THE GEOLOGICAL SURVEY OF CANADA

Into the Seventies –

the Fourteenth Decade

DEPARTMENT OF ENERGY, MINES AND RESOURCES

GEOLOGICAL SURVEY
OF CANADA

Miscellaneous Report 18

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Into the Seventies – the Fourteenth Decade

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DEPARTMENT OF ENERGY, MINES AND RESOURCES

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INTRODUCTION

The Geological Survey of Canada, a branch of the Department of Energy, Mines and Resources, was founded in 1842 and is the principal geological agency of the federal government. Its primary role is to provide an overview of all facets of Canadian geology as a basis for national policy, for government and industrial planning, and for public information.

Geological information in Canada comes from four principal sectors employing nearly 6000[1] geoscientists. These, with the approximate number of geoscientists employed, are:

1. the mining and oil industries (3600);
2. government agencies (federal and provincial) (1100);
3. universities (600); and
4. geoscience consultants and services (450).

Of the 670 geoscientists in various agencies of the federal government, approximately 295 are in the Geological Survey.

In Canada, jurisdiction over mineral and fuel resources on land[2] is vested in the provincial governments except north of 60°N where it is the responsibility of the federal department of Indian Affairs and Northern Development. These government agencies maintain geological staffs appropriate to their responsibilities.

It is the private companies however, which explore for, develop and operate Canada's mines and oil fields, that employ the greatest number of geoscientists. In addition, a group of geoscience consultants and service companies serve both industry and government agencies.

The Geological Survey receives information from all these sources which with the results of its own field and laboratory projects, is integrated to provide the geological basis for national policy in all fields affected by geology; for the search and evaluation of Canada's potential mineral resources; for the planning by industries and governments concerned with regional and northern development; for land use and urban development; for conservation, recreation, and engineering; for construction; indirectly for forestry, agriculture and water supply; and for national security.

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[1] As reported in "Earth Sciences Serving the Nation" 1971.

[2] The federal government's interest in the fuel and mineral resources of the continental shelves is represented by the Department of Energy, Mines and Resources except in the North where it is represented by Indian Affairs and Northern Development.

OBJECTIVES

The role of a geological survey is fundamentally to provide a comprehensive inventory and understanding of the geological framework of the nation, interpreted in terms of all national activities that make use of, or are affected by geology. In earlier years the principal use was the search for sources of energy, minerals and water. This use remains pre-eminent but in today's more crowded and complex civilization, geological factors affecting land use, the environment and its ecology, urban development, increasing yields in forestry and agriculture, recreation, potential uses of continental shelves and ocean floors, and engineering design are of increasing concern. Expanding populations have increased the need for energy and mineral products as well as for those of agriculture and forestry, have posed a threat to our environment and have increased demands for recreational space. The needs compete for knowledge and for land use and are reflected in greatly increased long range planning and the need for enlightened decisions by government and industry. All of this has heightened the need for more precise knowledge of the geology of Canada and also for greater comprehension of geological processes that are corrently active in marine, limnological and terrestrial environments.

The objectives of the Geological Survey comprise geological aspects of the objectives of the official Mineral and Energy Resources Program and the Earth Sciences Program of the Department. Current objectives of the Geological Survey are:

To provide a comprehensive inventory and understanding of the geological framework and processes in Canada as a basis for national policy and planning in all matters affected by geology, with special emphasis on:

- ascertaining our national energy and mineral resources,
- facilitating their exploration and development
- promoting regional development in Canada
- identifying and describing geological features and processes that affect environmental and ecological equilibrium, with particular emphasis on the effects of energy and mineral development
- identification and inventory of Quaternary and Recent features and on-going geomorphological processes that affect use of the terrain, engineering design, urban development, and the renewable resource industries (forestry, agriculture, fisheries)
- identifying and assessing natural hazards
- disseminating information on the Canadian landmass and surrounding continental shelves and the resources they contain.

SCOPE

The Geological Survey has responsibility for investigating the geology, resource geophysics, geochemistry, geomorphology and physical geography of the landmass of Canada including the continental shelves and adjacent ocean floors. In addition to systematic mapping and comprehensive topical studies in the field, much attention is given to development of nationally-consistent standards in map legends, time scales, stratigraphic correlation; and mission-oriented palaeontological, petrological and mineralogical studies. In fields

of geophysics and geochemistry particularly, methods and equipment designed for Canadian conditions are developed and/or tested. New fields embrace shipborne studies of continental shelves and ocean floors; applications of statistics to prediction of mineral potential; regional limo-geochemistry and geoscientific contribution to the geotechnical field and to engineering planning.

The Geological Survey employs geology, geophysics and geochemistry to outline and evaluate regions of high mineral or fuel potential but it does not search nor drill for fuel or mineral deposits. It appraises the national endowment of mineral wealth but leaves assessment of the technical and socio-economic feasibility for their development to the Mines Branch and Mineral Resources Branch respectively. Similarly the GSC is responsible for applications of geophysics needed for mineral and fuel resource appraisal and exploration but the Earth Physics Branch is responsible for basic geophysical studies of the Earth. Its earlier responsibilities for studies of groundwater and inland waters have been transferred to the Department of the Environment.

Finally, results are published by the Geological Survey in several series of maps and reports, as papers in scientific journals and as reports of scientific meetings.

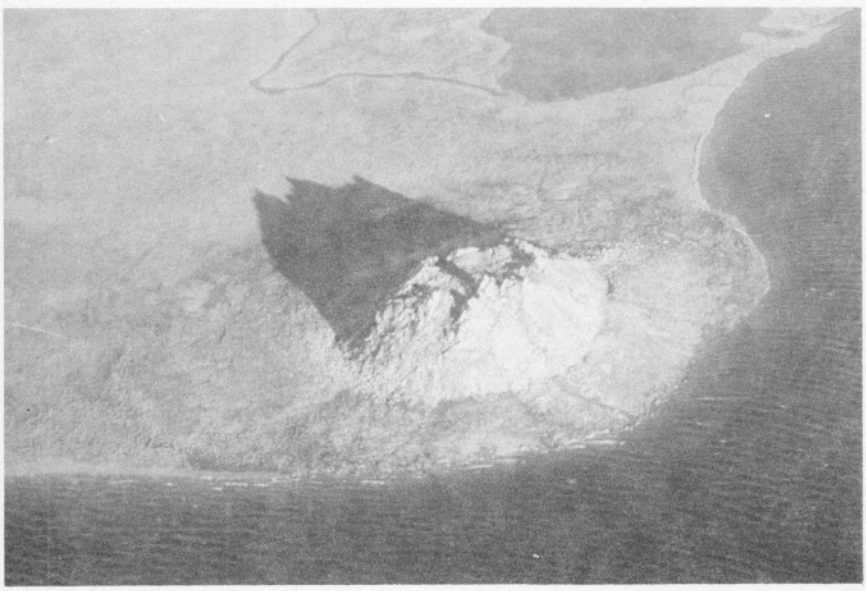


Figure I

MATRIX SHOWING RELATION OF ACTIVITIES TO OBJECTIVES

OBJECTIVES \ ACTIVITIES	1. Geoscience Surveys & analysis	2. Geological appraisal of fuel & mineral resources	3. Geology of man's environment	4. Development in the geosciences	5. Geoscience standards, controls & references	6. Scientific support operations	7. Information systems, development & operations
1. To ascertain Canada's energy & mineral resources	●	●	•	•	●	●	●
2. To facilitate exploration and development	●	●	•	●	●	●	●
3. To encourage regional development	●	●	●	•	•	•	●
4. To promote effective use of the terrain	●	•	●	•	•	•	•
5. To identify and assess natural hazards	•	•	●	•	•	•	•
6. To identify geological features affecting environmental equilibrium	•	•	●	•	•	•	•
7. To disseminate information on Canada's landmass & the resources it contains	●	●	•	•	•	•	●

Contribution of activity to objective

Low • Medium ● High ●

ACTIVITIES

Most activities of a geological survey serve a variety of purposes in widely differing sectors of the community. It is impractical therefore to classify them under specific objectives. Instead the activities are grouped functionally and related to objectives in a matrix (figure 1) in which the activities are shown along the horizontal axis and the objectives along the vertical axis.

Activities of the Geological Survey of Canada are grouped under seven principal headings as follows:

1. Geoscience surveys and analyses:

a. National systematic mapping at various scales, of bedrock, surficial materials, various air and ship-borne geophysical surveys, reconnaissance geochemistry etc.

b. Regional and topical investigations: including geological analyses of socio-economic regions, sedimentary basins, geological sub-provinces, geomorphic regions, volcanic piles, mobile belts etc.

2. The geological appraisal of mineral and fuel resources:

a. Geology of fuel and mineral deposits.

b. Identification, delineation and description of basins and metallogenic provinces.

c. Qualitative assessments of potential for mineral and fuel commodities by geological map-units, sub-provinces etc.

d. Quantitative appraisal of the national endowment (known and unkown) in minerals and fuels, nationally and regionally.

3. Geology of man's environment:

a. Environmental geology, geomorphology and geotechnical studies of urban areas.

b. Investigations of properties of geological materials and formations that affect land use, engineering design, terrain sensitivity, natural hazards and environmental and ecological equilibrium.

c. Geological processes and dynamic relationships of the terrain including erosion, sedimentation, slope stability, permafrost etc.

4. Development in the geosciences:

a. Guidelines for exploration for energy and mineral resources.

b. Methods for geological inventory and resource exploration.

c. Geoscience instruments.

d. Field and laboratory procedures.

5. Geoscience standards, controls, and references:

a. Standards for national geological mapping and correlation: stratigraphy, petrology, structure, tectonics etc.

b. A national time scale - palaeontology, isotopic geochronology and paleomagnetism.

c. Control studies to determine geological relationships and processes and to test hypotheses.

d. Classification and nomenclature of geological entities.

e. Reference collections and catologues.

6. Scientific support:

   a. Specialist consultation and collaboration.
   b. Laboratory services.

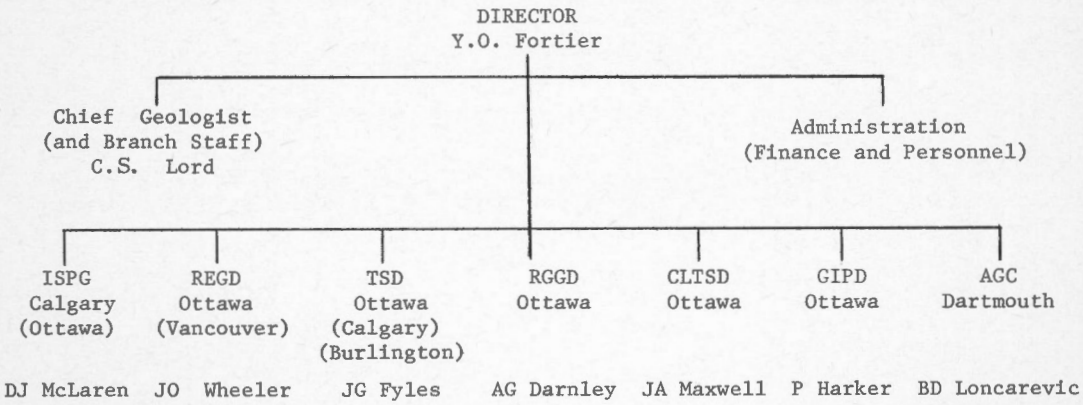
7. Information systems:

   a. Information processing, editing, cartography etc.
   b. Information distribution.
   c. Library services.
   d. Geoscience data systems.

A majority of field and laboratory projects are undertaken by Survey staff. However, an increasing percentage of the budget is now being spent on projects and services carried out under contract by private companies and individuals.

ORGANIZATION

The Geological Survey of Canada is a branch of the Science and Technology Sector of the Department of Energy, Mines and Resources. Its present staff[1] is just over 700. Of these, 295[2] are university graduates, including 185 who hold a Ph.D. Many of the others are trained in various technologies. It is organized in seven divisions which represent a combination of major functions and geographic requirements. The following skeletal chart identifies the divisions, their geographic location(s), and the senior scientific personnel:



For more detail, see Figure 5.

The Institute of Sedimentary and Petroleum Geology (ISPG) is housed in its own building adjacent to the University of Calgary with some paleontology and coal petrology staff housed in Ottawa. It is responsible for the geology of Canadian western and northern sedimentary basins and for assesment of our national fuel resources. It is staffed by specialists in stratigraphy and in the geology of fuels and sedimentary rocks, including a strong contingent in paleontology with additional capabilities in organic geochemistry. The Institute has its own laboratories and service facilities in Calgary. Total staff of 108[1] includes 60[2] scientists.

The Regional and Economic Geology Division (REGD) is responsible for the geology of all crustal rocks of the Canadian Shield, the Western Cordillera (including the Pacific Continental Shelf), and the Appalachian belt, and for appraisal of the nation's mineral resources. It is staffed by specialists in the geology of crystalline rocks and of mineral deposits and has capabilities in petrology, paleontology, isotipic geochronology and paleomagnetism. It is centered in the head office at Ottawa, but staff working in the Western Cordillera and Pacific Margin have their offices in Vancouver. The Division includes the Branch's extensive laboratory facilities for isotopic geochronology and computer facilities needed for geostatistics. Its staff of 149 includes 90 scientists.

The Terrain Sciences Division (TSD) undertakes geological surveys and investigations of the mantle of Quaternary deposits (largely unconsolidated) overlying bedrock throughout Canada. It is particularly concerned with

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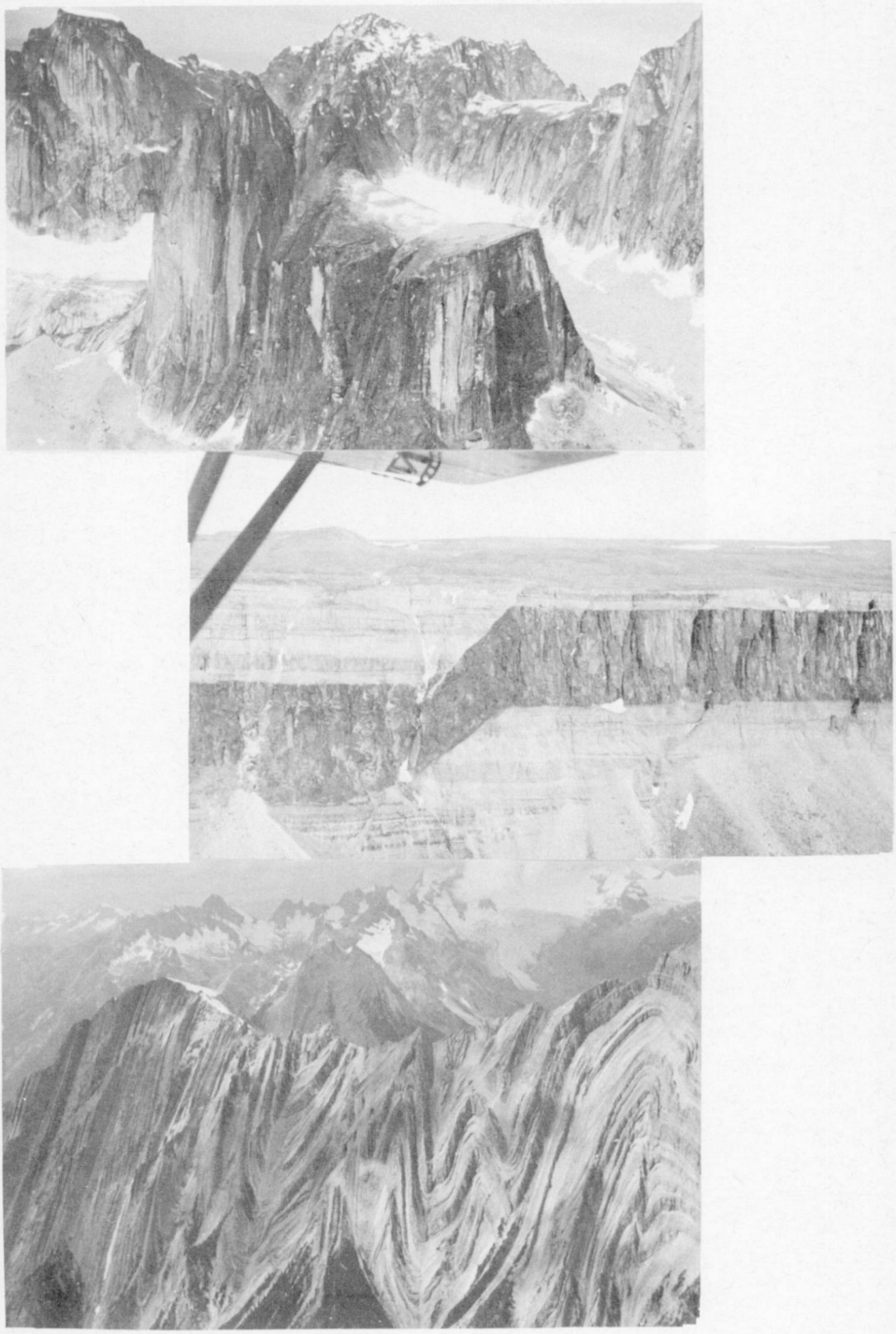
[1] includes total of continuing and casual staff compiled in man-years.

[2] includes total of continuing staff plus an average of casual staff.



geological aspects of man's environment - land use, agriculture, forestry, urban areas, parks, etc.; natural hazards; engineering requirements; transportation and stability of the environment. It is staffed by specialists in Quaternary and engineering geology and in physical geography with limited capability in paleontology. Specialist laboratories are provided for radiocarbon dating, sedimentology and engineering geology. The division is situated at headquarters in Ottawa with a few scientists stationed in Calgary and at the Department of the Environment's Centre for Inland Waters in Burlington. There are 40 scientists in a staff of 81.

Resource Geophysics and Geochemistry Division (RGGD) is responsible for national surveys of those aspects of geophysics and geochemistry that are needed in support of the inventory of the geological framework of Canada and for resource appraisal and discovery. An important aspect of the Division's duties is the development and testing of geophysical and geochemical methods and instruments suited to Canadian conditions. The division maintains capabilities in most aspects of inorganic geochemistry and in electrical, magnetic, seismic, radiometric, and in remote sensing methods. In addition to laboratories in these fields, it maintains two aircraft as flying test beds. The division is housed in Ottawa and has a staff of 87 of whom 40 are scientists.

The Central Laboratories and Technical Services Division provides scientific support to the Branch in mineralogy and analytical chemistry and operates a central instrument shop. It develops and tests methods and instruments used in these fields. Its laboratories and shops are in Ottawa. Of a staff of 44, 10 are scientists.

The Geological Information Processing Division (GIPD) is responsible for processing the maps, reports and other output of the Branch and for geoscientific information services to the Public. Its library, information and data systems are major services to scientific activities of the Branch. It maintains capabilities and facilities in scientific editing, cartography, library service, photography and publication distribution. Manuscript processing and publication is done in cooperation with the Department's Public Relations and Information Services and with government printing agencies. Total staff is 93 of whom 8 have professional training.

The Atlantic Geoscience Centre is responsible for geology and geophysics of the Atlantic continental shelf and adjacent ocean floors as determined from shipborne surveys, and for the geology and appraisal of fuel potential of sedimentary basins of the St. Lawrence and Hudson Bay lowlands and the Atlantic continental shelf. It also has the departmental responsibility for advising on technological development, and on exploration for, and exploitation of, energy and mineral resources of the sea bottom. The centre is housed at the Bedford Institute of Oceanography where it has its own laboratory facilities, as well as those available on oceanographic ships of the Canadian government. It is staffed by specialists in marine geology and geophysics with a strong contingent specialized in the geology of fuels and sedimentary rocks. Of a staff of 75, 35 are scientists - these figures do not include staffs for ships which are operated by the Department of the Environment.

Branch direction, staff activities and general administration including certain centralized clerical, typing and supply services are carried out by a staff of 64 of whom 13 have scientific or other professional training.

FACILITIES

The main offices, laboratories and storage facilities of the Geological Survey are housed in buildings designed for the purpose. Additional space is rented from other Grovernment agencies and from commercial sources. Headquarters and a majority of staff and laboratories are housed in a modern office building at 601 Booth St., Ottawa. The Institute of Sedimentary and Petroleum Geology has its own specially designed office and laboratory buiding on the campus of the University of Calgary at 3303 - 33rd Street, N.W., Calgary, Alberta. The Atlantic Geoscience Centre is housed in the Bedford Institute of Oceanography on the shores of Halifax harbour at Dartmouth, Nova Scotia. The Cordilleran Section of Regional and Economic Geology has its offices on the sixth floor of the Sun Building, 100 West Pender Street in downtown Vancouver, British Columbia.

For air transportation, the Branch charters a wide range of fixed wing aircraft and helicopters from companies across Canada. In addition, it has two aircraft of its own used as "flying test beds" for geophysical equipment and based at Ottawa. One of these, a Skyvan, can be converted in a matter of one working day from one purpose to another by use of pallet-mounted instruments on tracks in the floor of the aircraft. Ships used are principally specially designed government-owned oceanographic and hydrographic vessels operated by the Department of the Environment, but others are chartered, mainly for inshore work. Submersibles are chartered when required.

The Branch has a fleet of trucks and cars, many of which are special four-wheel drive vehicles, but increasingly vehicles are rented from commercial sources for the field season. Mention should also be made of motorized tricycles and toboggans that are used in the tundra of the high Arctic, and on snow respectively, replacing sledge and pack dogs which, when in use, were largely rented from native inhabitants of remote regions. As an historical footnote, the Survey sold its last string of packhorses in 1958.

Extensive laboratory and other specialized facilities are centred in the Ottawa area and are described in a companion booklet (GSC Misc. Report 17). Special requirements of Sedimentary and Petroleum geology are provided in a suite of modern laboratories in Calgary. Similarly, laboratories and instruments required for marine geology and geophysics are established ashore and aboard ship at Dartmouth. A few mobile field laboratories are used for geochemistry. Routine analytical and other laboratory requirements are being met increasingly by commercial laboratories.

The Branch maintains a specialized and well equipped cartographic section. Maps are printed by Surveys and Mapping Branch or by contract.

The Survey library is unquestionably the largest geological library in Canada and comprises over 125,000 volumes requiring 2 miles of shelving. Used primarily as a working tool of the Branch, its resources are also available to the scientific community in Canada. It includes responsibilities for an open file system, for storage of data and employs modern selective distribution of information services for many individuals or staff. An extensive map library is part of the main library. Branch libraries are maintained in Dartmouth, Calgary and Vancouver.

Computer services are provided principally by a main computer terminal in the Branch connected to the main Departmental computer centre. Data processing requirements of offices outside Ottawa are provided by commercial firms.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PUBLICATION AND INFORMATION SERVICES

Communication of the results is a necessary end-product of all scientific activity; it is achieved in the Geological Survey by its own publications, by allowing the staff to publish in scientific journals and by means of an open file system. Reports, maps and open file items are publicized by means of a notification card system sent to some 6,000 addressees; by the Information Canada daily check-list of government publications; by direct exchanges with other institutions, and by reviews in journals. Publications in scientific journals are documented by means of an annual volume of abstracts published by the Survey. The Geological Survey has become a major scientific publishing house and issues maps and reports in the following categories:

Memoirs – Comprehensive terminal reports on the geology of specific areas.

Bulletins – Comprehensive terminal reports on geological or related subjects.

Economic Geology Reports – Comprehensive reports on the geology of minerals and fuels in Canada and related subjects.

Miscellaneous Reports – Include popular guides designed mainly for the use of the general public.

Papers – Produced by photo-offset printing from typescript to permit prompt publication of geological information of all kinds. The series also includes annual reports on:
Results of field and office activities,
Index to the year's publications,
Abstracts of GSC papers in scientific journals,
Compilation of current research projects in geosciences in Canada,
Isotopic and radiocarbon age determinations.

Maps – Preliminary maps in black and white may carry marginal notes and be issued separately, but are generally included with a Paper.
Aeromagnetic maps present information in the form of isomagnetic contours, and are designed to assist in geological mapping, particularly in drift-covered areas, and to direct attention to magnetic anomalies that may be of economic significance.
Final multicolour maps are commonly included with a Memoir or Bulletin, but may carry marginal notes and be issued separately.

Open File – To place results in the hands of the user as quickly as possible, manuscript texts and maps are made available at the principal offices of the Survey. In most cases, the public may arrange to have copies made commercially. Many reports that are being prepared for publication are first placed on Open File.

The publication program of the Geological Survey provides a measure of its scientific activity during the half decade 1965-70. Statistics are as follows: Papers 312; Memoirs 21; Bulletins 66; Economic Geology Reports 7, and Miscellaneous Reports 11. The total output comprises about 28,000 printed pages and the reports range from short papers of 15-20 pages to major treatise-like volumes of many hundreds of pages. Most of these reports present the work of the Survey's scientific staff; in addition there were a number of volumes presenting the results of national and international symposia sponsored by the Survey, the National Advisory Committee on Research in the Geological Sciences and the International Upper Mantle Project.

Many maps were produced during the same period; some of these maps accompanied printed reports; others, including the geophysical maps, were copied separetely. The following statistics indicate the magnitude of the effort and show the approximate areas of Canada that were mapped: Bedrock geology – 154 maps, 2,847,004 square miles; Surficial deposits - 29 maps, 519,715 square miles; Geophysics (including federal/provincial aeromagnetic program) - 2,446 maps, 615,000 square miles, and Geochemical surveys - 28 maps, 55,406 square miles.

GSC scientists are permitted to publish in Canadian and international journals of science. This provides a desirable balance between 'in-house' and 'outside' publication and also gives a measure of the calibre of GSC research within the scientific community. 613 papers were published in scientific journals during the period.

NATIONAL AND INTERNATIONAL ACTIVITIES

The Survey provides the chairman, secretary and budget for the National Advisory Committee on Research in the Geological Sciences which reports to the Minister of Energy, Mines and Resources. The executive of this committee, usually with additional representatives, acts as the Canadian Committee for Geology in international affairs. The Survey also funds and mans the Canadian Centre for Geoscience Data which coordinates the development of a national computer oriented system for geoscience data storage and retrieval. An important national service is the sponsorship of symposia in geological subjects.

On behalf of the Canadian International Development Agency, Survey geoscientists undertake geological projects abroad.

Budgetary provision is made for Canadian support of the International Union of Geological Sciences and for the Commonwealth Geological Liaison Office. Correspondence with these agencies is usually undertaken by the Survey. Branch geoscientists represent Canada on many international commissions, committees and other organizations.

One important contact with geology abroad is the availability of post-doctoral fellowships tenable in the Survey.

SERVICES TO THE PUBLIC

The Survey maintains an information service on all matters to do with geology in Canada. Written enquiries should be addressed to the Director; local information may be sought by telephoning the offices in Calgary, Dartmouth, Ottawa or Vancouver.

Examination of specimens of Canadian provenance is provided as a free service. Specimens should be mailed to the Director with information as to where they were found.

A series of reports on rock and mineral collecting and guides to suitable localities are available for purchase by ordering from offices in Calgary, Ottawa or Vancouver, or through the Queen's Printer.

Sets of rocks, minerals and ores are available from offices in Ottawa, Calgary or Vancouver.

ACHIEVEMENTS

The principal achievement of the Geological Survey is the major contribution it has made to the present high level of knowledge of the geology of Canada particularly the correlation and integration of such knowledge to uniform standards of nomenclature and map legends. This contribution is contained in over 3,900 reports and more than 12,000 maps published by the Survey together with over 100 papers per year by Survey geologists in journals of Scientific Societies.

A recent milestone is the completely rewritten fifth edition of the "Geology and Economic Minerals of Canada" which summarises in over 800 pages our present understanding of all aspects of the geology of Canada. It is accompanied by a folio of maps of the geology, tectonics, mineral deposits, glaciation, physiography, magnetism and gravity of Canada together with detailed geotectonic correlation charts of the Canadian Shield, Southeastern Canada, Western Canada and the Arctic Archipelago.

In a brief review it is possible to select only a few examples of the Survey's achievements: some of these are discrete, but the larger number represent cumulative results of ongoing activities. In this selection preference is given to those of recent date and others that are coming to fruition in this decade.

The basic reconnaissance of Canada's geology in part at a scale of 8 miles to the inch and in more complex areas at 4 miles to the inch will be completed by field work scheduled for 1976 (See figure 2). In large measure this has been made possible by the Survey's pioneer development of traversing by helicopter which was begun in 1952. More than 60% of this reconnaissance was done in the past two decades.

A parallel accomplishment was development and implementation of aeromagnetic mapping as an aid to interpretation of bedrock trends under Quaternary glacial sediments. A majority of the Canadian Shield has been mapped and coverage is extended to parts of Eastern Canada and the eastern continental shelf (see Figure 3). The Survey's current development of high resolution magnetometry permits delineation of bedrock trends in areas of low magnetic relief.

Work of the past decade on Quaternary geology and terrain sensitivity of Arctic regions is now providing the basis for route selection and identification of geological engineering factors for the proposed Mackenzie Valley pipeline and transportation corridor. In more southern regions, Quaternary geology is playing an important role in studies of environmental equilibrium - physical, economic and social - and particularly in decisions on land use. Figure 4 indicates progress in mapping the Quaternary of Canada.

Reconnaissance geology of the Arctic Archipelago led the Survey to recognize the oil and gas potential of that frontier region in which active development is now taking place aided by current Survey guidance in paleontological correlation, in organic geochemistry to distinguish between oil-rich, gas-rich and barran strata and in multi-disciplinary analysis of the principal sedimentary basins. The Survey's reconnaissance aeromagnetic offshore surveys indicated the presence of great thicknesses of sediments off the Labrador Coast, where oil potential is being assessed by industry.

Inevitably geological field parties have found exposures of valuable minerals, some of which have been developed as mines. It is, however, the recognition of geographic regions in which the geological environment favours

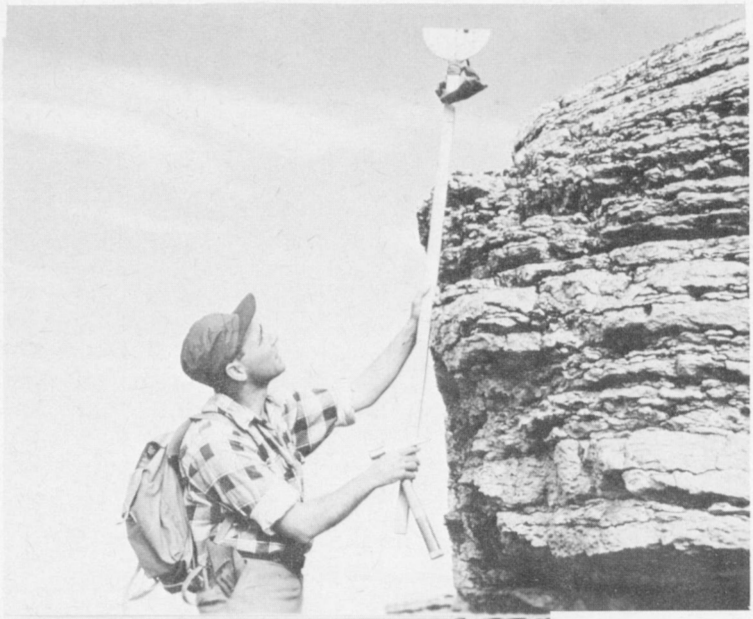
occurrence of mineral deposits of various types that is the Branch's main contribution to development of mineral resources.

Most geological reports contain qualitative assessments of mineral potential in the areas mapped. Recently recognition of major sub-provinces of the Canadian Shield has materially advanced the basis for prospecting by recognition of similarity of large geological belts. More specific data are becoming available from aeromagnetic surveys and geochemical compilations. These together with stratigraphic, tectonic, volcanic, metamorphic and other factors are being interpreted for purposes of identifying sub-provinces in the Shield and assessing their potential for occurrence of different types of mineral deposits. Most recently the Survey has begun pioneer applications of statistics to systematically mapped geological variables as a basis for evaluation of regional mineral potential. A report of the prototype study was published in 1972.

Another major contribution to appraisal of mineral potential and to prospecting are studies in depth of the geological occurrence of major metals and fuels. These provide identification and characteristics of all important types of deposits and indications of geological conditions favourable to their occurrence and are described in the Survey's Economic Geology Reports.

The third major field is the development and testing of prospecting methods for use in Canada's glaciated terrain and cold climate. In geophysics the Survey has developed a high resolution airborne magnetometer; has successfully tested the world's most sensitive airborne gamma ray spectrometer, and is making important progress in electrical methods. In geochemistry, recent work has proved that a) sampling stream sediments, waters and surficial materials will delineate anomalies in areas of permafrost and b) that reconnaissance geochemical sampling of lake waters and sediments delineates regional anomalies successfully. Eskers, moraines and basal tills provide samples of underlying bedrock and recent studies of these are proving their potential as a basis for regional mineral evaluation and for detailed prospecting.

The Survey has been particularly successful in developing procedures for fieldwork adapted to Canada's terrain and climate. These include the use of university students as field assistants which began in the first decade of this century and has resulted in generations of Canadian geologists who, on graduation, are equally at home in the field and in the University. The presence of endless lakes in northern Canada led to early use of light float planes as a major means of reaching remote areas, moving camp and providing supplies. The treeless barrens of the northern mainland led the Survey to initiate use of helicopters for large scale reconnaissance traversing in 1952, a breakthrough that increased speed of reconnaissance mapping by an order of magnitude. For work in the Arctic Islands, advantage was taken of inexpensive light fixed wing aircraft which are able to land almost anywhere on large soft balloon tires. The Atlantic Geoscience Centre has pioneered the use of shipborne geophysical instrumentation and sample recovery equipment, supplemented as necessary by use of small submersibles. In recent years the Survey has made increasing use of computer-based data storage and retrieval for geological mapping as exemplified by such diverse projects as the 40,000 square mile area of the Coast Range Mountains and the detailed examination of surficial materials on the site of the new international airport at Ste-Scholastique, Quebec.



It is impossible in a brief space to mention more than a few examples to illustrate the scope of the Survey's contributions to the geosciences. In 1963 L.W. Morley and A. Larochelle first attributed the magnetic reversals on the floor of the Pacific Ocean to ocean floor spreading. The work of E.T. Tozer in developing the systematic time scale of the Triassic has gained world-wide recognition. C.H. Smith and T.N. Irvine's studies of the structure and cyclic differentiation of the Muskox ultramafic intrusion gave new insight into the provenance and genetic processes of these bodies. J.G. Souther's studies of the Pliocene to Recent Mt. Edziza volcano, now exposed through great vertical range by erosion, has added to knowledge of evolution of volcanoes on the Pacific Rim. A major contribution to the subdivision of Precambrian time based on tectonic analysis and isotopic geochronology of the Canadian Shield was made by C.H. Stockwell. The structural analysis of the Foothills of the Rocky Mountains by R.J.W. Douglas, R.A. Price and others provided a geological basis for interpretation of geophysical anomalies as they apply to the search for fuels. The work of G.A. Gross on iron formations and of G.A. Gross and R.H. Ridler on equivalent exhalative facies has significantly affected appraisals of World resources of iron and other metals. Boyle's recent work on the geochemistry of silver has already become a standard reference. The discovery and interpretation of an exceptional fossil vertebrate record by A.M. Stalker and C.S. Churcher has added significantly to our knowledge of Pleistocene time including possible evidence of the earliest presence of man in Canada. The work of B.D. Loncarevic and others on the Mid Atlantic Ridge has materially advanced our knowledge of the rate of continental drift. Recent development by R.J. Fulton and others of a new method of rapid reconnaissance mapping of surficial materials may well have world-wide applications.

HISTORICAL OUTLINE

1842 Resolved by the Legislature of the newly united Province of Canada that a Geological Survey of the Province be made. William Logan appointed for the task.

1845 An act of the Provincial Legislature stated "Whereas a Geological Survey of this Province of Canada has been instituted for ascertaining the Mineral Resources thereof; ..."

1867 Confederation of Canada brought enlargement of G.S.C. responsibilities to serve the new Dominion.

1880 The Survey's headquarters were moved from Montreal to Ottawa.

1890 The Survey became a department of government. At this time, most activities concerning the landmass of Canada including its flora and fauna were administered under the aegis of the Survey. In subsequent years various functions were split off as autonomous units which now serve Canada in their own right.

1907 The Mines Branch became a separate entity and the Geological Survey reverted to Branch status in the new Department of Mines.

1911 The Survey moved to its new headquarters in the Victoria Museum Building.

1920 The National Museum was separated from the Survey under its own Director, but the headquarters of the Survey remained in the Victoria Museum Building.

1947 The Topographic Survey split off to form the nucleus of the Surveys and Mapping Branch.

1956 Growth and diversification of the Survey in post-War years required administrative subdivision into five operational divisions.

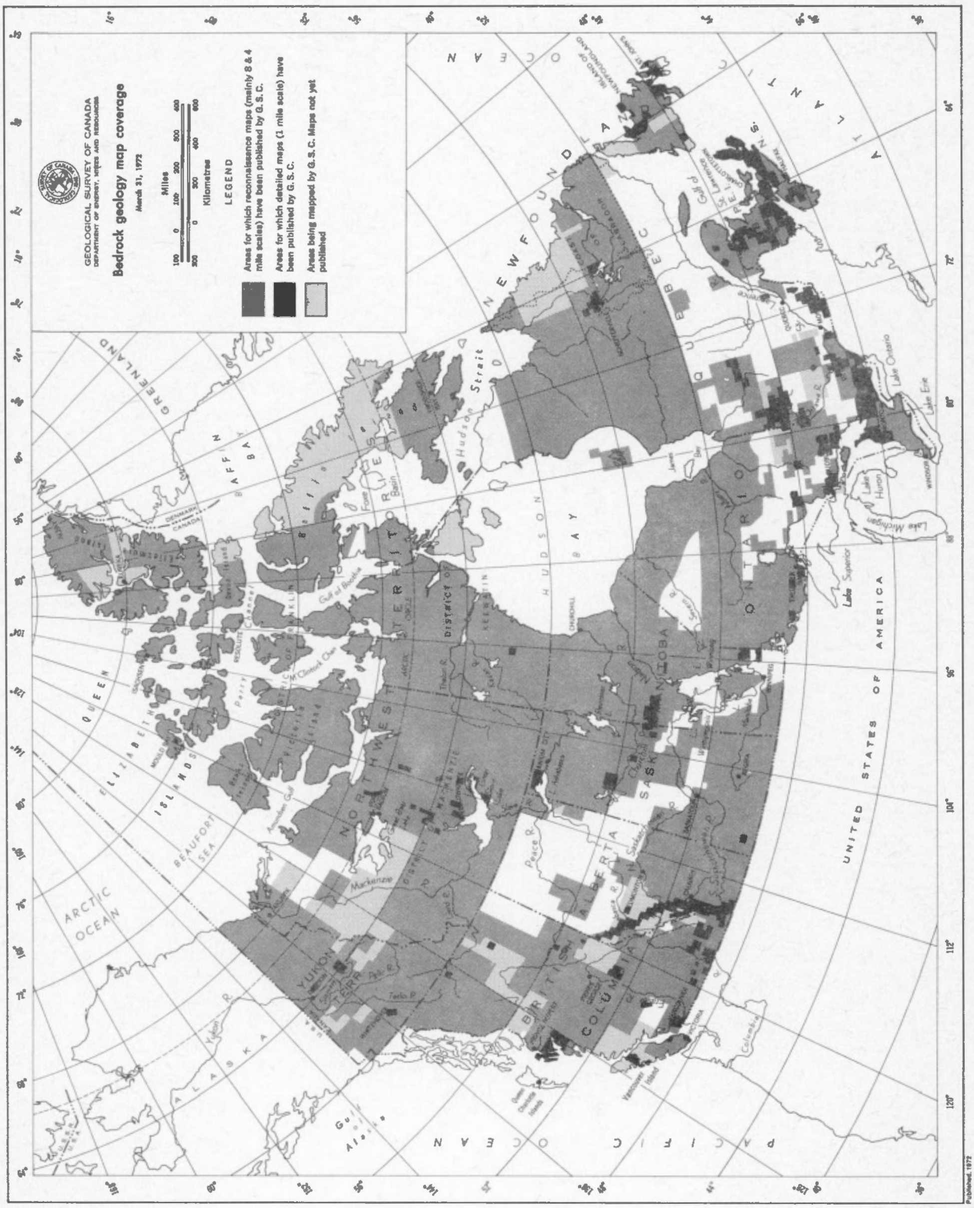
1959 The Survey moved to its new headquarters building at 601 Booth Street.

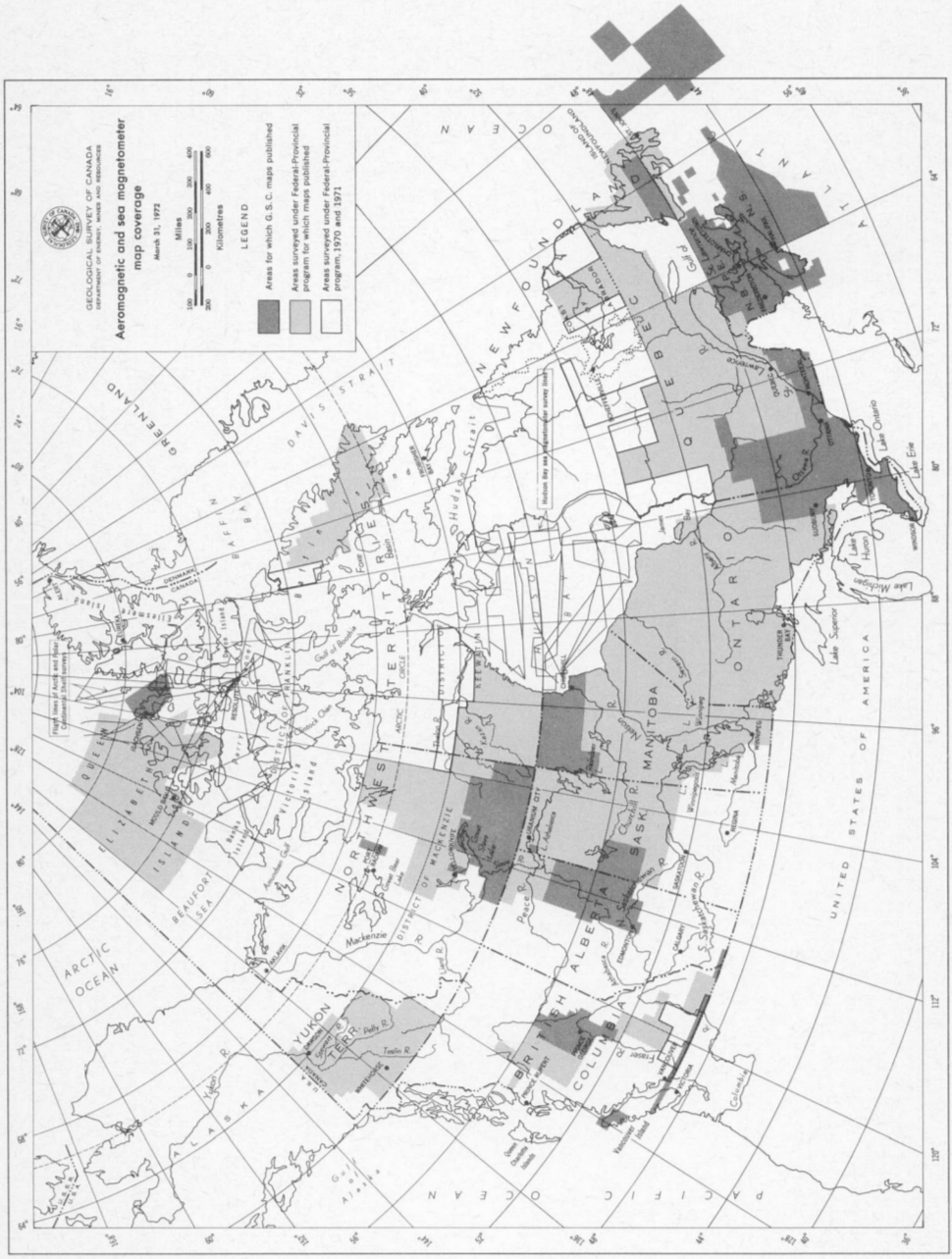
1966 The groundwater and limnological geology Sections left to join the new Inland Waters Branch.

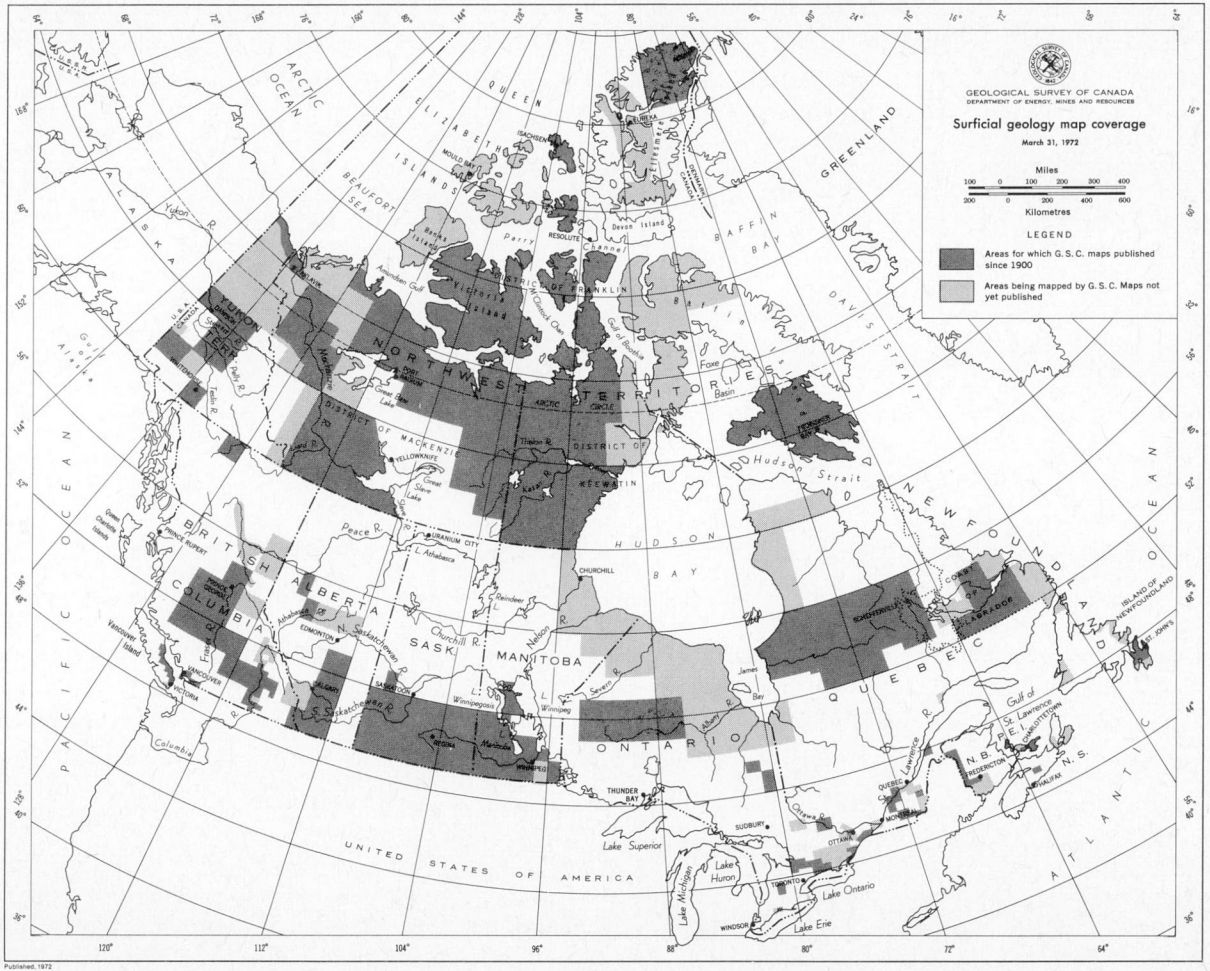
1967 The Institute of Sedimentary and Petroleum Geology moved into its new building in Calgary.

1972 The Atlantic Geoscience Centre joined the Geological Survey from the Bedford Institute of Oceanography.

The Geological Survey, as it enters its fourteenth decade, is a vigorous scientific organization expanding in scope and sophistication in order to meet new needs of the nation's economy and environment. As the oldest scientific arm of the Government of Canada, it is an excellent example of how an agency of the Public Service is progressively modified in response to changing requirements.

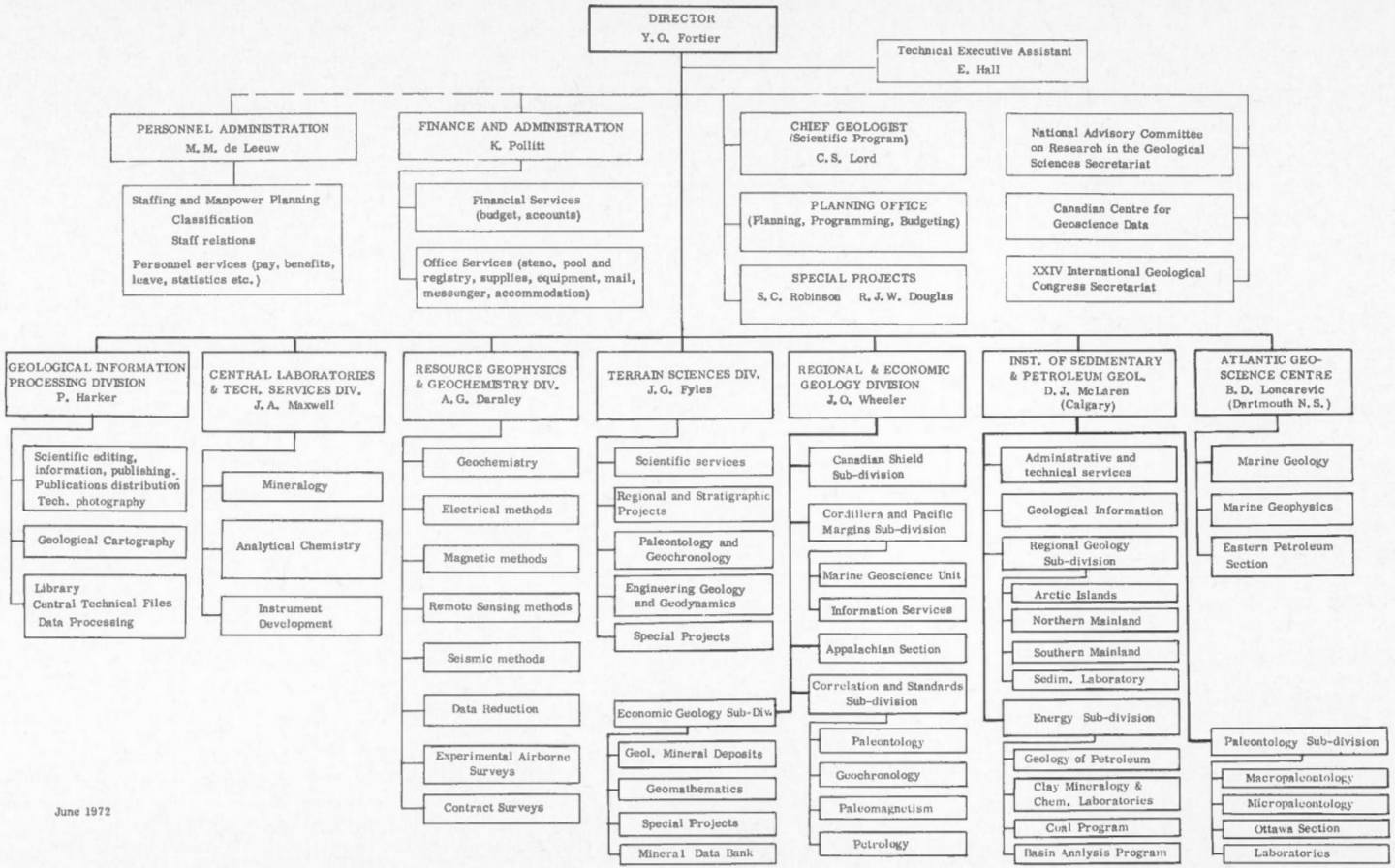

GEOLOGICAL SURVEY OF CANADA
DEPARTMENT OF ENERGY, MINES AND RESOURCES
Bedrock geology map coverage
March 31, 1972
Miles
Kilometres
LEGEND
Areas for which reconnaissance maps (mainly 8 & 4 mile scales) have been published by G. S. C.
Areas for which detailed maps (1 mile scale) have been published by G. S. C.
Areas being mapped by G. S. C. Maps not yet published
ARCTIC OCEAN
PACIFIC OCEAN
ATLANTIC OCEAN
HUDSON BAY
BAFFIN BAY
GREENLAND
ALASKA
UNITED STATES OF AMERICA
NORTHWEST TERRITORIES
YUKON TERR
BRITISH COLUMBIA
ALBERTA
SASK
MANITOBA
ONTARIO
QUEBEC
NEWFOUNDLAND
Hudson Strait
Lake Superior
Lake Huron
Lake Michigan
Lake Ontario
Lake Erie
Published, 1972


GEOLOGICAL SURVEY OF CANADA
DEPARTMENT OF ENERGY, MINES AND RESOURCES
Aeromagnetic and sea magnetometer map coverage
March 31, 1972
Miles
Kilometres
LEGEND
Areas for which G.S.C. maps published
Areas surveyed under Federal-Provincial program for which maps published
Areas surveyed under Federal-Provincial program, 1970 and 1971
Published, 1972
ARCTIC OCEAN
BEAUFORT SEA
DAVIS STRAIT
BAFFIN BAY
GREENLAND
NEWFOUNDLAND
LABRADOR SEA
ATLANTIC OCEAN
PACIFIC OCEAN
ALASKA
YUKON TERR.
NORTHWEST TERRITORIES
BRITISH COLUMBIA
ALBERTA
SASK.
MANITOBA
ONTARIO
QUEBEC
UNITED STATES OF AMERICA



Published, 1972

GEOLOGICAL SURVEY OF CANADA



June 1972

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PHOTOGRAPH DESCRIPTIONS

Page	Photo No.	Caption	Photo Credit
iv	201752	Institute of Sedimentary and Petroleum Geology, Calgary.	
	112907-A	Headquarters, Geological Survey of Canada, Ottawa.	
	202034	Bedford Institute of Oceanography, Department of the Environment where Atlantic Geoscience Centre is housed. Dartmouth N.S.	
3	202042	Pingo north of Libby Lake, N.W.T. This 80-foot-high 'frost-boil' is developed in dolomite.	B.G.Craig
6	202056	Sledge dogs and helicopter in the Arctic Islands.	R.G. Blackadar
8	Rock features		
	117969	Banded grains.	C.K. Bell
	202043	Fractured dolomite.	L.M. Cumming
	202053	Agmatite.	W.W. Hutchison
9	Geological features		
	202045	Glacial erosion in quartz monzonite.	R.G. Garrett
	131185	Gabbro sill in Proterozoic strata.	R.L. Christie
	154571	Folding in Rocky Mountains.	R.A. Price
12	Air transport		
	202055	Helicopter hovering.	Unknown
	202051	Ballon tires in Arctic.	P. Harker
	202049	Float plane.	R.G. Garrett
13	Transportation		
	202039	C.G.S. Baffin.	Bedford Institute
	202040	Motorized tricycle.	D.M. Barnett
	202036-A	'Flying test beds' of G.S.C.	NRC
15	202035	Some recent publications of the Geological Survey of Canada.	J.W. Kempt
16	202054	Rubber boats are replacing canoes.	W.W. Hutchison
19	Measuring strata		
	202041	On the Boothia Peninsula	George Hunter
	202052	Near Ottawa.	J. Foster
20	89561	Backpacking is still necessary.	A.H. Lang
	202048	Winter clothing, Operation Sverdrup 1972.	G.D. Hobson

Layout -
Leona R. Mahoney


CANADA
1842
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