



Annual Report 2014

Includes 2015 Outlook

WHAT IS GEOSCIENCE?

Geoscience, or earth science, is the study of the earth and its natural mineral and energy resources.



Photo by W. Jackaman

WHO WE ARE

Geoscience BC is a non-profit organization established in 2005, with investments from the Province of British Columbia totalling \$51.7 million.

OUR VISION: Our earth science builds the BC economy.

OUR MISSION: We are a trusted partner providing earth science to encourage investment that benefits all British Columbians.



Photo by B. Ortman

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Content

Message from the Chair.....	2	Coming in 2015	14
Message from the President & CEO	3	Ongoing Projects	16
Geoscience BC in 2014	4	Data & Publications	18
Deep Aquifer Fluid Disposal Project	6	Summary of Activities 2014	19
Natural Gas Liquids in Northeast BC	7	Scholarship Recipients.....	20
The TREK Project	8	Where are they now?	23
The SEEK Project.....	10	Geoscience BC Team in 2014.....	25
New Minerals Projects.....	12	Summary Financial Statements.....	27



*Dr. John Thompson
Chair of the Board,
Geoscience BC*

Message from the Chair

Over the past year, Geoscience BC's ninth, our focus was on strengthening the organization, building on an established foundation, and developing new programs. In mid-2104, we completed a strategic planning session that brought new ideas and a broader vision of our future.

Our guiding principle remains the same—delivering quality geoscience products and making them accessible to everyone. Toward that objective we were very pleased in the spring of 2014 to receive \$3 million in interim funding from the Provincial Government, an investment made at a time of financial restraint in BC. We are grateful for the opportunity to continue to work with Government on their commitment to achieve long term, predictable funding for Geoscience BC.

We continue to employ a range of funding and organizational models to deliver results that help attract private sector investment

in responsible resource development in British Columbia. Programs are made possible by three complementary efforts: hours of dedicated work by volunteers from the minerals and energy sectors examining and evaluating numerous project proposals; careful development and planning by staff and consultants; and sustained engagement with industry, government, academia, First Nations and communities. The success of Geoscience BC results from the contributions of everyone involved in this work.

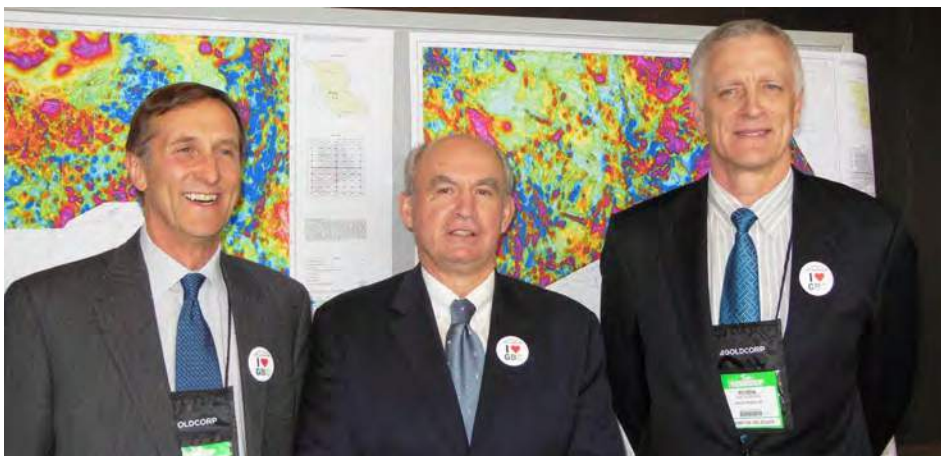
Through Geoscience BC programs, we seek to understand the concerns of First Nations and communities, a prerequisite to achieving the social license to operate. Collectively, our work helps to enable the responsible development of BC's minerals and natural gas resources at a time of significant challenges and great opportunities. For example, our programs in the northeast of BC are focused on

assessing the availability of water and other critical components necessary for resource development while also meeting the needs of First Nations and communities.

As Geoscience BC celebrates its 10th anniversary in 2015, we will remain committed to producing the highest quality geoscience information and maximizing the benefits that come from these data — decision making, investment and responsible resource development.

As Chair of the Board, I wish to thank all involved in Geoscience BC who contributed their time, efforts and guidance in 2014.

Dr. John Thompson
*Chair of the Board,
Geoscience BC*



*TREK Airborne Magnetic Survey Data
Release Event at Roundup 2014
Left to right: Dr. John Thompson, the
Honourable Bill Bennett, Minister of
Energy and Mines, Robin Archdekin.
Photo by A. Clifford*



*Robin Archdekin
President & CEO
Geoscience BC*

Message from the President & CEO

As I look back on my first year as President & CEO and reflect on Geoscience BC's many achievements, I'm impressed by the commitment and passion of our team of volunteers, staff and associates as well as the province-wide support and respect that exists for this unique organization.

One of the most notable successes of 2014 was the British Columbia government's investment of \$3 million in interim funding for Geoscience BC. This reaffirmed their commitment to establish "long term, predictable funding" for Geoscience BC, enabling us to pursue valuable new geoscience initiatives related to minerals and natural gas throughout the province.

A strategic planning session was held in June of 2014, during which we refreshed both our vision ("Our earth science builds the BC economy") and our mission ("We are a trusted partner providing earth science to encourage investment that benefits British Columbians"). Our new vision and mission leave us well positioned to continue our valuable work in 2015 — our 10th anniversary.

The natural resource sector supports our high standard of living in this remarkable province, yet it remains a topic of hot debate. It has been noted that the often adversarial nature of discussions about resource development is one of our province's greatest economic challenges. At Geoscience BC we believe that sound, scientific-based information is the

foundation for building public confidence in resource development.

Geoscience BC's independence enables us to take a unique and holistic approach to gathering information required for sound project development. We listen carefully and respectfully to the interests and concerns of First Nations, local communities, the resource sector, academia and government. Through the selfless contribution of countless hours by our volunteer Technical Advisory Committee members, we translate the earth science related concerns into scientific studies providing information to help guide responsible development of BC's underground natural resources.

Over the past several years in northeast BC, Geoscience BC has been working collaboratively with First Nations, local communities, government and the resource sector to conduct baseline water studies that will help guide responsible and environmentally sustainable development of our vast natural gas resource. In the summer of 2014, we extended our Horn River Basin water project for an additional year and initiated a study to identify safe zones for fluid disposal. In 2015 we look forward to unveiling a new project that will map the Peace Region's shallow groundwater aquifers.

We began a number of smaller-scale minerals research projects in 2014 through a request for proposals. The new projects

include initiatives that "mine data", test new exploration methods and add value to existing Geoscience BC datasets, including the Northern Vancouver Island Exploration Geoscience Project and QUEST. In southeastern BC, we supported two new mapping projects, and through the SEEK project provided an additional \$10,000 to support the East Kootenay Chamber of Mines' Fort Steele Drill Core Library.

As I noted earlier, 2015 will be Geoscience BC's 10th year of operation. We remain committed to producing earth science information to support the exploration and responsible development of the resources beneath our feet—including mineral exploration, mining and natural gas development. All of these activities are fundamental to BC's economy. Accessible, unbiased earth science information fosters a sound understanding of our resources and allows informed decision-making about resource development that benefits everyone.

A stylized, handwritten signature in black ink, appearing to read 'R. Archdekin'.

Robin Archdekin
President & CEO
Geoscience BC

Geoscience BC in 2014

In 2014, we received new funding, launched new projects, released new data, hired new staff, sponsored workshops and participated in numerous conferences and meetings. Here are a few of our highlights from 2014...

New Funding

In May 2014 at the Minerals North conference in Vanderhoof BC, the Honourable Bill Bennett, Minister of Energy and Mines, announced \$3 million in interim funding for Geoscience BC. This interim funding demonstrated the Government of British Columbia's commitment to establish "long term, predictable funding" for the organization, and Geoscience BC will continue to work with government to realize this goal.



New Staff

Bruce Madu began working with Geoscience BC on June 1 as Vice President, Minerals and Mining. Bruce previously served as Director of the BC Geological Survey's Mineral Development Office (MDO) in Vancouver. The MDO promotes the province's opportunities in the minerals and coal industries, and its geological and geoscience advantages. He has held several positions as a geologist within the provincial government in Kamloops, Prince George and Smithers.

Christa Pellett returned from leave on July 1 as Project Manager, and Andrea Clifford started full-time in a new position at Geoscience BC as Director, Business Development. This new position is responsible for developing and delivering outreach and communications in close cooperation with the President and Vice Presidents.

Major Projects

Geoscience BC launched the 3-year TREK ("Targeting Resources for Exploration and Knowledge") project in 2013 and new activities for the TREK Geology component began in 2014 with mapping by field crews from the Mineral Deposit Research Unit at the University of British Columbia. TREK geochemical surveys for mineralogical and geothermal studies continued in 2014 and a 2-day workshop was held in the First Nation community of Nazko in June. For more information, see pages 6 and 7.

In spring 2014, Geoscience BC initiated a new oil and gas study in northeast BC's Montney gas play called the Deep Aquifer Fluid Disposal, or DAFD project. This study will examine geological zones deep below the earth's surface capable of accepting water used in the natural gas extraction process. Go to page 8 to read more information about this project.

Two new SEEK ("Stimulating Exploration in the East Kootenays") projects were launched in summer 2014, as were six new minerals projects, submitted through a request for proposals (RFP) in May of 2014. Brief overviews of the SEEK projects can be found on pages 10-11 and RFP project descriptions can be found on pages 12-13.

New Data and Reports

This past year also saw the completion of several Geoscience BC projects. Twelve separate reports were released through

Geoscience BC in 2014, including the Summary of Activities 2014 volume, a compilation of 21 papers from various projects and 2014 scholarship recipients. For more information on 2014 data and report releases, go to page 19.

Geoscience BC was also pleased to participate in the April 2014 Canadian Journal of Earth Science Special Issue: "New Insights in Cordilleran Intermontane Geoscience (Part 2): reducing exploration risk in the mountain pine beetle-affected area, British Columbia." This volume follows Part 1 (published in June 2011) and showcases the continued work on several projects focused on better understanding the hydrocarbon potential of the Nechako-Chilcotin plateau, architecture of underlying sedimentary basins and characteristics of the near-surface volcanic rocks. The work in the two part volume represents a plan, developed in 2006 by the Geological Survey of Canada, Geoscience BC and the British Columbia Ministry of Energy, Mines, and Petroleum Resources (now the British Columbia Ministry of Energy and Mines and the British Columbia Ministry of Natural Gas Development), to acquire regional geoscience data that would provide a suitable framework to stimulate future resource exploration.

Looking to 2015

We have exciting things planned for the coming year, including a new oil and gas initiative called the "Peace Project" a new minerals project called "SeArch" and a new geothermal project. Full details on these new projects can be found on pages 14-15. In addition to these new projects, a dedicated seismologist has been hired for the Induced Seismicity Monitoring project in northeast BC and the Horn River Basin Water Monitoring project has been extended for another year. See page 16.

GBC-Sponsored Workshops and Events:

April 7, 2014:

Effective Cost-Effective Geophysical Techniques

1-day workshop at the Kamloops Exploration Group Conference, Kamloops led by Peter Kowalczyk and Ward Kilby

June 23-24, 2014

Let's Talk Mining & TREK Geochemistry and Geothermal programs Data Release and Networking Event, Nazko

2-day workshop to introduce the community to the mineral exploration cycle on day 1, and on day 2 overview of 2013 field activities and field trip to demonstrate work



Photo by Beothy Photography



Photo by D. Jepsen

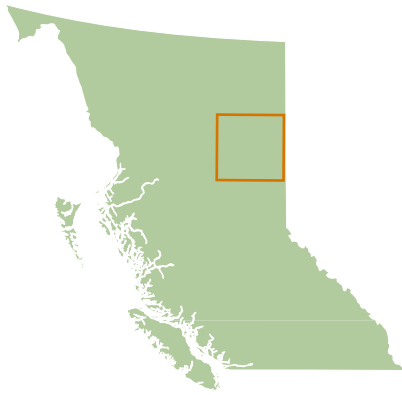


Photo by A. Clifford

Conferences and Meetings

Geoscience BC staff and consultants attended numerous conferences and workshops this year, giving presentations on Geoscience BC-supported projects at many events. Events attended in 2014 include:

- International LNG in BC Conference
- All you wanted to know about prospecting and mineral exploration on North Vancouver Island (AME BC-Nanwakolas Council-North Vancouver Island Aboriginal Training Society-BCIT)
- Association of Vancouver Island and Coastal Communities Conference (AVICC)
- Association of Kootenay-Boundary Local Government Conference (AKBLG)
- BC Natural Gas Symposium
- BC Water and Waste Association Annual Conference
- Canadian Aboriginal Minerals Association Conference
- Canadian Institute of Mining, Metallurgy and Petroleum Convention (CIM)
- Canadian Society of Petroleum Geologists, GeoConvention 2014
- Canadian Society of Unconventional Resources Annual Technical Conference
- Coal Association of Canada Conference
- First Nation Shale Gas/LNG Summit – Striking the Balance
- Fort Nelson First Nation Shale Gas Summit
- Globe 2014
- Geological Society of America Conference (GSA 2014)
- Kamloops Exploration Group Conference (KEG)
- Lower Mainland Local Government Association Conference (LMLGA)
- Mineral Exploration Roundup
- Minerals North
- Minerals South
- Natural Gas in British Columbia Research Roundtable—UBC Shale Research Roundtable
- NEBC Induced Seismicity Workshop
- North Central Local Government Association Conference (NCLGA)
- Premier's BC Natural Resource Forum
- Prospectors and Developers Association of Canada Conference (PDAC)
- Resources North Association AGM & Conference
- Science Advisory Board for Contaminated Sites in BC; Conference and Workshop on Contaminated Sites
- Select Standing Committee on Finance and Government Services
- Society of Economic Geologists Conference (SEG)
- Southern Interior Local Government Association Conference (SILGA)
- Unconventional Gas Technical Forum
- Union of BC Municipalities Convention (UBCM)
- Working Effectively with Aboriginal Peoples Workshop



Deep Aquifer Fluid Disposal Project

DID YOU KNOW?

Deep saline aquifers used as disposal zones are sedimentary rocks that contain water up to four times saltier than sea water.

Natural gas exploration and development in northeast BC require large volumes of water. This water is needed to access the natural gas locked within tight shale rock reservoirs during a process called hydraulic fracturing, or “fracking.” This process releases the gas and/or oil by creating spaces in the otherwise tight reservoir that allow the gas to flow.

In utilizing large volumes of water to access shale gas, large volumes of “produced” water are created and have to be disposed of and stored in a safe and sustainable manner. To ensure no contamination of drinking water, these produced waters must be injected into deep aquifers known as disposal zones.

In the ongoing effort to foster responsible development of BC’s natural gas resource, Geoscience BC collaborated with the BC Oil and Gas Commission (BCOGC) in 2014 to develop a program that would address the challenges of water disposal. Called the Deep Aquifer Fluid Disposal, or DAFD project, the objective is to characterize the capacity of deep disposal zones within the Montney unconventional play fairway in northeast BC. Petrel Roberston Consulting

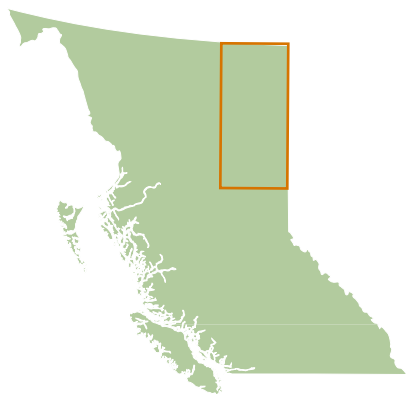
Ltd. (PRCL) was contracted to perform the first step of the DAFD project: map and characterize three different deep saline aquifers identified as high-priority disposal zone targets.

A regional map suite was created by PRCL using the region’s pre-existing well information in combination with rock samples to examine the ability of the zones to accommodate large volumes of produced water. The maps also give a high/medium/low favourability ranking for each potential aquifer or zone, where high favourability indicates areas with good aquifer characteristics and capacity with little or no risks arising from development of potential nearby shale gas reservoirs. On the other hand, a low favourability ranking for a target aquifer indicates poor aquifer characteristics and/or significant risks of impacts from existing or potential shale gas development.

In early 2015, Geoscience BC will engage Canadian Discovery Ltd. to perform step two of the DAFD project. This will involve a focused assessment of aquifer hydrogeology, including projections of the capacity of the aquifers to accept produced fluids.

Photo by E. Bordet





Natural Gas Liquids in Northeast BC

In 2013, Geoscience BC started a project with the University of British Columbia (UBC) and industry partners to quantify gas and natural gas liquids (NGLs) and flow characteristics in unconventional reservoirs. “Unconventional” reservoirs are those in which oil and/or gas do not flow naturally through the rock and require non-traditional ways of unlocking the hydrocarbons. In northeast BC, these are the shale gas reservoirs, where the process of hydraulic fracturing is necessary to access the natural gas locked within the highly compact shale source rocks.

This three-year study aims to help better understand liquids-rich fairways and corresponding flow characteristics of these

liquids from different shale gas source rocks in northeast BC. NGLs include propane, butane and ethane, and are important today because production of these liquids, simultaneously with natural gas, drives the economics of most unconventional prospects due to low gas prices. Research is focusing on six key source rock (shale) horizons in northeast BC.

Using currently available data, new regional maps of the major producing shale horizons in northeast BC are being created. Next, any data “gaps” identified after compiling the data will be filled in with help from industry partners, who are providing access to new rock samples (drill cores) for sampling and analyses. The

completed maps will be combined with shale gas production data available in the public domain.

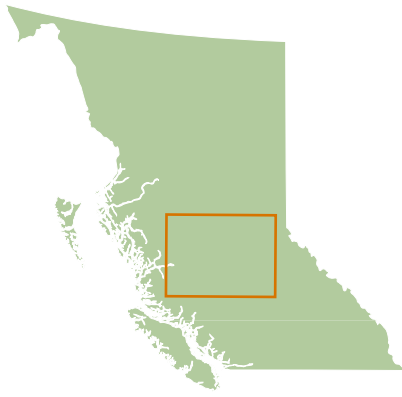
A model that can predict which shale gas source rocks also produce NGLs will be developed. This requires a strong understanding of the total oil and gas system in northeastern BC. Further work will aim to better predict how and how fast oil, gas and NGLs “flow” within tight shale reservoirs. Paired with the ability to predict which shale source rocks produce NGLs, the resource sector will be well-equipped with good science to facilitate continued success in the exploration and development of natural gas in northeast BC.



Photo by F. Hirschfield

DID YOU KNOW?

There is enough natural gas in BC to support energy needs in Canada and around the world for more than 150 years



The 24,000-square-kilometre project area covers much of BC's Interior Plateau, stretching south from Vanderhoof and Fraser Lake and west from Quesnel, and includes the well-known Blackwater Gold District.

The TREK Project

Targeting Resources through Exploration and Knowledge

2014 efforts built on 2013 work, which included flying a new airborne magnetic survey and commencement of a regional geochemical survey.

Summer 2014 marked the second field season for the multidisciplinary TREK project, short for Targeting Resources through Exploration and Knowledge. Developed by Geoscience BC and initiated in 2013, the \$4.1 million project is generating new information in an underexplored yet highly prospective area for mineral resources like gold and silver. The 24,000-square-kilometre project area covers much of BC's Interior Plateau, stretching south from Vanderhoof and Fraser Lake and west from Quesnel, and includes the well-known Blackwater Gold District. 2014 efforts built on 2013 work, which included flying a new airborne magnetic survey and commencement of a regional geochemical survey.

Field crews with the University of British Columbia's Mineral Deposit Research Unit (MDRU) were out for the first time in 2014 to begin the three-year TREK Geology & Integration program. MDRU is using the 2013 TREK airborne magnetic data to support improved geological interpretations and update the regional geology map of this portion of the Interior Plateau. MDRU focused its 2014 work on the northern part of the project area and examined some of the prominent magnetic features highlighted by the airborne survey.

NOTABLE QUOTABLE

Decoors Mining Corp. President Peter Shorts calls Geoscience BC's datasets "some of the best tools in any prospector's toolbox."



Photo by C. Hart

Geoscience BC held a two-day workshop in the Nazko First Nation community in June 2014.

Day one of the workshop, called "Let's Talk Mining," was delivered by C3 Alliance Corp. The discussion was about the steps of the mining life cycle, from mineral exploration through to reclamation, and associated economic opportunities.

Day two included presentations by TREK project consultants about till and geothermal sampling done in the area in 2013. This second day also involved a field trip to select sites around the community to describe local geology and share TREK sampling methods and rationale with community participants.

WORKSHOP



Photo by A. Clifford

Ultimately, the TREK Geology project will help mineral explorers by distinguishing regions that may have more potential for hosting precious metals.

Noble Exploration Services Ltd.'s crew returned to the field in summer 2014 to add 582 new till samples, bringing the total of new geochemical samples collected within the TREK project area to 1546. Results for 684 till and 280 lake sediment and lake water samples collected in 2013 were released in mid-2014. Data from the 582 till samples collected in 2014 plus

1393 reanalysed archived till samples from the project area will be released in 2015.

A component of the TREK geochemistry program was the production of Basal Till Potential Maps (BTPMs) for the area. These maps are valuable tools for planning regional surveys and assisting exploration companies in conducting their own detailed follow-up activities. Ten of these maps were released in 2014 in partnership with the British Columbia Geological Survey (BCGS).

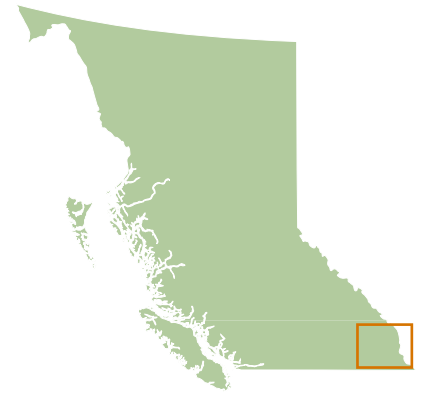
Geothermal sampling around the Nazko volcanic cone also continued in summer 2014. During initial TREK project consultations, local First Nations expressed an interest in potential geothermal resources and Geoscience BC responded by including geothermal research in the TREK project. Sample results from 2013 field work did not provide convincing evidence for geothermal activity, so additional work continued in 2014 and will continue into summer 2015 to detect other signs of geothermal activity. The work aims to improve existing methods for sampling and analysis of seepage-gas samples, which occur around the Nazko cone, and improve ways of differentiating geochemical patterns caused by a geothermal source from patterns caused by mineralization in local bedrock.

In the coming year, TREK project activities will involve continued geological studies and geochemical sampling to provide as complete a dataset as possible across the project area. Where sample material is poor and/or site access is limited, the use of treetop biogeochemical surveys to provide data coverage will be assessed. Geological studies by MDRU will continue to ground-truth and interpret the airborne magnetic data and strive to provide insight into controls on mineralization in the area. For more information on the TREK project, go to www.geosciencebc.com/s/TREK.asp.



Photo by D. Sacco

The SEEK project was initiated by Geoscience BC and the East Kootenay Chamber of Mines in 2011 to bring the region's rich exploration history into the present public domain.



The SEEK Project

Stimulating Exploration in the East Kootenays

In 2014, remaining SEEK project funds were committed to two new projects and a second installment of funding was extended to the East Kootenay Chamber of Mines (EKCM) to support the Fort Steel Drill Core Library. The SEEK project was initiated by Geoscience BC and the East Kootenay Chamber of Mines in 2011 to bring the region's rich exploration history into the present public domain to encourage continued exploration for economic mineral deposits in southeast BC.

The Core Library project was initiated by the EKCM in 2004 and archives drill core from the world-class Sullivan mine and surrounding exploration properties in southeast BC. This archive is intended to be

a resource for individuals and companies, university, government research geologists and local college and grade school education. Funding support for this library was provided by Geoscience BC in 2012 and an additional \$10,000 was presented to the EKCM at the Minerals South conference in November 2014 to support the installation of new infrastructure to protect the core.

New SEEK projects

One of the two new projects funded in 2014 aims to highlight the potential for undiscovered massive-sulphide mineralization in the Purcell Basin. Similar geological settings to the past-producing

Sullivan mine exist elsewhere in southeast BC, making these other areas prime exploration candidates for new deposits. Field mapping and sampling in the Cranbrook area was undertaken in summer 2014. Results of this study may outline the characteristics of specific settings that have higher potential to host massive-sulphide silver-lead-zinc deposits. A final report for this project is expected in June 2015.

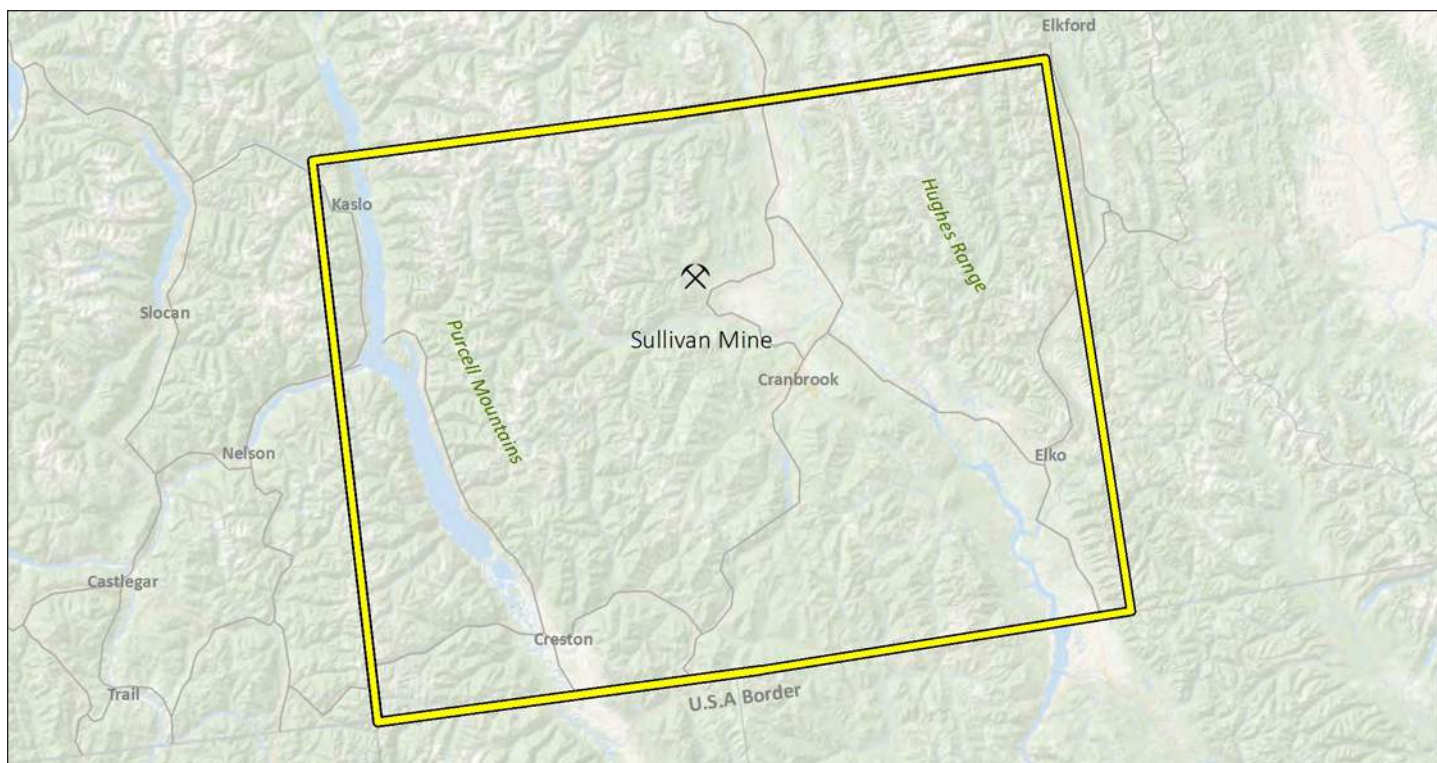
The second of the two new projects will study the Kimberly Gold Trend, focusing on the Purcell Mountains west-southwest of the town of Cranbrook. The Kimberly gold trend hosts four rich placer-gold streams discovered in the late 1800s, on which mining activities still continue today. Many small gold deposits and occurrences have

DID YOU KNOW?

Massive sulphide deposits are major sources of zinc and copper. The former Sullivan mine is a sediment-hosted massive sulphide lead-zinc-silver deposit that produced over 17 million tons of zinc and lead and more than 285 million ounces of silver.



Photo by M. Seabrook



been discovered in the area; however, a significant source for the rich placer deposits has not yet been discovered.

In order to identify characteristics associated with known gold occurrences in and around the project area, geological mapping and historical data compilation will be undertaken. In 2011 and 2013, the project proponents conducted mapping programs for industry clients within the project area, and this industry work will also be included to enhance the project outputs. From this combination of new and historical data, a model will be

developed that describes the emplacement of gold within the Kimberly gold trend and hopefully stimulate grassroots exploration and development of known gold targets in southeast BC.

The Hughes Range Paleomagnetic Study

The Hughes Range Paleomagnetic Study began in the summer of 2013 and wrapped in late 2014, with the final report to be released in early 2015. This project tested a new interpretation of faulting in the northern Hughes Range, which is the

location of two past-producing mines. Paleomagnetic samples were collected and analyzed at Okanagan College's newly established research lab.

These samples appear to validate the new geological interpretation, which leads to several interesting theories about the local base metal and gold occurrences and their geological setting. It is hoped that this study will lead to an improved geological understanding of the area and lead to future mineral discoveries.

For more information about the SEEK project, go to www.geosciencebc.com/s/SEEK.asp.



VP Minerals and Mining Bruce Madu (right) presents a cheque for \$10,000 to Jason Jacob, president of the EKCM to support the core library. Other EKCM members in the photo are also past and present SEEK project proponents Ted Sanders and Sean Kennedy (far left and middle left respectively) Minerals South
Photo by A. Clifford

DID YOU KNOW?

Despite the drop in exploration spending since the peak in 2012, exploration expenditures in 2013 were still \$476 million, representing nearly 20% of exploration spending in Canada



Photo by T. Bissig

New Minerals Projects

Geoscience BC issued a Request for Proposals (RFP) for new minerals projects in May and launched six new projects. Early results from all six projects can be found in Geoscience BC's Summary of Activities 2014 volume (see page 19 for more information).

Photo by T. Hoy



Historical Exploration Data Capture Pilot Project, Northwestern British Columbia (NTS 093L) – C. Kilby and M. Fournier

Over 32,000 mineral assessment reports are publicly available through the British Columbia Assessment Report Indexing System (ARIS); however the information is locked in scanned pdfs, or “analogue” format. This pilot project focuses on select assessment reports filed within NTS 1:250 000 map area 093L and aims to extract primary exploration data such as soil geochemistry, drillhole and rock samples, etc. and convert this data into downloadable and interactive digital formats. This proof-of-concept study will augment and enhance the existing provincial database and will undertake to establish collection procedures and develop techniques and protocols to facilitate the continuation of this work. A final report is expected in early 2015.

Catchment Analysis Applied to the Interpretation of New Stream Sediment Data from Northern Vancouver Island, British Columbia (NTS 102I and 092L) – D. Arne and O. Brown

The terrain of northern Vancouver Island is considered ideal for the automated generation of catchment basins, which help define the zone of geological influence on a specific stream sediment sample site. For this reason, this project is using stream sediment data collected as part of the Northern Vancouver Island Exploration Geoscience Project, a partnership between Geoscience BC and the Island Coastal Economic Trust.

New map products will be produced, adding value to existing stream sediment datasets by providing additional information not readily available to most prospectors and geologists working for small exploration companies. It is hoped that these new maps, their release anticipated for early 2015, will encourage further mineral exploration on northern Vancouver Island.

Use of a Field Portable Photometer for Rapid Geochemical Analysis of Stream and Spring Waters: A Case History from Poison Mountain, Southwestern British Columbia (NTS 092O/02) – R. Yehia and D. Heberlein

A range of portable analytical instruments called spectrophotometers, or photometers, is available for field-based surface water testing that can provide close to real-time results. These photometers can measure concentrations of dissolved ions at a fraction of the cost of analysis at a commercial laboratory.

This proof-of-concept study was carried out at the Poison Mountain copper-gold-molybdenum deposit in southwest BC in late August and again in October of 2014 to demonstrate repeatability of this technique. Final interpretation of the photometer results will include testing the reliability, accuracy and precision of its readings based on: comparison with results of identical samples analyzed in a commercial lab, duplicate photometer readings and results of field duplicate samples. The interpretation will also

address the dispersion of key ions from exposed mineralization at the Poison Mountain deposit and discuss the advantages of using this technique for mineral exploration in BC. The project is expected to be complete in early 2015.

Toward an Improved Basis for Beneath-Cover Mineral Exploration in the QUEST Area, Central British Columbia: New Structural Interpretation of Geophysical and Geological Datasets (NTS 093A, B, G, H, J, K, N) – M. Sánchez, T. Bissig and P. Kowalczyk

The bedrock geology of Geoscience BC's QUEST project area, especially in the Prince George area, remains poorly defined despite the wealth of publicly available regional geophysical and geochemical data. This new structural interpretation aims to improve previous geological maps for the area by pairing field observations with new and systematic multi-dataset 'stacking' methodology for interpretation of existing geophysical and satellite data.

The goal is to generate an updated 1:400 000 scale geological map for the QUEST project area, including digital files with the new set of geophysical filters by spring of 2015. This new dataset will contribute to a better understanding of BC's geology and will be usable as a base layer for the exploration of porphyry-style deposits across the QUEST project area.

Mineralogical Characteristics of Porphyry-Fertile Plutons: Guichon Creek, Takomkane and Granite Mountain Batholiths, South-Central British Columbia

– F. Bouzari, C. Hart and T. Bissig

The relationship between magmatic processes and ore deposits like copper porphyries has long been the focus of ore deposit research, but past studies have generally concentrated on the local deposit scale. This project is looking at processes on the regional district to batholith scale to identify features of enhanced prospectivity, which have not been previously documented in BC.

The batholiths studied here host copper porphyries, including the Highland Valley mine, Woodjam camp and Gibraltar mine, and are therefore considered 'porphyry-fertile plutons.' Project activities will identify their unique geological characteristics and develop exploration tools for subsequent identification of new fertile plutons in BC. Sampling for this project began in August 2014 and will continue in summer 2015. Expected project completion is winter 2016.

DID YOU KNOW?

Mine upgrades at Gibraltar mine have made this mine one of the largest employers in the Cariboo.

Geological Mapping, Compilation and Mineral Evaluation of the Almond Mountain Map Area, Southern British Columbia (NTS 082E/07) – T. Höy and W. Jackaman

The Almond Mountain project is a western extension of work done in previous years to the east. Field work will commence in 2015 and extend the earlier studies into an area that has attracted some historical and recent exploration, mainly due to successful gold and base-metal exploration in the Greenwood area to the south. Geological mapping began in late 2014 and another 40 days of mapping are planned in 2015 to complete the work.

Mapping will focus on areas of mineral occurrences and higher mineral potential as well as updating the mineral occurrence database. The project will also digitally compile all regional geological, geophysical and geochemical data for the area. New maps and databases will be produced that comprise all of the above-listed data, serving as suitable products for guiding mineral exploration. Final project deliverables are expected in winter 2016.



Mineral spring at Poison Mountain showing naturally-occurring oxidation (rust-coloured rocks)

Photo by R. Yehia.



Photo by J. Angen

Coming in 2015

Web Map Application

Geoscience BC is developing an internal web mapping application to profile nearly a decade of the new geoscience it has produced. Inspired by the BC Geological Survey's MapPlace, Geoscience BC's web mapper can quickly and effectively deliver all of our datasets, from the smallest to the largest. The application will feature many additional publicly-available datasets that are familiar to geoscience users in a simple and easy-to-use interface.

The site is supported by ArcInfo GIS and Geoscience BC's internal management; which means it has the ability to respond quickly to users' needs. The application will be migrated to a full HTML platform, which means it will work on all devices from workstations to smartphones.

Geoscience BC is excited to launch its web mapping application and democratize our data in a forum that will help First Nations, prospectors, industry, government and the public at large to benefit from the best geoscience possible.

New Projects

Geoscience BC is also planning to launch new regional geoscience initiatives in 2015, including initial phases of Geoscience BC-generated oil and gas and minerals projects. A third new project will be a geothermal project, generated by a request for proposals. Here's what we've got so far...

The Peace Project

Water is fundamental to our existence and our economy. In March 2014, the BC provincial government announced the new Water Sustainability Act, to be brought into effect in spring 2015. For the first time in BC in 100 years, this Act will regulate groundwater usage—at a time of growing public and First Nations' concerns around groundwater quality and quantity with the natural gas development surge in northeast BC. In addition to the new Water Sustainability Act, the government is working with Treaty 8 First Nations on the Northeast Water Strategy to address these concerns.

To help protect our water and support these initiatives, Geoscience BC is planning the new "Peace Project," aimed at gaining a better understanding of regional aquifers in northeast BC, especially where few water wells exist north of the Peace River. Peace Project partners to-date include the Ministry of Environment, the Ministry of Forests, Lands and Natural Resource Operations, the BC Oil and Gas Commission and the Ministry of Natural Gas Development. With these partners, the Peace Project will serve as a key component of the Northeast Water Strategy.

Additional partners from industry have come forward to support the project, including Progress Energy Ltd., Conoco-Phillips, and the Canadian Association of Petroleum Producers. The Peace River Regional District and their Water Stewardship Committee are also strongly

supportive of this project. In October of 2014, in partnership with the Treaty 8 Tribal Association, Geoscience BC held a workshop to share the background, rationale and proposed methods for the Peace Project. Land use representatives from five Treaty 8 Tribal Association member communities as well as staff and consultants for the Association itself contributed important information and shared valuable feedback. In the New Year, we look forward to feedback from the Blueberry First Nation.

How will this project "map" aquifers?

The Peace Project proposes to use airborne geophysics to map groundwater aquifers in northeast BC's Peace Region, over an area totaling approximately 31,000 square kilometres. The airborne electromagnetic (EM) survey can "see" up to a depth of 350 metres below the earth's surface and show the location of groundwater aquifers. Different EM signatures indicate different water qualities. In addition to the airborne survey the project would integrate groundwater wells, shallow 3D seismic (where possible) along with shallow well logs for the most accurate quantification of shallow aquifers to date.

What does this mean?

Information from the Peace Project will be important for the protection of shallow groundwater aquifers. The Project will serve as a key component of the Northeast Water Strategy and the establishment of the Northeast Groundwater Monitoring Network, as the information will highlight where to best place groundwater observation wells.

The airborne survey may also locate non-potable sources of water that could be used by the energy sector and alleviate their reliance on surface water sources. Information would allow for industry to optimize the placement of their monitoring and source-water wells and support environmental net-effects assessments for comparison of water sources. Additionally, in the unlikely case of a spill, project information would enable a rapid and effective mitigation response. The resulting data would also help to map overburden thickness and help industry optimize their development of infrastructure.

Understanding shallow groundwater involves several components, including water quality, water quantity and aerial extent of individual aquifers. The Peace Project will provide First Nations, the energy sector, governments and stakeholders with the information needed for informed decision-making and effective dialogue.

The SeArch Project

As highly effective exploration tools, airborne geophysical surveys have played a key role in each of Geoscience BC's major minerals projects. In June of 2014, the Minerals Technical Advisory Committee (TAC) discussed ideas for the next regional project and concluded that high resolution airborne magnetics surveys be flown as part of the next generation of projects. These would assist with property-scale interpretations and hopefully lead to mineral discoveries. An additional priority

of adding value to all of the current and past geoscience information through various integrations projects was also identified. A selection of high-interest areas throughout the province were prioritized—the top ones being incorporated into a new project to be named “SeArch”.

The Phase I budget of \$1.415 million for SeArch was approved by the Board of Directors in December of 2014. Planning is underway to identify the best specific location to start the project that will begin with a limited airborne magnetic survey flown at 250 metre line spacing to greatly enhance the previous Geoscience BC and government surveys. Similar to the TREK project, Geoscience BC may consider acquiring proprietary industry airborne magnetic data from projects within the SeArch project area. Purchased data would be stitched into the larger SeArch airborne magnetic dataset and provide a cost effective solution to covering larger areas that already have been surveyed.

In addition to an airborne magnetic survey, the SeArch Phase I will include limited geochemical infill work where necessary to bolster sample density, as well as information sessions, community outreach and workshops.

Geothermal Research

Geothermal energy is the natural heat energy contained within the earth, and today it is used to generate electricity in more than 70 countries with a total installed capacity of more than 12,000

megawatts. At the Union of BC Municipalities Conference in September 2014, a resolution put forward by the Village of Valemount was passed unanimously that asked the provincial government to support development of geothermal power in BC and to encourage Geoscience BC to survey potential heat resources.

In response, Geoscience BC issued a Request for Proposals on November 24th titled “Economic Viability of Geothermal Resources in British Columbia”. The RFP defined two major themes: data compilation and the technical and economic assessment of those areas deemed favourable. The first theme, data compilation, requires re-evaluation of previous geothermal studies in BC, including 18 known geothermal sites throughout the province and completion of a Geothermal Development Decision Matrix for each site.

The second theme, titled “Favourability Table and Economic Evaluation”, defines that the sites identified as “favourable” in the first compilation step be further evaluated for economic potential of estimated energy generation using an established methodology. The RFP outlined that the study would categorize confidence levels of the input data and the resulting megawatt capacity estimate for each site deemed favourable. A levelized cost of power for each site would then be calculated using a Geothermal Electricity Technology Evaluation Model (GETEM) or other suitable model.

The ultimate objective of this geothermal study will be to deliver an assessment of the economic viability of geothermal energy for electrical power generation in the province of British Columbia to answer the question: is geothermal electricity generation economic? The project also aims to lower geothermal exploration risk by analyzing existing and new geothermal data with an emphasis on direct-use applications, which in turn, could create economic development and job creation opportunities that can be pursued by local governments and First Nations.



Photo by T. Bissig

Ongoing Projects

Geoscience BC has several active projects, some of which are partnerships generated through our request for proposals process, typically led by consultants and university researchers.

The following is a selection of some of the ongoing projects in 2014. For a complete listing of all Geoscience BC-supported projects, check out www.geosciencebc.com/s/Projects.asp.

Oil & Gas Projects

Induced Seismicity Monitoring Project: Northeast BC – Geoscience BC, Canadian Association of Petroleum Producers, BC Oil and Gas Commission, Natural Resources Canada

To help reduce the risk of inducing low-magnitude earthquakes, this project was initiated in late 2012 to monitor seismic events created by oil and gas operations related to hydraulic fracturing and fluid disposal. Work began in March 2013 with the installation of six state-of-the-art seismograph stations in key areas of northeast BC to complement the previously-existing two stations of the Canadian National Seismographic Network (CNSN). The six new stations were integrated into the CNSN by August of that year.

Since August 2013, 252 events in the range from 1.0 to 4.4 ML (local magnitude or Richter) have been noted. Of the 252 events, 170 were related to hydraulic fracturing (fracking) and 82 were related to water disposal. Almost half of these events originated from one operating site in the Northern Montney Play. For the recorded seismic events related to fracking, 55 were within the mean of 2.0 to 2.4 ML and 32 were between 2.5 and 2.9 ML. Generally speaking, only events greater than 3.5 ML might be felt on surface in this region of BC. In nature, the estimated annual frequency of events between 2.0 and 2.9 ML is more than one million. On average, earthquakes at this magnitude are not known to cause damage to buildings and are only rarely felt by some people.

In November 2014, the work was profiled in Calgary at the “NEBC Induced Seismicity Workshop” sponsored by Geoscience BC. Also in November, two more stations were brought online by NRCAN and the BCOGC to further enhance the resolution of the CNSN. At the end of 2014, the Geoscience BC-led research consortium hired a dedicated seismologist to analyze the seismic data collected to-date. This seismologist will begin work on the project in February 2015.

Horn River Basin Water Project: Horn River Basin, BC – Geoscience BC, Horn River Basin Producers Group, Fort Nelson First Nation, Fort Liard First Nation (Acho Dene Koe)

This project was originally projected for completion in August 2014 and was extended for a fourth year. This project will continue to study surface water and collect relevant data to better understand water quantity in the region, determine water quality, evaluate environmental health and build First Nations capacity in water management.

A Geoscience BC-supported study by the Cold Regions Research Centre at Wilfrid Laurier University has yet to begin. This project will examine the surface and shallow groundwater interaction in areas of muskeg and discontinuous permafrost. The aim of this work is to improve understanding of water balance in these complex areas.



Photo by B. Ortman



Photo by I. del Real

Minerals Projects

Porphyry Integration Project – Merlin Geoscience Inc.

During the KEG conference in April 2014, the final geology map of the Mount Polley Intrusive Complex was released. Work continued on additional deposits, including Endako, Mount Polley, Mount Milligan and Lorraine. The Porphyry Integration Project is a comprehensive compilation of public, and in some cases, company datasets to identify a wide range of geological characteristics of British Columbia's porphyry deposits at the district scale. Final products will include geo-exploration atlases (consisting of a suite of maps in .pdf format) and accompanying databases for the four above-listed porphyry districts.

Enhancing Exploration Effectiveness for Polymetallic Mineralization in Southeastern BC: A Combined Petrological and Tectonic Approach – D. Pattison and E. Webster, University of Calgary

This PhD project is aiming to better define the geological evolution of the complex area between Nelson, Salmo and Creston, BC, including establishing links between mineralization and metamorphism and developing metamorphic mineral assemblage vectors to guide mineral exploration in the region. This project was extended in 2014 and completion of the work is projected for June 2015.

PIMs: Porphyry Indicator Minerals from Alkalic Cu-Au Porphyry Deposits in BC – F. Bouzari and M.A. Celis (MDRU)

A continuation of an earlier Geoscience BC-sponsored pilot project, this project is examining PIMs from the alkalic Mount Polley, Mount Milligan and Copper Mountain deposits in BC. The research will be used to determine PIMs minerals assemblages and diagnostic parameters, and establish criteria for PIMs use in BC mineral exploration. The project was extended in 2014 and final deliverables are now expected in early 2015.

Relationships Between Calc-alkalic and Alkali Mineralization Styles at the Copper-Molybdenum Southeast Zone and Copper-Gold Deerhorn Porphyry Deposits, Woodjam property, central British Columbia – F. Bouzari, C.J.R. Hart and I. del Real (MDRU)

This MSc project is being done in collaboration with Gold Fields Canada Exploration at the Woodjam camp, where a cluster of multiple porphyry centres with a narrow age range at the edge of the Takomkane batholith have alkalic, calc-alkalic, and alkalic to calc-alkalic characteristics. The research will characterize the host-rocks and nature of mineralization and alteration at several selected porphyry centres, as well as determine the relationships between alkalic and calc-alkalic ore types.

Projects completed in 2014

The following Geoscience BC projects wrapped up in 2014. All project deliverables (posters, presentations, technical articles and final reports) are available through Geoscience BC's website.

- Subsurface Aquifer Study to Support Unconventional Gas and Oil Development, Liard Basin, Northeastern British Columbia (NTS 094J, K, N, O) (*Petrel Robertson Consulting Ltd.*)
- Northern Vancouver Island Exploration Geoscience Project (*Geoscience BC*)
- Till Geochemistry of Tahtsa Lake District North and Adjacent Areas, West-Central British Columbia – A key ingredient for the discovery of new porphyry, VMS and polymetallic vein mineralization (NTS 93E, 93L) (*T. Ferbey, BC Geological Survey*)
- Gravity and Magnetic Inversion Modelling: Nechako Basin, BC, Canada (*Mira Geoscience Ltd.*)

DID YOU KNOW?

The natural gas industry uses less than half of 1% of the annual water runoff in northeastern BC for hydraulic fracturing

Data and Publications

All Geoscience BC data and reports can be accessed through our website at www.geosciencebc.com/s/DataReleases.asp.

All releases of Geoscience BC reports and data are announced through our website and e-mail distribution list. If you are interested in receiving e-mails regarding these reports and other Geoscience BC news, please contact info@geosciencebc.com

Geoscience BC Report 2014-01

Geoscience BC Summary of Activities 2013 volume (contains 14 technical papers on Geoscience BC project activities in 2013, *various authors*)

Geoscience BC Report 2014-02

Subsurface Aquifer Study to Support Unconventional Gas and Oil Development, Liard Basin, Northeastern British Columbia, *by Petrel Robertson Consulting Ltd.*

Geoscience BC Report 2014-03

Regional Stream Sediment Geochemical Data, Sample Reanalysis (INAA), Northern Vancouver Island, British Columbia, *by W. Jackaman*

Geoscience BC Report 2014-04

Fixed Wing Magnetic Geophysical Survey, TREK Project, Interior Plateau/Nechako Region, British Columbia, Canada, *by Aeroquest Airborne Ltd.*

Geoscience BC Report 2014-05

Acquired Heliborne High Resolution Aeromagnetic Surveys in the Blackwater District, TREK Project Area, British Columbia, *by Geoscience BC*

Geoscience BC Maps 2014-06-01 to -10 / British Columbia Geological Survey Open Files 2014-06 to -15

Basal Till Potential Maps for the Interior Plateau, TREK Project, British Columbia, *by D. Sacco, T. Ferbey and W. Jackaman*

Geoscience BC Report 2014-08

Geology of the Mount Polley Intrusive Complex (Final Version), *by C. Rees, G. Gillstrom, L. Ferreira, L. Bjornson and C. Taylor*

Geoscience BC Maps 2014-09-01 & -02 / British Columbia Geological Survey Geoscience Maps 2014-01 & -02

Surficial Geology of the Nadina River and Colleymount Map Areas (NTS 093E/15 & 093L/01), British Columbia, *by T. Ferbey*

Geoscience BC Report 2014-10

Geochemical and Mineralogical Data, TREK Project, Interior Plateau, British Columbia, *by W. Jackaman and D. Sacco*

Geoscience BC Report 2014-11

Geochemical Expression in Soil and Water of Carbon Dioxide Seepages near the Nazko Volcanic Cone, Interior Plateau, Central BC, NTS 093B/13, *by R. Lett and W. Jackaman*

Geoscience BC Report 2014-12

Geologically-Constrained Gravity and Magnetic Earth Modelling of the Nechako-Chilcotin Plateau, British Columbia, Canada, *by Mira Geoscience Ltd.*

DID YOU KNOW?

69% of TSX and TSX-V stock exchange-listed companies based in BC are involved in the mineral exploration and mining sectors.

Summary of Activities 2014

Released every January at Mineral Exploration Roundup, Summary of Activities is Geoscience BC's annual technical volume.

The volume is composed of scientific papers describing our new and ongoing projects. For the first time this year, the volume also includes project updates from the 2014 Geoscience BC scholarship winners.

This year's Geoscience BC Summary of Activities is the eighth in the series (Geoscience BC technical papers were published in the BC Geological Survey Fieldwork volume in 2005 and 2006). Printed in full colour and available digitally through Geoscience BC's website, Summary of Activities 2014 features 21 articles over 162 pages of new information on Geoscience BC-funded projects.



Minerals Projects

Targeted geochemical and mineralogical surveys in the TREK project area, central British Columbia: year two, by D.A. Sacco and W. Jackaman

Tracing the source of anomalous geochemical patterns in carbonate-rich bog soils near the Nazko volcanic cone, central British Columbia, by R.E. Lett and W. Jackaman

TREK geology project: recognizing Endako Group and Chilcotin Group basalts from airborne magnetic data in the Interior Plateau region, south-central British Columbia, by J.J. Angen, E. Westberg, C.J.R. Hart, R. Kim and C. Raley

Characterization of Late Cretaceous volcanic suites in the TREK project area, central British Columbia, by R. Kim, C.J.R. Hart, J.J. Angen and E. Westberg

Catchment analysis applied to the interpretation of new stream sediment data from northern Vancouver Island, British Columbia, by D. Arne and O. Brown

Use of a field portable photometer for rapid geochemical analysis of stream and spring waters: a case history from Poison Mountain, southwestern British Columbia, by R. Yehia and D.R. Heberlein

Toward an improved basis for beneath-cover mineral exploration in the QUEST area: new structural interpretation of geophysical and geological datasets, by M.G. Sánchez, T. Bissig and P. Kowalczyk

Mineralogical characteristics of porphyry-fertile plutons: Guichon Creek, Takomkane and Granite Mountain batholiths, south-central British Columbia by F. Bouzari, C.J.R. Hart and T. Bissig

Geological mapping, compilation and mineral evaluation of the Almond Mountain map sheet, southern British Columbia, by T. Höy and W. Jackaman

Structural controls on the Kimberley gold trend, southeastern British Columbia, by M. Seabrook and T. Höy

Mud volcanoes in the Purcell Basin and their relevance to Middle Proterozoic massive-sulphide Ag-Pb-Zn deposits, Southeastern British Columbia, by S. Kennedy and T. Höy

Historical exploration data capture pilot project, northwestern British Columbia, by C.E. Kilby and M.A. Fournier

Oil and Gas Projects

Characterization of Belloy, Kiskatinaw and Debolt water disposal zones in the Montney play area, northeastern British Columbia, by B.J.R. Hayes, S. Macleod and J. Carey

Quantification of the gas- and liquid-in-place and flow characteristics of shale and other fine-grained facies in northeastern British Columbia, by R.M. Bustin, E. Munson, E. Letham and A.M.M. Bustin

Scholarship Recipients

Carbonate alteration footprints of carbonate-hosted zinc-lead deposits in southeastern British Columbia: applying carbon and oxygen isotopes, by N.L. Cook and C.J.R. Hart

Preliminary results from a trace-element study of amphibole-cumulate rocks from the Bonanza Arc, Vancouver Island, British Columbia by R.J. D'Souza and D. Canil

Evaluation of Mozley C800 laboratory mineral separator for heavy mineral concentration of stream sediments in exploration for carbonatite-hosted specialty metal deposits: case study at the Aley carbonatite, northeastern British Columbia, by D.A.R. Mackay, G.J. Simandl, B. Grcic, C. Li, P. Luck, M. Redfearn and J. Gravel

Assessing fracture network conductivity of prefeasibility-level high-temperature geothermal projects using discrete fracture network modelling at the Meager Creek site, southwestern British Columbia, by S.W. Mak, E. Eberhardt and J.A. Meech

Structural geology of the Granite Lake pit, Gibraltar copper-molybdenum mine, south-central British Columbia: preliminary observations, by N. Mostaghimi, L. Kennedy and J. Gabites

Magnetite as a porphyry copper indicator mineral in till: a test using the Mount Polley porphyry copper-gold deposit, south-central British Columbia, by L.K. Pisiak, D. Canil, C. Grondahl, A. Plouffe, T. Ferbey and R.G. Anderson

Uranium-lead age constraints and structural analysis for the Ruddock Creek zinc-lead deposit: insight into the tectonic evolution of the Neoproterozoic metalliferous Windermere Supergroup, northern Monashee Mountains, southern British Columbia, by L.M. Theny, H.D. Gibson and J.L. Crowley

Scholarship Recipients

In July 2014, Geoscience BC awarded seven scholarships of \$5,000 each to graduate students working on BC-based projects directly relevant to mineral or energy exploration. Since 2007, Geoscience BC has awarded up to ten scholarships annually to graduate students working on BC-based projects relevant to the mineral, oil & gas and geothermal exploration industries.

Each year the applicants are evaluated on their project's technical merit and ability to attract exploration investment to BC, and their academic qualifications and work experience. Preference is given to applicants whose projects were deemed to have the greatest potential benefit to BC exploration activities, and whose research and career interests are primarily focused toward the exploration sector.

For more information on the Geoscience BC graduate scholarship, including past recipients, their projects, and posters and theses derived from their work, please visit www.geosciencebc.com/s/scholarships.asp. Detailed articles about the 2014 recipients' work are also included in this year's Summary of Activities volume (Geoscience BC Report 2015-1), which can be found at www.geosciencebc.com/s/SummaryofActivities.asp.

DID YOU KNOW?

10,720 people worked in direct jobs in BC's mining industry in 2013, up from 10,419 in 2012

Natalie Cook

MSc Student,
University of British Columbia

Carbonate Alteration Footprints of British Columbia's Carbonate-hosted Zn-Ag-Pb Deposits: Applying C and O Isotopes

Natalie's Masters project will characterize carbonate alteration footprints for carbonate-hosted zinc-silver-lead (Zn-Ag-Pb) deposits using carbon (C) and oxygen (O) isotopes, and use their isotopic signatures as an exploration tool. In carbonate-hosted mineral deposits, there are often narrow and poorly developed hydrothermal alteration footprints. Fluid:rock interactions can be recorded by C and O isotopes within the carbonate host rocks and veins, with the intensity of invisible isotopic alteration increasing from regions bordering mineralization into the centre of it. This isotopic signature of the alteration footprint may extend beyond the limits of the ore body, beyond visible alteration or even beyond geochemical anomalies. To make the most of applying stable C and O isotopes as exploration tools, she will use the new rapid, field-portable Mineral Isotope Analyzer (MIA) instrument that the Mineral Deposit Research Unit (MDRU) at UBC has developed.



Rameses D'Souza

PhD student, University of Victoria

Geochemical characterization of the Jurassic Bonanza arc and Tertiary intrusions on Vancouver Island

This is the second year in a row that Rameses has been awarded a Geoscience BC scholarship, as the second part of his PhD thesis. His project is focused on

understanding the source of copper enrichment in porphyry copper deposits, which is important as these deposits are the world's primary source of copper and molybdenum (and an important source of other elements like gold and silver). British Columbia hosts a number of porphyry copper deposits that are economically feasible to mine, including the past-producing Island Copper mine on Vancouver Island. The rocks that host this former mine are part of what is known as the Bonanza arc. Rameses is studying crustal differentiation and the evolution of island arcs as well as testing recent hypotheses about the source of copper enrichment in porphyry deposits in space and time by studying the Bonanza arc rock samples.

Duncan Mackay

MSc Student, University of Victoria

Deposit characteristics and optimization of exploration techniques for carbonatite-hosted Nb, Ta, and REE deposits in British Columbia

Duncan's project focuses on optimizing existing exploration methods (e.g. stream sediment geochemistry and indicator minerals) for carbonatite-related niobium, tantalum and rare earth (Nb, Ta, and REE) deposits in British Columbia. The project area covers several of these types of deposits in north central British Columbia near Mackenzie and Prince George, including the Aley, Lonnie, and Wicheeda carbonatites. The goal is to create new methodologies that will improve exploration efficiency directly applicable to these and other complex deposits. This will be accomplished by using different types of analyses including portable x-ray fluorescence, scanning electron microscopy, and electron microprobe analyses of sediments and indicator minerals grains from carbonatite-related Nb, Ta, and REE deposits and other deposit types.



Stephen Mak

MSc Student,
University of British Columbia

Assessing the developmental risk of high temperature geothermal projects through an evaluation of geological uncertainty using discrete fracture network modelling

Despite the vast number of high temperature geothermal sites in BC, there has never been a single watt of commercial electricity generated by geothermal energy in this province, or even in Canada. This is due to the high exploration and development costs associated with geothermal projects, which are incurred early in the project life when little site-specific geological data is available. This means that large capital investments must be made in order to delineate, characterize and develop a geothermal reservoir, with no certainty that the reservoir will be able to produce sufficient volumes of heated water at an economically viable rate.

Stephen's research involves the development of a discrete fracture network (DFN) model for the Meager Creek geothermal site, which is one of the most promising high temperature geothermal sites discovered in Canada. Although a substantial amount of exploration has been conducted sporadically at Meager Creek since 1975, no DFN models were developed. Through the development of a site-specific DFN model, the aim is to find out why past attempts to develop the Meager Creek site were unsuccessful, and if DFN modelling can be used at the prefeasibility level to estimate the likelihood of success of geothermal projects. This project is supported by the National Sciences and Engineering Research Council (NSERC) and the Pacific Institute for Climate Solutions in addition to Geoscience BC.



Nader Mostaghimi

MSc Student,
University of British Columbia

Geological setting, structural geology and timing of deformation at the Gibraltar Cu-Mo Mine: controls on mineralization

The Gibraltar mine is a copper-molybdenum (Cu-Mo) porphyry deposit located 65 km northwest of Williams Lake and 45 km southeast of Quesnel. It is hosted in the Late Triassic Granite Mountain batholith. The Gibraltar mine is one of several mineralized systems currently being studied as part of the Geological Survey of Canada's Intrusion Related Ore Systems TGI4 Program. The main ore zone on the mine property is structurally disjointed by several deformation events and questions still exist regarding the relationship between mineralization and the earliest deformation. Nader's research is aimed at unravelling the geometry, kinematics and timing of the deformation events that have affected ore distribution and to determine if mineralization was synkinematic with the earliest deformation event.





Laura Pisiak

MSc Student, University of Victoria

A Test of Fe-Ti Oxides as Porphyry Cu Deposit Indicator Minerals in Glacial Till

Mineral exploration for porphyry copper (Cu) deposits in the Canadian Cordillera is largely focused on prospective Mesozoic calc-alkaline and alkaline intrusive igneous rocks, some of which are overlain and effectively hidden by extensive unconsolidated sediment cover. Magnetite is an abundant mineral in all porphyry systems and is resistant during supergene weathering. Trace element analysis of ore-related magnetite from various porphyry deposits in British Columbia indicate that individual ore deposits show unique trace element signatures in hydrothermal magnetite that differ from typical magnetite in igneous or metamorphic rocks. Laura will use quantitative assessments (i.e. discriminant functions or multivariate analysis) to test correlations of magnetite chemistry to barren or prospective igneous sources. The ultimate goal of her project is to investigate if the trace element signature of ore-derived magnetite in basal till can provide a unique exploration vector for effectively identifying mineralized porphyry systems.

Lucia Theny

MSc Student, University of Victoria

Structural, Geochronological and Petrographic Analysis of the Ruddock Creek Zn-Pb deposit, Northern Monashee Mountains, British Columbia

The study area for this project is located at the Ruddock Creek Property of Imperial Metals Inc., situated within the northern Monashee Mountains. The Ruddock Creek deposit is interpreted to be a sedex deposit and the current resource at the Ruddock Creek deposit is 10,036,000 tonnes of 8.07% combined zinc and lead (indicated and inferred resource at 4% cut off). The rocks of the deposit are complexly folded through three phases of deformation that have been defined by earlier studies.

Lucia's research focus will be on:

1. constraining the deposit formation;
2. refining the Ruddock Creek property structural history through mapping at 1:10 000 scale; and,
3. relating the deposit to the metallogenic evolution of the Cordillera.



Where Are They Now?

Since 2007, Geoscience BC has awarded up to ten scholarships annually to graduate students working on BC-based projects relevant to the mineral, oil & gas and geothermal exploration industries.

Many of these students continue to work in the BC exploration industry after graduation, while others move on to work internationally.



Joel Cubley
2008 and 2009
Scholarship Recipient

Tell us about your winning project.

My Ph.D. dissertation was focused on constraining the metamorphic and structural history of the Grand Forks Complex, a Paleocene-Eocene metamorphic core complex in southeastern British Columbia. A large component was a petrological characterization of the complex, including thermodynamic modeling, microprobe analysis, and in situ monazite dating. From an economic geology perspective, I spent time evaluating and petrologically constraining Cu-Pb-Zn skarn/manto showings in the Christina Lake area, as well as investigating the potential for late mineralization along the Kettle River fault.

How did winning a Geoscience BC scholarship support you and your research?

Fieldwork can be very expensive, and Geoscience BC funding was critical for supporting three full field seasons in southeastern British Columbia. In addition, the scholarships allowed me to reduce my teaching assistantship load at critical points in the project, allowing me to direct more focus on the project at hand.

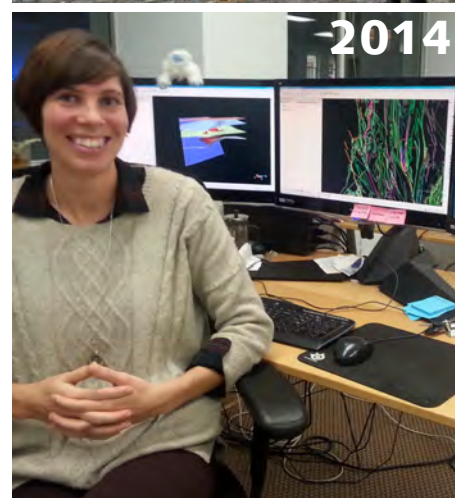
After finishing your degree, what did you go on to do and where?

With a few months left in my degree, I took a faculty position at Yukon College in Whitehorse, Yukon. The College had received third-party funding to launch a new Geological Technology diploma program, and I was hired to spearhead the planning and development of that program. The program, now incorporated under the College's Centre for Northern Innovation in Mining (CNIM), has been running for nearly 3 years now, and my position has transitioned into a mainly instructional role. With a very small department of only two full-time faculty, it has been an appreciated challenge juggling classes ranging from Mineralogy/Petrology to Mining Computing to Rock Mechanics. My research programs have shifted northwards, and currently include petrologic and geochemical research on metavolcanics in Kluane National Park and tephra deposits near the Yukon-Alaska border.

Shannon Frey
2008 Scholarship Recipient

Tell us about your winning project.

Sedimentological and ichnological analyses of three beaches on the coast of Vancouver Island were undertaken to quantify process-response relations in straits and to develop a model for strait-margin beach-shorefaces. Wave processes dominate sediment deposition in the backshore and foreshore. In the middle to lower shoreface and offshore zones, tidal energy is dominant and manifests in sedimentologic and ichnologic characteristics. Consequently, the term "tide-influenced shoreface" describes these depositional environments.





2014



2011

How did winning a Geoscience BC scholarship support you and your research?

Winning the Geoscience BC scholarship contributed funding to the execution of the initial field season in 2008, which provided the bulk of the data used to complete this research. The field season was conducted over two months on the west coast of Vancouver Island and included extensive sampling of both onshore and offshore environments.

After finishing your degree, what did you go on to do and where?

After completing my degree I stayed at Simon Fraser University for a brief period to focus on publishing the results of my research. In March of 2011, I accepted a position at Mira Geoscience as a GOCAD specialist/Geologic modeller.

Where are you working now and what kind of work are you doing?

I have continued with Mira Geoscience since 2011 as the Vancouver office's GOCAD expert. I work as part of an integrated interpretation team, constructing 3D geologic models for a variety of purposes and clients.

**Lindsay McClenaghan
2011 Scholarship Recipient**

Tell us about your winning project.

I completed my MSc studies with the Mineral Deposit Research Unit at UBC. My thesis is titled the *Geology and Genesis of the Newton bulk-tonnage gold-silver deposit central British Columbia*. Investigations focused on drill core logging, petrography, short wave infrared spectroscopy, X-ray diffraction, lithogeochemistry, geochronology and stable isotopic analyses. Age dating of the volcanic host rocks, later intrusive phases, and sulfide mineralization yields similar Late-Cretaceous ages. This result indicates that volcanism, subsequent intrusions and hydrothermal mineralization are essentially coeval. Additional results of my research suggest that Newton is a disseminated strata-bound intermediate-sulfidation type epithermal deposit. The Newton deposit is comparable to the Capoose and Blackwater deposits.

How did winning a Geoscience BC scholarship support you and your research?

I consider myself fortunate to have been selected for the Geoscience BC Scholarship. The extra funding allowed me to dedicate my attention to my thesis and contributed to the timely completion of the project. The Geoscience BC award also inspired me to give back to the geological community. During my time at UBC I organized several mine tours, field trips and networking events for fellow geology students through the Society of Economic Geology student chapter.

After finishing your degree, what did you go on to do and where?

In early 2013 I began working for MMG Limited as an exploration geologist based out of their Vancouver office. I initially joined the Nickel exploration team, which focused on early stage exploration field work in the USA. During field work, I developed my leadership skills and tackled the challenges of working in remote locations. The skills I acquired during my graduate research have certainly been useful on the job. The multidisciplinary approach of my thesis project was good preparation for combining and interpreting multiple types of datasets in order to generate mineral exploration targets.

Where are you working now and what kind of work are you doing?

Currently, I am working on an early stage Cu exploration project in South America. I have been out in the field collecting geochemical samples, logging RC chips and drill core and practicing my Spanish!

The Geoscience BC Team in 2014

Photo by R.Kim

Board of Directors

(as of December 2014)

John Thompson,
Chair of the Board
Principal, PetraScience
Consultants Inc.

Robin Archdekin
President and CEO, Geoscience BC

Brad Armstrong
QC, Partner, Lawson Lundell LLP

Mike Cathro
Principal, Cathro Resources Corp.

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Relations Canadian Division,
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Energy Holdings Ltd. and President,
Native Investment and Trade
Association

Stephanie Killam
District of Mackenzie
(retired Mayor)

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Susannah Pierce
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LNG Canada

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Randy Smallwood
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Bruce Madu
Vice President, Minerals & Mining

Andrea Clifford
Director, Business Development

Christa Pellett
Project Manager

Jeff Hamilton
GIS Specialist

Lynda Tierney
Office Administrator

Primary Consultants

Kevin Brown
Kevin Brown Communications

Fionnuala Devine
Merlin Geosciences Inc.

Russell Hartlaub
BCIT

Dave Heberlein
Heberlein Geoconsulting

Wayne Jackaman
Noble Exploration Services Ltd.

Dan Jepsen
C3 Alliance Corp.

Peter Kowalczyk
PK Geophysics

Martin Livingston
Living Communications Inc.

Sarah Markwick
Light the Lamp

Stuart McNish
On Message Media

Rhonda Schultz
Accountant and Corporate Secretary

Scott Simpson
Communications Consultant

Technical Advisory Committees

(as of December, 2014)

Geoscience BC has three Technical Advisory Committees (TACs), a Minerals TAC, an Oil & Gas TAC and a Geothermal TAC. Individuals on these committees represent a range of expertise in industry, academia and government. The TACs are tasked with reviewing and recommending proposals under consideration by Geoscience BC, and guiding Geoscience BC's technical priorities. The TAC's recommendations are presented to Geoscience BC's Board of Directors for final funding approval.

Minerals Technical Advisory Committee

Henry Awmack
Equity Exploration Consultants Ltd.

James Barr
Tetra Tech EBA Inc.

Tim Baker
Eldorado Gold Corp.

Lindsay Bottomer
Consultant

Peter Bradshaw
First Point Minerals Corp.

Rob Cameron
Bearing Resources Ltd.

Stephen Cook
Teck Resources Ltd.

Andrew Davies
Teck Resources Ltd.

Craig Hart
University of British Columbia
– MDRU

Jacques Houle
Consultant

Jules Lajoie
CanAlaska Uranium Ltd.

Bob Lane
Plateau Minerals Corp.

Mark Rebagliati
Hunter Dickinson Inc.

Victoria Sterritt (on leave)
Teck Resources Ltd.

Pim van Geffen
Reflex Geochemistry

Andrew Wurst
Barrick Gold Corp.

Non-Voting Members

Adrian Hickin
Ministry of Energy and Mines
– BC Geological Survey

Steve Irwin
Natural Resources Canada
– Geological Survey of Canada

Paul Jago
Ministry of Energy and Mines
– BC Geological Survey

Bruce Madu, Chair
Geoscience BC

Oil & Gas Technical Advisory Committee

Dan Allan
Canadian Society of
Unconventional Resources

Marc Bustin
University of British Columbia

Andrew Calvert
Simon Fraser University

Kelvin Colquhoun
Simon Fraser University

Bruce Hancock
Encana Corp.

Brad Hayes
Petrel Robertson Consulting Ltd.

Scott Hillier
ConocoPhillips Canada

Clint Tippet
Shell Canada Ltd.

Non-Voting Members

Allan Chapman
BC Oil & Gas Commission

Fil Ferri
BC Ministry of Natural Gas
Development

Jeff Johnson
BC Oil & Gas Commission

Carlos Salas, Chair
Geoscience BC

Geothermal Technical Advisory Committee

Catherine Hickson
Consultant

Sara Kimball
BGC Engineering Inc

Tim Sadlier-Brown
Sadlier-Brown Consulting Ltd.

Nathalie Vigouroux
Douglas College

Jeff Witter
Mira Geoscience

Non-Voting Members

Stephen Grasby
Natural Resources Canada

Warren Walsh
Ministry of Energy and Mines

Carlos Salas, Chair
Geoscience BC

Geoscience BC Society

Management's Responsibility for Ongoing Financial Reporting and the Accompanying Summary Financial Statements

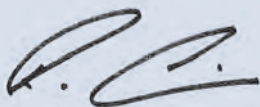
The summary financial statements and the information contained in the annual report are the responsibility of the management of Geoscience BC Society (the "Society").

The summary financial statements have been prepared in accordance with Canadian accounting standards applicable to summary financial statements for not-for-profit organizations. As part of its responsibilities, the Society maintains systems of internal accounting and administrative controls of high quality, consistent with reasonable cost. Such systems are designed to provide reasonable assurance that the financial information is relevant, reliable and accurate, and that the Society's assets are appropriately accounted for and adequately safeguarded.

The Society carries out its responsibilities with regard to these summary financial statements and the audited financial statements upon which they are based mainly through its Finance Committee (the "Committee"). The Committee reviews the summary and annual financial statements and other information contained in the annual report and recommends these to the members of the Society for approval. The Committee meets periodically with management and the external auditors. Following these meetings, the Committee may meet privately with the auditors to ensure free and open discussion of any subject the Committee or the auditors wish to pursue. The Committee also recommends the engagement or re-appointment of the external auditors, reviews the scope of the audit and approves the fees of the external auditors for audit and non-audit services.

The accompanying summary financial statements, and the audited financial statements on which they are based, have been audited by Beauchamp & Company Chartered Accountants in accordance with Canadian generally accepted auditing standards, and have been approved by the Society on the recommendation of the Finance Committee.

December 10, 2014



Director



Director

Geoscience BC Society

Report of the Independent Auditor

on the Summary Financial Statements

To the Members of Geoscience BC Society

The accompanying Summary Financial Statements, which comprise the Summary Statements of Financial Position as at March 31, 2014 and the Summary Statements of Revenues and Expenditures and Changes in Net Assets for the year then ended, and related notes, are derived from the audited Financial Statements of Geoscience BC Society as at and for the year ended March 31, 2014. We expressed an unmodified audit opinion on those Financial Statements in our report dated September 26, 2014. Those Financial Statements, and the Summary Financial Statements, do not reflect the effects of events that occurred subsequent to the date of our report on those Financial Statements.

The Summary Financial Statements do not contain all the disclosures required by Canadian accounting standards for not-for-profit organizations as included in Parts II and III of the CPA Handbook. Reading the Summary Financial Statements, therefore, is not a substitute for reading the audited Financial Statements of Geoscience BC Society.

Management's Responsibility for the Summary Financial Statements

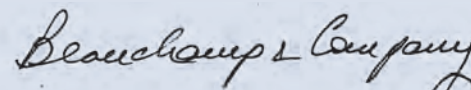
Management is responsible for the preparation of a summary of the audited Financial Statements in accordance with the Basis of Preparation disclosed in footnote 2 to the Summary Financial Statements.

Auditor's Responsibility

Our responsibility is to express an opinion on the Summary Financial Statements based on our procedures, which were conducted in accordance with Canadian Auditing Standards 810, 'Engagements to Report on Summary Financial Statements'.

Opinion

In our opinion, the Summary Financial Statements derived from the audited Financial Statements of Geoscience BC Society as at and for the year ended March 31, 2014 are a fair summary of those Financial Statements, in accordance with the criteria described in the Basis of Preparation.


CHARTERED ACCOUNTANTS

Vancouver, British Columbia

December 10, 2014

Geoscience BC Society

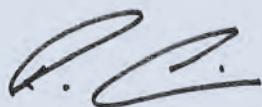
Summary Statements of Financial Position

As at March 31, 2014 and 2013

	2014	2013
ASSETS		
Current Assets		
Cash and cash equivalents	\$ 259,992	\$ 380,467
Investments	12,131,923	14,882,845
Accrued interest receivable	44,662	33,467
Amounts receivable	3,204,695	979,183
Prepaid expenses and deposits	72,662	10,154
	15,713,934	16,286,116
Capital Assets	22,005	19,871
	\$ 15,735,939	\$ 16,305,987
LIABILITIES		
Current Liabilities		
Accounts payable and accrued liabilities	\$ 325,930	\$ 302,689
NET ASSETS		
Net Assets Restricted For Approved Programs	4,144,643	6,878,829
Unrestricted Net Assets	11,265,366	9,124,469
	15,410,009	16,003,298
	\$ 15,735,939	\$ 16,305,987

Nature Of Operations And Going Concern (Note 1)
Basis Of Preparation (Note 2)

Approved By The Board:



Director



Director

See accompanying notes to the financial statements

Geoscience BC Society

Summary Statements of Revenues and Expenditures

For the years ended March 31, 2014 and 2013

	2014	2013
Revenues		
Grants – BC Ministry of Energy and Mines	\$ 3,000,000	\$ –
Grants – BC Ministry of Jobs, Tourism and Skills Training	376,935	–
Grants – other, and program reimbursements	192,278	873,456
Investments	651,040	941,414
Funding recoveries	–	7,296
Sublease rent and other	19,914	16,760
	4,240,167	1,838,926
Expenditures - Programs		
Program costs incurred	3,194,858	3,042,703
Program management	303,405	289,236
GST/HST, non-refundable portion	40,737	110,152
ArcGIS Server – implementation & maintenance	74,779	44,268
Publishing costs	27,217	26,483
	3,640,996	3,512,842
Expenditures - Administration		
Amortization of capital assets	8,077	8,019
Communications and marketing	145,104	103,234
Consulting	59,568	65,870
Gifts and promotion	16,078	16,061
Dues and memberships	6,619	3,244
Equipment lease	5,157	4,243
GST/HST, non-refundable portion	16,017	31,357
Insurance	3,130	5,507
Investment management fees	31,180	58,552
Office and sundry	18,368	17,333
Professional fees	86,730	56,807
Recruitment	35,725	9,451
Rent and utilities	132,372	128,309
Salaries and benefits	481,527	425,759
Scholarship awards	25,000	35,000
Sponsorship	18,174	6,713
Staff training and professional development	1,835	4,120
Travel, conferences and meetings	87,355	110,574
Website, internet and e-mail	9,581	12,649
Workshops	4,863	4,028
	1,192,460	1,106,830
Deficiency Of Revenues Over Expenditures	\$ (593,289)	\$ (2,780,746)

See accompanying notes to the financial statements

Geoscience BC Society

Summary Statements of Changes in Net Assets

For the years ended March 31, 2014 and 2013

	Restricted For Approved Programs	Unrestricted	Total
Balance, March 31, 2012	\$ 3,735,021	\$ 15,049,023	\$ 18,784,044
Internally-imposed restrictions	6,375,231	(6,375,231)	–
(Deficiency) Excess of revenues over expenditures	(3,231,423)	450,677	(2,780,746)
Balance, March 31, 2013	6,878,829	9,124,469	16,003,298
Internally-imposed restrictions	593,478	(593,478)	–
(Deficiency) Excess of revenues over expenditures	(3,327,664)	2,734,375	(593,289)
Balance, March 31, 2014	\$ 4,144,643	\$ 11,265,366	\$ 15,410,009

See accompanying notes to the financial statements

Geoscience BC Society

Notes to

Summary Financial Statements

March 31, 2014 and 2013

1. Nature Of Operations And Going Concern

Geoscience BC Society ("Geoscience BC" or "the Society") was incorporated under the Society Act (British Columbia) on April 26, 2005 as a not for profit organization. The Society is exempt from taxation under subsection 149(1) of the *Income Tax Act* (Canada). The purpose of the Society is to promote, fund and otherwise support applied geoscience research in British Columbia. The Society had its genesis in a \$25 million funding commitment announced by the government of British Columbia in January 2005, which unrestricted funding was subsequently received and the Society incorporated. The Society has had certain members and directors in common with, and its creation was promoted by, both the Association for Mineral Exploration British Columbia and the Mining Association of British Columbia. However, the Society operates independently of both organizations and is controlled by a separate board of up to 13 directors, which also comprises the Society's membership. Although it functions to complement the efforts of pre-existing provincial and federal agencies, Geoscience BC also operates on an arms-length basis from the governments of both British Columbia and Canada.

The Society has no source of operating revenue and its future operations are therefore dependent upon the receipt of continued unrestricted and non-repayable funding, anticipated to be from government sources. In the event such funding is not received, the Society would in due course deplete its cash reserves and be required to cease operations. At March 31, 2014 the Society expects to maintain operations for a minimum period of two years based on its existing commitments to fund programs and its related liquid asset balances on hand.

Management believes that these actions make the use of the going concern basis appropriate; however, it is not possible at this time to predict the outcome of these matters. If the going concern basis is not appropriate, adjustments could be necessary to the carrying amounts and/or classification of assets, liabilities, revenues and expenditures in these summary financial statements, and these adjustments could be material.

2. Basis of Preparation

The Summary Statement of Financial Position and Summary Statements of Revenues and Expenditures and Changes in Net Assets are derived from, and are consistent with, the audited Financial Statements of Geoscience BC Society as at and for the year ended March 31, 2014. Omitted from this presentation are certain other financial statements and footnote disclosures, all of which are required in order for a complete and formal presentation pursuant to Canadian accounting standards for not-for-profit organizations. Accordingly, readers are directed to read the Summary Financial Statements in conjunction with these annual audited Financial Statements, available for viewing at <http://www.geosciencebc.com/s/FinancialStatements.asp>.

In the opinion of management, the Summary Financial Statements included herein faithfully reflect the financial information considered material to the expected users of the information, and accordingly the summarized presentation is not misleading in these circumstances.





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