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A Look at Canada's Provincial and Territorial Geological Surveys

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Article abstract

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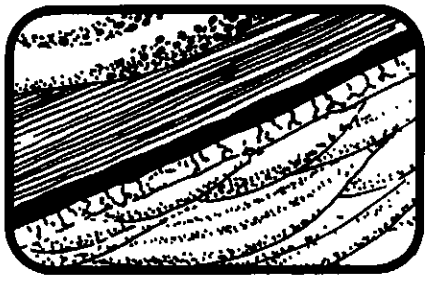
ARTICLES



A Look at Canada's Provincial and Territorial Geological Surveys

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SUMMARY
This paper gives an overview of Canada's provincial and territorial geological surveys as of late 1998. It describes the history and current activities of each briefly. A summary table provides information on the size of each organization, expertise, budget, locations and contacts.

RÉSUMÉ
Le présent article nous donne un aperçu des divers Services de levés géologiques provinciaux et territoriaux qui existent en cette fin de 1998. On y décrit l'histoire de chacun, et les projets de l'heure de chacun y sont brièvement décrits. Rassemblés dans un même tableau, on trouvera des données sur la grosseur de chaque Service, ses domaines de compétence, son budget, la localisation de ses bureaux et les personnes à contacter.

[1] With help from *Geoscience Canada* editor Roger Macqueen, who thanks Glen Edwards and Peter Neelands of GSC Calgary for their work on the figures.

INTRODUCTION
Geological surveys in Canada are major contributors to what has become known as the "geoscience knowledge base," the sum total of geological knowledge and expertise available in Canada. Here we present a snapshot of the current makeup and activities of the 11 provincial/territorial surveys as of late 1998. Over the past decade, as governments at all levels have struggled to reduce their debts and deficits, there has been a steady reduction in funding available to all of Canada's geological surveys: from ~$180 million in 1987 to ~$85 million in 1997 (*e.g.*, Blackwood and Ward, 1998). This has come at an awkward time in the history of these surveys, as they attempt to keep up with the expectations of the resource industries to provide regional geological maps and expertise, yet find themselves with new and growing responsibilities (and opportunities) in the areas of environmental protection, contamination and waste disposal problems, land-use, and other activities relatively new to the earth sciences (*e.g.*, McRitchie, 1994). Although field and laboratory studies and training of students have been much reduced in many geological surveys, one positive aspect of dealing with the major financial reductions has been significantly increased levels of co-operation among government, academic and industry geoscience communities. Major new earth science initiatives over the past decade — Mineral Development Agreements (MDAs), LITHOPROBE, National Geological Mapping Program (NATMAP), exploration technology program (EXTECH), and others — have helped enormously in encouraging greater co-operation and enthusiasm among all players, despite much diminished resources. The Intergovernmental Geoscience Accord signed in September 1996 also promotes co-operation among all of Canada's geological surveys. Before our brief review of Canada's provincial and territorial surveys is presented, some background is in order.

ROLE OF GOVERNMENT
In the area of earth resources, the responsibilities of government include: the protection of the interests of the owners of the resources, namely, the people; the promotion of orderly and sustainable development of the resources; and the collection of a fair economic rent for the people. With respect to our physical environment, government has the responsibility to resolve issues related to access to the land; natural hazards (such as landslides, floods and earthquakes); waste disposal; groundwater contamination; climate change; *etc.* To achieve this, governments need to facilitate societal decision making, and establish and enforce regulations and norms to the collective benefit of society.

GOVERNMENT GEOSCIENCE
Government geoscience can be defined as "all geoscience activities carried out by government or on its behalf in support of its responsibilities" (Boon and Everell, 1998). Geological surveys are responsible for the major portion of government geoscience activities, although as pointed out by Barnes *et al.* (1995), geologists are employed increasingly in

other government departments to deal with environmental, land-use, parks and other issues. Most government jurisdictions of the world have a geological survey whose mission is to provide, maintain and make publicly available the geoscience information base and expertise needed by industry, government and the public for responsible and sustainable development and management of energy, mineral and land resources. The benefits of a public geoscientific information base include the reduction of risk in decision making; promotion of capital investment and development; and a measure of protection against possible fraudulent claims by unscrupulous companies or individuals.

Government, rather than the private sector, has to assume the responsibility for geological surveys because the market mechanism cannot provide the correct type of geoscience information, in the desired amount, at the right time (Doggett *et al.*, 1996). Geoscience information simultaneously serves a wide and diffuse range of clients in industry, the public, and government, as well as providing a competitive advantage to the jurisdiction that it serves. An independent, impartial geological survey also enhances the credibility and reliability of geoscience information, and thus the confidence level of the mineral and energy industries and the investment community.

GEOLOGICAL SURVEYS

The responsibilities of geological surveys typically include the following:

- geological mapping and mineral reconnaissance
- delineation and characterization of resources
- definition of the geological structure of the jurisdiction
- collection and compilation of geoscience data, and the establishment and maintenance of the geoscience data bases of the jurisdiction
- dissemination of geoscience information and the provision of expert advice.

Geoscience information provided by geological surveys helps governments to increase their revenue in the form of royalties and taxes, and to solve environmental and societal problems. At the same time, it supports exploration and development in the private sector. In brief, geological surveys make important contributions to the prosperity of the jurisdictions they serve. MacKenzie *et al.* (1989) showed that, of five different types of government incentives, the provision of a geoscience knowledge base was the most effective in promoting mineral development in Newfoundland. Evaluation reports of mineral development agreements and anecdotal information from other projects carried out by provincial and territorial surveys suggest that every dollar invested in geoscience results in $4-20 of economic activity.

GEOLOGICAL SURVEYS IN CANADA

Each province and territory in Canada except Prince Edward Island has a geological survey, and all are reported on herein. The Geological Survey of Canada (GSC) operates at the national level. In 1997, the latest year for which complete figures are available, the provincial and territorial surveys had a combined budget of $55 million (*Provincial Geologists Journal*, 1998), whereas the Geological Survey of Canada had a budget of $66 million. In 1997 the combined staff of the provincial and territorial geological surveys numbered 601, while the federal Geological Survey of Canada complement was 640.

All of Canada's geological surveys face many challenges, including the high cost of information technology, budget reductions averaging 50% over the past decade (*e.g.*, Blackwood and Ward, 1998), and the difficulty of maintaining dynamic and competent staff and expertise. The main emphasis of provincial and territorial surveys is on providing direct support to the economic development of the jurisdiction, including resource management, environmental protection, land use, and the resolution of societal problems, as well as serving the needs of local clients of many types. There are signs that the traditional role of serving the resource industries is changing somewhat in response to new environmental and land use opportunities, in which earth science expertise commonly is critical for sound decisions. A thoughtful appraisal of the nature, role, challenges and pressures on provincial and territorial surveys, as well as opportunities for the future, has been provided by David McRitchie (1994), a former Director of the Geological Surveys Branch of the Manitoba government.

At the national level, the GSC is responsible for the national thematic mapping program, marine and coastal studies, frontier areas, and international geoscience representation. The GSC also provides leadership, technical and analytical expertise, and co-ordination within such co-operative projects as LITHOPROBE, NATMAP, EXTECH, and MDAs, as well as many other smaller co-operative projects (Fig. 1).

The following sections provide a thumbnail sketch of Canada's 11 provincial and territorial geological surveys. The Committee of Provincial Geologists hopes that this compilation will be useful to the Canadian earth science community and others. More detailed information can be obtained from the contacts listed in the summary table on pages 148-149, and from issues of the *Provincial Geologists Journal*, published annually since 1983.

CONCLUDING REMARKS

All of Canada's geological surveys originally were established to stimulate and encourage exploration and exploitation of mineral and energy resources. This is what they do best and this is their strength to this day. The 50% reduction in funding over the past decade has stretched these surveys to the limit, however, as pointed out by Blackwood and Ward (1998) in their report on the 1997 Geoscience Workshop held in conjunction with the 54th annual Mines and Energy Ministers Conference in July 1997. The workshop examined five topic areas, making recommendations in each: government responsibility for the geoscience knowledge base, information dissemination and database gaps and needs, university training, performance measures for the impact of (geological) survey programs, and alternative funding mechanisms for geological surveys. As a result of the workshop, a government-industry task force prepared a report, "Alternative Funding Arrangements for Government Geoscience," which was presented to the 1998 Mines Ministers Conference. The report concluded that stable, adequate funding of government geoscience is essential to maintain Canada's competitive position in global mineral exploration. Funding mechanisms that were considered as favourable included directed revenue streams (*i.e.*, funding directly related to industry's contribution to treasury) and the current system of allocations to government departments. The work of the task force continues and

is focussed on determining how much surveying is enough.

Although co-operation among the various players (government, academia and industry) is at an all-time high thanks in part to such exciting programs as LITHOPROBE, NATMAP, EXTECH and others, it is to be hoped that the steady erosion of human and financial resources is over, such that these joint programs and other new activities can thrive.

It is encouraging to see that despite the recent major decrease in human and financial resources, new geoscience projects are appearing apart from core resource industry studies, at least among the larger geological surveys. For example, in the British Columbia Geological Survey new and novel work is underway in earthquake studies, terrain sensitivity and stability, and geoscience aspects of municipal growth. In Manitoba the greater Winnipeg NATMAP project is concerned with hydrogeology in this populous area, and with the geological history of flooding in the Red River system. The Ontario Geological Survey's participation in the Oak Ridges Moraine project north of the Toronto urban area deals with the geoscience aspects of this important groundwater recharge system and the pressures attendant on it resulting from the major population growth of the region. In Nova Scotia, land-use decisions relating to undiscovered mineral potential and the establishment of parks are new areas of study. All surveys are increasingly involved in land-use planning, not always closely associated with mineral potential.

Meanwhile the provincial and territorial surveys continue to be most active in the key area of resource-related studies. Diamond plays are gaining importance across Canada following, naturally, the opening in October 1998 of Canada's first commercial diamond mine, Ekati, in the Northwest Territories. Provinces with Precambrian shield exposure or Phanerozoic mountain belts naturally tend to emphasize mineral deposit-related studies. Studies unique to particular provinces/territories include heavy oil and oil sands, and related industrial minerals and groundwater studies in Alberta; terrane-related mineralization in British Columbia; placer developments and patterns in Yukon; mining camp studies in Saskatchewan, Manitoba, Ontario, New Brunswick, and Newfoundland and Labrador. The Quebec survey has been given the status of a special operating agency, which allows it greater flexibility in undertaking an ambitious, large, new mapping program in the province's north.

The provincial and territorial geological surveys have played and continue to play an important role in the creation of wealth in Canada, and in helping to ensure that this is done in an environmentally sustainable way. The society they serve is changing, as is their role in it, and they are rapidly adapting to the new demands placed on them. Through increased mutual and federal-provincial co-ordination and co-operation, they are counteracting the effects of shrinking budgets. However, since 1987, investment in government geoscience in Canada has shown a linear decline. If this trend were to continue unabated at the same rate, government investment in geological surveys in Canada would reach zero by 2004. All geological surveys in Canada are working hard to prevent this from happening.

Figure 1 Geological field party examining Devonian carbonates near Redfern Lake, northeastern British Columbia, 1998 field season, as part of the Central Foreland NATMAP project. This co-operative project includes personnel from the British Columbia Geological Survey Branch (BCGSB), Yukon Geology Program, Northwest Territories Geology Division and Minerals, Oil and Gas Division; Geological Survey of Canada (GSC; Calgary, Vancouver and Sidney); and private sector personnel. Standing at back: Bill McMillan (BCGSB) and Josh MacDonald (Crestar Energy, Calgary). Seated left to right: Dave Morrow (GSC Calgary), Howie Zorian (Crestar Energy, Calgary), Lisel Currie (GSC Calgary), Suzanne Paradis (GSC Sidney), Rebecca Miller (student, University of Waterloo), Sandy McCracken (GSC Calgary), and Joanne Nelson (BCGSB) (photo by Mike Cecile, GSC Calgary).

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McRitchie, W.D., 1994, The role of Canada's provincial/territorial geological surveys circa 2000, *in* Bouchard, D.S., Findlay, D.C., Kiel, M.J., McLeod, C.R. and Scott, J.S., compilers, National Geological Surveys in the 21st Century: Geological Survey of Canada, Miscellaneous Report 55, p. 43-52.

Table 1 Provincial and territorial geological surveys in Canada: summary of relevant information, 1997-1998.

Name	Year Estab.	Parent Organization	Staff (FTE)	Funding ($000)			
				Host Gov'ts.	Industry Partners	Other	Total
British Columbia, Geological Survey Branch	1895	Ministry of Energy and Mines	47	$4146		$605	$4751
Yukon Geology Program	1996	Yukon Territorial Government	18	$792		$1391 (Joint DIAND/YTG)	$2852
		Department of Indian and Northern Affairs		$668			
Northwest Territories Geology Division	1968	Department of Indian and Northern Affairs	16	$1113		$125	$1238
	1988	Department of Resources, Wildlife and Economic Development, Government of NWT	11	$645		$50	$695
Alberta Geological Survey	1921	Alberta Energy and Utilities Board	39.4 (includes consultants)	$2588		$308	$2896
Saskatchewan	1948	Saskatchewan Energy and Mines	40	$2550			$2550
Manitoba Geological Services Branch	1946	Manitoba Energy and Mines	51.6	$3776	$130	$495	$4401
Ontario Geological Survey	1891	Ontario Ministry of Northern Development and Mines	140	$11,112		$2000	$13,112
Géologie-Québec	1891	Ministere des Resources naturelles du Québec	144	$20,966			$20,966
New Brunswick	1928	Natural Resources and Energy	36	$2214		$400	$2614
Nova Scotia	1995	Nova Scotia Department of Natural Resources	38	$2600		$160	$2760
Newfoundland	1864	Newfoundland Department of Mines and Energy	45	$3400			$3400

Area of Expertise	Contact(s)			
	Name	Phone	Fax	E-mail
Bedrock and surficial geology; economic geology-metallic minerals, industrial minerals, coal and aggregates; regional stream sediment geochemistry; mineral inventory systems and mineral potential estimation; earthquake hazard mapping; and Internet computer application	Ron Smyth, Director	(250) 952-0374	(250) 952-0381	Ron.Smyth@gems4.gov.bc
Bedrock and surficial geology; economic geology; mineral inventory systems; mineral potential estimation	Shirley Abercromble, A/Manager	(867) 667-3438	(867) 667-3198	sabercro@gov.yk.ca
Bedrock and surficial geology; economic geology; mineral inventory systems; mineral potential estimation	Grant Abbott, Chief Geologist	(867) 667-3200	(867) 667-3198	gabbott@gov.yk.ca
Precambrian geology; metallogeny; geology of diamond deposits; structural geology; metamorphic petrology; tectonics; resource evaluation	Carolyn Relf, Chief Geologist	(867) 669-2635	(867) 669-2725	relfc@inac.gc.ca
Sedimentology; basin analysis; coal geology; hydrogeology; metallic and industrial minerals; Quaternary geology; structural geology; GIS; computing and data base management	Jan Boon, Group leader	(403) 427-1741	(403) 422-1459	boon@enr.gov.ab.ca
Industrial minerals including diamonds; Precambrian mapping and metallogeny; mineral resources assessment; Phanerozoic stratigraphy and sedimentology with emphasis on petroleum geology	Gary Delaney, Chief Geologist	(306) 787-1160	(306) 787-2488	gary.delaney@gov.sk.ca
Precambrian geology; tectonostratigraphy; volcanology; geochemistry; structural geology; mineralogy; metallic and industrial mineral deposits; Quaternary geology; aggregate inventories; Mesozoic/Paleozoic geology; GIS	Christine Kaszycki, Director	(204) 945-6549	(204) 945-1406	ckaszycki@am.gov.mb.ca
Precambrian geology and tectonics; Quaternary geology; till; lake sediment and water geochemistry; Precambrian and glacial sedimentation; aggregate resources inventories; metallic and industrial minerals; kimberlite exploration techniques; Paleozoic/Mesozoic geology; potential field geophysics; digital techniques; digital standards; diamond drill libraries	Andy Fyon, Senior Manager	(705) 670-5924	(705) 670-5905	andy.fyon@ndm.gov.on.ca
	Cameron Baker, Senior Manager	(705) 670-5902	(705) 670-5905	cam.baker@ndm.gov.on.ca
	Johial Newsome, Senior Manager	(705) 670-5955	(705) 670-5754	hial.newsome@ndm.gov.on.ca
Cartographie géologique; SIGÉOM; minéraux industriels; métallogenie; géochimie; géophysique; assistance financière	Jean-Louis Caty, Directeur	(418) 627-6274	(418) 643-2816	jean-louis.caty@mrn.gouv.qc.ca
Bedrock geology; surficial geology; mineral deposits; GIS; industrial minerals	Rao Irrinki, Director	(506) 453-8825	(506) 453-3671	rirrinki@gov.nb.ca
Regional mapping; coal geology; dynamics of basin formation; Devonian to Permian flora; environmental earth sciences; land use planning; metallic and industrial mineral deposits; paleoecology of the Late Carboniferous; Quaternary geology; igneous petrology; sedimentology; structural geology	Scott Swinden, Director	(902) 424-8135	(902) 424-7735	hsswinde@gov.ns.ca
Systematic bedrock mapping; mineral deposit studies; geochemical surveys; terrain sciences; GIS; geoscience information services	R. Frank Blackwood, Director	(709) 729-6541	(709) 729-3493	rfb@zeppo.geosurv.gov.nf.ca

British Columbia

British Columbia Geological Survey Branch	
Year Established	1895
Parent Organization	British Columbia Ministry of Energy and Mines
Address	PO Box 9320, Stn Prov Gov't Victoria, BC V8W 9N3
Contact Person	Ron Smyth, Director
Phone	(250) 952-0374
Fax	(250) 952-0381
E-mail	Ron.Smyth@gems4.gov.bc.ca
Staff (full time equivalents)	47
1998-1999 Funding Sources	Ministry: $4,146,000 Partnerships with other government departments: $605,000 Total Budget: $4,751,000
Main Areas of Expertise	bedrock and surficial geology; economic geology; regional geochemistry; mineral inventory systems and mineral potential estimation; earthquake hazard mapping; Internet computer applications

BRIEF HISTORY

The British Columbia Geological Survey (GSB) dates back to 1895 with the appointment of a provincial mineralogist following the gold discoveries on the Fraser River and in the Cariboo. The subsequent development of the GSB parallels that of many other provincial surveys but with one major difference: it did not initiate a program of 1:50,000 scale quadrangle bedrock mapping until 1985. Earlier work was focussed on mapping British Columbia's numerous mining camps in close co-operation with mining companies. The GSB made significant geological contributions in support of two giant expansions in the province's mining sector: the porphyry copper boom of the 1960s and 1970s, and the coal developments of the 1970s and 1980s. Both deposit types remain the economic backbone of the province's mining industry.

During the 1984-1995 period of joint Federal-Provincial Mineral Development Agreement funding, the GSB doubled in staff and programming. Since then funding has declined and staffing has been reduced. However, strength in mapping (Figs. 2, 3) and mineral deposit research has been retained, and in addition the GSB has become a leader in providing maps and data through the Internet.

PRESENT ACTIVITIES

The current program has a dual focus: economic development and resource management. The Economic Development Program is targeted at surveying poorly known areas in order to identify the mineral potential. Survey work in British Columbia is now planned with the Geological Survey of Canada, and selected projects are jointly delivered under the umbrella of the National Mapping Program (NATMAP) (Fig. 4).

The major mapping project underway in 1998 is the multidisciplinary Nechako Natmap Project. This area lies within a regional zone of tectonic uplift and is a former producing porphyry copper district. A new NATMAP project in the Foreland Belt in the northeast Rocky Mountains was begun in 1998.

The GSB's strength in mineral deposit research is based on decades of study of mining camps. This work was summarized in the 1991 publication *Ore Deposits, Tectonics and Metallogeny in the Canadian Cordillera* and is being updated in a project to produce deposit profiles for all of British Columbia's mineral deposit types.

Stream sediment geochemistry is an effective exploration tool in British Columbia's wet, mountainous terrain. Approximately 75% of the province has been surveyed. The data collected have led to the discovery of many new mineralized areas. Research by the GSB discovered that moss mats in streams are an effective sampling medium in areas of high rainfall where the fine fractions have been flushed clean.

Coal is the province's most important mineral commodity. Mapping of the province's coalfields has been completed, and research has shifted to deposit scale studies including coal quality and coalbed methane.

Figure 2 Geologists Dani Alldrick and Mary MacLean, British Columbia Geological Survey Branch, tracing the Eskay Creek horizon, Mt. Shirley, northwestern British Columbia.

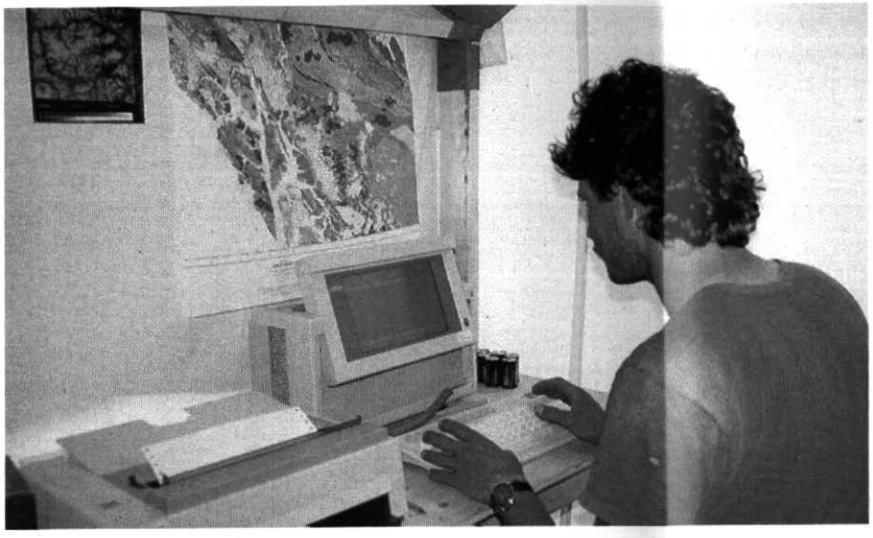


Figure 3 Geologist Jim Logan, British Columbia Geological Survey Branch, enters geological mapping data in the field, Forrest Kerr area, northwestern British Columbia.

The GSB has been a leader in mineral inventory data base development through the MINFILE project. Current efforts are directed at making this data base and others available over the Internet. Clients can now visit the "Map Place" at the GSB's website and create their own maps from a menu of data sets.

The Resource Management Program provides mineral inventory data and advice to government policy and planning. Land use planning in support of land claims and resource management continue at a brisk pace, and the GSB is a key data provider. Because of this responsibility, the branch recently completed a mineral resource assessment of the province at 1:250,000 scale.

Municipal growth is rapid in the southern part of the province. Aggregate resources are being depleted and many deposits have been sterilized by development. The GSB has developed a

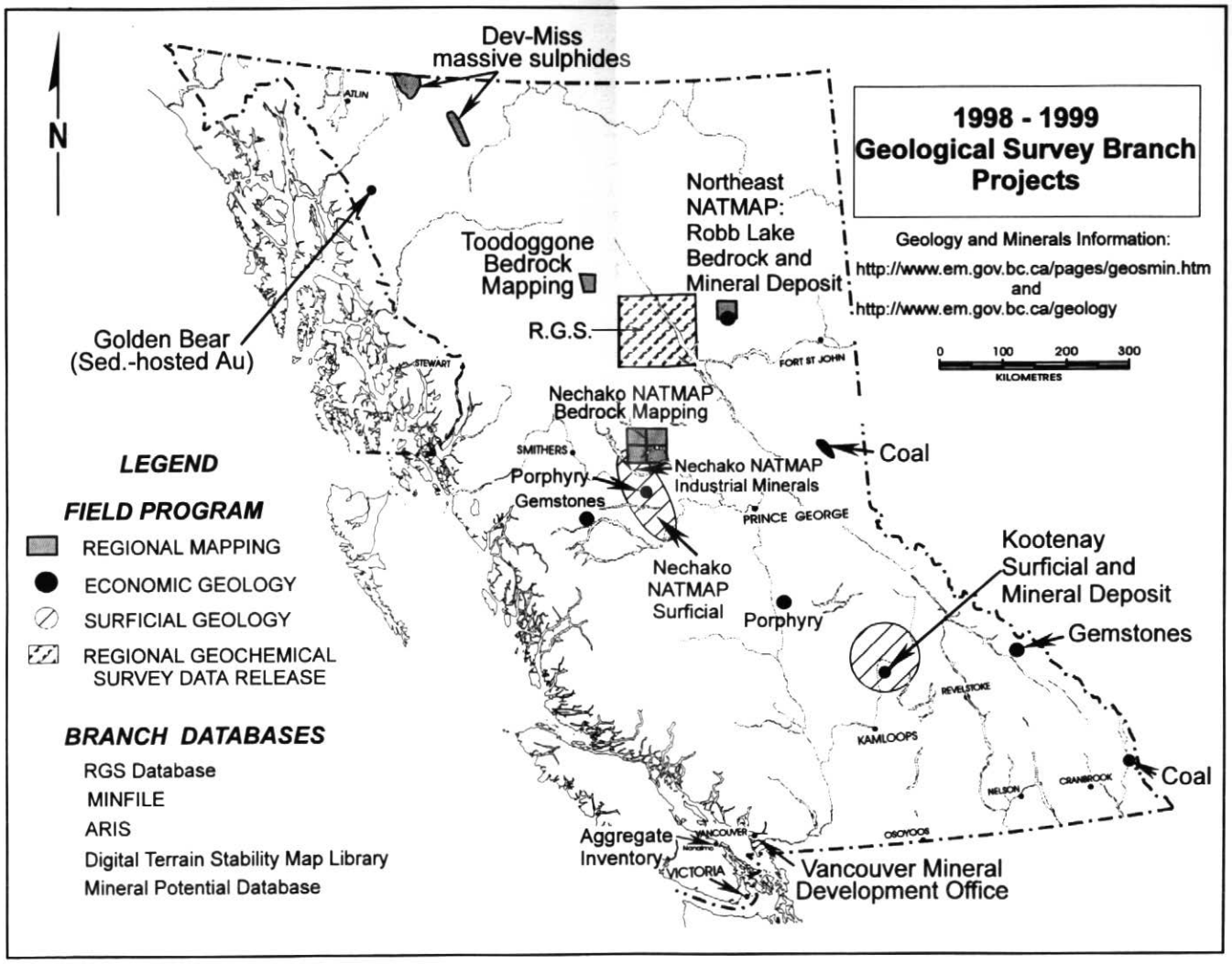


Figure 4 British Columbia Geological Survey Branch projects, 1998-1999.

methodology to assess aggregate potential that identifies areas of known and potential future resources. The Nanaimo Regional District is the current area of study.

The GSB, with funding from Forest Renewal British Columbia, is building a digital data base of Terrain and Terrain Stability information. Data is provided by forest companies under Forest Act regulations, which are designed to ensure that landslide risk is considered in logging plans.

Southwestern British Columbia sits on top of the seismically active Cascadia subduction zone. The GSB, with support from municipal governments in the Greater Victoria region, is preparing a 1:20,000 scale earthquake hazard map based on a detailed analysis of local soil and geology conditions.

Yukon

Yukon Geology Program	
Year Established	1996
Parent Organizations	Yukon Territorial Government (YTG) Department of Indian Affairs and Northern Development (DIAND)
Addresses	YTG: PO Box 2703 Whitehorse, YK Y1A 2C6 DIAND: 300-345 Main Street Whitehorse, YK
Contact Persons	YTG: Shirley Abercrombie, A/Manager DIAND: Grant Abbott, A/Chief Geologist
Phone	YTG: (867) 667-3438 DIAND: (867) 667-3200
Fax	YTG: (867) 393-6232 DIAND: (867) 667-3198
E-mail	YTG: sabercro@gov.yk DIAND: abbottg@inac.gc.ca
Staff (full time equivalents)	18
1998-1999 Funding Sources	YTG Department of Economic Development: $792,400 DIAND: $668,000 Cost-shared DIAND/YTG: $1,391,250 Total Budget: $2,851,650
Main Areas of Expertise	Bedrock and surficial geology, economic geology, structural geology, mineral inventory systems, mineral potential estimation

BRIEF HISTORY

The Yukon Geology Program was established as a *de facto* Yukon Geological Survey in 1996 when the Canada/Yukon Mineral Development Agreement ended. Under the Yukon Geology Program umbrella, two offices with three different administrative structures are integrated and jointly managed. These include a federal program (Department of Indian Affairs and Northern Development [DIAND], Exploration and Geological Services Division), a territorial program (Department of Economic Development, Mineral Resources Branch), and a separate cost-shared agreement also administered by the Mineral Resources Branch.

PRESENT ACTIVITIES

Two 1:50,000 scale bedrock mapping projects are underway. Both are in the Yukon-Tanana Terrane and will become part of the proposed Continental Margin NATMAP project that is expected to begin in 1999 (Fig. 5).

The Geological Survey of Canada is receiving support for a 1:250,000 scale mapping project and a 1:250,000 scale digital compilation map of the Yukon.

A multidisciplinary project will begin in the Anvil Zinc-Lead-Silver District, where the future of the Yukon's most significant mining camp has been placed in doubt with the recent bankruptcy of the Anvil Range Mining Company. The project will include field mapping and digital compilation of existing geological data, a till geochemistry case study, and a lithogeochemical alteration study.

Two surficial mapping, compilation and placer setting evaluation projects will be completed in 1998: the Mayo Placer Research Project, and White Channel gravel deposit studies in the Klondike area. A placer deposit study will begin in the Stewart River map area, where more than 90% of the Yukon's placer gold has been recovered. The Program is also funding the Geological Survey of Canada to produce a new Glacial Limits Map for the Yukon to commemorate the Klondike Gold Rush Centennial.

Two specific mineral deposit studies are in progress: a study of volcanogenic massive sulphide deposits in the Yukon-Tanana Terrane, the Pelly-Cassiar Platform and the Selwyn Basin; and a study of precious and base metal deposits in the Dawson Range.

Mineral potential studies are undertaken as needed (*e.g.*, First Nations land claims, parks, *etc.*). These resource assessments provide decision makers with a current evaluation of mineral potential so that land withdrawals can be made based on the best information available.

The Yukon Geology Program monitors mineral exploration activity and provides a strong liaison with the mineral industry. The Program manages the Yukon MINFILE data base, a compilation of the geology and work history of all

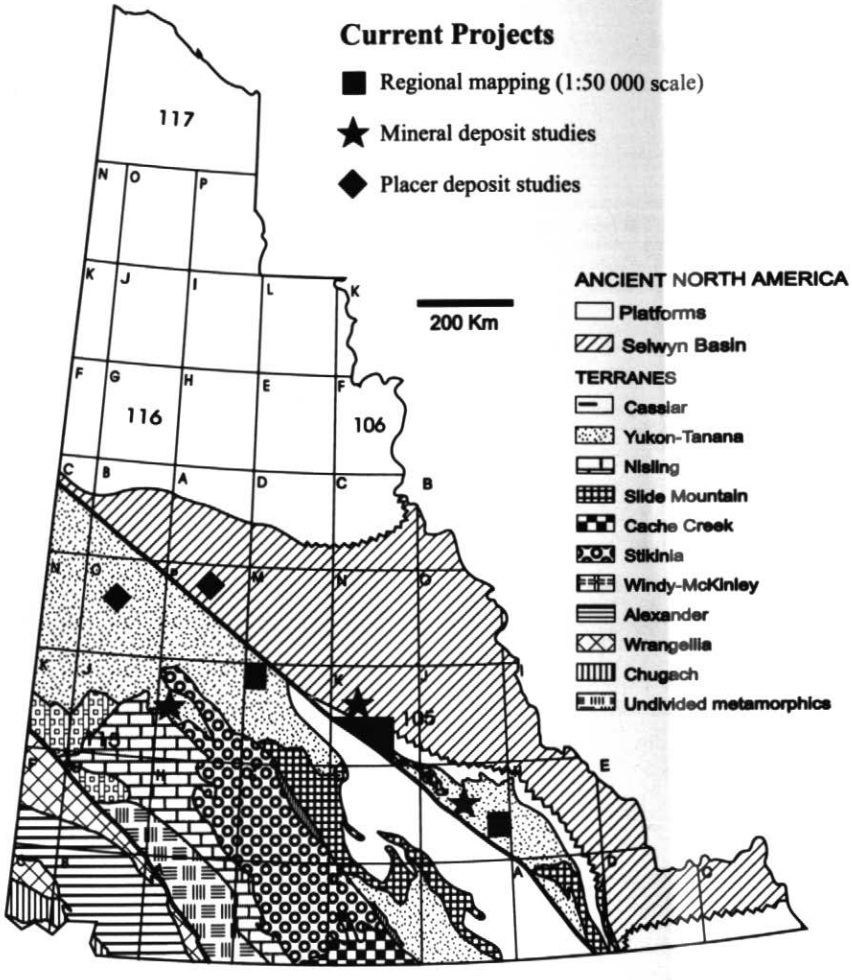


Figure 5 Yukon Geology Program projects, 1998-1999.

known Yukon mineral occurrences (>2500). Placer MINFILE is under development and will be released later this year. Yukon GEOPROCESS File is a summary of geology, geological processes, and terrain hazards. We also produce two annual publications: *Yukon Exploration and Geology,* and *Yukon Placer Activity Reports.* The H.S. Bostock Core Library contains approximately 123,000 m of diamond drill core from 179 mineral properties in Yukon.

The Yukon Mining Incentive Program (YMIP), a Yukon Government initiative, provides financial support to prospectors (<$10,000 per annum) and exploration companies (<$20,000 per annum) to help promote and enhance mineral prospecting, exploration and development in Yukon.

Northwest Territories

BRIEF HISTORY

In 1968, the Geological Survey of Canada (GSC) transferred its Regional Geologist's Office in Yellowknife, Northwest Territories (NWT) to the Department of Indian Affairs and Northern Development (DIAND), creating the DIAND NWT Geology Division. The Geology Division plays a province-like role in monitoring and administering mining and mineral exploration in the north, and delivers a geoscience program consisting primarily of bedrock mapping and mineral deposit studies. The Northwest Territories Region does not have responsibility for oil and gas development in the north; this is administered from Ottawa. The Government of the Northwest Territories established a geoscience office under the Canada-NWT 1988-1991 and 1992-1996 Mineral Development Agreements, and continued to fund the geoscience program following the completion of the second MDA. The office currently comprises part of the Minerals, Oil and Gas (MOG) Division of the Department of Resources, Wildlife and Economic Development (RWED), and delivers bedrock mapping, resource assessment, and prospector training programs.

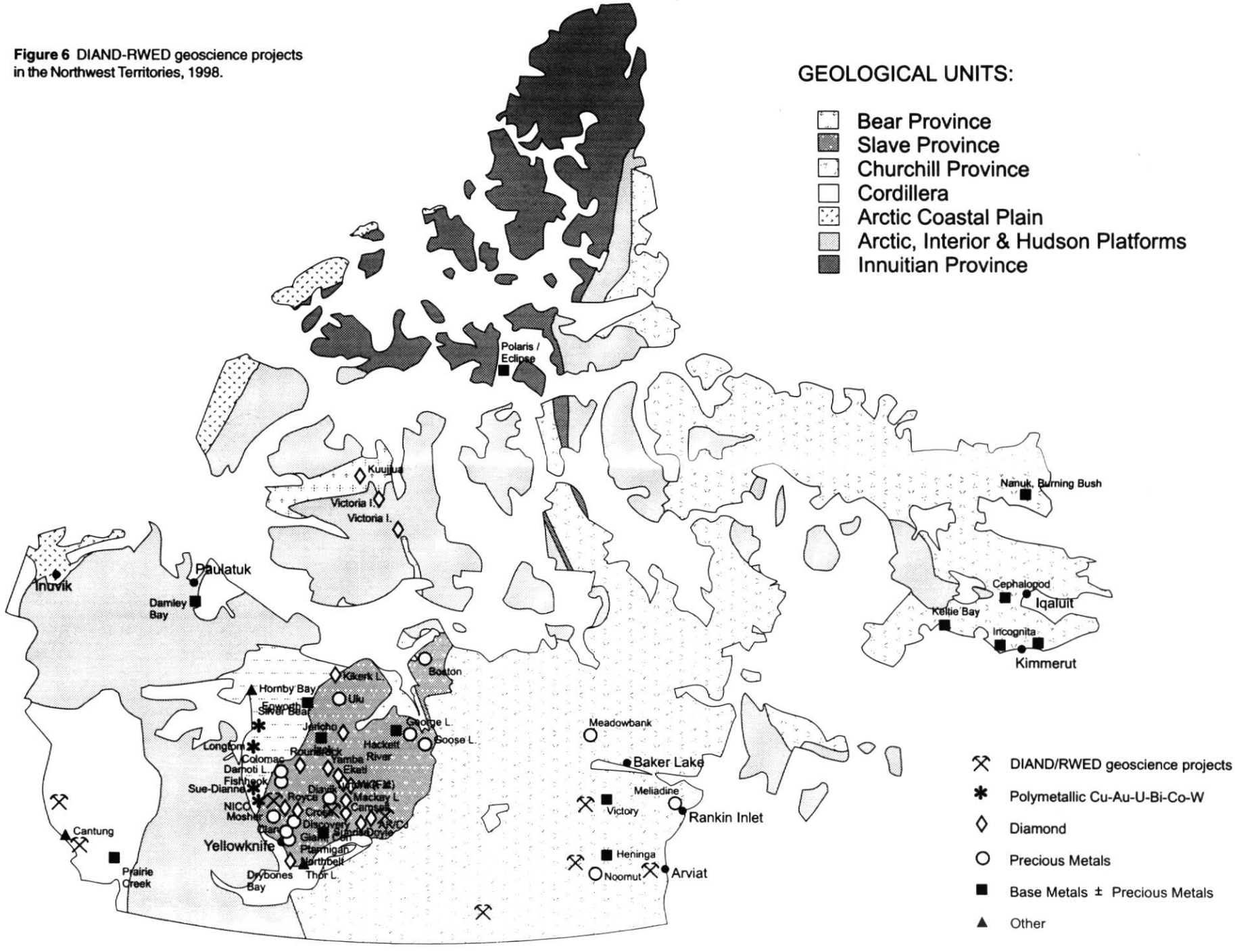
In April 1997, DIAND and RWED merged resources to create a single office (the C.S. Lord Northern Geoscience Centre) from which both agencies' geoscience programs are delivered. The Geoscience Centre is jointly administered by both departments.

PRESENT ACTIVITIES

DIAND Geology Division

As part of its legislated responsibilities, DIAND's Geology Division reviews mineral assessment reports and maintains a library and archives for use by the public. Open File reports released by DIAND include geological maps and reports produced by both RWED and DIAND. DIAND's Geology Division has been working over the past year to upgrade its geoscience information base to a digital format and to improve client services. To this end, it created and posted its first web page, is working on

Figure 6 DIAND-RWED geoscience projects in the Northwest Territories, 1998.



a file transfer protocol site, and in collaboration with the GSC is in the process of converting its open file bedrock maps from Autocad to ArcView format. The Geology Division recently developed a GIS-compatible data base of mineral showings for the NWT (NORMIN.DB), which can be accessed *via* the web. Phase I of the data base is complete, and data entry is ongoing. For its geoscience program, the Division is funding five bedrock mapping projects, two mineral deposit studies, and two lithogeochemistry studies.

RWED Minerals, Oil and Gas Division

RWED is currently supporting a bedrock mapping project, a regional geochemical study, three gold deposit-related studies, a grubstaking program, and prospector training. In addition, it is providing funding for NORMIN.DB data entry under the NWT's Protected Areas Strategy. RWED recently completed two new geoscience initiatives: a digital geoscience compilation and mineral potential assessment of the northern Baffin Island/Melville Peninsula area; and a digital directory of resource data on the Coronation Gulf area (the Coronation Gulf Mineral Development Area project).

Several of the current geoscience projects being undertaken in the NWT are joint initiatives between DIAND, RWED and the Geological Survey of Canada. These include the western Churchill NATMAP project, and the proposed Yellowknife EXTECH gold project (Fig. 6).

Northwest Territories Geology Division	
Years Established	1968 (Department of Indian and Northern Affairs [DIAND], Geology Division; office transferred from GSC Regional Geologist's office) 1988 (Department of Resources, Wildlife and Economic Development [RWED], Minerals, Oil and Gas Division; five geologists hired under the 1987-1991 Canada-NWT MDA)
Parent Organizations	DIAND, Government of Canada RWED, Government of the Northwest Territories
Addresses	DIAND Geology Division Box 1500 Yellowknife, NT X1A 2R3 RWED Minerals, Oil and Gas Box 1320 Yellowknife, NT X1A 2L9
Contact Person	Carolyn Relf, Chief Geologist NWT Geology Division, DIAND
Phone	(867) 669-2635
Fax	(867) 669-2725
E-mail	relfc@inac.gc.ca
Staff (full time equivalents)	DIAND: 16 RWED: 11 (includes all staff in MOG; 5 staff in geoscience program)
1998-1999 Funding Sources	DIAND: $1,238,000 RWED: $695,000 Total Budget: $1,933,000
Main Areas of Expertise	Precambrian geology, metallogeny, geology of diamond deposits, structural geology, metamorphic petrology, tectonics, resource evaluation

Alberta

ALBERTA

The mission of the Alberta Geological Survey (AGS) is: "To provide the geoscience information and expertise needed by government, industry and the public for earth resources stewardship and sustainable development." AGS' responsibilities are to build and further develop Alberta's geoscience information base; disseminate geoscience information; delineate Alberta's earth resources; support and promote energy and mineral exploration and development, land use planning, environmental management, and mineral rights management; and participate in energy, mineral and environmental research activities.

AGS delivers its mission and responsibilities through a team-based structure that currently is comprised of two units: Energy and Mineral Resources, and Client Services. The former is responsible for geological studies, and the latter for GIS, information dissemination, and related client service and program support.

BRIEF HISTORY

The Alberta Geological Survey was established in 1921 as the organization now known as the Alberta Research Council (ARC). The initial efforts of the AGS focussed on studies of the tar sands and coal resources. Studies in groundwater commenced in the 1930s. After the discovery of oil at Leduc in 1947 there was a major expansion in the Geological Survey, with an increase in professional staff and capabilities in geochemistry, mineralogy, petrology, hydrogeology and micropaleontology. Regional mapping of the surficial deposits started in 1953 and large-scale water resource studies were carried out.

Groundwater research moved from the AGS into the Environmental Research and Engineering Department of the ARC in 1984.

In the 1980s emphasis was placed on defining the province's industrial minerals, and a compilation of the Precambrian Shield area of northeast Alberta was carried out (Fig. 7). In addition studies continued on the oil sands and coal resources. A major achievement was the publication of the *Geological Atlas of the Western Canada Sedimentary Basin* in 1994. Production of the atlas involved the co-operative efforts of the AGS, the Canadian Society of Petroleum Geologists, the Alberta Department of Energy, the Geological Survey of Canada, and a large number of volunteers from industry, academia and government areas within Canada.

Over the years, ARC gradually moved into a variety of technology areas and by 1993, the Alberta Geological Survey constituted only about 10% of the entire organization. In 1995, the AGS was transferred to the Alberta Department of Energy, and in 1996, to the Resources Division of the Alberta Energy and Utilities Board.

Alberta Geological Survey	
Year Established	1921
Parent Organization	Alberta Energy and Utilities Board
Address	9945-108 Street, 6th Floor Edmonton AB T5K 2G6
Contact Person	Jan Boon, Group Leader
Phone	(403) 422-1741
Fax	(403) 422-1459
E-mail	boon@enr.gov.ab.ca
Staff (full time equivalents)	39.4
1998-1999 Funding Sources	Host government: $2,588,000 Other: $308,000 Total Budget: $2,896,000
Main Areas of Expertise	sedimentology, basin analysis, coal geology, hydrogeology, metallic and industrial minerals, Quaternary geology, structural geology, remote sensing, GIS, computing and data base management

CURRENT STRUCTURE

The AGS has employed a unique and successful strategy in accomplishing multidisciplinary projects through the implementation of team-based research.

The AGS reviews and makes mineral assessment reports available on behalf of the Alberta Department of Energy. A variety of geological studies and reviews is provided to other parts of the Alberta Energy and Utilities Board and the Alberta Department of Energy in support of regulatory activities.

Services that support the AGS include the Mineral Core Research Facility and Laboratory for geochemical analysis, mineralogical studies, and general sample preparation.

PRESENT ACTIVITIES

Northeast Alberta

Heavy Oil, Oil Sands

AGS projects in northeastern Alberta on Quaternary geology and stratigraphy, hydrogeology, and aggregate and other industrial minerals are designed to help address requirements for groundwater supply, residual water disposal, construction materials, limestone for sulphur dioxide scrubbing, steam loss avoidance, and environmental impact mitigation. These studies are in support of the oil sands developments that use Steam Assisted Gravity Drainage (SAGD) technology (Fig. 8).

Studies include:

- Oil sands depositional environments and their relation to reservoir characteristics; Quaternary and hydrostratigraphic mapping to identify aquifers;
- Bedrock geology; and aggregate studies, to provide basic geological information useful for oil sands development.

The results of all these studies will be combined with cultural, topographic, hydrographic, environmental, First Nations land claims, and other information in a Geographic Information System (GIS) through a land use compilation mapping project. The GIS allows

Figure 7 Outcrops of the Slave Granite, Precambrian Shield, northeastern Alberta, at Rapids of the Drowned on the Slave River south of Fort Smith, summer 1993. Field studies in this large region were conducted as part of the Canada-Alberta Partnership on Minerals project (Mineral Development Agreement), 1992-1995, and involved personnel from the AGS, GSC (Calgary and Ottawa) and several universities and private sector organizations (photo by Jan Bednarski, GSC Calgary).

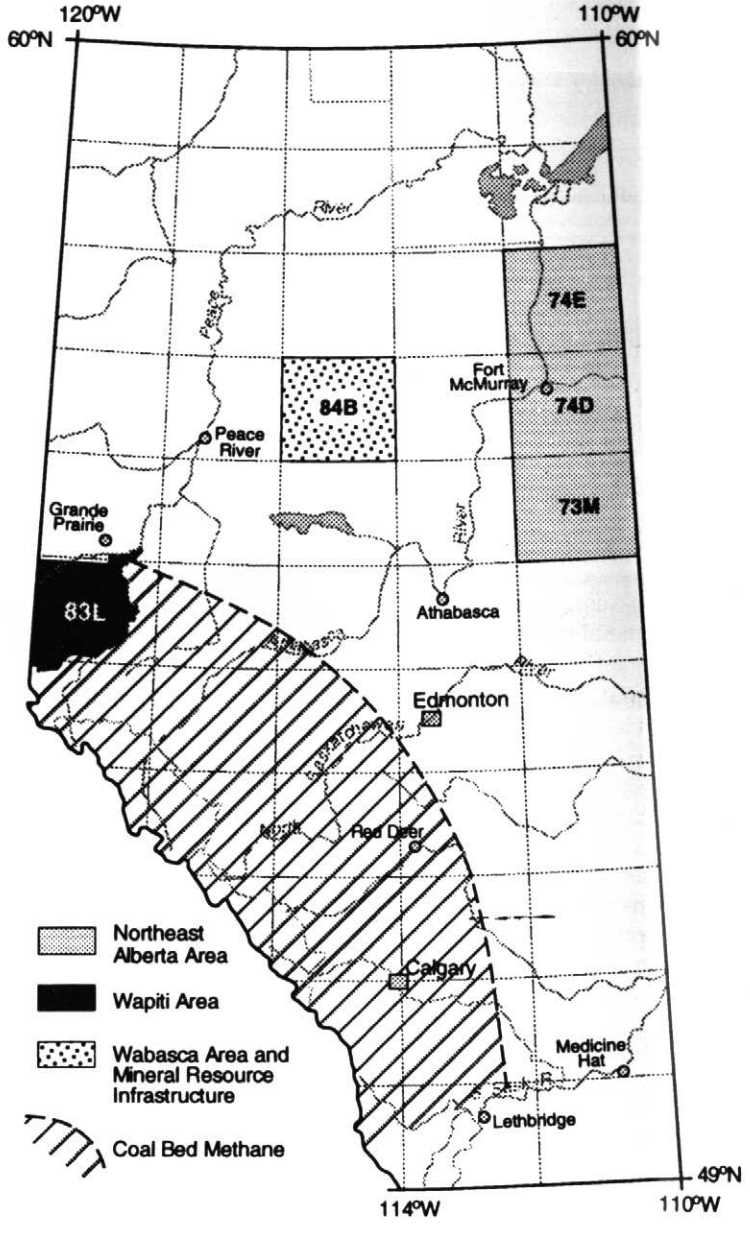


Figure 8 Alberta Geological Survey study areas, 1998-2001.

spatial analysis and modelling to identify potential land use conflicts, and provides comprehensive information to decision makers.

Birch Mountain-Wabasca Area

Studies related to diamond and metallic minerals exploration are under way in northeast and central Alberta. They include Quaternary stratigraphy, diamond indicator mineral sampling, and other methods as appropriate.

West Central Alberta

The Kakwa-Wapiti region has active coal, petroleum and diamond exploration. The metallic mineral potential of this area is not well known. Repeated external requests and comments have identified this area as requiring additional information for land use planning.

Bedrock geology, regional geochemical sampling and stratigraphic mapping, and Quaternary geology studies of the area will develop a framework of the stratigraphy and structural geology, and help establish target areas for exploration. The mineral aggregate and industrial mineral potential of the area will be determined. The AGS will develop an approach that maximizes the amount of information that can be obtained from a combination of existing small-scale maps, subsurface data, and limited field work, to produce information at 1:50,000 scale that is most useful for land use planning and resource development. The results of all studies will be combined with other information in a Geographic Information System, and provide important input to provincial land planners.

ONGOING ACTIVITIES

There is strong demand for a new geology map of the province. The AGS will produce a new map in digital format and post a retrievable version on the web every 3 months as new data are incorporated. A "zoom-in" capability will be developed.

Data bases and data base management systems are being updated as needed, and a complete catalogue of AGS data holdings (both digital and hard copy) is being developed. Reports and data releases are migrating toward digital retrieval *via* the world wide web. The AGS will maintain an information technology infrastructure that is responsive to the needs of its scientific program.

Saskatchewan

Saskatchewan Geological Survey	
Year Established	1948
Parent Organization	Saskatchewan Department of Energy and Mines
Address	1914 Hamilton Street Regina, SK S4P 4V4
Contact Person	Gary Delaney, Chief Geologist
Phone	(306) 787-1160
Fax	(306) 787-2488
E-mail	gary.delaney@gov.sk.ca
Staff (full time equivalents)	40
1998-1999 Funding Sources	Ministry: $2,550,000 Total Budget: $2,550,000
Main Areas of Expertise	Industrial minerals including diamonds, Precambrian mapping and metallogeny, mineral resource assessment, Phanerozoic stratigraphy and sedimentology with emphasis on petroleum geology

BRIEF HISTORY

Nineteen ninety-eight marks the 50th anniversary of the setting up and first field season of the Saskatchewan Geological Survey, by an Order-in-Council introduced in 1947 by the Co-operative Commonwealth Federation (CCF) government under Premier T.C. Douglas.

The government's intention to establish a geological survey was announced in the 1947-1948 annual report: "In order to assist those interested in developing Saskatchewan's mineral resources the Department of Natural Resources is inaugurating a Geological Survey, which will map the northern mineral areas as well as carry out geological surveys of potential gas and oil areas and other economic mineral resources in southern Saskatchewan." (Annual Report of the Saskatchewan Department of Natural Resources and Industrial Development for the year ended 31 March 1948). The following year's report states: "The Saskatchewan Geological Survey completed its first season with four field survey parties active, and a summer staff of 20 geologists and geology students from the universities." The Survey was given permanent standing in legislation passed during the 1949 session. Members of the Saskatchewan Geological Survey during its first years included such well-known names as J.B. Mawdsley, A.R Byers, W. Kupsch and C.D. Dahlstrom. Also in 1948, the department inaugurated a Prospectors' Assistance Plan and Prospectors Training School, the first of its kind in Canada, to stimulate exploration of the northern part of the province. From its early roots to the present, the activities of the Survey have helped with the understanding and discovery of Saskatchewan's bountiful mineral and petroleum resources including base metals, gold, natural gas, oil, potash, sodium sulphate, and uranium.

PRESENT ACTIVITIES

The Saskatchewan Geological Survey, part of Saskatchewan Energy and Mines, has its headquarters in Regina where it also maintains the Subsurface Geological Laboratory, which contains a comprehensive repository of drill core and drill cuttings recovered primarily from oil, gas and potash exploration by industry in the southern part of the province. There is also a Resident Geologist's Office in La Ronge that includes a collection of drill cores and samples from mineral deposits contained in the Precambrian shield of northern Saskatchewan.

Field mapping and research in the Precambrian Shield is currently aimed at three main areas: 1) the Eastern Rae Province on the north shore of Lake Athabasca (Ken Ashton and Russel Hartlaub); 2) the Wollaston Domain transect and base metals project southwest of Wollaston Lake (Gary Delaney, Gary Yeo and Hai Tran; and 3) the La Ronge Gold Belt and La Ronge-Lynn Lake Bridge covering the Byers Fault (Bruno Lafrance) and the southern end of Reindeer Lake (Charlie Harper, Ralf Maxeiner, Dave MacDougall) (Fig. 9). A co-operative project with the Geological Survey of Canada (David Corrigan) aims to map a north-south transect across the Bridge and neighbouring domains. Industrial minerals research includes mapping of the sub-Phanerozoic basement from drill cores, re-evaluation of sodium sulphate resources, and determination of the ages of Tertiary volcanic ash deposits (Lynn Kelley). The Petroleum Geology Branch continues work on the Colorado Group Medicine Hat Sands (Chris Gilboy), the Interlake and Red River formations (Fran Haidl), and the computerized Phanerozoic maps (Kim Kreis). A program of mineral resource assessment for land use planning covers various areas in the province (Murray Rogers). In 1998 18 university students majoring in geoscience were employed primarily on field projects. Some of the students are working on B.Sc. and M.Sc. theses related to these projects.

The Saskatchewan Geological Survey highlights its activities at an open house held each year at the end of November. Preliminary results of current research are presented in the *Summary of Investigations* report series which, starting in 1999, will be published twice a year. Late 1998 will see the release of a 1:1,000,000 scale digital geological map of Saskatchewan in CD-ROM format. Additional information about the Survey and its activities can be found on the Saskatchewan Energy and Mines website at www.gov.sk.ca/enermine.

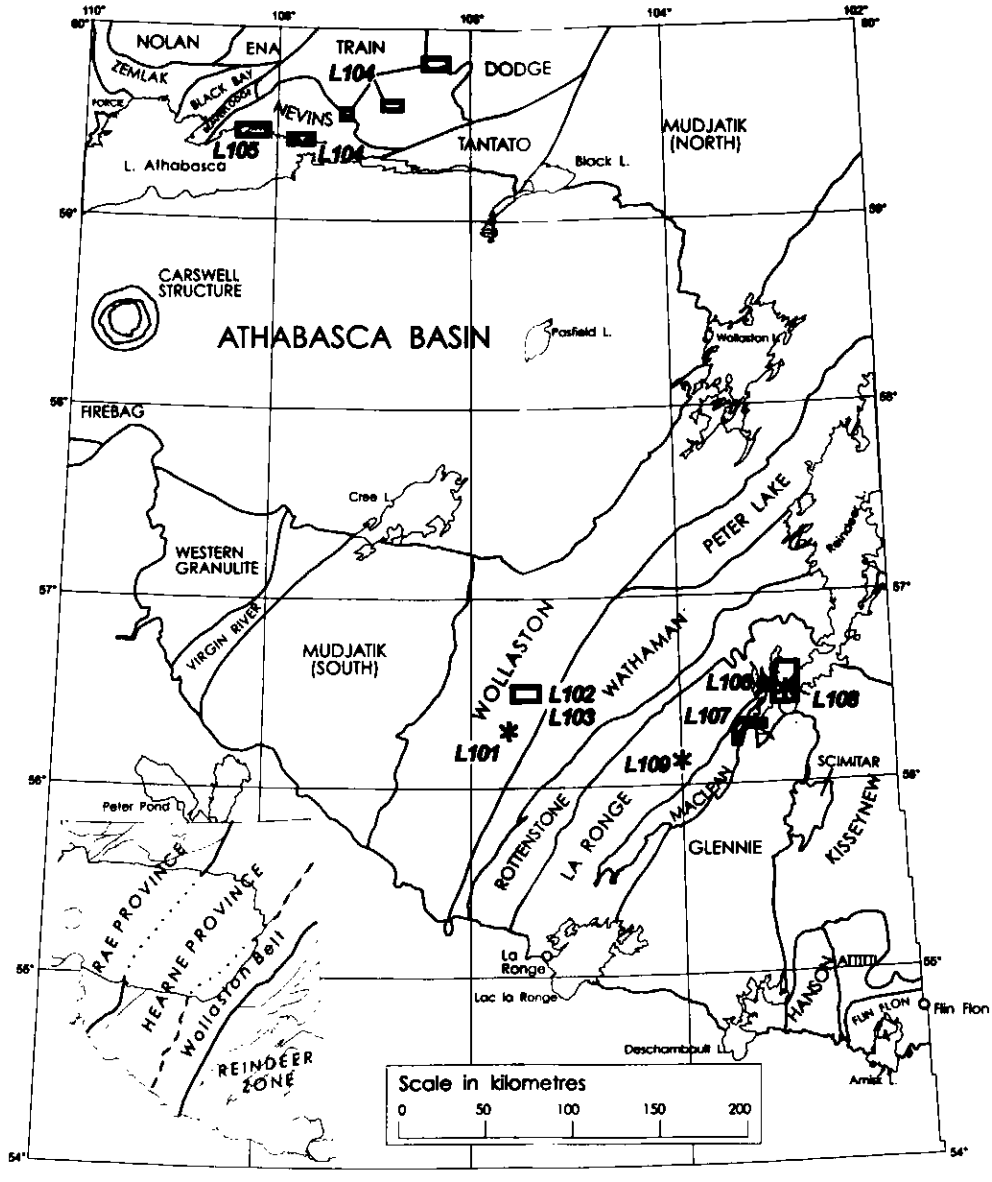


Figure 9 Location Map of 1998 northern field projects of the Saskatchewan Geological Survey. Legend: **L101** - Wollaston base metal studies (G. Delaney); **L102** and **L103** - Wollaston stratigraphic transect (G. Yeo and H. Tran); **L104** - eastern Rae Province reconnaissance (I. Ashton); K105 - Murmac Bay Group Study (R. Hartlaub); **L106 to L108** - La Ronge-Lynn Lake Bridge (R. Maxeiner, C. Harper and D. MacDougall); **L109** - Byers Fault gold (B. Lafrance).

Manitoba

BRIEF HISTORY

The Mines Branch of the Department of Mines and Natural Resources dates its official existence from 1 May 1930; however, it actually came into existence with the creation of the Department on 9 May 1928. The first two provincially funded mapping parties were launched by the Mines Branch in 1928. Geological mapping continued intermittently until after World War II. In 1946, the precursor to the Manitoba Geological Services Branch, as we know it today, was established with the appointment of four additional geologists to staff and the formation of the Geological Division of the Mines Branch. In early 1975, the Geological Survey Section within the former Mines Branch was regrouped as an integral unit of the newly established Geological Services. In 1979, departmental reorganization resulted in the transfer of the Geological Services Branches to the newly defined Department of Energy and Mines. The Geological Services Branch currently constitutes approximately 35% of the entire Department.

PRESENT ACTIVITIES

The Manitoba Geological Services

Branch has recently completed a major initiative in the Flin Flon-Snow Lake greenstone belt, carried out as part of the Shield Margin NATMAP project (Fig. 10). This highly successful program contributed immensely to our understanding of the controls on mineralization in this region, and newly mapped sub-Phanerozoic extensions of the greenstone belt provide some of the most active exploration targets in the province. With the completion of this project, programming continues to shift focus into the northern Superior Province and the Thompson Nickel Belt.

In 1995, the Department identified a need to upgrade the level of geological information for the northern Superior Province in an effort to promote exploration opportunities. "Operation Superior" was launched in 1996 and was linked to the Western Superior NATMAP project in 1997. Now in its third year, the very successful multimedia surficial geochemistry program will continue in the east central portion of the region, and and results from the past summer's work, much anticipated by industry, were released in June, in time for explorationists to follow up on results.

The industry-sponsored Thompson Nickel Belt CAMIRO Project is now entering its second year, drawing on the co-ordinated efforts of MGSB, GSC, five Canadian universities, and five industry sponsors. This program, directed by MGSB, represents the first integrated study of this world-class mining camp, and will develop new exploration tools that will yield long-term benefits to nickel explorers in the province.

MGSB is also developing new exploration and development opportunities in the southern and central parts of the province. Work in the west central part of the province suggests the potential for previously unrecognized metallic mineral deposits hosted within or beneath carbonate rocks overlying the Superior Boundary Zone. Although in the preliminary stages of development, this work could potentially lead to the identification of new deposit types.

In southern Manitoba, a new NATMAP project in the greater Winnipeg area, now entering its second year, in concert with a new GSC-sponsored hydrogeology initiative, will significantly augment MGSB's Capital Region Study,

Manitoba Geological Services Branch

Year Established	1928 (first mapping parties) 1946 (formalized as part of Mines Branch)
Parent Organization	Manitoba Department of Energy and Mines
Address	1395 Ellice Avenue, Suite 360 Winnipeg, MB R3G 3P2
Contact Person	Christine Kaszycki, Director
Phone	(204) 945-6549
Fax	(204) 945-1406
E-mail	ckaszycki@em.gov.mb.ca
Staff (full time equivalents)	51.6
1998-1999 Funding Sources	Host government: $3,776,200 Industrial partnerships: $130,000 Total Budget: $4,401,000
Main Areas of Expertise	Precambrian geology, tectonostratigraphy, volcanology, geochemistry, structural geology, mineralogy, metallic and industrial mineral deposits, Quaternary geology, aggregate inventories, Mesozoic/Paleozoic geology, GIS

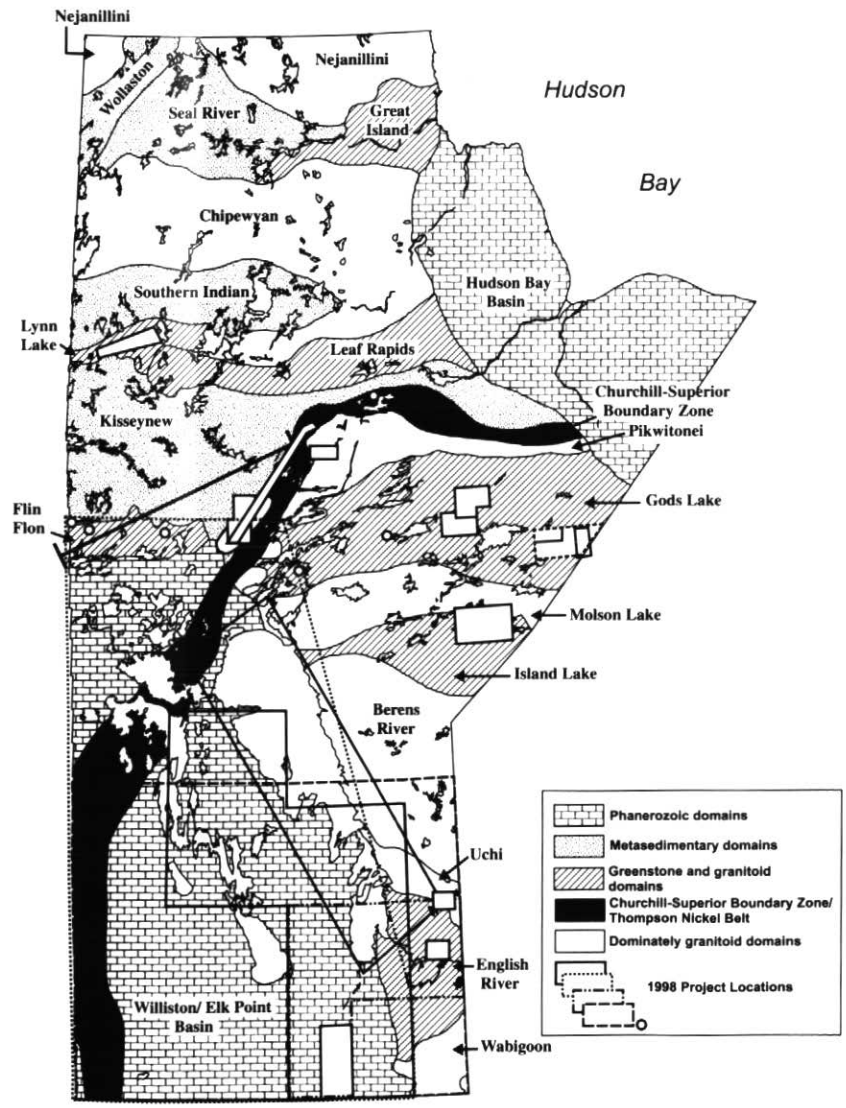


Figure 10 Manitoba Energy and Mines project locations, 1998.

and foster the development of 3-D stratigraphic mapping capabilities. This NATMAP project also includes a study of flood frequency in the Red River Valley.

The Department is also actively striving to promote the industrial minerals sector. An additional industrial minerals geologist will be hired and a specialty metals advisory board or steering committee is currently being established to identify market and development opportunities.

In terms of GIS functionality, the Department is in the process of developing an integrated implementation plan for the managment and distribution of digital data, including the purchase of an Internet map server and the development of geo-referenced digital data bases such as assessment files, claims, mineral deposits, and publications.

Ontario

Ontario Geological Survey	
Year Established	1891
Parent Organization	Ontario Ministry of Northern Development and Mines
Address	933 Ramsey Lake Road, 7th Floor Sudbury, ON P3E 6B5
Contact Person Precambrian Geoscience Division:	Andy Fyon, Senior Manager (Precambrian bedrock mapping, geophysics, metallic mineral deposits)
Phone	(705) 670-5924
Fax	(705) 670-5905
E-mail	andy.fyon@ndm.gov.on.ca
Contact Person Sedimentary Geoscience Section:	Cameron Baker, Senior Manager (Quaternary mapping, surficial geochemistry, aggregate, Paleozoic mapping)
Phone	(705) 670-5902
Fax	(705) 670-5905
E-mail	cam.baker@ndm.gov.on.ca
Contact Person Resident Geologist Program:	Johial Newsome, Senior Manager (resident geologist field office, land use planning)
Phone	(705) 670-5955
Fax	(705) 670-5754
E-mail	hial.newsome@ndm.gov.on.ca
Staff (full time equivalents)	140 (120.5 classified, 19.5 contract)
1998-1999 Funding Sources	Host government: $11,112,000 *Other: $2,000,000 Total Budget: $13,112,000
Main Areas of Expertise	Precambrian geology, Precambrian tectonics, Quaternary geology (mapping and drift sampling programs), till, lake sediment and water geochemistry, Precambrian and glacial sedimentation, aggregate resource inventories, metallic and industrial mineral deposits, kimberlite exploration techniques, Paleozoic/Mesozoic geology, potential field geophysics, digital data collection techniques, geologic digital standards

Notes: *Prospector grants are part of the government allocation
The OGS is involved in and supports approximately 30 collaborative projects involving university, private sector, and other governments

BRIEF HISTORY

The Ontario Geological Survey (OGS) was established on 4 May 1891 as the Ontario Bureau of Mines (OBM), a division of the Ontario Department of Crown Lands. The name was later changed to the Ontario Department of Mines (ODM). In 1972 the Department of Mines, through amalgamation with the former Department of Lands and Forests, became part of the new Ministry of Natural Resources. The OGS became part of the Ministry of Northern Development and Mines in 1985.

Six sections provide geoscience functions. These are the Precambrian Geoscience Section (Precambrian geology, metallic mineral deposits, geophysics); the Sedimentary Geoscience Section (Quaternary geology, Paleozoic/Mesozoic geology, surficial geochemistry, aggregate resources); the Resident Geologist Program (mineral deposit inventory, MDI data base management); the Information Services Section (cartography, publication, library); the Data Services Section (digital data distribution and archive); and the Geoscience Laboratory (analytical services).

PRESENT ACTIVITIES

Current Precambrian Geoscience Section (PGS) bedrock projects include: mapping in readily accessible parts of the Superior Province emphasizing 1:20,000 scale to 1:100,000 scale mapping with geochronology and geochemical characterization of major units; collaborative projects conducted with private sector, university and other governments (Québec Ministère des Ressources naturelles, Manitoba Geological Services Branch, Geological Survey of Canada), including support of LITHOPROBE and Western Superior NATMAP projects; and the reprocessing and new anomaly selection of high-resolution airborne geophysical data jointly with the Data Services Section (Fig. 11).

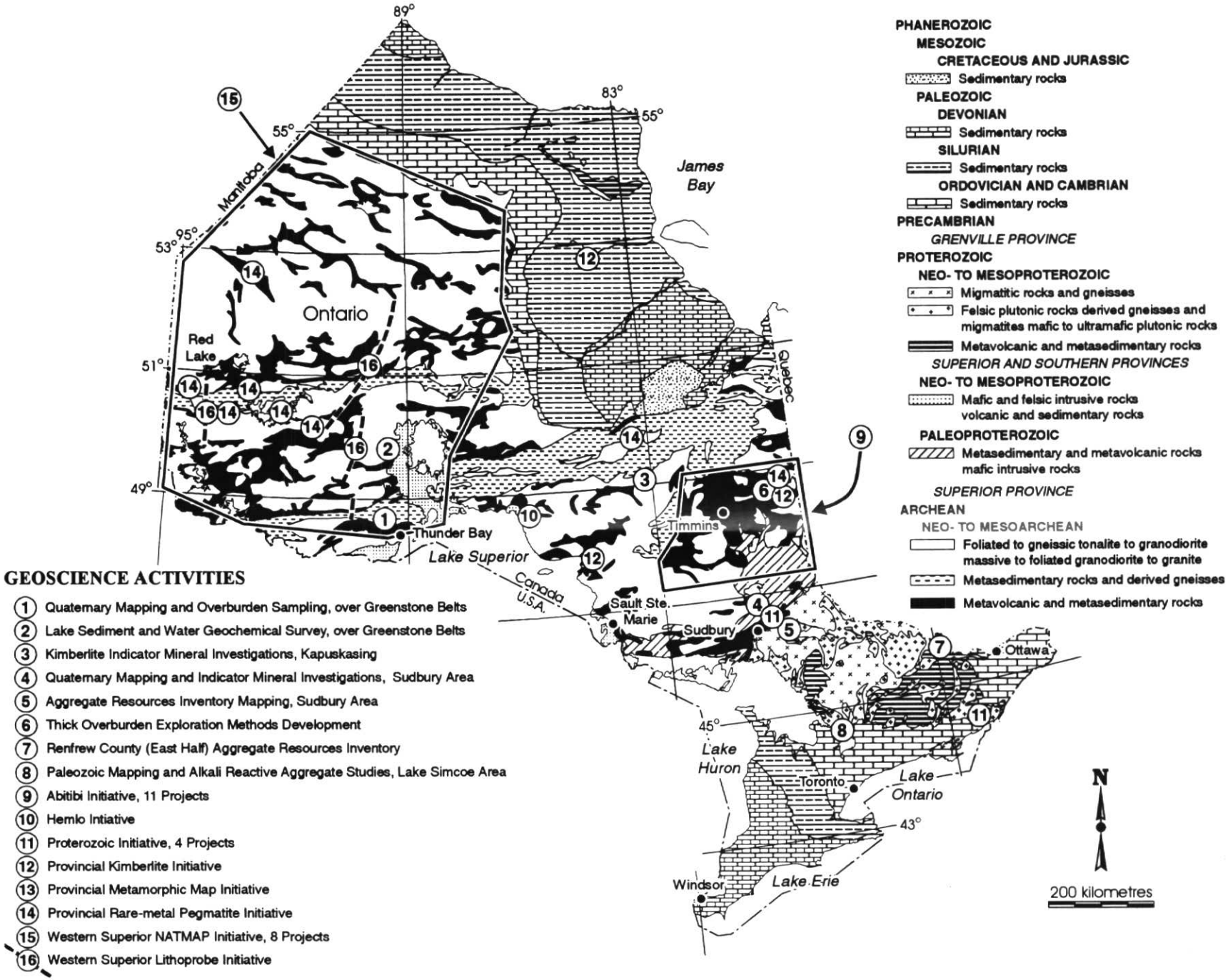


Figure 11 Geoscience activities, Ontario Geological Survey, 1998. Location of projects.

The Sedimentary Geoscience Section (SGS) is presently undertaking projects across the province. These include: mapping and research of Quaternary sediments, including mapping and sampling/geochemistry surveys in the Thunder Bay, Kapuskasing and Sudbury areas as well as the Oak Ridges Moraine area of southern Ontario; lake sediment and water surveys slated for areas underlain by greenstone belts located on the west side of Lake Nipigon; research on developing geochemical exploration techniques for use in areas of thick overburden and on the applicability of selective leaches; Paleozoic mapping in the Lake Simcoe area of south-central Ontario; and aggregate resource inventories in the corridor between Sudbury and North Bay and southeastern Ontario.

The Resident Geologist Program (RGP) monitors, stimulates and facilitates economically sustainable and environmentally sound mineral exploration and development of Ontario's mineral resources through a network of offices located across Ontario. The RGP collects and records information on mineral occurrences and deposits (MDI data base); maintains assessment files; manages the diamond drill core libraries across Ontario and is currently leading a major assessment of mineral potential across Ontario, with the assistance of PGS and SGS, as part of a provincial, inter-ministry land use planning exercise.

The Information Services Section now provides all paper geological maps and reports on demand; the Data Services Section provides the digital data and maps on demand. The Data Services Section is migrating to a data warehouse function and the dissemination of data and information *via* the Internet.

The OGS uses a variety of computer tools to collect data and construct geological maps in the field, to analyze data in the office, and cartographically produce and disseminate professional maps to clients.

THE FUTURE

The OGS is focussed on the interests and needs of the minerals industry. The Survey's goal is to maintain the geoscience infrastructure of Ontario by continuing to deliver high-quality geoscience products in support of the minerals industry. The newly established OGS Advisory Board is working at a strategic level with the Survey and the Minister of Northern Development and Mines to help achieve that goal.

The exact geoscience program delivery mechanism is being reviewed to determine if there are alternative delivery models that would secure an appropriate level of service, in order to help ensure Ontario remains attractive to minerals investment.

OGS mapping units have embraced collaborative, jointly delivered geoscience projects to complement the OGS program and to acquire additional geoscience information about Ontario. The joint OGS-Laurentian University, M.Sc. mapping school degree program is another means to acquire additional, but very focussed, geoscience data sets and also help train students in the fundamental field mapping skills. NATMAP and LITHOPROBE collaborative projects are another way that students acquire field experience, and the geoscience infrastructure of Ontario is expanded.

The OGS continues to develop new methods and concepts relevant to mineral exploration, such as lake sediment sampling technology, selective leach techniques, airborne geophysical data processing techniques, and concepts about the relationship between Precambrian geology, tectonics and mineralization. These advances are firmly rooted in the field mapping program, and lead to enhanced exploration opportunities in Ontario.

Québec

Géologie-Québec	
Année de fondation	1891 (Bureau des Mines)
Organisme responsable	Ministère des Ressources naturelles du Québec
Adresse	Direction de la Géologie 5700, 4e avenue ouest, bureau A-208 Charlesbourg, PQ G1H 6R1
Personne ressource	Jean-Louis Caty, Directeur
Téléphone	(418) 627-6274
Télécopieur	(418) 643-2816
Courriel	jean-louis.caty@mm.gouv.qc.ca
Nombre d'employés	144 (equivalent à temps complet)
Budget 1998-1999	Salaire: $7,226,000 Fonctionnement et immobilisations: $8,188,000 Transfert: $5,552,000 Budget: $20,966,000
Principaux domaines d'expertise	Cartographie géologique, SIGÉOM, minéraux industriels, métallogénie, géophysique, assistance financière

BREF HISTORIQUE

Au départ, le Bureau de Mines se consacrait entièrement aux visites des mines et à l'avancement des travaux miniers. Ensuite, au début du siècle, le Bureau a commandé des travaux d'exploration et de cartographie à des professeurs d'université durant les périodes estivales. Après 1910, la contribution scientifique du Bureau des Mines s'est développée progressivement jusqu'à atteindre celle qu'on connaît aujourd'hui.

En juin 1997, la Direction de la géologie devient officiellement une Unité autonome de service (Géologie-Québec); ce statut lui confère une plus grande autonomie administrative et une marge de manoeuvre accrue dans ses opérations. L'unité Géologie-Québec demeure toujours rattachée au Ministère des Ressources naturelles.

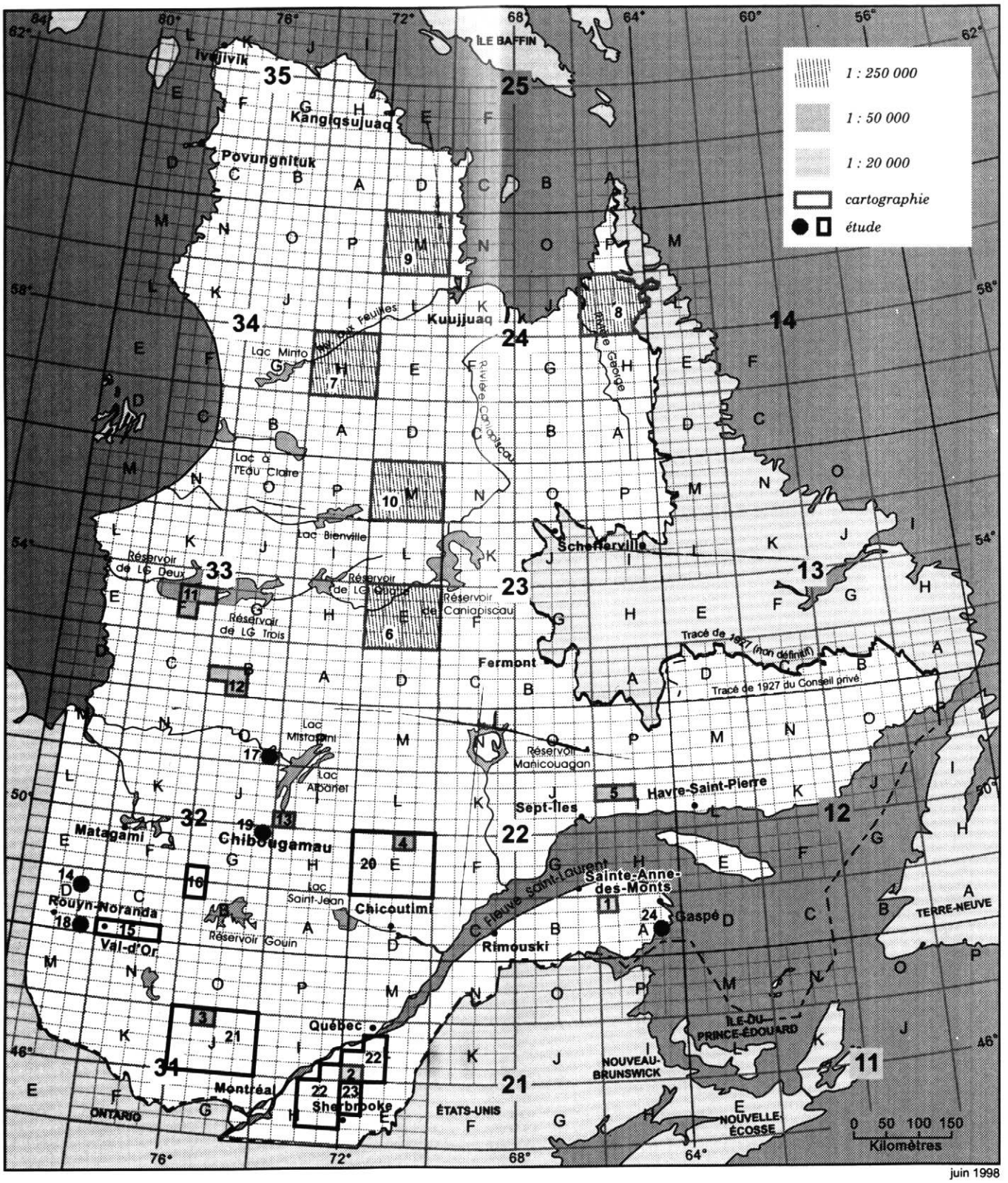


Figure 12 Ministère des Ressources naturelles du Québec localisations des projets, 1998. (Location of projects)

Géologie-Québec	
Year established	1891 (Bureau des Mines)
Parent organization	Ministère des Ressources naturelles du Québec
Address	Direction de la Géologie 5700, 4e avenue ouest, bureau A-208 Charlesbourg, PQ G1H 6R1
Contact person	Jean-Louis Caty, Directeur
Telephone	(418) 627-6274
Fax	(418) 643-2816
E-mail	jean-louis.caty@mrn.gouv.qc.ca
Number of employees	144 (full time employees)
Budget 1998-1999	Salaries: $7,226,000 Operations and fixed assets: $8,188,000 Transfers: $5,552,000 Total budget: $20,966,000
Major areas of expertise	Geological mapping, GIS, industrial minerals, metallogenesis, geochemistry, geophysics, financial assistance

ACTIVITÉS COURANTS

Géologie-Québec réalise des inventaires géoscientifiques dans toutes les régions du Québec et un effort particulier est dirigé présentement vers le Grand Nord du Québec (Fig. 12).

Le SIGÉOM (Système d'information géominière) diffuse les données géoscientifiques numériques au fur et à mesure de la digitalisation de l'information analogique. Un projet de production de cartes de potentiel minéral est en voie de réalisation.

Environ le quart du budget de Géologie-Québec est consacré aux programmes d'assistance financière à l'exploration minière. Ces programmes s'adressent aux prospecteurs et aux compagnies d'exploration.

Géologie-Québec offre les mêmes services à sa clientèle dans tous ses bureaux: Charlesbourg, Montréal, Val-d'Or, Rouyn-Noranda, Chibougamau, Sept-Îles et Ste-Anne-des-Monts

CONCLUSIONS

Le Gouvernement du Québec assure le financement des activités de Géologie-Québec. Une ouverture a déjà été créée auprès de l'industrie pour qu'elle participe à des projets en partenariat.

Le SIGÉOM accroît sans cesse sa banque de données géoscientifiques disponibles à la clientèle.

BRIEF HISTORY

Initially, Bureau des Mines was entirely dedicated to mine inspections and to the advancement of mining. Subsequently, at the beginning of this century, the Bureau has contracted out exploration and mapping studies to university professors during the summer period. Since 1910, the scientific contribution of the Bureau has developed progressively until it reached the level for which it is known today.

In June 1997, the Direction de la Géologie officially became an autonomous service unit (Géologie-Québec); this statute confers it greater administrative autonomy and an increased freedom of movement in its operations. The Géologie-Québec Unit continues to be linked to the Ministère des Ressources naturelles.

PRESENT ACTIVITIES

Géologie-Québec carries out geoscience inventories in all regions of Quebec, and a special effort is directed toward Quebec's great north (Fig. 12).

The SIGÉOM (geomining information system) disseminates digital geoscience data as analog information becomes digitized. A project to produce mineral potential maps is underway.

Approximately one quarter of the budget of Géologie-Québec is dedicated to financial assistance for mineral exploration. These programs are directed at the prospectors and the exploration companies.

Géologie-Québec offers the same service to its clients through all its offices: Charlesbourg, Montréal, Val-d'Or, Rouyn-Noranda, Chibougamau, Sept-Îles and Ste-Anne-des-Monts.

CONCLUSION

The government of Quebec assures the financing of the activities of Géologie-Québec. Overtures have already been made to industry for it to participate in projects. The SIGÉOM continues to enhance its geoscience data bases available to the clients.

New Brunswick

BRIEF HISTORY

Abraham Gesner held the position of Provincial Geologist for a period of 4 years (1838-1842). In 1928, Dr. W.J. Wright was appointed Provincial Geologist, following the introduction of the Mining Act in 1927. Over the years Dr. Wright initiated many of the functions that have now become the responsibility of the Geological Surveys Branch, which was formally established in 1980. In 1993, the province formally adopted a mineral policy that strengthens geoscience programs.

PRESENT ACTIVITIES

The Geological Surveys Branch is responsible for building and maintaining a comprehensive geoscience data base of the province and using it to promote mineral exploration and development, as well as to advise government and the public regarding land use (Fig. 13). The Branch has a staff of 36 located in two regional offices, one in Bathurst and the other in Sussex. The regional offices provide direct contact with the mineral

New Brunswick Geological Surveys Branch	
Year Established	1928
Parent Organization	New Brunswick Department of Natural Resources and Energy
Address	PO Box 6000 Fredericton, NB E3B 5H1
Contact Person	Rao Irrinki, Director
Phone	(506) 453-8825
Fax	(506) 453-3671
E-mail	rirrinki@gov.nb.ca
Staff (full time equivalents)	36
1998-1999 Funding Sources	Host government: $2,214,000 Other/Regional Development: $400,000 Total Budget: $2,614,000
Main Areas of Expertise	bedrock geology, surficial geology, mineral deposits, GIS, industrial minerals

industry based in northern and southern New Brunswick, respectively. The major activities of the branch are geological mapping (bedrock and regolith), mineral deposit inventory and studies, geophysical and geochemical surveys, management of exploration assistance programs, and distribution and maintenance of geoscience information. The CARIS-based Geoscience Information System has been used to digitize all the data collected since 1988. In addition to carrying out mapping, the branch has undertaken four major programs: EXTECH II, NATMAP, Bathurst Geophysical Survey, and Restigouche Geophysical and Geochemical Surveys.

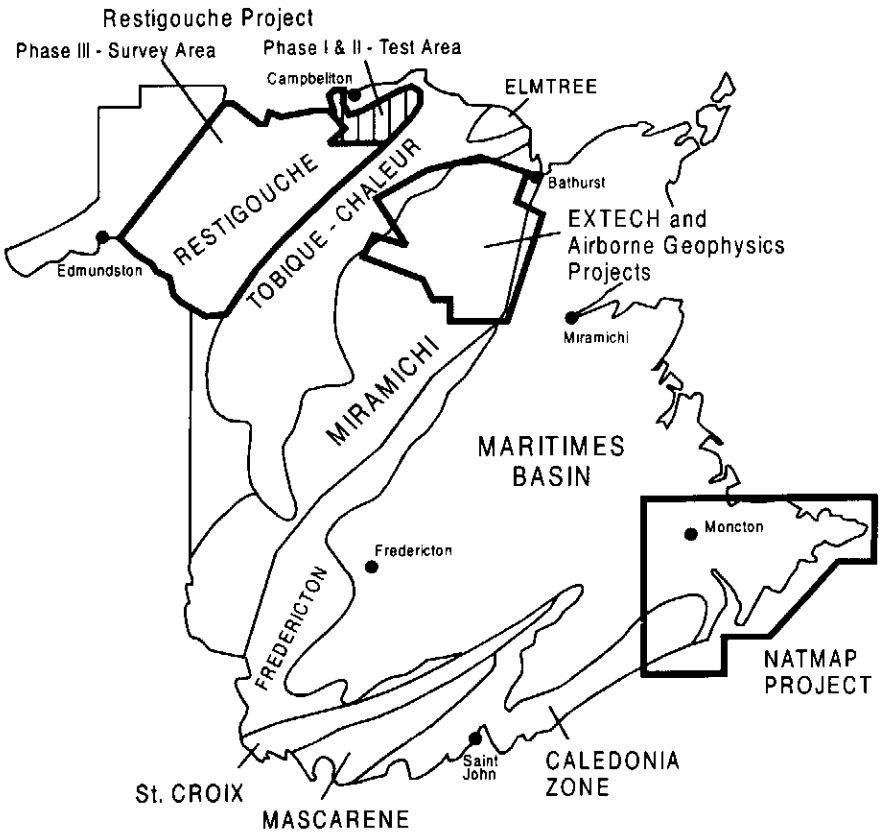


Figure 13 Major geoscience projects in New Brunswick with geological terranes, Geological Surveys Branch, 1998.

Exploration Technology II (EXTECH) is a joint Geological Survey of Canada and New Brunswick Geological Surveys Branch program, addressing problems of declining base metal reserves by developing integrated and multidisciplinary approaches to exploration and by improving the geoscience knowledge base in the Bathurst Mining Camp. The program was initiated in 1994 with total funding of $6.6 million over 5 years, and completion is planned for 31 March 1999. During the last 4 years, field work was carried out in order to collect data on bedrock geology, surficial geology, mineral deposits, geochemistry and geophysics. Most of the data were published as maps and reports by New Brunswick's Geological Surveys Branch and the Geological Survey of Canada. Most of the collected data have been maintained in digital format, which will be used for 2-D and 3-D modelling in an attempt to find mineral deposits. It is planned to publish several papers in a special volume of *Economic Geology Monograph.* A comprehensive summary of the project is available on the website, htpp:extech2.gsc.nrcan.ca/homeEXTECH2.htm.

New Brunswick is participating in the 5-year (1993-98) National Mapping Program (NATMAP) that began in 1994 under the leadership of GSC geologists Peter Giles and Greg Lynch. The program entailed mapping the Carboniferous Maritimes Basin, which underlies parts of Nova Scotia, New Brunswick, Prince Edward Island, Newfoundland and Quebec. The Geological Surveys Branch participants are Malcolm McLeod, Clinton St. Peter, and Susan Johnson, who were responsible for mapping part of the Moncton, Sackville and Cumberland subbasins. The project and previous geological mapping helped to attract oil and gas and bituminous shale exploration to New Brunswick.

A state-of-the-art multiparameter helicopter geophysical survey that consisted of electromagnetics, magnetics and radiometrics was carried out in 1996-1997 on the entire Bathurst Camp (3400 km^2). The area was flown at a line spacing of 200 m, with a mean clearance of 200 m. The survey was managed by the Geological Surveys

Branch while the Geological Survey of Canada carried out the quality control. To date, more than 150 maps have been released to the public and, as a result, have generated new interest in this established mining camp.

The Restigouche project is comprised of three phases. Phase I involves an airborne geophysical survey, similar to the Bathurst Mining Camp, and a stream-sediment geochemical survey to be carried out over a test block on the northeastern part of the Restigouche Belt. Phase II will consist of an evaluation of Phase I results, including follow-up geological mapping. Phase III, involving the geological, geophysical and geochemical surveys for the entire Restigouche Belt, will be recommended based on the evaluation of Phase I results. Phases I, II and III are budgeted at $540,000, $50,000 and $2.2 million, respectively. Phase I was completed with a budget of $540,000 and results were released in July 1998.

Nova Scotia

Nova Scotia Department of Natural Resources Mineral and Energy Resources Division	
Year Established	1995 (precursors back to early 1970s)
Parent Organization	Nova Scotia Department of Natural Resources
Address	1701 Hollis Street, 3rd Floor PO Box 698 Halifax, NS B3J 2T9
Contact Person	Scott Swinden, Director
Phone	(902) 242-8135
Fax	(902) 424-7735
E-mail	hsswinde@gov.ns.ca
Staff (full time equivalents)	31 professional 10 clerical/technical
1998-1999 Funding Sources	A-base budget: $2,600,000 Other: $160,000 Total Budget: $2,760,000
Main Areas of Expertise	regional bedrock and surficial mapping, base and precious metal metallogeny, metallic and industrial mineral deposits, coal geology; igneous petrology, sedimentology; structural geology, dynamics of basin formation; paleoecology of the Late Carboniferous; environmental earth science; GIS and computer applications to earth science; land use planning

BRIEF HISTORY

Seven years after the discovery of gold in Nova Scotia in 1860, the provincial government established the Department of Mines to review and manage the gold development activities. Over the next 100 years, the Department mostly monitored mining development, with some work in mine inspection. The first full-time geologists became members of the Department in the 1960s. Prior to this time, the Department relied on the Geological Survey of Canada and its officers (Eugene Faribault, Hugh Fletcher, Walter Bell, *etc.)* to provide the needed geological expertise. Systematic regional mapping by provincial geologists began in the early 1970s with the start of agreements within the Department of Regional Economic Expansion and has continued as A-base work, funded by various Mineral Development Agreements. In the early 1980s energy became a full-time partner, as the Department of Mines became the Department of Mines and Energy. Since 1991 minerals, mines and earth science have been joined with crown lands, energy, forestry, parks and wildlife in the Department of Natural Resources.

PRESENT ACTIVITIES

The Mineral and Energy Resources Division is beginning the first year of a 5-year program of regional bedrock mapping, Quaternary geology, and mineral deposit investigation, resulting from a Users Needs Analysis carried out in 1996-1997 (Fig. 14).

A major new 1:50,000 scale geological mapping initiative began in 1998 in southwestern Nova Scotia with field work initially concentrated in the Annapolis Valley near Digby. A new integrated metallogenic and geological compilation is underway in the Meguma Terrane of eastern Nova Scotia, which will ultimately result in a compilation of all gold occurrences in the area and a new set of 1:50,000 scale geological maps for the area. In northern Nova Scotia, detailed geological mapping continues in the deformed Carboniferous rocks adjacent to the Cobequid-Chedabucto Fault Zone. The Mineral and Energy Resources Division is in the second year of a regional metallogenic study of the pre-Carboniferous rocks of Cape Breton Island; work to date has concentrated in volcanic environments that host volcanogenic massive sulphide deposits in southeastern Cape Breton.

Industrial minerals are major contributors to Nova Scotia's mineral industry, with production of gypsum, salt, barite and aggregate, among others. Field work this year focusses on slate, feldspar and kaolin in the central part of the province, and efforts are underway, through the mineral inventory project, to document zeolite occurrences in the Bay of Fundy region, in light of a recent exploration program to develop marketable commodities. Regional assessment of aggregate occurrences in southwestern Nova Scotia is

continuing. The Division also provides geological support to coal mining operations, principally in Cape Breton Island.

There is considerable interest in the Carboniferous Basins of Nova Scotia at present as a result of renewed interest in exploration for hydrocarbons and coal gas methane. To respond to this, a basins program is being initiated, consisting of compilation and analysis coupled with new mapping to produce detailed 3-D interpretations of basin architecture.

All scientific programs are supported by an editorial unit and by a Digital Information unit that manages our data bases and provides support for digital information dissemination and vision for future information technology directions.

This is the second year of a 4-year Prospectors Assistance Program, jointly funded by provincial and federal governments under the Economic Diversification Agreement, in which $600,000 will be spent for prospectors training, travel assistance to trade shows, and contributions to field activities. Division staff will be working with prospectors who have received assistance under the Prospector Assistance Program.

The Division continues its work in public education through minerals outreach activities and mineral promotion planning and activities. It also maintains a core library and client service centre in Stellarton where approximately 640,000 m of drill core is available for study. A major focus of action at present is participation in the Department's Integrated Resource Management Program, in which representatives of the various Natural Resources sectors cooperate to attempt to balance the needs of all land and resource users in land use decision making in Nova Scotia.

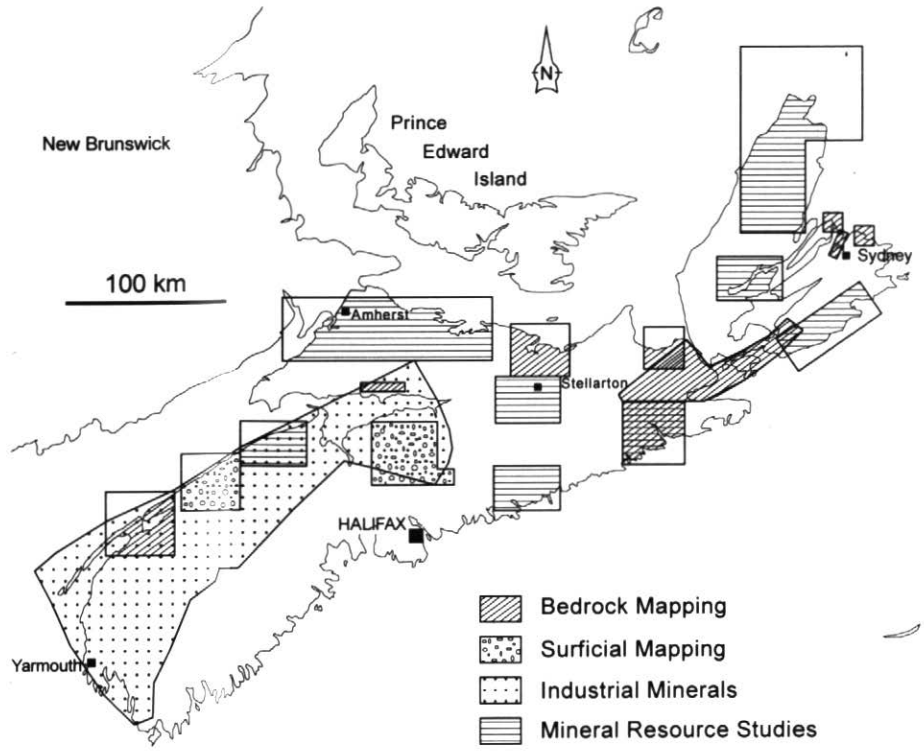


Figure 14 Geological projects, 1998, Nova Scotia Mineral and Energy Resources Division.

Newfoundland and Labrador

BRIEF HISTORY

The first systematic geological investigations in Newfoundland began in 1864 when the Geological Survey of Newfoundland was inaugurated under the directorship of Alexander Murray. Murray and his St. John's-born assistant (and eventual successor) James P. Howley produced the first geological map of Newfoundland, published in 1907. After Howley's retirement in 1909, the Survey was temporarily inactive. It was reactivated in 1926 for a few years, but it was not until the early 1930s that geological investigations became an ongoing activity. After Confederation, a single provincial geologist, sometimes with one or two assistant geologists, carried out regional investigations of specific mineral commodities. Very little regional geological mapping was being done by the province due to limited funding. This all changed in the 1970s: government sponsorship of mineral-development activities resulted in the growth of a modern multidisciplinary geological survey.

STRUCTURE AND RESEARCH

To efficiently pursue its objectives of systematic bedrock mapping, Quaternary studies, geochemical and geophysical surveys, mineral deposit studies, and geoscience information services (Fig. 15), the Geological Survey is organized along similar research and service activities. Consequently, four subdivisions or sections form the organizational structure of the Survey: the Regional Geology Section (responsible for bedrock mapping), the Geochemistry-Geophysics and Terrain Sciences Section, the Mineral Deposits Section, and the Geoscience Publications and Information Section.

Four main research thrusts have underpinned the Survey's research program during the past several years:

- Systematic mapping of the Canadian Shield (Labrador) and the Appalachian Orogen (Newfoundland) at 1:100,000 and 1:50,000 scales, respectively (see figure). This has resulted in the compilation and release of new 1:1,000,000 scale geological maps of the Island and Labrador.
- Regional and detailed mapping of surficial deposits and ice-flow indicators in areas of known mineral potential. A preliminary 1:500,000 scale surficial-geology map of the Island has been released.
- Regional geochemical analysis of el-

Geological Survey of Newfoundland and Labrador	
Year Established	1864
Parent Organization	Newfoundland Department of Mines and Energy
Address	PO Box 8700 St. John's, NF A1B 4J6
Contact Person	R. Frank Blackwood, Director
Phone	(709) 729-6541
Fax	(709) 729-3493
E-mail	rfb@zeppo.geosurv.gov.nf.ca
Staff (full time equivalents)	45
1998-1999 Funding Sources	Provincial government appropriation: $3,400,000 Total Budget: $3,400,000
Main Areas of Expertise	systematic bedrock mapping, mineral deposit studies, geochemical surveys, terrain sciences, GIS, other geoscience information services

ement distribution in stream and lake waters, stream and lake sediments, soil and bedrock. Geochemical atlases of these data are available on CD-ROM.

- Economic geology studies, including mapping, mineral deposit modelling, and industrial mineral assessment, in areas having "favourable" geology or containing mineral prospects and mines. These studies directly stimulate mineral exploration activity and help support projects underway.

The maps and reports emanating from the above research are edited and published by the Survey's Publications and Information Section. This group also maintains and makes available to clients the province's complete holdings of geoscientific information, and provides direct consultation to industry clients seeking to explore in the province.

CURRENT PROJECTS

During the 1998 field season, bedrock mapping projects were carried out in the following areas: Cambro-Ordovician carbonates of western Newfoundland; Siluro-Devonian granitoids of north-central Newfoundland; Late Proterozoic volcanic rocks of eastern Newfoundland; and Proterozoic plutonic and gneissic rocks in the central Grenville Province, Labrador (Fig. 16).

Mineral deposit studies included the following field projects: metallogenic studies of Ni-Cu mineralization of the Nain-South Voisey's Bay area, Labrador; metallogenic studies of epigenetic gold and volcanogenic massive sulphide occurrences of the northwestern Dunnage Zone (Baie Verte Peninsula); industrial mineral assessment of the talc prospects of the Baie Verte Peninsula.

Terrain sciences field projects in 1998 consisted of the following: surficial geology mapping of the St. John's Peninsula; granular-aggregate assessments on the Avalon Peninsula; and surficial geology mapping in western Newfoundland. Geochemical field studies consisted of follow-up lake sediment and lake water surveys in north-central Labrador. Several other recent field projects are currently in the write-up stage and consequently had little or no field activity in 1998. As well, many ongoing office-based projects are major contributors to the Survey's overall program, *e.g.*, compilations of government and industry geophysical data; description and inventory of all mineral occurrences in the province, known as the Mineral Occurrence Data System (MODS); provision of access to indexed bibliographic data on all geoscience documents, including company assessment reports; consultations with industry on where to explore and provision of information accordingly; promotions of the province's mineral potential to industry clients.

Figure 15 Collecting a heavy mineral concentrate from a small stream bed in northern Labrador for mineralogical and geochemical analysis.

FUTURE PLANS

The Geological Survey took a major step to prepare for the future by conducting a provincial geoscience needs study in the fall of 1998. It was carried out in co-operation with the GSC as part of the Memorandum of Agreement between the two surveys, and involved all the client groups in the province. The study will help guide GSC activity in the province over the next few years, and will be a significant contribution to the development of a 5-year strategic plan for the Geological Survey of Newfoundland and Labrador.

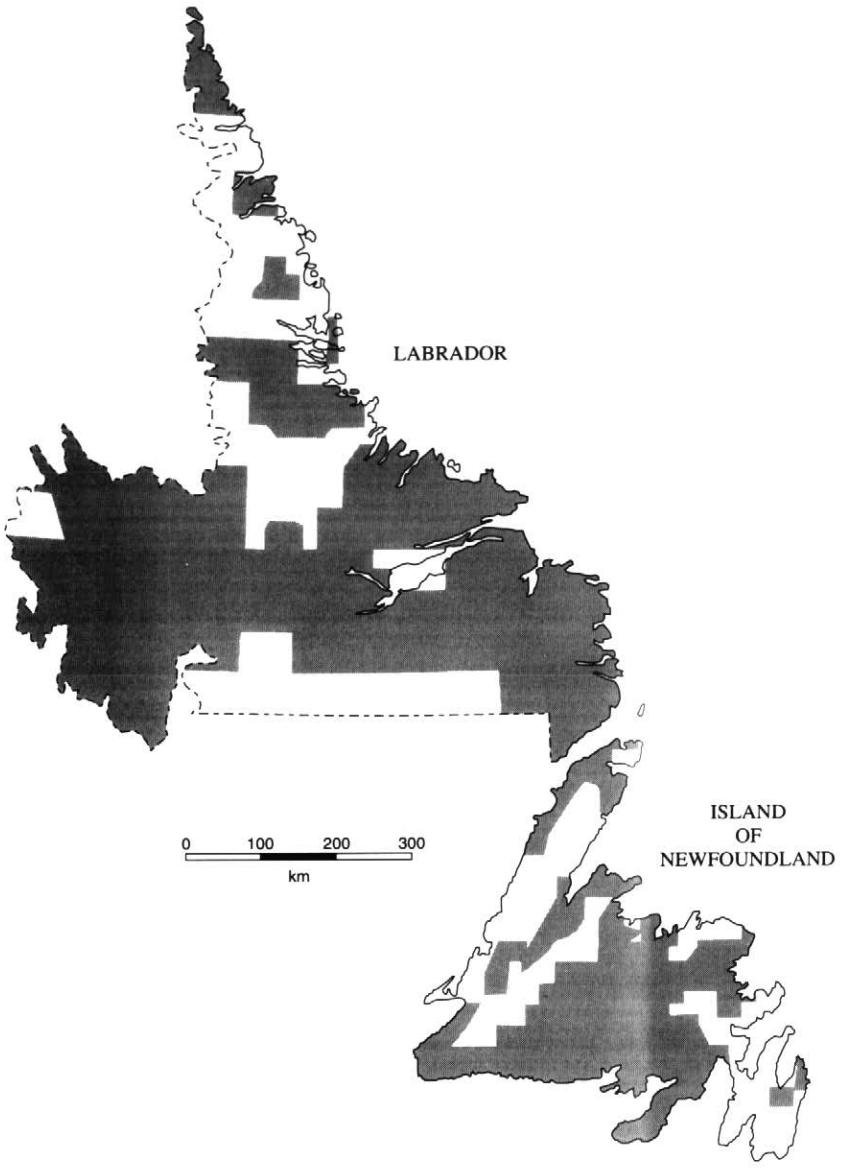


Figure 16 Bedrock mapping carried out by the Geological Survey of Newfoundland and Labrador over the past 25 years. Mapping in Labrador was mostly at the 1:100,000 scale, and in some areas was conducted in co-operation with the Geological Survey of Canada. Mapping on the Island was mostly at the 1:50,000 scale.

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