Energy, Mines and Resources • *Yukon Geological Survey*

YUKON
EXPLORATION & GEOLOGY OVERVIEW
2016

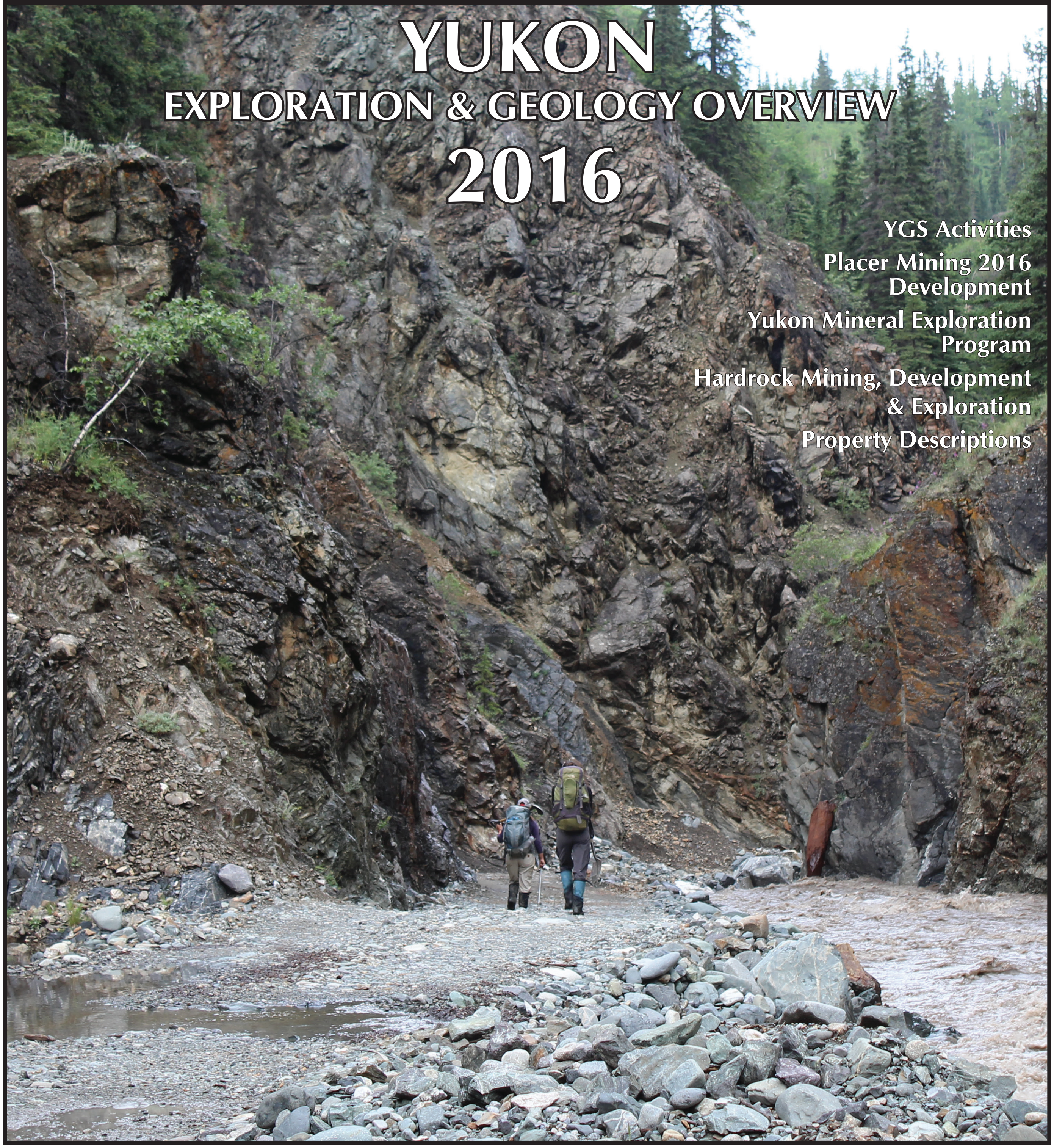
YGS Activities

Placer Mining 2016 Development

Yukon Mineral Exploration Program

Hardrock Mining, Development & Exploration

Property Descriptions



YUKON GEOLOGICAL SURVEY

Yukon

Energy, Mines and Resources

Yukon Geological Survey staff: (standing, left to right): Craig Nicholson, Kathy Walker, Derek Torgerson, Patrick Sack, Jeff Bond, Tiffani Fraser, Steve Israel, Maurice Colpron, Panya Lipovsky, Scott Casselman, Kristen Kennedy, David Moynihan, Karen MacFarlane, Robert Deklerk, Brett Elliot, Rosie Cobbett, Bailey Staffen; (kneeling, left to right) Leyla Weston, Olwyn Bruce, Melissa Friend, Carolyn Relf, Esther Bordet, Lara Lewis, Sydney van Loon
Missing from photo: Midori Kirby, Sarah Laxton, Sue Roy

YUKON EXPLORATION & GEOLOGY OVERVIEW 2016

Edited by

K.E. MacFarlane

Yukon Geological Survey

Energy, Mines and Resources

Government of Yukon

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Front cover photograph: Geologists investigating placer settings on Burwash Creek. Photo by Syd van Loon.

PREFACE

Yukon Exploration and Geology (YEG) papers and the Yukon Exploration and Geology Overview continue to be 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 only and can be downloaded from our website. The YEG Overview is available in a digital format; we continue to do a limited colour print run.

YEG 2016 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 who 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.

Leyla Weston joined me this year for the YEG marathon. I am not extirely convinced that Leyla knew that her extra duties as acting YGS Outreach Geologist would include YEGging, but she's done this before and I thank her for helping with the technical papers. Many of the papers submitted have been authored or reviewed by colleagues at the Yukon Geological Survey - thank you for being involved and making production of this publication easier.

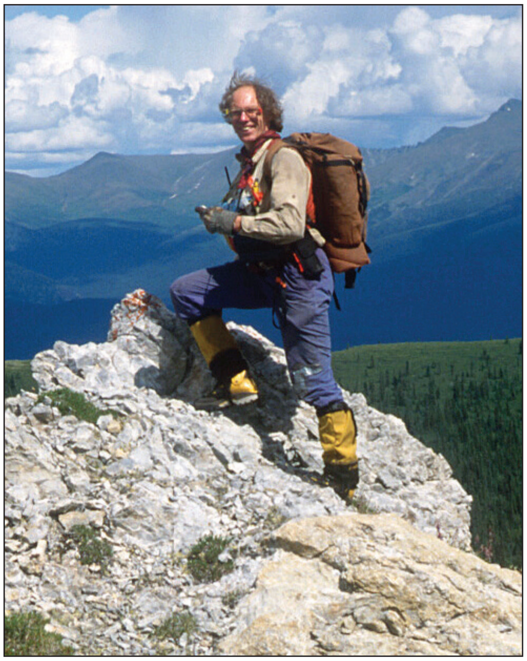
Sherry Tyrner of the Queen's Printer ensured that the printing process went smoothly.

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

Karen

Karen MacFarlane

IN MEMORIAM



CHARLIE ROOTS

(1956-2016)

Charlie Roots, a research scientist with the Geological Survey of Canada (GSC), passed away on June 28, 2016, five years after being diagnosed with amyotrophic lateral sclerosis (ALS).

Charlie's interest in, and love of the natural world was kindled at a young age by his father, the late Fred Roots (who recently passed away in October 2016), and godfather, the late John Wheeler (1924-2015) – both legendary scientists with the GSC. Charlie first studied geology at Dartmouth College for his BSc, and then at Carleton University for his MSc and PhD. After completing his PhD in the Ogilvie Mountains of Yukon, he joined the GSC in 1988 and started what would be a distinguished research career, mapping Yukon's geology and seeking to understand the tectonic history recorded in the rocks.

He moved to Whitehorse in the spring of 1992 to join the team that ascended Mount Logan under the auspices of the Royal Canadian Geographical Society. This expedition had both historic and scientific significance: it celebrated three anniversaries of national importance to our country – Canada's 125th anniversary, the Geological Survey of Canada's 150th anniversary, and the 50th anniversary of the Alaska Highway – and it marked the first use of GPS instruments to measure the height of Mount Logan. Charlie was a key member of the team, and is remembered by his fellow climbers as a tireless worker and reliable friend.

Upon completion of the Logan Expedition, Charlie joined the newly-formed mapping team established in Whitehorse under the Canada-Yukon Mineral Development Agreement. This group was the nucleus for what was to become the Yukon Geological Survey, and although Charlie was employed by the federal survey, he was considered by YGS, and many in Yukon government, as "one of us".

Charlie dedicated his career to mapping and understanding the geology of northern Canada, focusing primarily on Yukon but extending his work to other parts of the north. Over his career he authored or co-authored more than 70 publications, including geologic maps, reports and scientific papers. The fundamental knowledge that he generated has contributed to our understanding of Cordilleran geology and its resource endowment; his work has also served as a foundation for new research into the breakup of Rodinia, global glaciation, and the evolution of northwestern Laurentia.

Charlie was passionate and knowledgeable about many aspects of Earth Science and was enthusiastic about sharing his knowledge with Yukoners. He gave many public lectures, led geological walking tours, and collaborated on a number of publications that describe Yukon's dynamic and evolving landscapes (including the GSC's GeoScape series of posters and the book 'Ecoregions of the Yukon Territory'). He also mentored many student assistants and younger colleagues who joined the survey after him, sharing his knowledge and indulging their ideas and enthusiasm. Over the length of his career he collaborated with numerous university researchers and their graduate students, modestly deferring credit for new ideas to his younger protégés. Charlie's interests and enthusiasm resonated with several Yukon artists, leading to collaborative activities in places such as Tombstone Park.

Throughout his career, his wife Mary Ann, a well-loved Montessori school teacher and dance instructor, was a cherished partner and avid participant in some of Charlie's professional projects. She was working as a GSC camp cook when they met in their early years in Yukon; she participated in the Dome Road race with the geologists; and she is referenced numerous times in his field notes from the Logan Expedition. Charlie, Mary Ann and their children Galena and Logan hosted many visiting scientists in their home over the years and were actively engaged in the community in sports, arts and education.

Notwithstanding his scientific contributions, what Charlie is most likely to be remembered for is his character, which embodied enthusiasm, unbiased curiosity, modesty, and a contagious sense of fun. Those who worked in the field with Charlie will remember his capacity and enthusiasm for epic traverses and hard work. As a party chief, he would regularly be the first up to get ready for the day and the last to bed as he spent the late evening on his diary. He cheerfully took on the least desirable jobs around camp and an unkind or discouraging word was almost unknown. Over the last five years, in the face of his increasingly debilitating illness, Charlie came to terms with his fate to become a beacon of courage and strength. He maintained his positive attitude to the end as he purposefully wrapped up his projects by publishing several maps and papers using a voice-controlled computer. His colleagues and friends were fortunate to have been able to celebrate his life and say goodbye at the gatherings that he held for them, and at those that were held for him. He will be missed by everyone who knew him.

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Summary of Yukon Geological Survey 2016-17 Activities

Carolyn Relf*
Yukon Geological Survey

Relf, C., 2017. Summary of Yukon Geological Survey 2016-17 Activities. *In*: Yukon Exploration and Geology Overview 2016, K.E. MacFarlane (ed.), Yukon Geological Survey, p. 1-19.

INTRODUCTION

The mandate of the Yukon Geological Survey (YGS) is to support the stewardship of Yukon's energy and mineral resources and to contribute to the sustainability of Yukon's communities. 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. Another important aspect of YGS' work is the dissemination of information in the form of maps, reports, raw data, and outreach activities such as public lectures and school visits.

In 2016, YGS staff undertook twelve field-based projects and supported an additional seven (including three graduate student thesis studies). YGS also worked on several data management/data mining projects, and completed planning for a new geothermal study in the Whitehorse area. Fifty-two YGS publications were released, including results from a geophyiscal survey in the Livingstone Creek area, and staff published or contributed to eight external publications (including five in refereed journals).

YGS continued to liaise with industry to track hardrock and placer exploration and production (*see* Lewis and Casselman, 2017; Bond and van Loon, 2017, respectively) and to support clients via the provision of geologic information and advice. Under the Yukon Mineral Exploration Program (YMEP), fifty-seven proponents were offered exploration grants totaling $1.4M; highlights of this year's projects are summarized in this volume (*see* Torgerson, 2017).

This paper provides an overview of YGS program activities in 2016. Several of the projects described here are presented in more detail in the accompanying Yukon Exploration and Geology volume, while others will be released as stand-alone publications.

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YUKON GEOLOGICAL SURVEY PROGRAM FUNDING AND OVERSIGHT

Yukon Geological Survey's 2016-17 budget totals $3 465 000. This includes $1 265 000 in core O&M funding, $1 400 000 for the Yukon Mineral Exploration Program (which helps to fund early-stage mineral exploration), and $800 000 from the Canadian Northern Economic Development Agency's (CanNor's) Strategic Investments in Northern Economic Development (SINED) Program.

Annual allocations of funds are based on a number of factors, including Energy, Mines and Resources' (EMR's) strategic priorities, input from clients, and collaborative research opportunities. Client input is acquired via two formal advisory committees (one representing the mineral exploration sector and one representing the energy sector) and through annual workshops with representatives of the placer industry. Input regarding educators' needs is obtained at annual teacher workshops, and YGS liaises with EMR's Land Planning Branch and the Aboriginal Relations Branch of the Executive Council Office to meet requests for mineral potential assessments.

Collaborative research partners include the Geological Survey of Canada (GSC), who are delivering a multi-year project in southern Yukon comprising bedrock mapping, geophysical surveying and targeted thematic studies under their Geo-mapping for Energy and Minerals (GEM) program. Other examples of collaboration include work recently completed on community mapping with Yukon College, and studies being undertaken at universities with support from YGS.

Every five years YGS undertakes a multi-stakeholder workshop to identify geoscience knowledge gaps across the territory. Discussions span fundamental science questions, information needs of the exploration, transportation and development sectors, an evaluation of geohazards, and geoscience education opportunities. Participants provide insights into their current and future information needs (for example: exploration trends, plans for highway and community development, *etc.*) and delivery mechanisms. This input is immensely helpful for defining YGS research priorities and planning for future capacity requirements.

SINED FUNDING

SINED funding has comprised a significant portion of YGS' total budget for more than a decade. Under the program, CanNor provides partial funding for projects that stimulate economic development in the territory. Matching funds are derived from YGS' operating budget, university research partners, and other Yukon government departments.

Performance measures are reported annually to CanNor, including outputs, such as numbers of reports, maps, raw data; and impacts, which are reported as summaries of client surveys on the influence SINED-funded projects have on exploration investment decisions. Performance measures indicate that clients see significant value in SINED investments.

This fiscal year, YGS is spending $800 000 on sixteen SINED projects, two of which (the "Footprints" project and a geothermal study, described below) are significant investments.

YUKON GEOLOGICAL SURVEY ORGANIZATIONAL OVERVIEW

Yukon Geological Survey's organization chart is shown in Figure 1. The most notable staff changes this year were in the Minerals Geology unit, with the departure of Johann Slam, the addition of two new staff (Scott Casselman and Craig Nicholson) and some adjustments to the organizational structure. Nicholson backfilled Slam as the Core Library manager and Casselman was initially hired as an Economic Geologist. Over the course of the field season, staff in the Minerals unit undertook an assessment of the complementary strengths, expertise and key interests of everyone in the unit and developed a proposal to re-organize Minerals Geology with Casselman as head and Lewis as Economic Geologist. The re-organization was completed over the fall.

In the Bedrock Geology unit, Rosie Cobbett started a year of maternity leave in November following the birth of her second son. She is scheduled to return to YGS in November 2017.

In August, Sarah Laxton (Outreach Geologist in the Surficial Geology unit) started a ten-month leave to pursue a teaching degree at the University of Fraser Valley. The program in which she is enrolled focuses on engaging with students in small, remote communities, which will be a good fit with her role at YGS.

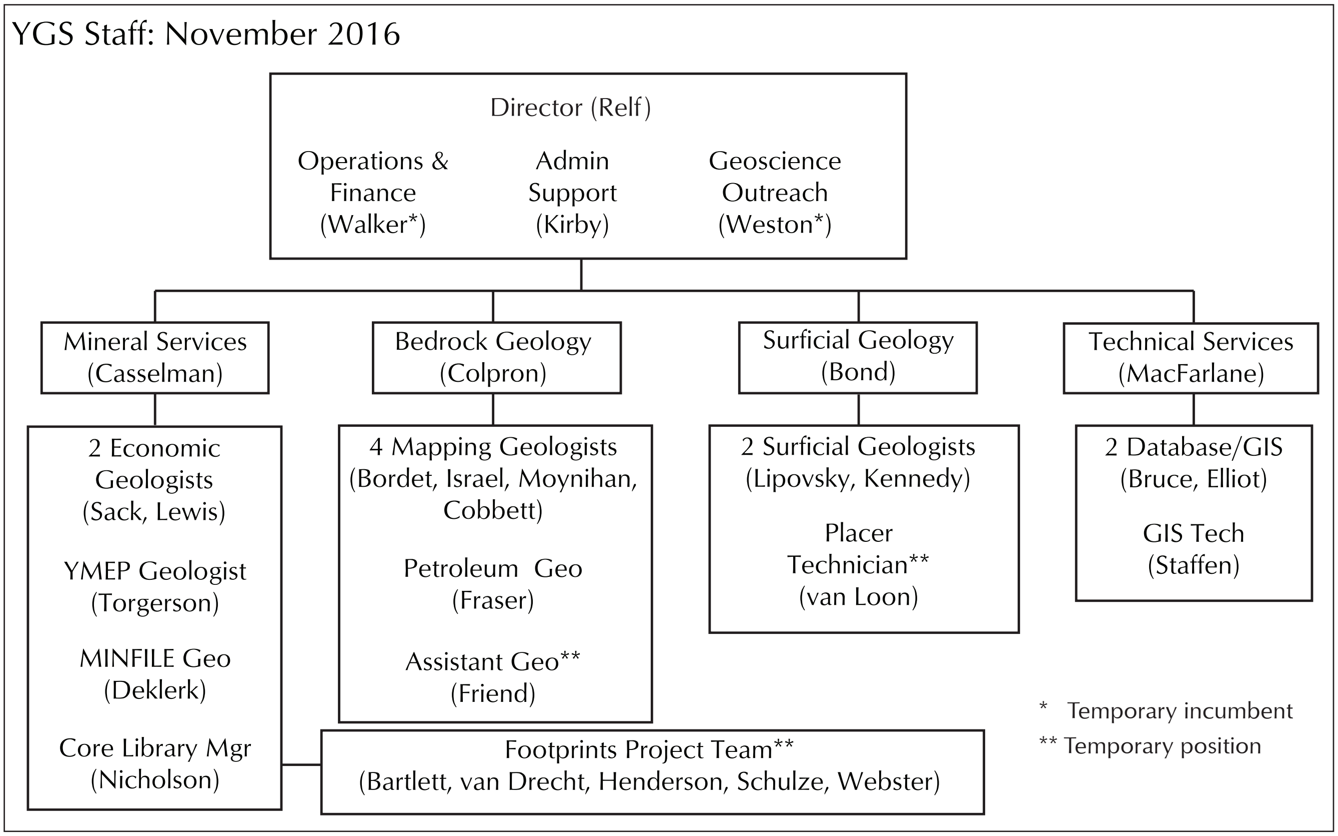

Figure 1. *Yukon Geological Survey organizational chart.*

In addition to indeterminate staff, YGS hired a number of temporary employees in the fall to assist with a short term project called the Footprints project (described under *Information management*, below). The project is expected to extend into 2017, likely wrapping up over the summer.

Finally, on a sad note, the Yukon Geological Survey suffered a loss this year with the passing of Charlie Roots in June (*see* the tribute at the front of this volume). An employee of the Geological Survey of Canada, Charlie had been co-located with the YGS for twenty-four years and was an integral part of YGS and the Whitehorse community generally. He is missed by staff and clients.

HIGHLIGHTS OF 2016-17 FIELD ACTIVITIES

BEDROCK GEOLOGY PROJECTS

YGS staff led or participated in six bedrock mapping projects and three thematic studies in 2016. Locations of the field areas are shown in Figure 2.

Upper Hyland River area bedrock mapping

David Moynihan continued bedrock mapping in the upper Hyland River area in 2016, extending map coverage in the northeastern part of NTS sheet 105H (Figs. 2 and 3). The area is underlain by Neoproterozoic to Cambrian rocks of the Hyland Group deposited during the breakup of Rodinia, overlain by Paleozoic sedimentary rocks associated with the formation of Selwyn basin.

Mapping in 2015 led to the definition of new stratigraphic subdivisions of the Yusezyu Formation of the lower Hyland Group (Moynihan, 2016a). The revised stratigraphy included two newly-identified limestone units which Moynihan was able to trace into the 2016 map area (Moynihan, 2016b); these units are not only useful stratigraphic markers but they are helpful in delineating structures.

Cretaceous folding and faulting overprints the supracrustal sequences and was accompanied by voluminous plutonism and regional low-pressure metamorphism; the latter is the subject of an MSc thesis being undertaken by

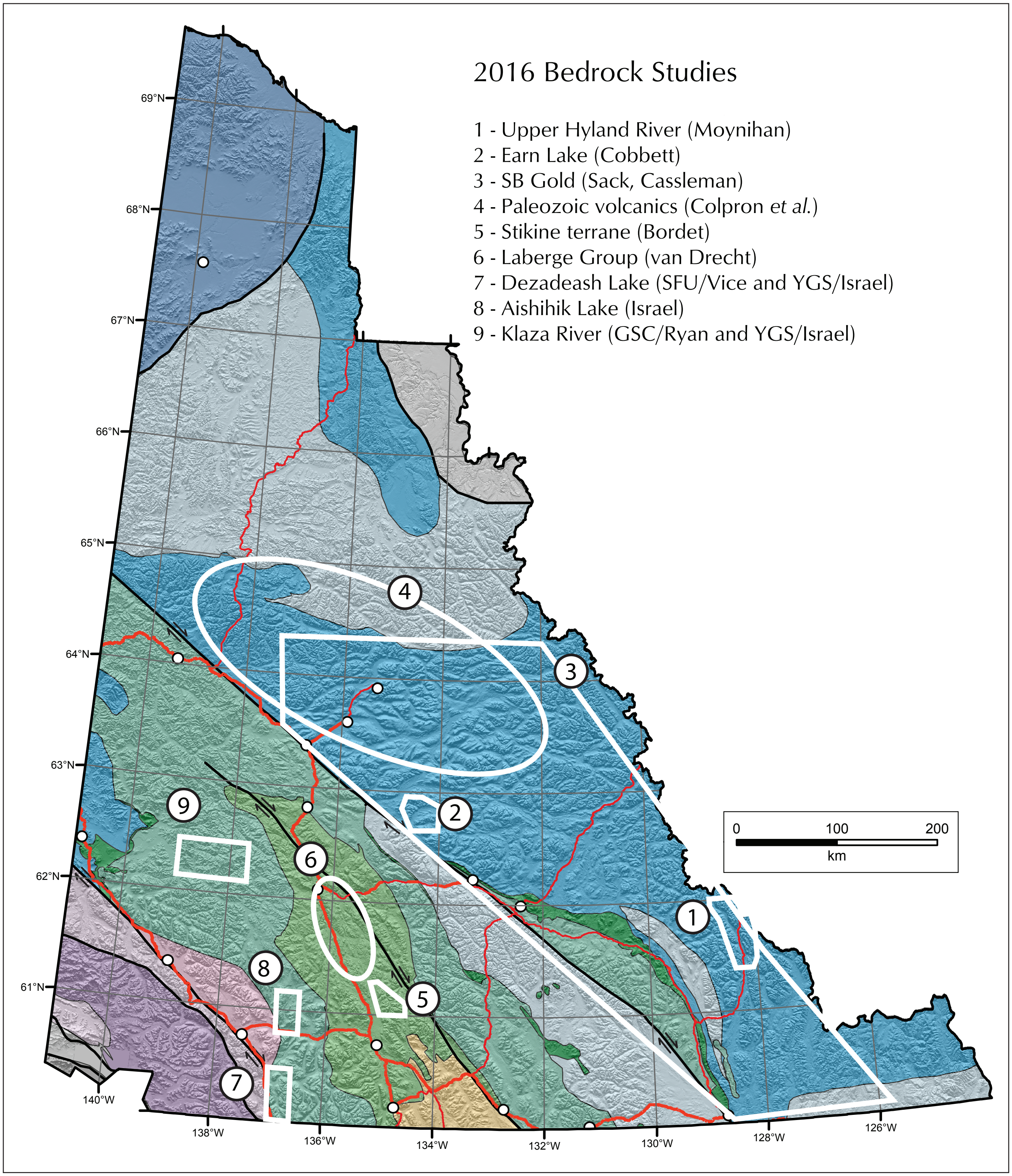

Figure 2. *Locations of bedrock projects undertaken by YGS in 2016.*

Figure 3. *Geologist David Moynihan taking notes in the field.*

Figure 4. *Chert pebble conglomerate from the Earn Group.*

Colin Paget at the University of Calgary and co-supervised by Moynihan. Newly-recognized structures in the area include several strands of a major dextral strike slip fault system that appears to have seen at least 80 km of displacement (Moynihan, 2017). Dextral faulting coincided with intrusion of some granitic plutons and may have implications for the distribution for gold prospects in the region. Moynihan (2016b) provides a more detailed description of the results of mapping.

Earn Lake bedrock mapping

Rosie Cobbett completed a third summer of mapping in the Glenlyon/Tay River area in 2016, focusing primarily in NTS sheet 105L/15 and surrounding area (Figs. 2 and 4). Field mapping and new geochronological data have led to some revisions of existing stratigraphic interpretations, including the reassignment of a widespread volcanic unit from the Devono-Mississippian Earn Group to the Ordovician Menzie Creek Formation.

New mapping has also identified a series of northeast-vergent thrust faults that imbricate units. The recognition of these thrust faults, coupled with new age data, is enabling regional stratigraphic correlations that have implications elsewhere in Selwyn basin.

The results of 2016 mapping were recently released by Cobbett (2016) and will be incorporated, along with the earlier work on this project, in an updated version of the Yukon bedrock geology compilation early in 2017.

Selwyn basin gold study

A new thematic project aimed at understanding the timing and character of gold occurrences in Selwyn basin was initiated this year by Patrick Sack and Scott Casselman. Initial sampling focused on occurrences that do not appear to be related to Cretaceous intrusions (Fig. 5). Samples from 3 Aces, Golden Culvert, Hyland Gold and Plateau South were collected and have been submitted for age dating (Ar-Ar on micas and U-Pb in phosphate minerals). This preliminary work may lead to a broader study of gold metallogeny in Selwyn basin, allowing occurrences to be fit into the tectonic/stratigraphic/magmatic framework that is emerging from new mapping.

Paleozoic volcanic rocks in Selwyn basin

Other thematic studies underway in Selwyn basin focus on volcanic sequences and their age, setting and mineral potential (Fig. 2). Paleozoic volcanic rocks from the east end of the Rackla belt were sampled in 2014 by Maurice Colpron and David Moynihan. This work led to questions about stratigraphic correlations with volcanic rocks in the Ogilvie Mountains (sampled in 2015), in the area east of Mayo (2016), and other parts of Selwyn basin. The YGS work triggered the interest of university colleagues at Dartmouth College (Justin Strauss) and Memorial University (Luke Beranek and Stephen Piercey).

Ongoing studies, supported in part by SINED funds, are being carried out by Beranek and a student, who are examining the age, petrology and VMS potential of Cambro-Ordovician alkaline volcanic rocks; and Piercey, who is assessing the use of radiogenic isotopes as an

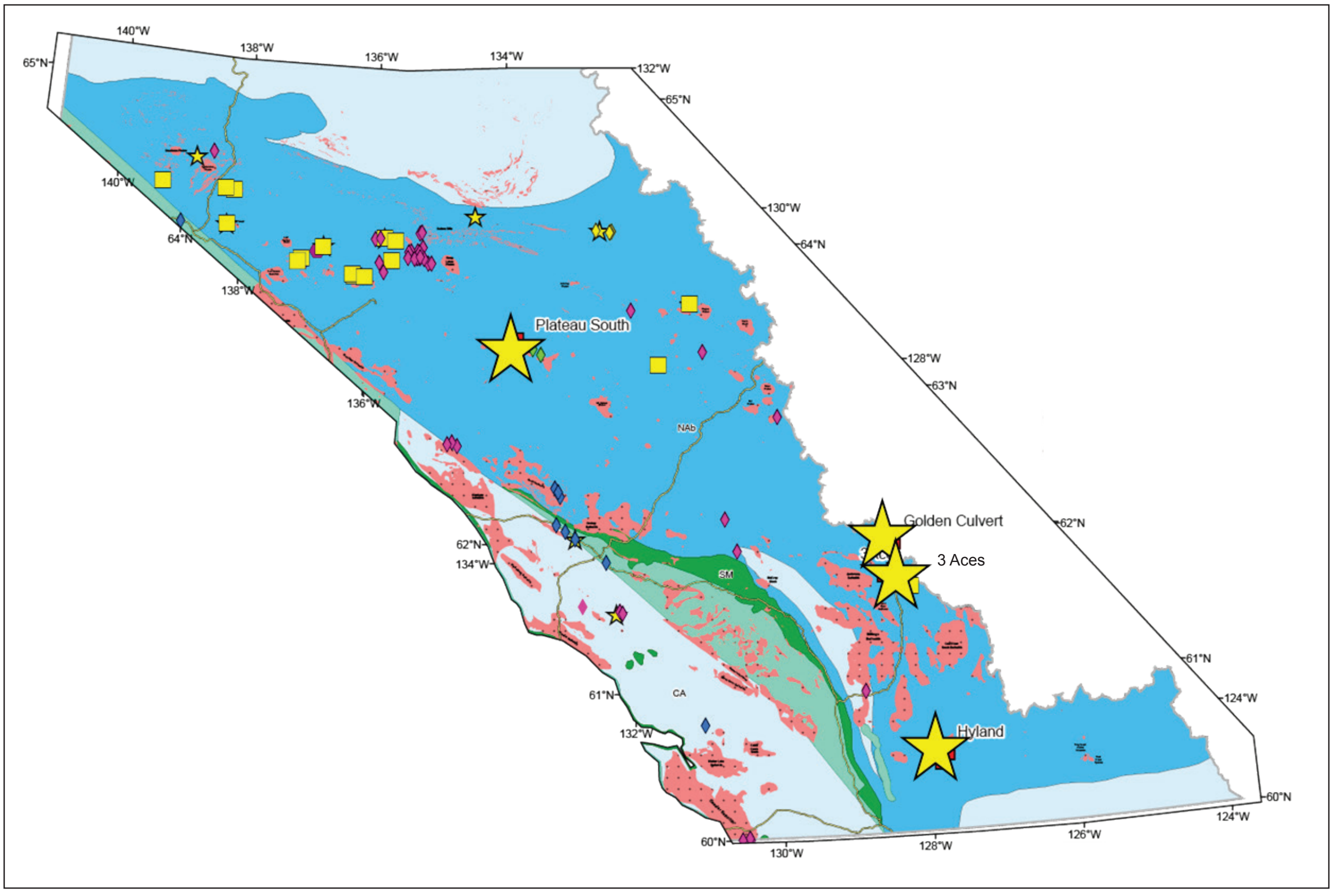

Figure 5. *Simplified map of Selwyn basin in Yukon; stars indicate gold occurrences sampled to date by Sack and Casselman.*

indicator of metal fertility in Devono-Mississippian felsic volcanic rocks. These studies are timely in that data on the age and petrologic character of volcanic units will support regional stratigraphic correlations across Selwyn basin, further enhancing the stratigraphic framework that is emerging from ongoing bedrock mapping and supporting assessments of VMS and SEDEX potential. Preliminary results of both studies have been published in YGS' Yukon Exploration and Geology papers (Campbell and Beranek, 2017; Piercey *et al.*, 2017).

Stikine terrane bedrock mapping

Esther Bordet completed a second year of mapping in rocks of the Stikine terrane east of Lake Laberge (Fig. 2), focusing on the internal stratigraphy and structure of the Middle Triassic Joe Mountain Formation and Upper Triassic Lewes River Group (Fig. 6). Her work includes new age data (U-Pb geochronology and fossils) and whole rock geochemistry, which are providing an improved understanding of the evolution of the Stikinia arc and its relationship with overlying sedimentary rocks of the Jurassic Laberge Group (Bordet, 2016, 2017).

A number of MINFILE occurrences have been documented in the area, including skarn Cu, porphyry Cu-Mo, and Au occurrences of unknown origin. This mapping project is providing an improved framework within which to understand the age and geological controls on these occurrences.

Sedimentology of lower Laberge Group

Leigh van Drecht from Memorial University of Newfoundland began field work on an MSc thesis in the Whitehorse trough (van Drecht and Beranek, 2017). The study, which is being co-supervised by Maurice Colpron, is examining the provenance, depositional environment and stratigraphy of the lower Laberge Group. The results will be a nice complement to Bordet's mapping, as the lower Laberge Group records the initial opening of the basin following the collapse of the Stikine arc.

Figure 6. *Geologist Esther Bordet in the field, with Lake Laberge in the background.*

Figure 7. *Metamorphosed rocks of the Yukon-Tanana terrane in the Takhanne River area.*

Bedrock mapping in southwestern Yukon

Mapping in the Coast Belt area of southwestern Yukon was undertaken in three areas in 2016 (Fig. 2). The southernmost map area was near Dezadeash Lake in the Takhanne and Kluhi rivers area, where Lianna Vice completed a summer of mapping as part of an MSc thesis at Simon Fraser University. Her project focuses on resolving the structural and metamorphic history recorded in supracrustal rocks of the Yukon-Tanana terrane and Late Cretaceous metasedimentary rocks of the Blanchard River assemblage (Fig. 7). Steve Israel is co-supervising the thesis.

Immediately north of this project, Steve Israel extended 2015 mapping in the Aishihik Lake area across the Alaska Highway into the Hutshi Lakes and Cracker Creek map areas (Israel *et al.*, 2017; Israel and Friend, 2016; Fig. 2). Here, Yukon-Tanana rocks are intruded by plutons of the Jurassic Long Lake and Paleocene Ruby Range suites. Mapping has focused on distinguishing the different magmatic events, documenting evidence for emplacement depths, and assessing intrusion-related mineral potential across the region.

Israel spent part of the summer mapping in the Klaza River area with Jim Ryan of the Geological Survey of Canada. This project was funded by the GSC under the GEM Program. The mapping had similar goals to those in the Hutshi Lakes/Cracker Creek area: document the relationships between supracrustal rocks of the Yukon-Tanana terrane and Cretaceous to Paleocene plutons that intrude them. Of particular interest in the Klaza River area is the potential for mineralization associated with Casino-age equivalent intrusions (*ca.* 78-72 Ma). The bedrock map will be released by the GSC.

Metallogeny of Jurassic plutons

Patrick Sack and Maurice Colpron are wrapping up the final stages of a study that examines the petrology and metallogeny of Late Triassic to Jurassic plutons in south-central Yukon. Based on field relationships and geochronological data they have subdivided the plutons into five suites (Fig. 8). New geochemical and isotopic data have allowed a petrologic characterization of the suites, and Al-in-hornblende geobarometry has yielded information regarding depth of emplacement.

Sack and Colpron plan to publish an Atlas of Late Triassic to Jurassic plutons by the end of 2017. The atlas will include lithologic descriptions, field and laboratory photos, analytical data (including physical properties, geochemistry and isotopic results) and a discussion of the metallogenic implications of the suites.

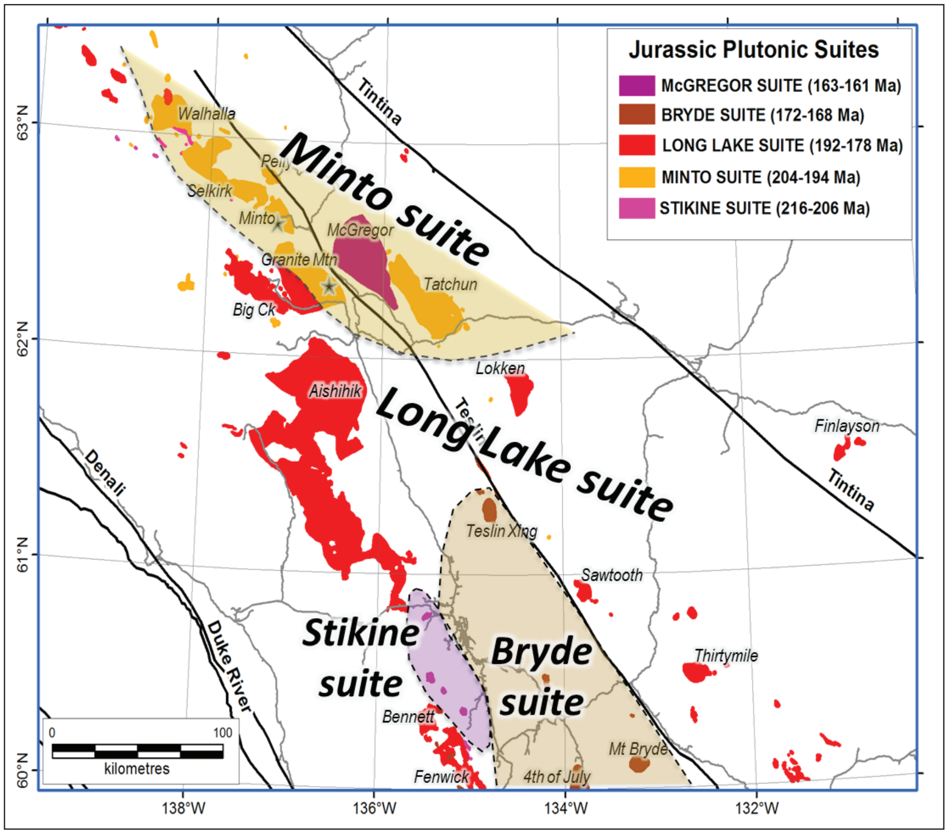

Figure 8. *Distribution of Late Triassic to Jurassic plutons suites in southern Yukon.*

Klondike area studies

Last year, Jeff Bond (Bond, 2016) reported on the results of a stratigraphic re-interpretation of Pliocene gravels in the Klondike. He identified a pre-White Channel Gravel deposit which he named the Paradise gravel, and reported that it was likely the primary source of gold on benches in the area.

In 2016, Bond returned to the area with Paul Sanborn (University of Northern BC) to examine paleo-weathering surfaces within the White Channel Gravel and collect samples of paleosols. This study will provide insights into paleoclimate conditions during deposition of these important gravels.

Between 2013 and 2016 Sydney van Loon oversaw the scanning of historic Yukon Consolidated Gold Corporation files that are housed at the National Archives in Ottawa. These documents are now available from the YGS, and YGS has started to digitize the data to enhance its value (*e.g.*, *see* van Loon, 2016). This year, van Loon “mined” data from a 28 km long section of Sulphur Creek, digitizing spatial information on gold grades, depth to bedrock, and the footprint of historic workings. Figure 10 shows the distribution of gold grades encountered by historic drill holes; when integrated with historic workings, a number of previously-unmined pay streaks are revealed. This project is reported on in more detail elsewhere (van Loon, 2017).

Yukon-Alaska metallogeny project

The Yukon-Alaska metallogeny project is a joint university-industry-government partnership initiated in 2014 that is focused on defining gold metallotects in southwestern Yukon and eastern Alaska. The project is being led by Murray Allan, Craig Hart and Jim Mortensen at the Mineral Deposits Research Unit at the University of British Columbia, and is examining local and regional structural and magmatic controls on gold mineralization in the region. YGS is supporting the project through the contribution of SINED funds.

SURFICIAL GEOLOGY PROJECTS

In 2016 YGS staff undertook five placer-related projects (two within the Klondike and three in glaciated areas) and two geohazard studies. Locations of these projects are shown in Figure 9.

Placer studies in glaciated areas

Jeff Bond began examining placer deposits in the Mayo mining district in 2016 (Fig. 9), documenting the character of the pay, which tends to be extensively re-worked by glaciers. He plans to extend his observations to other mines in the area over the next year or two, in order to better understand the factors that influence the preservation of placer deposits in glaciated terrains.

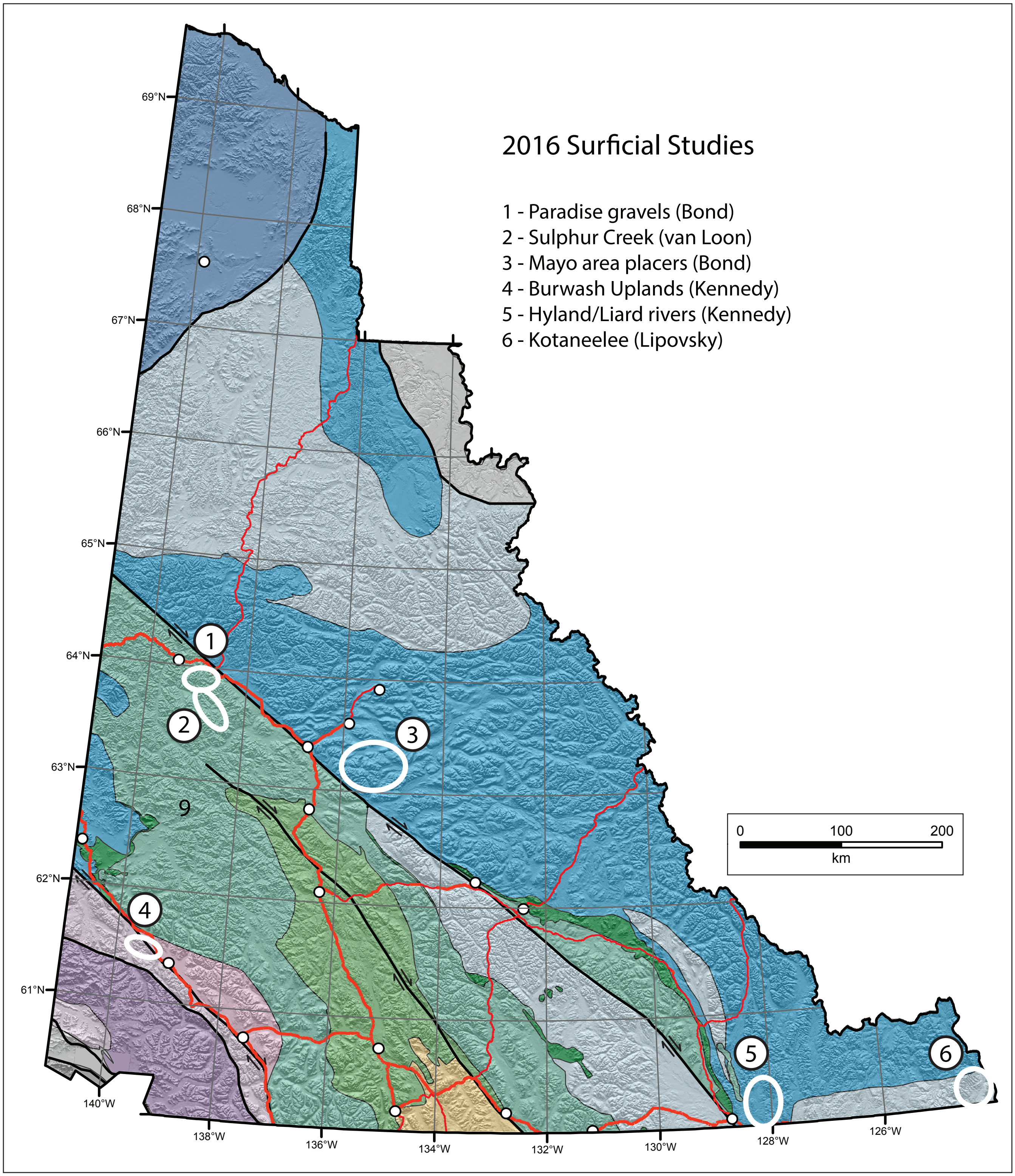

Figure 9. *Locations of surficial projects undertaken by YGS in 2016.*

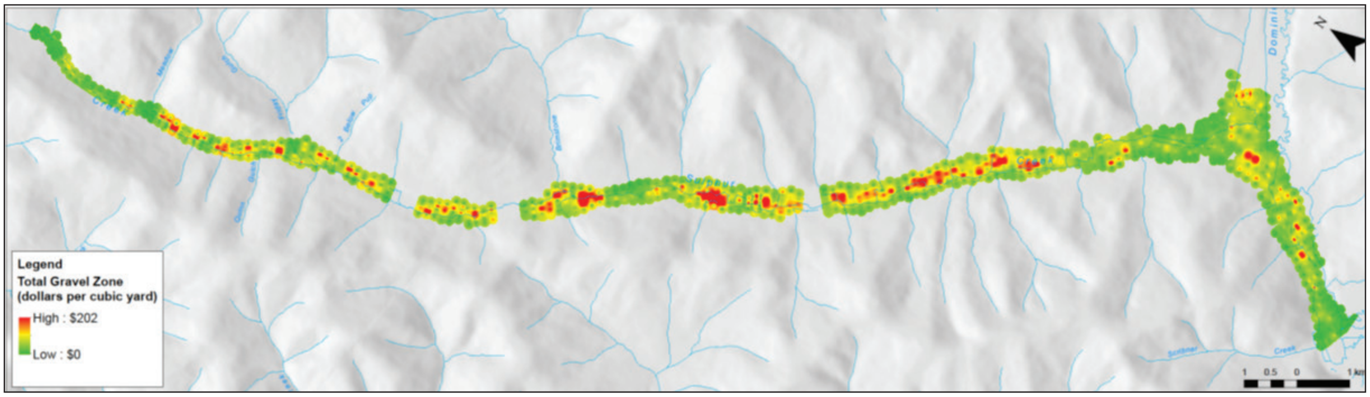

Figure 10. Distribution of gold grades along Sulphur Creek, generated from data derived from Yukon Consolidated Gold Corporation files (van Loon, 2017).

Kristen Kennedy undertook ten days' reconnaissance work along creeks that drain the Burwash Uplands southwest of Kluane Lake (Fig. 11). Over the next year, the project will examine the stratigraphy, glacial history and distribution of pay gravel of creeks in this region. Preliminary results of the work are summarized in Kennedy and van Loon (2017).

In southeastern Yukon, Kennedy visited two sites where a pre-glacial quartz pebble-rich gravel unit is exposed along the Liard and Hyland rivers (Figs. 9 and 12). She undertook the fieldwork with Nick Roberts (University of Lethbridge), who collected samples for paleomagnetic analysis to test the possibility that this gravel unit is age-equivalent to the White Channel Gravel.

Geohazard mapping in Old Crow

2016 marked the final year of collaboration between YGS and the Northern Climate Exchange (Yukon College) on a program to support climate change adaptation planning for communities. The community-based studies were underpinned by detailed surficial mapping led by Kristen Kennedy. The maps identify potential geologic hazards (*e.g.*, landslides, degrading permafrost, floods, *etc.*) and assess their risk against climate change models.

The most recently completed map was in the Old Crow area in northern Yukon (Kennedy, 2016). Kennedy travelled to Old Crow in the fall to present the results of mapping to the community.

Figure 11. Kristen Kennedy examining sediments exposed in a section along Arch Creek in the Kluane area.

Figure 12. *Section of pre-glacial quartz-rich gravel exposed on the Liard River.*

Landslide monitoring in Liard basin area

In September, Panya Lipovsky initiated a multi-year landslide monitoring project in the Liard basin area. Work included collection of LiDAR data from the Kotaneelee area (Figs. 9 and 13), funded by CanNor, and the installation and differential GPS measurement of 13 rebar monuments. The monument locations will be re-measured annually for three to four years to determine whether the area is seeing any active ground movement. Yukon government is currently overseeing well abandonment and remediation of the Kotaneelee site, and knowledge of slope stability will be an important factor in regulating the work.

GEOPHYSICAL AND GEOCHEMICAL SURVEYS

VTEM SURVEY OF LIVINGSTONE CREEK AREA

Between March and June, 2016, a SINED-funded airborne VTEM survey was flown over the Livingstone Creek area in south-central Yukon. Placer mines operating in this area have yielded anomalously large nuggets, but to date no bedrock source for the gold has been found. One of the intents of the survey was to refine the structural framework of the area to assist in targeting potential load sources for the gold.

Figure 14 is an image of the first vertical derivative magnetic map for the Livingstone Creek area, and Figure 15 shows conductivity. Colpron *et al.* (2017) have examined the survey results in detail, generating derivative maps and integrating them with bedrock geology observations. They identified a series of subtle, NNE-trending lineaments in the geophysics that locally coincide with late brittle faults. NNE-striking faults have been noted to exert control on gold grades along some of the few gold-bearing veins that have been found near Livingstone Creek. Colpron *et al.* (2017) also identified a number of interesting geophysical anomalies, including a conductor along the western contact of an Early Mississippian pluton in the central part of the study area (Fig. 15). The anomaly coincides with the headwaters of several gold-bearing creeks, suggesting a possible bedrock gold source.

The implications of the survey are not limited to bedrock mineral exploration, as magnetite-rich sediments along creek valleys locally reveal what appear to be stranded paleo-channels. These represent unexplored placer targets that justify further investigation.

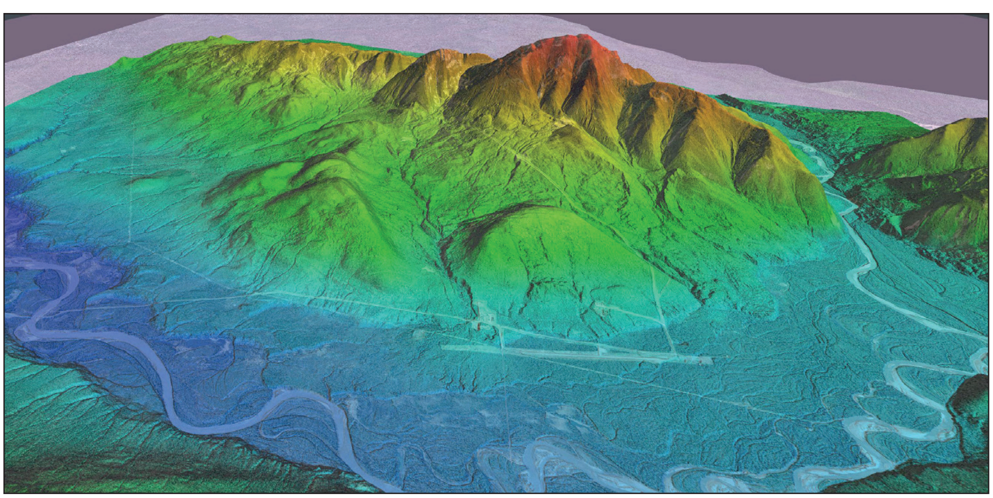

Figure 13. *3-dimensional image of the Kotaneelee area derived from LiDAR data draped over a satellite image.*

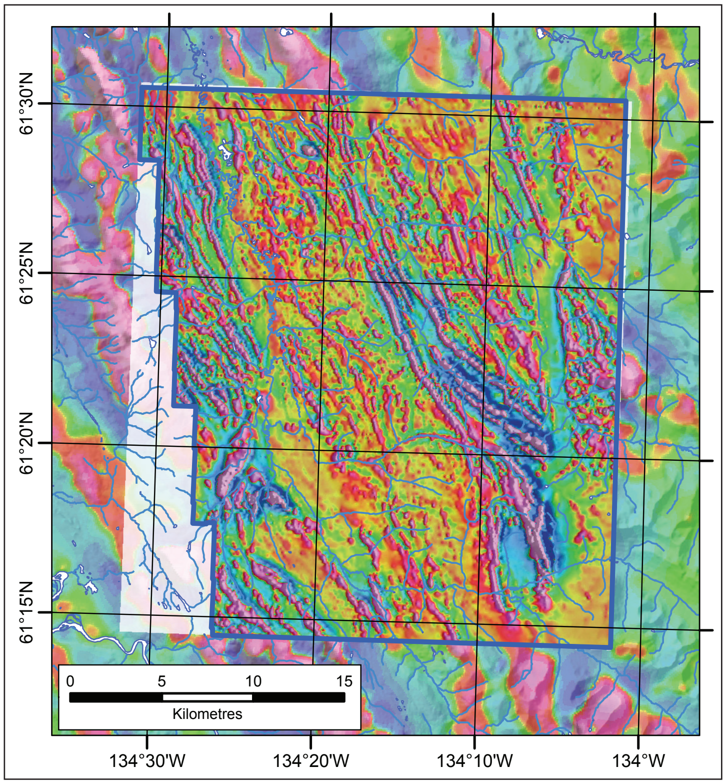

Figure 14. *Image of the first vertical derivative magnetic map for the Livingstone Creek area.*

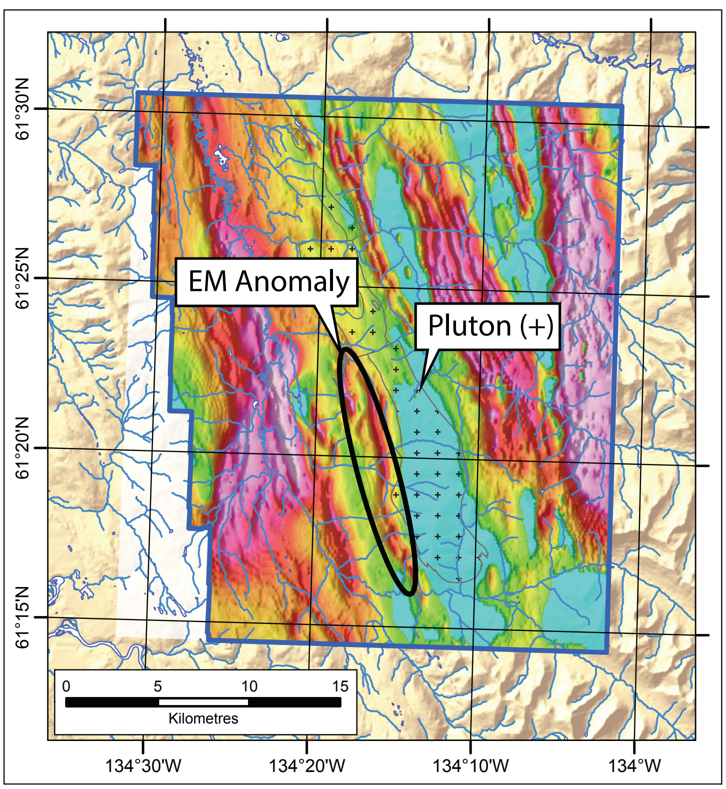

Figure 15. *Conductivity map, showing outline of Early Mississippian pluton. Conductor along west side of pluton is indicated.*

A more detailed description of the survey results and their geologic implications are presented by Colpron *et al.* (2017).

EARTHQUAKE MONITORING IN LIARD BASIN

In June, YGS worked with Michael Schmidt (Arctic Institute of North America) and Nanometrics to install five seismometers in the northern part of the Liard sedimentary basin. Four of the instruments belong to YGS and the fifth was purchased by the GSC.

The seismic instruments serve two purposes. First, a widespread network of seismic instruments is deployed (or will soon be deployed) across Alaska, Yukon, northern British Columbia and western Northwest Territories (Fig. 16). The bulk of the instruments are part of the U.S. Array project, a multi-year National Science Foundation-funded study being managed by a consortium of U.S. based universities. Other instruments currently installed in Yukon include ones operated by NRCan, and the universities of Ottawa and Colorado. South of the border, a BC-based seismic consortium operates several instruments to monitor seismicity induced by oil and gas development activity. The seismometers installed by YGS in the Liard basin area fill a gap in the existing coverage and will contribute to a more complete picture of seismic activity in Yukon.

The second reason for the Liard seismic installation is linked to the regulation of potential future oil and gas exploration in the region. The Exshaw-Patry shale in Yukon's portion of the basin was recently estimated to contain eight trillion cubic feet of marketable natural gas (National Energy Board, 2016), and although there are currently no plans for development of that gas, collection of regional baseline data will help to determine background levels of seismicity in the area in advance of any potential future development, as recommended in 2015 by the Select Committee on the Risks and Benefits of Hydraulic Fracturing. Data from the five new instruments will be integrated with seismic information being collected in northeastern BC to provide a more comprehensive picture of the crust in this area. This study is being supported with SINED funds.

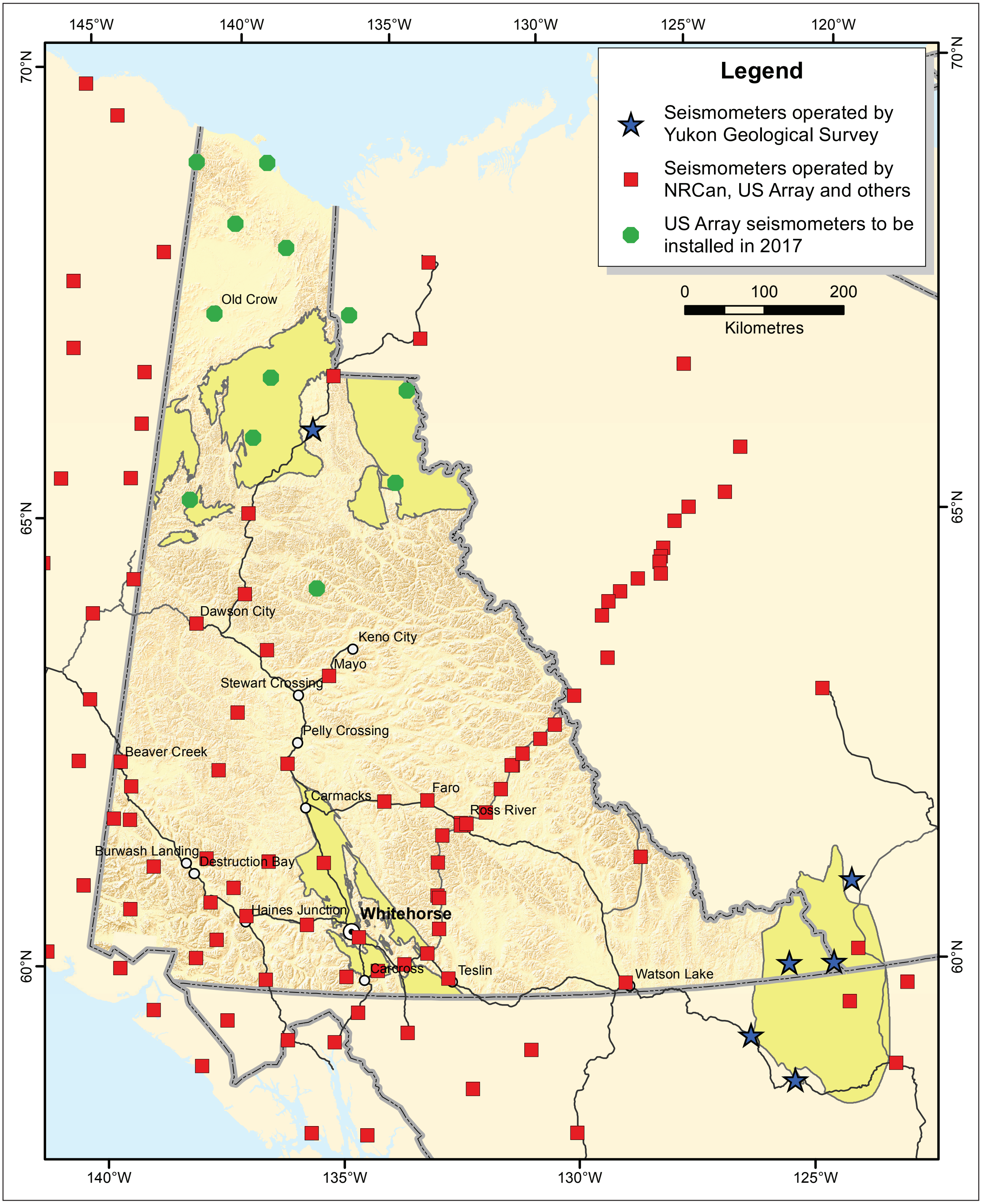

Figure 16. *Distribution of existing and planned seismic instruments in Yukon. Blue stars indicate instruments that are owned by YGS.*

REGIONAL STREAM SEDIMENT GEOCHEMISTRY

Upgrading of Yukon's stream sediment geochemical database has been ongoing for the past several years, funded primarily through SINED. In May, upgraded data for the final six map sheets were released (Jackaman 2016a to d). All available archived samples south of 65°N have now been re-analyzed via 53-element inductively coupled plasma mass spectrometry.

The upgraded geochemical data have been merged into a single layer that is viewable and queryable via the online Mapviewer, and can be downloaded as a single file by users. Metadata such as analytical technique, sample location and Open File number are linked to the individual samples.

In addition to upgraded geochemical analyses, YGS contracted CSA Global to generate probabilistic models for different mineral deposit types by integrating geochemical data with bedrock and surficial geology for each sample catchment. This SINED-funded project wrapped up last fiscal year and the final ten map sheets were released this fall (Mackie *et al.*, 2016a to g).

The sample catchment areas that were digitized for the modeling exercise are in the process of being merged across all Yukon map sheets south of 65°N (corresponding to the area for which modern geochemical data are available). These merged catchments will provide a useful backdrop for evaluating the geochemical data; for example, polygon size will provide information on sample dilution when interpreting the data, and will also highlight drainages where in-fill sampling would be beneficial.

GEOSCIENCE OUTREACH

In early June YGS and Yukon College co-hosted the annual joint meeting of the Geological Association of Canada and the Mineralogical Association of Canada (GAC®-MAC). The conference featured technical sessions highlighting northern Cordilleran geology and resources, and included five field trips and three workshops. Field trip guides, which were released by YGS in the fall, are a legacy product of the conference (Colpron *et al.*, 2016; McOnie, 2016; Mortensen *et al.*, 2016; Pigage and Rainey, 2016; Sack *et al.*, 2016).

A geologic highway map for southern Yukon (Laxton *et al.*, 2016) was also released at the GAC®-MAC conference; all conference delegates received a copy, and copies were distributed to schools and visitors' centres in communities over the summer. This map is the culmination of work started by Karen Pelletier, who delivered YGS' outreach program until her retirement in 2011.

Rather than holding YGS' annual geoscience teachers' workshop in the fall, this year's workshop was held in June, in conjunction with the GAC®-MAC conference. This allowed educators attending the conference from outside of Yukon to participate, and leveraged some of the resources associated with the conference for the workshop.

Over the summer, Laxton organized activities for classes attending Yukon Mining Week and led interpretive hikes in the Whitehorse area (Miles Canyon, Fish Lake, Whitehorse waterfront) and at Tombstone Territorial Park. The latter event included installing a plaque at the park centre commemorating the contributions made to geo-education over the years by Charlie Roots.

Leyla Weston backfilled the Outreach Geologist position early in the fall, organizing a number of school field trips and classroom visits. At the annual Geoscience Forum, she debuted YGS' new Augmented Reality Sandbox, a hands-on teaching tool that projects colour-shaded elevation topography onto hills and valleys created by students in a sandbox (Fig. 17). As users "play" in the sand, the topographic projection adjusts in real time to reflect changes in the sandbox landscape. The system, created at the University of California, Davis, was built by Brett Elliott and Craig Nicholson for YGS' outreach program, and will be brought into schools over the next year.

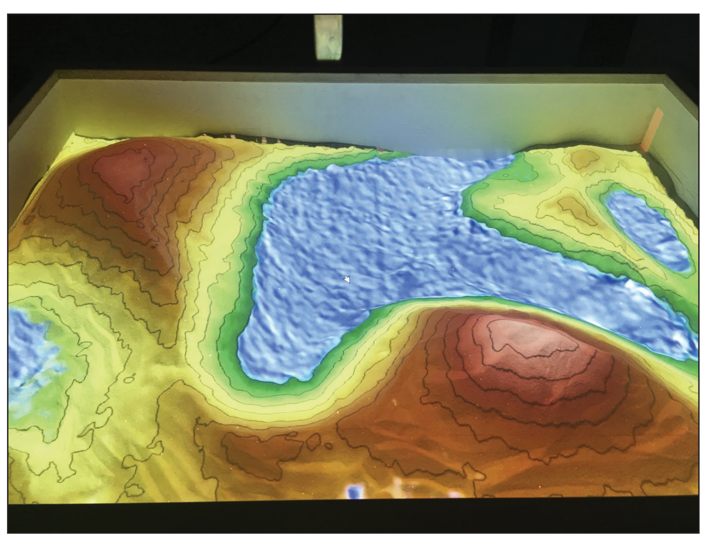

Figure 17. *Photo of coloured relief projected on "topography" in the Augmented Reality Sandbox.*

NEW ACTIVITIES

Following the territorial election in October 2016, the incoming government confirmed its commitments to exploring opportunities for renewable energy and to re-starting land use planning. Both commitments have implications for YGS priorities going forward, and as it turns out, and the survey already has work underway that align with these interests.

In response to federal commitments to renewable energy research, YGS initiated a SINED-funded study of geothermal energy potential over the summer, and following recent concerns about exploration in areas with unsettled land claims, YGS has been examining ways to update mineral potential maps in a timely manner to support land use discussions.

HEAT FLOW STUDY IN WHITEHORSE TROUGH

In 2015 the Canadian Geothermal Energy Association (CanGEA) undertook a Yukon-wide assessment of geothermal energy potential. Their report can be accessed at http://www.energy.gov.yk.ca/geothermal.html. The study, supported with SINED funds through EMR's Energy Solutions Centre Branch, concluded that Yukon has potential to generate 1700 MW of power from geothermal resources to a depth of 5 km, and it identified a number of areas with moderate to high potential for geothermal energy development.

One of the areas identified as having moderate to high potential corresponds closely with the Whitehorse trough sedimentary basin. The area's favourable potential, coupled the presence of an existing power grid and the fact that the bulk of Yukon's population lives in the area, led YGS to propose further work to assess the trough's attractiveness for geothermal exploration. The two-year study (2016-18), being coordinated by Maurice Colpron and Tiffani Fraser, will involve drilling two wells and instrumenting them with thermistor strings to directly measure heat flow.

The first well, scheduled to be drilled in spring 2017, will target an area near Whitehorse that is underlain by a young granite pluton. The planned well will be 500 m deep and will allow YGS to assess whether the pluton is a significant source of radiogenic heat. The second well, targeted for fall 2017, will test heat flow in a deeper well (to 1 km) within a thick section of sedimentary rocks of the Laberge Group along the Robert Campbell Highway.

In addition to the work focused on Whitehorse trough, YGS plans two additional studies. The first involves calculating the heat-generating potential of various Cretaceous and younger plutons for which whole rock geochemical data (in particular, U, Th and K) exist. The second will entail calculating Curie point depths from regional aeromagnetic data to generate a ~580°C isothermal surface map. The latter study will be carried out by Innovate Geothermal. Both studies are designed to advance knowledge of Yukon's geothermal potential by identifying areas with anomalous heat flow.

MINERAL POTENTIAL MAPPING

Two key challenges for land use planners in integrating mineral potential information into the planning process are understanding the nuances of mineral potential values and accommodating uncertainties, to ensure that decisions do not preclude future economic opportunities. Over the past year, Scott Casselman and Patrick Sack have been evaluating methodologies used by different jurisdictions to generate mineral potential maps and assessing how effectively those maps reflect not just mineral potential values, but the inherent uncertainties associated with those values.

Based on what they have learned from this exercise, they have adopted a system that assigns 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 mineral potential values assigned to each polygon subjectively reflect the confidence associated with the assigned values.

While this system is less rigorous than the Monte Carlo simulations undertaken for YGS' original mineral potential maps (Bradshaw and VanRanden, 2003) updating the maps will be relatively simple as the values are derived from the data tables behind the Yukon bedrock compilation map. As new data are incorporated into the compilation, the mineral potential values (and confidence for each value) can be updated very quickly, ensuring that land use planners have access to the most up-to-date information.

ONGOING YGS ACTIVITIES

INDUSTRY LIAISON

Scott Casselman, Patrick Sack and Derek Torgerson visited twenty-four mineral exploration properties in 2016, liaising with prospectors and company geologists, documenting exploration expenditures and tracking results. Highlights of this year's exploration and development activities are summarized elsewhere in this volume (Lewis and Casselman, 2017) and were presented at the annual Geoscience Forum in November.

In addition to field visits, Sack, Casselman and Relf represented YGS at the Yukon Mining Alliance's annual media tour and investors' forum in Dawson City in August, liaising with industry representatives and connecting with investors.

Jeff Bond and Sydney van Loon visited active placer operations in 2016, documenting information on gold distribution and character, work activity and geologic setting. An overview of 2016 placer highlights was presented at the 2016 Yukon Placer Forum and the Geoscience Forum, and is summarized in this volume (Bond and van Loon, 2017).

INFORMATION MANAGEMENT

In 2016 YGS released fifty-two publications (*see* the appended list of 2016 publications at the end of this volume) and eight external publications (including five in refereed journals). The 2016 Yukon Exploration and Geology volume, to be released early in 2017, contains thirteen technical papers describing 2016 project highlights.

Regarding data management, a new feature was added to the MINFILE database in 2016: it is an interactive map that displays the location of mineral occurrence(s) queried by the user. The map has a bedrock geology backdrop to provide a geologic context for the occurrences.

In the spring, YGS initiated a new SINED-funded project that involves digitizing the footprints of Assessment Reports (ARs) and capturing key metadata such as company, year, type of work and exploration expenditures. A preliminary map-based web application has been developed to display ARs (Fig. 18); it was demonstrated at the Geoscience Forum. The application has several filters which allow searches to be further narrowed, for example, by selecting reports with drilling or soil sampling results, and individual ARs can be interrogated with a query tool. Queries return metadata and a *.pdf copy of the report.

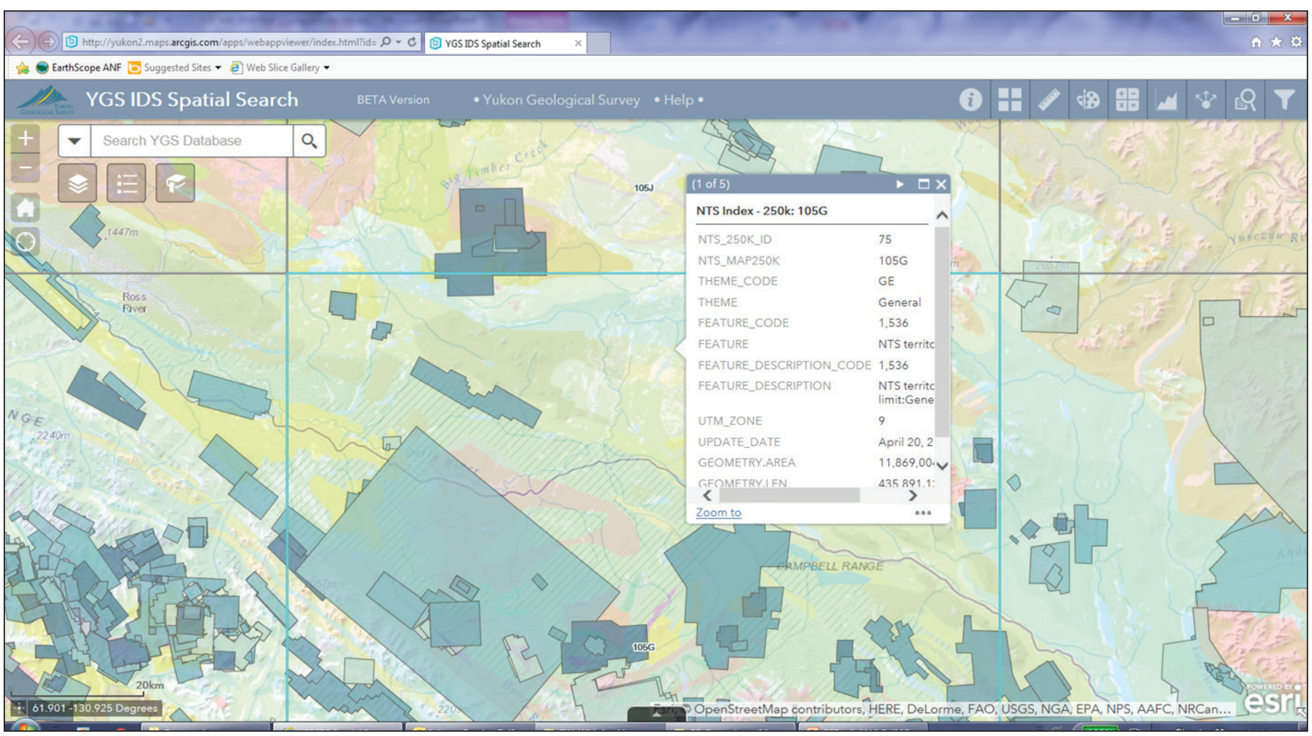

Figure 18. *Screen capture of the Footprints web application, showing the areal coverage of assessment reports and the tools available to users to query the reports.*

In addition to the AR Footprints application, ARs can be found via non-spatial YGS IDS searches, and MINFILE searches yield links to ARs (as references). Ultimately though, the spatial and temporal (*i.e.*, ARs by year) attributes of data in the AR Footprints application will make searches much simpler and will enable compilations of property work histories.

To date, roughly 3000 ARs have been captured (out of a total ~7000). YGS hopes to complete the backlog of reports by spring, after which point AR metadata will be captured as reports are submitted. YGS is working closely with the Mining Recorder to streamline the flow of AR metadata between offices so that footprint and metadata can be uploaded more efficiently. The survey is also contemplating creating an FTP site to allow clients to upload digital copies of ARs directly, as a first step in a longer-term vision to eliminate the requirement for paper submissions.

DRILL CORE COLLECTION

Between 2013 and 2015 the bulk of YGS' existing drill core collection was moved to the new core library to allow clients year-round access to the core. The survey's longer-term vision is to expand the collection so that all significant mineral occurrences and deposits in the territory are represented. The intent is to retain sample suites that represent the variable character of Yukon's mineral occurrences and allow clients access to the samples to support exploration and research.

Over the summer, YGS received donations of new core and drill logs from the Minto, Casino and Kudz Ze Kayah deposits. Descriptions of 2 of the donated collections are presented by Sack *et al.* (2017; Minto core) and Casselman and Brown (2017; Casino core).

This spring, YGS will web-enable selected fields from the drill core database to allow users to peruse core metadata and request access to samples. In cases where enough material is available, core may be sampled for assaying, thin sections, or other analytical purposes. Requests for more information on the drill core can be made to the core library manager (craig.nicholson@gov.yk.ca) or to the YGS Minerals Geology unit (YGS-minerals@gov.yk.ca). Policies for sampling and analysis will be posted when the web application is launched.

SUMMARY

2016 was another busy year for YGS, highlighted by capacity growth in the Mineral Geology unit. Mapping and industry liaison continue to be foundational activities of the survey, but new government commitments will see new research priorities and capacity emerge over the next few years.

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Yukon Placer Mining 2016 Development Overview

Jeffrey Bond* and Sydney van Loon
Yukon Geological Survey

Bond, J. and van Loon, S., 2017. Yukon Placer Mining 2016 Development Overview. *In:* Yukon Exploration and Geology Overview 2016, K.E. MacFarlane (ed.), Yukon Geological Survey, p. 21-33.

INTRODUCTION

The Yukon placer gold mining industry continued to show signs of stability and growth in 2016. Primary variables that affect the industry including gold price, the Canada-U.S. exchange rate and fuel prices remained favourable. For a good portion of the production season the price of gold surpassed (CDN) $1700/oz, while diesel prices remained 20% lower than the period 2011-2015[1] (NRCAN, 2016). Positive responses in the industry are also associated with the duration of the sustained strong gold price that has exceeded (CDN) $1000/oz for the eighth year in a row. In a privately funded industry, where growth is dependent on profit, the sustained prices have allowed miners to improve equipment, efficiencies and take greater expansion risks. The end result has been increasing production and an opportunity for new-comers to gain a foothold in the industry. An estimated 170 placer mine sites, that directly employed approximately 700 people, were active in 2016.

CLIMATE FOR MINING

Early season weather patterns continue to improve for the placer mining industry. Snow cover in Dawson City had melted by April 11th and the average maximum daytime temperature in April was 11.5°C. The average low temperature for April was also favourable equalling -2.1°C. These temperatures improved in May with average maximum temperatures reaching 18°C. Ample precipitation fell in the Klondike region and included a deluge in early August that challenged mining infrastructure in narrow valley settings. A mid-summer precipitation shortage was felt in southwestern Yukon where only 5 mm was recorded between July 24th and August 24th at the Burwash airport; this affected some high elevation mines in the Ruby Range. Fall temperatures were generally cooler across most districts with overnight lows dropping below freezing by the fourth week of September.

GOLD PRODUCTION AND VALUE SUMMARY

Placer gold production, according to royalty reporting, reached 65,646 crude ounces for the period May 1st to November 14th, 2016 (Fig. 1). Additional reporting is expected from the 2016 mining season that will likely bring the production total above 70,000 crude ounces. This is the highest production total since 2005 when 70,322 crude ounces were reported. The total value of the production as of November 14th is (CDN) $90.2 million, which, when adjusted for inflation is the highest value in 27 years (1989). The financial success of the industry in 2016 is owed in large part to the sustained gold price and favourable Canada-U.S. exchange rate that increased the value of an ounce of gold in Canadian dollars by a factor of 1.304[2].

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[1] *statistics calculated based on average weekly retail diesel prices for Whitehorse.*
[2] *average exchange rate from May 2nd to October 31st, 2016.*

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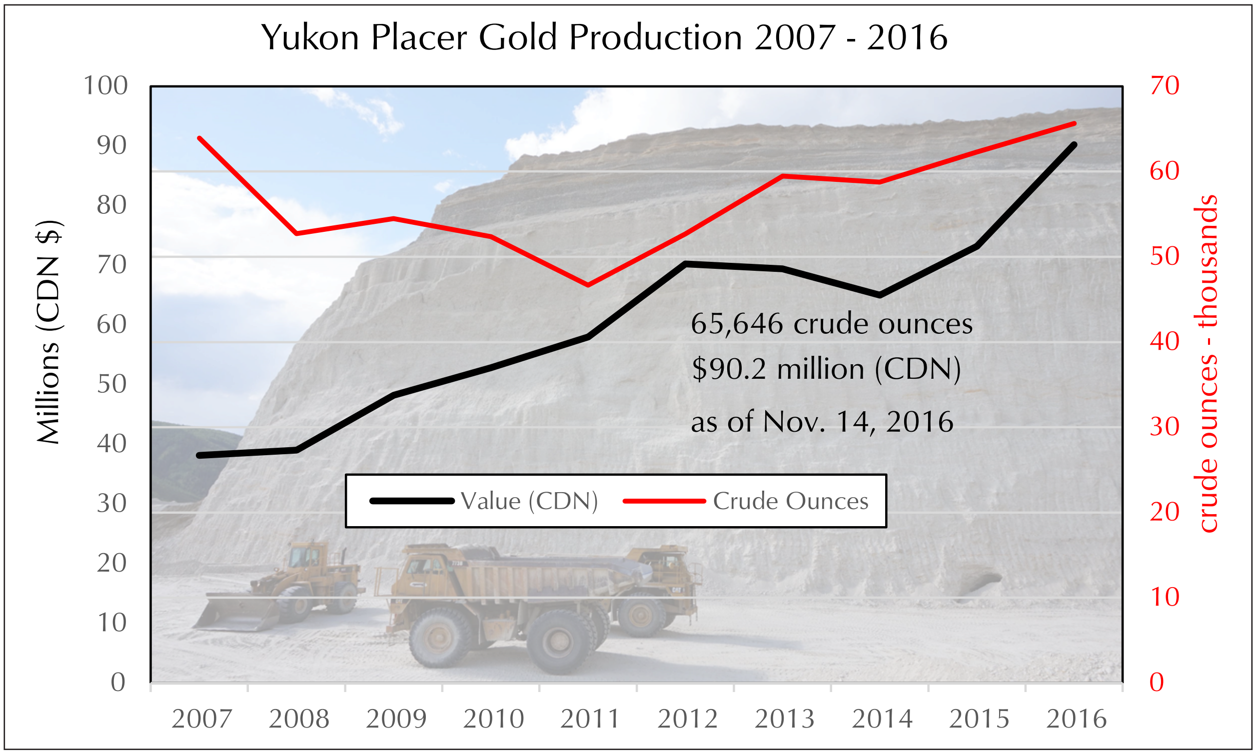

Figure 1. *A chart illustrating placer gold production and its value over the last 10 years. Production has been rising steadily since 2011 and its value in Canadian dollars is at a 27 year high.*

REGIONAL PRODUCTION SUMMARIES

Regional production summaries provide an overview from the various informal placer districts in Yukon. Production is reported in crude ounces from royalty figures from May 1st to November 14th, 2016.

INDIAN RIVER

The Indian River drainage consistently produces the most placer gold in Yukon. Significant placer gold producing tributaries within the Indian River drainage include Dominion, Gold Run, Sulphur, Quartz and Eureka creeks. In 2016, placer gold produced from the drainage amounted to 31,796 crude ounces or 49% of the total Yukon production (Fig. 2). Much of the Yukon placer production increase in recent years is owed largely to activity in the Indian River drainage. This year was no exception with production exceeding 2015 totals by more than 5,000 crude ounces.

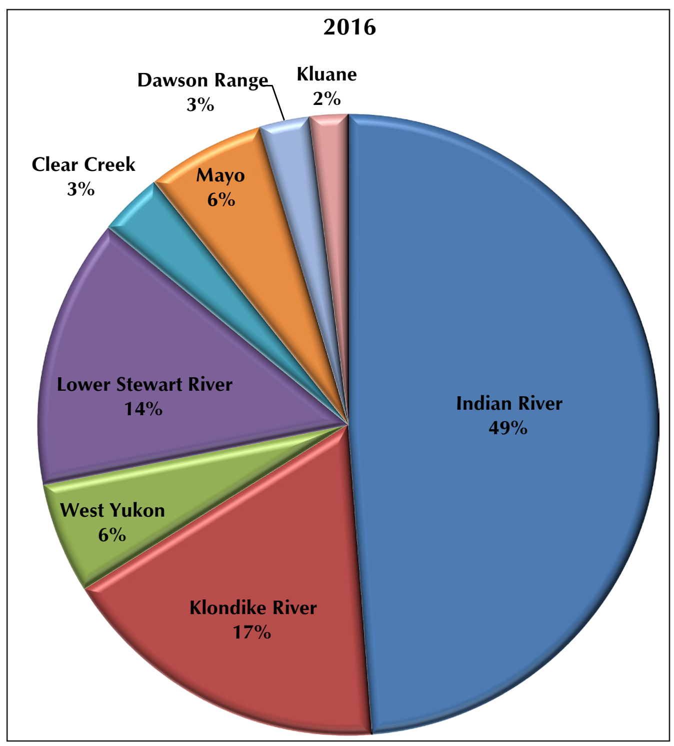

Figure 2. *A pie chart illustrating production from the various regional placer districts in Yukon. Unglaciated districts account for 86% of the placer gold production and include Indian River, Klondike River, West Yukon and Lower Stewart River.*

Quartz Creek

Large scale production continued from Schmidt Mining's operation on the Quartz Creek bench (Fig. 3). The White Channel Gravel pay zone varies between 61 and 91 m (200-300 ft) in width and has a total sluice thickness of 4.2 m (14 ft) including 2.4 m (8 ft) of gravel and 1.8 m (6 ft) of weathered bedrock. Overburden thicknesses are increasing towards the hillside and reached 23 m (75 ft) in 2016. Mining of the bench deposit continued upstream into Little Blanche Creek where undulations in the bedrock become more pronounced.

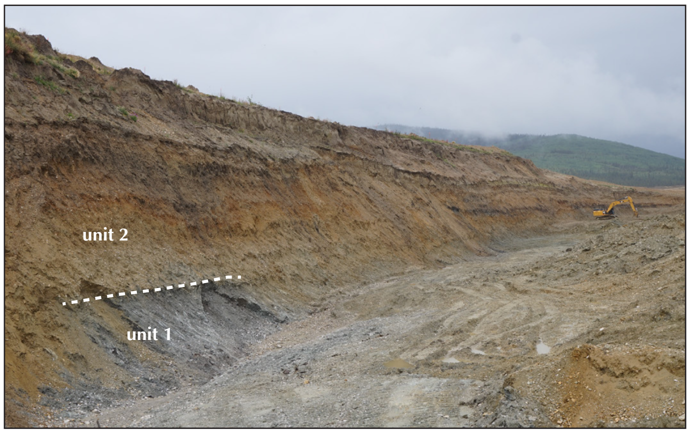

Figure 3. A view looking upstream along the right-limit of the Quartz Creek bench. A greyish gravel (unit 1) is visible near the base of the section. The lower 4.2 m (14 ft) of this unit is considered pay gravel and in places is separated from unit 2 by a woody layer representing a possible depositional hiatus. The section thickness measures 23 m (75 ft).

Canyon Creek

Two operations were active on Canyon Creek, a tributary to Quartz Creek. Schmidt Mining continued hydraulic stripping on the left limit of lower Canyon Creek and processed valley bottom pay gravel. In upper Canyon Creek, Lori Cail was actively mining valley bottom deposits in a narrow-valley setting (Fig. 4). The lower 1.5 m (5 ft) of gravel is processed and a 380 m-long (1250 ft) stretch of valley bottom was mined in 2016.

Eureka Creek

Fine Gold Resources operated up to four wash plants simultaneously on Eureka Creek and the Indian River in 2016. This included cuts both upstream and downstream of the mouth of Eureka Creek on the left limit of the Indian River and multiple locations within the Eureka Creek drainage. Notably, Fine Gold Resources continued exploitation of the large left limit bench resource on Eureka Creek, which has added confidence in the continuity of this lengthy resource (Fig. 5). Encouraging results were obtained from an exploration program on the upper left fork of Eureka Creek where Fine Gold Resources, in partnership with the Yukon Mineral Exploration Program (YMEP), completed a program of geophysics, drilling and a 3000 cubic yard bulk sample near the mouth of the tributary.

Indian River

Northern Exposure's efforts on the Indian River shifted towards evaluating the potential of previously disturbed ground near the mouth of Quartz Creek. Some of the first mining efforts on the Indian River in the early 1980s were conducted in this area, and at first glance, the area looks mined out. Northern Exposure's perseverance identified a section of partially stripped, shallow, virgin ground, near their camp measuring approximately 28 000 m^2 (Fig. 6). The gravel section was 3 m (9.8 ft) thick and was overlain by 0.3 m (1 ft) of overbank sandy silt. Additional testing and mining is expected within this disturbed area in 2017.

Figure 4. Lori Cail's wash plant and settling ponds on upper Canyon Creek. Mining can be challenging in narrow valley settings but Mr. Cail does an excellent job managing water quality and recontouring overburden so vegetation can re-establish.

Figure 5. *A view to the southwest of Fine Gold Resources left limit bench cut in 2016. Bulldozers are used to remove overburden and expose the pay gravel. The channel continues upstream in this photo and is visible by the change in slope at the base of the hill.*

Figure 6. *Al McGregor of Northern Exposure and geologist Kevin Kivi pose next to the Indian River cut they discovered in the disturbed area opposite the mouth of Quartz Creek. The entire gravel section visible in this photo was processed. Indian River Formation quartz pebble conglomerate forms the bedrock surface.*

KLONDIKE RIVER

Production from the Klondike River and its tributaries continued to be steady with 11,310 crude ounces reported. The largest contributions were from Hunker, Bonanza and Last Chance creeks (Fig. 2).

Dago Hill

Favron Enterprises had a successful year on Dago Hill targeting both the upstream and downstream edges of the Neogene bench, and a gulch deposit that drains into Last Chance Creek (Fig. 7). The gulch deposit contains gold that was reconcentrated from the high-level bench gravel following incision of Last Chance Creek into the Neogene surface 2.6 million years ago. Mining on the north rim of the Neogene bench exploited Paradise gravel (Fig. 7).

Cheechako Hill

A new project was initiated on the upstream (south) end of Cheechako Hill by Beron Placers (Fig. 8). The goal of this project is to mine the remaining bench gravel that was not exploited during hydraulic operations in the early 1900s. This component of the White Channel Gravel is adjacent to the main pay streak and represents the paleo-side channel of Bonanza Creek. To improve the economics of the project, Beron Placers is evaluating fine gold recovery techniques such as spirals and centrifuges in order to extract gold from the overlying low-grade gravel that would normally be stripped. Theoretically the fine gold extracted from the low-grade gravel will pay for stripping down to the enriched gravel near the bedrock interface. If their technique proves successful it could breathe new life into the remaining deposits on the Bonanza Creek benches.

Lovett Hill

Northern Shoveler continued to mine the White Channel Gravel near the mouth of Bonanza Creek (Fig. 9). This year's operation was closer to the Klondike River valley and under a greater thickness of Klondike River outwash gravel. The total section thickness exceeds 100 m (328 ft) with approximately equal parts White Channel Gravel and Klondike outwash. The pay gravel on bedrock was partially exploited by room and pillar mining in the early 1900s. Bostock (1957), reported in his compilation a grade of $2-$15 per cubic yard at $20/ounce, which

Figure 7. *Favron Enterprises cut near the north rim of Dago Hill. The section consists of Paradise gravel overlain by the former soil surface (black organics) and tailings.*

Figure 8. Beron Placers operation on the south rim of Cheechako Hill. A cross cut of the remaining White Channel Gravel was completed in order to evaluate gold grades both vertically and laterally on the bench. The elevated site will facilitate a tiered processing system in 2017.

Figure 9. A view to the north of Northern Shoveler's cut on Lovett Hill in late September, 2016. Much of the season was spent excavating to the high grade pay channel on bedrock.

equals $140 per cubic yard at the current gold prices. Northern Shoveler confirmed this grade while processing the remaining gravel in the underground workings. A hydraulic stripping program is planned for 2017 to assist in overburden removal.

All Gold

Dulac Mining shifted their focus onto the left limit bench of All Gold Creek in 2016 (Fig. 10). An accumulation of knowledge gained from mining in the valley bottom indicates that placer gold contributions or pay streaks originate from tributaries that eroded the left limit bench. This is further supported by old timer workings found over a significant area on the bench. The 2016 mining program excavated a cut measuring 45 m (148 ft) in width and discovered an economic gravel that is likely correlative with the White Channel Gravel in Hunker and Bonanza creeks. The lowermost unit is a cobble-pebble gravel measuring 3.4 m (11 ft) in thickness (unit 1; Fig. 10) and is overlain by an oxidized pebble-rich gravel that is 6 m (20 ft) in thickness (unit 2; Fig 10). Capping the section is a finely-bedded glaciolacustrine silt to fine sand that was deposited when the All Gold Creek was dammed by a late Pliocene to early Pleistocene glacier in Tintina Trench (unit 3; Fig. 10). Placer gold mined from the bench is identical in character to the gold found in the pay streaks in the valley bottom. This discovery will add considerable mine life in All Gold Creek.

LOWER STEWART RIVER

Production from tributaries to the lower Steward River continued to rise for the third year in a row. The total production, largely from Henderson, Black Hills, Kirkman, Maisey May and Scroggie, was 9174 ounces (Fig. 2).

Henderson

H.C. Mining focused their operations on lower Henderson Creek, with activity also on a left limit bench (Fig. 11). Progressively mining downstream towards the Yukon River, they targeted a 1.2 m (3.9 ft) thick poorly sorted, cobble-pebble gravel that overlies a 0.7 m (2.3 ft) thick mixing zone of gravel and weathered bedrock. Up to 1.8 m (6.0 ft) of weathered mafic schist bedrock was sluiced. A lower left limit bench was also exploited as a result of exploration in 2015. The bench contains 12 m (40 ft) of pebble-gravel with consistent grades; this represents a significant continuation of mineable ground remaining on Henderson Creek.

Figure 10. *Dulac Mining's cut on the left limit bench of All Gold Creek. Units 1 and 2 represent the Pliocene gravel that is equivalent in age to the upper White Channel Gravel. Unit 3 is a glacial lake sediment that was deposited during one of the first glaciations to block drainage in the Tintina Trench. The oxidized horizon at the top of unit 2 is the former pre-glacial soil about 2.6 million years old.*

Figure 11. *H.C. Mining operation on lower Henderson Creek in 2016.*

Black Hills

Rod Smith and Paydirt Holdings, located on upper Black Hills Creek, continued to focus on a left limit bench gravel that is overlain by 20 m (66 ft) of muck (Fig. 12). According to geophysics and drilling, the bench has a width of 46 m (150 ft) and only the rim has been exploited to date. This prospect has considerable length and the focus for 2017 is to expose a larger section of the deposit to determine its viability.

Brewer

Coulee Resources moved a part of their operation from Davidson Creek in the Mayo district to Brewer Creek, a tributary to the lower Stewart River. Limited development work has been completed on this creek in the past so efforts focused on building camp and excavating an initial cut to test the valley bottom pay gravel (Fig. 13).

WEST YUKON-FORTY MILE, SIXTY MILE AND MOOSEHORN

Production from placer creeks west of the Yukon River has declined over the past 3 years from 7236 crude ounces in 2013 to 3767 crude ounces in 2016 (Fig. 2). This trend is partly due to reduced activity from Matson, 10 Mile and Miller creeks. Despite the lower production total this district is seeing an increase in exploration activity and new operations have started in California Creek, 12 Mile Creek, Enchantment Creek and the 60 Mile River benches near the mouth of 12 Mile Creek. This added attention in the district will undoubtedly increase production in the coming years.

Sixty Mile

M2 Gold, who is also active on the lower Indian River, initiated an option on the Hakonson claims on the left limit 60 Mile River bench at the mouth of 12 Mile Creek (Fig. 14). The focus in 2016 was to test the viability of the bench and valley bottom deposits in order to make a long term investment decision on the property. The bench gravels are relatively thin and overlain by an apron of silt (loess) that increases in thickness towards the valley side. Near the rim of the bench the fluvial gravel is 1.5 to 2.0 m (5-6.5 ft) thick and overlain by 2.8 m (9 ft) of muck. A cut measuring 50 by 750 m (164 by 2461 ft) was mined in 2016 which represented only a narrow portion of the benches overall width.

Glacier

K-1 Mining was active on Glacier Creek, a tributary to 60 Mile River, in 2016. One of their objectives in the upper parts of the drainage was to follow the wandering valley bottom pay streak onto a low terrace under the right limit colluvial blanket (Fig. 15). The section consisted of 2 m (6.6 ft) of Glacier Creek gravel overlain by 14 m (46 ft) of frozen colluviated angular bedrock, massive ice and silt. The majority of the placer gold is found within 0.3 m (1 ft) of the bedrock contact and therefore the sluice volume is relatively low. An old timer drift is present in the area, which adds further support that the pay streak trends well over to the right limit.

Figure 12. *Exposure of the left limit bank at Rod Smith's mine on upper Black Hills Creek. The pay gravel is overlain by 20 m of ice-rich muck and a monitor is used for stripping.*

Figure 13. *A view down Brewer Creek of Coulee Resources' camp and first cut.*

Figure 14. *M2 Gold's operation on the 60 Mile River bench in 2016. A 50 m-wide cut was processed along the rim of the bench using two excavators and a mobile plant.*

Figure 15. *A view of the right limit bank on upper Glacier Creek. K-1 Mining is excavating the pay streak under colluviated weathered bedrock and muck.*

California

Clayton Construction, a newcomer to the placer mining scene, in partnership with Yukon Exploration Green Gold Inc., started a new mining operation in the upper California Creek drainage in 2016. Efforts this season included road building, mine training and exploitation of a valley bottom deposit. Bands of marble bedrock crosscut the valley providing a unique and challenging bedrock character on the property. Fluvial erosion and mass wasting of the marble has created an undulatory bedrock surface that is more difficult to clean (Fig. 16). This characteristic may also be responsible for trapping some of the placer gold.

CLEAR CREEK AND MAYO

Production from the Clear Creek and Mayo district has steadily increased in recent years with a combined production total of 6161 crude ounces in 2016 (Fig. 2). Increased production from streams like Granite and Minto creeks is a large part of the success in the district. This is expected to continue in coming years with new attention given to the Little South Klondike tributaries that lie east of Clear Creek.

Barlow

Storm Structures operated two shifts on lower Barlow Creek in 2016 and estimated that 120,000 cubic yards was processed (Fig. 17). The pay gravel is a 2 m-thick (6.5 ft), poorly to moderately sorted, boulder-rich unit that overlies a false bedrock of sand. The upper surface of the pay preserves a paleo-soil that contains silt, which was affected by cryoturbation and is more compact compared to rest of the underlying pay material. This compact layer provides a good marker to identify the top of the economic gravel. Overlying the pay gravel is modern Barlow Creek gravel, which consists of a cobble-pebble gravel, fewer boulders and is often capped by 1 m (3 ft) of overbank fluvial silt.

Figure 16. *Bands of marble bedrock have created an unusual bedrock surface at the base of upper California Creek where Clayton Construction and Yukon Exploration Green Gold Inc. is operating.*

Big

Test mining was initiated on a tributary to Big Creek in the Little South Klondike River drainage. Schmidt Mining optioned the ground from Yukon Exploration Green Gold Inc. and opened a cut on an unnamed right limit tributary to Big Creek (Fig. 18). Little is known about the placer deposits in this drainage and how early Pleistocene alpine glaciation may have affected gold distribution. Results were encouraging in 2016 and operations are expected to expand in 2017.

Granite

Davies Contracting continued to mine on upper Granite Creek in the Gustavus Range southeast of Keno City. Placer gold is being extracted from a pre-last glaciation till that underlies an alpine glacier end moraine from the last glaciation (Fig. 19). This unique placer setting likely developed when a local alpine glacier in upper Granite Creek reworked a pre-existing fluvial gravel enriched with coarse gold. Evidence of glacio-tectonic thrusting of near surface bedrock is also present within the economic deposits, which may have inverted the stratigraphy of the pay zone by emplacing stratigraphically lower units higher in the section. In 2017, mining is expected to continue upstream where the older tills may have become reworked into till from the last glaciation.

Minto

Mining interests in Minto Creek, a tributary to Mayo River, have increased in recent years. Ken Wilson had the largest operation in the drainage near the mouth of Bennett Creek. The primary map unit in the valley bottom is a near surface coarse gravel that overlies a false bedrock of sand. A testing operation on a left limit bench at the mouth of Bennett Creek contained similar near surface stratigraphy, although the gravel appears to originate from Bennett Creek. Fine-grained sediment that forms the false bedrock in Minto Creek was likely deposited when the Cordilleran Ice Sheet, flowing from the east, dammed the mouth of Minto Creek valley causing the valley to in-fill with glacio-deltaic and glacial lake sediment.

Figure 17. *Storm Structures wash plant on Barlow Creek.*

Figure 18. *A view to the southwest of Schmidt Mining's operation on a tributary to Big Creek. Big Creek is the valley visible on the right side of the photograph looking toward West Ridge.*

Figure 19. *Jim Davies is mining oxidized (orange) till from under grey morainal sediment deposited during the last glaciation. The oxidized-gold-bearing till is likely from an older alpine glacier that reworked a pre-existing fluvial deposit.*

DAWSON RANGE

Production from the Dawson Range, including Mount Nansen and the Freegold Mountain placer camps, improved in 2016 to 1699 crude ounces (Fig. 2). Primary production was from Back, Nansen, Seymour and Summit creeks.

Seymour

Derek Dodge was active on Seymour Creek and made a significant investment decision to mine the deep channel based on a YMEP-funded drilling program in 2015. Early season work in 2016 consisted of a Boart Longyear mini sonic drilling program to further refine the orientation of the deep channel and develop a mine plan. Two Volvo 750 excavators were purchased and used to open up the channel that ranged between 27 and 30 m (90-100 ft) in depth (Fig. 20). The pay gravel is a rounded boulder-rich unit that was likely emplaced from high energy run-off from a former ice sheet near the drainage divide. Encouraging grades have been identified in areas of the channel that are wider and permitted the outwash flow to decrease. Mining will continue in the deep channel in 2017 and near surface pay gravel will be targeted at the mouth of Guder Creek.

Figure 20. *A view of the right limit deep channel pit on Seymour Creek in 2016.*

KLUANE

Placer gold production from the Kluane district in southwest Yukon was largely associated with mining on Gladstone, Burwash, Rabbit and Ruby creeks. The total production from the district was 1289 crude ounces with 60% of the production coming from Gladstone Creek (Fig. 2).

Gladstone

Tic Exploration had two wash plants operating on Gladstone Creek in 2016 and was the most productive mine in the Kluane district. Cuts on both the left and right limits mine down to a false bedrock of consolidated grey till that may have originated in the Ruby Range prior to the last glaciation (Fig. 21). The placer gold-enriched coarse gravel overlying the till can have different origins depending on the amount of reworking that has occurred in a particular location of the valley bottom. Deposits closer to the valley side were more likely to have been buried by slumped sediment and therefore protected from reworking. Deposits in the middle of the valley were likely reworked by recent fluvial activity. Regardless of the amount of reworking, economic placer deposits seem to be found on the till surface across the valley bottom.

Rabbit

A new operation, FTG Placers, in the Ruby Range initiated mining on Rabbit Creek, a tributary to Larose and 12th of July creeks (Fig. 22). Their focus was a near surface periglacial gravel on a fan-like deposit at the mouth of Rabbit Creek. The mine employed 6 crew and represents the first mining activity in the 4th of July drainage in a number of years. Activity is expected to increase in the area as a result of Sidhu Trucking buying the 4th of July Creek claims.

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Figure 21. *A view of the right limit excavation on Gladstone Creek. Mining efforts are focused in coarse gravel deposits overlying a compact till. Thick sequences of sediment are located above the excavation that contain past interglacial and glacial material.*

Figure 22. *FTG Placers operation at the confluence of Rabbit and Larose creeks in the Ruby Range.*

Yukon Mineral Exploration Program: 2016-17 Update

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Torgerson, D., 2017. Yukon Mineral Exploration Program: 2016-17 Update. *In:* Yukon Exploration and Geology Overview 2016, K.E. MacFarlane (ed.), Yukon Geological Survey, p. 35-41.

PROGRAM SUMMARY

The Yukon Mineral Exploration Program (YMEP) is a funding program, administered by the Yukon Geological Survey (YGS), that 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. 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 hardrock 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 www.geology.gov.yk.ca/ymep.html.

As in previous years, the 2016 program comprised three modules with different levels of funding available (Table 1).

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Table 1. *Summary of YMEP program guidelines. Please reference YMEP guidebook or www.geology.yk.ca/ymep.html for more detailed information.*

YMEP 2016 At A Glance			
	Grassroots	**Focused Regional**	**Target Evaluation**
Funding	max $15 000	max $25 000	max $40 000
Reimbursement rate	up to 100% of eligible expenses	up to 75% of eligible expenses	up to 50% of eligible expenses
Scope of work	to generate new targets	to generate new targets and advance existing ones	to evaluate and advance already known 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
Work to proceed on	on claims, leases, or crown land	on claims, leases, or crown land	on claims, leases, coal exploration licenses, or quarry leases, not crown land
Advance of funds	no advance	no advance	no advance
Work requirements	minimum 30 person-days in field, daily log and final technical report	no constraints on time in field, final technical report	no constraints on time in field, final technical report
Holdback/reports	15% of funds will be held back until submission of final reporting requirements		
Reporting deadlines	Project proposal: March 31, Status Report: September 30, Final Financial Report and Final Summary/Technical report: January 31 of following calendar year		
Confidentiality	reports will be kept confidential for 5 years	reports will be kept confidential for 2 years	
Module-specific eligible expenses	applicant cannot draw wages but wages for one assistant are eligible	n/a	road building costs up to 25% of YMEP contribution if pre-approved, drilling
Eligible expenses	conventional exploration work, assays, shipping, wages (applicant not eligible in grassroots module), WCB, contracts, equipment rental, daily field expenses, fuel, claim staking, reclamation, limited physical work		
Staking	staking costs up to 20% of eligible contribution		
Travel	travel within Yukon (truck, helicopter, *etc.*) up to 25% of eligible contribution		
Reimbursement rate guidelines	Expenses reimbursed according to YG guidelines. Private and commercial rates are provided. Private rates for heavy equipment are 75% of commercial rate as approved by YG.		
Non-eligible expenses	GST, recording fees, management fees, costs of applying for permits or licenses, project planning and compilation, legal fees, promotional expenses, transportation outside Yukon, underground work, preparation for mining, mining, acquisitions, repairs		
Compliance	applicants must ensure that all required permits, licenses and authorizations are in place and that their work programs satisfy existing laws and regulations		

UPDATE FOR 2016

Late in 2015, Yukon government recognized that economic conditions in 2016 were likely to continue to be challenging for the exploration sector, and so maintained the enhanced level of YMEP funding ($1.4M) for a third year in a row. As expected, interest in the 2016 program was strong, with YGS receiving 100 applications seeking nearly $2.9M.

A total of fifty-seven applicants were offered funding in 2016. Forty-two of the funded applications were for hardrock exploration projects (eight under the Focused Regional module and thirty-four under Target Evaluation); and fifteen placer applications were funded (all Target Evaluation). The majority of unfunded applications were considered eligible for funding, but budget constraints precluded them receiving support. 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.

Figure 1 shows the locations of YMEP projects that were funded in 2016. The majority of placer projects (ten) were centered in the Klondike placer district, with two projects in the Mayo/Keno area, two in the Mt Nansen area and one project in the Livingstone area. Hardrock projects were fairly evenly distributed throughout the territory. Gold was the most sought-after commodity of hardrock projects, with twenty-nine proponents exploring for structurally-controlled, epithermal, Carlin style, intrusion related and orogenic gold. Other targets included vein-hosted silver (two), porphyry copper (five), VMS style mineralization (two), jade (one), and magmatic massive sulphide copper/nickel/PGE prospects (three).

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

In 2016, hardrock projects accounted for 74% of the successful applications and placer projects accounted for the remaining 26%. Individual prospectors and private companies secured 69% of available funds, while public junior mining/exploration companies received 31% of the funds. The breakdown between the different modules and the demographics of the applicants over the past three years are outlined in Table 3. Over this period, the funding split between placer and hardrock sectors has been fairly consistent. The biggest change has been the increase in the share granted to individuals, from 30% in 2014 to 39% this year. This increase was at the expense of funding to publicly-traded companies.

To date, most 2016 YMEP projects have been successfully completed and preliminary results suggest there are several potentially significant discoveries resulting from the work.

Table 2. *Summary of total YMEP funding, application numbers, and module funding levels for fiscal years 2010-11 through 2016-17.*

Historical funding	2010-11	2011-12	2012-13	2013-14	2014-15	2015-16	2016-17
available funding	$1.67M	$570 000	$570 000	$1.17M	$1.4M	$1.4M	$1.4M
no. of applications	165	83	79	81	111	103	100
approved projects	83	34	29	55	51	62	57
max. funding level grassroots	$15 000	$15 000	$15 000	$15 000	$15 000	$15 000	$15 000
max. funding level focused regional	$25 000	$15 000	$15 000	$15 000	$25 000	$25 000	$25 000
max. funding level target evaluation	$50 000	$25 000	$25 000	$35 000	$50 000	$40 000	$40 000

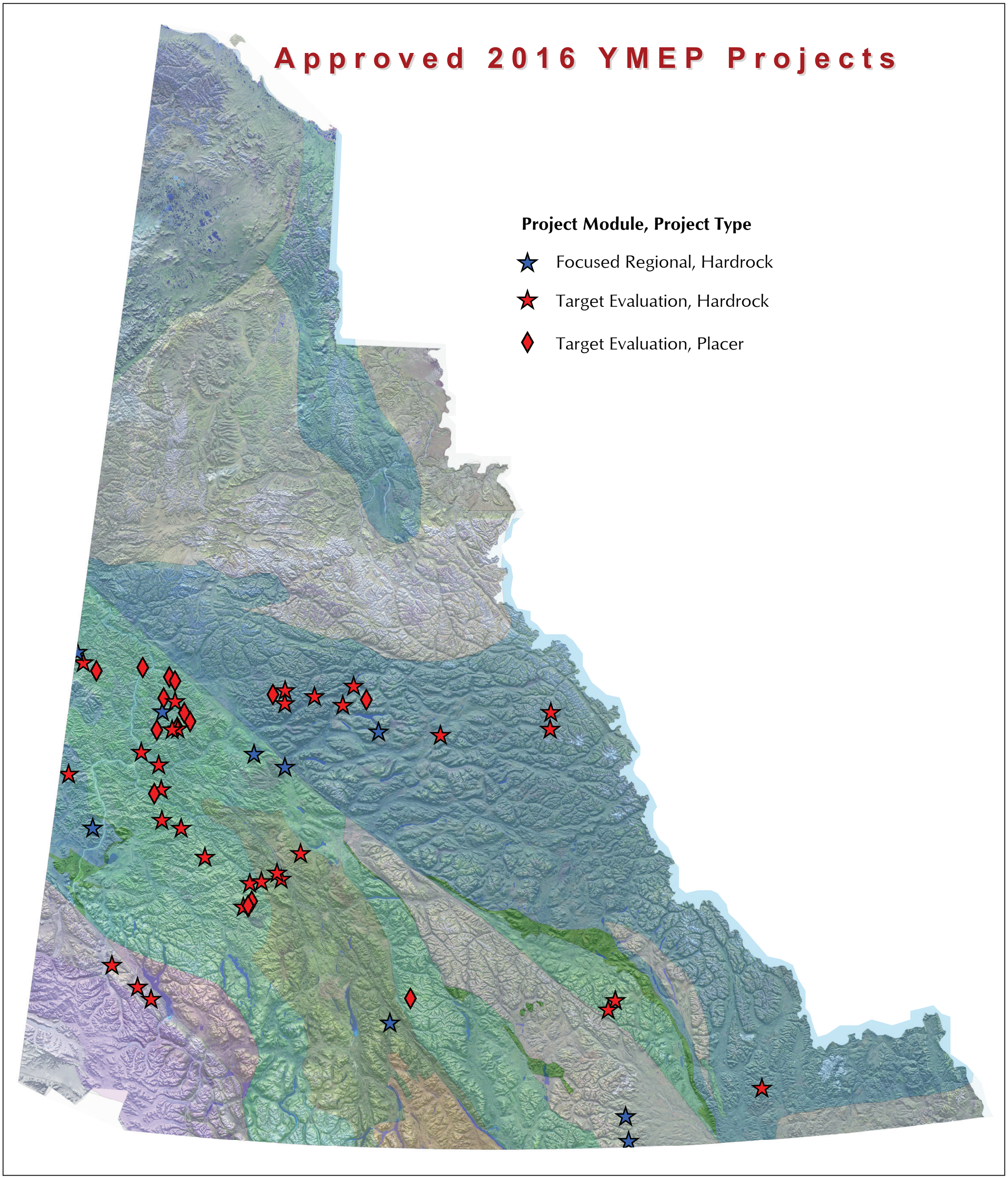

Figure 1. *Locations of approved YMEP exploration projects for 2016.*

Table 3. *Allocation of YMEP funds between sectors and funding for fiscal years 2014-15 through 2016-17.*

	2014-15		2015-16		2016-17	
Approved projects	**# of approved projects**	**% of approved funding**	**# of approved projects**	**% of approved funding**	**# of approved projects**	**% of approved funding**
approved placer	14	22%	15	28%	15	26%
approved hardrock	37	78%	47	72%	42	74%
total projects approved	55		62		57	
prospectors/ individuals	20	30%	24	34%	24	39%
private companies	12	29%	21	32%	16	30%
public companies	19	41%	17	34%	17	31%

YMEP PROGRAM REVIEW

In 2014, YGS undertook a client survey to measure how applicants perceive the program. A total of 67 responses were received from both successful and unsuccessful applicants. Responses indicated that the program has a significant impact on exploration, with a majority of recipients (91%) indicating that their grant contributed to their exploration success. The majority of respondents felt the funding levels and the proportion of matching funds required for each module were appropriate, and that evaluation criteria were fair. Responses varied regarding “fair share” between sectors, with placer sector respondents suggesting that placer applicants should receive an equal share (50%) of the funds.

As a follow up to the client survey, YGS compiled statistics on YMEP to allow the survey results to be compared to actual data (funding levels, success rates, applicants by sector, *etc.*). The compilation covered the last fifteen years, which is the period for which robust statistics exist. The data show that since 2000, YMEP has invested $14.8M in 846 projects leveraging $36.5M of additional exploration expenditures in the year the grants were awarded.

An analysis of the 2014 survey results and the data compilation is underway. The data reveal a significant increase in the number of placer applications since 2011. November 2010 was the second year that YGS held the (now annual) Placer Forum, and the first year that the author was invited to give a presentation at the forum to promote the funding program. The increase in interest by placer proponents is attributed largely to this effort to promote YMEP. Since 2011, the total amount of funding requested by placer applicants has averaged 23% of the total “ask” of all applications (Fig. 2a). Over this same period, placer applicants have received, on average, 23.5% of the available funds. While this suggests that placer applicants have been receiving a “fair share”, it also indicates that YGS could do a better job of communicating information about annual allocations, including the balance achieved between sectors.

While YGS has not yet had an opportunity to analyze the YMEP data in detail, a few trends are apparent. For example, applications for grants under the Grassroots module have decreased over the years, with a corresponding increase in applications under the Target Evaluation module. Figure 2b shows the breakdown of grants by module between 2010 and 2015.

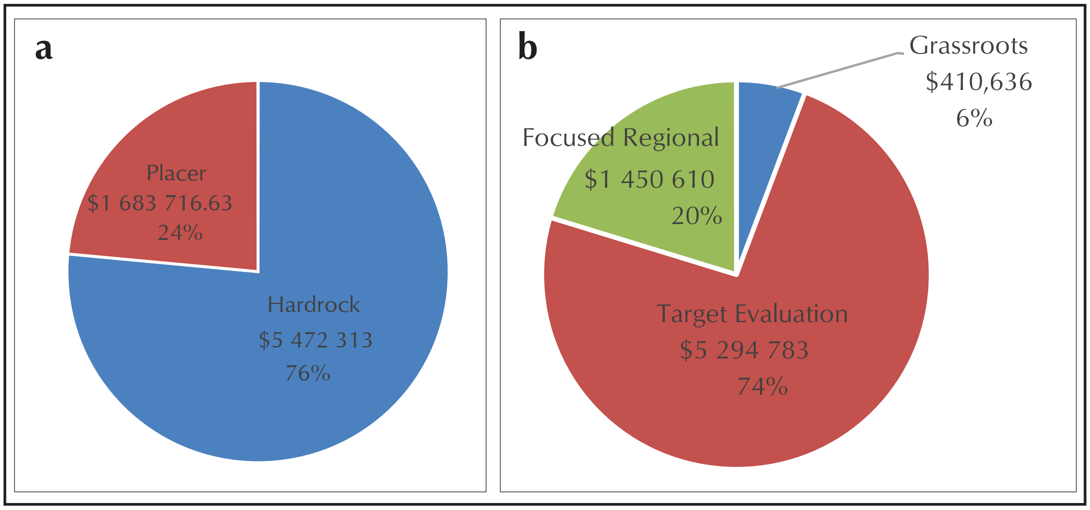

Figure 2. *Allocation of YMEP funds between 2010 and 2015, broken out by* ***(a)*** *sector and* ***(b)*** *funding module.*

The YMEP is designed to meet the needs of users of the program and to act as an engine for stimulating economic development, and YGS is open to making changes to the program to meet these goals. For example, YGS has begun consultations with operators in the placer industry with regard to the creation of a placer-specific funding module. Whereas existing modules describe exploration activities that apply to hardrock exploration, the draft Placer module includes exploration activities that are specific to placer exploration, such as shafting and geophysical surveys that target depth to bedrock. These discussions will conclude in January to allow time to include the new module in the 2017 YMEP competition.

In addition to allowing trends to be identified, the compilation of YMEP data is intended to enable success measures to be developed. Success can be measured by a number of indicators, such as dollars leveraged, new discoveries and option agreements entered. In 2016, YMEP recipients committed ~$4.5 M in exploration investment, corresponding to a leveraging ratio of over 3:1. 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. To that end, a number of encouraging YMEP discoveries were made in 2016 which should stimulate exploration expenditures in the years ahead. One junior explorer is in discussions to option their property to a Yukon based placer miner, and three prospectors were able to option or sell 100% interest in their projects to junior explorers. Other applicants have been in discussions regarding the optioning or sale of their YMEP funded projects. In total, fourteen potentially significant discoveries were made in 2016; these projects will be tracked by YGS going forward.

Looking back at other examples of YMEP-funded discoveries, the Coffee, Red Mountain and Andrew projects stand out as having stimulated significant investment beyond their initial YMEP-funded expenditures. The projects collectively represent a total investment in excess of $147M and have combined resources of 7.14 Moz gold, 990 Mlb zinc, and 238 Mlb lead with a contained value in excess of $12.1B. The total YMEP investment in these projects was $396K, corresponding to a leveraging ratio of 371:1. Figure 3 illustrates the relative investments of public (YMEP) vs. private funds in these three projects.

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. In the meantime, updates to program materials will be made for the 2017 call for applications. Application forms, scoring criteria and hardrock and placer program guidelines will be available for download by March 1, 2017 at www.geology.gov.yk.ca/ymep.html.

Figure 3. *Graphs showing total YMEP contributions (left axis) and company expeditures (right axis) over project life for **(a)** the Andrew project, **(b)** Coffee project and **(c)** Red Mountain project.*

Yukon Hardrock Mining, Development and Exploration Overview 2016

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Lewis, L.L. and Casselman, S., 2017. Yukon Hardrock Mining, Development and Exploration Overview 2016. *In*: Yukon Exploration and Geology Overview 2016, K.E. MacFarlane (ed.), Yukon Geological Survey, p. 43-59.

INTRODUCTION

Mineral exploration in Yukon began 2016 much like it finished 2015. Challenging equity markets and cautious investors meant junior exploration companies started the season conservatively; however, the mid-May announcement of Goldcorp Inc.'s (www.goldcorp.com) intent to acquire Kaminak Gold Corp. and its Coffee gold property was a significant boost to the industry. Subsequently, many companies expanded their field programs mid-season due to increased interest by investors.

Of the 65 hardrock exploration projects in Yukon in 2016, 17 were diamond-drilled and 10 were reverse-circulation or rotary-air-blast drilled (Fig. 1). Exploration spending was $57 million, a slight decrease from the previous year (Fig. 2). Fifteen projects tipped the expenditure scale of more than one million dollars, including three companies that spent more than $5 million: BMC Minerals at its Kudz Ze Kayah project, Goldcorp Inc. at the Coffee Project and Victoria Gold Corp. at its Dublin Gulch project. Across Yukon, almost 67% of exploration programs were gold-focused; the remainder were for lead, zinc, copper, nickel, silver, platinum group metals and jade.

Funding levels for the over-subscribed Yukon Mineral Exploration Program (YMEP) remained at (CDN) $1.4 million. A total of 57 placer and hardrock exploration projects were offered funding to offset exploration costs (*see* Torgerson, 2017 in this volume for more information). Claim staking for the year more than doubled that of 2015, with 7420 new hardrock claims staked. The overall number of claims in good standing remains high at 188 810 claims (Fig. 3).

The activities and results presented in this report are a summary rather than a comprehensive list of Yukon exploration, development and mining projects. Some results are still pending at the publication deadline of this volume. Summary statistics and analytical results are based on technical reports and news releases by companies and personal communication with company representatives.

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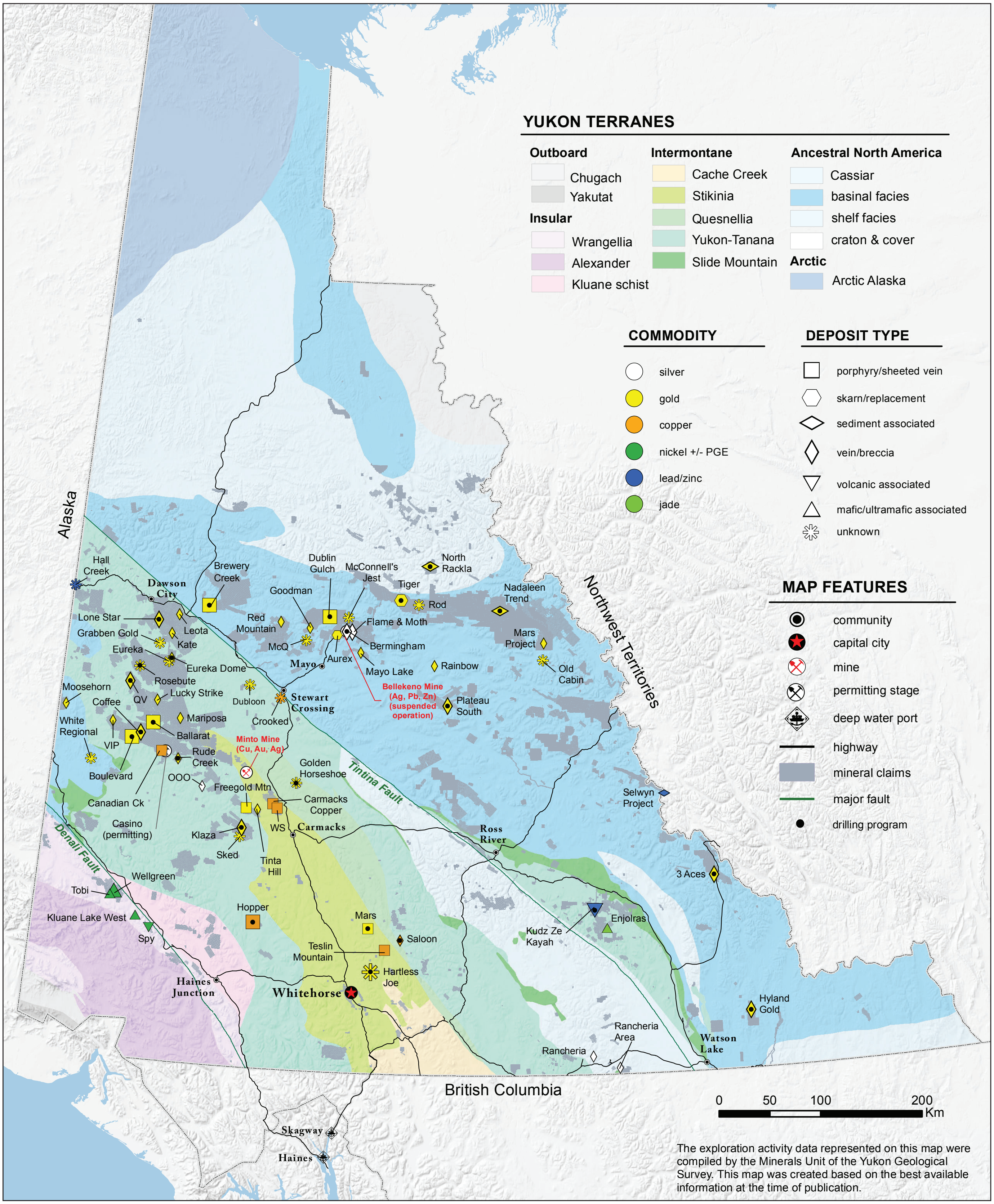

Figure 1. *Yukon exploration projects, 2016. Large symbols represent projects with estimated expenditures ≥$500 000, small symbols with <$500 000. Black dot in the centre of a symbol indicates that drilling constituted part of the exploration activities.*

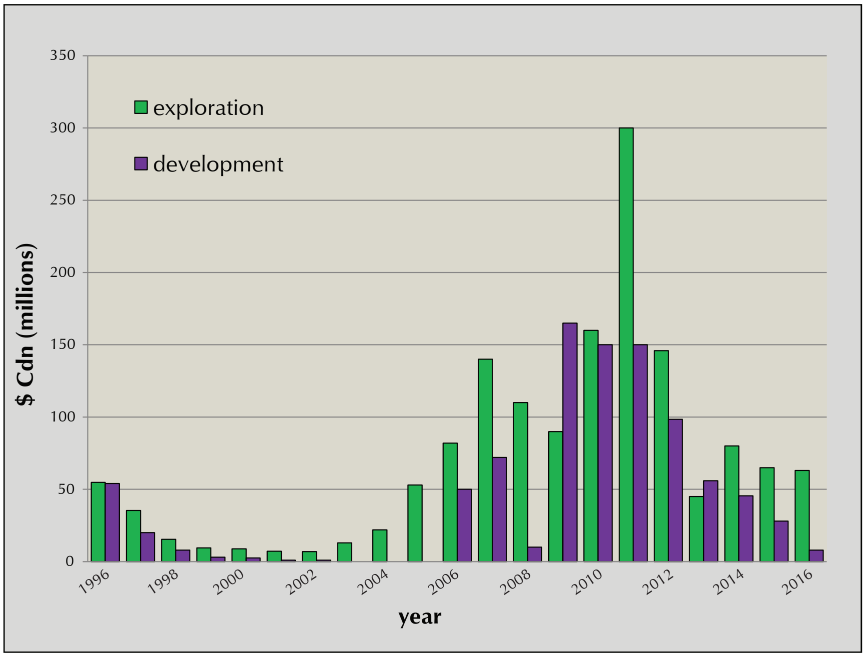

Figure 2. *Estimated exploration and development expenditures on Yukon projects, 1996-2016.*

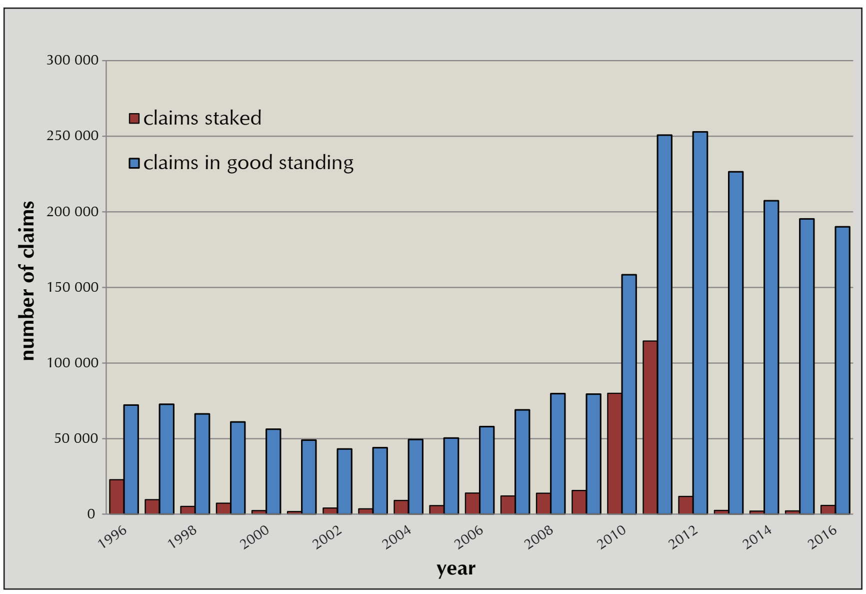

Figure 3. *Hardrock claims staked and in good standing between 1996 and 2016.*

MINING

Yukon's sole operating hardrock mine is Capstone Mining Corp.'s (www.capstonemining.com) **Minto** copper-gold silver mine (Yukon MINFILE 115I021, 022). The company mined out the open-pit Minto North deposit in September 2016, but continues to mine underground high-grade ore. Production for the first three quarters of 2016 totalled 22 625 tonnes of copper at a cash cost of $1.30 per pound, with by-products of zinc, molybdenum, lead, silver and gold. In December 2016 the company received approval to strip Area 2-Stage 3 for open-pit mining. Capstone Mining Corp. donated select drill core to the YGS's core collection in 2016. See the detailed property description for Minto in this volume for more information (Sack *et al.*).

MINE DEVELOPMENT

Overall development expenditures in Yukon in 2016 totalled $8 million, largely due to work done at Capstone Mining's Minto property, Goldcorp's Coffee property and Alexco Resources' Keno Hill property (Fig. 2).

ADVANCED PROJECTS

The industry was buoyed by positive news in mid-May with the announcement of Goldcorp Inc.'s (www.goldcorp.com) intention to acquire Kaminak Gold Corp. and its 100% owned **Coffee** gold property (Yukon MINFILE 115J 110, 111) in western Yukon. Kaminak shareholders approved the $520 million deal in July 2016. Exploration at the Coffee project was focused on the evaluation of early stage targets. Reverse circulation and diamond drilling were undertaken on seven gold-in-soil anomaly targets: Arabica, Supremo T8, T3 North, Espresso, Americano, Kazaar and Kona. Diamond drilling was also undertaken at the Latte deposit for metallurgical testwork of deeper sulphide mineralization. Goldcorp plans to focus on review and optimization of the Kaminak feasibility study (Fig. 4), First Nations consultations and studies to support the permitting process.

Victoria Gold Corp. (www.vitgoldcorp.com) continued to explore its **Dublin Gulch** gold property with 20 000 m of drilling on the higher grade Olive and Shamrock zones, located 2 km from the Eagle Gold deposit. A second phase drill program tested extensions of the mineralized zone at the Olive-Shamrock deposit. Diamond drill hole DG16-759c returned 29.1 m of 1.00 g/t Au and a slightly deeper intersection of 1.23 g/t Au over 6.5 m. Victoria Gold demonstrated the viability of its licenced Eagle mine through the release of a new feasibility study (JDS Energy & Mining Inc., 2016). The study determined all-in sustaining costs for the 33 700 tonne per day open-pit operation at (US) $638 per ounce. The project has a post-tax net present value (NPV) of (US) $508 million and an internal rate of return (IRR) of 29.5%. Annual gold production is estimated to be 190,000 ounces per year over ten years.

Alexco Resource Corp. (www.alexcoresource.com) explored its Keno Hill property with diamond drilling (17 371 m, 50 holes) on the high grade Bear zone of the

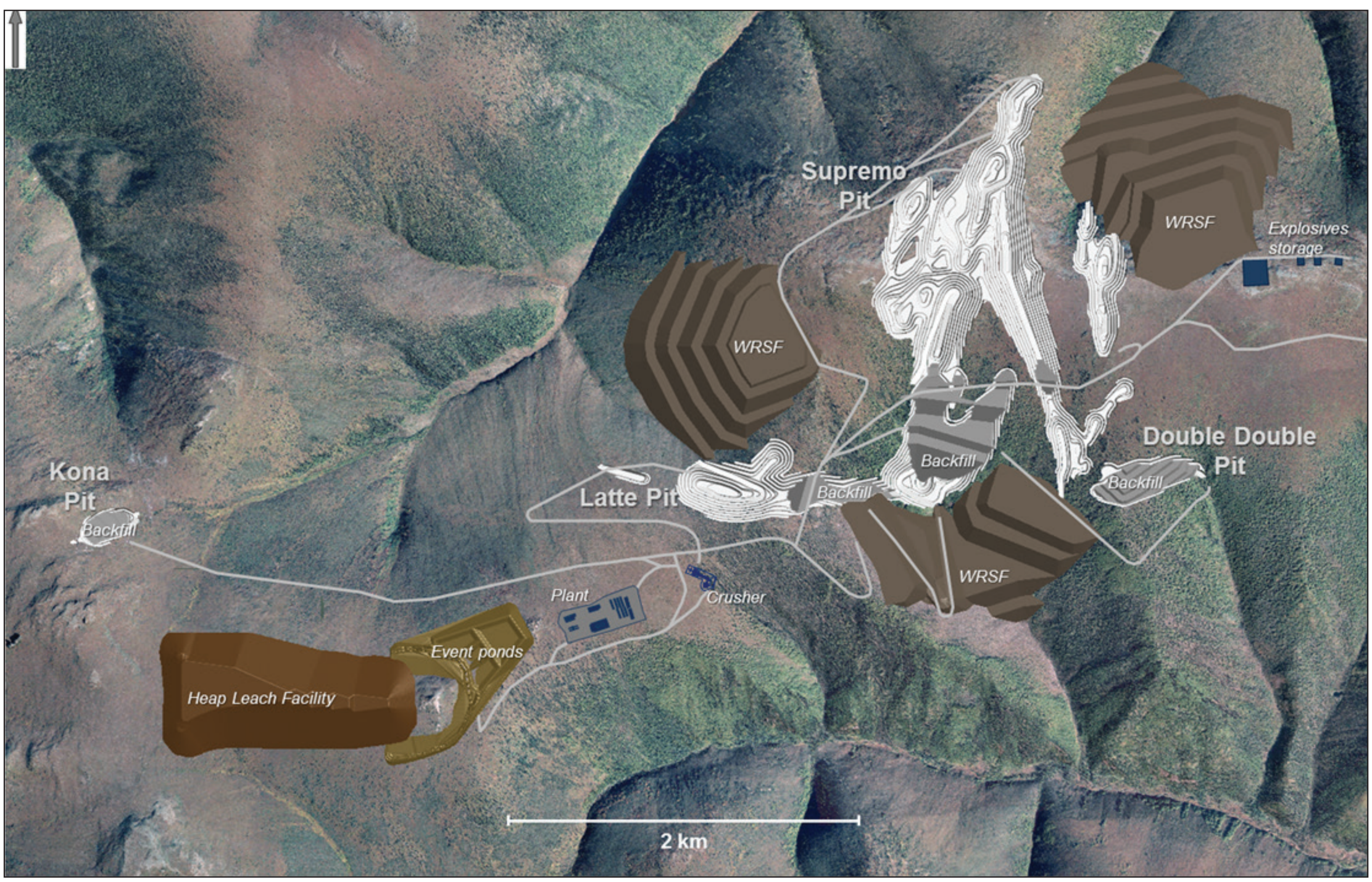

Figure 4. *Coffee Project end-of-mine site layout, 2016 Kaminak Feasibility Study. Image courtesy of Goldcorp Inc.*

Bermingham deposit (Yukon MINFILE 105M 086). A significant intersection assayed 2715 g/t Ag over 7.5 m in drill hole K-16-0608, which was drilled 100 m down-plunge from the deepest drill intercept from 2015. Alexco is preparing for an eventual return to production by collaring a portal into the recently discovered Flame & Moth deposit adjacent to the mill. The company has also initiated a mill assessment and maintenance program, and is undertaking hydrological drilling, geotechnical investigation, metallurgy and waste rock characterization studies in support of permitting. A new resource estimate for the Bear zone is being calculated and will be included in an updated Preliminary Economic Assessment.

Wellgreen Platinum Ltd. (www.wellgreenplatinum.com) advanced its mafic/ultramafic intrusion-hosted platinum group metals (PGM)-nickel-copper **Wellgreen** deposit (Yukon MINFILE 115G 024) in southwestern Yukon. Metallurgical testing was undertaken in April 2016 in order to refine recovery to produce either a marketable bulk Ni-Cu-PGM concentrate or separate marketable nickel and copper concentrates. A modest drill program (2503 m) of infill and exploration drilling was undertaken. The drill program was designed for resource expansion on the North Arm and Middle Arm of the Wellgreen deposit, upgrading the inferred resources in the Central zone and testing the continuity of high-grade intercepts at depth in the Central zone (Fig. 5). The company is updating the geological model based on 2015-16 drilling and is conducting baseline environmental studies required for permitting.

Copper North Mining Corp. (www.coppernorthmining.com) released a preliminary economic assessment (PEA) on its **Carmacks Copper** copper-gold-silver property (Yukon MINFILE 115I 008) in central Yukon, which included an updated resource calculation (Table 1). The PEA evaluated the recovery of gold and silver, along with copper using tank leach technology as opposed to heap leaching (JDS Energy & Mining Inc., 2016). The process involves agitated tank leach processing of the copper oxide mineralization to produce cathode copper, followed by agitated tank leach cyanidation and carbon-in-leach for recovery of gold and silver doré bars.

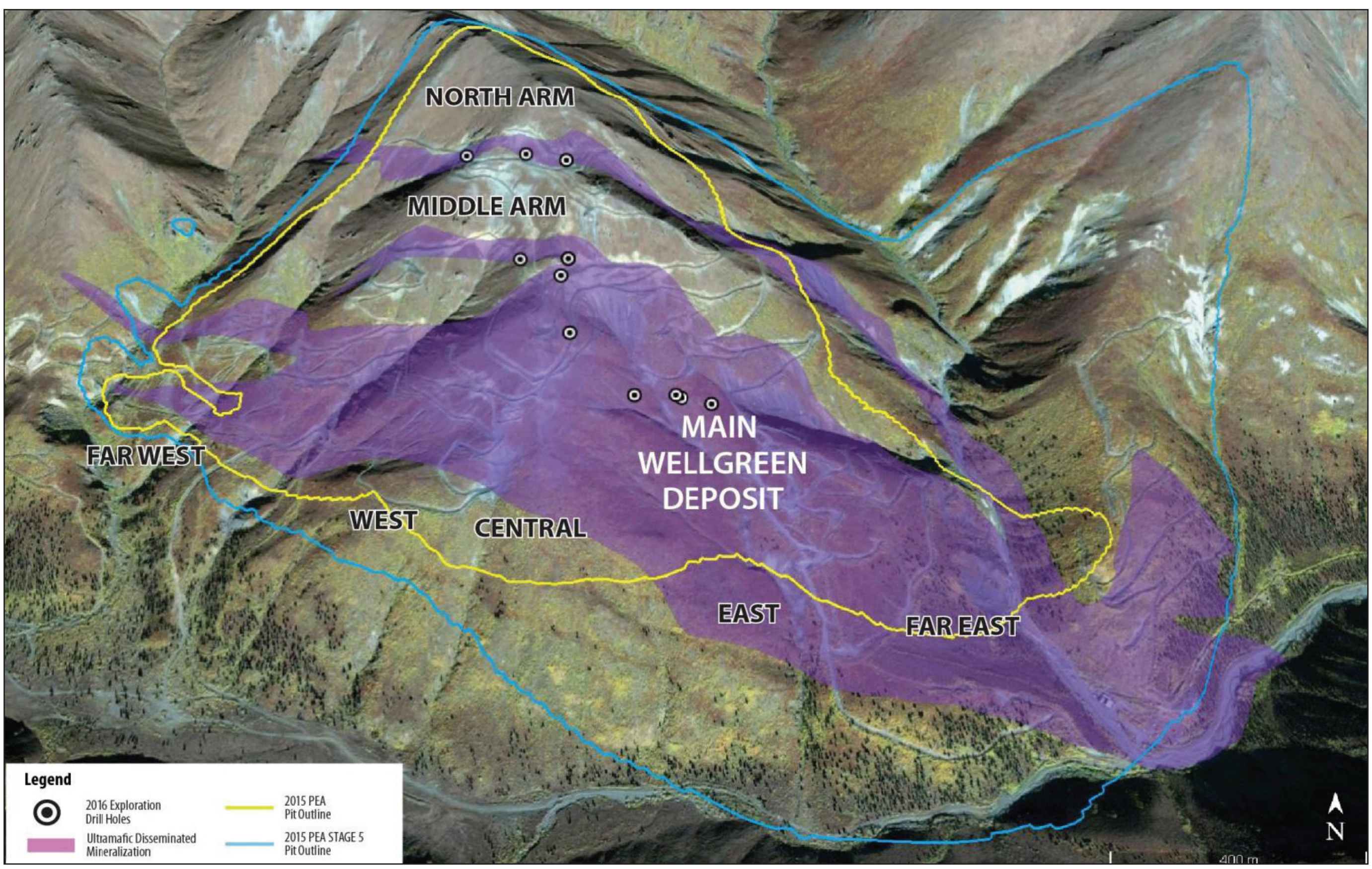

Figure 5. *Plan map of Wellgreen Platinum Ltd.'s Wellgreen property showing zones and 2016 drill hole locations. Image from Management's Discussion and Analysis, Nov. 10, 2016 from www.sedar.com, accessed December 5, 2016.*

Table 1. *NI 43-101 compliant resource assessment for Copper North Mining's Carmacks Copper property (JDS Mining and Energy, 2016b).*

Deposit	Classification	Tonnes (000)	Total Cu (%)	Cu (%) acid-soluble	Au (g/t)	Ag (g/t)
Oxide & Transition	Measured & Indicated	15 690	0.94	0.74	0.38	3.97
	Inferred	913	0.45	0.30	0.12	1.90
Sulphide	Measured & Indicated	8068	0.68	0.05	0.18	2.33
	Inferred	8407	0.63	0.03	0.15	1.99

Continued baseline environmental studies and redesign of the Tailings Management Facility are being undertaken by Western Copper and Gold Corp. (www.westerncopperandgold.com) at its **Casino** copper-gold porphyry deposit (Yukon MINFILE 115J 028) in western Yukon. Submission to the Yukon Environmental and Socioeconomic Assessment Board (YESAB) for panel review is expected at the end of 2017. In 2016, Western Copper donated select drill core to the YGS's core collection. See the detailed property description for Casino in this volume for more information (Casselman and Brown, 2017).

PRECIOUS METALS EXPLORATION – GOLD

Sediment associated

Atac Resources (www.atacresources.com) explored its extensive **Rackla Gold** project (Yukon MINFILE 106C 045, 055, 064) along the northern margin of Selwyn basin. The company filed a favourable PEA for the Tiger carbonate replacement gold deposit (Yukon MINFILE 106D 098) in the Rau trend. The PEA determined that the project has an NPV of $106.6 million and an IRR of 34.8% before tax, and an NPV of $75.7 million and an IRR of 28.2% after tax, with an all-in sustaining cost of (US) $864/oz. Work at the Airstrip anomaly (south of the Tiger deposit) included prospecting, mapping, soil sampling and RAB drilling. RAB drilling returned 3.05 m of 3.75 g/t Au, 1.52 m of 6.00 g/t Au and 13.71 m of 1.43 g/t Au in hole ASR-16-006. Work at Tiger East included prospecting, geological mapping and float sampling at a gold-in-soil geochemical anomaly 125 m away from the proposed Tiger deposit pit. Twenty-one oxide float composite grab samples were collected and assay values ranged from below detection up to 18.30 g/t Au. The company has submitted an application to YESAB for development of an all-season access tote road, partially on the pre-existing Wind River Trail, to the property. On the eastern Nadaleen trend, the company completed phase 1 rotary air blast drilling and phase 2 diamond drilling on the Orion zone, which was discovered in 2015. Diamond drill hole AN-16-010 successfully twinned the Orion rotary air blast discovery hole and returned 61.29 m of 2.75 g/t Au.

Vein/breccia

Golden Predator Mining Corp. (www.goldenpredator.com) conducted a significant program on its **3 Aces** property (Yukon MINFILE 105H 066) in southeastern Yukon. The company constructed a bridge over the Little Hyland River and completed an access road to the property. An airborne magnetic/radiometric survey was flown to elucidate the structure, rock types and alteration on the property. Interpretation of the results suggest there are two types of intrusions at depth under the property. More than 20 new mineralized quartz veins were discovered on the property in 2016, largely from trenching gold-in-soil anomalies. Golden Predator undertook panel sampling of trenches in several zones and completed 31 reverse circulation drill holes (3776 m) to test high-grade mineralization in trenches at the Ace of Spades and Jack of Spades as well as mineralized veins in the Spades, Hearts and Clubs areas (Fig. 6). Highlights from the RC drilling include 11.43 m of 31.89 g/t Au from a depth of 12.80 m, including 6.10 m of 50.50 g/t Au from hole 3A16-RC015. A PQ (85-mm diameter) core winter drill program was also completed (539 m).

Diamond drilling (8427 m, 44 holes) at Rockhaven Resources Ltd.'s (www.rockhavenresources.com) **Klaza** property (Yukon MINFILE 115I 067) in southwestern Yukon was focused on defining and expanding resources as well as testing geophysical and geochemical anomalies across the property. A new gold-rich vein zone was discovered through drilling the Rex zone. The Rex zone contains three near-surface veins (DDH KL-16-314: 1.39 m of 5.90 g/t Au, 1.42 m of 10.55 g/t Au and 1.48 m of 7.74 g/t Au) and was discovered while testing a strong chargeability anomaly at depth. Rockhaven released an

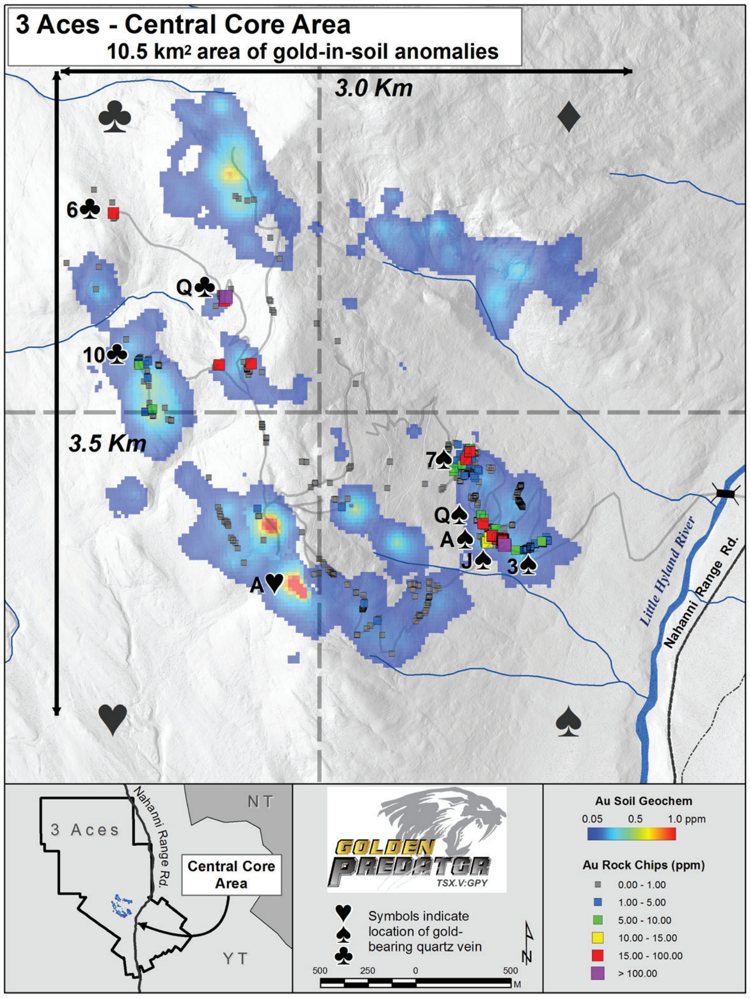

Figure 6. *Gold-in-soil anomalies in the Central Core area of Golden Predator's 3 Aces project. Image courtesy of Golden Predator.*

initial PEA for the property in March, 2016. The results of the PEA include a pre-tax NPV at a 5% discount rate of $150 million with a pre-tax IRR of 20% and a post-tax NPV at a 5% discount rate of $86 million and a post-Tax IRR of 14%. See detailed property description for Klaza in this volume (Turner and Dumala, 2017).

Goldstrike Resources Ltd. (www.goldstrikeresources.com) explored its flagship **Plateau Gold** property (Yukon MINFILE 105N 034, 035, 036) through diamond drilling (>1500 m in 11 holes) on the Goldstack zone (Fig. 7), one of several targets along the 50-km-long Yellow Giant trend. DDH PSGS-16-01 returned 6.05 g/t Au over 45.5 m, including 21.13 g/t Au over 12.25 m. All holes intersected mineralized stockwork and breccia and the zone remains open. Drilling indicates that the main control on mineralization is the Eldorado fault, a northeast-trending structure. A regional prospecting program on the property led to doubling the known strike length of the Yellow Giant trend to 50 km and staking additional ground on the trend.

Independence Gold Corp. (www.ingold.ca) completed a reverse circulation drilling program on its **Boulevard** property (Yukon MINFILE 115J 050), which is contiguous with Goldcorp's Coffee property in the White Gold district. A total of 1401 m of reverse circulation drilling was completed in 15 drill holes within the Sunrise-Sunset area. On the Sunset trend, multi-element soil anomalies within the 2.3-km-long trend were the focus of drilling. Drill hole BV16-54 returned 7.73 g/t Au over 6.1 m within a broader intersection that assayed 1.58 g/t Au over 39.6 m and ended in mineralization. The company also performed RC drilling on the Denali zone (1545 m, 15 drill holes), which lies on an interpreted extension of the Coffee Creek fault system, a major structure that transects Goldcorp's Coffee property. At Denali, YCS16-08 was drilled approximately 50 m downdip to the northeast from the 2015 discovery hole on the zone and returned 4.28 g/t Au over 4.6 m.

Independence Gold also conducted a rotary air blast drilling program (12 holes, 923.5 m) on the **Rosebute** property in western Yukon, optioned from Taku Gold Corp. Drilling on the Hudbay zone, a 1.3 km-long gold-silver-tungsten-molybdenum soil geochemical anomaly, intersected multiple zones of low-grade gold mineralization, e.g., RO16-15 - 0.50 g/t Au over 36.6 m, 0.31 g/t Au over 38.1 m and 0.15 g/t Au over 91.4 m, starting at 12 m depth. Higher gold values are spatially associated with an increased concentration of massive sulphide-poor quartz veins.

Klondike Gold Corp. (www.klondikegoldcorp.com) had a productive season exploring its **Klondike Goldfields** property, doubling its land position by acquiring 1125 claims, diamond drilling (71 drill holes, 5636 m) and conducting a 230-line-kilometre ground magnetic survey. Diamond drilling tested three separate targets (Lone Star, Christie and Nugget zones; Lone Star, Yukon MINFILE 115O 072) on the property for gold mineralization at shallow depths (Fig. 8). Lone Star DDH LS16-58 samples assayed 2.4 g/t Au over 37.0 m and 9.4 g/t Au over 3.6 m.

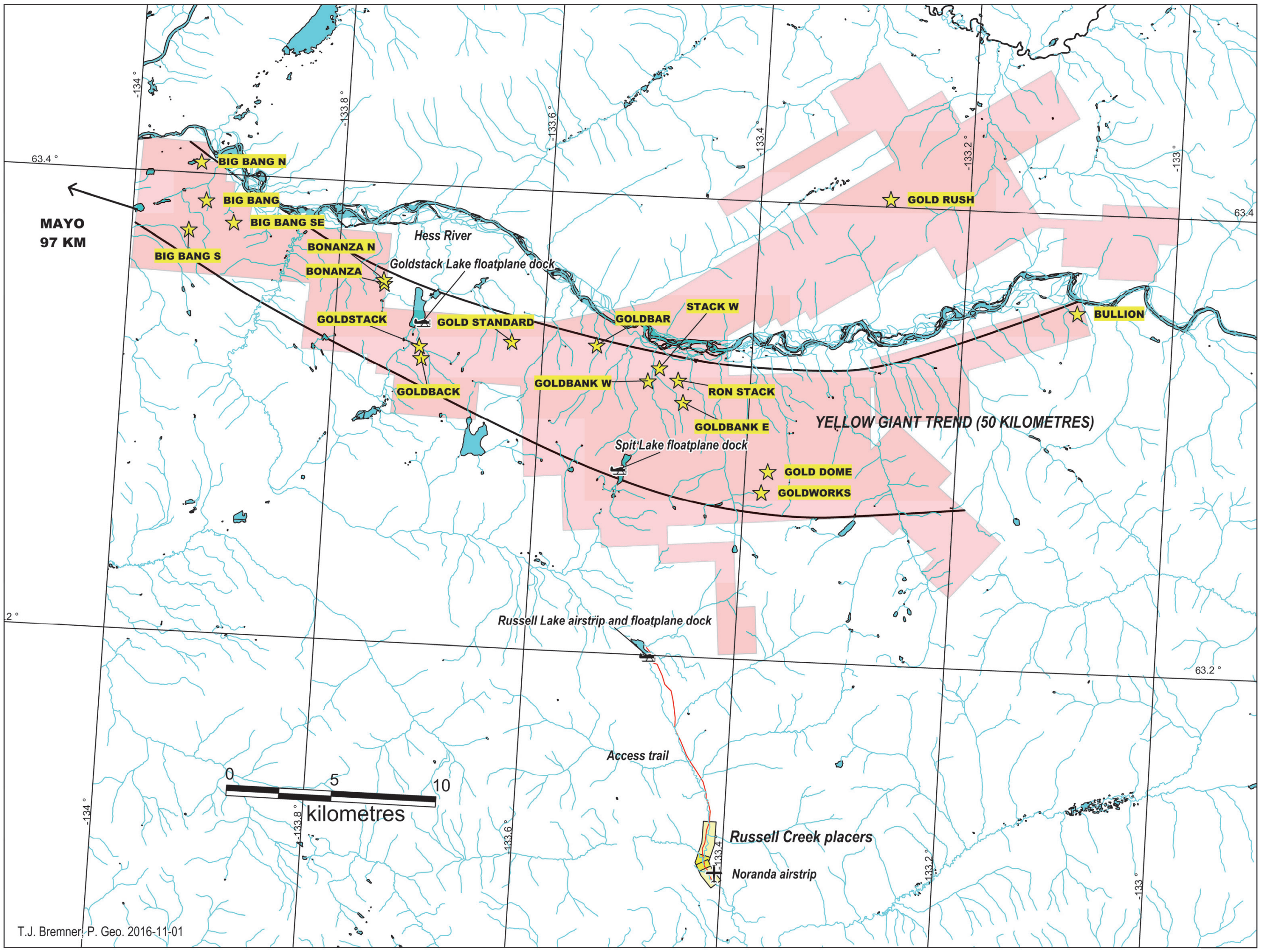

Figure 7. *Plateau Property map. Image from www.goldstrikeresources.com, accessed December 2, 2016.*

Figure 8. *Geologists examining the Nugget vein on Klondike Gold Corp's Klondike Goldfields property.*

Exploration work at the **Ballarat** (Yukon MINFILE 115J061) gold property of Stakeholder Gold Corp. (www.stakeholdergold.com) included soil sampling, direct current induced polarization/resistivity geophysical surveys, direct push probe sampling, a drone survey and rotary air blast (RAB) drilling. At the Eastern zone, soil sampling along strike has extended the gold-in-soil anomaly to 700 m in length. Gold-in-soil values at the Eastern zone range up to 310 ppb. Float rock samples of quartz-sericite-ankerite altered gneiss at the Eastern zone assayed 0.759 g/t Au and 0.587 g/t Au. RAB drilling results are pending.

Banyan Gold (www.banyangold.com) completed 475 m of diamond drilling in three holes (including one for metallurgical testing) near the Main zone of its **Hyland Gold** project (Yukon MINFILE 095D 011) in southeastern Yukon, as well as soil sampling and trenching over arsenic-gold soil anomalies. DDH HY-16-48 intersected 30.7 m of 1.30 g/t Au and 8.0 g/t Ag near surface.

Comstock Metals Ltd. (www.comstock-metals.com) revisited the **QV** property (Yukon MINFILE 115O 004) in western Yukon, completing work on the Stewart, Shadow and VG targets (Fig. 9). The phase 1 program included high resolution IP/resistivity surveys, GT probe sampling, geological mapping and soil sampling. Partial funding was provided by the Yukon government's Yukon Mineral Exploration Program (YMEP). The phase 2 program included 2423 m (34 holes) of rotary air blast drilling on the Stewart, Shadow and VG targets. An optical televiewer was used in 26 of the RAB holes. The device takes 360 degree downhole photos which allows for structural interpretations. Highlights of the drilling on the VG zone include 3.05 m of 7.79 g/t Au near-surface in drill hole 16QVRAB00. RAB hole 16QVRAB012 returned 18.29 m of 1.81 g/t Au starting at surface, representing an interpreted extension of the VG deposit 55 m to the east.

The **Lucky Strike** property of Goldstrike Resources Ltd. (www.goldstrikeresources.com) in the White Gold district benefitted from YMEP funding, which enabled the company to undertake soil sampling and a trenching program (477 m). Trenching on the 1400 by 350 m gold-in-soil anomaly at the Monte Carlo zone returned 0.42 g/t Au over 154 m, including 0.76 g/t Au over 78 m. The anomalous zone is characterized by elevated values of silver, tellurium, molybdenum, and copper, and is coincident with a strong northwest-trending geophysical anomaly. The Monte Carlo zone is one of four large gold-in-soil anomalies at Lucky Strike that lie on a 9 km northwest gold trend that remains open. An induced polarization survey successfully identified a northwest-trending geophysical anomaly that coincides with gold mineralization in trenches. The program also included soil sampling with results up to 255 ppb gold.

Strategic Metals Ltd.'s (www.strategicmetalsltd.com) **Saloon** copper-gold property in south Yukon has only seen two historic holes drilled on it, despite first being staked in 1901. The 2016 drill program centred on the 1993 drilling beneath the Main showing. DDH Sal-16-01 tested the geological features of the 1993 drill holes along the same line of section and returned 30.23 m of 0.40% Cu, 128.46 g/t Ag and 0.05 g/t Au, as well as two other modest intercepts to the bottom of the hole which ended in mineralization at 110 m depth. Chip sampling along the Main showing returned higher values of gold, including an average of 0.565 g/t Au, 0.11% Cu and 3.89 g/t Ag over 20.0 m.

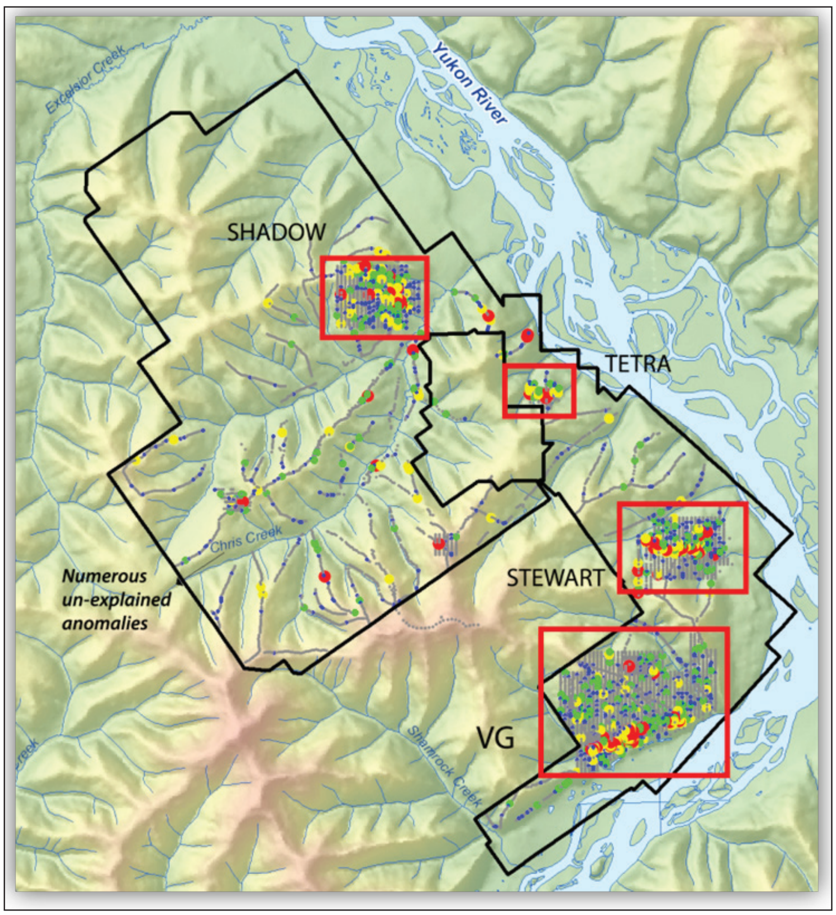

Figure 9. *Gold-in-soil anomalies underlying main targets at the QV property of Comstock Metals Ltd. Image modified from November 14, 2016 corporate presentation accessed December 2, 2016.*

Strategic Metals' work program at the **Mars** gold property in southern Yukon consisted of three diamond drill holes (393 m) that tested along strike and down dip from a 2004 drill intercept that assayed 6.44 g/t Au over 4.57 m. Diamond drill hole Mar-16-003 returned several mineralized intercepts: 0.87 g/t Au over 4.99 m, 0.53 g/t Au over 2.75 m and 0.98 g/t Au over 1.79 m.

Exploration at Strategic Metals' **Hartless Joe** gold property, also in southern Yukon, targeted the three main showings: Ace (Fig. 10), King and Queen. The King showing, discovered in 2015, was trenched and sampled, returning values of 44.3 g/t Au, 375 g/t Ag, 2.04% Pb and minor zinc and copper over 2.10 m. The showings contain sphalerite, chalcopyrite, pyrite and galena as bands and disseminated in quartz horizons. Six shallow diamond drill holes were completed on the property (367.3 m). Drilling intersected weakly silicified sediment with disseminated, banded and fracture-filling sulphide mineralization, however, the best intersection returned only 1.57 g/t Au over 2.78 m (DDH HA-16-001). The company also completed a heritage resource impact assessment survey, First Nations elders property tour and First Nations oral history recordings.

Northern Freegold Resources Ltd. (www.northernfreegold.com) completed a modest work program on its **Freegold Mountain** property. The company conducted a magnetic and VLF-EM survey and completed a multi-element geochemical soil survey at Tinta Hill (Yukon MINFILE 115I058), outside of the main deposit, to define trenching and diamond drill targets. Mapping and relogging select historic core at the Nucleus (Yukon MINFILE 115I107) and Revenue (Yukon MINFILE 115I042) deposits was undertaken to define a paragenetic sequence and better target porphyry mineralization.

Figure 10. *Project geologist Jack Morton sampling at the Ace showing of Strategic Metal Ltd.'s Hartless Joe property. Photo courtesy of Strategic Metals Ltd.*

Sheeted vein (Intrusion-related)

There was renewed activity at the past-producing **Brewery Creek** gold property (Yukon MINFILE 116B 160) owned by Golden Predator Mining Corp. (www.goldenpredator.com). The company completed more than 1300 m of geotechnical and metallurgical drilling near old pits to evaluate the remaining gold mineralization of those deposits. Twelve PQ metallurgical core holes totalling 639 m were drilled on the previously mined Lucky, Kokanee and Golden deposits. The drilling provided oxide material for heap leach testing as well as high-grade sulphide material to test for gold recovery by carbon-in-leach and flotation methods. Geotechnical and groundwater monitoring drilling (11 HQ holes, 694 m) were completed, with Geotech hole No. 11, drilled on the high wall of the conceptual Lucky pit, intersecting 21.2 g/t Au over 8.2 m).

PRECIOUS METALS EXPLORATION – SILVER

Cantex Mine Development Corp. (www.cantex.ca) focused on its **North Rackla** property with infill soil-talus sampling, prospecting, trenching and geological mapping. A late season diamond drilling program of eight holes successfully intersected the target oxidized massive sulphide zone. This silver-lead-zinc-copper zone has been outlined on surface through talus sampling and extends over 1900 m. Diamond drill results are pending.

BASE METALS EXPLORATION – COPPER

Strategic Metal Ltd.'s (www.strategicmetalsltd.com) largest exploration program in 2016 was at its road-accessible **Hopper** copper-gold skarn and porphyry property (Yukon MINFILE 115H 019, 034) in southwestern Yukon. The company tested the up-dip and along-strata projection of gold skarn horizons with diamond drilling (15 holes, 2156 m; Fig. 11). Diamond drill hole HOP16-014 hit several mineralized intersections: 0.4% Cu and 0.5 g/t Au over 4.6 m, 0.6% Cu and 0.5 g/t Au over 5.8 m and 0.6% Cu and 0.1 g/t Au over 3.0 m. The company also performed heritage studies and undertook road building for future drill-access to projected skarn horizons.

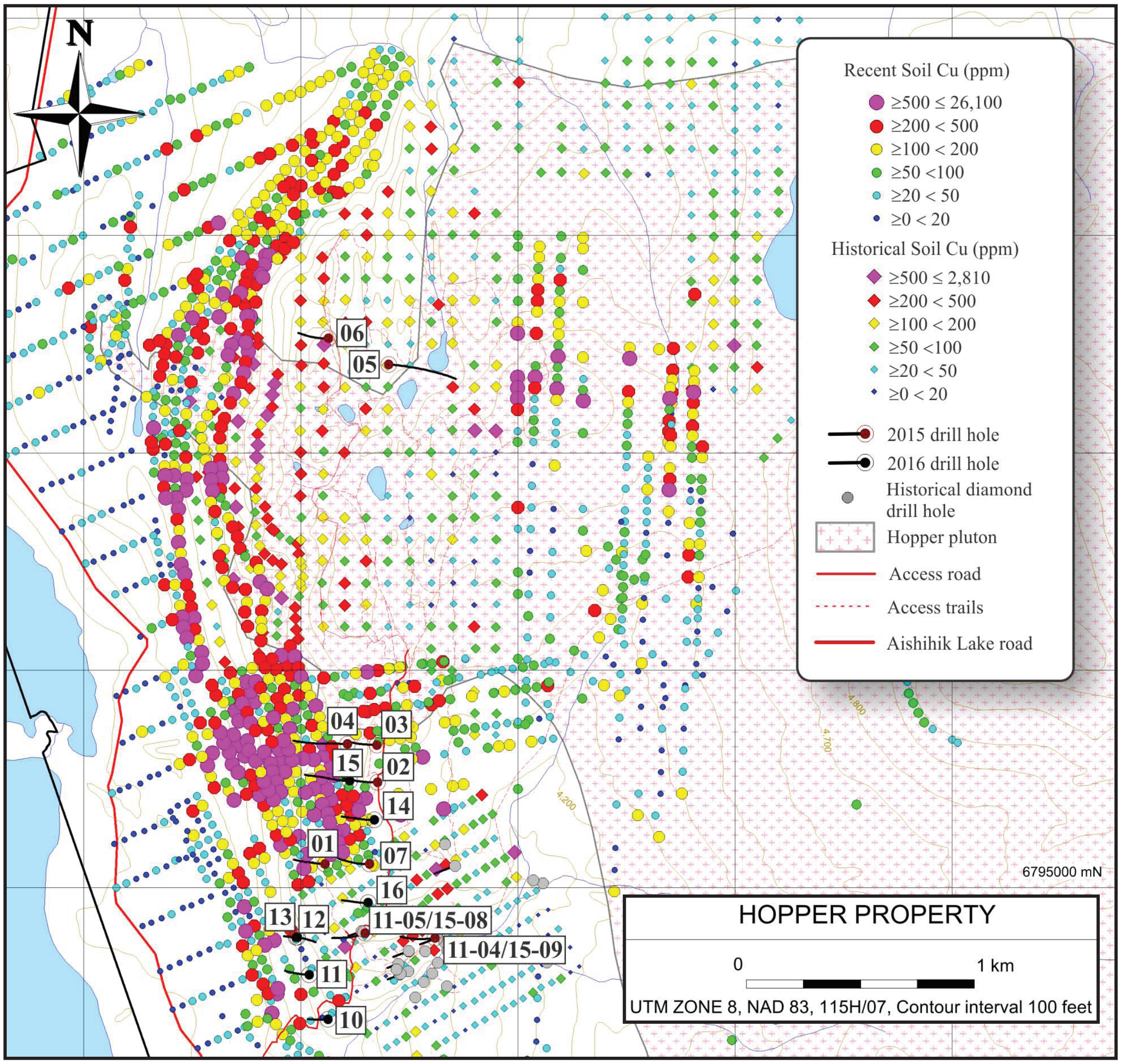

Figure 11. *Hopper property map showing location of 2016 drilling and copper-in-soil anomalies. Image courtesy of Strategic Metals Ltd.*

BASE METALS EXPLORATION – LEAD + ZINC

Volcanic associated

The most substantial exploration program in Yukon was undertaken by BMC Minerals (http://bmcminerals.com) on its recently acquired **Kudz Ze Kayah** volcanogenic massive sulphide property (Yukon MINFILE 105G 117) in the Finlayson Lake district of southeastern Yukon. After two exploration seasons, BMC Minerals announced an updated resource (November 2016) on the ABM and GP4F deposits (Table 2). BMC completed metallurgical test work and completed 19 000 m of exploration and definition diamond drilling, which will allow the company to complete a prefeasibility study by the end of 2016. In 2016, BMC donated select drill core to the YGS's core collection.

GRASSROOTS EXPLORATION

Taku Gold Corp. (www.takugold.com) soil sampled its newly acquired **McQ** property in the Mayo region; results returned up to 260 ppb Au. The gold-in-soil anomaly extends 300 m in a westerly direction. Gold is correlated with arsenic values up to 1682 ppm.

Table 2. *JORC-compliant mineral resource estimate for BMC Minerals Ltd.'s Kudz Ze Kayah property (modified from November 10, 2016 News Release).*

Deposit	Classification	Tonnes (Mt)	Ag (g/t)	Au (g/t)	Pb (%)	Cu (%)	Zn (%)
ABM	Indicated & Inferred	19.2	148	1.4	1.9	0.9	6.3
GP4F	Indicated & Inferred	1.7	73	1.4	2.6	0.2	5.3

Strategic Metals worked its **OOO** silver-gold epithermal property (Pride; Yukon MINFILE 115J 005; www.strategicmetalsltd.com) by hand trenching an area where a mineralized rock sample was collected in 2015. Chip sampling results from the trench included 570 g/t Ag, 2.76% Pb and 0.08 g/t Au over 6.4 m. Strategic also completed a heritage resource overview assessment and an impact assessment survey for the property. Other Strategic Metals activities included work at the Rod (Yukon MINFILE 106C 087) gold-silver-copper-zinc property in the western Rackla belt with geological mapping and sampling as well as a small program of geochemical sampling to expand the gold-in-soil geochemical anomaly at the Eureka Dome gold property in western Yukon (Yukon MINFILE 115O 057).

Independence Gold Corp. (www.ingold.ca) completed two soil geochemical sampling grids and extended the soil geochemical anomaly on the **Moosehorn** property (Yukon MINFILE 115N 024) in western Yukon (Fig. 12). The company excavated three trenches for a total of 527 m, confirming gold mineralization in each trench. Trench 1 intersected 2.0 m of 5140 ppb gold; trench 2 intersected 6.0 m of 730 ppb gold and 6.0 m of 524 ppb gold. Detailed quartz vein sampling within the anomalous zones of trench 2 returned values ranging from 100 to 1600 ppb gold. All gold values occur within a broader arsenic halo with values ranging from below detection to 3990 ppm. The Moosehorn property is underlain by a granodiorite intrusion and is situated two kilometres south of an active placer gold operation.

Figure 12. *Dave Gale, Senior Geologist with Independence Gold examines a rare outcrop on the Moosehorn property. Photo courtesy of Independence Gold Corp.*

Nevada Zinc (www.nevadazinc.com) extended the East Big Creek anomaly on its **VIP** gold property to a 700-m-long northwest-trending gold-in-soil anomaly. Recent reprocessing of a previously flown airborne magnetic geophysical survey outlined newly interpreted buried intrusions along trend and south of the East Big Creek anomaly.

Pacific Ridge Exploration (www.pacificridgeexploration.com) completed geological mapping and sampling over the central area of its **Mariposa** gold project (Yukon MINFILE 115O 075) in west-central Yukon. The company also completed a modest program at its Eureka project in western Yukon, including geological mapping, prospecting and a soil sampling survey. Results of the program have not yet been announced.

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APPENDIX 1. 2016 EXPLORATION PROJECTS

Project	Optioner/Owner	Occurrence	NTS	Work type	Commodity	Depost type
PRECIOUS METALS - GOLD						
3 Aces	Golden Predator Mining Corp.	105H 066	105H/09	G, SGC, T, BS, DD, RC, CR	Gold	vein/breccia
Aurex	StrataGold Corp.	105M 060	105M/13	P, G, SGC	Gold	skarn/ replacement
Aurex	Nicolai Goeppel	105M 060	105M/13	P, SGC	Gold	skarn/ replacement
Ballarat project	Stakeholder Gold Corp.	115J 061	115J/14	GGP, SGC, T, RC	Gold	porphyry/sheeted vein
Boulevard	Independence Gold Corp.	115J 050	115J/13	RC	Gold	porphyry/sheeted vein
Brewery Creek	Golden Predator Mining Corp.	116B 160	116B/01	DD	Gold	porphyry/sheeted vein
Coffee project	Goldcorp Inc.	115J 110	115J/14	RGC, DD, RC, MD	Gold	vein/breccia
Dublin Gulch	Victoria Gold Corp.	106D 025	106D/04	GGP, T, DD	Gold	porphyry/sheeted vein
Dubloon	Jeff Mieras		115P/06	P	Gold	Unknown
Eureka	Strategic Metals Ltd.		115O/10	P, G, SGC	Gold	Unknown
Eureka Dome	Pacific Ridge Exploration Ltd.	115O 057	115O/10	P, AGP, SGC, RC	Gold	vein/breccia
Freegold Mountain	Northern Freegold Resources Ltd.	105I 107	115I/06	G, GGP, SGC	Gold	porphyry/sheeted vein
Golden Horseshoe	Nicolai Goeppel		115I/09	P, DD	Gold	Unknown
Goodman	Nevada Zinc Corp.	106C 025	115P/16	SGC, T	Gold	vein/breccia
Grabben Gold	Bernie Kreft		115O/11	P	Gold	Unknown
Hartless Joe	Strategic Metals Ltd.	105D 203	105D/15	T, DD	Gold	Unknown
Hyland Gold	Banyan Gold Corp.	095D 011	095D/12	SGC, T, DD	Gold	vein/breccia
Kate	44984 Yukon Inc.		115O/15	P, G, SGC	Gold	vein/breccia
Klaza	Rockhaven Resources Ltd.	115I 067	115I/03	GGP, T, DD, ES	Gold	vein/breccia

Abbreviations

G – geology
CS – claim staking
GGP – ground geophysics
RGC – rock geochemistry
AGP – airborne geophysics
DD – diamond drilling
MD – mine development
SGC – soil/silt geochemistry
BS – bulk sampling
ES – economic studies
P – prospecting
T – trenching
CR – road construction
NC – non-core drilling
RS – remote sensing

APPENDIX 1 (continued). 2016 EXPLORATION PROJECTS

Project	Optioner/Owner	Occurrence	NTS	Work type	Commodity	Depost type
Leota	Goldbank Mining Corp.	115O 074	115O/15	SGC, RGC	Gold	vein/breccia
Lone Star	Klondike Gold Corp.	115O 072	115O/14	P, G, GGP, DD	Gold	vein/breccia
Lucky Strike	Goldstrike Resources Ltd.		115O/03	SGC, RGC, T	Gold	vein/breccia
Mariposa	Pacific Ridge Exploration Ltd.	115O 075	115O/01, 02; 115J/15, 16	G, SGC	Gold	vein/breccia
Mars	Strategic Metals Ltd.		105E/07	DD	Gold	porphyry/sheeted vein
Mars (Einarson)	Anthill Resources Ltd.		105O/14	P, G, SGC	Gold	vein/breccia
Mayo Lake	Mayo Lake Minerals Inc.		115M/11	P, G	Gold	vein/breccia
McConnell's Jest	Strategic Metals Ltd.		106D/03	P, SGC	Gold	Unknown
McQ	Taku Gold Corp.		115P/16	SGC	Gold	unknown
Moosehorn	Independence Gold Corp.	115N 024	115N/02	SGC, T	Gold	vein/breccia
Nadaleen trend	ATAC Resources Ltd.	106C 045	106C/01	SGC, RC, CR	Gold	sediment associated
North Rackla	Cantex Mine Development Corp.		106C/12	G, SGC, RGC, T, DD	Gold	sediment associated
Old Cabin	Ron Berdahl	105O 039	105O/11, 12	P	Gold	Unknown
Plateau South	Goldstrike Resources Ltd.	105N 036	105N/06	P, G, SGC, RGC, DD	Gold	vein/breccia
QV	Comstock Metals Ltd.	115O 004	115O/05	CS, G, GGP, SGC, T, RC	Gold	vein/breccia
Rainbow	Scott Berdahl		105N/12	P	Gold	vein/breccia
Red Mountain	Am Gold Corp.	115P 006	115P/15	P, SGC	Gold	vein/breccia
Rod	Strategic Metals Ltd.		106D/01	G, RGC	Gold	sediment associated
Rosebute	Independence Gold Corp.		115O/05, 06, 11, 12	RC	Gold	Unknown

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APPENDIX 1 (continued). 2016 EXPLORATION PROJECTS

Project	Optioner/Owner	Occurrence	NTS	Work type	Commodity	Depost type
Rude Creek Gold	0890763 BC Ltd.	115J 022	115J/10	SGC, RC	Gold	vein/breccia
Sked	Rockhaven Resources Ltd.	115I 119	115I/03		Gold	Unknown
Rau trend (Tiger)	ATAC Resources Ltd.	106D 005	106D/01	P, G, SGC, RGC, T, RC, ES	Gold	skarn/ replacement
Tinta Hill	Northern Freegold Resources Ltd.	115I 058	115I/07	GGP, SGC	Gold	vein/breccia
VIP	Nevada Zinc Corp.		115J/13, 115K/16, 115O/01, 04	SGC	Gold	vein/breccia
White Regional	Shawn Ryan		115K/09	SGC	Gold	Unknown
PRECIOUS METALS - SILVER						
Bermingham	Alexco Resource Corp.	105M 086	105M/14	DD	Silver	vein/breccia
Flame & Moth	Alexco Resource Corp.	105M 087	105M/14	MD	Silver	vein/breccia
OOO	Strategic Metals Ltd.	115J 005	115J/08	T	Silver	vein/breccia
Rancheria	Cathro Resources Corp.	105B 014	105B/02	P	Silver	vein/breccia
Rancheria area	Adam Travis		105B/01, 02, 07, 08	P	Silver	vein/breccia
BASE METALS - COPPER						
Canadian Creek	Cariboo Rose Resources Ltd.	115J 101	115J/10, 11, 14, 15	SGC, T	Copper	porphyry/sheeted vein
Carmacks Copper	Copper North Mining Corp.	115I 008	115I/07	SGC, T, ES	Copper	porphyry/sheeted vein
Crooked	Gord Richards		115P/01, 02	P	Copper	Unknown
Hopper	Strategic Metals Ltd.	115H 019	115H/07	DD, CR	Copper	porphyry/sheeted vein
Saloon	Strategic Metals Ltd.		105E/01	DD	Copper	vein/breccia
Teslin Mountain	Daniele Heon		105E/01	P, G	Copper	porphyry/sheeted vein
WS	BC Gold Corp.	115I 007	115I/07	GGP	Copper	porphyry/sheeted vein

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APPENDIX 1 (continued). 2016 EXPLORATION PROJECTS

Project	Optioner/Owner	Occurrence	NTS	Work type	Commodity	Depost type
BASE METALS - LEAD, ZINC						
Hall Creek	Glen Prior	116C 133	116C/02	P, G	Zinc-Lead	Unknown
Kudz Ze Kayah	BMC Minerals	105G 117	105G/07	DD	Zinc-Lead	volcanic associated
Selwyn project	Selwyn Chihong Mining Ltd.	105I 037	105I/06		Zinc-Lead	sediment associated
BASE METALS - NICKEL, PGEs						
Kluane Lake West	Kluane Mineral Services		115G/06	P, G	Nickel-PGE	mafic/ultramafic associated
Spy	Group Ten Metals Inc.		115G/02	P, GGP, SGC	Nickel-PGE	volcanic associated
Tobi	41376 Yukon Inc.		115G/05	P, T	Nickel-PGE	mafic/ultramafic associated
Wellgreen	Wellgreen Platinum Ltd.	115G 024	115G/05	DD	Nickel-PGE	mafic/ultramafic associated
GEMSTONES						
Enjolras	AKG Exploration Inc.	105G 114	105G/08	P	Jade	gemstones

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AGP – airborne geophysics
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MD – mine development
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NC – non-core drilling
RS – remote sensing

APPENDIX 2. 2016 DRILLING STATISTICS

Property	Optioner/Owner	# of drill holes	# of metres
DIAMOND DRILLING			
3 Aces	Golden Predator Mining Corp.	23	539
Bermingham	Alexco Resource Corp.	50	17 371
Brewery Creek	Golden Predator Mining Corp.	23	1333
Coffee project	Goldcorp Inc.	26	6703
Dublin Gulch	Victoria Gold Corp.	136	19 764
Golden Horseshoe	Nicolai Goeppel		~400
Hartless Joe	Strategic Metals Ltd.	6	367
Hopper	Strategic Metals Ltd.	7	2156
Hyland Gold	Banyan Gold Corp.	3	475
Klaza	Rockhaven Resources Ltd	44	8427
Kudz Ze Kayah	BMC Minerals	83	18 944
Klondike Goldfields	Klondike Gold Corp.	71	5365
Mars	Strategic Metals Ltd	3	393
Nadaleen trend - Rackla project	ATAC Resources Ltd.	10	1541
North Rackla	Cantex Mine Development Corp.	8	
Plateau South	Goldstrike Resources Ltd.	11	1500
Saloon	Strategic Metals Ltd.	1	113
Wellgreen	Wellgreen Platinum Ltd.		2503
ROTARY AIR BLAST/REVERSE CIRCULATION			
3 Aces	Golden Predator Mining Corp.	31	3776
Ballarat project	Stakeholder Gold Corp.	18	1728
Boulevard	Independence Gold Corp	30	2946
Coffee project	Goldcorp Inc.	261	20 470
Nadaleen trend - Rackla project	ATAC Resources Ltd.	33	1675
QV	Comstock Metals Ltd.	34	2423
Rosebute	Independence Gold Corp.	12	924
Rau trend - Rackla project	ATAC Resources Ltd.	9	466

Casino porphyry copper-gold-molybdenum deposit, central Yukon (Yukon MINFILE 115J028)

S.G. Casselman*
Yukon Geological Survey

H. Brown
Western Copper and Gold Corporation

Casselman, S.C. and Brown, H., 2017. Casino porphyry copper-gold-molybdenum deposit, central Yukon (Yukon MINFILE 115J028). *In:* Yukon Exploration and Geology Overview 2016, K.E. MacFarlane (ed.), Yukon Geological Survey, p. 61-74, plus digital appendices.

ABSTRACT

The Casino deposit is located in west-central Yukon, 300 km northwest of Whitehorse. Porphyry-style mineralization was discovered on the property in 1969 and the property has experienced exploration on and off since that time. Casino is a calc-alkaline porphyry copper-gold-molybdenum deposit hosted in Late Cretaceous quartz monzonite of the Casino suite and associated breccia along the margins of the intrusion. The deposit exhibits typical alteration assemblages of a porphyry copper deposit, with a central core of potassic alteration grading outwards to concentric phyllic and propylitic zones. The Casino deposit is unique among Canadian porphyry deposits in that it has a substantially preserved, outcropping leached cap; an upper, copper oxide supergene mineralized zone; a lower, copper sulphide supergene mineralized zone; as well as an underlying hypogene zone. The total resource of the Casino deposit in the measured, indicated and inferred category includes 101 million tonnes grading 0.39 g/t Au in the oxide gold zone, 87 million tonnes grading 0.25% Cu, 0.29 g/t Au, 0.02% Mo and 1.7 g/t Ag in the supergene oxide enriched zone and 2.7 billion tonnes of sulphide ore grading 0.16% Cu, 0.19 g/t Au, 0.02% Mo and 1.5 g/t Ag in the combined supergene sulphide and hypogene zone.

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INTRODUCTION

The Casino porphyry copper-gold-molybdenum deposit (Yukon MINFILE 115J 028) is located at the headwaters of Canadian and Casino creeks, on Patton Hill in northeastern Stevenson Ridge of the Dawson Range Mountains. It is centered at 62°44'16" N latitude and 138°49'41" W longitude, 21 km south of the Yukon River, 300 km northwest of Whitehorse, and 120 km due west of Pelly Crossing, Yukon (Fig. 1).

The deposit was discovered in 1969 and it has a long history of exploration and ownership. The discovery was made by the Brynelsen Group, which consisted of Brameda Resources, Quintana Minerals and Tech Corporation. In 1991, Archer Cathro & Associates (1981) Ltd. optioned the property and assigned the option to Big Creek Resources Ltd. The following year, Big Creek amalgamated with Pacific Sentinel Gold Corp. In 2003, First Trimark Resources and CRS Copper Resources acquired the property and in 2004 they combined to form Lumina Copper Corporation. Western Copper Corporation acquired Lumina in an all shares deal in 2006, and in 2011, Western Copper reorganized and changed their name to Western Copper and Gold Corporation.

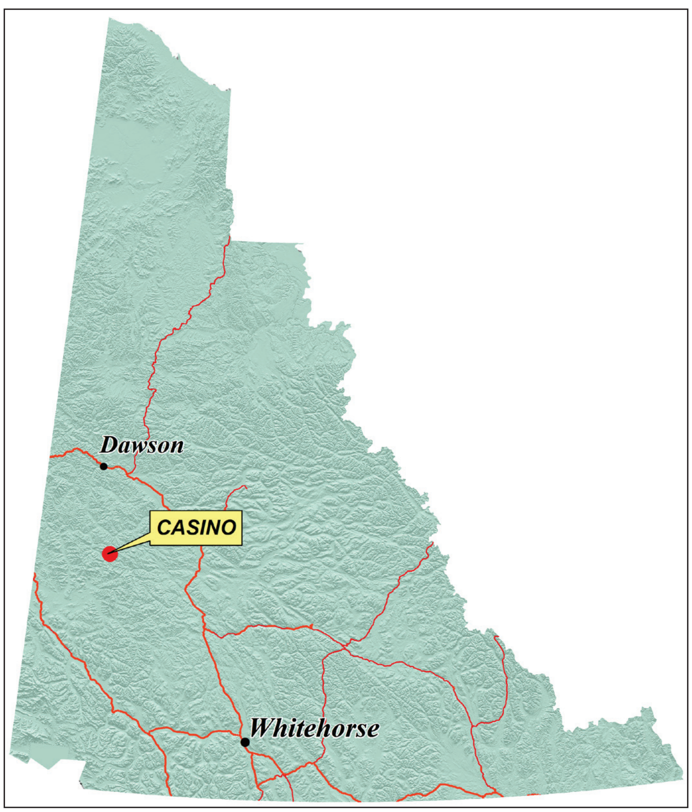


Figure 1. *Casino deposit location.*

The exploration history of the property includes property scale mapping, soil sampling, ground geophysical surveys (VLF-EM, HLEM, magnetics, Titan-24 DC Resistivity, IP and MT Resistivity), bulldozer trenching, reverse circulation drilling (5188 m) and diamond drilling (117 334 m), including drilling for geotechnical, hydrogeological and metallurgical purposes (11 466 m).

The Casino deposit is unique among Canadian porphyry deposits in that it has a substantially preserved, outcropping leached cap; an upper, copper oxide-enriched supergene mineralized zone; a lower, copper sulphide-enriched supergene mineralized zone; and underlying hypogene mineralized zone. In 2013, Western Copper and Gold updated the mineral resource estimate of the deposit in the measured, indicated and inferred (M, I & I) resources for the leached cap of 101 million tonnes grading 0.38 g/t gold at a 0.25 g/t gold cut-off. The M, I & I resource of the combined supergene sulphide and hypogene zone, at a 0.25% copper equivalent cut-off, is 2.7 billion tonnes grading 0.16% copper, 0.186 g/t gold, 0.021% molybdenum and 1.49 g/t silver for an equivalent copper grade of 0.42%.

REGIONAL GEOLOGY

The regional geological setting of the northeastern Stevenson Ridge area consists of metamorphosed and poly-deformed Paleozoic basement rocks of the Yukon-Tanana terrane intruded by relatively little-deformed mid to Late Cretaceous granitoids (Fig. 2; Ryan *et. al.*, 2013).

YUKON-TANANA TERRANE

The oldest rocks of the Yukon-Tanana terrane are the pre-Devonian Snowcap assemblage (unit PDSs) which consists of mostly amphibolite facies siliciclastic rocks including quartzite, micaceous quartzite and psammitic quartz-muscovite-biotite (± garnet) schist. Marble occurs as decametre-thick lenses interlayered with amphibolite and garnet amphibolite (Ryan *et. al.*, 2013). The amphibolite is interpreted as the metamorphosed equivalent of mafic sills and dikes (Ryan *et. al.*, 2013).

Southwest of the Casino property the Late Devonian-Early Mississippian Finlayson assemblage (unit DMFbp), locally termed the Stevenson Ridge schist (Ryan *et al.*, 2013) forms a monotonous sequence of grey to black, carbonaceous quartzite, psammite and phyllite. Protoliths likely include carbonaceous, siliceous shale, pelite and chert (Ryan *et al.*, 2013).

Highly foliated to gneissic hornblende-biotite and biotite granodiorite rocks, of the Mississippian Simpson Range suite (unit MgSR), are located north of the property, along Britannia Creek and north of the Yukon River. Locally, these rocks are thrust over the Snowcap assemblage along the Yukon River thrust, however, regionally they are known to intrude the Snowcap assemblage (Ryan *et. al.*, 2013).

Both the Snowcap and Finlayson assemblages are intruded by K-feldspar porphyroblastic augen granite of the Permian Sulphur Creek suite (unit PqS); the extrusive equivalent is the Klondike schist (unit PKf). Both of these units are mapped west of the Casino property.

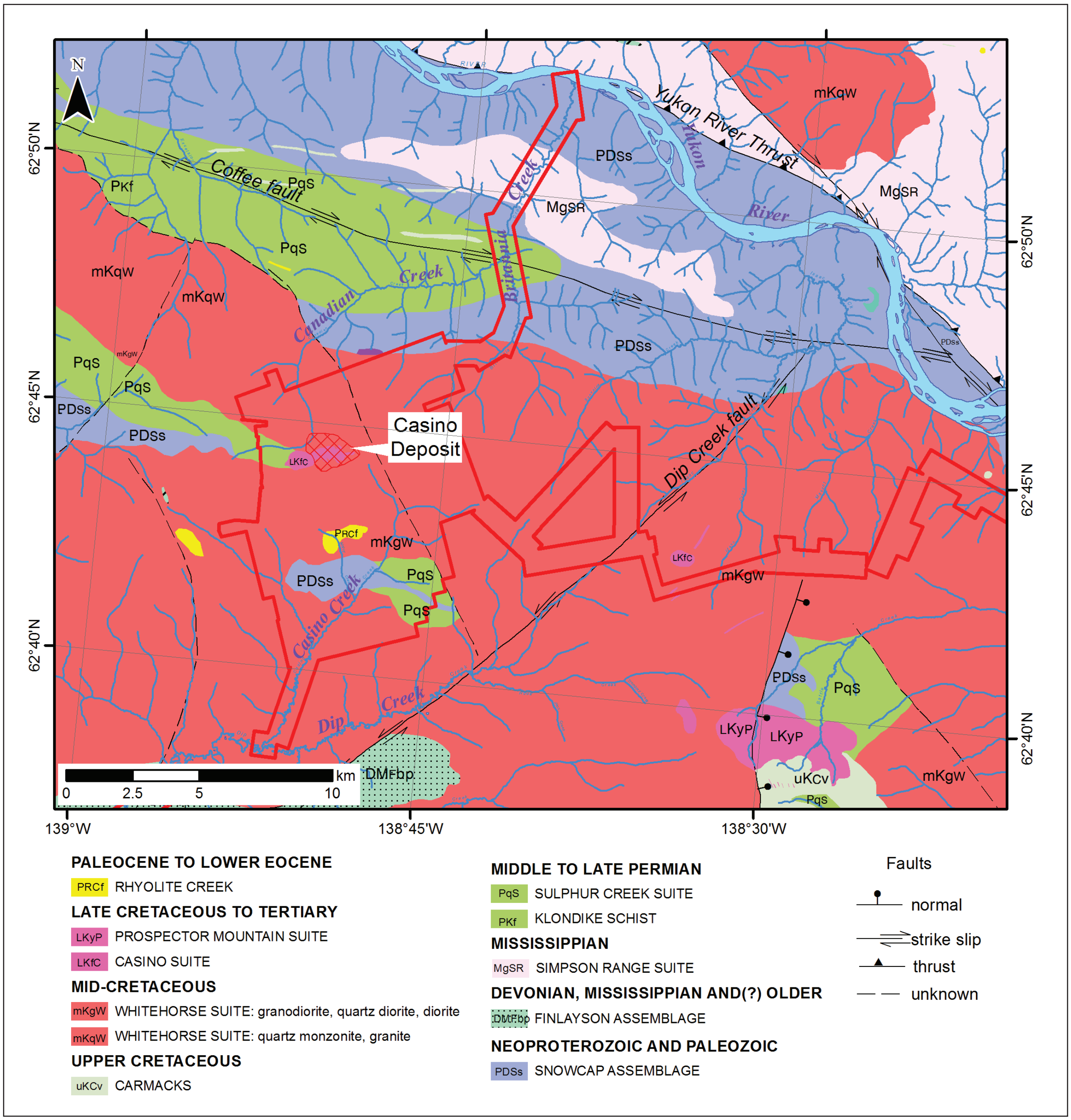


Figure 2. *Regional geology map modified from Ryan et. al. (2013).*

MESOZOIC IGNEOUS ROCKS

The central part of the northeastern Stevenson Ridge area is dominantly middle Cretaceous (104±0.5 Ma; Selby and Nesbitt, 1998) Whitehorse suite granitoid of two distinct phases. The more voluminous Dawson Range phase (unit mKgW) is composed of white to beige, hornblende-biotite granodiorite and lesser granite, tonalite, quartz diorite and diorite. It is characteristically blocky weathering, hornblende-phyric and medium to coarse-grained. Foliation is weak to absent. The less voluminous Coffee Creek phase (unit mKqW) is composed of unfoliated pink to beige, biotite monzogranite. It is medium to coarse-grained, characterized by smoky quartz phenocrysts, and is locally pegmatitic. The Dawson Range and Coffee Creek phases generally occur as distinct plutons.

The Late Cretaceous (72.4±0.5 Ma U-Pb zircon; Selby and Nesbitt, 1998) Casino suite (unit LKfC) comprises sparse, small volume porphyritic quartz monzonite plutons that host the Casino Cu-Au porphyry and other intrusion-related mineralization in the region (*e.g.*, Sonora Gulch, Revenue). Casino suite intrusions are fine to medium-grained, and are alkali feldspar-plagioclase-biotite-quartz-phyric. The Prospector Mountain Suite (unit LKyP) is largely co-spatial with the Casino suite and is characterized by light grey to pink alkali feldspar-biotite-hornblende porphyritic, fine to medium-grained quartz monzonite dikes, sills and hypabyssal plugs.

The Late Cretaceous Carmacks Group (unit uKCv) comprises an intermediate to mafic volcanic and volcaniclastic lower sequence, and a more mafic, flow-dominated upper sequence (Colpron, *et. al.*, 2016). Basalt to andesite flows, sills, and tuff-breccia are the most abundant rock type, and are in part coeval with the Prospector Mountain Suite. The Carmacks Group is widespread throughout west-central Yukon.

The Paleogene Rhyolite Creek complex (unit PRCf) constitutes small erosional remnants and intrusions in the southwestern part of the area. Quartz (generally smoky) and feldspar-porphyritic dikes predominate, with less common flow-banded rhyolite and locally grey-green to mauve andesitic volcanic to hypabyssal rocks. These are easily confused with similar looking hypabyssal varieties of the Casino suite and the Coffee Creek phase.

STRUCTURAL GEOLOGY

The central belt of Yukon-Tanana terrane is characterized by at least two phases of isoclinal folding and development of transpositional foliation (Ryan *et. al.*, 2013). The main foliation developed at upper greenschist to amphibolite facies conditions. The second regionally pervasive foliation is present in Permian and older rocks, and is thought to have developed in the late Permian Klondike orogeny. The main structural feature in the region is the Yukon River thrust, which emplaces Simpson Range suite rocks on top of Snowcap and Sulphur Creek rocks south of the Yukon River. Mid to Late Cretaceous strike slip and normal faults in the Dip Creek and Casino Creek valleys appear to have long strike length, but do not have significant offset (Ryan *et. al.*, 2013).

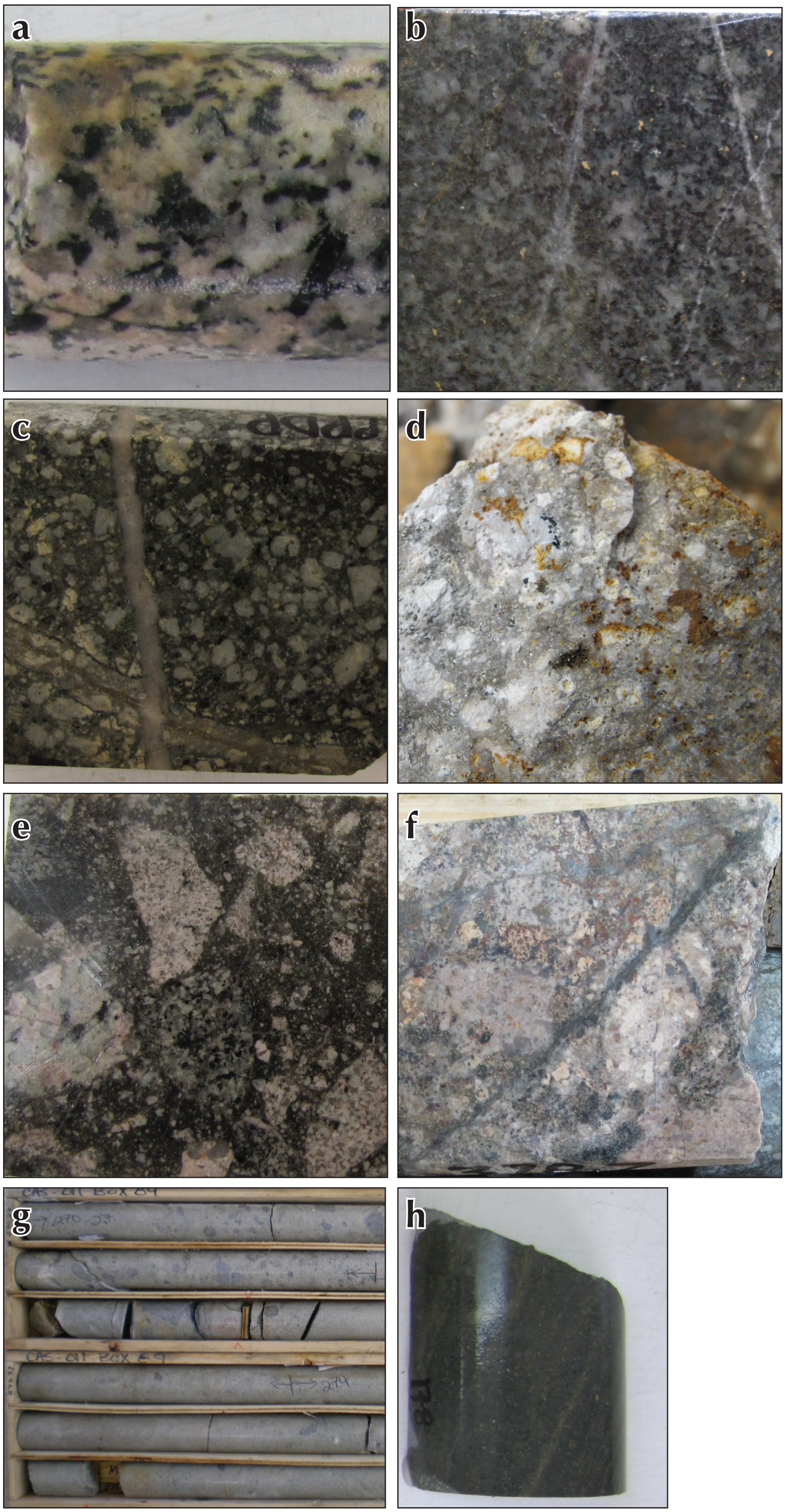
DEPOSIT GEOLOGY

Casino is classified as a calc-alkaline porphyry deposit. The geology near the deposit consists of five main units: the Dawson Range phase of the Whitehorse suite and four Casino suite units. These are locally named *Patton Porphyry, Intrusion Breccia*, *Explosion Breccia and Patton Dikes*. The majority of the ore at Casino is hosted in the Dawson Range phase, *Patton Porphyry* and *Intrusion Breccia*. Secondary supergene mineralization does spread into the upper few hundred metres of all units listed; including the *Explosion Breccia*.

WHITEHORSE SUITE - DAWSON RANGE PHASE

The mid-Cretaceous Dawson Range phase of the Whitehorse suite is the main country rock of the deposit area and, locally is a biotite-hornblende granodiorite (Fig. 3a), hornblende-biotite-quartz diorite, hornblende-biotite diorite (Fig. 3b). Hornblende-biotite bearing phases are common throughout the deposit, and lesser biotite-hornblende bearing phases are generally north of Patton Hill. Diorite is concentrated north and northeast of the deposit, and is considered to be the earliest phase of the batholith (Godwin, 1975).

The diorite is typically dark grey to brown and inequigranular. Average grain size is less than 1 mm, dominated by locally aligned and/or zoned plagioclase, hornblende, and interstitial, anhedral quartz. In places, primary biotite is more abundant than hornblende. Accessory minerals include up to 1% apatite and trace sphene. Some intrusions show foliation and increased mafic content near their margins, particularly north of the deposit and in the block east of the Casino Creek fault (Bower *et al.*, 1995). Locally, mafic diorite is cut by later, more felsic phases of the Dawson Range batholith (Johnston, 1995).



Granodiorite units are generally pale grey, medium to coarse grained and equigranular to porphyritic. They can be distinguished by scattered, subhedral hornblende phenocrysts averaging 0.5 to 1.2 cm long; poikilitic K-feldspar; zoned plagioclase; and 10 to 20% mafic minerals, which may be layered. Plagioclase shows minor myrmekitic rims when in contact with K-feldspar. Anhedral quartz and K-feldspar are interstitial to earlier subhedral plagioclase, hornblende and biotite. Locally, quartz forms interlocking aggregate of slightly, to moderately strained grains. Accessory minerals include honey-coloured sphene and apatite to 1% each.

CASINO SUITE

Late Cretaceous igneous activity of the Casino suite is locally represented by the *Patton Porphyry* intrusive and associated breccia. The main body of the *Patton Porphyry* (Fig. 3c,d) is an irregular hypabyssal intrusion that is surrounded by an intrusive breccia in contact with rocks of the Dawson Range phase of the Whitehorse suite. The *Patton Porphyry* intruded as a relatively narrow pipe-shaped body on the east side of Patton Hill and blossomed upwards and westwards into a sill-like body that measures 600 by 800 m in plan and is up to 300 m thick, thinning to the west (Fig. 4). Contacts between the hypabyssal intrusion and breccia are variable and range from sharply intrusive (as in the case of the later *Explosion Breccia*) to

Figure 3. *Representative rock samples from the Casino deposit.* ***(a)*** *Dawson Range suite granodiorite,* ***(b)*** *Dawson Range suite diorite,* ***(c)*** *Patton Porphyry (fresh),* ***(d)*** *Patton Porphyry (weathered),* ***(e)*** *Intrusion Breccia,* ***(f)*** *phyllic altered Intrusion Breccia,* ***(g)*** *Explosion Breccia,* ***(h)*** *Patton Dike.*

gradational and brecciated (as in the case of the *Intrusion Breccia*). It has been suggested by Bower *et al.* (1995) and Selby and Creaser (2000) that this suite consists of two or more episodes of high-level intrusions.

The *Patton Porphyry* has an overall composition of rhyodacite (Bower *et al.*, 1995). It most commonly occurs as distinct, euhedral, phenocrysts of plagioclase (generally 4 to 7 mm, locally up to 2.5 cm in length) that can comprise up to 50% of the rock, and lesser biotite, hornblende, quartz and opaque minerals. Biotite is subhedral, generally chloritized and kink banded, 2-3 mm across, and makes up 1-5% of the rock. Hornblende phenocrysts are generally altered and difficult to recognize in hand sample; they have generally been replaced by chlorite and other opaque minerals, but can be recognized by their diamond cross section. Quartz phenocrysts are not always present but can be anhedral, embayed, and 3-5 mm in size. K-feldspar phenocrysts are rare but the mineral is abundant in the microcrystalline matrix that is commonly medium to dark green.

The *Intrusion Breccia* (Fig. 3e,f) surrounding the main *Patton Porphyry* body consists of angular blocks and fragments of granodiorite, diorite and lesser meta-igneous and metasedimentary xenoliths of Snowcap assemblage and Sulphur Creek suite origin, in a finer grained rhyodacitic matrix of *Patton Porphyry* origin. The *Intrusion Breccia* formed along the margins of the *Patton Porphyry* by the stoping blocks of country rock. Fragments range in size from less than 1 cm to greater than several metres, and are generally found proximal to similar country rock, indicating limited transport and/or mixing (Bower *et al.*, 1995). For example, fragments of the Dawson Range phase granitoid increase along the southern margin of the breccia body; older metamorphic fragments are more common to the north; and bleached diorite to the east.

Two late stage breccia pipes are observed in the deposit area, one on the eastern edge of the deposit and one on the western edge (Fig. 5). These host the *Explosion Breccia*. The pipes are steep-sided, heterolithic,

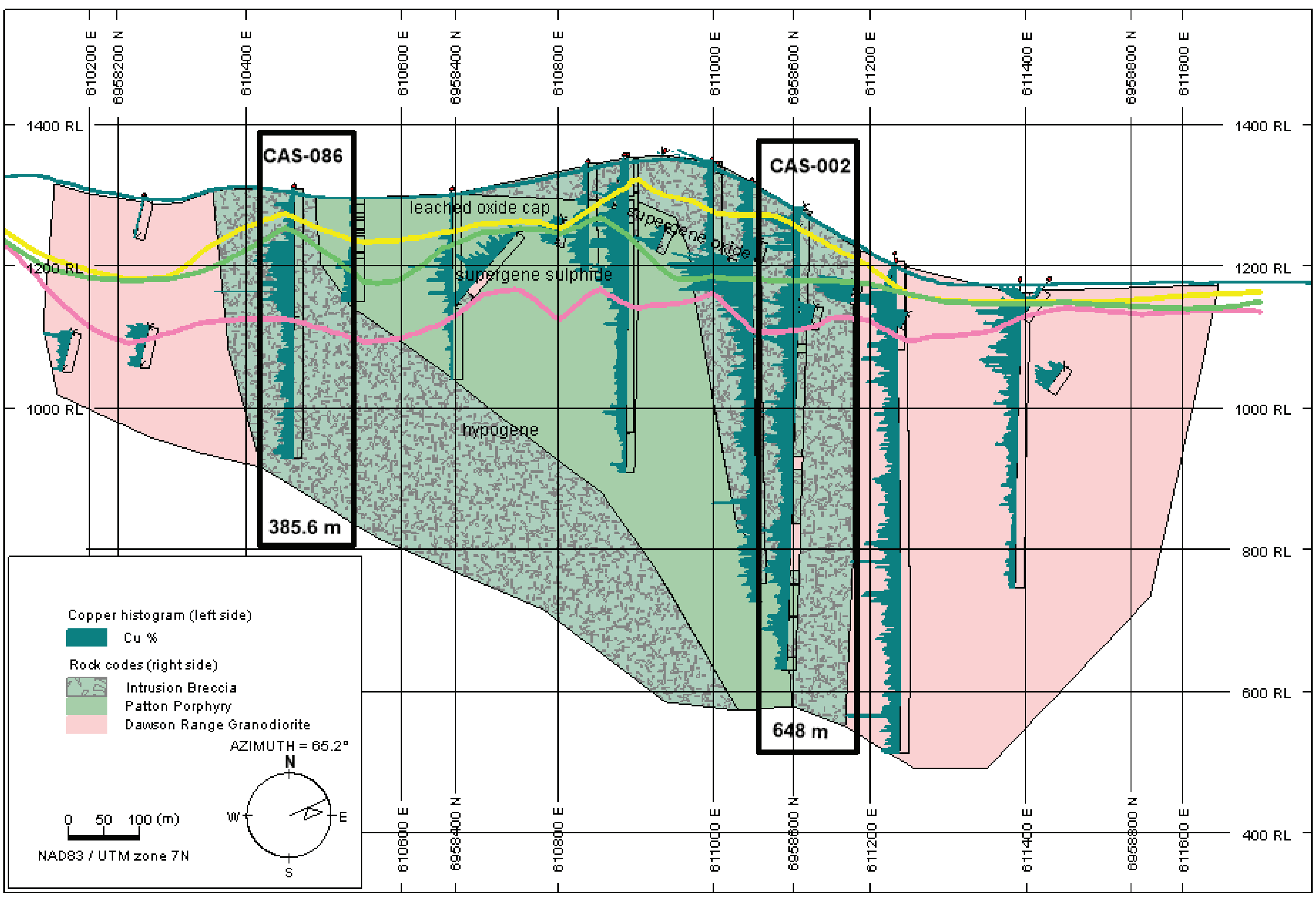


Figure 4. *Cross section C-C′; east-west cross section through the Casino deposit including diamond drill holes CAS-002 and CAS-086.*

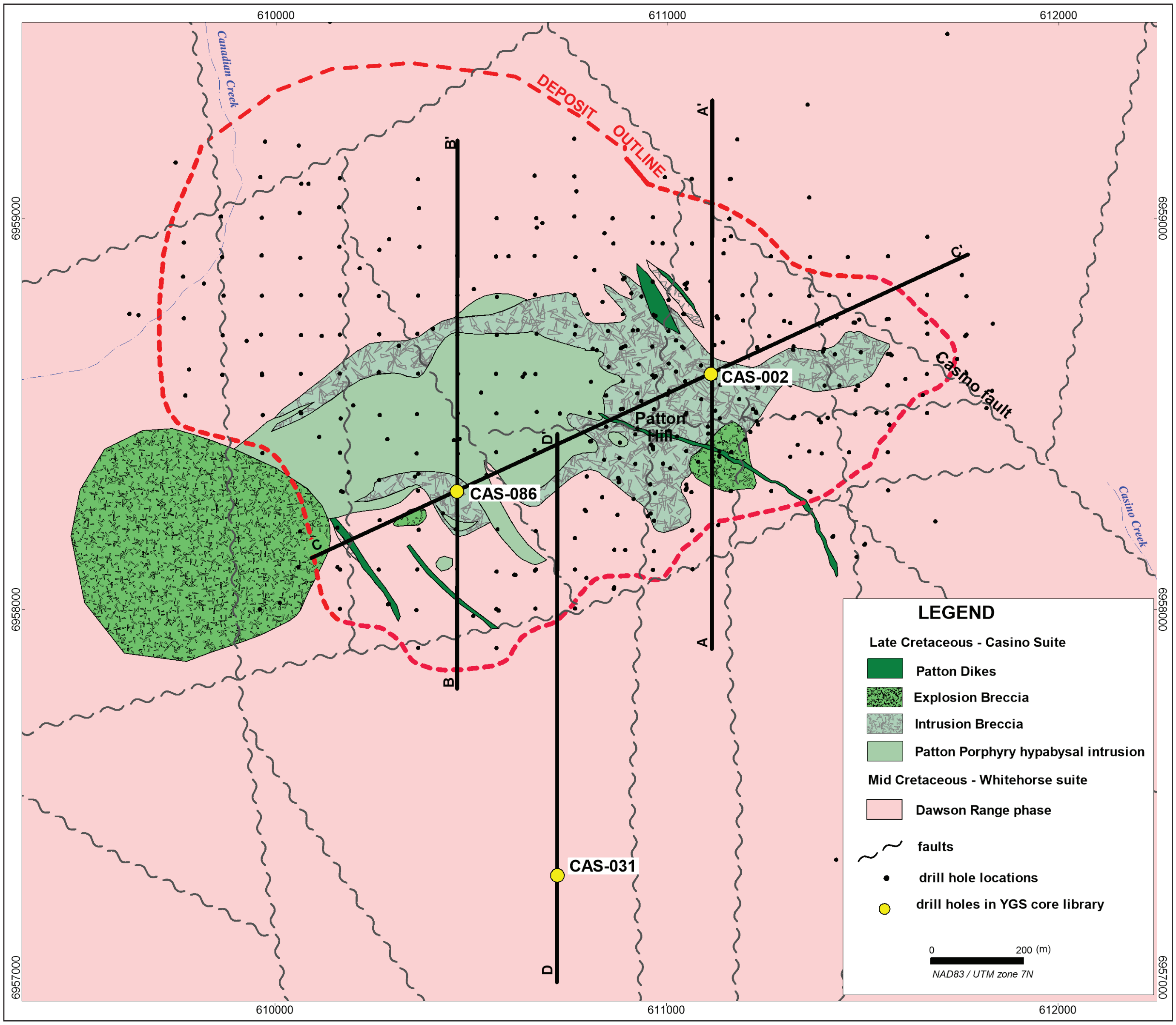


Figure 5. *Casino property geology. Section locations as marked are included in Figure 9 (section A-A'), Figure 10 (section B-B') and Figure 4 (Section C-C'). Section D-D' is included in digital appendix.*

block and bomb breccia (Fig. 3g), that contains 5-50% ragged fragments of *Patton Porphyr*y, *Intrusive Breccia*, altered *Intrusive Breccia*, Dawson Range granitoid, and metamorphosed fragments. The matrix is generally white to cream to grey, and can be vesicular with quartz filled amygdules. Locally the groundmass has a very fine grained, interlocking igneous texture; elsewhere it resembles milled rock flour with up to 10% plagioclase and lesser quartz phenocrysts (Bower *et al.*, 1995). The largest plug, on the west side of the property, truncates most of the western margin of the main *Patton Porphyry* intrusion (Fig. 5).

Godwin (1975) concluded that these breccia pipes most likely represent subvolcanic necks, brecciated from explosions caused by the rapid expansion of hot water (phreatomagmatic) and vesiculation of rhyolitic magma, and that any extrusive volcanic rocks related to this event have since been weathered away. Godwin also noted large, angular cavities are a distinctive quality of this unit, measuring up to 10 cm in size. This unit displays multiple episodes of brecciation (Bower *et al.*, 1995).

Dikes of *Patton Porphyry* material in the south-central part of the deposit somewhat resemble the main *Patton Porphyry* body. They are pale to light to dark green with 2 to 5% quartz phenocrysts and up to 35% plagioclase phenocrysts in an aphanitic groundmass (Bower *et al.*, 1995). The dike margins can have a glassy groundmass, and may show flow banding and/or lenticular structures near contacts (Bower *et al.*, 1995). These dikes intruded after the main hydrothermal event and contain only minor base and precious-metal mineralization, as well as locally abundant disseminated pyrite (Godwin, 1975).

ALTERATION

There are two phases of alteration related to the Casino deposit: primary hydrothermal alteration related to the intrusion and cooling of the *Patton Porphyry*; and secondary supergene alteration related to the weathering and erosion of the porphyry copper system. The primary hydrothermal alteration of the Casino deposit is typical of a porphyry copper mineralizing system with a potassic-altered core centered on and around the main *Patton Porphyry* intrusion and *Intrusion Breccia* (Fig. 6). This is bordered concentrically by an inner phyllic zone and an outer propylitic zone. Advanced argillic alteration occurs above the phyllic alteration. The secondary supergene

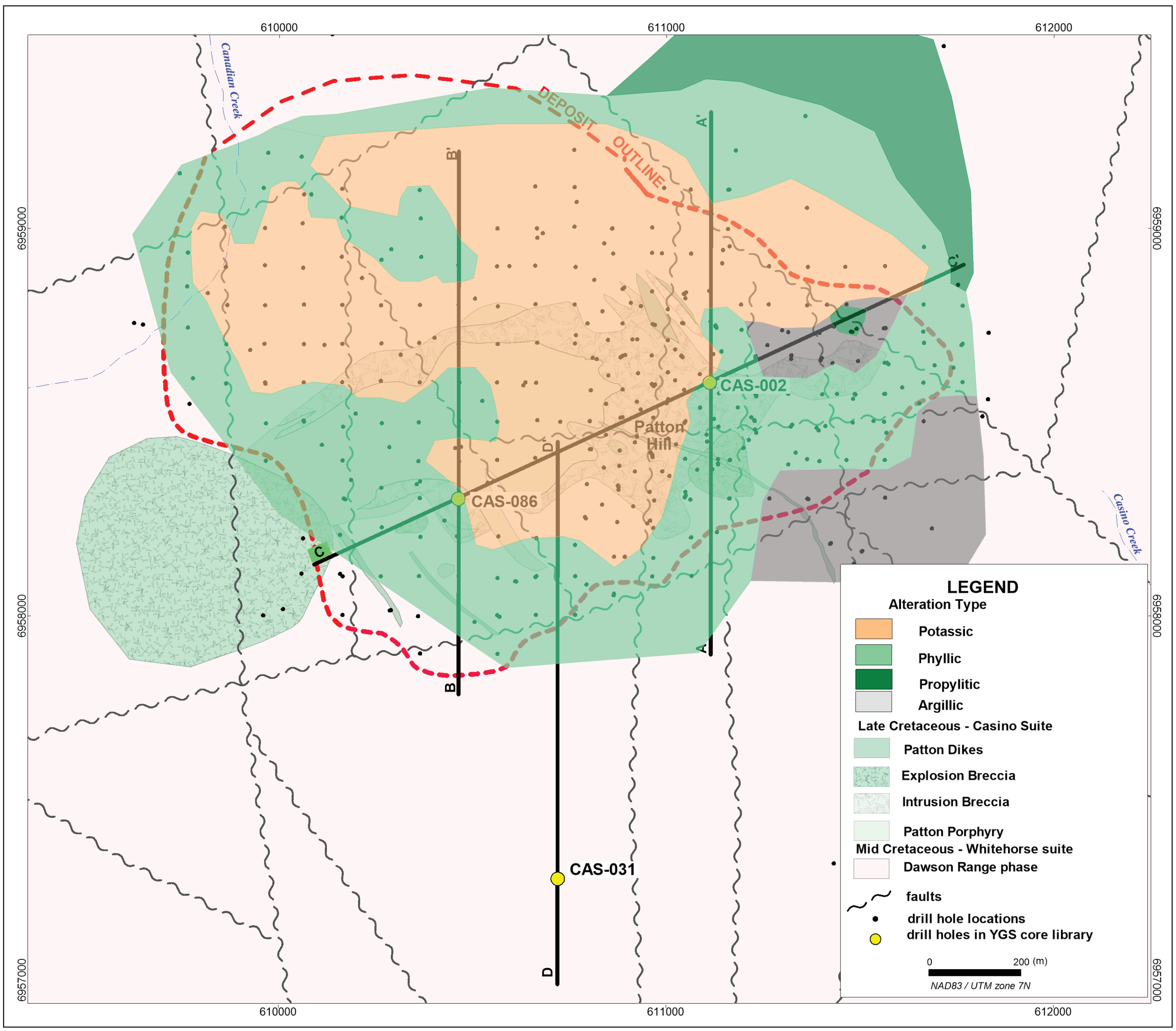


Figure 6. *Casino deposit alteration assemblage map.*

leaching and remobilization is a result of weathering of the exposed sulphide minerals. It is discontinuous and overprints the upper parts of the deposit.

The potassic alteration zone is a broad zone of pervasive biotite and k-feldspar alteration of the *Patton Porphyry* and immediately surrounding breccia and involves K and Fe-metasomatism. Potassic alteration minerals include texturally destructive K-feldspar, biotite, magnetite and quartz with lesser hematite, purple anhydrite and gypsum (Godwin, 1975). Biotite is generally felted and pseudomorphs hornblende (Fig. 7a). Locally, magnetite may form braided veinlets. The potassic zone contains less sulphide minerals than the phyllic zone.

The texturally destructive phyllic zone is found on the periphery of the deposit, is a retrograde alteration assemblage, locally overprinting potassic alteration. It is strongly developed with a distinctive 'bleached' appearance, and somewhat structurally controlled (Fig. 7b). Phyllic alteration is dominated by quartz, sericite and pyrite, but also includes muscovite (after biotite), and tourmaline, as well as minor hematite and/or magnetite towards the potassic zone. Quartz and sericite generally alter potassic and plagioclase feldspars. Biotite alters to muscovite or sphene; hornblende to chlorite, calcite, quartz and biotite (Bower *et. al.*, 1995). Tourmaline forms radiating crystal masses and veinlets. Sulphide content is typically high, with pyrite ranging from 5-10% throughout.

Field relationships show mineralized quartz veins of the phyllically altered zones crosscut those of the potassically altered zones, indicating potassic alteration was first. Re-Os age dating by Selby and Creaser (2000) shows that the dates of the potassic and phyllic alteration are contemporaneous at around 74.4±0.28 Ma.

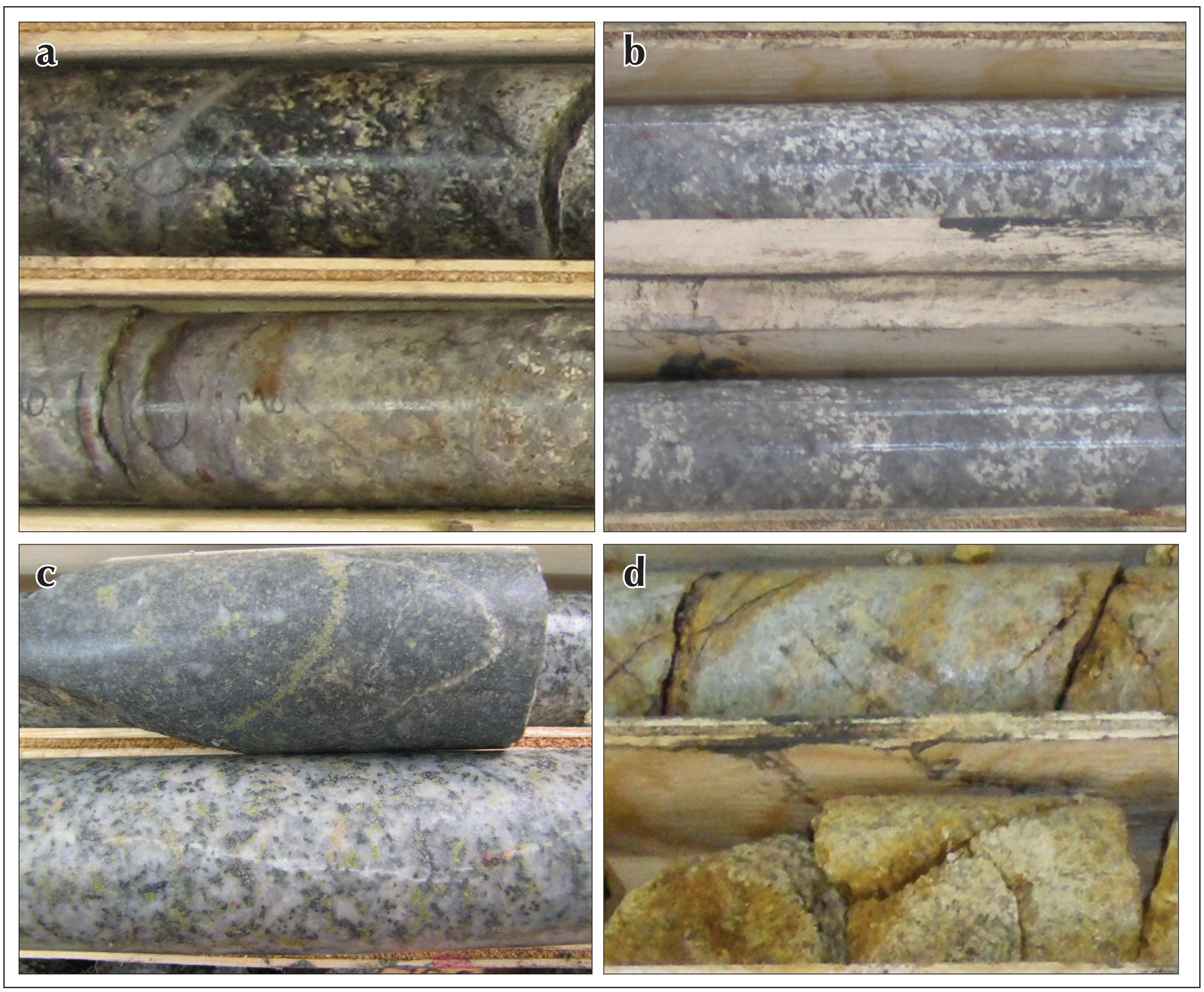


Figure 7. *Representative alteration types from the Casino deposit.* ***(a)*** *Potassic alteration – patchy biotitization of granodiorite,* ***(b)*** *phyllic alteration of Intrusion Breccia,* ***(c)*** *propyllitic alteration – epidote alteration of feldspars and chlorite alteration of mafic minerals,* ***(d)*** *weathering and leaching of cap rocks.*

Propylitic alteration is weakly developed and rarely observed on surface, but forms a wide halo around the deposit and is gradational with the inner phyllic alteration. Alteration minerals include epidote, chlorite and calcite (Fig. 7c), with lesser carbonate, clay, sericite, pyrite and albite. Hornblende and biotite are completely chloritized in the propylitic alteration zone (Godwin, 1975).

Advanced argillic alteration occurs above the phyllic alteration and consists of sericite, chlorite, pyrophylite and other clay minerals such as illite. Copper minerals in the advanced argillic zone are enargite and covellite and occur more commonly in veins.

The secondary supergene alteration is effectively acid leaching of the rock. The alteration is most intense at surface with a gradual decrease at depth and is closely associated with the leached cap and upper supergene zone. In the upper most part of the deposit, acid leaching has converted the sulphide minerals to iron oxide minerals and converted felsic and mafic minerals to kaolinite and montmorillonite clays (Fig. 7d). With depth the intensity of the clay alteration decreases.

MINERALIZATION

The Casino deposit displays a number of mineralization styles. Primary hypogene mineralization can be divided into two phases: copper-gold and molybdenum. Secondary supergene mineralization involves leaching the upper parts of the ore body enriching the supergene layers below. Supergene-enriched mineralization can be further subdivided into an upper, thin and discontinuous supergene oxide layer and a lower supergene sulphide layer of a variable thickness that is laterally extensive.

Hypogene mineralization occurs throughout the various alteration zones. However, the majority of Cu-Au-Mo mineralization occurs in the *Intrusion Breccia*, with lesser mineralization in the altered portions of the Dawson Range phase and *Patton Porphyry*. Mineralization in the potassic zone is mainly finely disseminated pyrite, chalcopyrite, molybdenite, trace sphalerite and bornite. Chalcopyrite commonly occurs in quartz stockwork veins (Fig. 8a), disseminations and irregular patches. In breccia and granodiorite west of the Casino fault, disseminated chalcopyrite is more abundant than chalcopyrite in veins and veinlets; whereas, east of the fault, chalcopyrite is controlled by brittle deformation and found in fractures and open space fillings (Bower *et. al.*, 1995). Pyrite to chalcopyrite ratios range from less than 2:1 in the core of the deposit, to greater than 20:1 in the outer phyllic zone (Bower *et al.*, 1995). Locally, bornite and tetrahedrite can be coarsely intergrown with chalcopyrite (Bower *et al.*, 1995).

Molybdenite is not generally intergrown with other sulphide minerals and occurs as selvages in early, high temperature, potassic quartz veins (Fig. 8b) as discrete flakes and disseminations. Molybdenite is largely unaffected by supergene processes, other than local alteration to ferri-molybdenite.

Native gold is very rarely seen with the naked eye. It occurs as free grains in quartz (50 to 70 microns) and as inclusions in pyrite and/or chalcopyrite grains (1 to 15 microns; Bower *et al.*, 1995).

The supergene oxide mineralization is characterized by copper oxide minerals chalcanthite, malachite and brocanthite, with minor azurite, tenorite, cuprite and neotocite (Bower *et al.*, 1995). These are most often seen as coatings on open space fractures and in vugs.

Supergene sulphide mineralization consists predominantly of chalcocite, diginite and/or covellite which occur on grain borders and fractures in chalcopyrite, bornite and tetrahedrite (Fig. 8c,d; Bower *et al.*, 1995). Chalcocite also coats pyrite grains and clusters in the phyllic alteration zone, and may extend along fractures well into the hypogene zone. Where the supergene enrichment is intense, the secondary sulphide minerals completely replace primary sulphide minerals.

ORE ZONES

The Casino deposit is unique among Canadian porphyry deposits in that it has an outcropping leached cap, an upper, copper oxide supergene mineralized zone, a lower, copper sulphide supergene mineralized zone, and an underlying hypogene zone (Figs. 7, 8, 9 and 10). The development and preservation of the weathered zones is due to the lack of recent glaciation in northern Yukon.

The leached cap (oxide gold zone) is enriched in gold and depleted in copper due to weathering and acid leaching. The mass-loss in the leached cap by the removal of sulphide minerals and the alteration of feldspar and mafic minerals to clays accounts for the gold enrichment. This zone averages 70 m thick and is characterized by boxwork textures filled with limonite, goethite and hematite (Bower *et al.*, 1995). Molybdenum in the cap was generally not mobilized, but rather chemically modified from molybdenite to ferri-molybdenite.

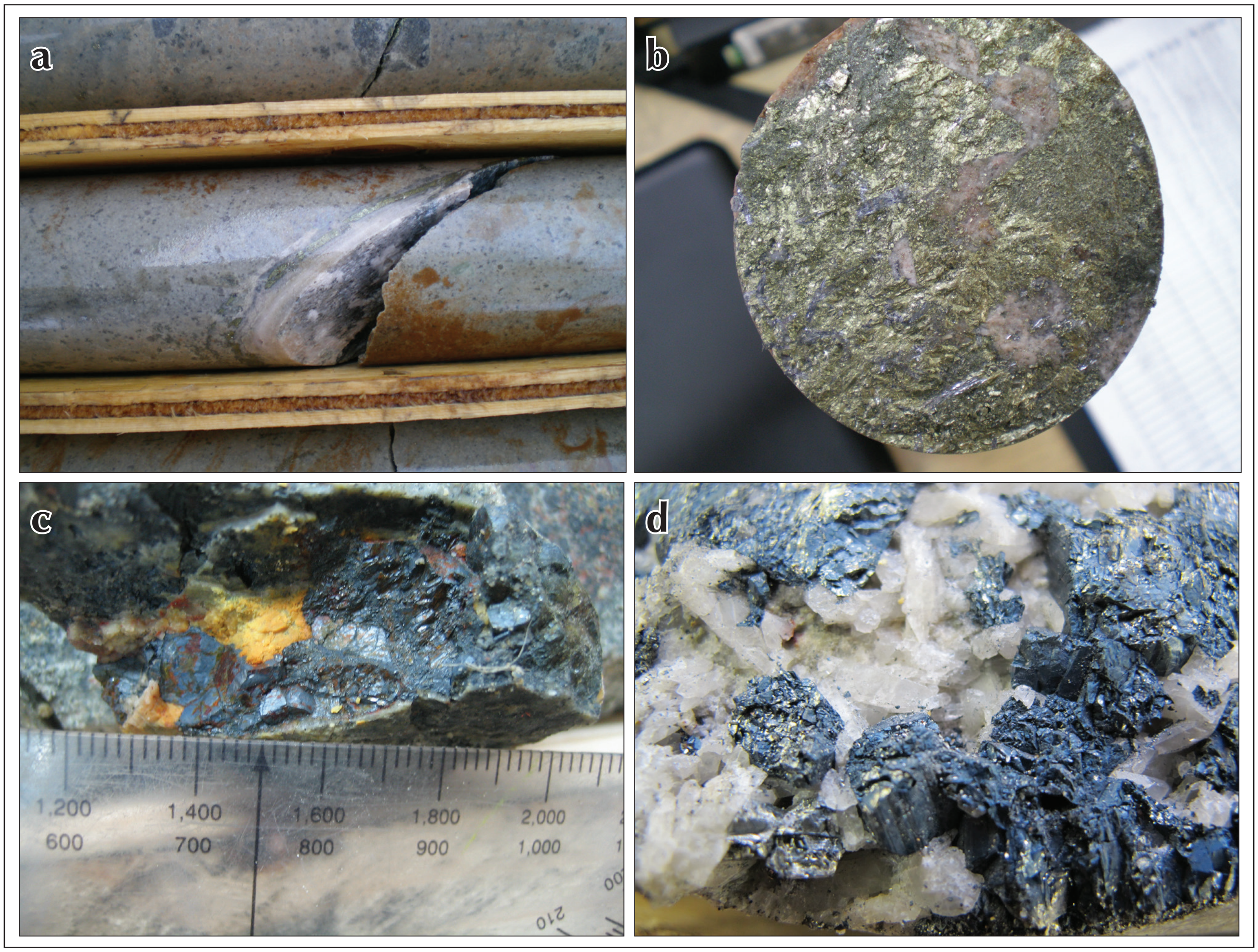


Figure 8. *Representative mineralization types from the Casino deposit.* ***(a)*** *Pyrite-chalcopyrite-quartz stockwork vein in Intrusion Breccia,* ***(b)*** *pyrite-molybdenite mineralization,* ***(c)*** *chalcocite coating pyrite in supergene zone,* ***(d)*** *chalcocite coating pyrite in supergene zone.*

The supergene oxide zone is discontinuous and varies from non-existent to tens of metres thick. It is also found as perched lenses, likely due to a periodic drop in the water table (Godwin, 1975). This zone is thought to be related to present day topography, and is best developed where oxidation of earlier secondary copper sulphide occurs above the water table on well drained slopes (Bower *et al.*, 1995).

The supergene sulphide zone is relatively flat lying and pancake shaped with an average thickness of 60 m; along the rim of the deposit it is less than 30 m thick to a maximum depth of 80 m, and in the centre of the deposit it is up to 110 m thick to a maximum depth of 280 m. Supergene alteration and mineralization is thickest and richest within the phyllic alteration zone, due to the permeability of the breccia and concentrations of pyrite, which act as a localizing catalyst for the precipitation of the secondary copper sulphide minerals, particularly chalcocite. The supergene sulphide zone is particularly important for the economics of the deposit due to the upgrading of copper concentration to nearly double the concentration in the hypogene zone; 0.43% Cu vs. 0.23% Cu.

RESOURCES

The resource estimate for the Casino deposit was updated in 2013 (Huss *et. al.*, 2013). Table 1 shows the mineral resource estimate for the various zones of the deposit.

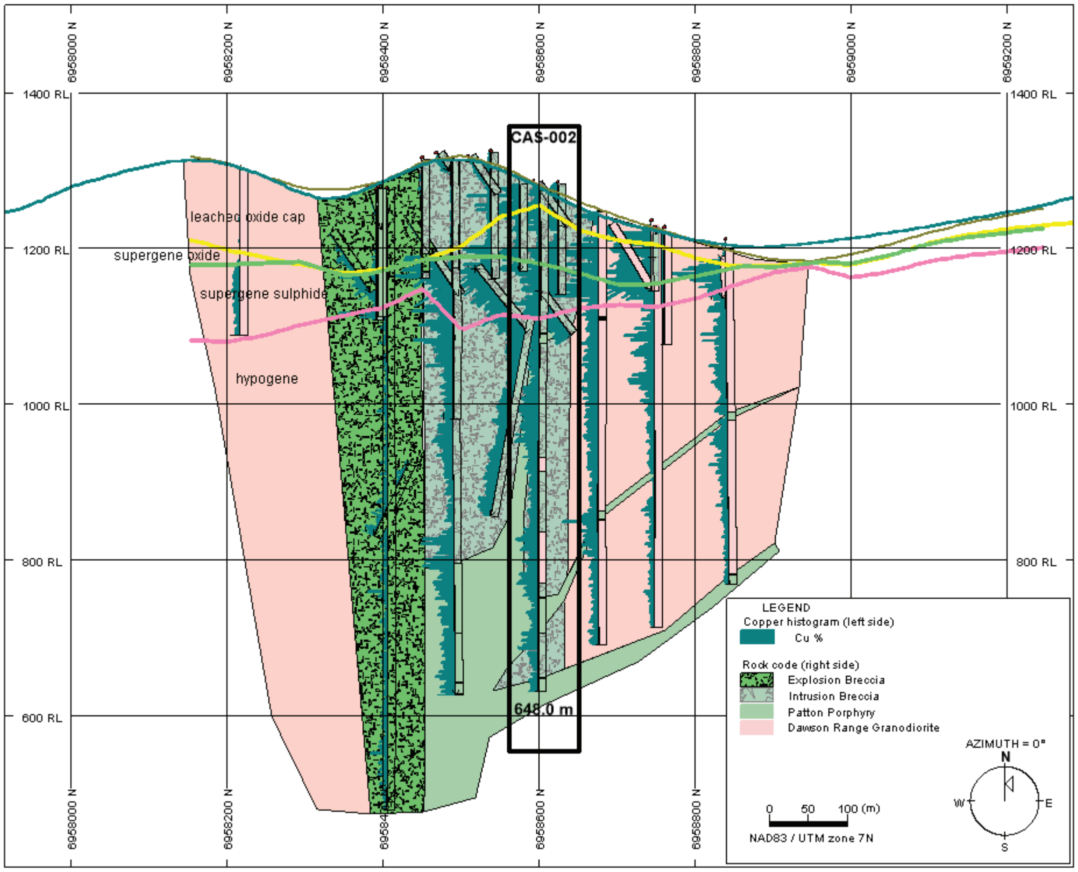


Figure 9. Cross section A-A′; north-south cross section through the core of the Casino deposit including diamond drill hole CAS-002.

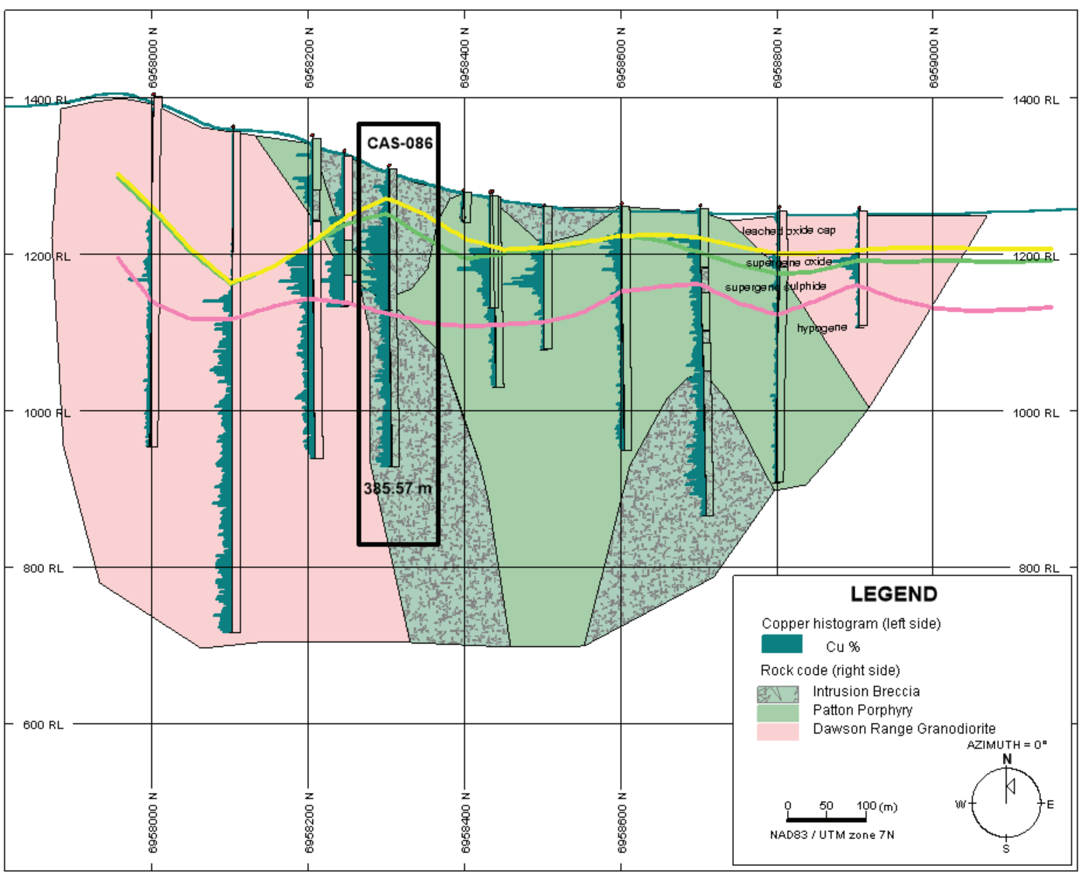


Figure 10. Cross section B-B′; north-south cross section through the western portion of the Casino deposit including diamond drill hole CAS-086.

Table 1. *Casino deposit mineral resource summary. The cut-off grade for the Leached Cap/Oxide Gold zone was 0.25 g/t gold and that for the supergene oxide, supergene sulphide and hypogene zone was 0.25% copper equivalent using the following metal prices to calculate the copper equivalent (prices in CDN $): $2.00/lb Cu, $875.00/oz Au, $11.25/lb Mo, and $11.25/oz Ag. M, I & I=measured, indicated and inferred.*

						Contained metals			
	Tonnage (000)	Cu (%)	Au (g/t)	Mo (%)	Ag (g/t)	Cu (lbs)	Au (oz)	Mo (lbs)	Ag (oz)
Leached Cap									
Measured and Indicated	84 000	0.04	0.400	0.020	2.57	74,075,299	1,080,274	37,027,200	6,940,758
Inferred	17 000	0.01	0.310	0.008	1.93	3,747,857	169,436	2,997,440	1,054,874
Total M, I & I	101 000	0.03	0.385	0.018	2.46	77,823,157	1,249,709	40,024,640	7,995,632
Supergene Oxide									
Measured and Indicated	61 000	0.25	0.340	0.022	1.83	336,204,855	666,812	29,577,680	3,589,016
Inferred	26 000	0.26	0.170	0.010	1.43	149,032,447	142,107	5,730,400	1,195,374
Total M, I & I	87 000	0.25	0.289	0.018	1.71	485,237,302	808,919	35,308,080	4,784,390
Supergene Sulphide									
Measured and Indicated	252 000	0.26	0.250	0.021	1.81	1,444,468,334	2,025,513	116,635,680	14,664,714
Inferred	102 000	0.20	0.190	0.010	1.49	449,742,888	623,086	22,480,800	4,886,309
Hypogene									
Measured and Indicated	743 000	0.17	0.220	0.023	1.66	2,784,658,048	5,255,402	376,641,560	39,654,400
Inferred	1 568 000	0.14	0.160	0.020	1.36	4,839,586,214	8,066,043	691,174,400	68,561,364
Supergene Sulphide & Hypogene									
Total M, I & I	2 665 000	0.16	0.186	0.021	1.49	9,518,455,485	15,970,045	1,206,932,440	127,766,788

DIAMOND DRILL CORE IN YGS CORE COLLECTION

Core from two complete holes within the deposit and one hole from outside the deposit have been donated by Western Copper and Gold Corporation to the YGS core collection (Table 2, Fig. 3). Drill hole CAS-002 is from the eastern part of the deposit near the central part of the *Patton Porphyry* intrusion and shows the relationship between the *Patton Porphyry* intrusion and *Intrusion Breccia* with Dawson Range phase country rocks, as well as the hydrothermal alteration, secondary weathering and supergene enrichment. Drill hole CAS-086 is located on the western portion of the deposit, where the *Patton Porphyry* flattens out into a sill-like intrusion. It is mostly in the *Intrusion Breccia* along the margins of the *Patton Porphyry* and has good representation of each of the ore zones: the leached cap, the supergene oxide zone, supergene sulphide zone and hypogene zone. Drill hole CAS-031 is from 450 m south of the deposit and shows lesser altered Dawson Range phase granodiorite with examples of the distal sphalerite-galena veins associated with the mineralizing system.

Available data for each diamond drill hole includes digital data in the form of Excel files, pdfs of original logs, and core photographs. The Excel files include collar, survey, lithology, assay and geochemistry data.

Table 2. *Drill core donated to YGS library.*

Hole No.	Easting (m)*	Northing (m)*	Year drilled	Length (m)	Entire hole at YGS	Area	Mineralization style
CAS-002	611110.11	6958601.29	2008	648.00	Yes	Central core of deposit	Leached Cap, Supergene Oxide, Supergene Sulphide, Hypogene
CAS-031	610717.3	6957322.78	2009	638.56	No (only 596.1 - 638.56 m)	500 m south of deposit	distal Pb-Zn veins
CAS-086	610462.64	6958303.34	2010	385.57	Yes	Western part of deposit	Leached Cap, Supergene Oxide, Supergene Sulphide, Hypogene

*UTM NAD 83, Zone 7

ACKNOWLEDGEMENTS

The authors would like to thank Western Copper and Gold Corporation for the permission to publish this paper and for the donation of core from three diamond drill holes and accompanying data and photographs to the Yukon Geological Survey H.S. Bostock core library.

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DIGITAL APPENDIX

The digital appendix to this paper includes two summary pages for each drill hole. Each summary is designed to be printed as a double-sided sheet. The first page has a plan map, a table summarizing collar information, and strip logs showing downhole lithology and assay data. The second page has a section with the drill hole highlighted and a table of the key assay data for the hole.

Update on the Minto deposit (Yukon MINFILE 115I021,022)

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Yukon Geological Survey

Roisin Kerr and Douglas McIlveen
Capstone Mining Corp., Minto Mine

Sack, P.J., Kerr, R. and McIlveen, D., 2017. Update on the Minto deposit (Yukon MINFILE 115I021, 022). *In:* Yukon Exploration and Geology Overview 2016, K.E. MacFarlane (ed.), Yukon Geological Survey, p. 75-87, plus digital appendices.

ABSTRACT

The Minto property is located in central Yukon, 75 km northwest of the village of Carmacks. Copper-gold-silver mineralization was discovered on the property in 1971 and the mine has been in continuous production since 2007. The deposits are hosted by the Minto pluton, a Late Triassic to Early Jurassic granitoid that is one of many plutons of similar age which extend the length of the northern Cordillera. Mineralization at Minto is hosted in a variety of foliated rocks with individual bodies up to tens of metres thick and one kilometre laterally. The origin of these foliated bodies is enigmatic. They are typically high-grade (>1% Cu) with sulphides ranging in form from disseminated or foliaform lenses through to semi-massive or massive lenses. Primary hypogene ore minerals are chalcopyrite, bornite, and euhedral chalcocite with minor pyrite; less abundant ore minerals include covellite, silver, native gold and electrum.

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INTRODUCTION

The Minto copper-gold-silver (Cu-Au-Ag) mine has a global resource of more than 725 000 tonnes of copper (Table 1) in several deposits and is located in central Yukon, 75 km northwest of the village of Carmacks (Fig. 1). The mine is accessed via the Klondike Highway to a seasonal barge across the Yukon River and then via a private 27 km road to the mine site. Mineralization on the property was discovered in 1971 and the mine has been in continuous production since 2007. Since the mid-1990s, core from 18 diamond drill holes has been donated to the Yukon Geological Survey (YGS) core collection, which is housed at the H.S. Bostock Core Library. In 2016, core from three additional diamond drill holes was donated by Capstone Mining Corporation, owners and operators of the Minto mine, to ensure a robust set of core from the Minto property is available to the geologic community. In addition to the donation of core, Capstone provided associated data (*e.g.*, drill logs, assays, collar coordinates *etc.*) for all Minto holes in the YGS collection. This additional data enables the YGS to put each Minto diamond drill hole in the collection into a consistent and complete geologic context.

The addition of the new Minto core to the YGS collection coincides with the final stages of a collaborative research project between the YGS, University of British Columbia Mineral Deposit Research Unit (MDRU) and the Geological Survey of Canada (GSC). The project was initiated to investigate the regional metallogenic and petrogenetic character of Late Triassic to Jurassic plutonic rocks of the Intermontane terranes in Yukon. In the northern Cordillera, the Intermontane terranes (Yukon-Tanana, Stikinia, Quesnellia and Cache Creek) are host to a large number of low-grade, bulk-tonnage copper deposits. Most of these deposits are well understood Late Triassic to Early Jurassic porphyry deposits in British Columbia (Logan and Mihalynuk, 2014). In Yukon, coeval plutonic rocks also host copper (gold ± silver) mineralization, such as that seen on the Minto property, but the deposits are typically high-grade and relatively small tonnage, of ambiguous origin and thus significantly different to those in British Columbia.

The present contribution provides an update on the regional context for the Minto deposits, outlines the main geologic characteristics of the deposits, and puts the core in the YGS core collection into a consistent deposit context. The donated Minto core and associated data will provide a lasting resource for future geologists to learn about this intriguing deposit.

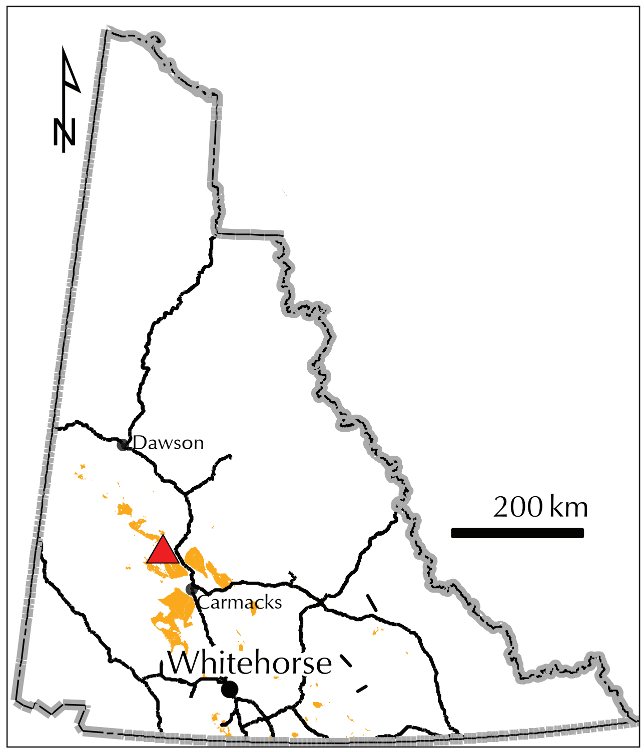

Figure 1. *Location of Minto property shown by red triangle. Late Triassic to Jurassic plutons shown in orange, main highways in black.*

Table 1. *Global Minto resource recalculated from Mercer and Sagman (2012) for Minto South, Ridgetop, Minto North and Minto East deposits (their Tables 1-2 through 1-5 respectively). Minto Main deposit estimate is from SRK (2008; their Table 1-5, Dec. 2007 Model). The Dec. 2007 model, was done after approximately 6 months of mining and doesn't include mined out material; it is considered a slight underestimate. A cut-off grade of 0.5% Cu was used for each estimate. M&I = Measured & Indicated.*

	Tonnes	Cu (%)	Au (ppm)	Ag (ppm)	Cu (lbs)	Cu (tonnes)	Au (oz)	Au (tonnes)	Ag (oz)	Ag (tonnes)
Total M&I	54 513 000	1.21	0.45	4.4	1,449,715,364	657,579.29	771,233	21.9	7,696,197	218.2
Total Inferred	8 491 000	0.81	0.24	2.9	151,741,000	68,828.50	64,300	1.8	787,000	22.3
Global Resource (M&I plus Inf)	63 004 000	1.15	0.42	4.2	1,601,456,364	726,407.80	835,533	23.7	8,483,197	240.5

EXPLORATION AND MINING HISTORY

The initial Minto portion of the current claim package was staked by the Dawson Syndicate (Silver Standard Mines Ltd. and Asarco) in 1971 based on anomalous results of a regional stream sediment geochemical program shortly after the discovery of the Williams Creek, now Carmacks Copper, deposit (Yukon MINFILE 115I008). In 1973, United Keno Explorations discovered mineralization on the adjoining DEF claims, and between 1973 and 1977 exploration was mostly a joint venture between the Dawson Syndicate and United Keno Explorations. In 1977, the results of a joint feasibility study were released and cited Main zone reserves (pre-NI 43-101) of 6 550 748 t grading 1.86% Cu, 0.51 g/t Au and 6.86 g/t Ag. This initial economic study was released as copper values were declining (Fig. 2), consequently, work on the Minto/DEF claim package was suspended until the early 1990s. Various corporate activities and exchanges resulted in all of the claims being owned by Minto Explorations Inc., a company created specifically to acquire and develop the Minto property.

Beginning in 1994, Minto Explorations performed engineering and geotechnical studies to support a feasibility study and to begin the process of acquiring various environmental permits required for mining and production. Minto Explorations also calculated an initial *in situ* geological reserve (also pre-NI 43-101) for the property using a cut-off grade of 0.5% Cu. The company reported 8 818 000 tonnes grading 1.72% Cu, 0.48 g/t Au and 7.5 g/t Ag (Yukon MINFILE, 2016). Between 1995 and 1998, company efforts were largely directed towards putting the previously defined resource into production. Some exploration, mostly on the fringe of the existing deposit, was conducted throughout this period. By 1998, the value of copper was approaching a 40 year low (Fig. 2) and operations were again suspended.

In early 2005, Sherwood Mining Corp. took over Minto Explorations and within five months released the first NI 43-101 resource for the property at 8 340 000 t grading 1.83% Cu, 0.55 g/t Au and 7.95 g/t Ag in the measured and indicated categories, with a further 700 000 tonnes grading 1.41% Cu, 0.45 g/t Au and 6.0 g/t Ag in the inferred category (Giroux, 2005). All major permits were received by June 2006, with pre-stripping of the Main zone and mill construction occurring in the latter half of the year. In early 2007, Sherwood Copper completed the mill and pre-stripping of the Minto Main deposit. The first copper-gold concentrates were produced on May 1, 2007 and the first load of concentrates were delivered to the port of Skagway, Alaska on July 16, 2007. On October 1, 2007 commercial production was announced. The discovery of mineralization in Area 2 in early 2006 demonstrated the property potential, and between 2006 and 2011, nine zones of Cu-Au-Ag mineralization were discovered, including the Minto South (made up of earlier Area 2, Area 118, Wildfire and Copper Keel discoveries), Ridgetop, Minto East, Minto North and Minto North 2 deposits. Significant exploration potential, particularly for deeper resources, remains on the property (Fig. 3).

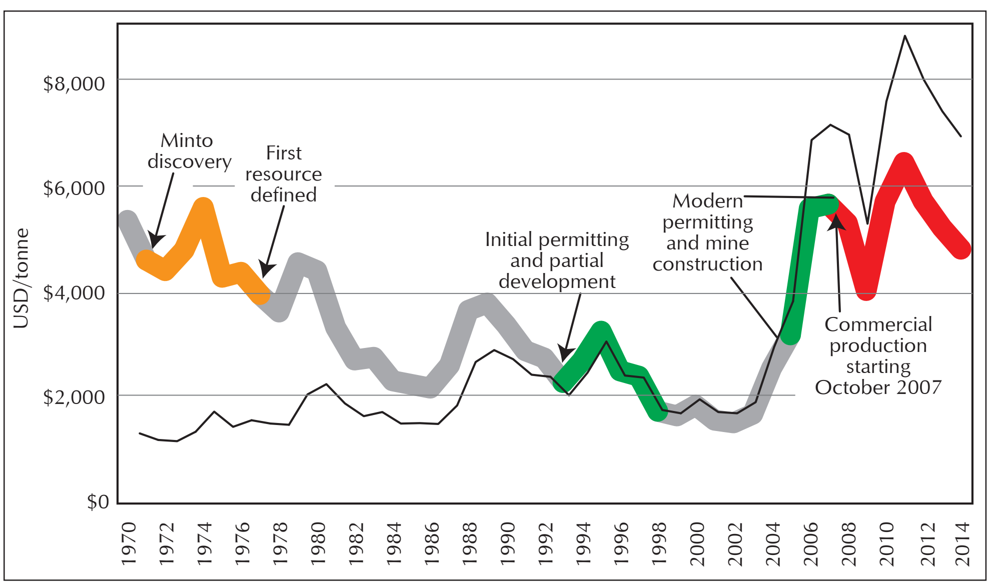

Figure 2. *Historical value of copper. Thick line shows historical average annual copper price in 1998 constant U.S. dollars per tonne with coloured segments indicating periods of activity on the Minto property. Thin black line shows copper price in dollars of the day per tonne. Data for both lines from Kelly and Matos (2014). Annotated milestones for Minto property based on Yukon MINFILE, accessed November 25, 2016.*

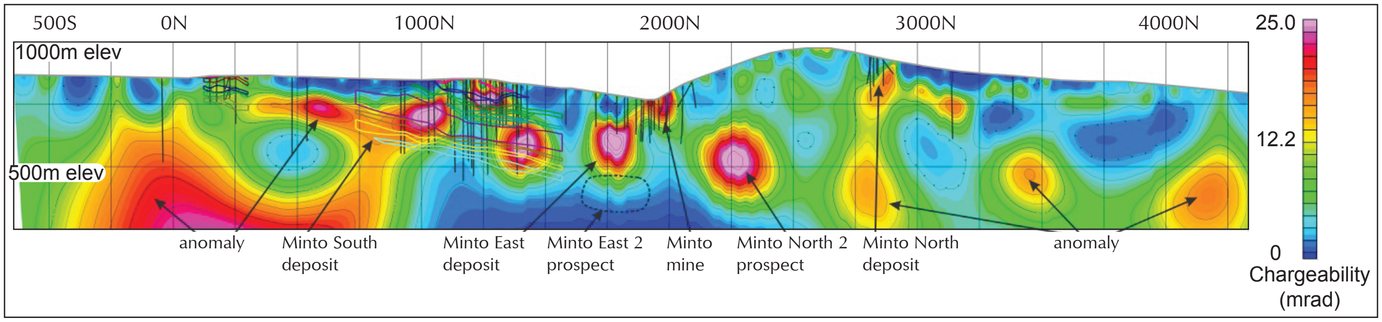

Figure 3. *Titan-24 survey Line 3. Smooth IP chargeability from DC resistivity reference, Line 3 shown by bold line on Figure 5 (Mercer and Sagman, 2012). Note correspondence of high chargeability anomalies with known deposits.*

GEOLOGY

REGIONAL GEOLOGY

The Minto pluton is one of a series of Late Triassic to Jurassic plutons that occur along the length of the northern Cordillera (Fig. 4). These plutons are associated with two paired magmatic arcs preserved as the Quesnellia and Stikinia terranes (Fig. 4; Logan and Mihalynuk, 2014). In Yukon, these Late Triassic to Jurassic plutons are mostly located at, or near, the contact between the Paleozoic Yukon-Tanana terrane and late Paleozoic to Mesozoic Stikinia/Quesnellia terranes (Fig. 4). The plutons can be divided into five suites, from oldest to youngest these are Late Triassic Stikine Suite, latest Triassic to Early Jurassic Minto suite, Early Jurassic Long Lake Suite, Middle Jurassic Bryde suite, and Middle to Late Jurassic McGregor suite (Colpron *et al.*, 2016; Joyce *et al.*, 2016; Woodsworth *et al.*, 1991).

The Minto property is located in the centre of the Carmacks map area (NTS 115I) within the Carmacks copper belt of west-central Yukon. This mineralized belt is made up of several similar Cu-Au ± Ag mineral occurrences hosted by the Minto suite. Occurrences similar to those at the Minto property include the Carmacks Copper deposit, and the Stu prospect (Yukon MINFILE 115I011), restricting known mineralization to the Granite Mountain batholith and Minto pluton. The Minto suite includes other plutonic bodies such as the Tatchun and Selkirk batholiths that may have potential to host similar mineralization (Fig. 4; Topham *et al.*, 2016).

The Minto pluton is interpreted to be part of the Minto suite (*e.g.*, Colpron *et al.*, 2016), which is broadly intermediate (granodioritic) in composition. Based on the modal mineralogy QAP based classification of Le Bas and Streckeisen (1991), the Minto suite varies between granite, monzonite to monzodiorite, granodiorite and tonalite. Major and trace element contents are typical of calc-alkaline volcanic arc granite. Magnetic susceptibility measurements from outcrop are ≥1 x10^{-3} SI units indicating most Minto suite plutons are weakly oxidized to oxidized magnetite series, though a few plutons have values <1 indicating locally they can be reduced ilmenite series (Ishihara, 1977). The range of U-Pb zircon ages from samples of the Minto suite is approximately 204 Ma to 194 Ma, straddling the Late Triassic to Early Jurassic boundary. Emplacement depths ranging from 30 to 20 km (7.2 ± 1.0 to 6.4 ± 0.8 kbar, respectively) have been calculated for several plutons of the Minto suite using the aluminum-in-hornblende geothermobarometer (McCausland *et al.*, 2002; Tafti, 2005; Topham *et al.*, 2016).

PROPERTY GEOLOGY

The Minto pluton has an exposed surface area of 170 km²; the local geology of the area is shown in Figure 5. The Minto pluton intrudes the Late Triassic augite-phyric basalt of the Stikine terrane (Lewes River Group) to the east and north, and presumably the Late Devonian-Early Mississippian metaplutonic rocks of Yukon-Tanana terrane (Simpson Range plutonic suite) to the west (Tempelman-Kluit, 1984). The contact between the Minto pluton and Yukon-Tanana rocks is covered by younger rocks of the Carmacks and Selkirk Volcanic groups, and so the exact nature of that contact is unknown (Fig. 5). The northern end of the Minto pluton is covered by Pliocene and younger basalt flows of the Selkirk Volcanic Group (Tempelman-Kluit, 1984). The eastern margin of the Minto pluton is locally faulted against rocks of the Lewes River Group by the dextral Ingersoll fault (Tempelman-Kluit, 1984). The southern margin of the Minto pluton is overlain by volcanic and sedimentary rocks of the

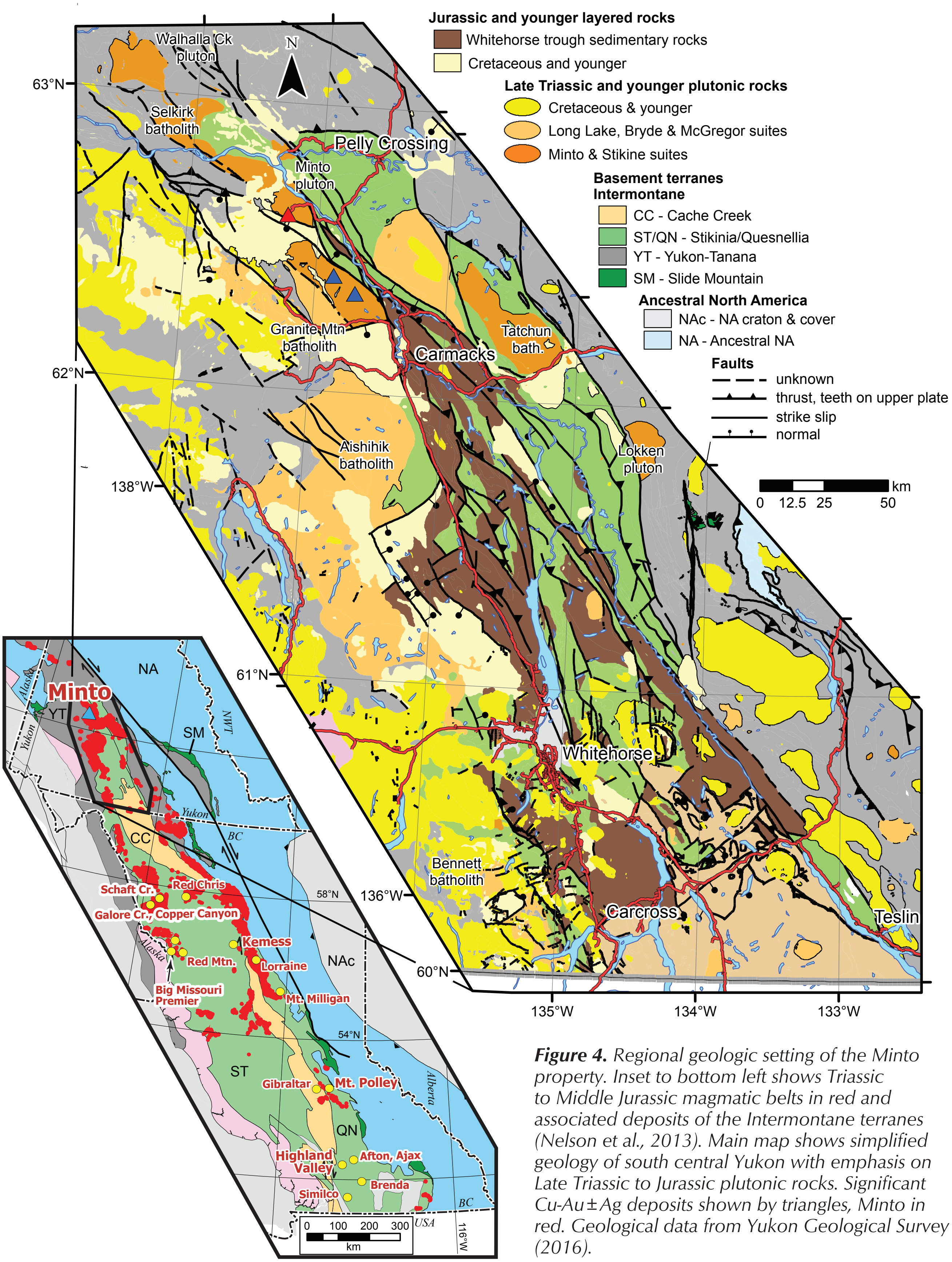

Figure 4. *Regional geologic setting of the Minto property. Inset to bottom left shows Triassic to Middle Jurassic magmatic belts in red and associated deposits of the Intermontane terranes (Nelson et al., 2013). Main map shows simplified geology of south central Yukon with emphasis on Late Triassic to Jurassic plutonic rocks. Significant Cu-Au±Ag deposits shown by triangles, Minto in red. Geological data from Yukon Geological Survey (2016).*

Cretaceous Carmacks Group, and is defined by an unnamed normal fault (Tempelman-Kluit, 1984). The Cretaceous Carmacks Group unconformably overlies the Minto pluton, as demonstrated locally by a clast-supported cobble to boulder conglomerate that includes clasts of mineralized Minto lithologies (Hood, 2012). The Minto pluton may link to the south, under Carmacks Group cover, with the Granite Mountain batholith and to the northwest, under the Selkirk Volcanic Group cover, with the Selkirk batholith.

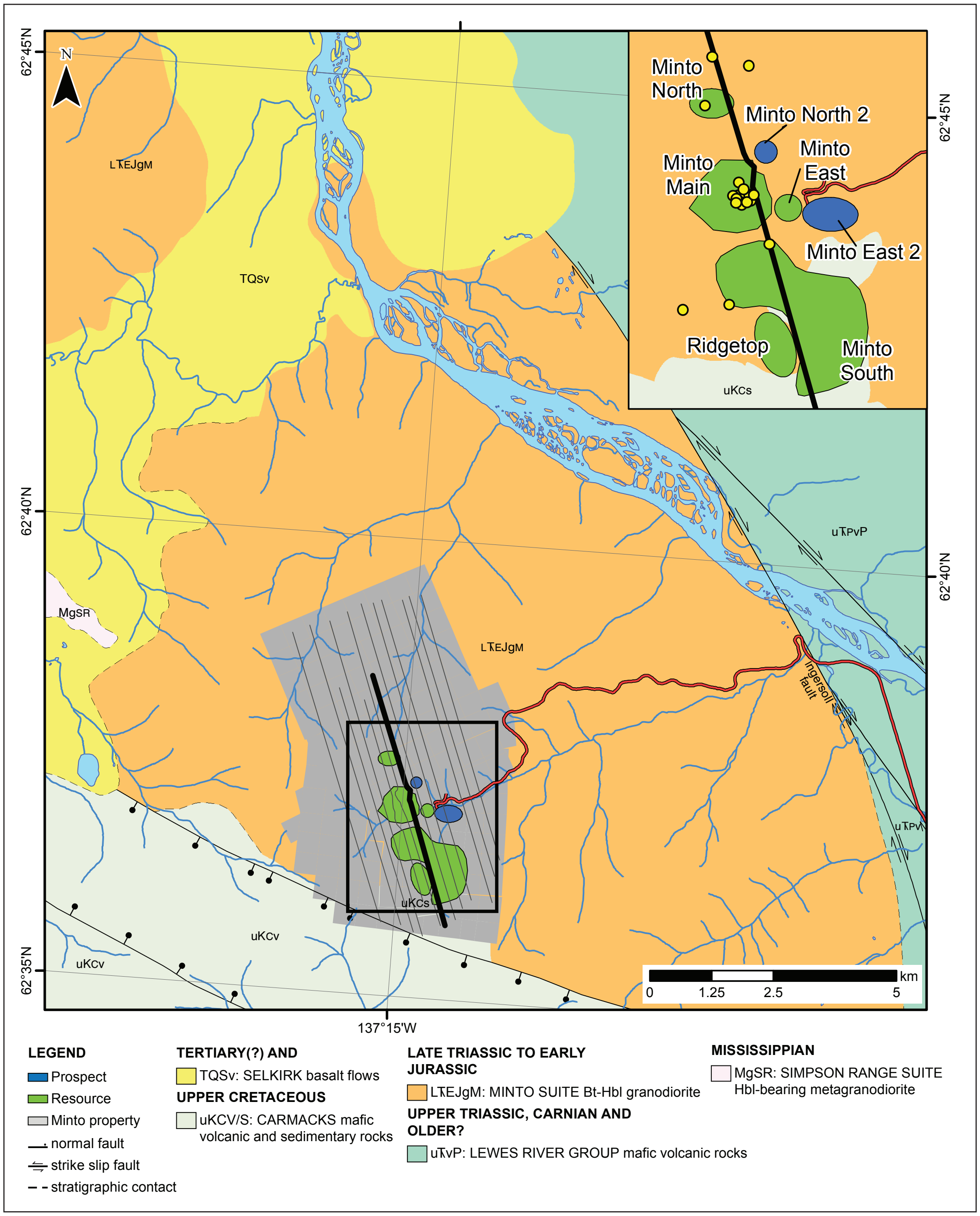

Figure 5. *Simplified geology on the Minto property. Top right inset map shows location of deposits and prospects on the Minto property with collar location of diamond drill holes in the YGS collection shown as yellow circle. Titan-24 geophysical survey lines from 2009 and 2010 are on the Minto property (light grey) and oriented north-northwest; Line 3, shown as a pseudo-section in Figure 3, is bold.*

DEPOSIT GEOLOGY

The Minto deposits are hosted within the Minto pluton, a relatively simple intrusive body mainly composed of medium to coarse-grained, K-feldspar phyric to equigranular, unfoliated granodiorite (Hood, 2012; Tafti, 2005). The orebodies are associated with foliated rocks. At various times since discovery, the deposit type for Minto has been interpreted as porphyry copper, volcanogenic massive sulphide (VMS), redbed copper, magnetite skarn (Pearson and Clark, 1979) or iron oxide copper gold (IOCG; Mercer and Sagman, 2012). The range of deposit styles in the literature is likely because workers have ascribed different interpretations to similar observations based on their background and the popular models of the day (Mercer and Sagman, 2012). Early descriptions of the foliated rocks were interpreted to represent various stages of digestion of previously foliated rocks (Pearson and Clark, 1979). More recent interpretations suggest foliated rocks represent various stages of deformation of the same unit, likely the Minto pluton granodiorite (Hood, 2012). In this contribution, we will focus on descriptive aspects and not on interpreted genesis of lithologies.

Granodiorite (Fig. 6a) is the dominant rock type of the Minto pluton. The actual composition and texture varies from crowded K-feldspar megacrystic syenite to equigranular tonalite or quartz diorite (Hood, 2012), similar to the range seen regionally within the Minto suite. In general, the granodiorite contains approximately 30 to 50% plagioclase, 10 to 50% K-feldspar, 20 to 25% quartz, and total biotite ± hornblende 10 to 15% (Hood, 2012). Accessory minerals include magnetite, epidote, titanite, apatite, and zircon, all of which have sharp euhedral crystal faces in thin section (Hood, 2012). K-feldspar occurs most commonly as phenocrysts 1 to 3 cm long, with inclusions of biotite, plagioclase, hornblende, epidote, and zircon commonly along growth zones (Hood, 2012). Compositions tending to tonalite or diorite (Fig. 6b) are generally slightly coarser grained and typically contain anhedral K-feldspar as well as plagioclase that occurs both as euhedral crystals up to 1 cm in length and anhedral equigranular crystals that are evenly distributed (Hood, 2012). Quartz forms anhedral masses interstitial to feldspar, but locally forms glomeroporphyritic masses up to 1 cm in diameter. Biotite and hornblende are the most common mafic minerals; they are typically <1 cm, and comprise up to 15% of the granodiorite (Hood, 2012). Both magmatic epidote and secondary epidote are present; magmatic epidote has sharp euhedral boundaries with mafic phases and growth zoning (as described by Zen and Hammarstrom, 1984). The age of the Minto pluton is best constrained by U-Pb zircon ages from Hood (2012) that range from 197.6 ± 1.6 Ma to 200.1 ± 1.1 Ma.

Deformed rocks vary from moderately to strongly foliated and recrystallized (Fig. 6c,d) with mafic content up to 80% (Fig. 6e; Tafti, 2005). Foliated rocks consist of alternating mafic and felsic layers. Mafic layers are millimetres to centimetres thick and consist of moderately aligned biotite, hornblende, epidote, magnetite, and titanite separated by thicker felsic layers that are centimetres to tens of centimetres and composed of medium to coarse-grained quartz and plagioclase with lesser amounts of biotite, hornblende, epidote, magnetite and titanite (Hood, 2012). Foliated rocks contain most of the sulphides at the Minto deposits, and individual bodies are up to tens of metres thick. Higher grade ore tends to occur with thicker layered, coarser grained and more siliceous lithologies while lower grade ore is often associated with thin, discontinuous layering and mafic rocks (Fig. 7a-c; Mercer and Sagman, 2012). Contacts between foliated and unfoliated rocks are typically sharp, marked by rapid grain-size change (Fig. 6d,e). Locally, k-feldspar phenocrysts from unfoliated granodiorite impinge on foliation suggesting the contacts are, at least locally, intrusive in nature (Hood, 2012). Individual foliation planes or mafic-felsic bands vary from regular to irregular in orientation, often at a high angle to contacts with unfoliated rocks (Mercer and Sagman, 2012). Despite the internal variation, the zones of foliated rock form consistently subhorizontal horizons that can be traced laterally for more than one kilometre in diamond drill core. The zones are often stacked in parallel to subparallel sequences (Mercer and Sagman, 2012).

Four types of relatively late, volumetrically insignificant dikes crosscut the Minto pluton; from youngest to oldest these are (i) hornblende diorite dikes, (ii) andesite dikes, (iii) aplite dikes, and (iv) granitoid pegmatite (Hood, 2012). The hornblende diorite dikes are unaltered, undeformed and likely related to the Selkirk mafic volcanic rocks found to the north of the deposit. The andesite dikes are similarly undeformed but can be locally altered and are likely related to the volcanic rocks of the Carmacks Group. The aplite and pegmatite dikes (Fig. 8) are mutually crosscutting suggesting a similar age for both; a pegmatite dike dated at 195.5 ± 0.7 Ma by Tafti (2005) indicates they are essentially coeval with crystallization of the Minto pluton.

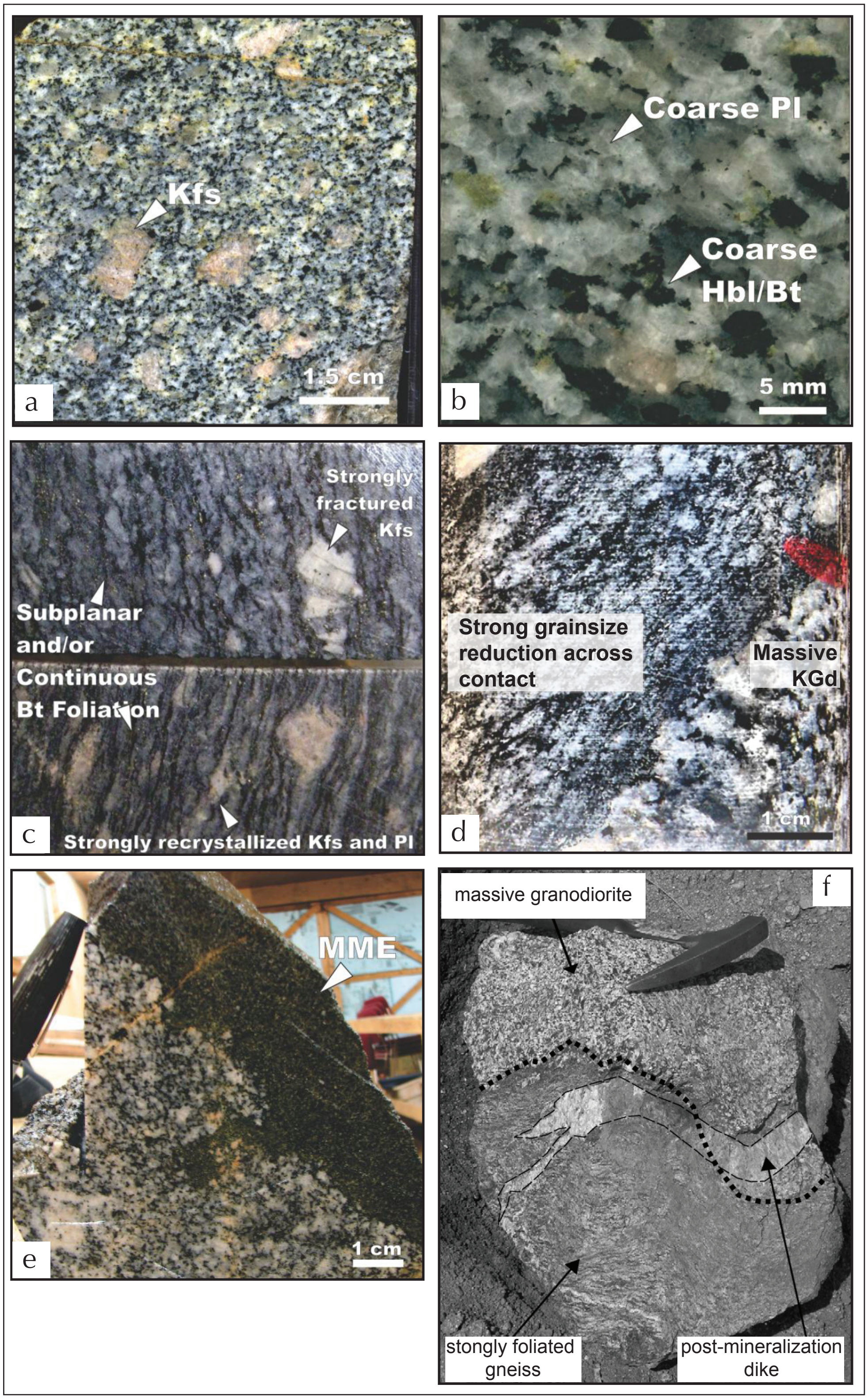

***Figure 6.** Lithologies on the Minto property. **(a)** Granodiorite is the most common host rock and is typically medium-grained granodiorite with centimetre-scale K-feldspar phenocrysts. Kfs=K-feldspar. Sample S09-13-03A. **(b)** The other common host lithology is less potassic and coarser grained tonalite (Tlt) which contains plagioclase (Pl) and euhedral hornblende (Hbl) and biotite (Bt) that are typically >5mm long. **(c)** Moderately deformed and recrystallized gneiss is the most common foliated unit at Minto. **(d)** Strongly deformed gneiss in contact with undeformed granodiorite (KGd), contact defined by an abrupt reduction in grain size. Very fine grained chalcopyrite and magnetite are present in the gneiss but not in the incipiently deformed rock. **(e)** Mafic-rich schist (MME) sharing irregular boundary with granodiorite, suggesting granodiorite engulfed the mafic-rich schist. **(f)** Contact between a well-foliated gneiss and massive KGd with a small crosscutting dike. (a - e) from Hood (2012); (f) from Tafti and Mortensen (2004).*

Late brittle fracturing and faulting is noted throughout the area (Mercer and Sagman, 2012). The Minto Creek fault bisects the Main deposit, dividing it into north and south areas, and is modeled as a steeply dipping east-northeast sinistral reverse fault (Mercer and Sagman, 2012). Both the vertical and horizontal displacements are evident by offsets in mineralized horizons, and appear to be minimal. The DEF fault defines the northern end of the Main deposit, strikes west, dips north-northwest and cuts off mineralization in the Main deposit. It may share a similar sense of movement to the Minto Creek fault, but a significant amount of displacement is inferred (Mercer and Sagman, 2012). The Minto and DEF faults are interpreted as late block faults with a rotational component, a style common to the area (Tempelman-Kluit, 1984). One example is documented by Tafti and Mortensen (2004) south of the Minto deposits where Cretaceous Carmacks Group sedimentary rocks are rotated up to 60° from horizontal. Several poorly defined faults are also noted on the property. For example, the boundary between Area 2 and Area 118 is a northeast-dipping fault with significant displacement, and at least two parallel structures displace mineralized horizons in Area 118. A similar northwest-striking fault zone appears to define the northeastern boundary of the Ridgetop deposit and the southwest extent of the Wildfire resource area (Mercer and Sagman, 2012).

Mineralization and alteration

The primary hypogene sulphide mineralization of the Minto deposits consists of chalcopyrite, bornite, euhedral chalcocite and minor pyrite; metallurgical testing also indicates the presence of covellite (Mercer and Sagman, 2012). Silver telluride (hessite) is observed in polished samples, and native gold and electrum have both been reported as inclusions within bornite accounting for the high gold recoveries in test copper concentrates (Mercer and Sagman, 2012). Locally, coarse free gold is observed associated with chloritic or epidote-lined fractures that crosscut the sulphide mineralization and are attributed to secondary enrichment during a process overprinting the main copper sulphide mineralization (Mercer and Sagman, 2012). Sulphide mineralization is almost always accompanied by increased amounts of magnetite and biotite thought to be the result of potassic alteration (Mercer and Sagman, 2012).

Texturally, sulphide minerals predominantly occur as disseminations and foliaform stringers along foliation planes in the deformed rocks (*i.e.*, sulphide stringers tend to follow the foliation planes; Fig. 7). However, sulphide mineral content tends to increase where foliation is intensely disrupted and can result in semi-massive sulphide accumulations up to several metres thick or, locally, massive sulphide accumulations up to 0.5 m in thickness (Mercer and Sagman, 2012). In these sulphide-rich areas, sulphides are found interstitial to the rock-forming silicate minerals and texturally resemble magmatic sulphide accumulations (*e.g.*, net textured sulphides). The highest concentrations of bornite are associated with coarse-grained disseminated and stringer-style magnetite mineralization, up to 20% by volume locally (Mercer and Sagman, 2012). The stringers of magnetite are often folded or boudinaged, suggesting that at least some of the magnetite mineralization predates peak ductile deformation (Mercer and Sagman, 2012). Sulphide minerals on the other hand, locally show both evidence and absence of ductile deformation (Mercer and Sagman, 2012) possibly the result of different rheologic properties compared to magnetite. The best geochronologic constraints on the age of mineralization come from Re-Os molybdenite dates by Hood (2012) that range from 197.4 ± 0.8 Ma to 201.8 ± 0.8 Ma. It is notable that there are two morphologies of molybdenite grains (Hood, 2012), suggesting that there may be more than one generation of mineralization.

At the orebody scale, the Minto Main, Minto North and Minto East deposits each exhibit crude zoning from higher grade bornite-dominant ore in the west to lower grade chalcopyrite-dominant ore in the east. The bornite-dominant mineralization has a metallic mineral assemblage of magnetite-chalcopyrite-bornite. In these deposits, bornite mineralization occurs as strong disseminations and foliaform stringers, locally >10%, and locally as semi-massive to massive lenses up to 2 m thick. The chalcopyrite zone is characterized by chalcopyrite-pyrite ± very minor bornite and magnetite. Chalcopyrite mineralization typically contains 1 to 2% sulphides, but locally can reach concentrations greater than 10%. The only significant supergene mineralization on the Minto property is near surface at the Ridgetop deposit and the Wildfire resource sub-domain of the Minto South deposit where the near surface horizons have been affected by supergene oxidation (Mercer and Sagman, 2012). The deeper zones are similar to the other Minto South sub-domains described below.

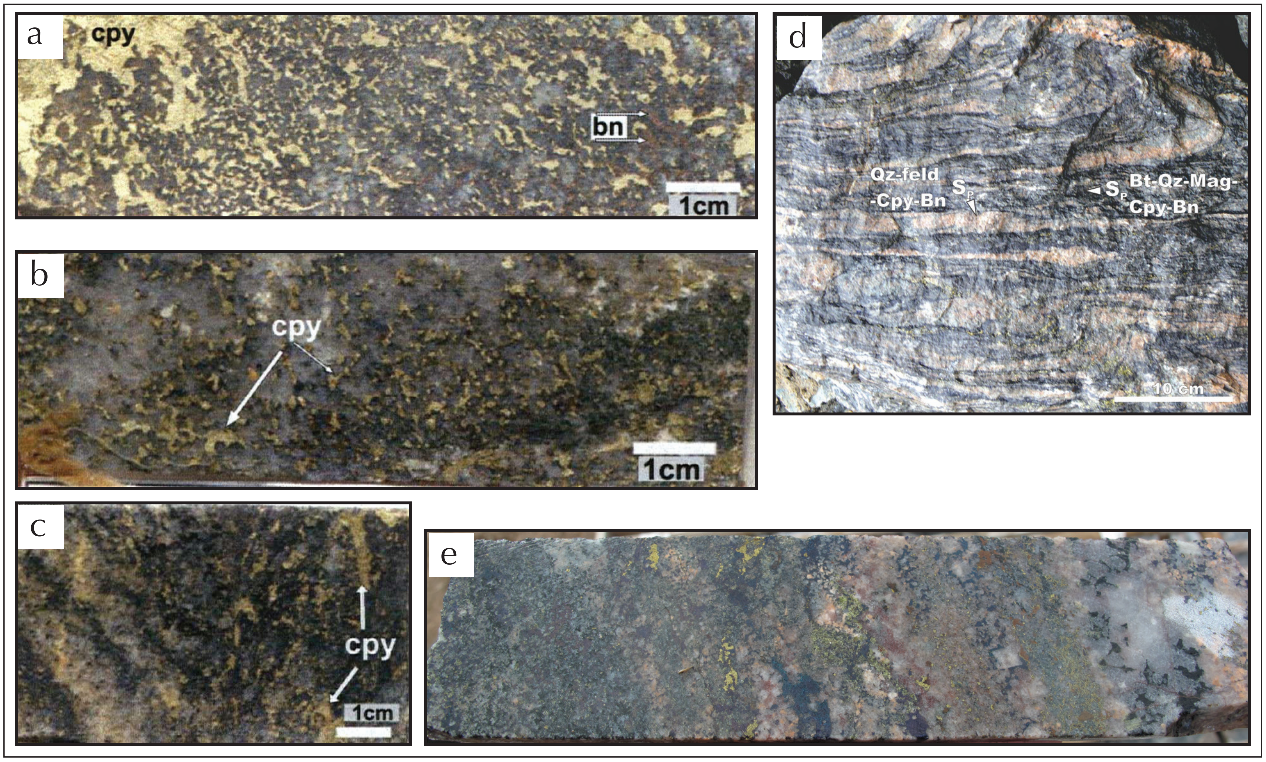

Figure 7. *Representative altered and mineralized samples from the Minto deposits.* ***(a to c)*** *Slabs of siliceous ore with increasing amount of biotite and decreasing amounts of quartz, magnetite, chalcopyrite and bornite representing a gradation in alteration intensity and grade of mineralization from higher* ***(a)*** *to lower* ***(c)***. ***(d)*** *A typical sample of gneissic banding at Minto taken from a high-grade zone in the Minto open pit. Melanocratic bands (black) are mostly composed of quartz, magnetite, mafic minerals (biotite and hornblende) and sulphides (chalcopyrite and bornite). Leucocratic bands (pink) are mostly composed of quartz, plagioclase and K-feldspar.* ***(e)*** *Mineralized core from the Copper Keel zone, diamond drill hole 08SWC389, chalcopyrite and bornite occurring as coarse grained blebs coincident with medium-coarse grained biotite-magnetite. (a to c) from Tafti and Mortensen (2004), (d) from Hood (2012).*

Figure 8. *Granitic pegmatite in diamond drill hole 08SWC278 crosscutting unfoliated granodiorite of the Minto pluton. Core diameter is NQ2, 5.7 cm.*

Mineralization at the Area 2/118/Copper Keel sub-domains of the Minto South deposit are distinct in that mineralization is predominantly disseminated, with localized foliaform stringers, but is lacking the semi-massive to massive sulphide mineralization typical of the Minto Main, North and East deposits. The primary mineral assemblage in the Area 2/118/Copper Keel resource sub-domains includes chalcopyrite-bornite-magnetite with minor amounts of pyrite (Fig. 7e); the northern half of the Minto South deposit shows increased bornite concentrations, up to 8% locally, and is higher grade (Mercer and Sagman, 2012).

DIAMOND DRILL CORE IN YGS CORE COLLECTION

Core from a total of 21 holes, 14 complete and 7 partial, from the Minto property has been donated to the YGS core collection over the years (Table 2; Fig. 9). The majority of core is from the Minto Main deposit but there is also core from the Minto South and Minto North deposits (Fig. 9). There is also core from four exploration holes outside of current deposit limits. The core from all of these diamond drill holes covers the variety of mineralization on the property (*e.g.*, disseminated, foliaform, semi-massive and massive) as well as the various foliated and unfoliated rocks.

Table 2. *Summary table of Minto diamond drill core currently in the YGS core collection.*

Hole No.	Easting (m)*	Northing (m)*	Year drilled	Length (m)	Entire hole at YGS	No. of boxes at YGS	Area	Details
06SWC125	384841	6944601	2006	179.22	Yes	31	Area 2 (South Minto deposit)	
08SWC278	383940	6943900	2008	246.80	Yes	39	Exploration west of Ridgetop deposit	
09SWC477	384191	6945979	2009	174.00	Yes	31	Minto North deposit	
2001-08	384676	6945083	2001	122.53	Yes	28	Minto Main deposit	
2001-09	384656	6945016	2001	90.53	Yes	22	Minto Main deposit	
2001-12	384725	6945095	2001	113.39	Yes	27	Minto Main deposit	
2001-13	384617	6945148	2001	131.67	Yes	31	Minto Main deposit	
2001-14	384544	6945004	2001	96.16	Yes	18	Minto Main deposit	
93-A	384562	6945084	1993	100.89	No*	22	Minto Main deposit	*Have boxes 1-19, 22-24
93-B	384569	6945214	1993	150.88	Yes	38	Minto Main deposit	
93-C	384569	6945007	1993	96.01	No*	17	Minto Main deposit	*Have boxes 1-10, 16-22
93-D	384635	6945108	1993	104.24	Yes	22	Minto Main deposit	
93-E	384691	6945096	1993	230.73	No*	35	Minto Main deposit	*Have boxes 1-9, 14, 21-45
93-F	384698	6945036	1993	108.81	No*	18	Minto Main deposit	*Have boxes 1-6, 15-26
93-G	384626	6945010	1993	76.81	Yes	16	Minto Main deposit	
93-H	384605	6944985	1993	91.44	Yes	21	Minto Main deposit	
94-06	384518	6943969	1994	152.40	No*	2	Exploration west of Ridgetop deposit	*Have boxes 33 & 34
94-17	384513	6945075	1994	100.89	Yes	20	Minto Main deposit	
99-03	384623	6946401	1999	79.55	No*	2	Exploration north of Minto North deposit	*Have boxes 2 & 3
99-04	384244	6946476	1999	154.53	No*	1	Exploration north of Minto North deposit	*Have box 4
99-06	384547	6945048	1999	136.25	Yes	32	Minto Main deposit	

*UTM NAD 83, Zone 8

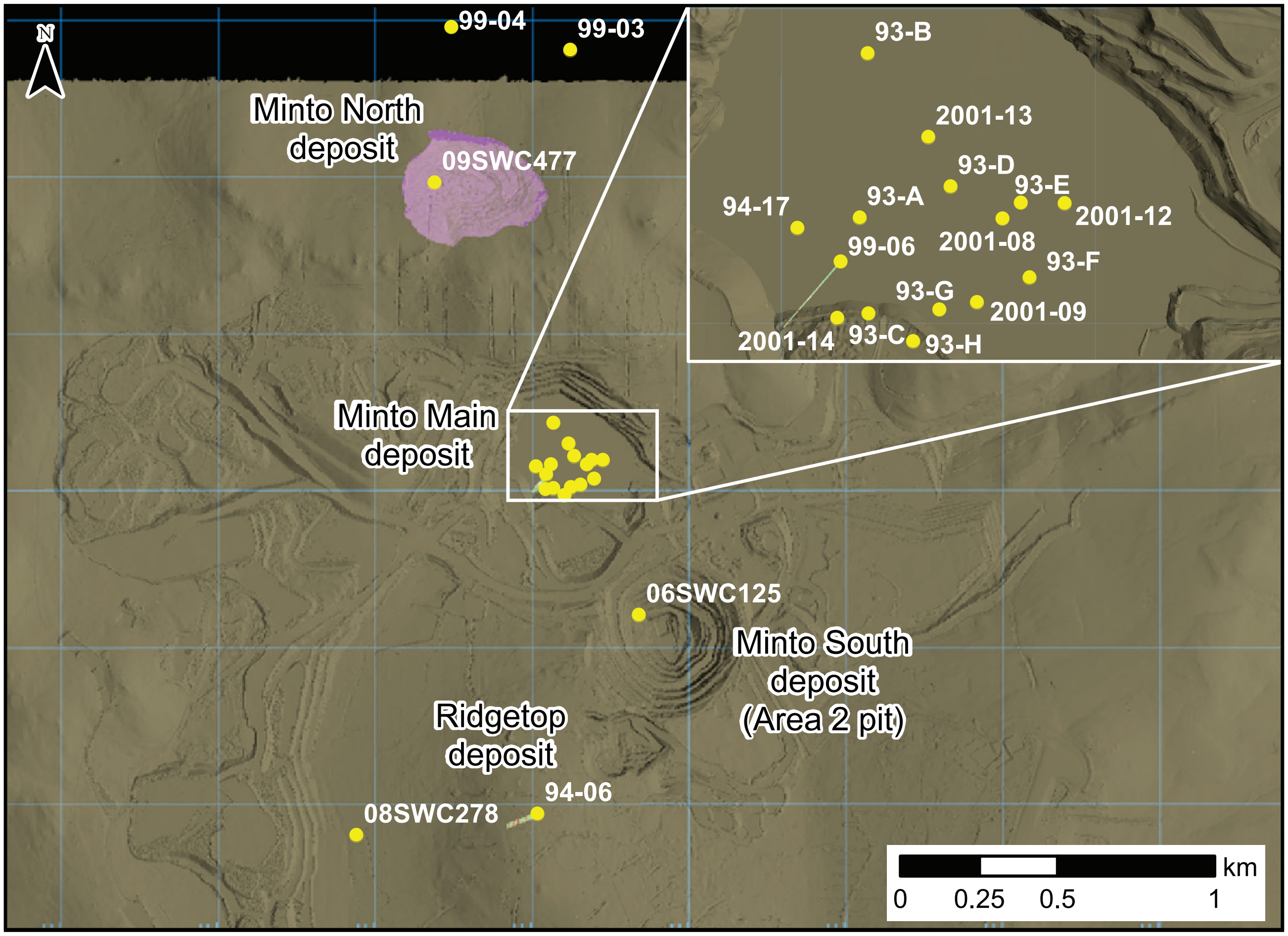

Figure 9. *Plan view orthophoto of area around Minto deposits showing collar locations (yellow circles) of diamond drill holes in YGS core collection.*

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APPENDICES

Available data for each diamond drill hole includes digital data in the form of Excel files, pdfs of original logs, and wet and dry core photographs. The Excel files include collar, survey, lithology, assay and geochemistry data. The digital appendix to this paper includes two summary pages for each drill hole. Each summary is designed to be printed as a double-sided sheet. The first page has a plan map, a table summarizing collar information, and strip logs showing downhole lithology and selected assay data. The second page has a section with the drill hole highlighted and a table of the key assay data for the hole.

The Klaza Project: An expanding high-grade gold and silver resource in the Mount Nansen gold camp (Yukon MINFILE 115I067)

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Turner, M. and Dumala, M., 2017. The Klaza Project: An expanding high-grade gold and silver resource in the Mount Nansen gold camp (Yukon MINFILE 115I067). *In:* Yukon Exploration and Geology Overview 2016, K.E. MacFarlane (ed.), Yukon Geological Survey, p. 89-96.

ABSTRACT

The Klaza property is wholly owned by Rockhaven Resources Ltd. and covers an area of 25 410 ha. It is located within the Mount Nansen gold belt, an area that hosts a historical gold mine, rich placer gold deposits and key infrastructure such as road access. Rockhaven's exploration to date includes more than 78 000 m of diamond drilling, 21 000 m of excavator trenching, extensive soil geochemical surveying, and airborne and ground geophysical surveying.

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

The property has an inferred resource estimate of 9 421 000 tonnes containing 1,358,000 oz gold at 4.19 g/t and 26,962,000 oz silver at 89.02 g/t (Ross *et al.*, 2016b). A preliminary economic analysis, announced in March 2016, yielded encouraging results, with a pre-tax $NPV_{(5\%)}$ of $150 million and 20% IRR (Ross *et al.*, 2016a).

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INTRODUCTION

The Klaza property is 100% owned by Rockhaven Resources Ltd. (www.rockhavenresources.com). It comprises 1317 mineral claims and covers an area of 25 410 ha (254.1 km²). The property lies within the Mount Nansen gold camp in southwestern Yukon, a historical mining district that can be accessed from the village of Carmacks via a 50 km government maintained road. The Klaza property covers gold-silver-lead-zinc mineralization associated with an extensive system of subparallel vein and breccia zones, which are open to extension in all directions and to depth. Copper-molybdenum-gold porphyry mineralization has also been identified on the southeastern end of the vein system in a part of the camp that has been named the Mount Nansen porphyry complex.

The mineralized zones at Klaza have been traced over strike lengths of 300 to 2500 m and have been intersected in drill core to a vertical depth of more than 500 m from surface. All of the mineralized zones begin at surface and were originally discovered in excavator trenches cut across coincident soil geochemical and geophysical anomalies. The property hosts one of the highest grade gold deposits discovered to date in Yukon that contain more than one million ounces of gold. The most updated inferred mineral resource (Table 1) for the property totals 9 421 000 t grading 4.48 g/t gold, 89.02 g/t silver, 0.75% lead, and 0.95% zinc. A preliminary economic analysis was announced in March 2016 and yielded encouraging results, with a pre-tax $NPV_{(5\%)}$ of $150 million and 20% IRR.

EXPLORATION HISTORY

Between 1899 and 2014, several operators explored on various claim groups that now lie within the Klaza property. Although strong geochemical and geophysical anomalies were identified by this work, follow-up trenching and drilling produced sporadic results, in part because of physical and technological limitations. Early bulldozer trenches rarely reached bedrock, often because of permafrost, and small diameter drill holes typically gave poor core recoveries, especially in the more fractured, mineralized intervals. The most extensive historical exploration on the property took place between 1986 and 1988 by Chevron Minerals Ltd. and BYG Natural Resources Inc. Diamond drilling, excavator trenching and stripping, soil geochemical sampling and geophysics were done during this time.

Rockhaven purchased the initial Klaza claims in late 2009 and began exploration on the property in 2010. Exploration to date by Rockhaven has included over 78 000 m of diamond drilling, 21 000 m excavator trenching, extensive soil geochemical surveys, and airborne and ground geophysical surveys including magnetics, very-low frequency electromagnetics, induced polarization and radiometrics.

Table 1. *Klaza property Inferred Resource (using CIM definition standards) in Pit-Constrained and Underground (Ross et al., 2016a). The mineral resource estimation was completed by Adrienne Ross, P. Geo (of AMC Mining Consultants Ltd.) who is a Qualified Person (QP) and independent of Rockhaven, based on the criteria defined by NI 43-101 and using drilling results to September 30, 2015. [1]Near surface mineral resources are constrained by an optimized pit shell at a gold price of (US)$1300/oz. [2]Cut-off grades applied to pit-constrained and underground resources are 1.3 g/t Au EQ and 2.75 g/t Au EQ respectively. [3]Gold equivalent values for the mineral resource were calculated using the following formula: Au EQ = Au + Ag/85 + Pb/3.74 + Zn/5.04 and assuming: (US)$1300/oz Au, (US)$20/oz Ag, (US)$0.90/lb Pb and (US)$0.90/lb Zn with recoveries for each metal of Au: 96%, Ag: 91%, Pb: 85% and Zn: 85%. Refer to Klaza property technical report dated January 22, 2016 for additional data.*

	Tonnes	Grade					Contained Metal				
	(kt)	Au (g/t)	Ag (g/t)	Pb (%)	Zn (%)	Au EQ[3] (g/t)	Au (koz)	Ag (koz)	Pb (klb)	Zn (klb)	Au EQ[3] (koz)
Pit-Constrained[1,2]	2366	5.12	94.51	0.93	1.18	6.71	389	7,190	48,258	61,475	510
Underground[2]	7054	4.27	87.18	0.69	0.88	5.65	969	19,772	107,159	136,416	1,282
Total	9421	4.48	89.02	0.75	0.95	5.92	1,358	26,962	155,417	197,891	1,793

GEOLOGY

REGIONAL GEOLOGY

The oldest rocks in the area are part of the Yukon-Tanana terrane which is regionally made up of a variety of Proterozoic and Paleozoic metavolcanic, metasedimentary and metaplutonic rocks, of arc and back-arc affinities (Colpron *et al.*, 2006; Piercey *et al.*, 2006). In the Klaza area recent regional bedrock mapping (Fig. 1; Ryan *et al.*, 2016) shows the Yukon-Tanana basement rocks are mainly schist and gneiss, with sedimentary and volcanic protoliths (Snowcap assemblage, Finlayson assemblage respectively) and plutonic protoliths (Simpson Range suite). Basement rocks were intruded in the Late Triassic to Early Jurassic by weakly to unfoliated plutonic rocks (Stikine and Long Lake suites; Klöcking *et al.*, 2016). The youngest rocks in the area are unfoliated and represented by five sets of Cretaceous to Paleogene plutonic and volcanic rocks: Whitehorse suite plutons, Mount Nansen volcanic rocks, Prospector Mountain Suite plutons, Carmacks volcanic rocks and the Casino suite plutons (Fig. 1). The 79 to 72 Ma Casino suite is of particular significance because it is associated with most of the epithermal vein and porphyry deposits in the Dawson Range (*e.g.*, Allan *et al.*, 2013).

PROPERTY GEOLOGY

Detailed mapping on the property is limited by sparse outcrop and extensive vegetation cover. The geology map of the Mount Nansen gold camp (MNGC) is shown on Figure 2, a compilation map of data collected over the last 50 years. The oldest exposed units are Snowcap assemblage schist, limestone and amphibolite that underlie the southern part of the property. A wedge of orthogneiss belonging to the Simpson Range suite is mapped in the southeastern corner of the property.

The northern and western parts of the property are mostly underlain by mid-Cretaceous Whitehorse suite granitoid, locally a coarse-grained, non-foliated rock with 30% hornblende and biotite.

Sub-aerial volcanic and volcaniclastic rocks of the Mount Nansen and Carmacks groups are common in the central part of the property. They include medium green to grey andesite flows and pyroclastic rocks with localized buff to tan rhyolitic tuff. These rocks are believed to be extrusive equivalents of the middle and Late Cretaceous intrusions, respectively.

A small quartz-rich granite to quartz monzonite stock intrudes granodiorite approximately 3 km southeast of the Klaza mineral resource (Fig. 2). This stock is called the Mount Nansen porphyry complex and is thought to be the main heat source for hydrothermal fluids responsible for mineralization on the property. A series of northwest trending feldspar porphyry dikes emanate from the Mount Nansen porphyry complex and cut Whitehorse suite granodiorite in the area of the Klaza vein system (Fig. 2). These porphyry dikes are up to 30 m wide and consist of buff aphanitic groundmass containing up to 15% orthoclase phenocrysts (1 to 2 mm) with minor biotite and rare quartz phenocrysts. Commonly the dikes occupy the same structural zones as the mineralized veins, and they are often strongly fractured. Some veins crosscut dikes.

The monzonite-granite and feldspar porphyry dikes are scattered throughout the property and assigned to the Casino suite, which geochronological work indicates are Late Cretaceous (78.2-76.3 Ma; Mortensen *et al.*, 2016) making them younger than the Mount Nansen volcanic rocks but older than intrusions of the Prospector Mountain Suite. The porphyry dikes, are spatially, and likely genetically, related to porphyry and vein mineralization on the property.

Two main fault trends (NW and NE) are present in the MNGC (Fig. 2) and are best documented where they are delineated by trenching and drilling at the Klaza vein system. The first set strikes northwesterly and dips between 60° and 80° to the southwest. Although these faults lack strong topographic expression, they are important because they host mineralized veins and breccia zones and appear to control the distribution of porphyry dikes. The second set of faults strike northeast, almost perpendicular to the primary set, and dip subvertically.

DEPOSIT GEOLOGY

The Klaza mineral resources lie within the northern part of the MNGC, a northwest elongated structural belt that hosts more than 30 known mineral occurrences (Hart and Langdon, 1997; Fig. 2). Gold and silver-rich veins within the MNGC predominantly occur in northwest trending structures. The hydrothermal system associated with mineral occurrences in the MNGC is cored by weak porphyry copper-molybdenum centres, and transitions outwards to anastomosing sheeted veins and more distally to cohesive base and precious metal veins. The mineralizing events within the MNGC are interpreted to be related to the emplacement of the Late Cretaceous Casino suite intrusive centres.

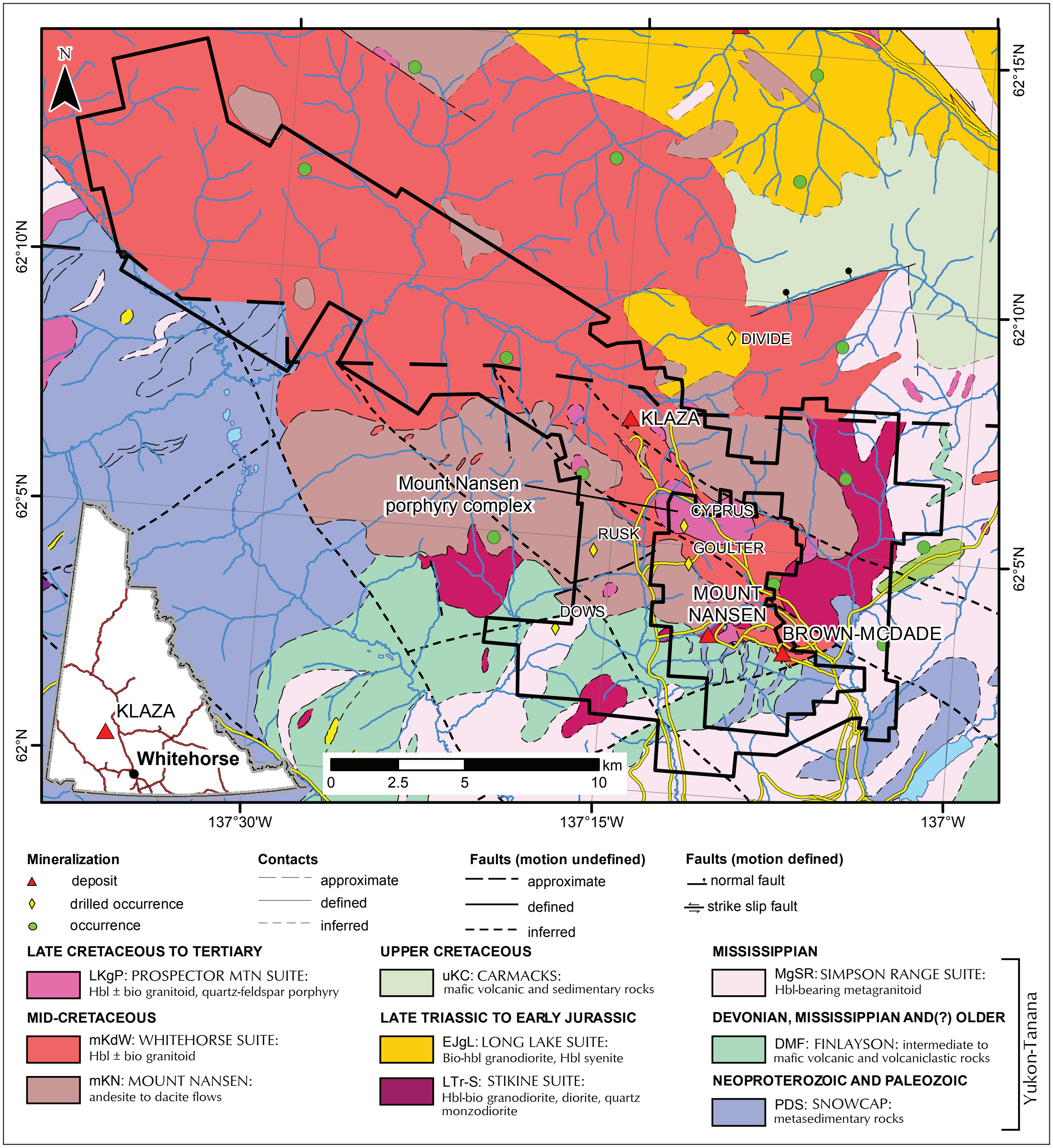

Figure 1. *Simplified geology map around the Klaza property; bottom left inset shows location in Yukon. Geology north of heavy dashed line is from Yukon Geological Survey (2016), south from Ryan et al. (2016). Rockhaven Resources current property outlined in heavy, solid black line excluding the central portion which contains the Mount Nansen and Brown-McDade deposits.*

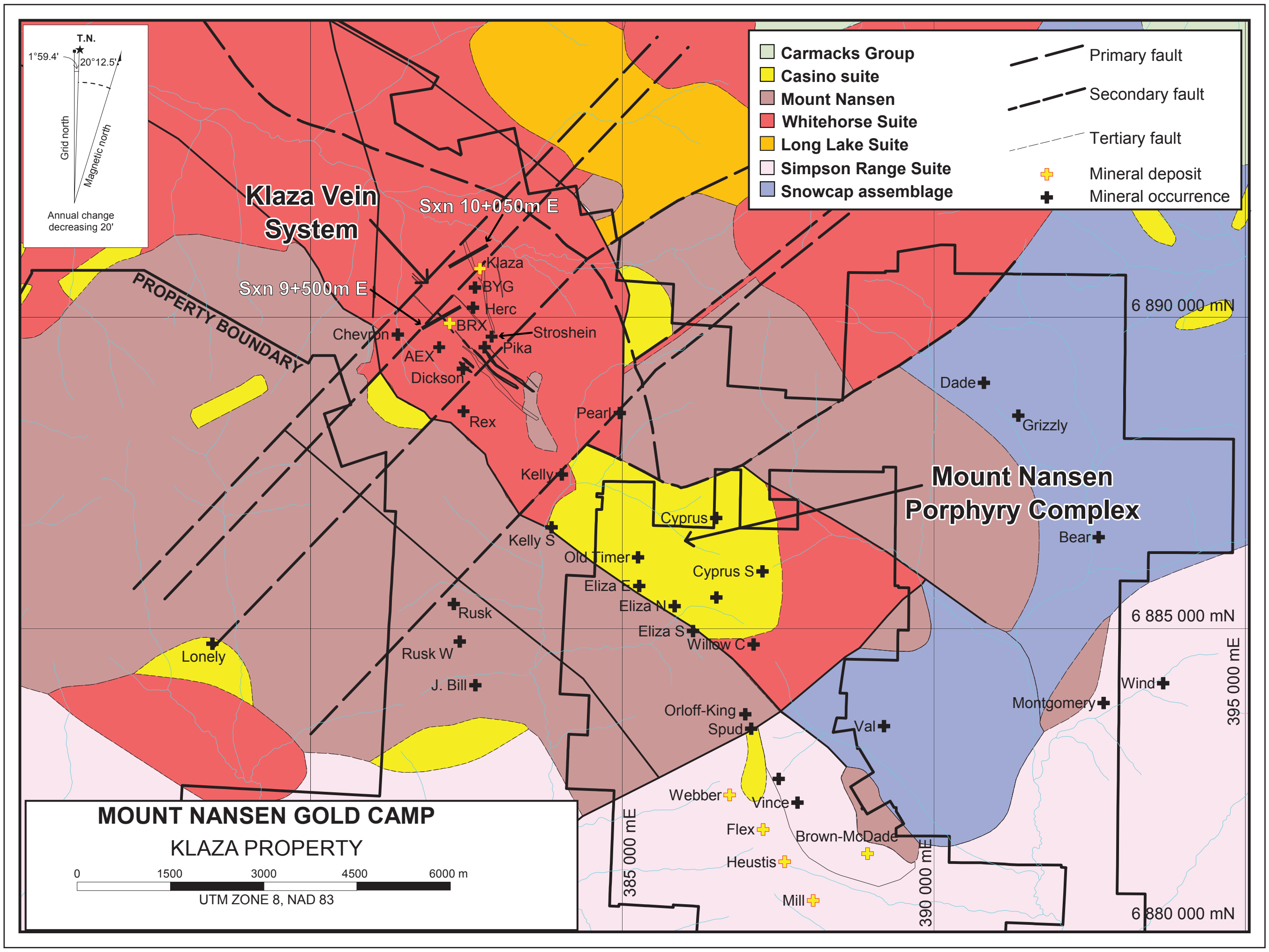

Figure 2. *Property geology interpreted from regional mapping, trenching, drilling and geophysical surveys.*

The majority of Rockhaven's exploration activities have been focused on the discovery and delineation of vein mineralization, which lies in the distal part of the local hydrothermal system where copper-deficient, precious metal rich veins predominate. Eleven main, mineralized structural zones are developed northwest of the porphyry targets. The structural zones collectively form a 2 km wide corridor that cuts northwesterly through mid-Cretaceous granodiorite for a length of 4 km or more. Individual zones exhibit exceptional lateral and down-dip continuity, and all of them remain open for extension along strike and to depth. From south to north, the zones are: Rex, Dickson, AEX, Chevron, BRX, Pika, Stroshein, Herc, BYG, Klaza and Pearl (Fig. 2). Rockhaven's exploration has focused mainly on the Klaza and BRX zones, which have been subdivided into the Western BRX, Central BRX, Eastern BRX, Western Klaza and Central Klaza sub-zones. The current mineral resource estimate in Table 1 contains mineralization from parts of these five sub-zones.

ALTERATION AND MINERALIZATION

Four significant alteration facies are observed in drill core and trench exposures. These phases are propylitic (calcite, chlorite and sericite), argillic (montmorillonite and kaolinite), phyllic (quartz, sericite and pyrite) and potassic (biotite, K-feldspar) alteration. The alteration facies and intensities vary, based principally on the spatial relationships of each zone with respect to the primary heat source. Further controls on alteration include proximity to feldspar porphyry dikes, and presence of multiple phases of mineralization. Generally, propylitic alteration represents the most distal alteration facies, followed by weak argillic and advanced argillic alteration, then phyllic alteration and finally, the most proximal, potassic alteration.

The main mineralized structural zones in the mineral resource areas range from 1 to 100 m wide and are usually associated with feldspar porphyry dikes. Mineralization occurs within veins, sheeted veinlets and some tabular breccia bodies. Cross sections from the Western BRX and Central Klaza zones are shown on Figure 3. The host granodiorite exhibits pervasive weak argillic alteration immediately adjacent to and up to 30 m peripherally to the mineralized bodies. Sericitization and potassic alteration are developed directly adjacent to

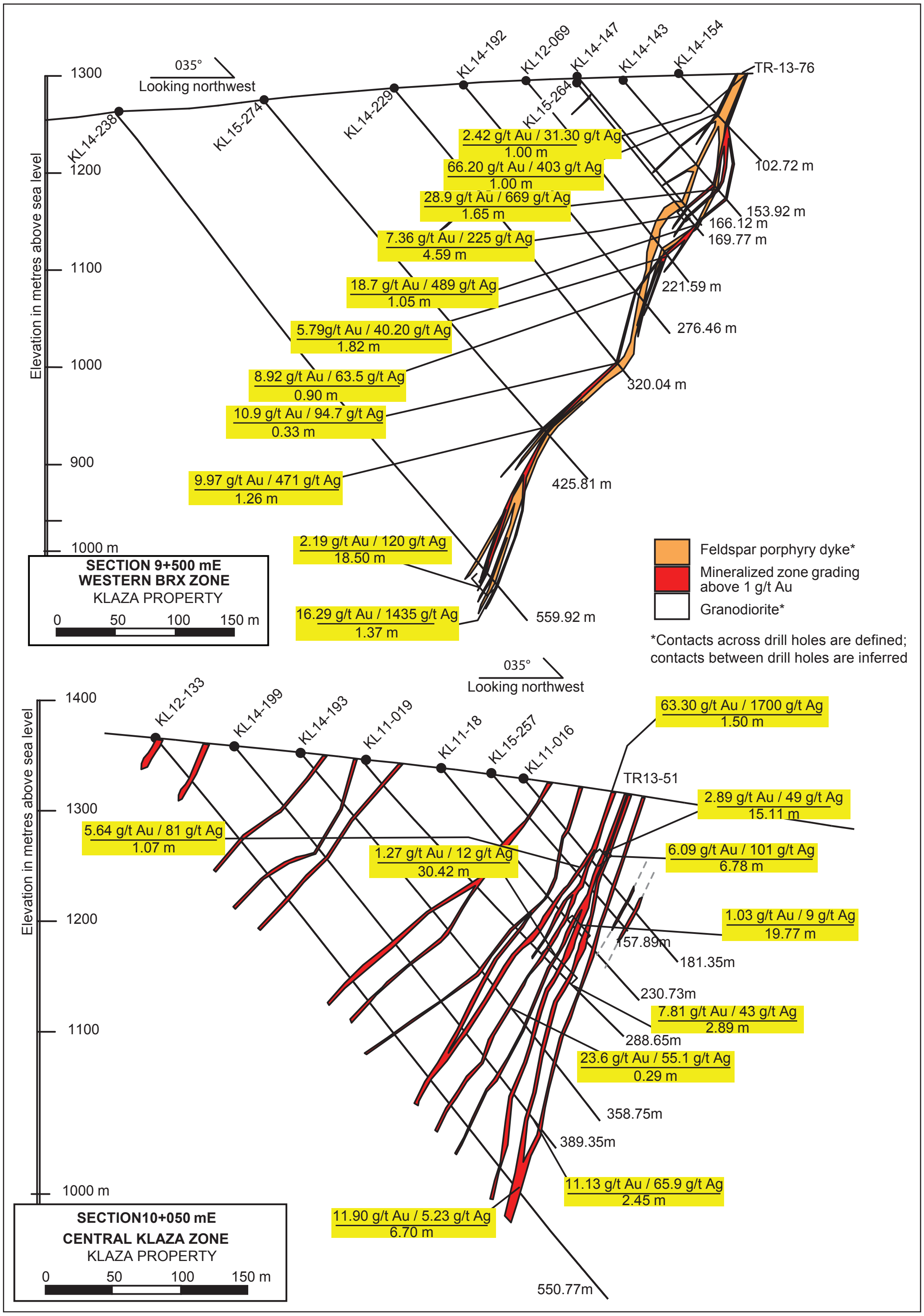

Figure 3. *Cross section 9+500 mE, from the Western BRX zone (upper) and 10+500 mE from the Central Klaza zone. Section locations are shown in Figure 2.*

hydrothermal channel ways. The granodiorite is magnetite-bearings except where it is destroyed around mineralized structures, and this has been used to aid exploration within this package of rocks (Fig. 4).

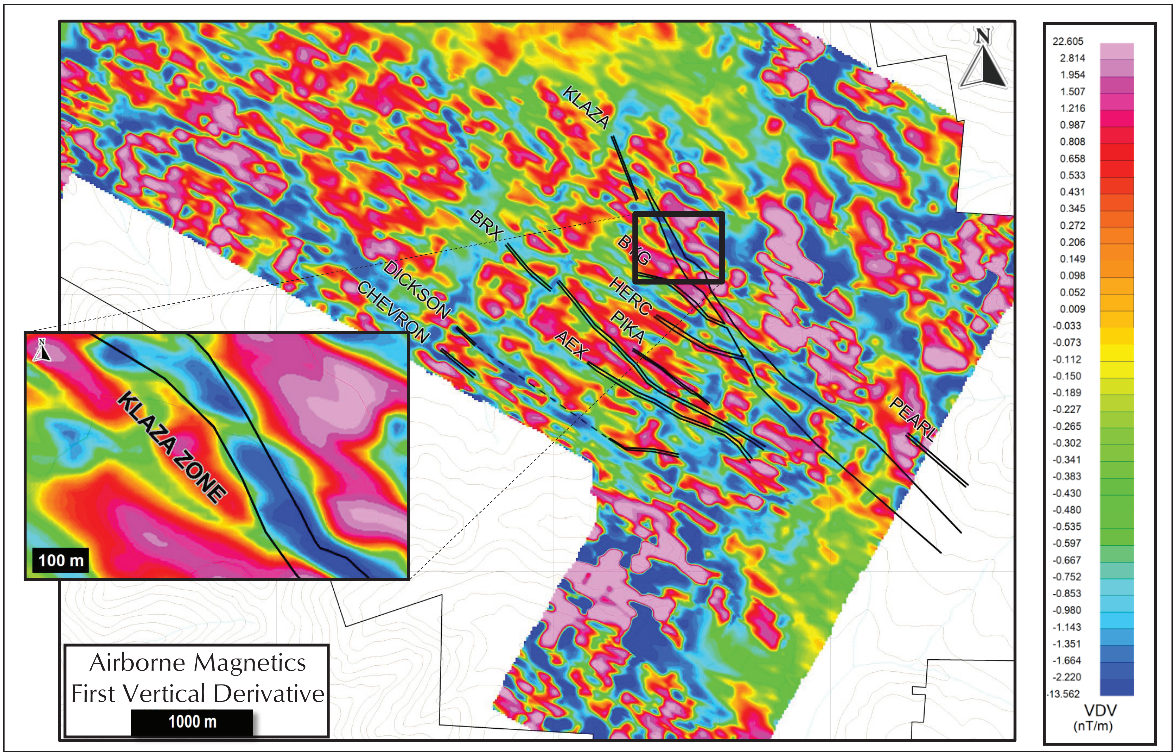

Figure 4. *Traces of mineralized zones on the Klaza property overlain on the first vertical derivative of aeromagnetic data.*

Interpretation of vein paragenesis is based on observations made from drill intersections at the Western BRX, Central BRX, Western Klaza and Central Klaza zones. The general sequence of mineralizing events for the veins is interpreted as:

Phase I: Early barren quartz veining associated with brecciation and alteration (phyllic and argillic) of the host granodiorite.

Phase II: Smoky quartz veining hosting disseminated to semi-massive pyrite, arsenopyrite, ±sulphosalt mineralization.

Phase III: Carbonate veining (calcite, rhodochrosite, ankerite and siderite) accompanied by sphalerite and galena.

Phase IV: Single to multi-stage brecciation of veins by faulting and late hydrothermal fluids.

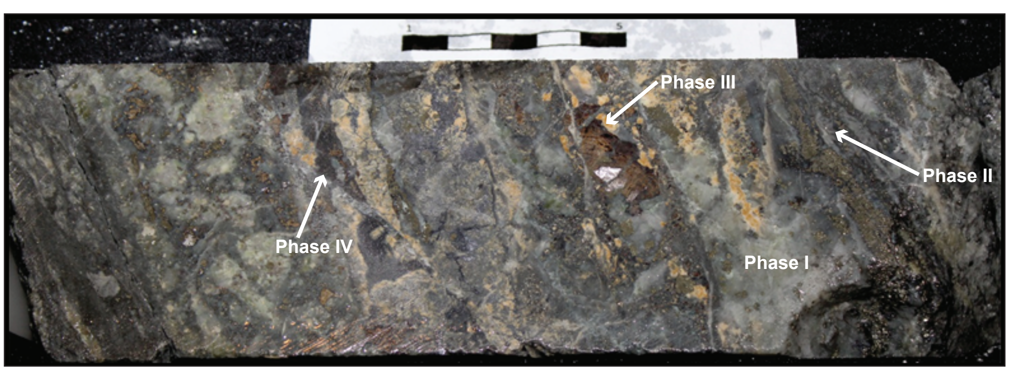

Figure 5. *Diamond drill core from hole KL14-156 (114.20 m) from the Western BRX zone intersect illustrating vein phases I through IV. Sphalerite and galena are clearly seen in proximity to tan ankerite.*

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Kathy Sutherland
Mining Lands, Energy, Mines and Resources

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EXCELLENCE IN ENVIRONMENTAL STEWARDSHIP IN PLACER MINING: H.C. MINING LTD.

Henderson Creek has had a long and varied mining history. Historically it was an active creek that supported dredge mining early in the last century. When dredging ceased, the method of mining switched to conventional large scale dozer use for many years. Throughout this period, the area saw a succession of owners until Hayden Cowan acquired much of it through his company H.C. Mining Ltd. in the late 1990s.

H.C. Mining Ltd. has mined several locations on the Henderson Creek watershed since 2000, including Henderson Creek, North Henderson Creek and Moosehorn Creek.

H.C. Mining Ltd. begins reclaiming areas where mining has been completed as soon as possible, and every finished site has been fully reclaimed. The method of reclamation is to contour the ground into low-relief piles covered with overburden and organics. Most of the areas mined by H.C. Mining Ltd. are rapidly being overgrown with new tree growth. This nomination recognizes that Mr. Cowan has completed a significant amount of reclamation, and that the timeliness and finished results are commendable.

Natural revegetation of contoured ground with a natural seed source.

Photos taken from same location, one year apart. Shows rate of revegetation with good reclamation work.

EXCELLENCE IN ENVIRONMENTAL STEWARDSHIP IN QUARTZ MINING: KLONDIKE GOLD CORPORATION

Klondike Gold Corporation (KGC) has been operating in the Eldorado and Upper Bonanza valleys in the Dawson mining district, under various management since the 1980s.

The current management assumed control of KGC in 2014. Since then, the company has been actively reclaiming disturbances and liabilities, including those left by previous operators.

The list of debris and structures removed by KGC is extensive and includes: buildings, tent frames, fuel tanks, a ball mill, holding tanks, scrap metal, woody debris, and numerous pallet-loads of sundry refuse. In 2016, KGC focused on reclaiming the Hunker Dome trench and moved approximately one half million tonnes of material to create new contours and landform features.

KGC has demonstrated clear leadership in reclamation and is seen by industry as raising the bar with their practices.

RESPONSIBLE AND INNOVATIVE EXPLORATION MINING PRACTICES IN QUARTZ MINING: BMC MINERALS (NO.1)

BMC Minerals (No.1) Ltd. (BMC) is the owner and operator of the Kudz Ze Kayah (KZK) project, situated approximately 125 km southeast of Ross River, Yukon. BMC assumed control of KZK in 2014 and has been actively reclaiming disturbances and liabilities, along with those left by previous operators.

BMC's approach to mineral exploration sets them apart from the rest of the industry. Their commitment to meeting and exceeding best management practices and guidelines helps to minimize environmental impact and maximize socio-economic benefits for local communities.

BMC has mitigated exploration impacts through minimizing trail construction and maximizing sediment control, utilizing advanced drill cuttings management systems, preventing metal leaching and acid drainage, prioritizing reclamation, monitoring wildlife and invasive plant species, and diligent waste management. BMC's demonstrated commitment at such an early stage is testament to what can and will be achieved at the KZK project in the future.

Yukon Exploration and Geology 2016 Abstracts

The following abstracts are from the Yukon Exploration and Geology 2016 volume. Full versions of the individual papers are available from the Yukon Geological Survey website, www.geology.gov.yk.ca.

UPDATES ON THE MIDDLE TRIASSIC-MIDDLE JURASSIC STRATIGRAPHY AND STRUCTURE OF THE TESLIN MOUNTAIN AND EASTERN LAKE LABERGE AREAS, SOUTH-CENTRAL YUKON

E. BORDET

Stratigraphic and structural relationships within Stikinia, and overlap assemblages of the Whitehorse trough, are investigated in the Teslin Mountain and eastern Lake Laberge areas, south-central Yukon. Regional north-trending faults divide the map area into rock assemblages with distinct structural and stratigraphic characteristics. Volcanic arc rocks of the Middle Triassic Joe Mountain Formation exposed at the southeastern tip of the Laurier Creek fault display an east-trending structural fabric. West of the Laurier Creek fault, the Upper Triassic Lewes River Group was the result of several events of carbonate sedimentation and reef development on the rim of a volcanic arc. Deformation in these strata is characterized by tight east-verging folds and west-dipping thrust faults. An angular unconformity marks the basal contact of the Early-Middle Jurassic Laberge Group.

VOLCANIC STRATIGRAPHY OF THE CAMBRIAN-ORDOVICIAN KECHIKA GROUP, PELLY MOUNTAINS, SOUTH-CENTRAL YUKON

R.W. CAMPBELL AND L.P. BERANEK

Volcanic rocks occur throughout the lower Paleozoic passive margin successions of western Canada. The tectonic significance of post-breakup magmatism is uncertain, however, some volcanic rocks are spatially associated with margin-parallel normal faults. At the plate-scale, such magmatism is consistent with asymmetric rift models for passive margins, including those with lineaments or transform-transfer zones that form at high angles to the rifted margin. A two-year project was conducted to define the stratigraphy of post-breakup volcanism in the Pelly Mountains, south-central Yukon, and test genetic relationships with the adjacent Liard Line lineament. Field studies targeted Cambrian-Ordovician volcanic strata of the Kechika group in the Quiet Lake map area (NTS 105F). Observed lithofacies are indicative of submarine volcanic edifices and sediment-sill complexes that develop during continental extension. Analogous margin-parallel extension is recognized along the length of the Canadian Cordillera, but the influence of the Liard Line on Cambrian-Ordovician magmatism requires further testing.

GEOPHYSICAL, GEOCHEMICAL AND GEOCHRONOLOGICAL CONSTRAINTS ON THE GEOLOGY AND MINERAL POTENTIAL OF THE LIVINGSTONE CREEK AREA, SOUTH-CENTRAL YUKON (NTS 105E/8)

M. COLPRON, S. CARR, D. HILDES AND S. PIERCEY

The Livingstone Creek area, known for its coarse placer gold, is underlain by mid-Paleozoic metasedimentary, metavolcanic and metaplutonic rocks of the Yukon-Tanana terrane. These rocks were penetratively deformed, metamorphosed under high-pressure conditions in the Permian, and retrogressed to amphibolite facies before the Early Jurassic. A new VTEM™ Plus helicopter-borne geophysical survey over the area helps enhance the interpretation of the bedrock geology and identify potential exploration targets. The lithological, geochemical and isotopic characteristics of metavolcanic rocks, and Early Mississippian U-Pb dates from two metagranitoid plutons in the Livingstone Creek area are consistent with the regional character of correlative assemblages in the Yukon-Tanana terrane. Mid-Permian and Middle Triassic U-Pb dates from two granitic intrusions further constrain the timing of development of the transposition foliation in the area. Magnetic anomalies and electromagnetic conductors define potential exploration targets for the source of placer gold in the centre of the Livingstone Creek area. Identification of NNE lineaments in the magnetic and electromagnetic data may help locate late brittle faults that are locally observed to correspond with upgrade in gold in quartz-carbonate veins. In the eastern part of the area, coincident magnetic highs and electromagnetic conductors are associated with a greenstone-hosted Cu-Zn anomaly and Ag-Pb vein occurrences. The magnetic intensity data may also be helpful in assisting exploration for magnetite-rich placer deposits.

PRELIMINARY BEDROCK GEOLOGY OF THE LONG LAKE AND MORAINE LAKE AREAS, SOUTHWESTERN YUKON, (NTS 115A/15 AND 115H/2, 7)

S. ISRAEL, M. FRIEND AND A. BORCH

Bedrock mapping by the Yukon Geological Survey in Long Lake and Moraine Lake areas in southwestern Yukon covers a gap in recent, similar mapping projects in the Aishihik Lake area and the region south of the Alaska Highway to the British Columbia border. This project focuses on the geological relationships and the regional mineral potential of the Yukon-Tanana terrane, the Kluane schist and the intrusive suites found in the area.

The Yukon-Tanana terrane is characterized by strongly deformed and metamorphosed siliclastic and volcanic rocks of probably Late Proterozoic to Devonian age. These are intruded by several generations of plutonic rocks that exhibit a variable state of deformation and metamorphism. Gneiss that is structurally interleaved with the Yukon-Tanana terrane is likely Mississippian and Permian in age. Relatively undeformed Early Jurassic Long Lake and Paleocene Ruby Range suites intrude the structural top and base, respectively, of the Yukon-Tanana terrane. Both these suites overprint ductile deformation within the Yukon-Tanana terrane but are deformed by brittle faults.

Several mineral occurrences are found within the project area, all related to Late Cretaceous intrusions of the Casino suite. In the project area, this suite is characterized by highly magnetic, granodiorite and quartz-diorite plutons and porphyritic dikes. Skarn and porphyry mineralization that is associated with these intrusions are part of a much larger regional metallogenically significant belt that encompasses an area from north of the Dawson Range south to the Alaska Highway.

PRELIMINARY INVESTIGATIONS OF PLACER GOLD SETTING IN ARCH CREEK, KLUANE DISTRICT

K.E. KENNEDY AND S. VAN LOON

Preliminary investigations of the glacial history, surficial geology, and placer gold setting in Arch Creek are focused on natural exposures and mining cuts to constrain stratigraphic relationships. Surficial deposits in the creek are primarily related to glacial advances from the Donjek valley, but are complicated by glaciation in the nearby Burwash Uplands and Shakwak Trench. While it is likely that bedrock sources of placer gold are being augmented by buried paleo-placer deposits, mining to date has focused on modern channel deposits. Potential paleo-channel and glacial deposit exploration targets are suggested.

NEW GEOLOGICAL INSIGHTS INTO THE CARMACKS COPPER CU-AU-AG DEPOSIT, CENTRAL YUKON (YUKON MINFILE 115I008)

N. KOVACS, M.M. ALLAN, A. ZAGOREVSKI, J.E. MILTON AND C.J.R. HART

The Carmacks Copper Cu-Au-Ag deposit is hosted in compositionally heterogeneous, foliated and folded, and variably migmatitic metamorphic rocks, which occur as elongate, NNW-trending inliers in Early Jurassic granitoid rocks of the Granite Mountain batholith. Hypogene copper mineralization is restricted to metamorphic host rocks, and occurs both as foliation-parallel chalcopyrite-dominant stringers in schistose rocks, and as net-textured bornite-chalcopyrite-dominant sulphides in the migmatitic rocks prevalent along the eastern margin of the largest metamorphic inlier. The latter style of mineralization is interpreted to originate from a sulphide melt phase generated during partial melting of a previously mineralized protolith, during emplacement of the Granite Mountain batholith.

NEAR-SURFACE GEOPHYSICAL INVESTIGATION OF A GRAVEL SITE NEAR WHITEHORSE, YUKON

Y.K. LEE, C.-G. BANK AND S. LAXTON

Three near-surface geophysical survey methods, electrical resistivity tomography (ERT), ground-penetrating radar (GPR), and seismic refraction tomography, were used along a 96 m transect to compare the suitability of these techniques in determining the thickness of a gravel layer. ERT shows three distinct layers: a high resistivity layer (~4000 Ωm) at depth 2-8 m, sandwiched between low resistivities (~2000 Ωm). GPR results show two prominent subhorizontal reflections, one around 1 m and a second around 6 m depth with dipping reflections in between. Seismic refraction data show sharp velocity changes and seismic refraction tomography images a similar layering. We tentatively interpret the top layer in all three methods (above ~2 m) as soil, the middle layer (to ~8 m) as gravel, with glacial till below. Each method is useful to imaging the gravel, though we prefer ERT because it provides quick results that are straight-forward to interpret.

PRELIMINARY OBSERVATIONS ON THE VOLCANIC ROCKS OF THE KENO-MAYO DISTRICT (NTS 105M/13, 14), THE ANVIL DISTRICT (NTS 105K/3, 6), AND THE MACMILLAN PASS DISTRICT (NTS 105O/1, 2), CENTRAL YUKON

J.A. MOERTLE, S. PARADIS, N. VAN WAGONER AND M. LEYBOURNE

Over the past few years, the idea of volcanism being related to the formation of base-metal deposits, especially clastic sediment-hosted Zn-Pb (±Ag, ±Ba) deposits (sedimentary exhalative [SEDEX]), has been developing. During the 2016 field season, a study was initiated to test this hypothesis within the Selwyn basin, an area with known syngenetic deposits and numerous occurrences of volcanic rocks. Three districts were investigated. In the Keno-Mayo district, Ag-Pb-Zn vein deposits are hosted in the Carboniferous Keno Hill quartzite and may be related to Triassic intrusions. In the Anvil district, the Cambrian to Ordovician Vangorda formation and lower Cambrian Mount Mye formation, which host the Zn-Pb-Ag-Ba SEDEX deposits, may be related to the volcanic rocks of the Ordovician to Silurian Menzie Creek formation. In the MacMillan Pass area, the Devonian Earn Group volcanic rocks are coeval with the formation of the Tom and Jason SEDEX deposits.

PROGRESS REPORT ON GEOLOGICAL MAPPING IN THE UPPER HYLAND RIVER REGION OF SOUTHEASTERN YUKON

D. MOYNIHAN

Most of the upper Hyland River area of southeastern Yukon is underlain by Neoproterozoic-Cambrian rocks of the Hyland Group. Excellent exposure allows for identification of new stratigraphic subdivisions within the Hyland Group, in addition to those previously recognized in its type area to the north. A steeply-dipping fault zone, comprising several subparallel splays (the upper Hyland fault) is coincident with the upper reaches of the Hyland River. The upper Hyland fault is continuous with the northern part of the Acland fault in the Coal River area (95D) and likely accommodated tens of kilometres of dextral offset. Displacement took place during or after emplacement of the Shannon pluton (97 ± 2 Ma), which is penetratively deformed adjacent to the fault zone. Dextral faulting followed widespread Early Cretaceous (pre-107 Ma) penetrative deformation and greenschist to upper amphibolite facies metamorphism.

THE SLIDE MOUNTAIN OPHIOLITE, BIG SALMON RANGE, SOUTH-CENTRAL YUKON: PRELIMINARY RESULTS FROM FIELDWORK

A.J. PARSONS, J.J. RYAN, M. COLEMAN AND C.R. VAN STAAL

The Dunite Peak area of the Big Salmon Range, south-central Yukon, exposes klippen of mafic-ultramafic strata belonging to the Slide Mountain terrane that structurally overlie metasedimentary strata of the Yukon-Tanana terrane. Previous workers also infer the suture between the allochthonous Yukon-Tanana terrane and parautochthonous Cassiar terrane close to this area. This study forms the groundwork for a detailed investigation of the timing and kinematics of closure of the Slide Mountain ocean, and its involvement in subsequent collisions between Yukon-Tanana and Cassiar terranes. At present, a variety of tectonic models may be applied to ophiolite formation and subsequent obduction and deformation of the Slide Mountain terrane in this region. We consider these models and postulate future investigations that should be undertaken to ascertain their validity and applicability to the NW Cordilleran orogenic evolution.

MAPPING MAGMA PROSPECTIVITY FOR CORDILLERAN VOLCANOGENIC MASSIVE SULPHIDE (VMS) DEPOSITS USING ND-HF ISOTOPES: PRELIMINARY RESULTS

S.J. PIERCEY, L.P. BERANEK AND J.M. HANCHAR

Preliminary whole rock Nd-Hf isotopic data for porphyritic rhyolitic intrusive rocks from the Wolverine volcanogenic massive sulphide (VMS) deposit are presented herein. Pre-VMS (~352 Ma) quartz-feldspar porphyritic intrusive rocks (QFP) have Nb/Ta ratios (~12) and lower εNd_t and εHf_t values, compared to syn-VMS (~347 Ma) feldspar porphyritic intrusive rocks (FP), which have higher Nb/Ta ratios (~17) and lower εNd_t and εHf_t. Both suites have Proterozoic to Archean depleted mantle model ages indicative of crustal inheritance; however, the FP suite has a more juvenile signature. The progression from the crustal-dominated QFP suite, to a more basalt-influenced FP suite reflects the progressive opening of the Wolverine back-arc rift where early QFP magma was dominated by continental crustal melting, whereas the FP magma reflects greater back-arc basin extension, upwelling of basaltic magma beneath the rift, and enhanced continental crust-juvenile basalt mixing. Basalt upwelling beneath the Wolverine basin likely created the elevated geothermal gradient required for Wolverine VMS deposit formation.

JURASSIC STRATIGRAPHY AND TECTONIC EVOLUTION OF THE WHITEHORSE TROUGH, CENTRAL YUKON: PROJECT OUTLINE AND PRELIMINARY FIELD RESULTS

L.H. VAN DRECHT, L.P. BERANEK AND M. HUTCHISON

Lower to Middle Jurassic strata of the Laberge Group define the Whitehorse trough and preserve syntectonic sedimentation in central Yukon during the exhumation of adjacent terranes. A two-year project was initiated in summer 2016 to investigate Laberge Group stratigraphy and test the relationships between the timing of exhumation, sedimentation, and terrane accretion in the northern Canadian Cordillera. Field studies along the Robert Campbell and North Klondike highways near Carmacks targeted marginal marine, tidal and fluvial-dominated strata of the Tanglefoot formation that were likely deposited in semi-arid environments. Studied outcrops of fan-delta conglomerate and turbiditic strata of the Richthofen formation along the eastern shoreline of Lake Laberge and on Mount Laurier are consistent with the south-directed deepening of the Whitehorse trough. Field observations will be integrated with detrital zircon (U-Pb and Hf isotope) studies to constrain the provenance of the Laberge Group and reconstruct source-to-sink pathways in the Whitehorse trough.

DIGITAL ANALYSIS OF HISTORIC DRILLING DATA TO RECONSTRUCT THE PLACER GOLD DISTRIBUTION IN SULPHUR CREEK AND LOWER DOMINION CREEK

S. VAN LOON

Yukon Consolidated Gold Corporation (YCGC) conducted an industrious exploration and dredging operation in the Klondike for more than four decades. The main objective of their exploration was to determine which creeks were economical for dredging, and create an inventory of Klondike drainages based on placer gold grade and surficial material characteristics. As a result of their exploits, thousands of maps and associated technical reports were produced, which provide records of the economic potential in many Klondike creeks. Despite the vintage of the data, these historical documents are proving to still be valuable to the modern placer exploration and mining industry.

The placer gold distribution of Sulphur Creek can be modeled in a Geographical Information System (GIS) which provides opportunities for analysis and interpretation. After a drill hole dataset is modernized through the process of digitizing, patterns emerge and can be used to analyze gold distribution, investigate tributary influences, and assess untapped side-pay potential. Desktop evaluation using grade information is an economical exploration technique and can be an effective tool for modeling pay channel distribution, potentially leading to additional prospects.

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