

See
QE
185
G4
1990-91
RES

1990-1991

GEOLOGICAL SURVEY OF CANADA



RESERVE/RÉSERVÉ

NOT TO BE TAKEN FROM THE ROOM
POUR LA CONSULTATION SUR PLACE



Energy, Mines and
Resources Canada
Hon. Jake Epp,
Minister

Energie, Mines et
Ressources Canada
L'hon. Jake Epp,
Ministre

Canada

THE ENERGY OF OUR RESOURCES

THE POWER OF OUR IDEAS

This document was produced
by scanning the original publication.

Ce document est le produit d'une
numérisation par balayage
de la publication originale.



TABLE OF CONTENTS

A MESSAGE FROM THE ASSISTANT DEPUTY MINISTER OF THE GEOLOGICAL SURVEY OF CANADA

GEOLOGICAL SURVEY OF CANADA

Introduction

PROGRAM HIGHLIGHTS

Geoscience Surveys

Minerals

Energy

Environment

- Environmental Geoscience and
Public Safety
- Global Change

New Publications

Information Technology

Outreach

Conferences and Workshops

Research Grants

Arctic Logistics - Polar Continental Shelf Project

ORGANIZATIONAL PROFILE

DIRECTORY

ORGANIZATION CHART

FINANCIAL STATEMENT

LIBRARY / BIBLIOTHÈQUE

FEB 25 1992

GEOLOGICAL SURVEY
COMMISSION GEOLOGIQUE

A MESSAGE FROM THE ASSISTANT
DEPUTY MINISTER OF THE
GEOLOGICAL SURVEY OF CANADA



R. Taylor, GSC

Increased collaboration in research and wide-ranging consultation aimed at improving the Survey's level of service to its users were the hallmarks of the past year. Both endeavours have brought about solid results.

Extensive discussion between all levels of staff resulted in a consensus as to what direction the Survey should follow over the next five years. The resulting Long-Term Strategic Plan and its accompanying questionnaire were released in January 1991 to many of our clients or "stakeholders" for their input. To encourage feedback on the plan, our senior managers made many special presentations to key industry groups, professional associations and our provincial counterparts. The plan will be finalized in late 1991 and will be, in effect, the blueprint for the Survey's future.

A dynamic exchange of ideas with our provincial and territorial counterparts as to how to strengthen collaboration and coordination of research also bore fruit this year. The Survey signed "Principles of Cooperation" with the geological surveys of British Columbia, Alberta and Manitoba, and one with Newfoundland neared the final stages of negotiation. These agreements are designed to formalise joint planning and the execution of work in areas of mutual interest and responsibility. They complement liaison committees set up last year for this purpose with all provinces and the territories, as well as existing federal/provincial mineral development agreements.

Throughout the report that follows you will find many examples of specific research programs that benefitted from strengthened ties and consultation with other players in the geoscience community. We are all gaining from this trend, and it should be encouraged by all of us. Toward that end, I would welcome hearing any ideas you may have where collaborative work with the Survey could be explored.

Looking ahead to the immediate future, the Survey will commemorate its 150th anniversary in 1992. We plan to celebrate this landmark in Canadian science to the fullest. We see it as an excellent opportunity to let Canadians know how much they benefit from the first-rate geoscience capability to be found at all levels in this country. I hope you will join in our celebrations and look forward to seeing you at some of the many events planned throughout the year.



Elkanah A. (Ken) Babcock



The 150th anniversary logo: the geological hammers superimposed on the map of Canada signify the importance of geology to the exploration and development of our country.



Janet King's dramatic shot of a storm fast approaching a field camp at Olga Lake, Northwest Territories won First Prize in the "GSC at Work" category of the 1990 GSC photo contest.

OUR MANDATE

A comprehensive knowledge of the geoscience of Canada and its vast offshore area is fundamental to environmentally responsible economic development, public safety and national sovereignty. Acquiring, interpreting and making that information available to all Canadians is the mission of the Geological Survey of Canada (known widely as GSC or the Survey), and has been since its founding in 1842.

This is an immense and challenging task — one that takes GSC staff to the farthest frontiers of the country and keeps them at the forefront of scientific knowledge and technology. The Survey's standards of scientific leadership and excellence are nationally and internationally respected.

OUR PEOPLE

Nearly 1000 highly skilled people work for the Survey. They are spread across the country at research centres in Dartmouth, Nova Scotia; Sainte-Foy, Quebec; Ottawa, Ontario; Calgary, Alberta; Vancouver and Sidney, British Columbia. Networks of seismological, geomagnetic and geodynamic observatories are found throughout Canada.



Fieldwork is a fundamental component of our research program. It is carried out both on land, often in Canada's most remote corners, and offshore.

The GSC also has administrative responsibilities for the Polar Continental Shelf Project (PCSP), a unique Arctic logistics unit which maintains research bases at Resolute and Tuktoyaktuk, Northwest Territories, and on an ice island adrift in the Arctic Ocean.

THE NATIONAL INDUSTRIAL ADVISORY COMMITTEE TO THE GEOLOGICAL SURVEY OF CANADA

The Survey is proud of its tradition of strong working ties with all levels of industry. A very important connection is an independent advisory committee made up of industry leaders who meet regularly to review the Survey's programs, priorities and strategic plans in terms of their relevance to private sector needs. The committee meets directly with the Minister of Energy, Mines and Resources Canada to report their recommendations. At the end of 1990, the Committee roster was:

Dr. E.W. Best (Chairman), Calgary, Alberta

Ms. N.J. Allman, Toronto, Ontario

M. Roger Doucet, Montreal, Quebec

Mr. J.F. Gartner, Markham, Ontario

Dr. L.C. Kilburn, Oakville, Ontario

Mr. D.K. Mustard, Vancouver, British Columbia

Dr. D.W. Pollock, Lower Sackville, Nova Scotia

Dr. D.S. Robertson, Toronto, Ontario

THE IMPACT OF OUR WORK

Geoscience information and expertise make a fundamental contribution to the high standard of living that Canadians enjoy. Some of the more significant applications include:

- supporting key sectors of the economy such as mining and the oil and gas industries.
- helping us better understand, and thus plan more effectively against, the dangers posed by natural hazards like earthquakes, landslides and volcanoes.
- assessing the environmental impact of large developments such as pipelines and offshore drill rigs.
- giving us knowledge about past environmental conditions against which we can assess contemporary global changes and their possible future impact.

The Geological Survey of Canada serves a broad and diverse range of clients in the mineral and oil and gas exploration industries, provincial resource development agencies, the geotechnical community, land use planners, policy groups of the federal government and the geoscience community both nationally and internationally.



Entre Nous, EMR

A new boardroom at GSC's Ottawa headquarters was dedicated in memory of the late James Merritt Harrison, one of Canada's foremost geologists. Dr. Harrison was the Director of the Survey from 1956 to 1964. Shown here, the Right Honourable Jake Epp and Mrs. Harrison at the ceremony.

NATIONAL GEOSCIENCE MAPPING PROGRAM

The National Geoscience Mapping Program (NATMAP) is an ambitious program initiative, led by the Geological Survey of Canada, that brings together Canadian geoscience expertise from government, industry and universities for the purpose of improving the quality, relevance and completeness of bedrock and surficial geological mapping programs across Canada. NATMAP was launched in 1991 with two major flagship projects:

- *The Shield Margin Project is a cooperative venture between GSC, the Manitoba and Saskatchewan geological surveys and several universities. This project will enhance understanding of the mineral-rich Flin Flon - Snow Lake area and provide guidance for exploration of the buried Precambrian Shield to the south.*
- *The Geology of the Slave Province Project in the Northwest Territories involves GSC, the Department of Indian Affairs and Northern Development's Northern Minerals Program and the Canada-Northwest Territories Geoscience Initiative Office. It will upgrade mapping in key parts of the Slave Province that are of particular interest for exploration and that will contribute to resolving fundamental geological questions.*

Although still in their initial stages, both projects have already demonstrated the benefits of cooperation and good communication among the participating agencies. Novel uses of computer technology in the field and laboratory have resulted in significant reductions in the time normally required to analyse field data and produce final maps.

This cooperation exemplifies today's research world, which is increasingly based on collaborative efforts. Working together is bringing us all benefits; most encouragingly, Canadian geoscientific knowledge and expertise will be the real winners in the long run.

For more information, contact:

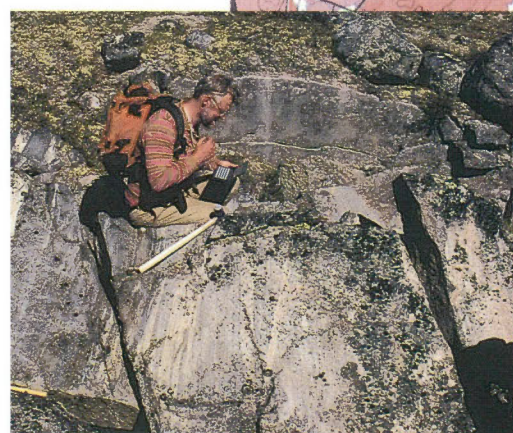
NATMAP Coordinator

Geological Survey of Canada

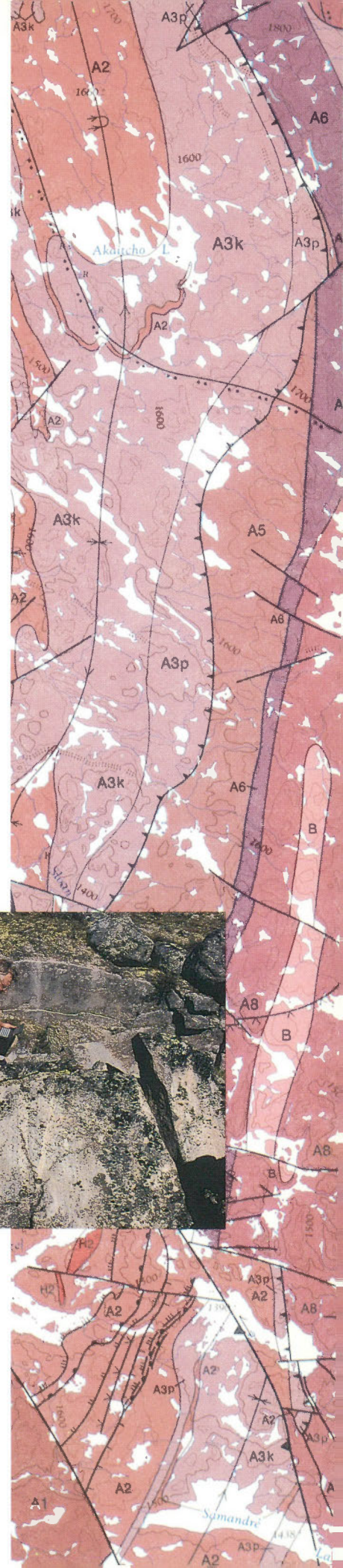
601 Booth Street

Ottawa, Ontario

K1A 0E8



C. Jefferson, GSC





R.H. Rainbird, GSC

Victoria Island, Northwest Territories.

The GSC's research program supports key sectors of the Canadian economy and major policy objectives of government in a broad range of areas that include geoscience surveys, minerals, energy and environment. Making this information available and accessible to all Canadians and the provision of Arctic logistics round out the Survey's program. The highlights of the 1990-91 research program that follow are grouped accordingly.

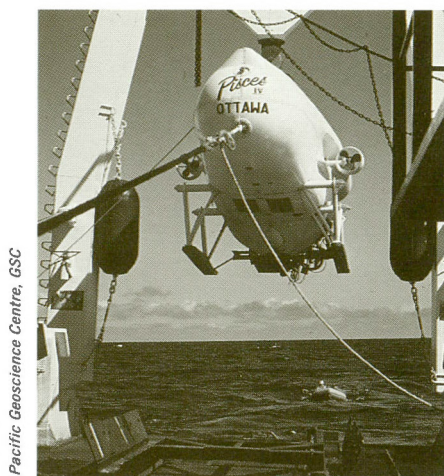
GEOSCIENCE SURVEYS

■ GSC continued its strong participation in LITHOPROBE, the largest multidisciplinary study of the earth's crust ever undertaken in Canada. In May 1990 the government announced that its funding for this project, which comes mainly from the Natural Sciences and Engineering Research Council, would grow by 50% to \$18.9 million over the next three years. LITHOPROBE, which enables us to "see" as much as 50 km beneath the earth's surface, is revealing important new information about the dynamic interior forces that formed the planet and that are the source of Canada's mineral and petroleum wealth. The past year also saw more mining companies participating in LITHOPROBE with both Noranda Ltd. and BP Resources contributing funding to the Abitibi-Grenville project. Industry foresees significant spin-offs from the advanced seismic techniques used for the work. Other benefits include improved geological information for the area and the development of better mineral exploration techniques.

■ As part of GSC's ongoing development of technology and techniques for marine investigations, a new 30-metre piston coring system was used extensively for seabed sampling

in 1990. With it, scientists can obtain longer and less disturbed samples of seafloor sediments. New techniques are also being developed under the Digital Initiative Program to highlight coastal zone environmental concerns. Digital sidescan and seismic data will enhance analogue data and give a clearer, more focused picture of the seafloor. These techniques will have important applications for environmental assessment, seabed mapping, waste disposal, pollution monitoring, mineral exploration and marine engineering.

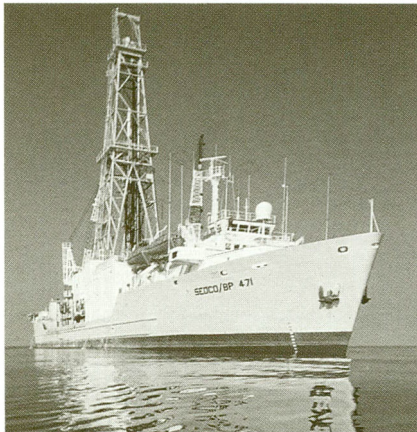
■ GSC's National Geochemical Reconnaissance database is finding valuable new applications. One of the most significant is that this basic information about the natural geochemistry of the landmass provides a framework against which environmental impact assessments can be made. To meet increased demands for this information, GSC continued to add to the database and improve accessibility to it. The database currently contains information from 200 surveys, representing 180 000 sample sites collected over 2.1 million km², and the results of 135 of these surveys can now be purchased on floppy disks.



Pacific Geoscience Centre, GSC

Marine geoscience studies require sophisticated and highly specialized equipment. The submersible PISCES IV enables scientists to travel to the bottom of the ocean for first-hand observations and sample collection.

There were two excellent examples of the diverse practical applications of GSC's offshore mapping programs and marine expertise. In July 1990, using deep tow, high resolution sidescan sonar equipment and the PISCES IV submersible, GSC helped the Department of Defense rapidly locate and recover key parts of the wreckage of a CF-18 aircraft lost off Vancouver Island in about 1300 m of water. South of Newfoundland, GSC data was used to help the RCMP and Canadian Navy locate a sunken ship suspected of drug smuggling. As a result of its ongoing regional mapping program off the east coast, GSC had detailed data on the sediments and seabed features of the area where the suspected drug ship was last reported. GSC experts were able to help the Navy successfully interpret seafloor conditions, and locate the shipwreck.



Ocean Drilling Program

The international Ocean Drilling Program's (ODP) aim is to gain a better understanding of the earth's last frontier, the ocean bottom. Research is conducted from the drillship, JOIDES Resolution, the most sophisticated floating laboratory in the world. The ship's visit to Canadian waters in September 1991 will give scientists a chance to explore the Juan de Fuca Ridge off the west coast.

MINERALS

■ The integrated, multidisciplinary EXTECH (Exploration Science and Technology) Project focused on massive base metal sulphide environments in the Snow Lake and Rusty Lake areas of Manitoba. Detailed geological mapping revealed a new distal extension of the ore horizon at the Ruttan Mine and identification of widespread iron-magnesium alteration associated with several deposits in the Chisel Basin. EXTECH activities also included airborne and ground surveys to characterize the geophysical signatures of the deposits and associated alteration, and integrated geochemical and Quaternary geological studies in both areas. Finally, a "Geographic Expert System", which combines Artificial Intelligence and Geographic Information System technologies was developed for Chisel-type volcanogenic massive sulphide deposits.

■ GSC continued to perform Mineral and Energy Resource Assessments (MERA) of proposed National Park sites in northern Canada. In the Northwest Territories, the assessment of the area around Wager Bay was completed in 1990 and an assessment of the Bluenose Lake area was begun. The MERA process endeavours to minimize potential conflicts between parks and the exploration and development of non-renewable resources.

■ Seafloor minerals investigations off the west coast continued to build towards the planned visit of the international Ocean Drilling Program's research vessel JOIDES Resolution to Canadian waters off the west coast in September of 1991. The goal of the research is a better understanding of the underwater Juan de Fuca Ridge with its extraordinary hydrothermal vents or "black smokers" that spew out super-heated, mineral laden waters. This should give us new insight into the origins of economically important volcanogenic massive sulphide deposits on land and possibly set new criteria for exploration.

■ In the Atlantic, a seafloor project with the U.S. Geological Survey used the research submarine ALVIN to collect rock and hot fluid samples at

a hydrothermal field on the Mid-Atlantic Ridge and resulted in an undersea first: the fluid samples were found to contain native gold. This provides valuable information on the nature of gold-bearing mineralizing fluids while the deposits are actually being formed.

■ These seafloor investigations are closely linked to the shift in emphasis of GSC's mineral deposits research towards base metals. This change is in response to the sharp reduction in Canadian reserves of copper, lead and zinc over the last decade. New studies were initiated in the Notre Dame Bay area of Newfoundland; southeastern Cape Breton Island; Bathurst, New Brunswick; and the Ansil Mine at Rouyn, Quebec.

■ A number of projects carried out under the four year (1987-1991) Canada-Northwest Territories Mineral Development Agreement were completed; the resulting maps and reports are being prepared for publication. These will cover areas of current exploration interest such as Contwoyto Lake, Pistol Lake-Turner Lake, Cameron River Greenstone Belt in Slave Province and the area of the Mystery Island Intrusive Suite of the Wopmay Orogen.

R. Ernst, GSC



■ Investigations in Quebec and eastern Canada focused on the Appalachians and the Grenville Province, and these are clarifying the origins and relationships of different Grenville and Appalachian terranes and their mineral potential. An offshoot of the work was the development of closer links with provincial agencies, especially the Quebec Ministry of Energy and Resources with which partnership projects were implemented. Mapping and regional investigation of surficial deposits of most of Abitibi, Quebec also neared completion. This is a region of active mineral exploration and lumbering, and the maps and understanding of its Quaternary history will greatly aid regional development, particularly in the areas of mineral exploration, forestry and environmental assessments.

Portable drill designed by GSC being used for a paleomagnetic study, Great Slave Lake, Northwest Territories.

AEROMAGNETIC SURVEY OF SOUTHERN ALBERTA

The first phase of a collaborative aeromagnetic survey of southern Alberta involving GSC and eight major oil and mining companies was successfully completed between July and September 1990. The work was carried out by a Canadian airborne survey company and covered an area of 96 800 km² in central Alberta. The survey will contribute to oil exploration activities in Alberta and, under the terms of the cost-sharing agreement, the data will become available to the public after five years. GSC is negotiating similar joint ventures with industry and the Saskatchewan and Manitoba governments.



D. Skubiski, Geoterrex Ltd. Ottawa

The survey work was flown by Geoterrex Ltd. of Ottawa. The aircraft, Cessna 404, Titan C-GGTA was equipped with a Scintrex cesium

vapour magnetometer installed in a tail boom stinger (sensor). A Sercel NR103 GPS receiver was used for navigation and flight path recovery.

ENERGY

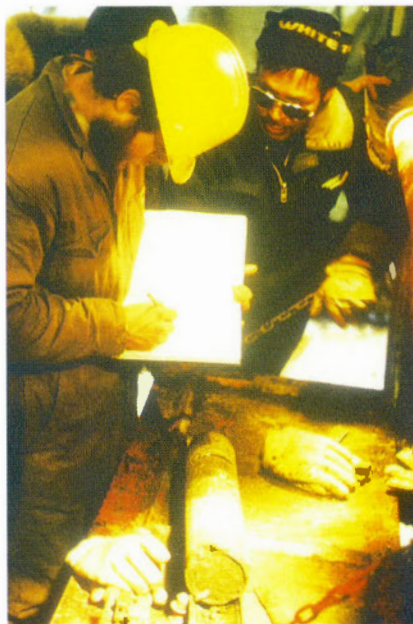
■ Field studies of the well exposed Upper Palaeozoic strata of the Arctic Islands have resulted in an excellent understanding of the nature and distribution of organic reef formations which are present in these rocks. Reefs of similar age are important petroleum reservoirs in other parts of the world and are potential drilling targets in the Canadian Arctic. A summary report was recently completed and will be of much value in interpreting their occurrence and petroleum potential.

■ GSC is leading a new multidisciplinary team that is developing a quantitative understanding of the hydrocarbon histories of Canada's east coast frontier basins (off Nova Scotia and Newfoundland). The project pulls together expertise from government, the petroleum industry and universities. Numerical modeling of basin charge history will allow more accurate predictions of basin resource potential and will provide a quantitative platform for development and testing of new concepts for hydrocarbon generation, migration and entrapment.

■ GSC coordinated a multidisciplinary transect involving drilling of onshore and offshore sediments in the Mackenzie Delta and Beaufort Sea Shelf. The results are providing answers to major questions about the correlation of both onshore-offshore surficial geology and the geotechnical and mechanical properties of permafrost in coastal regions. This knowledge will contribute to the environmentally sound design of facilities necessary for hydrocarbon exploration and development in the Beaufort Sea region.

■ Three-dimensional models of coalfields in Nova Scotia and Saskatchewan developed by GSC were of much interest to mining officials in both provinces. The models, incorporating geological data from thousands of boreholes, are produced by software of GSC's National Coal Inventory integrated with microcomputer-based Computer Aided Design (CAD) and Geographic Information Systems (GIS). This resulting model is versatile, with the capability to portray a variety of geological and compositional parameters and to aid in the efficient development of coal deposits.

L.D. Dyke, GSC



Logging of lithology and ground ice data from cores recovered from a 100 m deep borehole of the onshore-offshore transect in the Mackenzie Delta - Beaufort Sea shelf region.

S.R. Dallimore, GSC



Geotechnical drilling along the onshore-offshore transect required the construction of ice roads on the Beaufort Sea shelf to access the drill sites.



J. Adams, GSC

GSC staff made an important discovery of a surface fault break caused by the magnitude 6 Ungava (Northern Quebec) earthquake of December 1989. The 10-km-long earthquake fault break is the first to be found ever in eastern Canada, and one of only ten such features known in the stable continental regions of the world. Seismologist Janet Drysdale is shown inspecting a section of the fault.

ENVIRONMENT

Environmental Geoscience and Public Safety

■ GSC continued efforts to better understand the offshore geohazards of British Columbia's densely populated and industrialized Fraser Delta area. The many environmental concerns include the potential for underwater landslides on the delta front and for large-scale movements of sediment under earthquake stresses and associated tsunamis. The studies also have direct bearing on land planning, waste disposal and pollution issues. Industry and other government agencies participated in the research. The work included a high resolution reconnaissance survey using the latest in digital mapping systems. Drilling was another component, and the cores are being examined for evidence of past earthquakes and related phenomena.

■ GSC completed a series of marine surveys of Halifax Harbour. These identified metal contaminants and mapped the distribution of sewage, allowing for an assessment of the effect of these pollutants on marine life in the Harbour. The resulting environmental geological maps will provide the geoscientific parameters for any decision-making by the Halifax Harbour Task Force about placement of a sewage system for the Halifax metropolitan area. In addition to its importance to public health issues, this information is vital to an understanding of the consequences of any such development on the local ecosystem.

■ GSC recorded and analyzed just over 800 earthquakes in or near Canada during the year; of those 148 were magnitude 3.0 or greater. The largest event, at magnitude 5.6, occurred near the British Columbia - Yukon border, but magnitude 5 earthquakes also struck Vancouver Island, western Quebec and the Mackenzie Valley in the Northwest Territories.

■ Radon surveys in a number of Manitoba communities, using a combination of ground monitors and detectors aboard the GSC Skyvan aircraft, have shown that natural outdoor

radon levels in some localities are elevated, and in some instances exceed the indoor levels thought to pose a human health risk by the U.S. Environmental Protection Agency. This finding will have implications for the determination of indoor radon limits in Canada.

■ A groundwater study of the Moncton region of New Brunswick has identified a number of areas where high levels of elements such as fluorine, sodium, barium, manganese and iron, and similarly deficiencies (e.g. fluorine) may be of concern in human health and other environmental issues. Data will be used by the provincial environment and health agencies for land and water planning management and health studies.

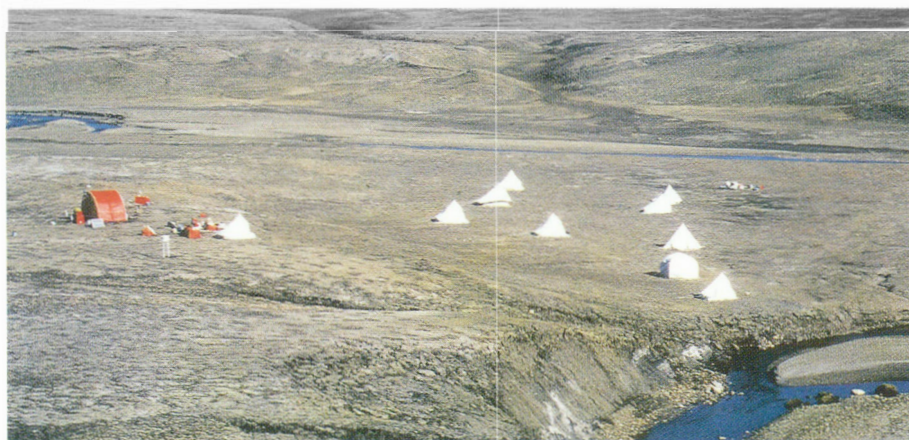
■ As part of ongoing investigations of acid leaching, sampling of selected open pit uranium mines was completed in Saskatchewan. The work was carried out in collaboration with mining companies and the Saskatchewan Department of the Environment. Analytical and selected leach extraction results will help determine whether there would be any detrimental effects to the environment when the mines are decommissioned.

GLOBAL CHANGE

The geological record provides crucial baseline information of past environmental change. It enables the reconstruction of past environmental conditions and provides a context for assessing contemporary global changes and their possible future impacts.

The GSC conducts research that looks at environmental variables at three Global Change "observatories". These are located in the high Arctic on Ellesmere Island, in the Mackenzie Valley region and, being planned for next year, a new observatory in a semi-arid region of the Prairies called the Palliser Triangle. This environmentally sensitive agricultural region is part of Canada's "bread basket". In the historic past severe droughts have occurred periodically, and the consequence of potential climate change in this area is of considerable significance to the interests of Canadian agriculture and governments.

On a related note, a new 10-minute video The Science of Change, produced by EMR, was released. It looks at the Global Change research program underway at the GSC.



*GSC's "Global Change" Observatory
at Hot Weather Creek, Fosheim
Peninsula, Ellesmere Island.*

S. Edlund, GSC

■ *The Canadian Geophysical Atlas* is a boxed set of 15 maps at the 1:10 000 000 scale (also available individually or as digital data) which displays the wealth of information contained in the GSC's geophysical databases. Of particular note, the "Seismicity Map of Canada" shows regional occurrences of earthquakes. Each map has explanatory notes.

■ *Tertiary Fossil Forests in the Geodetic Hills, Axel Heiberg Island, Arctic Archipelago* reports on a multi-disciplinary study to better understand the Canadian Arctic's surprising tropical past as recorded in its fossil forests. The existence of tropical forests so close to the North Pole 45 million years ago clearly indicates the great degree to which global climate has varied naturally over time.

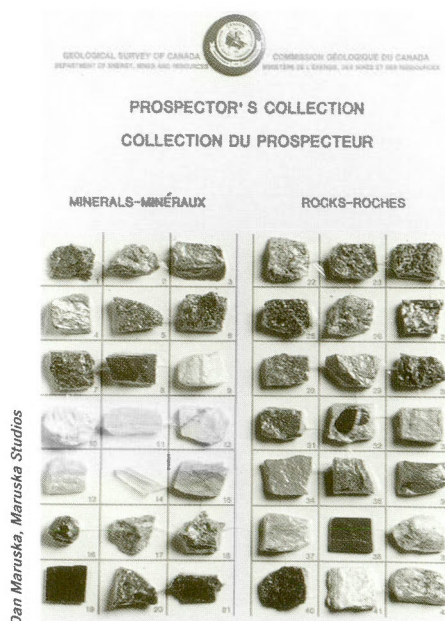
■ *Statistical Applications in the Earth Sciences* offers insight into techniques such as GIS-aided multiple data set integration, image analysis, pattern recognition, spatial statistics, and expert systems technology that can be used to solve geological problems in mineral resource appraisal and estimation.

■ Nine new 1:50 000 scale geological maps of an economically important part of the Selwyn Basin of the Yukon were released as GSC Open Files in June 1990. Since the discovery of the Faro mine in the late 1960s, Selwyn Basin has been the focus of much lead-zinc exploration, and this has been supported and spurred by detailed geological mapping by the Survey. These new maps should follow in this tradition and spark new exploration in the area.

INFORMATION TECHNOLOGY

■ GSC'S Geophysical Data Centre has begun a major upgrade of its computing facilities linked to its national aeromagnetic and gravity databases. The intent is to achieve significant long-term savings in operating costs and expand the range of services available to clients. During the conversion period, requests for Data Centre products from GSC users and external customers will be serviced with a minimum of interruption. During the past year the volume of client requests continued at a high level. There were 350 orders for aeromagnetic maps, plots, and other digital products and 435 orders for similar gravity products.

■ Another milestone was reached in digital colour separation with the production of the "Tectonic Assemblage Map of the Canadian



Dan Maruska, Maruska Studios

Cordillera" on the large format Scitex scanner-plotter at EMR's Surveys, Mapping and Remote Sensing Sector. The production of this complex A-Series map is the culmination of extensive developmental work and paves the way for future digital production.

■ GSC purchased GEOREF, the American Geological Institute's database, in CD-ROM format. GSC Library clientele now have the option of doing their own automated searches using the new system; the Library continues to provide full-service searches.

A new rock and mineral set, the "Prospector's Collection", was introduced and is proving to be popular with students, teachers and budding geoscientists. The kit, which includes 42 rock and mineral samples, costs \$20.00 (plus G.S.T. and provincial sales taxes) and is available from:

*Publications Office
Geological Survey of Canada
601 Booth Street
Ottawa, Ontario
K1A 0E8
Telephone (613) 995-4342
Fax: (613) 943-0646*



Atlantic Geoscience Centre, GSC

GSC's Atlantic and Pacific Geoscience Centres hosted very popular "Open Houses" in the fall of 1990 that attracted 20 000 and 12 000 visitors respectively. All GSC's other offices played leading roles in local and provincial programs aimed at bringing scientists into the schools.

OUTREACH

■ The revamp of GSC's popular poster series for students resulted in the release of the prototype "Meteorites" poster; another art-style poster on fossils was the brainchild of GSC paleontologists and teachers in the Calgary area who were working together to raise student science awareness. Both have been very well received and a targeted distribution is underway to get both posters into classrooms across Canada.

■ More aggressive marketing strategies of GSC products continued with good results. Increased visibility of the GSC and its products at conferences and mineral shows, specialized new order forms with direct mail campaigns, and the acceptance of credit cards have all contributed to the 30% increase in sales of GSC products from last year.

CONFERENCES AND WORKSHOPS

■ The GSC's annual Current Activities Forum, held in Ottawa in January 1991, took as its theme "Geoscience for Canada's Future", and attracted about 750 participants from industry, universities and government.

■ GSC sponsored and organized important international conferences during the year. Of particular note were GEOINFO IV, the 4th International Conference on Geoscience Information held in June 1990, which attracted 310 participants from more than 40 countries, and the Eighth Meeting of the International Association on the Genesis of Ore Deposits (IAGOD) and an associated Mineral Deposit Modeling Symposium in August 1990, which attracted over 600 participants from North America, Europe, USSR and the Far East. Both conferences brought considerable international credit to Canada.

■ In response to requests from industry, GSC put on two very successful workshops in November 1990 on the interpretation of airborne magnetic and gamma ray spectrometric data. The workshops gave geologists

and explorationists a better understanding of the application of these important data sets to geological mapping and mineral exploration.

■ The Quebec Geoscience Centre hosted a seminar on Appalachian geology in November 1990 that was attended by more than 100 participants from the eastern Canadian geoscience community.

■ A one-day GSC workshop on Exploration Geochemistry in March 1991 got top marks from its 126 paid registrants from industry, provincial government agencies and universities. The workshop volume is available as a GSC Open File.

■ Earthquake hazards were the topic of a two-day seminar also in March 1991 and the resulting recommendations will assist GSC in its production of new seismic zoning maps for the next edition of the National Building Code of Canada. Participants included seismic experts from the Ontario Geological Survey, universities and consulting firms in eastern Canada and the United States as well as representatives of Ontario Hydro, Hydro-Québec and the Atomic Energy Control Board.

RESEARCH GRANTS

■ The Energy, Mines and Resources (EMR) Research Agreements Program, which GSC coordinates, and the Natural Sciences and Engineering Research Council (NSERC) jointly awarded grants for 1991 totalling \$2 million. These will support 217 projects in the natural sciences and in engineering at 36 Canadian universities and research centres. The program, established in 1972, uses outside expertise to support EMR research priorities and fosters a dynamic exchange of information and technological innovation between government and the private sector. NSERC contributes to the program by providing additional funding to university-based projects.



R. Kelly, GSC

Staff from the Geological Survey and the Canadian Museum of Nature gathered at the Victoria Memorial Museum Building in Ottawa in April 1991 to start the official countdown to the GSC's 150th anniversary in 1992. The Victoria Building was the GSC's home from 1911 to 1959.



One of the major projects supported by PCSP in the 1990 field season was the test by the Canadian Hydrographic Service of an airborne Through-Ice Bathymetry System (TIBS). This new technology is successfully overcoming difficulties of measuring depths in ice-covered waters.

VIDEOTAPE - A NEW GEOLOGICAL TOOL

Aerial videotaping of Canada's coastline is helping GSC scientists understand how the coast is changing and how geological processes affect it.

Since 1983, the Survey has videotaped more than 7000 km of Canada's Atlantic and Arctic coastlines. The end product, a series of videotapes, is much in demand by industry and other government departments for a wide range of research and land use planning purposes including recreational facilities and harbours. Educators find them an excellent teaching aid. They are also proving to have many diverse environmental applications - including global change studies, environmental impact assessments and emergency planning for oil spill clean-ups.

For more information, contact: Atlantic Geoscience Centre, Geological Survey of Canada, Bedford Institute of Oceanography, Challenger Drive, P.O. Box 1006, Dartmouth, N.S., B2Y 4A2, Telephone: (902) 426-8513/Fax: (902) 426-4266

THE POLAR CONTINENTAL SHELF PROJECT

The Polar Continental Shelf Project (PCSP) is a unique and internationally recognized federal agency that provides a comprehensive logistics support network for scientists working in the Canadian Arctic. It operates from bases in Resolute and Tuktoyaktuk in the Northwest Territories, and from the Canadian Ice Island Research Station in the Arctic Ocean. In keeping with its mandate to help maintain Canada's stewardship of its Arctic region, PCSP plays a key role on behalf of other federal agencies in increasing awareness of the Arctic among all Canadians.

PCSP experienced its busiest field season ever in 1990; it supported 278 science programs and 16 Arctic Awareness Program arts projects. Some major projects receiving PCSP support were: a GSC seismic refraction program at PCSP's Ice Island Research Station; multidisciplinary studies at GSC's Global Change "observatory" at Hot Weather Creek on Ellesmere Island; a joint GSC and Canadian Hydrographic Service

(CHS) bathymetry/gravity survey of the northern Foxe Basin; and, in the western Arctic, a test by CHS of an airborne Through-Ice Bathymetry System (TIBS).

The founding meeting of the new International Arctic Science Committee was hosted by Canada at PCSP's Resolute base in August 1990. The committee, with membership from eight Arctic nations, will provide a forum for cooperative research in Arctic science.

PCSP also tested two satellite digital communications systems, one provided by Communications Canada, as alternatives to the traditional HF radio system now in use for base and field operations; radio communications between PCSP's bases and field camps can be interrupted for days by electromagnetic disturbances in the atmosphere.

For more information, contact:
Polar Continental Shelf Project
Room 6128, 344 Wellington Street
Ottawa, Ontario
K1A 0E4
Telephone: (613) 990-6990
Fax: (613) 990-1508

TESTING POLAR TECHNOLOGIES

Joint ventures to test polar technologies continued. In the summer of 1990, Coast Guard Canada loaned an ARKTOS BETA amphibious vehicle to a GSC research team, supported by PCSP, for a successful two-week test near Tuktoyaktuk, Northwest Territories, of the vehicle's ability to carry out nearshore geophysical surveys. The ARKTOS BETA was originally designed for transportation on ice, water and muskeg. The geophysical information gathered using the ARKTOS BETA will provide information for better oil and gas pipeline design in polar coastline areas and on how to reduce the erosion of the coastal area in Tuktoyaktuk Harbour and the adjacent Beaufort Sea.





The first prize winner in GSC's 1990 Photo Contest, "Scenic Geology" category was Alan Morgan's view of Oraefajokull in Iceland.

The Survey is divided into three scientific branches: Geophysics and Marine Geoscience, Minerals and Continental Geoscience, and Sedimentary and Cordilleran Geoscience. Each is headed by a Director General reporting directly to the Assistant Deputy Minister and, at a minimum, includes one of the Survey's regional centres.

Although each branch has individual research responsibilities, the Survey's program structure is designed to stimulate collaborative efforts that cross organizational boundaries, thus bringing the expertise of diverse specialists to major research initiatives.

The combined output and expertise of the three branches forms the Survey's geoscientific knowledge base — the applications of which support Canadian economic priorities, public safety and environmentally responsible development.

The work of the scientific branches is supported by two other units that provide a full range of shared services including publishing, communications, policy coordination and administrative services. These are the Information and Services Branch and the Office of the Chief Scientist.

GEOPHYSICS AND MARINE GEOSCIENCE BRANCH

This Branch acquires, interprets and disseminates geophysical information concerning the Canadian landmass and marine geoscientific information for its coasts and vast offshore area.

The Branch operates national observatories in seismology, geodynamics and geomagnetism; it also sets standards for and conducts national mapping programs of the Earth's gravitational and magnetic fields. With this information it is able to provide expert knowledge and advice on natural hazards such as earthquakes and magnetic storms. The Branch also undertakes marine geoscientific surveys of Canada's coastal and offshore regions. These provide fundamental geoscientific information about Canada's coastal zone, seabed, offshore sedimentary basins and crustal processes, past and present, near the continental margins of Canada in the Atlantic, Pacific and Arctic oceans.

The Branch consists of the Geophysics Division in Ottawa, Ontario; the Atlantic Geoscience Centre in Dartmouth, Nova Scotia; and the Pacific Geoscience Centre in Sidney, British Columbia.

MINERALS AND CONTINENTAL GEOSCIENCE BRANCH

This Branch carries out field and laboratory studies that contribute to our understanding of the Canadian Shield and the Appalachian region, of the crustal geology and deep geophysics of the Canadian landmass, and of the nature and distribution of Canada's mineral resources.

Two of the Branch's three divisions are in Ottawa. The Mineral Resources Division carries out mineral deposit studies, regional mineral resource appraisals, research in applied geochemistry and exploration geophysics, and mineralogical and chemical analyses of geological materials. The division undertakes systematic geochemical surveys which constitute the National Geochemical Reconnaissance Program, as well as multiparameter airborne geophysical surveys.

The Continental Geoscience Division carries out regional and detailed bedrock mapping and geophysical surveys, and topical research in petrology, geochronology and isotope geochemistry, paleomagnetism and rock properties. Synthesis and integration of these studies contribute to the understanding of the evolution of a large part of the Canadian landmass, and provides a basic geoscience information database for mineral, energy and environment-related investigations.

This Branch also includes GSC's newest regional office, the Quebec Geoscience Centre in Sainte-Foy, Quebec. Established in 1988, it has almost reached its full staff complement (24) and expanded its initial programs of regional geology, metallogeny and Quaternary studies, chiefly in eastern Canada.

SEDIMENTARY AND CORDILLERAN GEOSCIENCE BRANCH

This Branch provides geoscientific information on the energy-rich sedimentary basins of western and Arctic Canada, the geology of the Cordillera, and information and expertise on Canada's physical environment — through the study of unconsolidated

deposits and through geophysical, engineering and other associated studies related to terrain use and hazards.

The Branch has three divisions: the Ottawa-based Terrain Sciences Division, the Institute of Sedimentary and Petroleum Geology in Calgary, Alberta, and the Cordilleran Division in Vancouver, British Columbia.

It is responsible for carrying out bedrock geological surveys in western and Arctic Canada, for surficial geological surveys in all regions of Canada, and for coordinating oil, natural gas and coal resource assessments in western and Arctic Canada. It analyzes and assesses the resources of the sedimentary basins in western and Arctic Canada, and studies low-temperature geothermal energy sources, mainly in the Cordillera.

The Branch is the focal point within the Survey for research into *geoscience aspects of Global Change* and for international activities related to climate change. It also undertakes studies of modern geological processes, including permafrost and landslides (particularly in the Cordillera), and environmental impact assessments of development proposals. It takes the lead on behalf of the Survey for paleontological and paleoecological studies.

INFORMATION AND SERVICES BRANCH

A major responsibility of the Survey is ensuring that the results of its research are accessible to all Canadians.

Toward that end, this Branch manages all in-house publishing activities ranging from editing and cartography through to design and distribution.

Other important information-related duties include maintaining the National Geoscience Library in Ottawa and managing GEOSCAN, a cooperative federal-provincial program to produce a national bibliography for the geosciences.

Program coordination and planning services are carried out on behalf of the Survey by this Branch. These have recently been expanded to include the external liaison office and the departmental research agreements program secretariat. The Branch is also responsible for all common administrative services.

The Polar Continental Shelf Project (PCSP) forms part of the Branch as well. PCSP operates from its headquarters in Ottawa, bases at Resolute and Tuktoyaktuk, Northwest Territories, and the Canadian Ice Island Research Station in the Arctic Ocean.

OFFICE OF THE CHIEF SCIENTIST

The Chief Scientist advises senior management on the balancing of the overall scientific program so that it best addresses societal and client needs and priorities. In this regard, a major responsibility over the past year has been the development of the Long-Term Strategic Plan that will chart the course for the Survey's scientific programs for the next five years.

The Chief Scientist's Office also plays a coordinating role in broad program areas such as geophysics, environmental geoscience and Arctic research. External liaison is provided for special national and international cooperative research initiatives such as LITHOPROBE, the Ocean Drilling Program and the Canadian Continental Drilling Project.

Corporate communications and marketing are another major responsibility of the Office of the Chief Scientist. The objective of these activities is to increase the profile, impact and influence of the Survey and to improve public knowledge and appreciation of the role of the geosciences in everyday life. The celebration of the GSC's 150th anniversary in 1992 will provide an excellent opportunity in this regard. The planning and coordination of special anniversary events and the production of information materials are a main focus for the GSC's communications efforts.

HOW TO GET IN TOUCH WITH US

Nova Scotia

Atlantic Geoscience Centre
Geological Survey of Canada
Bedford Institute of Oceanography
Challenger Drive
P.O. Box 1006
Dartmouth, N.S., B2Y 4A2
Telephone: (902) 426-8513
Fax: (902) 426-4266

Quebec

Quebec Geoscience Centre
Geological Survey of Canada
2700 rue Einstein, C.P. 7500
Sainte-Foy (Quebec), G1V 4C7
Telephone: (418) 654-2604
Fax: (418) 654-2615
Publications Office: (418) 654-2677

Ontario

Geological Survey of Canada
Headquarters
601 Booth Street
Ottawa, Ontario, K1A 0E8
Telephone: (613) 996-3919
Fax: (613) 996-9990
Publications Office:
Telephone: (613) 995-4342
Fax: (613) 943-0646

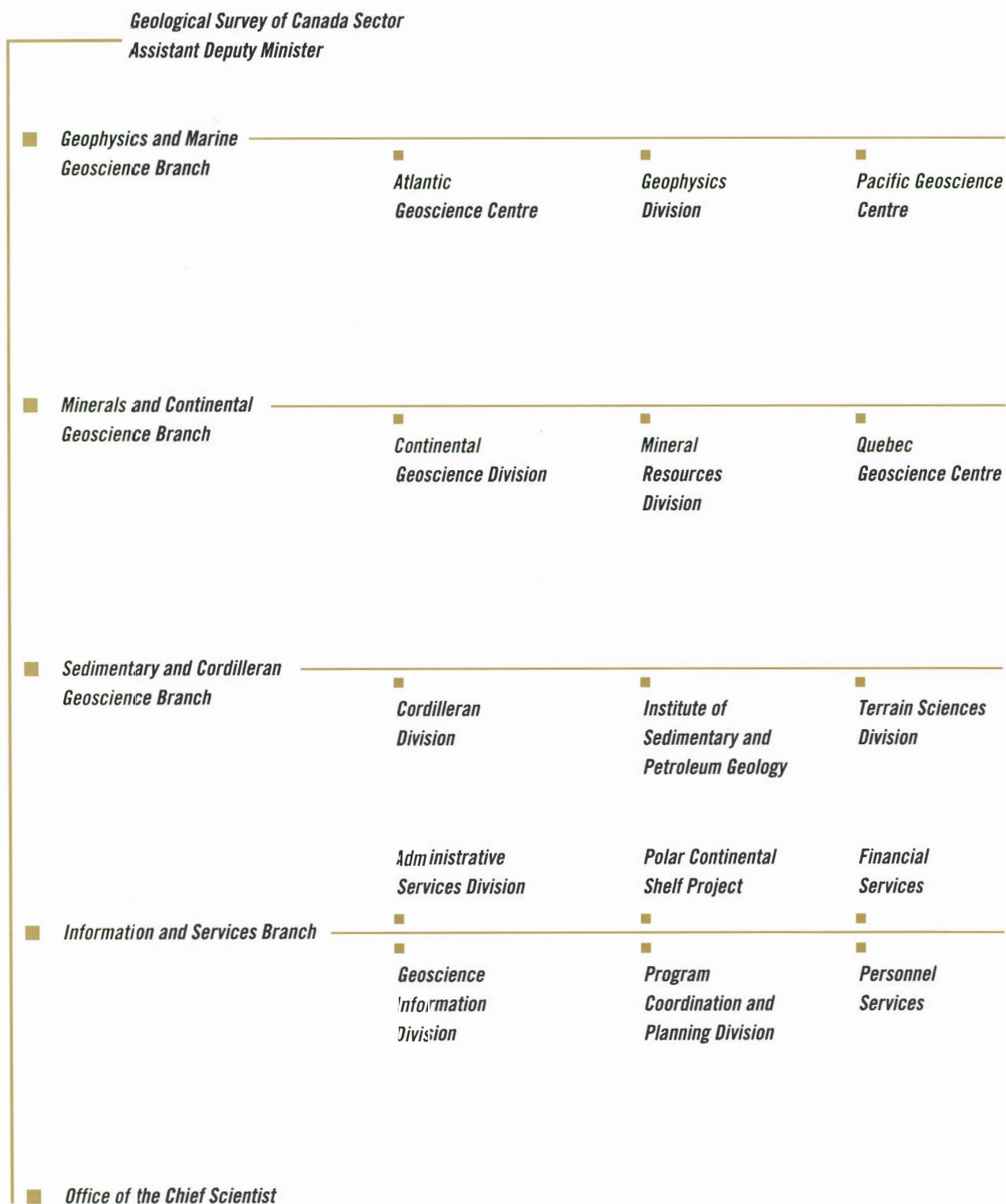
Alberta

Institute of Sedimentary and
Petroleum Geology
Geological Survey of Canada
3303—33rd Street N.W.
Calgary, Alberta, T2L 2A7
Telephone: (403) 292-7000
Fax: (403) 292-5377
Publications Office: (403) 292-7030

British Columbia

Cordilleran Division
Geological Survey of Canada
100 West Pender Street
Vancouver, B.C., V6B 1R8
Telephone: (604) 666-0529
Fax: (604) 666-1124
Publications Office:
Telephone: (604) 666-0271
Pacific Geoscience Centre
Geological Survey of Canada
9860 West Saanich Road
Sidney, B.C., V8L 4B2
Telephone: (604) 363-6500
Fax: (604) 363-6739

ORGANIZATION CHART



SECTOR FINANCIAL STATEMENT

GEOLOGICAL SURVEY OF CANADA

1990-91 Expenditures (in thousands of dollars)

| | Total | Personnel | Operating | Capital | Grants and Contributions | Person-Years |
|--|----------------|---------------|---------------|---------------|--------------------------|--------------|
| Office of the Assistant Deputy Minister | 3 811 | 238 | 198 | 0 | 3 375 | 4 |
| Chief Scientist's Office | 621 | 200 | 421 | 0 | — | 6 |
| Information and Services Branch | | | | | | |
| Director General | 1 342 | 188 | 94 | 1 060 | — | 2 |
| Sector Coordination and Planning | 1 036 | 885 | 121 | 30 | — | 12 |
| Administrative Services Division | 2 229 | 810 | 1 039 | 380 | — | 22 |
| Geoscience Information Division | 6 504 | 4 232 | 1 803 | 469 | — | 98 |
| Mineral Development Program Office | 223 | 5 | 218 | 0 | — | 2 |
| Total | 11 334 | 6 120 | 3 275 | 1 939 | — | 136 |
| Sedimentary and Cordilleran Geoscience Branch | | | | | | |
| Director General | 242 | 213 | 29 | 8 | — | 3 |
| Institute of Sedimentary and Petroleum Geology | 15 579 | 9 041 | 5 575 | 963 | — | 158 |
| Cordilleran Division | 3 845 | 2 244 | 1 338 | 263 | — | 36 |
| Terrain Sciences Division | 7 815 | 5 091 | 2 214 | 510 | — | 75 |
| Total | 27 489 | 16 589 | 9 156 | 1 744 | — | 272 |
| Geophysics and Marine Geoscience Branch | | | | | | |
| Director General | 119 | 68 | 51 | 0 | — | 2 |
| Atlantic Geoscience Centre | 14 381 | 7 354 | 5 971 | 1 056 | — | 116 |
| Pacific Geoscience Centre | 5 703 | 2 522 | 2 038 | 1 143 | — | 43 |
| Geophysics Division | 12 742 | 6 924 | 4 272 | 1 546 | — | 112 |
| Total | 32 945 | 16 868 | 12 332 | 3 745 | — | 273 |
| Minerals and Continental Geoscience Branch | | | | | | |
| Director General | 360 | 311 | 39 | 10 | — | 3 |
| Quebec Geoscience Centre | 2 444 | 1 166 | 1 052 | 222 | — | 22 |
| Continental Geoscience Division | 9 227 | 5 403 | 2 719 | 1 105 | — | 88 |
| Mineral Resources Division | 12 992 | 8 974 | 2 934 | 1 084 | — | 153 |
| Total | 25 010 | 15 854 | 6 744 | 2 412 | — | 266 |
| Polar Continental Shelf Project | 8 384 | 1 359 | 6 784 | 241 | — | 22 |
| Total Sector | 109 594 | 56 990 | 30 471 | 10 081 | 3 375 | 979 |