



Annual Report 2013



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

Message from the Chair

Geoscience BC's eighth year in operation was marked by exciting new programs, ongoing engagement with people across the province, and significant changes.

At the beginning of 2013, President and CEO, 'Lyn Anglin, announced her intention to step down. We were fortunate to attract Robin Archdekin to Geoscience BC as the new President and CEO and he took over on October 1. Robin's diverse background and experience in natural resources, management, government relations, First Nations, and community engagement provide a solid foundation to lead Geoscience BC's team and to maintain the organization's success.

Geoscience BC appreciates the tremendous support received from leaders of all persuasions across BC. We are particularly grateful for the commitment from Government to secure long term, predictable funding for Geoscience BC. We are working hard to assist the process of finding ways to achieve this commitment. The support that Geoscience BC has received to-date is a testament to our work. In collaboration with the Minerals and Oil & Gas industries, and our partners in

government and academia, this work attracts investments, opportunities and jobs to BC, especially for First Nations and local communities.

In 2013, the major TREK minerals program began in central BC and follow-up activities continued in northern Vancouver Island, northwest BC and the Kootenays. In the northeast, programs related to water resources and induced seismicity advanced. These programs underpin the sustainable development of BC's natural gas industry and therefore the goal of creating a major LNG export industry for BC.

In addition to the science, Geoscience BC maintained its reputation for innovative and effective approaches built on the efforts of over 100 volunteers from industry, academia and communities who identify, assess and prioritizing the most important areas for our programs. Geoscience BC strives to produce the highest quality of geoscience information to attract investment and support decision-making. We believe that our role as an honest broker increases our ability to foster confidence in the development of natural resources.

As Chair of the Board, I wish to thank all involved in Geoscience BC who contributed their time and guidance in 2013. On behalf of all of us, I would like to express our collective gratitude to 'Lyn Anglin, who led Geoscience BC from 2006. Her dedicated service created a well-respected and effective organization for the delivery of public geoscience. In late 2013, Women in Mining (UK) placed 'Lyn in the top 100 inspirational women in mining globally. To add to this accolade, she will be recognized by AME BC at the Mineral Exploration Roundup conference in 2014 with a Special Tribute for her contributions to geoscience and mineral exploration development. Both awards are highly deserved and reflect well on the organization that she and her team have built.

As we move into 2014, we look forward to working with Robin, the Geoscience BC team, and our many supporters as we advance to the next level.

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



*Robin Archdekin
President & CEO
Geoscience BC*

Message from the President & CEO

I am pleased to join Geoscience BC in the role of President & CEO. I recognize the commitment and contribution of the multitude of dedicated volunteers who have worked hard to build this organization's reputation and I look forward to furthering our success.

Our Chairman John Thompson neatly summed up Geoscience BC's role in the British Columbia economy and creating jobs when he described us as an "honest broker."

Geoscience BC is recognized for its unique role of delivering credible science quickly and efficiently, which is fundamental to the success of two of the province's significant resource sectors, Minerals and Oil & Gas.

First Nations, communities, industry and government know they can trust the work that Geoscience BC and its partners deliver to help ensure responsible development of BC's underground resources.

More than one million hectares of mineral claims have been staked as a result of the extensive science that Geoscience BC has

been delivering like clockwork into the public domain over the past eight years. Annual investment in BC mineral exploration is twenty times larger than it was a decade ago, and BC's mining industry is poised for expansion, creating family-supporting jobs as well as revenue for the province. Our work also encourages investors to continue to put their money into BC projects, and this is the goal of our newest regional minerals project, called TREK, which stands for Targeting Resources through Exploration and Knowledge.

Now, as BC prepares to leap into a spectacular new era of resource development led by the province's massive natural gas reserves, our organization is making preparations to play a pivotal role in sustainable development of this valuable resource.

We're already providing credible information about seismicity related to hydraulic fracturing ("fracking") in northeast BC, and we're collecting baseline water quality and quantity information in the Horn River Basin similar to what we

accomplished as part of our Montney Water Project. Water quality is a major public policy concern, not just in BC, but worldwide, and Geoscience BC can ensure that everyone interested in the issue has accurate information to effectively balance the needs of industrial water users with local water users.

In one of our newest projects, we're collaborating with the University of BC and natural gas explorers to better define underground gas reserves in order to develop them with the least economic risk possible.

I want to thank all those who continue to support Geoscience BC's highly valued work and I look forward to launching exciting new ventures with you in the future.

A handwritten signature in black ink, appearing to read 'R. Archdekin', written in a cursive style.

Robin Archdekin
President & CEO
Geoscience BC



Photo by W. Jackaman.

Geoscience BC in 2013

This year has brought with it many exciting changes for Geoscience BC. We hired new staff, launched new projects, released new reports and datasets, coordinated a networking event and participated in numerous conferences and meetings. Here are just a few of our highlights from 2013:

New Staff

On October 1, 2013, Robin Archdekin started as Geoscience BC's new President and Chief Executive Officer. Robin brings a diverse background and experience in natural resources, management, government relations, First Nations, and community engagement. From his first day, Robin made it a priority to work with government and their commitment to secure long term, predictable funding for Geoscience BC.

Andrea Clifford began with Geoscience BC on May 1, as Project Coordinator and Communications Manager. Andrea assumed Christa Sluggett's responsibilities under a 15 month contract, which include project management as well as communicating and delivering GBC's results to clients and stakeholders. Andrea's experience includes working as a project and senior geologist for different mineral exploration companies, and managing exploration programs from permitting and budgeting through to drilling and reporting.

New Major Projects

In September 2012, a research consortium was established to investigate the effects of hydraulic fracturing (or "fracking") on seismic activity in northeast BC. In 2013, six new seismograph stations were installed in northeast BC and were fully integrated into the Canadian National Seismic Network by mid-August. The new stations now provide real-time data to the Geological Survey of Canada's earthquake location operation. For more information, go to page 8.

Geoscience BC launched a major new minerals project in 2013, called TREK (Targeting Resources for Exploration and Knowledge). The TREK project area covers the northern Interior Plateau Region of central BC. This area is considered underexplored because of thick overburden, and the science that will be done as part of TREK will help to "uncover" what is underneath and lead explorers to new mineral discoveries. 2013 project activities included an airborne geophysical survey, and ground geochemical, geothermal and biogeochemical surveys. For more information, go to page 10.

In support of natural gas development, Geoscience BC funded a deep aquifer study in the Liard Basin in northeast BC that began in January 2013. The results of this work will help to identify zones of non-potable water suitable for industry use, as well as zones for industrial water disposal. In other natural gas development areas in northeast BC, industry has put this type of GBC research to good use to reduce surface water usage. Go to page 12 for more information about this project.

Geoscience BC also initiated a new oil and gas study in the summer of 2013 to gather scientific information to better understand the shale rocks that host BC's natural gas reserves in the northeast. The study results will help to direct exploration for natural gas as well as support development of this rich resource. Go to page 18 for more information about this project.

New Data and Reports

This past year also saw the completion of many Geoscience BC programs. Twenty-one separate reports were released through Geoscience BC in 2013, including the Summary of Activities 2013 volume, a compilation of fourteen papers from various projects. For more information on 2013 data and report releases, go to page 22.

Photo by W. Jackaman.

DID YOU KNOW?

In 2012, mining was valued at over \$8.3 billion to BC's economy (nearly 18% of the Canadian total) and exploration was recorded at \$680 million, a 47% increase over the previous year and the highest ever.



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 including:

- BC Chamber of Commerce AGM & Conference
- BC Natural Resource Forum
- Canadian Aboriginal Minerals Association Conference
- Canada Mining Innovation Council Second Annual Signature Event
- Canadian Society of Petroleum Geologists, Geoconvention 2013
- Canadian Society of Unconventional Resources Annual Technical Conference
- CanGEA 2013 Geothermal Conference
- Economic Development Association of BC: 2013 BC Economic Summit
- Kamloops Exploration Group Conference
- Fuelling the Future: Global Opportunities for LNG in BC
- Mineral Exploration Roundup
- Minerals North
- Minerals South
- Prospectors and Developers Association of Canada Conference
- Resources North AGM & Conference
- Rock Talk
- Select Standing Committee on Finance and Government Services
- Society of Economic Geologists: Whistler 2013: Geoscience for Discovery
- Tight Oil and Shale Gas Water Management Conference
- Unconventional Gas Technical Forum
- Union of BC Municipalities Convention
- Various Local Government Association Meetings (Vancouver Island and Coastal Communities, Southern Interior, Lower Mainland, North Central)



Minerals North Conference: Mayor Stephanie Killam and Deputy Mayor Pat Crook; District of Mackenzie at the Geoscience BC booth

GBC-Sponsored Workshops and Events

April 8, 2013

Principles and Strategies in Exploration Geochemistry

1-day workshop at the Kamloops Exploration Group Conference, Kamloops
Led by Dave Heberlein

May 28, 2013

Northern Vancouver Island Exploration Geoscience Project

Data Release and Networking Event, Campbell River

This event celebrated the release of new regional geochemical data for samples collected on Northern Vancouver Island in summer 2012. The results will help identify areas of mineral potential and assist mineral exploration targeting for copper, gold, silver and numerous other commodities. Representatives of project supporters, including Nanwakolas Council, Rivercorp, Vancouver Island Exploration Group and the Ministry of Jobs, Tourism and Skills Training were in attendance.



Reviewing the geochemistry maps at the Northern Vancouver Island Exploration Geoscience Project data release event.

Photo courtesy of D. Jepsen.

DID YOU KNOW?

Since the release of Geoscience BC's Northern Vancouver Island airborne geophysical data in January 2013, nearly 24,000 ha have been staked on the North Island.

The Geoscience BC Team in 2013

Board of Directors

(as of October 2013)

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

Robin Archdekin
President & CEO, Geoscience BC

Mike Cathro
Principal, Cathro Resources Corp.

David Caulfield
Co-Chair
Interim President & CEO,
Kiska Metals Corporation

Richard Dunn
VP, Regulatory & Government
Relations Canadian Division, Encana
Corporation

Geoff Freer
CEO, Firth Group

James Gray
Partner, De Visser Gray LLP
Chartered Accountants

Calvin Helin
Chairman & President, Eagle Spirit
Energy Holdings, Ltd. and President,
Native Investment and Trade
Association

Stephanie Killam
Mayor, District of Mackenzie

Brian Kynoch
President, Imperial Metals
Corporation

David Molinski
Policy & External Affairs Lead,
Kitimat LNG, Chevron Canada Ltd.

David Taylor
VP, Business Development &
Exploration,
Parex Resources Inc.

Staff

Robin Archdekin
President & CEO

Carlos Salas
VP, Oil & Gas

Kirstie Simpson (on leave)
VP, Minerals Research

Andrea Clifford
Project Coordinator &
Communications Manager

Christa Sluggett (on leave)
Project Coordinator &
Communications Manager

Fion Ma
GIS Specialist

Lynda Tierny
Office Administrator

Primary Consultants

Andy Calvert
Simon Fraser University

Fionnuala Devine
Merlin Geosciences Inc.

Russell Hartlaub
BCIT

Brad Hayes
Petrel Robertson Consulting Ltd.

Dave Heberlein
Heberlein Geoconsulting

Wayne Jackaman
Noble Exploration Services Ltd.

Dan Jepsen
C3 Alliance Corp.

Ben Kerr
Foundry Spatial Ltd.

Peter Kowalczyk
PK Geophysics

Rhonda Schultz
Accountant &
Corporate Secretary

Photo by D. Sacco.



Technical Advisory Committees

(as of December, 2013)

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.

Tim Baker
Eldorado Gold Corp.

Lindsay Bottomer
Entrée Gold Inc.

Peter Bradshaw
First Point Minerals Corp.

Rob Cameron
Bearing Resources Ltd.

Andrea Clifford, Chair
Geoscience BC

Stephen Cook
Teck Resources Ltd.

Andrew Davies
Teck Resources Ltd.

Craig Hart
University of British Columbia –
MDRU

Adrian Hickin
BC Ministry of Energy, Mines
and Natural Gas - BCGS

Jacques Houle
Consultant

Ward Kilby
Cal Data Ltd.

Jeff Kyba
BC Ministry of Energy, Mines
and Natural Gas

Jules Lajoie
CanAlaska Uranium Ltd.

Bob Lane
Plateau Minerals Corp.

Carmel Lowe
Natural Resources Canada

Mark Rebagliati
Hunter Dickinson Inc.

Kirstie Simpson, Chair (on leave)
Geoscience BC

Victoria Sterritt
Teck Resources Ltd.

Pim van Geffen
ioGlobal

Andrew Wurst
Gold Fields Inc.

Oil & Gas Technical Advisory Committee

Dan Allan
Canadian Society of
Unconventional Resources

Marc Bustin
University of British Columbia

Andrew Calvert
Simon Fraser University

Allan Chapman
BC Oil & Gas Commission

Satinder Chopra
ARCIS Resources Corp.

Fil Ferri
BC Ministry of Natural Gas
Development

Bruce Hancock
Encana Corp.

Brad Hayes
Petrel Robertson Consulting Ltd.

Scott Hillier
ConocoPhillips Canada

Jeff Johnson
BC Oil & Gas Commission

Carlos Salas, Chair
Geoscience BC

Clint Tippett
Shell Canada Ltd.

Geothermal Technical Advisory Committee

Oscar Cerritos
Alterra Power Corp.

Catherine Hickson
Alterra Power Corp.

Sara Kimball
BGC Engineering Inc.

Carlos Salas, Chair
Geoscience BC

Nathalie Vigouroux
Alterra Power Corp.

Jeff Witter
Mira Geoscience

DID YOU KNOW?

In 2012, more than 30,000 people were employed in mining, mineral exploration and related sectors. This is significant growth since 2001 when only 14,700 people were employed in mining.



The data collected by the network is being used by the BCOGC to develop the needed protocols for responsible fracking and fluid disposal operations.

Northeast BC Regional Seismographic Network

The Induced Seismicity Monitoring Project

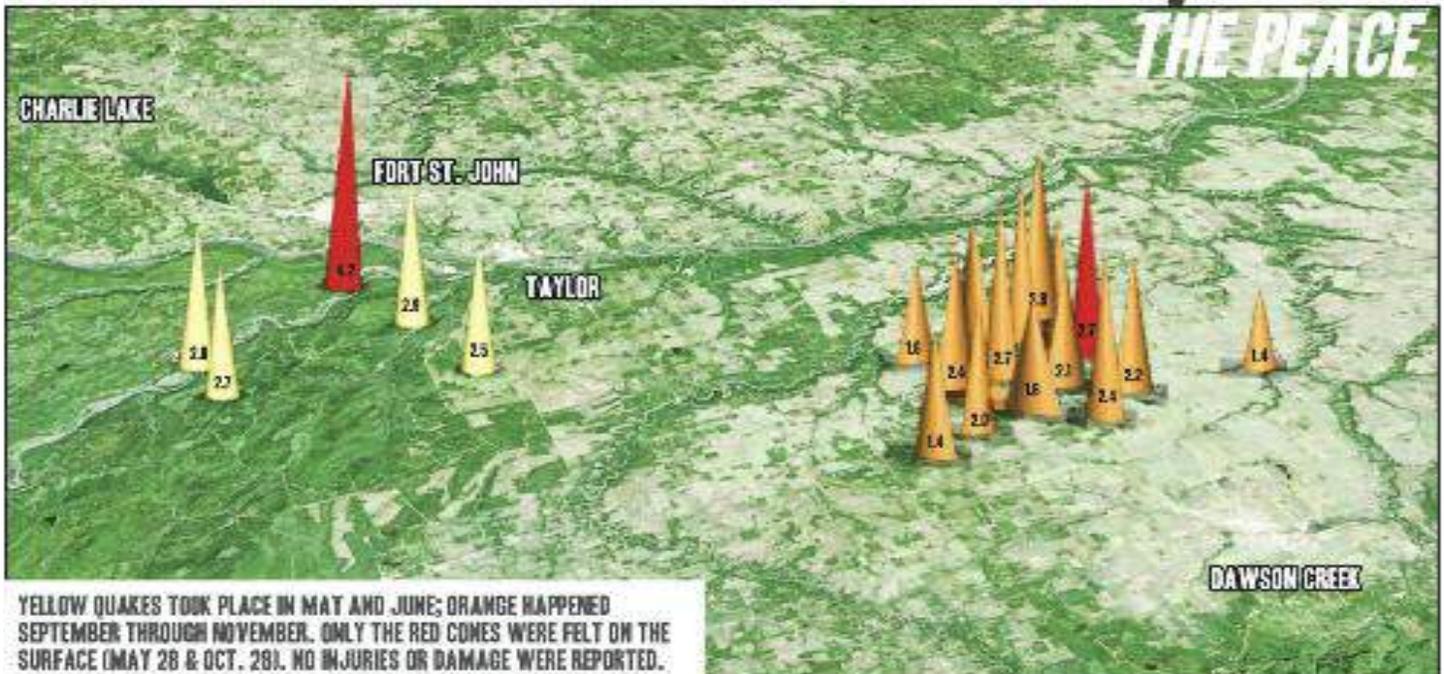
Geoscientists are now developing natural gas reserves that were previously inaccessible, using their knowledge of rock mechanics. The gas, or hydrocarbons, exists in very dense and compact rocks, and hydraulic fracturing completions, also known as fracking completions, use high volumes of water to create spaces in the rocks to allow the gas to flow more easily and increase a well's production.

In August of 2012, the BC Oil & Gas Commission (BCOGC) released a Report titled "Investigation of Observed Seismicity in the Horn River Basin." The report was commissioned in response to public and regulatory concerns with respect to minor earthquakes near areas of oil & gas development in the Horn River Basin. The report concluded that the low-level seismic events (minor earthquakes) were caused by fluid injection during hydraulic fracturing, or fracking, near pre-existing and naturally occurring faults in the earth's surface. The report noted that the low-level events caused no injury or property damage and

posed no risk to public safety or the environment.

The report made several recommendations, including upgrading and improving BC's seismograph grid and monitoring procedures, as well as a study to better understand the relationship between man-made earthquakes (also known as "induced seismicity") and hydraulic fracturing associated with natural gas development operations. In September of 2012, a consortium headed by Geoscience BC, along with the Canadian Association of Petroleum Producers (CAPP), BCOGC and

Image courtesy of Matt Lamers.





Nanometrics personnel with a newly installed seismograph station.
Photo courtesy of Nanometrics Inc.

Natural Resources Canada (NRCan), began a project to improve the accuracy of the Canadian National Seismographic Network (CNSN). To this end, six new state-of-the-art stations were installed to complement two pre-existing CNSN stations in northeastern BC.

The consortium's mandate is to collect, interpret and make public, the data collected from the installation of the six new stations added to the CNSN network (see map for locations). *The Induced Seismicity Monitoring Project* has \$1 million in funding from 50/50 equity partners Geoscience BC and CAPP (through Science and Community Environmental Knowledge, or SCEK, funding) with in-kind technical support from BCOGC and NRCan. The project will monitor induced seismic activity for a total of five years (until June 2017) with a review scheduled for June 2014 to assess the project's performance.

Installation of the new stations was done by Nanometrics Inc. in March of 2013, and they were fully integrated into the CNSN by August of 2013. The network provides real-time data to the Geological Survey of Canada's earthquake location operation. The results from analysis are posted on the Earthquakes Canada website: <http://www.earthquakescanada.nrcan.gc.ca/index-eng.php>.

Since the stations came online in March 2013, over 40 low-level seismic events have been recorded. The largest event was recorded on May 27th, 2013, and was felt

on surface in the community of Fort St. John. Of the over 40 recorded events, the development area north of Hudson's Hope has experienced 23 low-magnitude earthquakes, or seismic events that measured less than 2.5 Richter. The "Richter Scale" assigns a number to quantify the power of an earthquake, and events less than 2.5 Richter are usually not felt (they may be felt nearby, if at all). In the area between Fort St. John and Dawson Creek, the network has recorded six low-magnitude earthquakes. These low-level events are potentially due to completion activities as well as disposal of fracking fluids that are used for completions.

The first five months of operation have shown that the enhanced seismographic network has the ability to pinpoint the location of earthquakes within 2 to 15 kilometres (i.e. the "epicentre" or location on the earth's surface directly above where the earthquake originates underground). This epicentre resolution has been steadily improving since the enhanced network was established. A plan is underway to improve magnitude and epicentre accuracy.

Two recommendations have been made to continuously improve the seismic network: 1) hire a dedicated seismologist to reside at NRCan's Pacific Geoscience Centre in Sidney, BC and report directly to the research consortium; and, 2) purchase a portable dense array to further improve the information collected by the existing enhanced network.



Installation of a new seismograph station.
Photo courtesy of Nanometrics Inc.

The data collected by the enhanced seismographic network is being used by the BCOGC to develop protocols for responsible fracking and fluid disposal operations. It is expected that the information gained throughout this project will stimulate future induced seismicity studies into fracking and fluid disposal.

For more information about this project, please go to www.geosciencebc.com/s/nebc.asp

Installation of a new seismograph station.
Photo courtesy of Nanometrics Inc.





Focused on BC's northern Interior Plateau region, the TREK project covers more than 24,000 square kilometres south from Fraser Lake and Vanderhoof to Anahim Lake, and west from Quesnel.

The TREK Project

Targeting Resources through Exploration and Knowledge

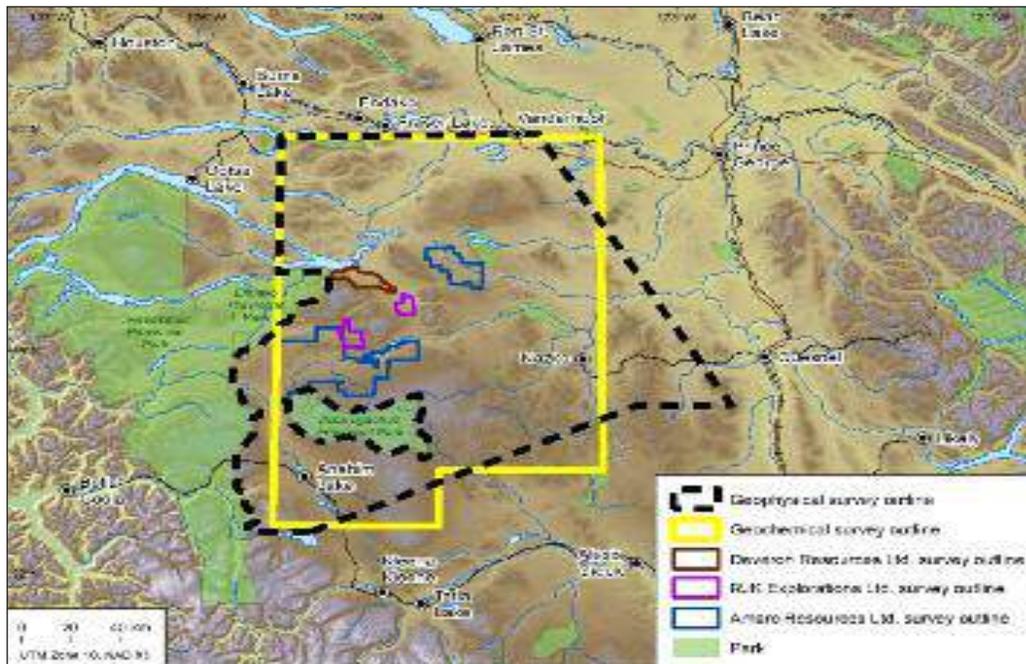
Geoscience BC's newest multiyear regional minerals project is called TREK, which stands for Targeting Resources through Exploration and Knowledge.

Though the area has not seen a great deal of mineral exploration, it is host to the active Blackwater gold district and is believed to have high potential for mineral resources.

First-year activities for the \$4.1 million TREK project included an airborne geophysical survey, a regional geochemical survey and local sampling programs (biogeochemical and geothermal). Aeroquest Airborne Ltd. started flying the airborne magnetic survey in August with two Cessna Grand Caravan aircraft—one stationed in Vanderhoof and the other in Quesnel. In October, the plane stationed in Vanderhoof repositioned to Anahim Lake to finish the southern portion of the survey, which was completed in November.

In total, Aeroquest collected nearly 104,000 flight line-kilometres of data over an area of 24,000 square kilometres. Geoscience BC also purchased high-quality airborne magnetic data from three exploration companies with properties in the TREK project area: Amarc Resources Ltd., RJK Explorations Ltd. and Deveron Resources Ltd. The data purchased from these companies will be merged with the new Aeroquest survey and the complete dataset will be released at AME BC's Mineral Exploration Roundup in January 2014.

TREK Project area.



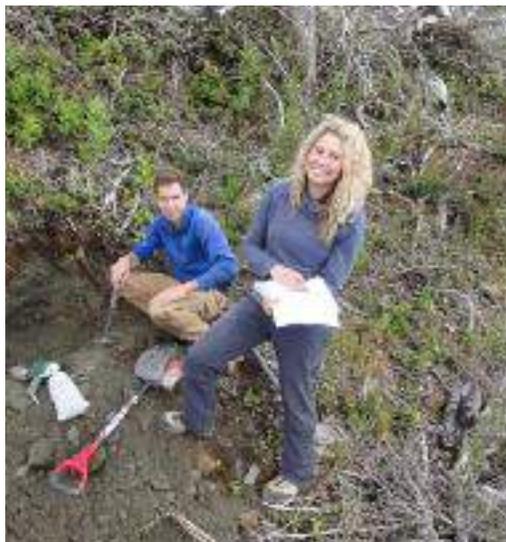
Cessna Grand Caravan Aircraft used to fly the TREK airborne survey.

Photo courtesy of Aeroquest Airborne Ltd.





Lake sediment sampling. Photo by W. Jackaman.



Till sampling. Photo by W. Jackaman.



Looking at the till profile. Photo by W. Jackaman.

The TREK geochemical survey is expected to span two to three years, and is managed by Noble Exploration Services Ltd. in partnership with the BC Geological Survey. During the 2013 field season, 684 till samples plus 280 lake sediment and lakewater samples were collected. The program focused on areas that had not been previously sampled. In addition, approximately 1,800 till samples were recovered from archive storage for reanalysis to the same standard as the new surveys.

In response to local First Nations' interest in potential geothermal resources, Geoscience

BC included a geothermal component within the TREK project. Geothermal sampling was concentrated near the Nazko volcanic cone west of Quesnel, where carbon-dioxide gas seepages were first documented in 2012. A biogeochemical survey was also done in the TREK area, which involved the collection of organic (plant) material to analyze for metals.

The TREK geology and integration program will be guided by results from the first-year TREK activities, and will be conducted by the Mineral Deposit Research Unit at the University of British Columbia. The geology component will improve the geological

understanding of the Interior Plateau region and the integration component will combine the new TREK information with currently available geological information and add value to existing data. Products will include new geological maps, digital databases and GIS layers.

Results from the TREK project are expected to encourage and assist with mineral exploration efforts in the region by providing a greater understanding of the region's geology. For more information on the TREK project, go to www.geosciencebc.com/s/TREK.asp.

The sampling crew gets training. Photo by W. Jackaman.



DID YOU KNOW?

Mining employs more First Nations than any other industry in BC.



Liard Basin Deep Aquifer Study

In early 2013, Petrel Robertson Consulting Ltd. (PRCL) started a six-month Geoscience BC project called, "Subsurface Aquifer Study to Support Unconventional Oil & Gas Development, Liard Basin, Northeastern BC". This project expanded on earlier work that PRCL did for Geoscience BC in the Horn River Basin and Montney Play development areas of northeast BC in response to major shale gas discoveries made in the Liard Basin in 2012.

Located in northeastern BC and extending into the Northwest Territories and Yukon, the Liard Basin is an exciting prospect for unconventional gas and oil development. It is a part of the Western Canada Sedimentary Basin and is flanked by geological structures that separate it from its next-door neighbour, the Horn River Basin. What makes the oil & gas reserves in the Liard Basin "unconventional" as opposed to conventional, is the requirement for special methods such as fracking to extract the oil and gas trapped within the tight shale host rocks.

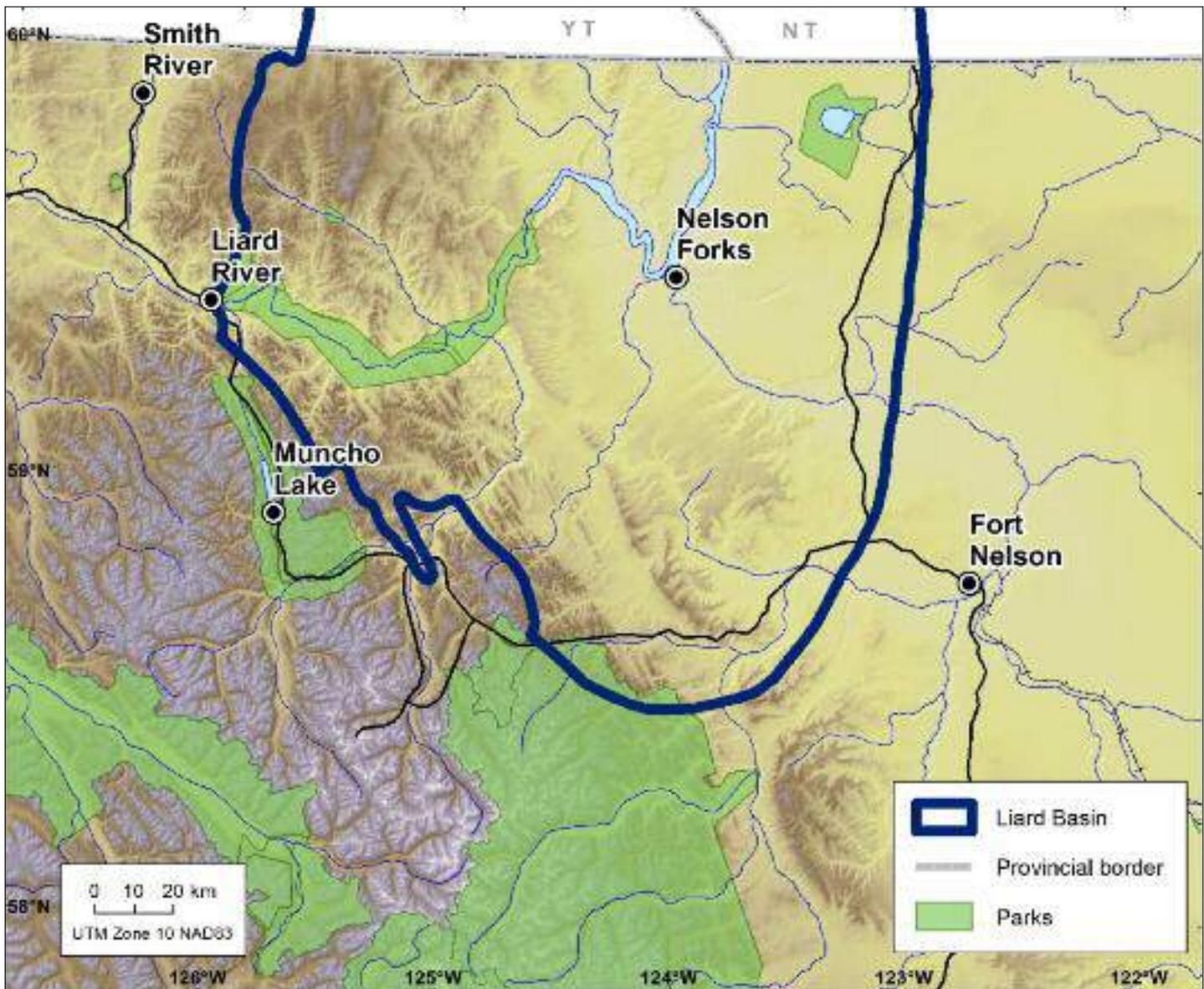
Industry has been very successful in developing unconventional reservoirs in other areas of northeastern BC by using horizontal wells stimulated by hydraulic fracturing, or frac jobs. Depending on the design, each frac requires large amounts of water. The water gets mixed with sand and other chemicals for injection into deep shale gas reservoirs at high pressures to create small cracks in the rock, which then allows gas to flow. Stimulated reservoirs that allow gas to flow eventually flow back a lot of the frac fluid as well, which becomes

Fine-grained, massive to planar-bedded Mattson sandstones with platy green-grey shale bed. Hess Aquitaine et al. Windflower d-67-A/94-O-11.

DID YOU KNOW?

The BC Government is overhauling the Water Act this spring, which is over 100 years old. In its place will be the Water Sustainability Act which will not only modernize the regulations but also regulate and protect groundwater.





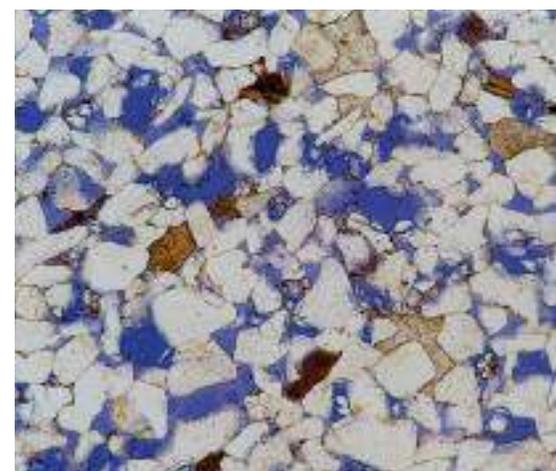
contaminated by naturally occurring materials from the reservoir and chemicals used in the fracking process. Natural gas developers require water sources that can deliver large water volumes at fast rates, and water disposal zones for the used frac fluid that are capable of accepting equal volumes and rates.

Aquifers—underground layers of water-bearing permeable rock—play a key role in both providing frac waters and disposing of them. While shallow aquifers are only suitable locally for source water, only deep aquifers are suitable for water disposal, to ensure the frac fluids do not migrate to drinking water aquifers. PRCL completed a comprehensive study of deep subsurface aquifers in the Liard Basin for Geoscience

BC, in support of disciplined sourcing and disposal of frac waters for unconventional hydrocarbon development.

Four aquifer intervals were investigated in detail and showed that reservoir quality, based on the limited data presently available in the Liard Basin, ranges from very poor to excellent. Further research into the use of aquifers in unconventional oil and gas development projects will greatly reduce the risks associated with fracking, thereby making BC a safer and more economically sound province.

Links to project deliverables, including the full PRCL report and a summary report are available on our website at www.geosciencebc.com/s/2012-005.asp



Moderately-sorted quartzarenite with minor dolomite cement. Ammin Aquitaine et al Windflower d-6-H/94-O-11, 1581 ft.



The Horn River Basin is one of the richest gas basins in North America.

Continuing Water Studies in the Horn River Basin

Kiwigana Climate Station.

Photo courtesy of Peace Country Technical Services Ltd.



Water availability plays a pivotal role in the development of the Horn River Basin; however, the available water and climate information in the basin to-date has been limited. 2014 marks the final year of a three-year surface water study that is part of the larger Horn River Basin Water Project, which began five years ago to collect this vital water information.

Geoscience BC and the Horn River Basin Producers Group (HRBPG), the Fort Nelson First Nation and the Fort Liard First Nation (Acho Dene Koe) all have a strong commitment to effective water management to support responsible natural gas development in the Horn River Basin. In order to meet this commitment, the Horn River Basin Water Project was initiated in late 2008 to study deep, shallow and surface water in the region. Deep and shallow water study components of the Project were completed in 2012, and work on the surface water aspect, part of Phase II of the Horn River Basin Water Project, is ongoing.

The three-year regional surface water study is focused on collecting relevant data to better understand water quantity in the region, determine water quality, evaluate environmental health and build First Nation capacity in water management. The Fort Nelson and Acho Dene Koe First Nations partners are providing people who are being trained as water monitors.

Bison – an example of local wildlife that makes fencing around monitoring stations a necessity.

Photo courtesy of Peace Country Technical Services Ltd.



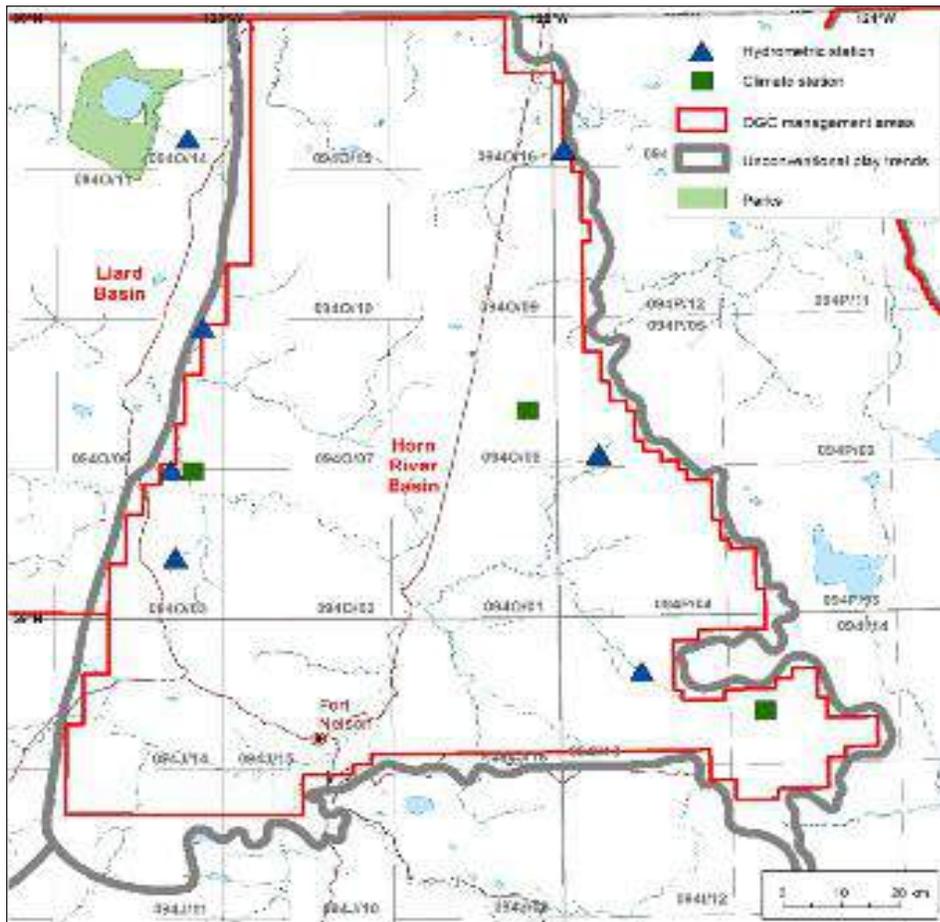


D'Easum Creek water monitoring equipment.
Photo courtesy of Peace Country Technical Services Ltd.

The Horn River Basin is one of the richest gas basins in North America. Natural gas development in the basin is water intensive with an average well using upward of 80,000 m³ of water. In 2011, 133 wells used 7 million m³ of water from the basin for oil & gas activities. The HRBPG recognized the need for a water management plan that would enable sustainable and responsible development of natural gas in this area.

The primary objectives of the surface water component of the Horn River Basin Water Study are to gain a better understanding of water flow, quality and conditions in order to provide effective water monitoring, plan the use of water in natural gas development and train First Nations representatives in all aspects of water monitoring. This is being achieved by installation and maintenance of an environmental monitoring network, which will provide important information to help answer the water balance question.

In addition to the Horn River Basin Water Project, an additional research program is being undertaken by the Cold Regions Research Centre at Wilfrid Laurier University. This program will study surface and shallow groundwater interaction in



Location of climate and hydrometric monitoring stations within the Horn River Basin.

areas of muskeg and discontinuous permafrost to improve understanding of the water balance in these complex areas. Research into this subject will provide essential information for building infrastructure and predicting the effects of development activities on water in these areas.

Seven water monitoring sites were installed as part of the surface water component of the Horn River Basin Water study—four of these capture real-time data. This data can be accessed and downloaded through Geoscience BC's website at www.geosciencebc.com/s/HornRiverBasin.asp.



Sierra field crew.
Photo courtesy of Peace Country Technical Services Ltd.



This study focused on the interaction of surface water and shallow groundwater and its findings are leading to a better understanding of the water availability and quality in the region.

Montney Water Project



Photo by A. Hickin.

The Kiskatinaw River Watershed (KRW) is an important water source for the city of Dawson Creek and natural gas development. In August 2013, the last component of the Montney Water Project, a partnership project with the University of Northern British Columbia called “Examining Present and Future Water Resources for the Kiskatinaw River Watershed, British Columbia”, was completed. Two Ph.D. research papers and one M.Sc. research paper as well as raw data from the research were delivered.

The Geoscience BC managed Montney Water Project started in 2010 and is an outstanding example of a collaborative study involving industry, government, universities and communities creating innovative solutions and producing scientific information necessary for proper water stewardship, thereby allowing for responsible development of unconventional gas in the Montney Gas Fairway.

Photo by F. Hirschfield.



DID YOU KNOW?

The Montney Unconventional Gas Fairway is one of BC's richest natural resource assets, with over 450 trillion cubic feet of in-place gas reserves.



Photo by A. Hickin.

Project Achievements:

- Results were instrumental in the development of **NEWT**, short for “Northeast Water Tool”, a GIS-based decision-support tool that estimates site-specific water runoff and provides guidance for all short-term water approvals issued by the Ministry of Forests, Lands and Natural Resource Operations and the BC Oil & Gas Commission (BCOGC). Development of NEWT began in summer of 2011 under the project name “New Hydrologic Modelling to Assist with Water Allocation Decisions”. In collaboration with the BCOGC, Foundry Spatial and the Ministry of Forests, Lands and Natural Resource Operations, Geoscience BC funded this online water allocation tool to support informed decisions on water management across northeast BC and aid with water use applications and licenses. NEWT also acts as the foundation to communicate and discuss water allocation decisions with the public, First Nations, and other stakeholders in northeast BC. The BCOGC’s webpage for this tool is www.bco.gc.ca/public-zone/northeast-water-tool-newt.



In July 2013, Geoscience BC approved additional funding to develop another web-map based interface tool and database to complement existing BCOGC websites and tools including NEWT. This new tool will store, manage and interact with hydrometric, weather, groundwater and other measurements and/or monitoring data related to water resource management in northeast BC. Data will include surface and groundwater quality and quantity measurements from Geoscience BC’s Horn River Basin Water Project. For more information about NEWT and this project, go to www.geosciencebc.com/s/2011-011.asp.

- Addition of eight hydrometric stations and one climate station in the Kiskatinaw watershed
- Temporal land use studies over the Kiskatinaw watershed
- 35 previously defined shallow groundwater aquifers were revised. 20 new shallow groundwater aquifers were identified
- 780 new water wells added to the Ministry of Environment’s WELLS database
- Characterization of deep saline aquifers within the Montney Gas Play fairway
- Encana used the deep saline aquifer study to confirm the location of the Farmington Water Resource Hub.

See www.geosciencebc.com/s/Montney.asp for more information on the Montney Water Project.

DID YOU KNOW?

In September 2013, the Northeast Water Tool won the Premier’s Award for Innovation. Geoscience BC is proud to share this award with partners BCOGC and Ministry of Forests, Lands and Natural Resource Operations.

Proposed Projects in the Montney Shale Gas Play

Geoscience BC has been engaging with industry to develop a deep aquifer disposal study. Natural gas development uses large quantities of water to fracture (frac) and extract the resource, and must deal with the post-frac fluids and other associated water from gas production.

A two-part study is being proposed to investigate appropriate aquifers for fluid disposal and measure potential induced seismicity as a result of water disposal. The second part would possibly run a pilot study within the Montney Gas Fairway (in the region of Dawson Creek-Fort St. John) to perform further tests using a test well.



BC's unconventional gas and hydrocarbon industry is rapidly growing, with the natural gas resource estimated at over 2,900 trillion cubic feet.

Mapping and Characterization of Natural Gas Liquid (NGL) Fairways in Northeast BC

In addition to BC's massive natural gas reserves is an unknown quantity of liquid hydrocarbons called "natural gas liquids" or NGLs. Increasing our understanding of shales as both the source rocks and the reservoirs for these hydrocarbons will significantly contribute to continued successful economic development.

Shales are highly compact and fine-grained rocks that host BC's natural gas reserves. The non-porous and non-permeable nature of these host rocks classifies these reservoirs as "unconventional." This is because special methods, such as fracking, are required to extract the hydrocarbons from the shales, rather than conventional (oil well) extraction methods.

In 2013, Geoscience BC began a three-year project with the University of British Columbia to study the nature of the oil & gas reserves in northeast BC. This work will map and describe the shales and other fine-grained rocks that host the province's valuable hydrocarbons to help guide development.

The project will examine if northeast BC's shales and other source rocks contain NGLs such as propane, butane and ethane. These NGLs command a much higher price on the markets compared to natural gas alone, which makes the liquids-rich projects economically feasible; this allows the natural gas development industry to continue operating when North American gas prices are low.

Research done as part of this project is aimed at better prediction of: 1) liquid (NGL) and gas relationships and their distribution in shale reservoirs; and 2) the way and the rate that these hydrocarbons flow within shale reservoirs. This information will in turn direct explorers to the most prospective areas for natural gas and NGL development.



The SEEK project was a new approach for Geoscience BC, created to capitalize on the region's rich exploration history by collecting vital mineral information from local prospectors and exploration geologists and bringing it into the public domain.



SEEK Project

In November 2011, Geoscience BC partnered with the East Kootenay Chamber of Mines to launch the SEEK project (Stimulating Exploration in the East Kootenays).

In 2012, the SEEK project extended funding to help create the new East Kootenay Chamber of Mines (EKCM) Core Storage Library. This library was generated to collect, restore and catalogue a selection of rocks from the Sullivan lead-zinc mine and surrounding areas. Individuals, companies and research institutions doing mineral exploration in the area can view mineralized and non-mineralized rocks of the Belt-Purcell Basin at the Core Storage

Core from the Sullivan deposit before being moved to the EKCM core storage facility.

Photo courtesy of EKCM.



Library. A second SEEK project, which compiled ground-station gravity data from the area, was also completed in 2012 and produced the East Kootenay Gravity Database.

Two new SEEK projects were funded in 2013. One project acquired new ground-station gravity data in the East Kootenay region to produce an updated version of 2012's East Kootenay Gravity Database (EKGDDB). The project was complete in early November. The second project is using new data to help unravel the movement history of faults in the Hughes Range and will use a newly established paleomagnetism lab at Okanagan College for analyses. Understanding fault

EKCM core storage facility.

Photo by A. Clifford.



movement could potentially lead to new regional exploration strategies to find the area's next lead-zinc deposit. Results from this project are expected in mid-2014.

Both projects that were undertaken in 2013 were presented at the November Minerals South Conference in Cranbrook. Under the SEEK project umbrella, Geoscience BC will consider funding future project proposals that aim to promote investment in mineral exploration by acquisition, compilation and/or interpretation of geoscience information in the East Kootenays. For more information about the SEEK project, go to www.geosciencebc.com/s/SEEK.asp

DID YOU KNOW?

One of the world's largest lead-zinc deposits—the former Sullivan mine—represented \$43 billion of production and sustained the economy of Kimberley and the East Kootenay region for almost 100 years.



Photo by W. Jackaman

Ongoing Projects in 2013

Geoscience BC has several active projects, many of which are partnerships identified through our request for proposals process. Consultants and university researchers typically lead these projects.

The following is a selection of some of the ongoing projects in 2013.

For a complete listing of all Geoscience BC-supported projects, go to www.geosciencebc.com/s/Projects.asp.

DID YOU KNOW?

Every British Columbian uses almost 23,000 kilograms (about 50,000 pounds) of mined products each year.

Oil & Gas Projects

Nature, Distribution, Thickness and Regional Structural Framework of Eocene Volcanic Centres in the Nechako Basin, South-central BC – E. Bordet and C.J.R. Hart, MDRU

This ongoing Ph.D. project is examining the Eocene geology of the Nechako Basin, with results expected to be relevant to both the oil & gas exploration industry (as the Eocene rocks cover older rocks with hydrocarbon potential) and the mineral exploration industry (as the Eocene rocks have mineral potential). Final project results will be released in 2014.

Subsurface Aquifer Study to Support Liard Basin Unconventional Gas and Oil Development, Northeastern BC

– B. Hayes, Petrel Robertson Consulting Ltd. This one-year project is a study of deep subsurface aquifers in the Liard Basin, similar to earlier projects undertaken by Geoscience BC in the Horn River Basin and Montney play areas. The study will use public and proprietary sources to compile well data to characterize three deep aquifer units potentially suitable for natural gas development in the region. The project began in early 2013 and results will be released in early 2014.

Quantification of the Gas and Liquids in Place and Flow Characteristics of Shale and other Fine Grained Facies in British Columbia – M. Bustin, UBC

This three-year project aims to develop methods for quantifying gas and liquids in place and measuring flow characteristics in

northeast BC's shale gas and shale oil reservoirs. The research components are designed to aid industry's understanding of British Columbia's resource potential and help focus oil & gas exploration and development.

Gravity and Magnetic Inversion Modeling: Nechako Basin, BC – Mira Geoscience Ltd. This project has undertaken constrained 3-D inversion modeling of airborne gravity and magnetic data in the Nechako region. Final project results will be released in early 2014.

Minerals Projects

Porphyry Integration Project – Merlin Geoscience Inc.

Two draft products from this project were released in fall 2013: a geology map of the Mount Polley Intrusive Complex and a geo-exploration atlas of the Endako porphyry molybdenum district. The porphyry integration project is a comprehensive compilation of public, and in some cases, company datasets to identify 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) and accompanying databases for six 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 two-year 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. Work on this project will continue in 2013.

Geochemical Models for BC Porphyry Deposits: Outcropping, Blind and Buried Examples – *F. Blaine and C. Hart, Mineral Deposit Research Unit (MDRU)*

This project is compiling a comprehensive geochemical database for porphyry deposits in BC, with the goal of categorizing deposits and geochemical data based on deposit and environment variables likely to affect geochemical distribution. This project has nearly wrapped, and will include delivery of a comprehensive database and final report in early 2014.

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. Final deliverables are expected in early 2014.

Mapping British Columbia's Geothermal Energy Resources – *CanGEA*

This is a collaborative project between the Canadian Geothermal Energy Association (CanGEA), BC Hydro and Geoscience BC. Project deliverables include a BC favourability map and geothermal database that will provide regulatory bodies, government agencies and investors the necessary standardized maps and databases needed to make confident investment and regulatory decisions. The database (the Canadian Geothermal Database) will be derived from multiple data sources including the Geological Survey of Canada, BCGS and other public data sources. The favourability map will be patterned after the US National Geothermal Data System (NGDS) and based on the compiled database. Completion of this project is expected in early 2014.

Photo by D. Pattison.



Projects completed in 2013

The following Geoscience BC projects wrapped up in 2013. All project deliverables (posters, presentations, technical articles and final reports) are available through Geoscience BC's website.

- New Hydrologic Modelling to Assist with Water Allocation Decisions (*Part II*; *A. Chapman, BCOGC and B. Kerr, Foundry Spatial*)
- Evaluation of plant exudates to assist in mineral exploration and the development of simple and cost effective field procedures and analytical methods (*D. Heberlein and C. Dunn*)
- Examining Present and Future Water Resources for the Kiskatinaw River Watershed, British Columbia (*J. Sui and J. Li, University of Northern British Columbia*)
- Seeing Through Chilcotin Basalts: The Geochemical Signal of What is Hidden Underneath (*T. Bissig, D. Heberlein, K. Russell, C. Dunn and C.J.R. Hart, MDRU*)
- Integrated Geological & Geophysical Porphyry Models: Adding Value to Geoscience BC Geophysical Data (*D. Mitchinson, MDRU*)
- Leveraging International Earth Science Standards to Enhance Mineral Exploration Success in BC (*C. Smyth, Georeference Online Ltd.*)
- Glacial Geologic Framework and Drift Prospecting for a Portion of the QUEST Project Area (*B. Ward, Simon Fraser University*)
- Geological Mapping, Compilation and Mineral Evaluation, Burrell Creek Map Sheet (082E/09), southern BC (*T. Höy*)
- Nelson–Lardeau Regional Geochemical Survey Reanalysis, Kootenays, BC (NTS 082F and 082K) (*W. Jackaman, Noble Exploration Services Ltd.*)
- Documentation and Assessment of Exploration Activities Generated by Geoscience BC Data Publications (*S. Reichheld*)
- NTS 093J (McLeod Lake) INAA Geochemical Reanalysis (*W. Jackaman, Noble Exploration Services Ltd.*)

Data and Publications 2013

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 2013-01

Geoscience BC Summary of Activities 2013 volume (contains 15 technical papers on Geoscience BC project activities in 2012, various authors)

Geoscience BC Report 2013-02

Heliborne High Resolution Aeromagnetic Survey: Northern Vancouver Island, British Columbia, by *Geo Data Solutions Inc.*

Geoscience BC Report 2013-03

Heliborne High Resolution Aeromagnetic Survey: QUEST-Northwest Project Area, British Columbia, Block 3, by *Geo Data Solutions*

Geoscience BC Report 2013-04

Lardeau (NTS 082K) Sample Reanalysis (ICP-MS), by *W. Jackaman*

Geoscience BC Report 2013-05

Iskut River Area Geology, Northwest BC (104B/08, 09, 10 & part of 104B/01, 07/11), by *P.D. Lewis*

Geoscience BC Report 2013-06

McLeod Lake (NTS 093J) Sample Reanalysis (INAA), by *W. Jackaman*

Geoscience BC Report 2013-07

Burrell Creek Map, by *T. Höy and W. Jackaman*

Geoscience BC Map 2013-08

Ice Flow Patterns in NTS 093G, H (west half) & J, and Detailed Ice Flow History for NTS 093J/05, 06, /11, /12, /13 & /14, by *D.A. Sacco, B.C. Ward and D.E. Maynard*

Geoscience BC Report 2013-09

Nelson (NTS 082F) Sample Reanalysis (ICP-MS), by *W. Jackaman*

Geoscience BC Report 2013-10

New Terrain Maps in the McLeod Lake Map Area (NTS 093J), British Columbia, by *D.A. Sacco, B.C. Ward, M. Geertsema and D.E. Maynard*

Geoscience BC Report 2013-11

Regional Stream Sediment and Water Geochemical Data, Northern Vancouver Island, British Columbia, by *W. Jackaman*

Geoscience BC Report 2013-12

Northern Vancouver Island Till Sample Reanalysis (ICP-MS), by *W. Jackaman*

Geoscience BC Report 2013-13

Leveraging Earth Science Standards to Enhance Mineral Exploration Success in British Columbia: Seeking the Efficiencies of Order, by *C. Smyth*

Geoscience BC Report 2013-14

Linking Porphyry Deposit Geology to Geophysics via Physical Properties: Adding Value to Geoscience BC Geophysical Data, by *D.E. Mitchinson, R.J. Enkin and C.J.R. Hart*

Geoscience BC Report 2013-15

Drift Prospecting for Porphyry Copper-Gold, Volcanogenic Massive Sulphide Mineralization and Precious and Base Metal Veins within the QUEST Project Area, Central British Columbia (NTS 093J), by *B.C. Ward, M.I. Leybourne, D.A. Sacco, R.E. Lett and L.C. Struik*

Geoscience BC Report 2013-17

Geochemical Techniques for Detection of Blind Porphyry Copper-Gold Mineralization under Basalt Cover, Woodjam Property, South-Central British Columbia (NTS 093A/03, 06), by *T. Bissig, D.R. Heberlein, and C.E. Dunn*

Geoscience BC Report 2013-19

Examining Present and Future Water Resources for the Kiskatinaw River Watershed, British Columbia, by *University of Northern British Columbia*

Geoscience BC Report 2013-20

Use of Organic Media in the Geochemical Detection of Blind Porphyry Copper-Gold Mineralization in the Woodjam Property Area, South-Central BC (NTS 093A/03, /06), by *D.R. Heberlein, C.E. Dunn and B. MacFarlane*

Geoscience BC Report 2013-21

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

Geoscience BC Report 2013-22

A Geo-Exploration Atlas of the Endako Porphyry Molybdenum District (Draft Version), by *F. Devine, M. Pond, D.R. Heberlein, P. Kowalczyk, W. Kilby and F. Ma*

Geoscience BC Report 2013-23

Stimulating Exploration in the East Kootenays (SEEK Project): The Updated East Kootenay Gravity Database (EKGDB) and the 2013 St. Mary Gravity Survey, by *T. Sanders*

DID YOU KNOW?

Resource development companies are planning to invest \$650 billion in hundreds of Canadian projects over the next decade.

– *Globe and Mail (Jan. 5, 2014)*

Summary of Activities 2013

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, ongoing and recently completed projects.

Geoscience BC's Summary of Activities is the seventh 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 2013 features 138 pages of new information on Geoscience BC-supported projects.

The 2013 volume includes papers on Geoscience BC's new TREK project, and updates on the SEEK project, Horn River Basin Phase 2 (Water Monitoring project) and the Induced Seismicity Monitoring project.



Summary of Activities 2013 Articles:

Documentation and assessment of exploration activities generated by Geoscience BC data publications, QUEST Projects, central British Columbia, by *S.A. Reichheld*

Targeting Resources through Exploration and Knowledge (TREK): Geoscience BC's newest minerals project, Interior Plateau region, British Columbia, by *A.L. Clifford and C.J.R. Hart*

Targeted geochemical and mineralogical surveys in the TREK Project area, central British Columbia, by *D.A. Sacco, W. Jackaman and T. Ferbey*

Geochemical expression in soil and water of carbon dioxide seepages near the Nazko volcanic cone, central British Columbia, by *R.E. Lett and W. Jackaman*

Three-dimensional thickness model for the Eocene volcanic sequence, Chilcotin and Nechako plateaus, south-central British Columbia, by *E. Bordet, M.G. Mihalynuk, C.J.R. Hart and M. Sanchez*

Petrographic characteristics of porphyry indicator minerals from alkali porphyry copper-gold deposits in south-central British Columbia, by *M.A. Celis, F. Bouzari, T. Bissig, C.J.R. Hart and T. Ferbey*

Relationships between calcalkalic and alkali mineralization styles at the copper-molybdenum Southeast Zone and copper-gold Deerhorn porphyry deposits, Woodjam property, central British Columbia, by *I. del Real, C.J.R. Hart, F. Bouzari, J.L. Blackwell, A. Rainbow and R. Sherlock*

U-Pb ages, geochemistry and Pb-isotopic compositions of Jurassic intrusions, and associated Au(-Cu) skarn mineralization, in the southern Quesnel terrane, southern British Columbia, by *J.K. Mortensen*

U-Pb dates for the Nelson and Bayonne magmatic suites in the Salmo-Creston area, southeastern British Columbia: tectonic implications for the southern Kootenay Arc, by *E.R. Webster and D.R.M. Pattison*

SEEK project update: Stimulating Exploration in the East Kootenays, southeastern British Columbia, by *A.L. Clifford*

British Columbia geothermal power and heat favourability maps and database, by *A.A. Derry, A. Thompson, L. Deibert, D. Yang and A. Pollock*

Update on regional seismograph network in northeastern British Columbia, by *C.J. Salas and D. Walker*

Subsurface aquifer study to support unconventional gas and oil development, Liard Basin, northeastern British Columbia, by *B.J.R. Hayes and S. Costanzo*

Horn River Basin Water Project update, northeastern British Columbia, by *C.J. Salas, D. Murray and C. Davey*

2013 Scholarship Winners

In May 2013 Geoscience BC awarded five scholarships of \$5,000 each to graduate students working on BC-based projects directly relevant to mineral or oil & gas exploration in the province.

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 directed towards the exploration sector.

For more information on the Geoscience BC graduate scholarship, including past winners, their respective projects, and posters and theses derived from their work, please visit www.geosciencebc.com/s/scholarships.asp

Irene Del Real
MSc student, University of British Columbia

Project: *The Southeast Zone (Cu-Mo) and Deerhorn (Cu-Au) porphyry deposits; a possible genetic relationship between a calc-alkalic and an alkalic deposit, Woodjam Property, central British Columbia*

Project Overview: The Woodjam property is located 65 km northeast from the city of Williams Lake and hosts several discrete porphyry deposits including the Megabuck (Cu-Au), Deerhorn (Cu-Au), Takom (Cu-Au), Southeast Zone (Cu-Mo) and recently discovered Three Firs (Cu-Au). These deposits display various styles and assemblages of alteration and mineralization comparable to calc-alkalic porphyry deposits, alkalic porphyry deposits, and a combination of both systems. Despite their differences, there are attributes of mineralization and alteration that indicate that at least some deposits within the Woodjam property may be related, providing a unique opportunity to study the relationship between calc-alkalic and alkalic porphyry deposits in British Columbia. Results of this investigation will have important implications in understanding the formation of porphyry clusters and planning the exploration of new targets in known mineralized districts in BC and similar regions worldwide.



Ewan Webster
PhD student, University of Calgary

Project: *Metamorphic and structural reinterpretation of the Southern Kootenay Arc and Purcell Anticlinorium, southeastern British Columbia.*

Project Overview: The aim of this project is to explain the tectonothermal history of a region of southeastern British Columbia

between Nelson, Salmo, Creston and the Canada--United States border that straddles the tectonic interface between the pericratonic metasedimentary and volcanic rocks of Quesnellia to the west, and distal marginal rocks of the ancestral North American margin to the east. This tectonic juxtaposition, and subsequent episodes of magmatism, metamorphism and deformation, occurred during Cordilleran orogenesis in a time interval spanning the Jurassic to Eocene.

This study is developing a new tectonothermal model for the region that helps constrain the spatial controls, genesis and timing of mineral deposition in an important, mineral rich region of southeastern British Columbia, with implications for improved exploration strategies. The model will be created using field-mapping techniques combined with whole rock geochemistry, detailed petrography and microstructural analysis, microprobe chemical analysis and phase equilibrium modeling (Theriak-Domino, THERMOCALC) in conjunction with U-Pb zircon and monazite geochronology and 40Ar/39Ar thermochronology to define a P-T-D-t path.

DID YOU KNOW?

Mining continues to be one of BC's safest heavy industries and has a lower injury rate than most of the other resource and industrial sectors.



Noga Vaisblat

PhD student, University of Alberta

Project: *The influence of diagenetic process on the petrophysical properties and geochemical composition of the Montney Formation in Alberta and northeastern British Columbia.*

Project Overview: The Montney Formation is a siltstone gas reservoir within the Western Canadian Sedimentary Basin with vast estimated reserves. Diagenesis has significant influence on reservoir characteristics such as porosity, permeability and mechanical properties. In order to better understand diagenetic processes and constrain their effects on reservoir quality in siltstone reservoirs such as the Montney Formation, Noga's project is designed to develop better reservoir models through chronostratigraphic correlations and identifying sediment sources and depositional systems through geochemical tracers. The methods that will be employed to accomplish this include: high resolution microscopy imaging techniques, ICP-MS analysis of major, minor and trace elements, mercury porosimetry and pulse decay permeability measurements of core samples. This work will allow for characterization of the mineralogical composition, diagenetic phases and the paragenetic sequence of the Montney Formation, and interpretation of the depositional environment and climatic conditions.

Rameses D'Souza

PhD student, University of Victoria

Project: *Geochemical characterization of the Jurassic Bonanza arc and Tertiary intrusions on Vancouver Island.*

Project Overview: Despite their economic significance in hosting known porphyry Cu-(Mo-Au) deposits and former mines, the Jurassic and Paleogene aged intrusions on Vancouver Island have received scant detailed study regarding their origin and emplacement. Rameses's study will involve isotopic characterization (Pb, Sr, Nd, O, S) to identify the source of the magmas and their related endowments in Cu, Mo or Au. This will aid in distinguishing suites of plutons that are suitable targets for exploration, and also shed light on the construction and evolution of continental crust. The first part of this project involves isotopic mapping of the intrusions of the Jurassic Bonanza arc, which form the substrate into which later Paleogene intrusions are emplaced.



Antonio Celis

MSc student, University of British Columbia

Project: *PIMS – Porphyry Indicator Minerals (PIMs) from Alkalic Porphyry Cu-Au Deposits in British Columbia*

Project Overview: The resistate minerals in mineralized and altered portions of British Columbia's alkalic porphyry copper

deposits suggests that these minerals can be utilized as indicators of mineralization and used for exploration in terrains covered by glacial till. These minerals typically display unique physical properties, such as colour, size and shape, which allow their presence to be used as a prospecting tool in a manner similar to that in which kimberlite indicator minerals (KIMs) are used.

The chemical compositions of PIMs can further identify and confirm mineralizing environments that relate directly to specific alteration zones in porphyry systems. Although easy to collect in heavy-mineral concentrates, these PIMs have rarely been used in porphyry exploration. Therefore, by evaluating the presence, abundance, relative proportions and compositions of PIMs from surficial materials, it is possible to follow-up geophysical and stream-sediment geochemical anomalies, which can act as vectors toward concealed alkalic porphyry copper deposits in highly prospective terranes, such as Quesnellia and Stikinia, in central BC. The purpose of this project is to identify the occurrence, types, relative amounts and compositions of selected PIMs in several alkalic porphyry deposits in order to elucidate important PIM signatures.

Since 2007, Geoscience BC has awarded up to ten scholarships annually to graduate students working on BC-based projects relevant to the mineral or oil & gas exploration industry. Many of these students continue to work in the BC exploration industry after graduation, while others move on to work internationally.

Geoscience BC caught up with Jean-François Gagnon and Jamie Kraft, two early scholarship winners, to see what they are doing now.

Where Are They Now?



Jean-François Gagnon, 2007 and 2008 Scholarship Winner

Tell us about your Ph.D. project.

My Ph.D. thesis consisted of a field-based project in northwestern British Columbia where I studied the tectonic and stratigraphic evolution of a Jurassic volcanic-sedimentary succession. The title of my thesis was "Stratigraphic and tectonic evolution of the Jurassic Hazelton trough – Bowser basin, northwest British Columbia, Canada." In addition to geological mapping in the Skeena fold belt, I measured detailed stratigraphic successions to document the timing and nature of subsidence and discriminate between different basin forming mechanisms during an episode of terrane accretion.

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

Since most of my fieldwork involved helicopter-supported mapping in remote areas of the cordillera, the Geoscience BC scholarship was essential for successful data acquisition and logistical support.

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

Upon completing my Ph.D. research in August 2010, I joined Royal Dutch Shell in Calgary as a petroleum exploration geoscientist. I have been involved in

various resource play evaluation, from Mesozoic clastics to Devonian-Mississippian carbonates. My day-to-day work consisted of petrophysical and stratigraphic analyses combining seismic and well data to produce geological models.

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

As of June 2013, I joined Shell international exploration in Den Haag, The Netherlands. I am currently working as portfolio analyst and I am involved in evaluation of current exploration licenses as well as new basin entries which mostly consist of deep-water opportunities. Having the privilege of being located at headquarters, I am directly involved in the strategic planning for Shell exploration.



Jamie Kraft, 2008 Scholarship Winner

Tell us about your Ph.D. project.

I conducted my Ph.D. with Philippe Erdmer at University of Alberta in collaboration with the Geological Survey of Canada's Targeted Geoscience Initiatives 3 program. The title of my project was "Stratigraphy, paleogeography and tectonic evolution of early Paleozoic to Triassic pericratonic strata in the northern Kootenay Arc, southeastern Canadian Cordillera, British Columbia."

I used field and laboratory data from the geologic record in the region of Upper Arrow, Trout and Shuswap lakes in southeastern BC to make inferences about the Paleozoic paleogeography and tectonic evolution of the southern Canadian Cordilleran margin. In the thesis I argued for the existence of arc-related Devonian strata in the northern Kootenay Arc, which would be inboard extensions of the VHMS-bearing, Devonian-Mississippian Eagle Bay assemblage of the Adams Plateau area, and proposed a mechanism for the southern Canadian equivalent of the Early Mississippian Antler orogeny in Nevada. A large new detrital zircon dataset in my thesis supports earlier notions that exotic continental crust entered the Canadian Cordillera in Devonian time.

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

The Geoscience BC scholarship gave me added financial freedom to focus on my research by allowing me respite from teaching duties. This also provided the flexibility to work on the GSC Open File versions of my thesis maps at a GSC office off-campus.

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

In 2011, I joined the mineral exploration group of Teck Resources Limited based in Vancouver. With Teck I've been applying the structural geology and field-based techniques I learned in grad school to a bedrock mapping and drilling program near Teck's Red Dog Zn-Pb-Ag mine in the Brooks Range of northwestern Alaska.

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

I continue to be employed with the zinc exploration group at Teck, working primarily as a structural geologist. In my role I focus mainly on geological mapping during the field season and work on various projects including structural interpretations of drilling and surface data while in the office. Zinc districts in the Canadian and Alaskan Cordillera tend to be rather strongly deformed so I have my work cut out for me.

Geoscience BC Society

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

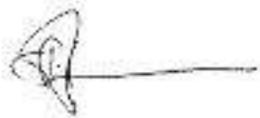
The summary financial statements and the information contained in the annual report are the responsibility of the management of Geoscience BC Society (the "Society").

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.

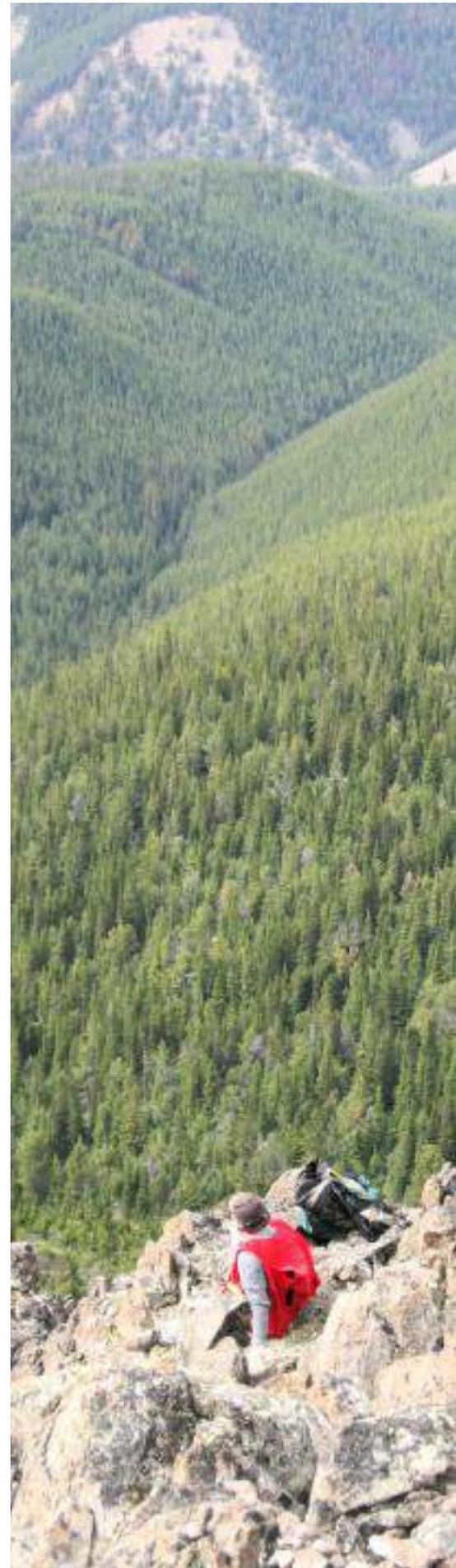
January 2, 2014



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 Statement of Financial Position as at March 31, 2013 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, 2013. We expressed an unmodified audit opinion on those Financial Statements in our report dated September 30, 2013. 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 Part III of the CICA 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, 2013 are a fair summary of those Financial Statements, in accordance with the criteria described in the Basis of Preparation.

Beauchamp & Company
CHARTERED ACCOUNTANTS

Vancouver, British Columbia

January 2, 2014

Geoscience BC Society

Summary Statements of Financial Position

As at March 31, 2013 and 2012

	2013	2012
ASSETS		
Current Assets		
Cash and cash equivalents	\$ 380,467	\$ 127,176
Investments	14,882,845	18,555,556
Accrued interest receivable	33,467	39,414
Amounts receivable	979,183	349,068
Prepaid expenses and deposits	10,154	5,984
	16,286,116	19,077,198
Capital Assets		
	19,871	10,274
	\$ 16,305,987	\$ 19,087,472
LIABILITIES		
Current Liabilities		
Accounts payable and accrued liabilities	\$ 302,689	\$ 303,428
NET ASSETS		
Net Assets Restricted For Approved Programs	6,878,829	3,735,021
Unrestricted Net Assets	9,124,469	15,049,023
	16,003,298	18,784,044
	\$ 16,305,987	\$ 19,087,472

Nature Of Operations And Going Concern (Note 1)

Basis of Preparation (Note 2)

Approved By The Board:



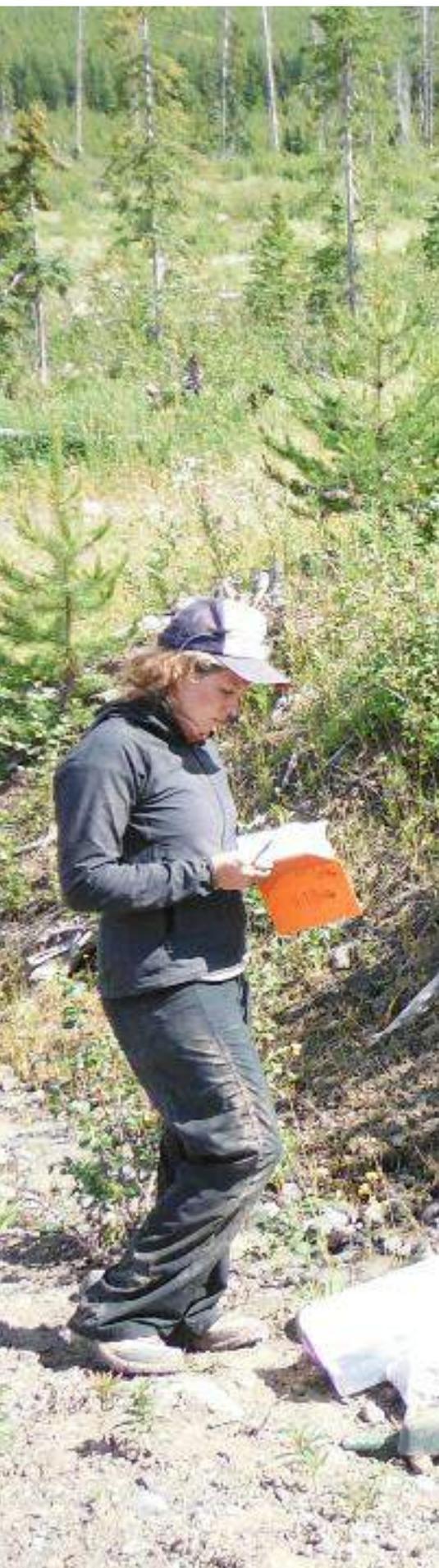
Director



Director

See accompanying notes to the financial statements.





Geoscience BC Society

Summary Statements of Revenues and Expenditures

For the years ended March 31, 2013 and 2012

	2013	2012
Revenues		
Grants and program reimbursements	\$ 873,456	\$ 481,552
Investments	941,414	773,319
Funding recoveries	7,296	5,502
Sublease rent and other	16,760	15,580
	<u>1,838,926</u>	<u>1,275,953</u>
Expenditures - Programs		
Program costs incurred	3,042,703	3,478,563
Program costs incurred, approved in principal	-	6,717
Program management	289,236	150,015
GST/HST, non-refundable portion	110,152	179,154
ArcGIS Server – implementation & maintenance	44,268	-
Publishing costs	26,483	23,946
	<u>3,512,842</u>	<u>3,838,395</u>
Expenditures - Administration		
Amortization of capital assets	8,019	9,840
Communications and marketing	103,234	52,964
Consulting	65,870	22,640
Gifts and promotion	16,061	15,886
Dues and memberships	3,244	3,200
Equipment lease	4,243	3,607
GST/HST, non-refundable portion	31,357	22,906
Insurance	5,507	5,467
Investment management fees	58,552	60,230
Office and sundry	17,333	12,367
Professional fees	56,807	54,255
Recruitment	9,451	5,222
Rent and utilities	128,309	127,105
Salaries and benefits	425,759	399,838
Scholarship awards	35,000	40,000
Sponsorship	6,713	4,024
Staff training and professional development	4,120	6,574
Travel, conferences and meetings	110,574	71,498
Website, internet and e-mail	12,649	10,282
Workshops	4,028	-
	<u>1,106,830</u>	<u>927,905</u>
Deficiency Of Revenues Over Expenditures	\$ (2,780,746)	\$ (3,490,347)

See accompanying notes to the financial statements.

Geoscience BC Society

Summary Statements of Changes in Net Assets

For the years ended March 31, 2013 and 2012

	Restricted For Approved Programs	Unrestricted	Total
Balance, March 31, 2011	\$ 2,873,470	\$ 19,400,921	\$ 22,274,391
Internally imposed restrictions (Deficiency) Excess of revenues over expenditures	4,565,985 (3,704,434)	(4,565,985) 214,087	– (3,490,347)
Balance, March 31, 2012	3,735,021	15,049,023	18,784,044
Internally imposed restrictions (Deficiency) Excess of revenues over expenditures	6,375,231 (3,231,423)	(6,375,231) 450,677	– (2,780,746)
Balance, March 31, 2013	\$ 6,878,829	\$ 9,124,469	\$ 16,003,298

See accompanying notes to the financial statements.





Geoscience BC Society

Notes to Summary Financial Statements

March 31, 2013 AND 2012

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.

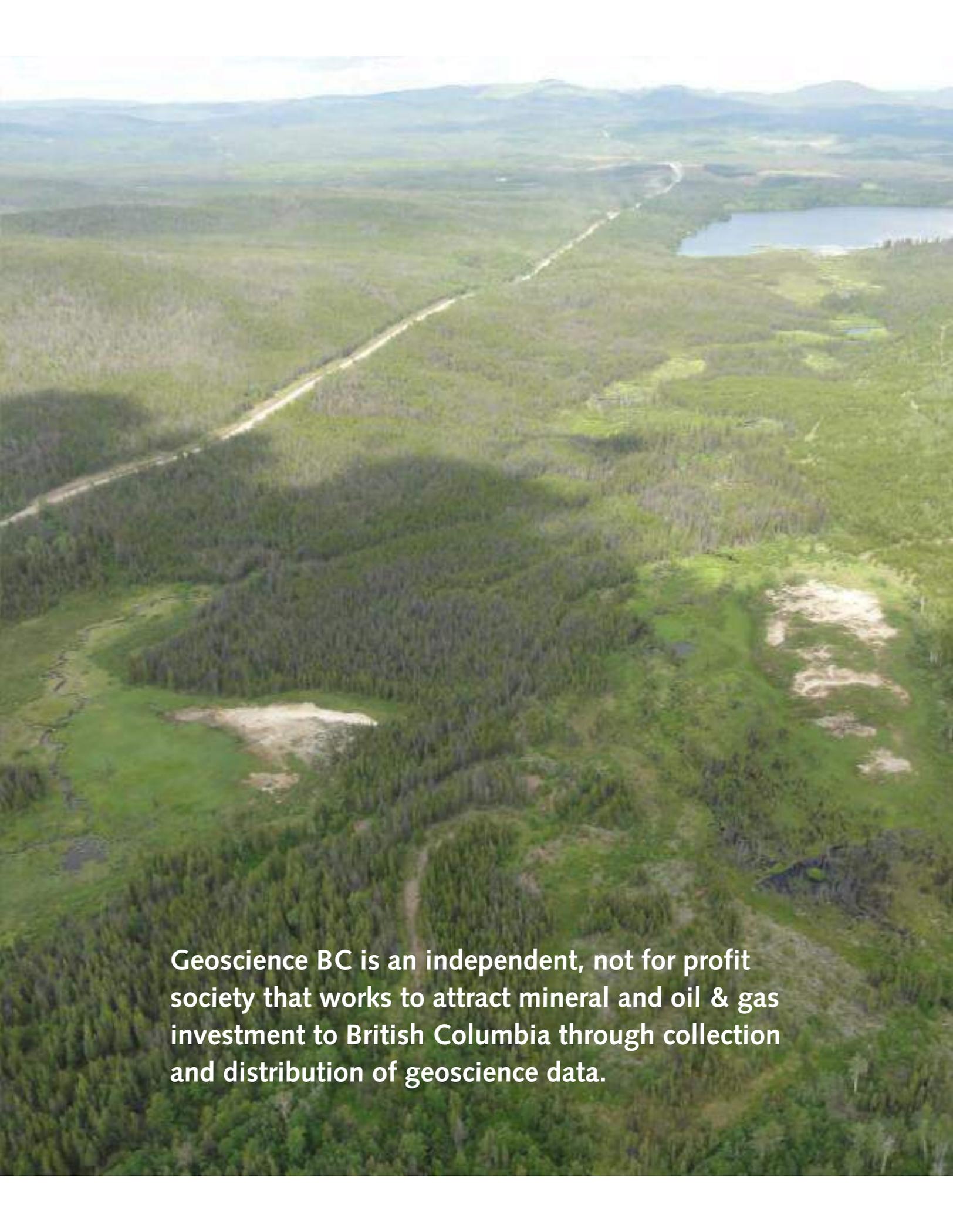
The Society has no source of operating revenue and its future operations are therefore dependent upon the receipt of continued unrestricted and non-repayable funding, anticipated to be from government sources. In the event such funding is not received, the Society would in due course deplete its cash reserves and be required to cease operations. At March 31, 2013 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 Presentation

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, 2013. 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.



Geoscience BC is an independent, not for profit society that works to attract mineral and oil & gas investment to British Columbia through collection and distribution of geoscience data.



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