

# British Columbia Geological Survey Activities in 2012

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## Abstract

Established in 1895, the British Columbia Geological Survey (BCGS) maintains its tradition of providing geological data and expertise to diverse clients. In 2012, BCGS field geologists, in collaboration with geoscientists from industry, universities, and other government agencies: 1) completed projects to determine the evolution and mineral potential of terranes on the northwestern flank of the Cordillera (as part of the Geo-mapping for Energy and Minerals program, GEM-Edges); 2) continued investigating specialty metals, rare earth elements, and Ni-Cu-PGE-Cr ore systems (as part of the Targeted Geoscience Initiative, TGI4), working on compilations to better understand tectonic controls on Cordilleran metallogeny, and researching porphyry deposits, which constitute a significant part of British Columbia's mineral wealth; and 3) started studies evaluating the use of mineral and geochemical indicators for detecting buried porphyry-style mineralization in drift-covered areas (TGI4). Results from these research projects were published extensively in the provincial, national, and international literature. The BCGS continues its web-based archiving and public access function via its MapPlace portal, Property File, MINFILE, and ARIS databases, and collection of Survey publications, all of which are available free of charge. Staff renewal included hiring a geologist to rebuild capacity in coal geology and GIS experts to revise and enhance the digital geology map of the Province. The Survey's in-house geochemical laboratory was completely refurbished, and a new archive was constructed to house over 600,000 samples. Through technical marketing campaigns that highlighted the Province's mineral and coal endowment, geoscience expertise, geological knowledge, and business climate, the Mineral Development Office in Vancouver (MDO) promoted industry domestically and abroad. Through the work of five Regional Geologists, the MDO monitored and reported the year's exploration and mining activities. From a pool of 118 nominations submitted by 16 BC Public Service agencies representing 27,000 civil servants, BCGS Emeritus Scientist Dr. Ray Lett was selected as a finalist for a 2012 "Premier's Award" in the Legacy category, and thirteen past and present BCGS staff who contributed to developing MapPlace were selected in the Innovation category.

**Keywords:** British Columbia Geological Survey, Cordilleran geology, Cordilleran tectonics, provincial geoscience, federal-provincial agreements

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## 1. Introduction

Founded in 1895, the British Columbia Geological Survey (BCGS) is the oldest scientific agency in British Columbia. A primary mandate of the BCGS is to provide objective geoscience expertise and data to government, industry, and the general public. This helps to create safe, thriving, and sustainable provincial mineral exploration and mining industries.

The BCGS maintains the flexibility to respond to changing priorities of government and changing market conditions driving the minerals industry. Organizational flexibility and expertise are reflected in a mix of short- and long-term, generally field-based, geoscience projects. The short-term projects typically last for one or two years, and focus on immediate industry needs. Such projects produce new and updated geological and geochemical maps, and generate new knowledge about specific commodities or mineral deposit types. Recent market interest in "hot" commodities (e.g., rare earth elements, metallurgical coal, copper) has led to renewed focus on the Province's rare earth element and coal potential, and a

re-examination of its many past-producing porphyry copper-gold mines and undeveloped deposits. Short-term projects are frequently completed through partnerships with industry, universities, and other public geoscience organizations. Longer term geoscience projects, ranging from two to five years, are typically collaborations with the Geological Survey of Canada (GSC). These projects generate fundamental geoscience knowledge, have a greater national focus, and are designed to achieve common strategic objectives of the federal and provincial governments. Recent long-term strategic partnerships include the GSC's Geo-mapping for Energy and Minerals (GEMs) program and the Targeted Geoscience Initiative program (TGI4). All geoscience products generated through these partnerships are made available online at no cost to the public via MapPlace, the internet portal of the BCGS. In 2012, the MapPlace team was selected for a "Premier's Award" in the Innovation category. These are the highest awards given to employees of the BC Public Service.

British Columbia's mineral exploration and mining industry performed well in 2012, despite the global

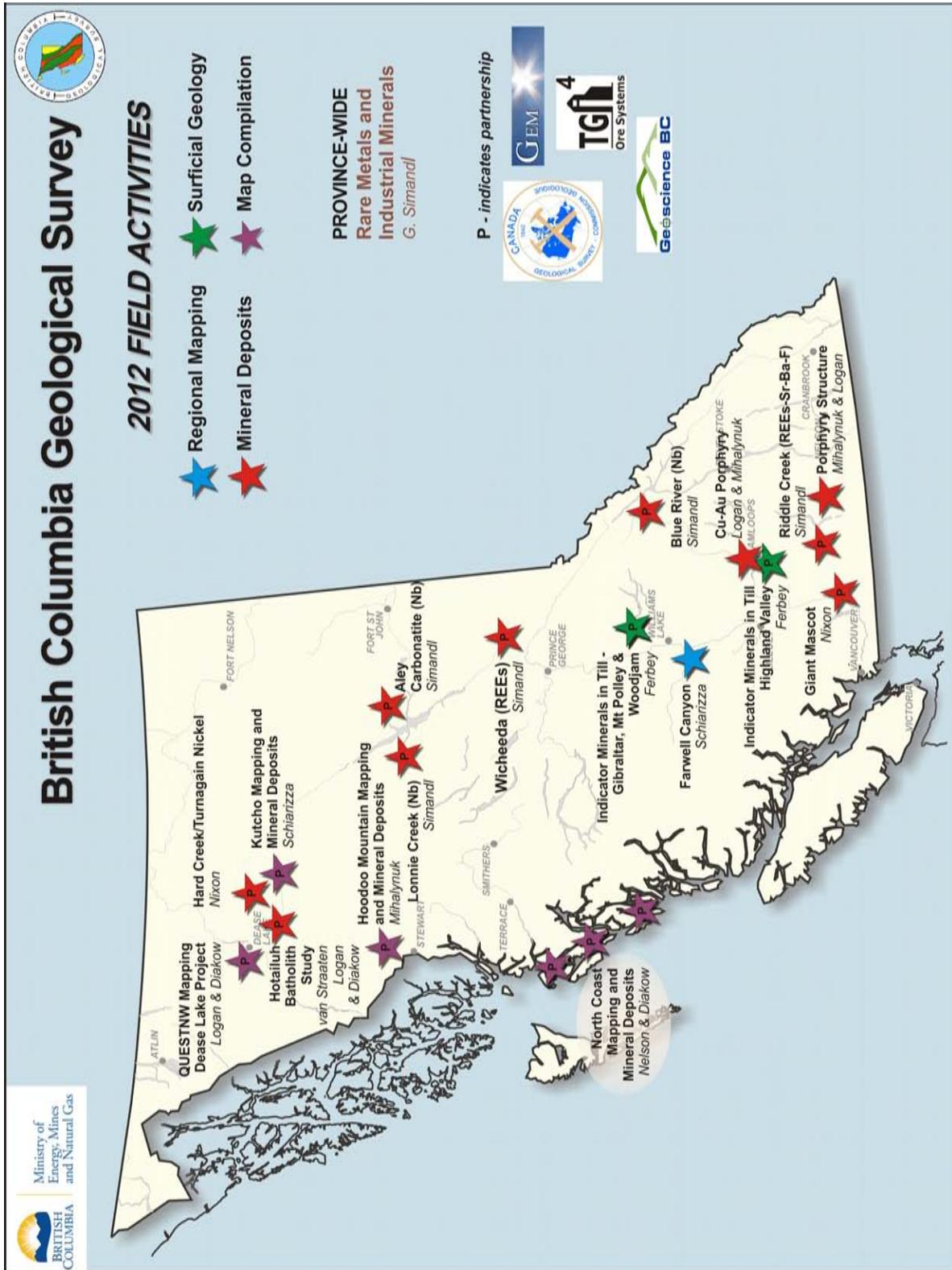


Fig. 1. British Columbia Geological Survey field activities in 2012.

economic slowdown that occurred mid-year. The total value of solid mineral production for 2012 was \$7.4 billion, and mineral exploration spending was \$680 million, up from the \$463 million spent in 2011. Core funding levels for the BCGS in 2012 remained similar to those in previous years. The BCGS continued its long and productive collaboration with the GSC by participating in seven joint projects in 2012. It was the fourth and final year for three GEMs “Edges” projects that targeted parts of northwestern and north-central British Columbia, where existing geological maps are either several decades out of date or at scales inadequate to evaluate mineral potential. Activity this year focused on data synthesis, write-up, and publication. A TGI4 “Specialty Metals” project that started in 2010 under the leadership of George Simandl continued in 2012. Its overall objective is to develop new exploration methods and technologies in the search for specialty metals. Another TGI4 project targeted Ni-Cu-PGE-Cr deposits associated with ultramafic intrusions in BC’s orogenic belts. These “orogenic” Ni-Cu-PGE-Cr deposits are poorly understood, and new models are needed. This initiative includes researchers from the BCGS, the GSC, and the University of British Columbia. Two new TGI4 projects in 2012 (Intrusion-Related Ore Systems) involved surficial mapping and till sampling for porphyry indicator minerals and bedrock mapping of regional structures in porphyry districts of central BC. As in past years, university students were employed as co-op interns and geoscience assistants to help deliver our field programs and improve our digital geoscience databases.

## 2. Cordilleran Geoscience Section

The Cordillera Geoscience Section collects, synthesizes, and interprets geological data, thereby creating new knowledge. We disseminate both raw and interpreted data to diverse clients through provincial, national, and international presentations and publications. Staffed by twelve full-time geologists with extensive knowledge of Cordilleran geoscience and particular expertise in regional mapping, tectonics, mineral deposits, rock and environmental geochemistry, Quaternary geology, and coal geology, much of the Section’s work is field based.

The Section partners in numerous provincial and inter-agency projects, many of which are multi-year initiatives (Fig. 1). In addition to the GEMs and TGI4 initiatives, the Section is also collaborating with Geoscience BC and organizing fieldtrips for the Society of Economic Geologists (SEG) Fall 2013 meeting in Whistler, BC. Provincial initiatives include updating the Provincial COALFILE database, revitalizing the Provincial geochemical laboratory, and reorganizing and cataloging the 600 000 geochemical and rock sample archive.

## 2.1. Projects 2012

### 2.1.1. GEM-Edges: Modeling the Evolution of the Northern Cordillera Resource Environment from the Edges of Exotic Terranes

The GEM-Edges Project is multi-year geological mapping collaboration between the Government of Canada, the Province of British Columbia, Yukon Territory, Geoscience BC, the United States Geological Survey and the Alaska Divisions of the Geological and Geophysical surveys. Initiated in 2009, the project included three field seasons in north-central and northwestern British Columbia and is currently in its final year. It consists of several components, including the North Coast Region Mapping and Metallogeny Project, Iskut River/Hoodoo Mountain Project, and the Kutcho Project, all of which were directed at determining the geological framework and evaluating the mineral potential of the outer terranes of the northern Cordillera.

#### 2.1.1.1. The North Coast Region Mapping and Metallogeny Project

The North Coast component of Edges focused on regional geological mapping of the southern part of the Alexander terrane along the north coast of British Columbia, between Bella Coola and Prince Rupert. This is an area known to host several volcanogenic massive sulphide (VMS) and mesothermal Au deposits. JoAnne Nelson and Larry Diakow compiled and synthesized three field seasons (2009-2011) of data, creating a 1:150 000-scale geological map (Fig. 2) that will be published separately and integrated into the online digital geology of British Columbia atlas. Building on discoveries reported in previous Geological Fieldwork articles, Nelson et al., (this volume) link Ordovician VMS deposits in the Alexander terrane to those of the Caledonides and Appalachians, including deposits in New Brunswick, Newfoundland, Quebec, and Norway.



**Fig. 2.** Larry Diakow with the first paper draft of the North Coast Open File map (to be released in 2013).

#### 2.1.1.2. Iskut River/Hoodoo Mountain Project

Mitch Mihalynuk and Jim Logan (BCGS) and Alex Zagorevski (GSC) collaborated on the Iskut River/Hoodoo Mountain component of the Edges

partnership, in the region between the Galore Creek porphyry Cu-Au camp and the past-producing Bronson Au camp on the Iskut River. Receding snow and glaciers in the area have uncovered extensive sections of bimodal Carboniferous volcanic rocks with VMS mineralization, and Late Triassic feldspar porphyry intrusions with copper mineralization. Fieldwork was completed in 2011, but geochronological and geochemical studies are ongoing, as aids to map compilation and, ultimately, mineral exploration. In this volume, Zagorevski et al., report a Miocene U-Pb zircon crystallization age ( $7.78 \pm 0.01$  Ma) for the Pheno Mountain volcanic complex (discovered by Mihalynuk et al., 2012) supporting inclusion of the complex as part of the Neogene to Quaternary Northern Cordilleran Volcanic Province. Digital geological maps at 1:50 000 scale of 104B/14E and 14W, are being prepared for anticipated release in 2013.

### 2.1.1.3. Kutcho Project, Wineglass Assemblage

The Kutcho Project was a two-year mapping study completed in 2011 by Paul Schiarizza as part of the Edges Project and in partnership with Kutcho Mining Corporation. This project was directed at gaining a better understanding of the Permo-Triassic Kutcho assemblage, which hosts the Kutcho Creek VMS deposit. Bedrock mapping was completed in 2011 and was released as Open File map 2012-08 (see section 4.2.1 below). Paul's 2012 activities built on his experience in the Sitlika assemblage and work at Kutcho Creek to examine the Wineglass assemblage in the lower reaches of the Chilcotin River, southwest of Williams Lake (Schiarizza, this volume). He concludes that the Wineglass assemblage correlates with the Kutcho assemblage and the volcanic unit of the Sitlika assemblage, on the basis of a remarkable similarity in lithologic components, overlapping ages, similar structural relationships to Cache Creek terrane, and similar unconformable relationships with overlying Upper Triassic-Jurassic sedimentary rocks.

### 2.1.2. Specialty Metals (TG14)

George Simandl is leading a BCGS-GSC collaboration on a multi-year national and Province-wide study of specialty metals and rare earth elements. Specialty metals are uncommon, nonferrous metals used in small quantities (typically <150 000 tonnes/year) or that are mined from geographically restricted areas. The Specialty Metals Program started in 2010 and will continue until 2015 with two major components: 1) reviewing ore deposits and their mineral economics in Canada; and 2) developing techniques to guide exploration towards ore-grade zones in host deposits. The project is expected to help the Canadian exploration and mining industry be more effective at locating and developing these strategic resources. A number of publications were released in 2012 (see section 4.2. below); the most recent studies focus on unusual Sr-Ba-REE-F mineralization in the Okanagan Valley, well beyond the limits of the British Columbia alkaline province, at the Riddle Creek prospect (Trofanenko et al.,

this volume) and the geological setting of the Lonnie Nb deposit in north-central British Columbia (Simandl et al., this volume).

### 2.1.3. Till Porphyry Indicator Mineral Study (TG14)

In 2012, Travis Ferbey initiated a field program to develop geochemical and mineralogical methods for detecting buried porphyry-style mineralization in drift-covered areas (Fig. 3). Carried out in collaboration with colleagues at the GSC, and as part of the Till Porphyry Indicator Mineral Study, this investigation is part of the GSC's Intrusion Related Ore Systems TG14 Program, scheduled for completion in 2015. The study is using the trace element compositions and mineral assemblages of basal till samples to characterize dispersal from known deposits such as Highland Valley (calcalkalic Cu-Mo), Gibraltar (calcalkalic Cu-Mo), and Mount Polley (alkalic Cu-Au) mines, and mineralized zones at the Woodjam developed prospect (calcalkalic Cu-Mo-Au). The objective is to help define which components of till are enriched near such deposits, and document which porphyry indicator minerals (PIMs) survive erosion, glacial transport, and near-surface oxidative weathering. This project also incorporates biogeochemistry as a tool to explore for buried porphyry-style mineralization.



**Fig. 3.** Till sampling as part of the Till Porphyry Indicator Mineral Study (TG14).

### 2.1.4. Ni-Cu-PGE-Cr Ore Systems (TG14)

The Ni-Cu-PGE-Cr Ore Systems project is a national initiative of the GSC. The BC component, lead by Graham Nixon (BCGS), Doreen Ames (GSC), and James Scoates (UBC), is examining the potential for "orogenic" Ni-Cu-PGE-Cr associated with supra-subduction zone ultramafic-mafic intrusions, exclusive of ophiolites and accreted large igneous provinces. The aim is to establish mineral deposit models and exploration criteria for two poorly understood magmatic sulphide deposits: 1) Giant Mascot, BC's only past-producing Ni mine (1958-74); and 2) the Turnagain Alaskan-type intrusion, which has a substantial resource of low-grade Ni. In 2012, Graham Nixon released a new geological map of the Turnagain

ultramafic intrusion (Open File 2012-05; see section 4.2.1 below). A short field program in 2012 oriented two University of British Columbia graduate students who will be supported by the project to carry out studies of the Turnagain and Giant Mascot deposits.

### 2.1.5. Update of Cordilleran tectonics and metallogeny

In partnership with the Society of Economic Geology (SEG), and in anticipation of the SEG conference in Whistler (September, 2013), JoAnne Nelson and Maurice Colpron (Yukon Geological Survey) are updating their Cordilleran tectonic and metallogeny synthesis (Nelson and Colpron, 2007). This update, to be released at the meeting in Whistler, describes the tectonic evolution of the Cordillera since the Middle Precambrian and explains how tectonics has governed metallogenesis through time.

### 2.1.6. Porphyry deposits

British Columbia is known for hosting porphyry deposits, which make up a significant component of British Columbia's mineral wealth. Hence, understanding the geological controls and timing of porphyry deposit emplacement and mineralization remain important fields of research (e.g., Logan and Mihalynuk, in press). The eastward migration of Mesozoic arc magmatism in southern Quesnellia led to the growth of three temporally distinct, north-trending, plutonic belts (from west to east): Late Triassic; Late Triassic-Early Jurassic; and Early Jurassic. Three porphyry copper mineralization events are directly linked to each of these calcalkaline (Cu-Mo±Au) and alkaline (Cu-Au±Ag) magmatic episodes. In 2012, Jim Logan and Mitch Mihalynuk continued their long-standing investigation of assessing the age, geological setting, and stratigraphic-structural controls of porphyry deposits across the Province. In two papers, Mihalynuk and Logan (this volume) report on studies of Late Triassic porphyry Cu-Au mineralization at Miner Mountain and Dillard Creek, in the Nicola belt of southern British Columbia. In a third contribution, Logan and Mihalynuk (this volume) examine the Bonaparte deposit near Kamloops, and consider if historical quartz vein network gold targets might represent an upper level of a buried porphyry system.

Jim Logan, in partnership with the SEG, spent part of 2012 developing a field trip guidebook for the SEG meeting being held at Whistler in September 2013. The field trip ("Porphyry Systems of Central and Southern British Columbia") will present the geological setting and structural history of the central Intermontane belt (a composite of Late Triassic to Early Jurassic volcanic and plutonic arc rocks), and focus on porphyry-related mineral deposits that developed on the fringes of ancestral North America, before terrane accretion in late Early Jurassic time. The trip comprises transects of southern Stikine, Cache Creek, and Quesnel terranes, with visits to six operating mines including Endako (Thompson Creek Metals Company), Gibraltar (Taseko Mines Limited), Mount Polley (Imperial Metals Corporation), Highland Valley (Teck Resources Limited), New Afton (New Gold

Incorporated), and Copper Mountain (Copper Mountain Mining Corporation). The architecture of the Nicola arc, its calcalkaline and alkaline mineral deposits, and the relationship between cospatial early calcalkaline and later alkaline volcanism, plutonism, and mineralization (Cu-Mo±Au vs. Cu-Au) will be presented and highlighted by mine geologists through deposit overviews and onsite tours over the course of this 5-day post-conference trip.

### 2.1.8. British Columbia coal geology

Janet Riddell was appointed Senior Coal Geologist in March, 2012, a position that was vacant for some years (Fig. 4). Work priorities are directed at updating and maintaining coal exploration databases, establishing contacts with the coal exploration industry, and rebuilding coal geology expertise in the Ministry. The Survey, through Purple Rock Inc. conducted an inventory of 873 existing COALFILE paper documents, locating missing documents, and ensuring that all components of the documents were available online. Janet audited the Coal Assessment Reports for exploration projects conducted since 2002, and contacted exploration and development companies to replace missing data. She will continue to work with industry and the MDO to profile coal geology and exploration opportunities in British Columbia.



**Fig. 4.** Janet Riddell, the new BCGS Senior Minerals Coal Geologist, at Fording River Coal Mine.

### 2.1.9. Geochemical laboratory revitalization

Alexei Rukhlov joined the Survey in January 2012 as the new Senior Geochemist. He has been working to revitalize the Geological Survey's in-house geochemical laboratory, and inventory British Columbia's extensive geochemical and rock sample archive. The laboratory is a preparation and analytical facility for ministry geologists and their partners. In 2012, the Ministry invested significant funds in updating the laboratory facility and refurbishing laboratory equipment. New equipment includes a rock saw, a Linkam THMS 600 fluid inclusion stage linked to an Olympus BX microscope modified for infrared studies, and a Thermo portable bench top Niton XRF analyzer. The BCGS Geochemical and Rock Archive was upgraded with a new storage library to accommodate over 600 000 geochemical samples analyzed during national and provincial geochemical surveys since the 1970s. This multi-million dollar archive includes till, silt, and other media samples, and representative rock samples from deposits and geological environments across British Columbia. The samples have been stored, cataloged, and incorporated into a corporate database for querying and retrieval.

In June, the Province recognized Dr. Ray Lett as a Premier's Award Finalist in the Legacy category for his contribution in developing British Columbia's national and provincial geochemical databases (Fig. 5). Ray, now retired, is an Emeritus Scientist at the BCGS.

#### 2.1.10. BCGS Emeritus Scientists

Nominally retired Emeritus Scientists Ray Lett and Nick Massey maintain their contributions to BCGS activities by continuing their research and collaborating with staff. Following up on fieldwork initiated in 2005 to better characterize lithological and geochemical variations of Paleozoic successions in the southern Okanagan region along the Canada-USA border (Boundary Project), Nick Massey and co-workers provide geochronologic (Massey et al., this volume) and geochemical (Massey and Dostal, this volume) data from the Knob Hill complex. This research supports the concept that Paleozoic basement to southern Quesnellia lacks a Laurentian heritage and is entirely exotic to North America. A complete set of geochemical data from the Knob Hill complex and Anarchist Group will be released as a GeoFile in 2013.

## 3. Resource Information Section

### 3.1. MapPlace

Since 1995, the MapPlace web service has provided industry and government agencies with comprehensive tools and open geoscience data to aid in the discovery of mineral potential in British Columbia. The mineral industry recognizes MapPlace as innovative and indispensable, with unique and interactive applications and tools to assist in investment decision making. MapPlace continues to provide clients with efficiencies in research time, data costs, and analysis. Data themes and applications available on MapPlace include mineral

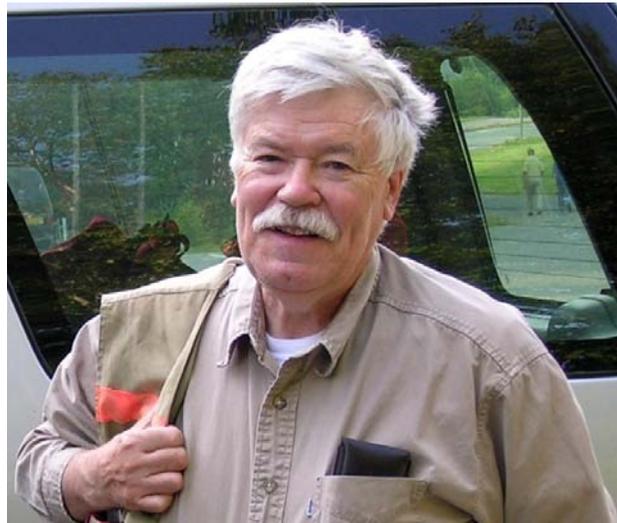


Fig. 5. BCGS Emeritus Scientist Ray Lett received a Premier's Finalist Award in the Legacy Category.

potential, bedrock and surficial geology, publications, mineral and petroleum tenure, MINFILE, assessment reports, geochemistry, and geophysical surveys. Yao Cui and Pat Desjardins contributed geomatic expertise to MapPlace enhancements and the integration of servers. Major technical advances have taken place since the inception of MapPlace 17 years ago, including growing databases, adding better servers, increasing bandwidth, and using affordable advanced database software. Pat and co-op students Thomas Edgehill and Stephen Zhao worked with the next generation of internet mapping and reviewed data modeling and architecture aspects to provide continued delivery of data for the exploration community.

### 3.2. Property File, MINFILE, and ARIS

During 2012, Property File, a collection of about 98 000 industry documents, continued to grow. As of December 2012, more than 34 270 Property File documents are available online, including those from Falconbridge, Cyprus-Anvil, Chevron, Placer Dome, Rimfire, Mine Plans, Library File items, RGS Maps and Tom Schroeter Project files. A recent collection from the late Dr. Rodney Kirkham is being indexed and scanned. Property File documents can be retrieved through the search application ([propertyfile.gov.bc.ca](http://propertyfile.gov.bc.ca)) or through links from MINFILE ([minfile.ca](http://minfile.ca)). Kirk Hancock is the Property File contact and is currently accepting donations to be included. Kirk works with the Property File contractor, Nicole Barlow, whose team indexes and delivers these valuable documents. Review of Property File documents has identified over 40 new occurrences, which have been added to the MINFILE database.

MINFILE contains geological, location, and economic information on more than 13 050 metallic, industrial mineral, and coal mines, deposits and occurrences in BC. The BCGS has been allocated extra funding to update MINFILE and to add new discoveries by reviewing mineral assessment reports, recent

publications, press releases, Property File, and company websites. Sarah Meredith-Jones is the MINFILE contact; contractors and staff updated over 1560 occurrences, and added 1035 new occurrences.

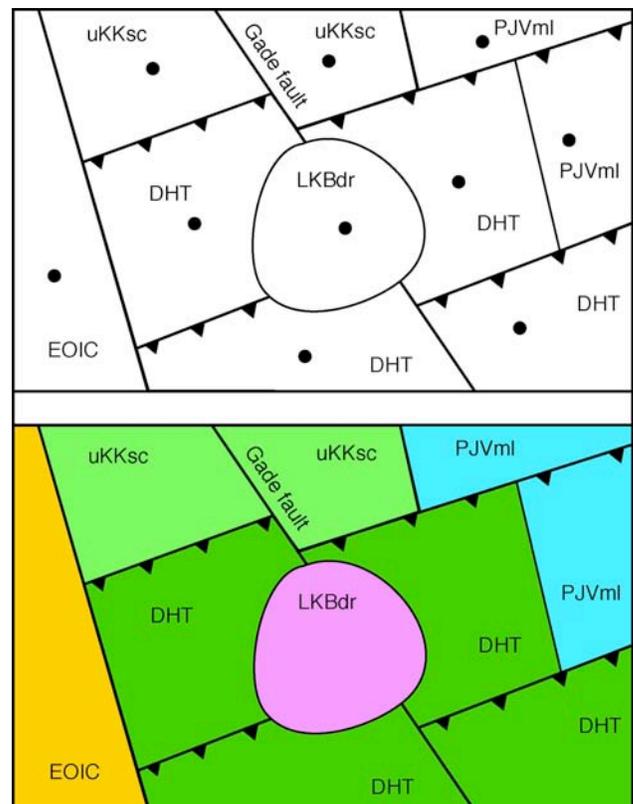
In compliance with the Mineral Tenure Act (MTA) Regulations, results of mineral exploration programs conducted on mineral claims in British Columbia are submitted to the Ministry of Energy, Mines and Natural Gas. These assessment reports contain information on geology, geophysics, geochemistry, drilling, prospecting and physical work. After a one-year confidentiality period, the reports become an open resource for planning mineral exploration investment, research, land-use planning, and resource management. Users can now access more than 32 600 company mineral assessment reports using the online ARIS database. More than \$1.9 billion of exploration expenditures have been recorded in assessment reports since 1947. The value of expenditures on 2010 exploration programs reported in 742 assessment reports, moved to off-confidential status in 2011, was \$155.0 million. The mining industry is encouraged to submit assessment reports in digital form (PDF by email, CD-ROM, DVD, or USB drive) to the Mineral Titles Branch. Benefits include higher quality digital reports; faster approval; and lower costs for printing, mailing, storage, scanning, and processing. In 2012, 866 reports were submitted, of which 793 were approved. Of these, 690 (87%) were submitted digitally, which is up 2% from the previous year. Allan Wilcox and Ted Fuller work with clients to approve reports. Approval rates increase if: adequate details are provided in cost statements; geochemical values are accurately located and plotted; full-scale geophysical maps are submitted; and cross sections and proper scales accompany drillhole data.

During the past year, Kirk Hancock provided mineral resource assessments of different areas of BC for the Ministry of Aboriginal Relations and Reconciliation to assist with treaty negotiations and other government business. Staff worked with the Mineral Policy and Regional Geology staff to develop economic and social assessments and exploration activity products. Laura de Groot continues to manage 11 000 web pages and keeps staff on track with database management plans and needs.

### 3.3. BC's Digital Bedrock Geology Map: BCGeology Map

The digital geological map of BC is important for mineral exploration and assessing mineral potential. Over the last couple of years, Yao Cui has been designing and implementing a sustainable and streamlined approach to integrate and deliver digitally seamless geological maps. Yao developed the Geology Operational Database Environment (GODE), using the spatial database PostgreSQL/PostGIS and the Geology Application Database Environment (GADE), using Microsoft® SQL Server 2008 (with spatial extension). Working with JoAnne Nelson, Yao and his team defined the geological framework data model as the base to maintain and edit contact and fault line work. The notion of anchored lines

and points will simplify data integration and reduce data boundary issues. Geological polygons are automatically generated from the line work and bedrock attributes are stored in the database as a point file (Fig. 6). With assistance from co-op students Graham Green and Victoria Francis, extensive initial data quality assurance work was carried out last year on the Province-wide geological framework data before and after its loading into the operational GODE database. This helped categorize and document a set of data quality specifications for the framework data. The approach was put into practice, with Fiona Katay and Leigh Sinclair joining the team this year to complete the recent data quality assurance and integration of updated framework data from North Coast, Terrace and QUEST. Tian Han developed scripts to check contact and fault linework, initially in the QUEST area. Yao and Fiona are working with JoAnne to review and standardize the lexicon and stratigraphic units in BC.



**Fig. 6.** Framework data showing linework and bedrock attributes stored in points or centroids (top), leading to a final bedrock geological map consisting of polygons, line work, and labels (bottom).

## 4. Conferences and publications

### 4.1. Conferences

Continuing a long-standing tradition, geoscientists of the British Columbia Geological Survey presented their research at national and international conferences, including meetings of the: Association for Mineral Exploration British Columbia (Mineral Exploration Roundup); Prospectors and Developer's Association of

Canada; Geological Association of Canada; Geological Society of America; Geochemical Society (22<sup>nd</sup> V.M. Goldschmidt Conference); International Union of Geological Sciences (34<sup>th</sup> International Geological Congress); Metallurgy and Materials Society of the Canadian Institute of Mining, Metallurgy and Petroleum (51<sup>st</sup> Conference of Metallurgists); and 47th Forum on the Geology of Industrial Minerals (Fig. 7). They also represented the Survey at provincial meetings in Kamloops (Kamloops Exploration Group) and Nelson (Minerals South).

In February, the British Columbia Geological Survey and the Pacific Section of the Geological Association of Canada co-hosted the 38<sup>th</sup> annual Cordilleran Tectonics Workshop (Fig. 8). Organized by JoAnne Nelson, and attended by 110 scientists from universities, government, and industry, the workshop highlighted 50 talks and posters devoted to past, ongoing, and future Cordilleran research. The workshop was capped by a field trip focused on the accretionary tectonics of southern Vancouver Island and led by Stephen Johnston and Dante Canil (School of Earth and Ocean Sciences, University of Victoria).

In November, the British Columbia Geological Survey and Pacific Section of the Geological Association of Canada joined forces again and co-sponsored the 2012 BCGS Open House (Fig. 9). Showcasing the work of BCGS geoscientists, the Open House featured a full day of presentations dedicated to the geology and mineral deposits of British Columbia. In addition to those by geologists from the BCGS, several talks were given by researchers from the School of Earth and Ocean Sciences (University of Victoria) and the Pacific Geoscience Centre (Geological Survey of Canada). The Open House was attended by over 130 geoscientists, with strong industry and student participation. Given its past success in 2009, and again in 2012, it is anticipated that this will become an annual BCGS event.

#### 4.2. Publications

In addition to the annual Geological Fieldwork volume, BCGS geologists published Open Files, GeoFiles, and papers in external peer-reviewed journals. All BCGS publications can be downloaded, free of charge, from [www.empr.gov.bc.ca/mining/geoscience/publicationscatalogue/pages/default.aspx](http://www.empr.gov.bc.ca/mining/geoscience/publicationscatalogue/pages/default.aspx).

##### 4.2.1. Open files

Britton, J., DeGrace, J., Grieve, D., Jago, P., Kyba, J., Madu, B., Northcote B., and Chu, R., 2012. Operating mines and selected major exploration projects in BC, 2011. British Columbia Ministry of Energy, Mines and Natural Gas, British Columbia Geological Survey, Open File 2012-01.

Ferbey, T., Levson, V.M., and Lett, R.E., 2012. Till geochemistry of the Huckleberry Mine area, west-central British Columbia (NTS 093E/11). British Columbia Ministry of Energy, Mines and Natural Gas, British Columbia Geological Survey, Open File 2012-02, 52 p.



Fig. 7. British Columbia Geological Survey booth at the Mineral Exploration Roundup, Vancouver, January, 2012.

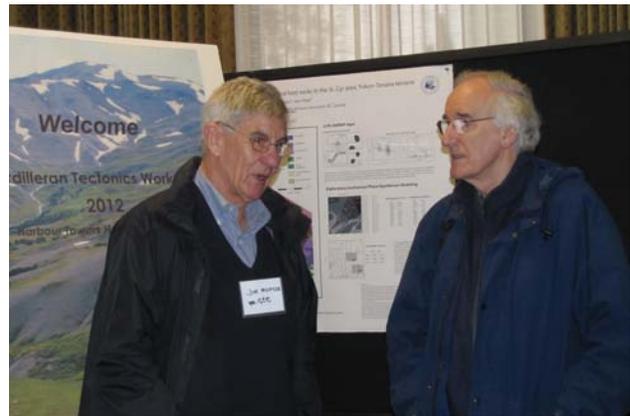


Fig. 8. Jim Monger (left) and Chris Barnes at the 38<sup>th</sup> annual Cordilleran Tectonics Workshop, Victoria, 2012.



Fig. 9. The open house, sponsored by the British Columbia Geological Survey and the Pacific Section of the Geological Association of Canada and held in Victoria, is anticipated to become an annual event.

Logan, J.M., Moynihan, D.P., Diakow, L.J., and van Straaten, B.I., 2012. Dease Lake - Little Tuya River Geology (NTS 104J/08 & 7E). British Columbia Ministry of Energy, Mines and Natural Gas, British Columbia Geological Survey, Open File 2012-04, scale 1:50 000.

Nixon, G.T., Hitchins, A.C., and Ross, G.P., 2012. Geology of the Turnagain ultramafic intrusion, northern British Columbia (parts of NTS 104I/07 and 10). British Columbia Ministry of Energy, Mines and Natural Gas, British Columbia Geological Survey, Open File 2012-05, scale, 1:10 000.

Simandl, G.J., E.A. Prussin, E.A., and N. Brown, N., 2012. Specialty metals in Canada. British Columbia Ministry of Energy, Mines and Natural Gas, British Columbia Geological Survey, Open File 2012-07, 48 p.

Schiarizza, P., 2012. Bedrock geology of the upper Kutcho Creek area (parts of NTS 104-I/01, 02). British Columbia Ministry of Energy, Mines and Natural Gas, British Columbia Geological Survey, 2012-08 (also released as GSC Open File 7234), scale 1:40 000.

van Straaten, B.I, Logan, J.M., and Diakow, L.J., 2012. Geology of the Hotailuh Batholith, northwestern British Columbia. British Columbia Ministry of Energy, Mines, and Natural Gas British Columbia Geological Survey, Open File 2012-06 and Geoscience BC Report 2012-10, 77 p.

#### 4.2.2. GeoFiles

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## 5. Mineral Development Office

The role of the BC Mineral Development Office (MDO) in Vancouver is to provide mineral and coal resource information to industry and government, promote the Province's minerals and coal industry domestically and abroad, and form a point of contact for industry on issues impacting the exploration and mining industries.

A primary output is the delivery of a technical marketing campaign that highlights the Province's mineral and coal potential, geoscience database and expertise, and attractive business climate. This includes developing publications aimed at a variety of audiences, from large foreign investors through to independent domestic entrepreneurs. These publications are distributed widely at conferences, business meetings, over the counter, and online.

This year saw the reformatting and release of "Opportunities to Explore" a popular publication geared to new investors with little knowledge of the Province's mineral resources. Financial and technical input from the Association for Mineral Exploration British Columbia, Mining Association of British Columbia, Geoscience BC and partner agencies have led to two print runs in two languages totaling 2000 copies, and wide access to the online versions. A daughter product of the publication includes a single page Infographic. In response to numerous coal inquiries a "Coal Industry Overview 2011" document was prepared; regular updating of this document is a priority of the Coal Geologist. Increased interest in the jade industry led to a new jade Information Circular, which updated a previous pamphlet.

The MDO coordinates the annual summary documents from the regional geologist program. Two products that represent a significant output from the program include a provincial overview and a regional summary. These publications maintain a reporting legacy that dates back to 1874, with the Annual Reports of the Minister of Mines.

In the past, the map "Communities that Benefit from Mining" was produced to illustrate the relationship between exploration expenditures and benefits to communities. It gained broad appeal from local government, area government representatives, and other parties that wanted to demonstrate the positive aspects of the exploration industry. Although the map has not been produced in recent years, a new version is under development. In an effort to capture the full effect of the industry beyond key exploration projects, the map now will include information about the tenure system and

claimed assessment work. The concept map will divide the Province into benefit 'watersheds'; however, because the map will have a GIS structure, its data can be viewed in a variety of perspectives.

The MDO interacts continuously with the mining and investment industry, including executive management, geologists, and prospectors at conferences, business meetings, trade missions and over the counter contacts. Significant events attended this year include: the Asia Investment Mission to China and Korea; the Pan-Canadian Mining Session in London, England; the Mineral Exploration Roundup, Vancouver; the Prospectors and Developers Association of Canada Convention, Toronto; the China Mining Conference, Beijing; the Sparwood Coal Symposium, Sparwood; and the KEG annual conference, Kamloops (Fig. 10).

The MDO works closely with other government agencies and the professional associations as part of a wider marketing effort. Using the resources of the BCGS, the office provides most of the technical expertise and professional delegates for presentations and meetings with inbound investment interest.

Given the location of the MDO in Vancouver, it is a natural point of contact for members of BC's mineral exploration and mining community. It plays an important role in flagging issues that impact the industry in BC and listening to their concerns.

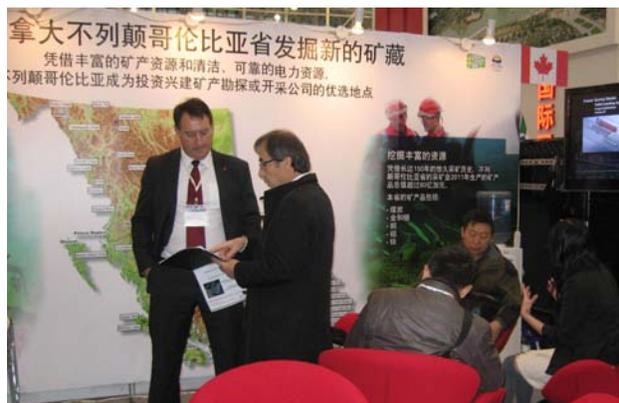


Fig. 10. Bruce Madu at the China Mining Conference held in Beijing.

## 6. Regional Geologists

In November, the British Columbia Regional Geologists were reassigned to the Ministry of Energy, Mines and Natural Gas from the Ministry Forests, Lands, and Natural Resource Operations. They are vital to government's ability to provide detailed geological knowledge at a regional level, and collate information on industry exploration and mining activity. Within their communities they are recognized experts on matters of exploration trends and successes. They support investment attraction initiatives, land-use processes, First Nation capacity building, and industry and public outreach. The MDO works closely with the Regional Geologists, helping them achieve their defined roles, and

profiling their important connection to the industry and the BCGS.

Regional Geologist	Office	Region
Jeff Kyba	Smithers	Skeena
Paul Jago	Prince George	Omineca and NE
Jim Britton	Kamloops	Thompson/ Okanagan/ Cariboo
Vacant (formerly Dave Grieve)	Cranbrook	Kootenay/ Boundary
Bruce Northcote	Vancouver	South/West Coast

### 7. Staff Update

The BCGS saw many staff changes in 2012 (Fig. 11). In January, Alexei Rukhlov joined the BCGS as the new Senior Geochemist. Alexei was recruited from the Alberta Geological Survey, where he conducted bedrock mapping and mineral deposit studies. He replaced Ray Lett who retired in October 2011 after more than 20 years of service as the Province’s Senior Geochemist. In March, Janet Riddell (Senior Coal Geologist), Lawrence Aspler (Editor and Publications Geoscientist), and Fiona Katay (GIS Geologist) filled temporary positions in the BCGS that were created to address critical backlog issues identified in the new BC Mineral Exploration and Mining Strategy. Holly Arnold (Junior Geoscientist) also joined in the Fall as part of the same backlog initiative. In May, Adrian Hickin arrived as the new Director of the Cordilleran Geoscience Section, a position vacated in November 2011 when Steve Rowins became the Chief Geologist and Executive Director. Adrian was previously the Director of Oil and Gas Geoscience in the Oil and Gas Division of the BC Ministry of Energy and Mines. In August, Melanie Mitchell, previously an Administrative Assistant with the Survey in Victoria, was promoted to the new position of Survey Branch Coordinator. Betty Chow joined the MDO in Vancouver as Administrative Assistant, shared with Mineral Titles Branch.

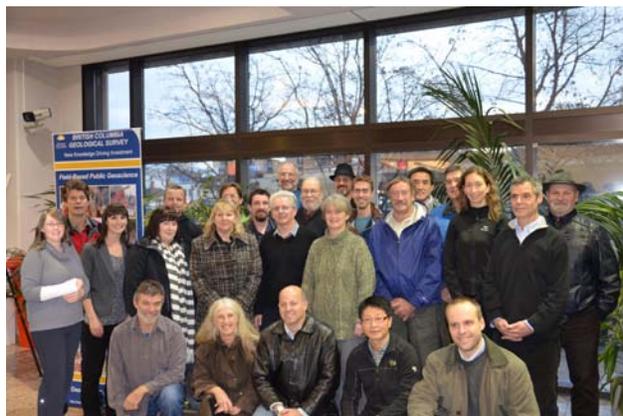


Fig. 11. British Columbia Geological Survey staff, 2012.

Finally, the Survey takes pleasure in recognizing Dave Grieve, the Regional Geologist for Cranbrook

(Southeast Region), who is retiring in early 2013, after more than 35 years of dedicated service to the Province (Fig. 12). We wish Dave a happy retirement.

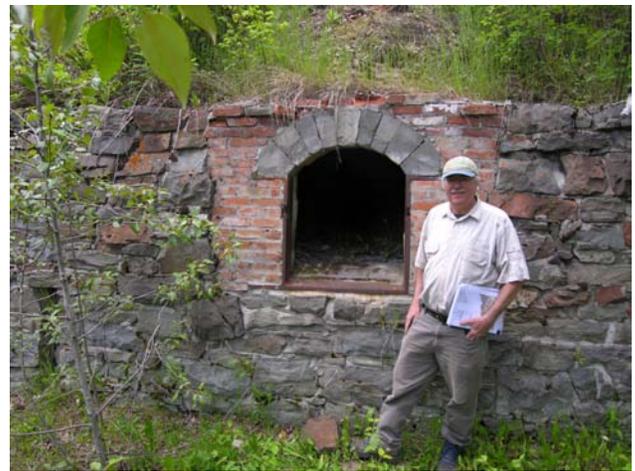
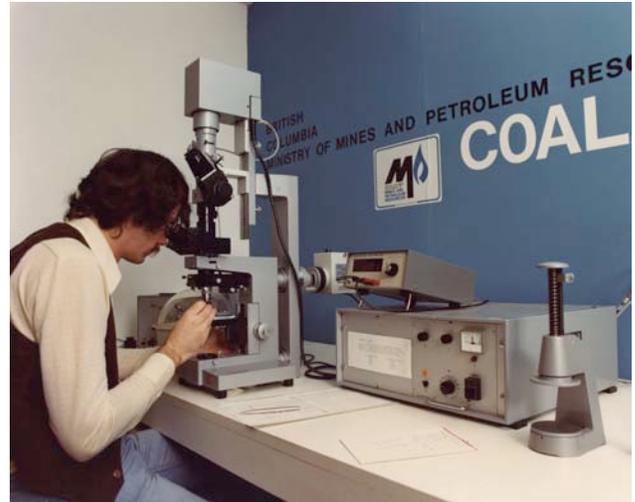


Fig. 12. Dave Grieve at the coal lab in 1977 (top) and at the Hosmer coke ovens in 2012 (bottom).

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