend on the Rocks" event in Tombstone Park.

## ONGOING YGS ACTIVITIES

### MINERAL EXPLORATION INDUSTRY LIAISON

Scott Casselman, Patrick Sack, Lara Lewis and Derek Torgerson visited nineteen mineral exploration properties in 2017, capturing information on exploration results and tracking exploration expenditures. Highlights of 2017 exploration and development activities are summarized elsewhere in this volume (Lewis and Casselman, 2018) 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 2018.

To support exploration efforts, YGS has been working to web-enable information on its drill core collection for the past couple of years. Over the summer, drill core data were cleaned and migrated to the drill core module of YGS' Oracle Enterprise database, and a map-based tool for querying the database was launched in the fall. To highlight drill core donations, Minerals Geology staff encourage companies to contribute papers to the Yukon Exploration and Geology volume. This year two such donations are highlighted: Sack *et al.* (2018), and Coulter *et al.*, 2018.

In addition to visiting exploration properties, YGS organized a two day workshop/field trip for prospectors and exploration companies in August, featuring field trips to the Mount Freegold and Klaza properties. The workshop, dubbed "Carmacks Rocks" was held in Carmacks and included an afternoon open house for community members (Fig. 13).

YGS also provided regional geology tours for companies with interests in Yukon in 2017. The tours provide a broad overview of the structural, stratigraphic and magmatic settings of mineral occurrences in a given region, and insights into the timing and mechanisms of mineralizing processes.

### PLACER INDUSTRY LIAISON

Jeff Bond and Sydney van Loon visited 128 placer operations in 2017, monitoring activities, documenting information on gold production and characterizing the geology of the various creeks they visited. The information they collected is currently being compiled into the 2015-2017 Yukon Placer Industry Report, scheduled for release in May at the 2018 Gold Show in Dawson City. The report will synthesize the geology and production details of 150 placer mines. Some of the highlights of the 2017 season were presented at the annual Placer Forum in November.

In April Jeff Bond was invited by the Canadian International Resource Development Institute to participate in a workshop in Quito, Ecuador on artisanal and small-scale placer mining. The workshop brought together geological survey representatives from Latin America to identify ways to improve extraction practices and reduce environmental impacts of small-scale mining operations. Bond presented a talk on the information services and technical support provided to Yukon's placer mining sector, highlighting how the relationship has helped build a sustainable industry in Yukon.



**Figure 13.** Scott Casselman and Melissa Friend show ore samples to residents during the Carmacks Rocks open house.

## SUMMARY

Regional mapping and targeted studies related to mineral deposits continued as core activities for YGS in 2017, while other areas of research such as permafrost studies and geothermal assessments grew. Areas of increasing focus over the next few years include mineral potential mapping and strengthening relationships with Yukon First Nations.

More than sixty publications were released, and staff are working on a number of synthesis volumes that will be published in the coming months (YGS bulletins on Kluane Ranges bedrock geology and Stevenson Ridge surficial geology; an Atlas of Jurassic plutons; and the 2018 Yukon Placer Industry Report). Additionally, an update to the digital bedrock compilation map will be released in January.

Significant changes to the YGS website are coming in 2018, although the web applications that provide access to publications and data will remain unchanged. Input on how to improve information services and ideas for new geoscience projects are always welcome.

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