

Department of Natural Resources

INFORMATION PAPER Role of the Geological Survey





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Iron Ore Company of Canada mill – Labrador City



Dimension stone quarry – Ten Mile Bay



Geological map – central Newfoundland

INTRODUCTION

The mineral- and petroleum-resource industries are important elements of the province's economy. The mineral industry contributes significantly to our economy through the production of over a dozen mineral commodities. Approximately 3300* people are employed directly in the mining industry and many more are employed with service companies and the almost 130 mineral-exploration companies active in the province. The estimated value of mineral shipments in 2005 was \$1.42-billion. This is expected to increase to \$2.6-billion in 2006 and mineral-exploration expenditure is expected to be almost \$80-million. The petroleum industry is pursuing exploration to discover and develop hydrocarbons in prospective geological basins onshore and nearshore western Newfoundland (off-shore oil and gas are under joint federal–provincial jurisdiction).

These extractive industries are attracted to national and international jurisdictions that offer them a competitive advantage. All other factors being equal, the quality of the geoscience database and the relative ease with which it can be accessed, figures significantly in deciding where companies will invest.

Construction projects and major industrial developments, such as highways and offshore platforms, all require specialized geological information for engineering purposes, including the location and performance of particular types of aggregate.

As all development has an impact on the natural environment, which is significantly influenced by the underlying geology, geoscientific data are essential in the land-use planning process to mitigate possible deleterious short- and long-term effects. It is important in the 21st century that government be well informed on the complex issues associated with sustainable development. In addition, decisions are increasingly being made or influenced by a wide variety of groups within the general public; such decisions require ready availability of accurate and unbiased information on the nature and potential of resources, and best practices in preventing environmental damage.

The province thus requires geoscientific data to stimulate and manage development of its mineral and onshore petroleum resources, and to provide a framework upon which regulatory issues may proceed. In addition, these data form an integral element of promotional activities designed to attract mineral-exploration investment to the province. To meet these and other demands, the Department of Natural Resources has fostered the growth of a small but effective Geological Survey, the only government agency charged with providing this information.

^{*} This and other statistics are from Department of Natural Resources, fall 2006.



Mineral exploration – drilling in central Newfoundland



Oil-and-gas exploration – drilling in western Newfoundland



Gold bars – Nugget Pond

The Geological Survey provides the basic research into bedrock geology, mineral deposits, surficial-sediment deposits and landform structures. It maps the distribution and level of naturally occurring, possibly toxic, elements, and provides other scientific data necessary to manage in a sustainable way the province's mineral and petroleum resources for the benefit of the province. Maintaining an active and competent 'Geological Survey' with its knowledgable, professional staff is thus both a necessity and a vital asset.

This information paper provides a review of the activities of the Geological Survey, and its impact on the economic development of the province.

RESOURCE DEVELOPMENT AND THE GEOLOGICAL SURVEY

Introduction. The economical extraction of useful materials (e.g., iron, nickel, copper, gold, dimension stone, bedrock aggregate, sand and gravel, oil and gas) from the ground for everyday societal consumption is the basis of the quarrying, mining and petroleum industries. Exploration is the process by which geoscientific surveying, prospecting and testing result in the discovery and eventual development of new mineral and petroleum resources. This generation of new wealth by the resource industries depends on exploration to replace resources and ensure their long-term viability. The Geological Survey plays an indispensable role in the exploration process.

Role of the Geological Survey. The mineral- and petroleum-resource industries rely on readily accessible, impartial, state-of-the-art geoscience information. This information, particularly in the case of the mineral industry, is provided by government geological surveys in Canada.

In the past, mines were usually discovered either accidentally or by relatively straight-forward prospecting and exploration. Many or most of these more readily seen, close-to-surface mineral deposits have been discovered. Now, detailed and sophisticated geoscientific information is needed to find deeper, hidden deposits. Government geological agencies have the responsibility for providing highly accurate bedrock and surficial maps and metallogenic analysis.

Onshore petroleum resources are the responsibility of the Department of Natural Resources. Reports of crude oil seeping from the rocks at Parson's Pond on the Great Northern Peninsula go back to 1812, and the first oil-exploration well in Newfoundland was drilled there in 1867. Today, petroleum companies are again interested in the rock formations of western Newfoundland, and are using geoscientific data gathered over the years by the Geological Survey to help them in their search for hydrocarbons.



Studying drill core – Duck Pond zinc-lead-copper deposit



Quarrying granular aggregate



Copper-lead-zinc ore – Buchans

Information on unconsolidated and bedrock aggregate is vital to sustain the growing demand from infrastructure developments such as roads, airports, bridges and dams, as well as hydroelectric and offshore hydrocarbon projects. Survey data on aggregate quality ensure that the right product goes to the right job, saving the province millions of dollars in repair and replacement costs.

The Geological Survey also:

- ✓ provides databases on rock formations, ages, mineral deposits and occurrences, fossils, aggregates, geochemistry, geophysics;
- defines and describes industrial-mineral resources such as dimension stone;
- ✓ provides information services to clients (e.g., prospectors) via face-to-face consultations, publications, promotions, and the internet;
- ✓ archives and makes available (via internet and over-the-counter service) over 17 000 documents on the geology and mineral potential of the province;
- ✓ provides advice and support to prospectors through the Matty Mitchell Prospector Resource Room;
- ✓ maintains a state-of-the art GIS-based internet delivery system for its data, and
- ✓ promotes new opportunities for mineral exploration at local, national and international mining conferences and trade shows.

Survey Impacts on Industry. Geological Survey programs have grown and evolved over the years to meet the immediate and anticipated needs of the mineral- and petroleum-resource industries. There are many direct and indirect links between geoscientific surveys and exploration activity, in particular for minerals. The discovery of a geochemical anomaly indicating mineralization, or the identification of a favourable rock type can be shown to have an immediate positive impact on the exploration industry, often leading companies to acquire exploration rights to land, and to spend exploration dollars immediately. For example, till-geochemistry studies in central Newfoundland have caused major acquisitions of mineral rights.

Examples also abound of geological mapping and mineral-deposit studies by the Survey directly stimulating mineral exploration by the documentation of: volcanic rocks north of Bay d'Espoir in 1983; gold-bearing outcrops north of Gander Lake mapped in 1987; precious-metal epithermal systems in eastern Newfoundland; tungsten-bearing granite on the



Till geochemistry – open file report



Lake geochemistry – Ni distribution



Urban development

Bay d'Espoir highway; geochemical anomalies leading to the discovery of the Strange Lake rare-earth deposit in Labrador, and tin, tungsten and molybdenum in south-central Newfoundland. Survey activities have directly influenced development of the Lower Cove aggregate quarry, dolomitic marble in western Labrador, and dimension-stone quarries at Ten Mile Bay (south of Nain) and Jumpers Brook in central Newfoundland.

The impacts of other projects are realized over the medium and long term. For example, geological maps of western Newfoundland, produced by the Survey over the last twenty years, have been in demand by oil companies seeking to assess the petroleum potential of that part of the province.

Even longer lags between research and benefits are expected for programs that investigate mineral commodities with little or no *current* market demand, or study areas of perceived little mineral potential. For example, the Survey's excellent database on the Voisey's Bay area was instrumental in directing mineral-exploration activity in Labrador after the discovery of the Voisey's Bay deposit. History has shown that market demand for certain commodities is cyclical, and that jurisdictions that have done their groundwork are in an excellent competitive position when markets improve, e.g., the geological and geochemical databases from the 1970s and 1980s in the Gander area have helped to direct and drive mineral exploration in that area during recent years. Mapping in Labrador's Central Mineral Belt carried out in the 1970s and 1980s forms the basis for ongoing staking, mineral exploration and land-use negotiations. These indirect roles are an important contribution of the Geological Survey.

SOCIETAL REQUIREMENTS AND THE GEOLOGICAL SURVEY

Introduction. Most people appreciate the connection between geological studies and the development of mineral or petroleum resources. What is not so clearly understood is the increasing demand for geoscientific information for other applications in society. A sustainable-development approach to economic activity requires a comprehensive geoscience database for the province, which must be constantly updated and provided by the Geological Survey.

Land-Use Planning. Geoscientific information is an essential ingredient in proper land-use planning. Mineral-resource data, for example, must be provided to policy makers considering the "pros" and "cons" of establishing a park or ecological reserve in the province. Survey data have also played a vital role in aboriginal land-claims negotiation and in resolving land-use conflicts.



Infrastructure development



Multiple land use – Humber Valley



Clean environment



Natural hazards – landslide, Harbour Breton

Surficial-geology data define the type and location of glacially derived sediments, which are the primary source of construction aggregate for towns in the province. In order to prevent municipalities from unknowingly encroaching on valuable nearby aggregate reserves, the Geological Survey must continue to provide up-to-date maps and reports on the quality and distribution of these deposits.

Identifying Natural Hazards. Natural hazards to human health and safety exist in the province. Sea-level change, coastal erosion, landslides and sink holes are potentially dangerous; geological investigations help to minimize these risks.

Geochemical studies to encourage mineral exploration are also used to detect natural hazards by identifying areas that have high levels of naturally occurring toxic and radioactive chemicals. Normally, these substances occur at low levels and pose no threat. However, in some areas natural conditions may result in above-guideline amounts of certain elements, e.g., arsenic in wells in certain areas of the Avalon Peninsula. The Geological Survey works with other agencies, such as the Emergency Measures Organization and the Department of Environment, on these issues.

Identifying Human-Induced Hazards. Regional and local geochemical and geological surveys are also necessary to assess hazards caused by human activity. In urban areas, the Survey has conducted studies on lakebottom sediments to determine what conditions were like before European settlement, thus providing a framework for measuring the extent of human-induced environmental change. The Geological Survey also provides surficial-geology information that is essential to the siting of landfills and the management of shallow groundwater resources.

Tourism and Educational Resources. In Newfoundland and Labrador, nature tourism, with a strong emphasis on the geological evolution of the province and its mining history, is becoming popular. The public must be made aware of the importance of rocks, minerals and petroleum products to our standard of living and economic well-being (hence the adage - *If it can't be grown, it must be mined*). The Survey's program of school visits, public lectures, and information displays supports these messages.

Outreach. The decision-making process for natural-resource development, including that tied to complex regulatory and land-use issues, is influenced heavily by public opinion. There is an increasing need to increase awareness of the importance of natural resources and Earth sciences, teach the principles of geology and mining to general audiences, and promote realistic expectations of mineral and energy development.



Alexander Murray – first Director of Geological Survey of Newfoundland (1864-1883)



Bedrock geological mapping



Surficial geological mapping



Mineral deposits studies – gypsum, western Newfoundland

GEOLOGICAL SURVEY PROFILE

Introduction. The first systematic geological investigations carried out in Newfoundland began in 1864, when the Geological Survey of Newfoundland was inaugurated under the directorship of Alexander Murray. The Survey continued in various guises for most of the years up to 1970. The current Geological Survey has a technical and support staff of approximately 45 people. This is a critical mass that is essential for the Survey to fulfill its mandate of providing geoscience information needed for industrial development and land-use planning. The Geological Survey seeks to fulfill its mandate through the following programs.

Bedrock Mapping. The Survey carries out province-wide systematic bedrock mapping in all areas of the province, including the ancient rocks of Labrador, and the relatively much younger rocks on the Island. The resulting state-of-the-art maps and reports are made available to industry, government and the general public.

Surficial Mapping. Much of the province is covered with debris scraped from bedrock during the last ice age (peaking about 18 000 years ago). The Survey is mapping this blanket of surficial deposits to aid mineral-exploration, land-use and environmental-protection planning.

Mineral-Deposit Research. Specific studies are conducted in mineralized areas to determine the nature of the mineralization and the conditions that existed in the Earth's crust to form these economically important mineral deposits. The private sector uses this information as a guide for mineral exploration. The Survey also identifies industrial-mineral (e.g., limestone) and dimension-stone (e.g., granite) deposits for possible development.

Aggregate Studies. Many of the sand-and-gravel deposits left by the glaciers form a valuable aggregate resource. These deposits, as well as suitable bedrock sites for making crushed stone, are being mapped, classified and tested for use in the construction industry.

Geophysical Studies. The physical properties of rocks, such as their magnetic and radioactive characteristics, are measured by sophisticated instruments. The Survey collects some of its own data, but utilizes a lot more collected by other agencies to compile computer-generated maps that give three-dimensional information on the shape and structure of rock formations.

Geochemical Studies. Variations in the levels of chemical elements throughout the province are mapped systematically by collecting and chemically analyzing surface materials (e.g., lake and stream water, sediment, and soil), all of which reflect the variations in composition of the underlying bedrock. Unusually high values of an element may indicate that the mineralized bedrock is nearby.



Geochemical surveys



Geochemical lab – assays and analyses



Desktop publishing



Client services – library and geofiles

Analytical Laboratory. The Geological Survey maintains a geochemical laboratory for the high-precision analysis of rock, sediment, mineral and water samples. Approximately 5000 samples are analyzed each year; this represents about 150 000 determinations.

Mineral Occurrence Data System. There are about 5000 mineral occurrences known in the province that are documented in maps and reports by the Survey's Mineral Occurrence Data System (MODS). These are made available to the mining industry and public on paper, as digital files, and over the internet.

Promotions, Information and Outreach. Geological Survey data and interpretations are published in reports and on maps produced by the Survey's cartographic, editing and production staff.

The most recent maps, reports and databases are available in digital format, including over the internet. They are also integrated into a Geographic Information System (GIS) environment and are available over the internet or on CD-ROM.

The Geological Survey also produces displays and promotional publications to increase public awareness, and to inform industry clients of Survey services and the province's potential for mineral development. The Geological Survey exhibits at three or four national mineral/mining meetings a year and a number of local conferences.

Industry Services. Providing the mineral industry and other clients with maps, reports and scientific advice is a major part of the Survey's mandate. Survey geoscientists work directly with industry clients who need consultations or access to technical information. There are approximately 17 000 documents, including almost 9000 mineral-exploration assessment reports, in the Survey's geofiles collection. Approximately 5000 documents are now available for viewing online; descriptive information (metadata) on the remaining documents can also be viewed online.

Prospector Services and Outreach. The Survey provides mentoring, technical support and promotional assistance to a growing prospector community through the Matty Mitchell Prospectors Resource Room. The Resource Room also provides logistical support to prospectors at local and national mining and exploration conferences and trade shows, and provides prospecting workshops and field trips in rural parts of the province.



Posters and promotions



Mining conference displays



Publications

FUTURE GEOSCIENCE NEEDS

All the provinces in Canada strive for a digital geoscientific database that consists of complete bedrock and surficial mapping, identification and assessment of all areas having mineral and petroleum potential, and complete geochemical and geophysical coverage.

Identification and assessment of areas with mineral or petroleum potential depends, initially, on the availability of geological maps, geochemical and geophysical data, and modern interpretations of the geological history of an area. All such assessment requires continual reappraisal in the light of new geological information and theories.

Bedrock and surficial geological maps at scales required for mineralpotential assessment and modern mineral exploration are still not available for all of the province and many of the existing ones are obsolete. Regional lake-sediment geochemistry is available for the whole province, but more detailed studies, using other sampling media, are required to follow up areas of high metal values outlined by the regional surveys. As demand or scientific knowledge change, archived samples are re-analyzed for elements that are now required. Airborne magnetic data are available for the entire province, but only in a few areas is the detail sufficient for modern resource exploration.

Future Objectives

- 1. Complete bedrock and surficial mapping at appropriate scales for modern exploration and land-use planning;
- 2. Continue acquisition and analysis of regional geochemical and geophysical information;
- 3. Assess the potential of all areas containing minerals and onshore petroleum;
- 4. Provide all data in an integrated digitized format accessible online in a GIS environment;
- 5. Increase efforts to promote the province as an investment destination by promoting geological-resource opportunities in Newfoundland and Labrador at local, national and international meetings; and
- 6. Maintain a core group of knowledgable, professional staff to provide expert advice and assistance to clients, the general public and government.



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Websites

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