



BRITISH COLUMBIA GEOLOGICAL SURVEY

Providing Geological Data for Mineral Resource Development and Management

- The Ministry serves a \$4 billion industry.
- New maps and mineral deposit studies continue to spur exploration activity.
- Survey geochemists have confirmed B.C.'s "golden fleece".
- MINFILE proves to be a valuable desktop prospecting tool.
- New technology notwithstanding, prospectors continue to find mineral deposits.

THE SURVEY'S GOALS

The Geological Survey Branch of the Ministry of Energy, Mines and Petroleum Resources has recently grown in order to provide additional services to the mineral industry and the citizens of British Columbia. These services include the provision of background data and sophisticated analyses for prospecting, exploration, and marketing. In addition, advice is given to industry and government on mineral and energy potential, and intelligent land use. Survey scientists generate new knowledge of the province's rocks and minerals, catalogue and store vast amounts of data, and disseminate information as they undertake a variety of activities.

Disseminating Information and Advice

- The Survey's Scientific Review Office has a recently acquired reputation for speedy publication of all scientific studies. Thus, the report on all field work undertaken in a given year is available in published form early in the following year, usually by the time of the annual "Cordilleran Roundup" in Vancouver.
- MINFILE data on the Province's mineral endowment is available to the public at modest cost in either hard copy sheets and maps, or as data diskettes for use with personal computers.
- Survey staff provide consultation and advice from the offices and laboratories in Victoria, and from the regional offices in Vancouver, Smithers, Prince George, Kamloops, and Nelson. The MINFILE system and industry assessment reports are also available for viewing at these locations.

THE SURVEY'S WAY

External Guidance

Advice from outside of its ranks is essential to the health of any research agency, especially one undertaking applied research. The Geological Survey Branch sought such advice from a committee of the Canadian Geoscience Council some years ago. Following the committee's advice, the Branch appointed a Technical Liaison Committee composed of senior managers and scientists from industry, the universities, and the Geological Survey of Canada. This Committee advises the Director on all important aspects of the Survey's operation. In addition, Survey scientists and the District Geologists continually seek the views and criticisms of their clients in order to tailor their products and programs to the needs of the province.

Team Work

- Advances in science are increasingly dependent on teamwork. The Survey's scientists and support staff are strong proponents of cooperative projects that cut across administrative boundaries.
- Project Geologists carry out geochemical sampling and work closely with mineral deposits geologists, District Geologists, and industrial mineral experts. All field workers contribute to the expansion and updating of MINFILE.
- Survey scientists participate in the training of prospectors, and provide advice on land-use problems.
- Close ties are maintained with UBC and universities across the country.



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The Survey collects and interprets data that help us understand the geological framework of the province. That understanding is essential to orderly exploration and development of energy and minerals and to the wise use of our land.



P. Fletcher



P. Fletcher



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Mineral Deposits

Studies of the geology and metallogeny of mining camps and areas of high mineral potential are traditional for the Geological Survey Branch. Thorough field studies are followed by isotopic analysis and whole-rock and trace element analyses. A major goal is to produce mineral deposit prediction models that will serve as guides to exploration and for land use planning. For example, research at the Toodoggone gold-silver camp has led to a model for epithermal deposits that can be usefully applied throughout the province. Geological models of skarn mineralization developed in the famous Hedley gold camp are also finding widespread application.

Changing Structure

The Geological Survey Branch has been reorganized in recent years to accommodate its increase in size and its expanding role in resource management. The Geological Survey Branch consists of four major operating sections. Their functions are briefly described here.

MINERAL DEPOSITS AND REGIONAL MAPPING SECTION

"PROVIDING THE GEOLOGICAL MAPS AND THE METALLOGENIC MODELS THAT INDUSTRY NEEDS."

Projects are selected during discussions with the Technical Liaison Committee, ensuring input from industry, university, and federal government managers and scientists.

Regional Mapping

The Branch first began its regional mapping work in 1985 with funding supplied under the Canada-British Columbia Mineral Development Agreement (MDA). Industry had identified 1:50 000 scale geological maps as fundamental to exploration work, yet only 5% of British Columbia had been mapped on this scale. Nine staff geologists now undertake regional mapping projects.

Mapping on this scale in rugged British Columbia terrain is very expensive, and care is taken to share ideas, as well as helicopters and other logistical support. These projects also include collecting silt samples so that geochemical overlays can accompany publication of the geological maps.



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RESOURCE DATA AND ANALYSIS SECTION

This section is responsible for storing mineral deposit data from many sources. Their program – MINFILE – provides an easily retrievable and widely usable format. MINFILE data is routinely used for land use planning and for promoting the search for new mineral deposits.

MINFILE is the centre of the inventory system in that it contains information on more than 10 000 metallic, industrial, and coal occurrences. It is a relational database programmed for personal computers. It is able to search, sort, and manipulate data entered into various information fields. As a desktop prospecting tool, it can play an important role in exploration program design.

Assessment reports submitted by exploration companies must be approved by Survey scientists. This information is then made available in hard copy and on microfiche cards at District Geologist offices throughout the province.

This section also maintains an inventory of industrial minerals through field and office studies. Use of industrial minerals is growing and opportunities are emerging for new developments in B.C.



P. Fletcher

"MINFILE IS ELECTRONICALLY AND GEOLOGICALLY SUPERIOR TO ANY MINERAL DEPOSIT DATA SYSTEM IN THE COUNTRY."

DISTRICT GEOLOGY AND COAL RESOURCES SECTION

"ABOUT 85 PERCENT OF NEW DEPOSITS IN BRITISH COLUMBIA ARE DISCOVERED BY PROSPECTING AND GEOLOGICAL INTERPRETATION."

This section includes the district geologists; the staff who manage the Prospectors Assistance Program; and, those who carry out research and inventory studies on the quality and distribution of the province's coal resources.

District offices are stocked with maps and reports produced by the branch and by industry. District staff endeavour to visit and compile data on all new exploration activity within their jurisdictions. They also make important contributions to the Provincial Mine Development Re-

view Process. This ensures that proposed developments meet strict technical and environmental guidelines before going into production.

The Prospectors Assistance Program began in 1932 when a small grubstake and a minimum of training was offered to provide employment in the Depression years. It has evolved into the current \$0.5 million program including an annual Advanced Prospecting Course taught by Survey geologists and volunteers from industry and the



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universities. Over 300 prospectors have taken the Survey course over the last decade.

Coal studies differ markedly from metallic mineral studies since we now know the stratigraphic horizons where coal can be found. The Survey pursues coal-quality and other studies through careful sampling, detailed petrography and chemical analyses. This helps producers to know their products and to blend coals to meet rigid customer requirements. Most of the province's \$1 billion coal production is exported to Japan.

APPLIED GEOCHEMISTRY AND SURFICIAL GEOLOGY SECTION

*"GEOLOGICAL PREDICTION AND ADVICE IS ONLY AS
GOOD AS THE DATA ON WHICH IT IS BASED."*

This section studies the surficial layer of unconsolidated materials that mantle much of British Columbia. The section's goal is to help locate, within the surface layer, mineral deposits of economic interest such as placer gold, and sand and gravel deposits. Its scientists conduct geochemical surveys and develop techniques to "see" through the drift to discover mineral deposits buried in the underlying bedrock. The section also includes an analytical laboratory, which provides analytical services to Branch geologists.

Geochemistry

Regional stream sediment and water surveys have been carried out since 1975 to define areas with high mineral content in sediments and help pinpoint favourable areas to search for new

mines. Approximately 42% of British Columbia has been surveyed at a density of one sample per 12.6 sq. km. Originally, samples were analyzed for 11 elements; now, in response to the needs of industry, analysis includes 22 elements, including gold. Data is readily available on floppy diskettes, suitable for use with personal computers.

Heavy rainfalls in parts of B.C. flush fine sands and clays from stream beds, making geochemical sampling difficult. A Survey research project has resulted in the discovery that the moss mats that grow on logs and rocks in B.C. streams trap and retain fine sediments and are natural collectors of gold and other heavy minerals. Moss mats may be an important data source for geochemical surveys.

Surficial Geology

The history of mining in British Columbia has its beginnings in gold placer mining. A survey conducted by the Ministry indicates that the placer gold mining industry is still an important factor in the provincial economy with an annual value of approximately \$52 million. However, known reserves will soon be depleted and new deposits must be found. In 1988 the government opened new areas to placer exploration. The Branch reinstated a surficial geology program in 1989 after a 20-year hiatus. The surficial geologists provide information to help explorationists locate new, hidden mineral deposits.



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Analytical Laboratory

The Geological Survey Branch maintains a modern laboratory to provide chemical analyses of ores, rocks, and minerals in support of its program. It also participates in and provides advice on coal-conversion studies and coal-quality analyses that will enhance the use of British Columbia coals in domestic and foreign markets.

Laboratory facilities include X-ray fluorescence, atomic absorption and emission spectroscopy; X-ray diffraction, and classical wet and fire assay capabilities. The laboratory, throughout its long history, has developed a reputation for reliable results and innovative methods.



MINERAL DEPOSITS & REGIONAL MAPPING

The Reason

Mineral production from volcanic and intrusive host rocks of Mesozoic age (i.e. 66 to 245 million years old) has exceeded that from rock of all other ages in British Columbia. The Geological Survey Branch has, and continues to, devote many of its resources to understanding the mineralizing processes and the large-scale controls of these ore deposits.

The Goals

Careful studies of mineral deposits and their geological surroundings allow interpretations of ore deposition processes that, in turn, lead to generic models that explain the formation of the deposits. The model serves as a guide to exploration in regions with similar geological settings.

The Methods

Detailed field studies of deposits in mining camps and other mineralized areas have been conducted by Survey staff. Recent 1:50 000 mapping in relatively unexplored areas is providing an opportunity to test the exploration models.

Field logistics have changed radically over the years: helicopters ease access permitting more time to be spent studying and attempting to understand the record of the rocks. Observations are stored in computers, usually on the day they are made. Laboratory work still involves the petrographic microscope but also includes rapid chemical analyses, fluid inclusion, and electron microprobe studies.



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Studies presently underway in central British Columbia include a review of mineral deposits along a chain of Mesozoic volcanic islands where large, low-grade copper-gold deposits are the target.

In the south, near the famous Rossland gold camp, another study is attempting to relate volcanic and structural history to mineralization. Here, vein and stratabound gold-copper deposits are the targets. Similar work in the northwest is examining the setting of a spectrum of Mesozoic deposits in the Stewart and the emerging Sulphurets/Iskut areas.

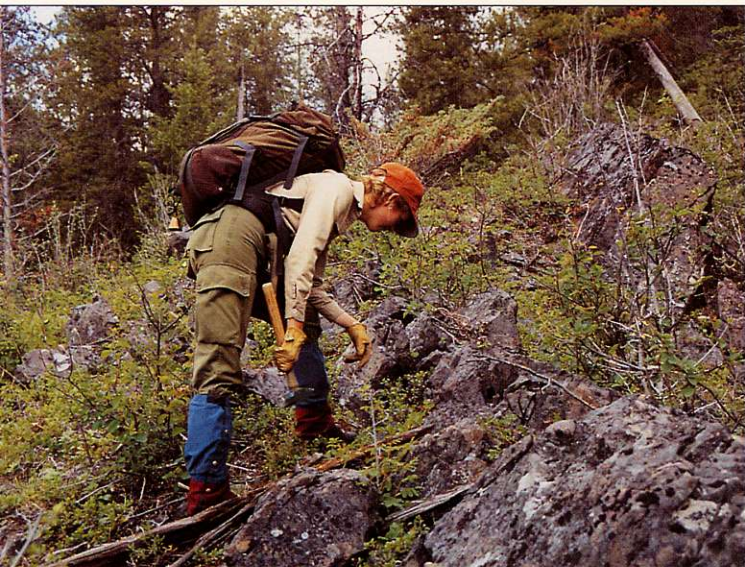
"Mapping and mineral deposit studies are paving the way to new discoveries."

The Products

Metallogenic models that have evolved from Survey studies have been widely used to explore for mineralization throughout the province. Survey contributions to metallogeny are made available to the public through papers in refereed journals and through the Branch's own series of maps and reports. Open file maps and preliminary reports are usually available within six months after the field season.

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A GEOCHEMISTRY PROJECT

Gold in Moss Mat Sediments

The Reason

Abundant annual rainfall in regions of British Columbia results in stream beds being flushed clean of fine sand and clay sediments. This presents a problem because these fine fractions are the material needed as samples in the Regional Geochemical Surveys that are carried out under the supervision of the Geochemistry Group. They are also the sampling medium used by mining companies in their more detailed geochemical surveys.

The Goal

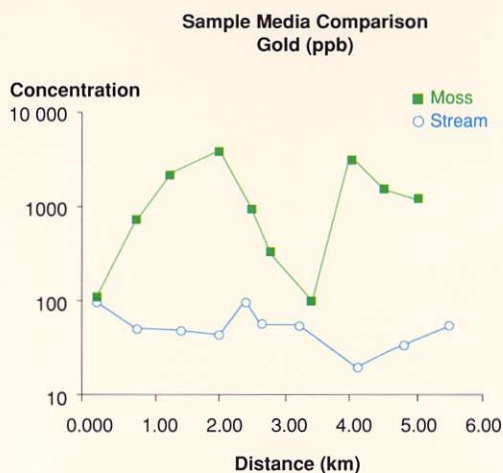
One of this group's research projects involves comparing traditional and innovative sampling techniques to identify more effective sampling methods. Early in this study, results showed exciting possibilities for the use of stream sediments trapped in moss mats. These sediments could be used as sampling media in cool, humid, mountainous regions where fine sandy sediments are not abundant. Moss mat sampling was successfully used in a 1988 regional sampling program of Vancouver Island.

"Like the legendary golden fleece, moss mats growing within a stream are natural collectors of gold."

The Method

Initial testing focused on Vancouver Island where moss mats are common, growing on the top and downstream faces of logs and boulders. The mat and its load of sediment are easily removed from these surfaces. After the mat has been dried, the fine sediment can

be separated from the plant fibres by pounding the mat with a wooden mallet and recovering the sediment through an eighty-mesh sieve. Moss mats typically yield 50 grams of the -80 mesh sediment required for analysis. This contrasts with an average of only 15 grams obtained from normal sandy sediment samples. Determination of 22 elements as well as an analysis for gold is best carried out with at least 23 grams.



Sampling has taken place in widely contrasting terrains on Vancouver Island. It has shown that where gold occurs as coarse particles, the analytical results of moss mat and conventional stream sediment samples are almost identical. Where gold is fine, it is almost an order of magnitude more abundant in moss mat sediments and, hence, provides greater geochemical contrast and better analytical precision.

The Products

Complete details of the method and the test results are published in the scientific exploration literature and in the Survey's annual publication, *Geological Fieldwork*. Explanations are offered in the poster sessions at forums such as the annual Cordilleran Roundup.

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EXPLORATION DATABASE

The Reason

Every year, for more than a century, valuable data has been recorded and understanding gained of British Columbia's mineral and coal deposits. In recent decades, the rate of information accumulation has expanded enormously. Today, a wealth of data from published and unpublished sources is available on over 10 000 mineral occurrences in the province. This information is invaluable to mining companies designing exploration and development programs, and is essential for government's management of resources.



Data is available on over 10 000 mineral occurrences in British Columbia.



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MINFILE is a computerized relational database. The Geological Survey Branch is the first agency in Canada to make its databank available to the public on floppy diskettes. The database is accompanied by MINFILE/pc, a search and report software program for explorationists. Searches are conducted with simple, user-friendly screen menus; information files are created that can be saved for future reference or to produce plots; and reports may be generated with the search results. It is truly a desktop prospecting tool!

"MINFILE – the value of a databank depends on regular updating, its accessibility, and its flexibility."

The Goals

- To include detailed, high quality information in the database.
- To keep the databank up-to-date.
- To make the information easily and quickly accessible to a public that includes both large corporations with sophisticated equipment and individuals who may or may not have personal computers.
- To make data available in forms that are useful to a wide variety of users.

The Method

MINFILE is a computer-based mineral inventory with more than 10 000 occurrence descriptions. Through a continuing process, occurrences in the file are updated. Each deposit entry includes historic information, a geological description, a bibliography and, where pertinent, data on production, reserves, and assays.



The Product

Data stored in MINFILE is available at nominal cost in the following formats:

- Hard copy printouts by map sheet.
- Mineral occurrence maps at 1:250 000 scale.
- Data diskettes with standard ASCII format files containing the entire database for each map sheet. The files, when loaded onto a hard disk, can be manipulated with common database management programs or with the MINFILE/pc program.
- A utility diskette to assist with data loading is provided without charge.

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INDUSTRIAL MINERALS

"AT THE TURN OF THE CENTURY, BRITISH COLUMBIA PRODUCED A WIDE VARIETY OF QUALITY DIMENSION STONE – TODAY, MOST IS IMPORTED."

The Reason

The story of dimension stone is the story of many other industrial minerals. Production value of asbestos and sulphur presently each amount to a respectable \$50 million per year. But only 11 other industrial minerals are produced, valued in total at \$12 million. Apparently, if we need more industrial minerals, we import them. Yet a new 1:2 000 000 scale map shows significant occurrences of 40 different mineral commodities.

The Goals

The Industrial Mineral group strives to arouse the interest of potential developers by describing the locations and availability of various types of commodities by providing data on their quality as well as identifying incentives to development.

The Methods

The industrial mineral scientists carry out literature search and compilation, detailed site-specific studies, and regional field investigations. Activity has increased greatly in the past few years. Work with other agencies in analytical and metallurgical testing and in commodity market research has prompted a number of promising studies:

A study of alkaline ultrabasic rocks has outlined a previously poorly-documented alkaline igneous belt in eastern British Columbia, parallel to and including the Rocky Mountain Trench. Carbon-



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ates of both Precambrian and Late Paleozoic ages have been identified. The study has stimulated much interest in rare earth element prospecting. Several promising occurrences, which contain niobium and rare earth elements, are being investigated.

A mineralogical assessment of the interior Tertiary volcano-sedimentary basins was undertaken to locate favourable stratigraphic intervals or geological settings for various industrial minerals. The study has shown occurrences of bentonite, zeolite, volcanic glass, and perlite along the Fraser River fault, and also zeolite and bentonite in the vicinity of Princeton. Ancillary studies include a Survey-sponsored thesis at the University of Guelph which has shown that zeolites, through an ion exchange process, slow down dissolution of phosphates. This implies that zeolites could promote delayed action in fertilizers.

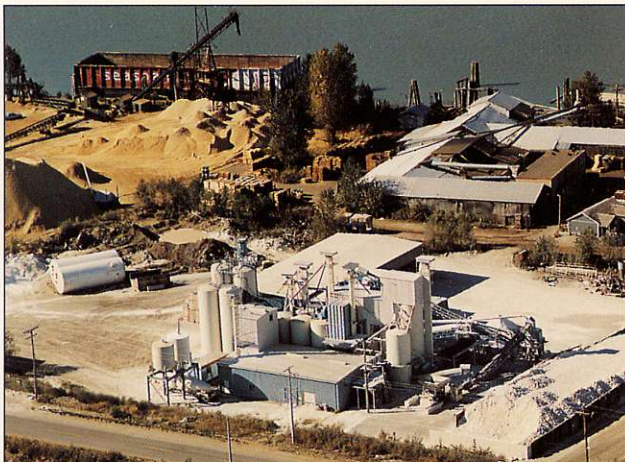
A study of dimension stone involved visits to abandoned quarries that supplied the attractive stones used in many of the province's public buildings earlier in this century. Sample blocks have been collected, finished in various ways, and strength tested. The market attributes of the quarries have also been assessed. An attractive colour brochure on dimension stone opportunities in British Columbia is available.

The Products

Studies of the province's many industrial mineral resources are released in a series of illustrated open file reports and pamphlets. Survey staff also give talks at mining society symposia. Liaison is maintained with potential developers.

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COAL

The Reason

Coal is the single most valuable mineral produced in British Columbia with sales over one billion dollars each year. Coal mines account for nearly half of the mining jobs in the province. Nearly all of this production is metallurgical coal from the Rocky Mountains and Foothills, yet coal deposits with a wide range of ranks and quality types occur throughout British Columbia. The Geological Survey Branch has developed, and continues to maintain and expand, a comprehensive data and knowledge base for the province's coal deposits and coal-bearing regions.



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The Goals

The Coal Group develops and communicates an understanding of the coal resources of the province. Detailed deposit analysis provides an exploration and development framework with respect to stratigraphy, structure and coal quality. Databases such as the Core Library, Coalfile and coal geology publications provide a strong base with which coal exploration can be launched. The Coal Group works not only to increase public awareness of coal so that its value to the economy is realized and environmental concerns are understood, but also to ensure that decisions on mining and coal utilization are made on an informed basis.

The Methods

The coal group strives to attain its goals through a variety of activities:

- Development of geological base maps of the coal-bearing areas of the province at appropriate scales.
- Development of a coal quality inventory for the coal deposits of the province and the promotion worldwide of this information to potential buyers and producers.

- Maintenance of over 150 000 metres of representative drillcore from provincial coal deposits ensures that valuable information is available to the public in the longterm.
- Maintenance of a library for public viewing of all coal exploration reports. In addition, a computer database (Coalfile) summarizes the information in the assessment reports to increase efficient access.
- Review and approval of all coal assessment reports for compliance with the Coal Act Regulations.
- Maintenance of a coal petrography laboratory for research into coal characterization and routine vitrinite reflectance analysis.

"The complex and varied nature of the province's coal resources demands multi-faceted data collection, interpretation and dissemination."

The Products

Coal information from coal assessment reports is available for public viewing or summarized on computer diskettes. Coal core at the Charlie Lake facility is available. Geological maps and reports describing the distribution and quantity of coal are available in a variety of Geological Survey publications from Information Circulars to Bulletins.



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DISTRICT & REGIONAL OFFICES

The Reason

To keep track of exploration and mining activities and to provide services to the community, it is essential that the Survey maintain offices where the people and the activities are located. The success of offices in places such as Smithers and Kamloops, prompted industry to suggest, through a Canadian Geoscience Advisory Committee, that an office be established in Vancouver to service the second largest concentration of mineral exploration professionals in Canada.

The Goals

The District and Regional offices keep up-to-date on the activities and plans of the exploration and mining community and provide advice, consultation, and services. They also provide feedback to Branch headquarters in Victoria in order to enhance current services and to aid in the design of new projects. District and Regional office staff act as a liaison between the Survey, industry, and the public.

The Methods

These offices are involved in a wide variety of activities:

- Maintenance of an up-to-date inventory of British Columbia's geology, mineral deposits, and exploration trends.
- Provision of advice and consultation to industry, the public, and government agencies.
- Field conferences that bring industry, government, and university scientists together to discuss and share geological data.



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- Geological input to the Land Use Review process.
- Forecasting of potential exploration targets to initiate interest and promote Branch research projects in key areas.
- Field and office research and compilation, conducted independently or in cooperation with other Branch scientists.
- Reviews and commentaries on submissions to the Mine Development Review Committee which oversees the permitting process for new mines.
- Talks, posters, and rock specimen collections exhibited at technical meetings, forums, and career days in schools.
- Maintenance of a small research library for the convenience of the public.
- Access to the MINFILE system.
- Access to industry assessment reports.
- Prospector training and assistance.

The Products

A major product is the goodwill and spirit of cooperation that exists between the Geological Survey Branch, the mining industry, and the general public. These Offices are a major contributor to the annual volume *Exploration in British Columbia* and to other Survey publications.

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PROSPECTORS ASSISTANCE & TRAINING

The Reason

Prospectors play a fundamental role in the discovery of new mineral deposits in British Columbia's rugged terrain.

It is therefore important that British Columbia maintain a cadre of well trained prospectors, and that a meaningful level of support be provided to these independent prospectors.

The Goals

The Prospectors Assistance and Training Program maintains a meaningful and technically superior program of assistance to individual prospectors. It comprises a grant program, basic to advanced training courses, a system to support training courses delivered by other agencies, and general scientific support.

The Methods

The Prospectors Assistance Program provides grants to individual prospectors to support field prospecting programs and delivers three levels of prospecting courses consisting of introductory level courses, the 18-day Advanced Prospecting Course, and Petrology for Prospectors.

Eight introductory level prospecting-geology courses sponsored by various agencies are delivered at centres throughout the province. The Prospectors Assistance Program delivers an introductory level course annually in Victoria, supports the introductory level courses offered by the British Columbia and Yukon Chamber of Mines in

Vancouver and the Chamber of Mines of Eastern British Columbia in Nelson, and supports other courses by providing various materials to the sponsoring agencies.

The annual Advanced Prospecting Course is a unique 18-day, live-in course that produces soundly trained prospectors capable of carrying out hardrock programs of all types.

A third level course, Petrology for Prospectors, introduced in 1990, is a continuing education course for those who have training/experience at or above the Advanced Prospecting Course level.

The Products

The program provides financial support for individuals engaged in legitimate prospecting programs and ensures that they have access to scientific support from Geological Survey Branch geologists. The program also provides or sponsors prospector training at introductory or advanced levels. These products directly contribute to the expertise and success of British Columbia prospectors, thereby sustaining the health of the mining industry and the economy in general.

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"Informed prospectors form a unique and valuable resource for British Columbia's mining industry."



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