CANADA

DEPARTMENT OF ENERGY, MINES AND RESOURCES

GEOLOGICAL SURVEY OF CANADA

ANNUAL REPORT

APRIL 1, 1973 TO MARCH 31, 1974

FOR DEPARTMENTAL USE ONLY

OTTAWA
1974

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GEOLOGICAL SURVEY OF CANADA

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OTTAWA

1974

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GEOLOGICAL SURVEY OF CANADA

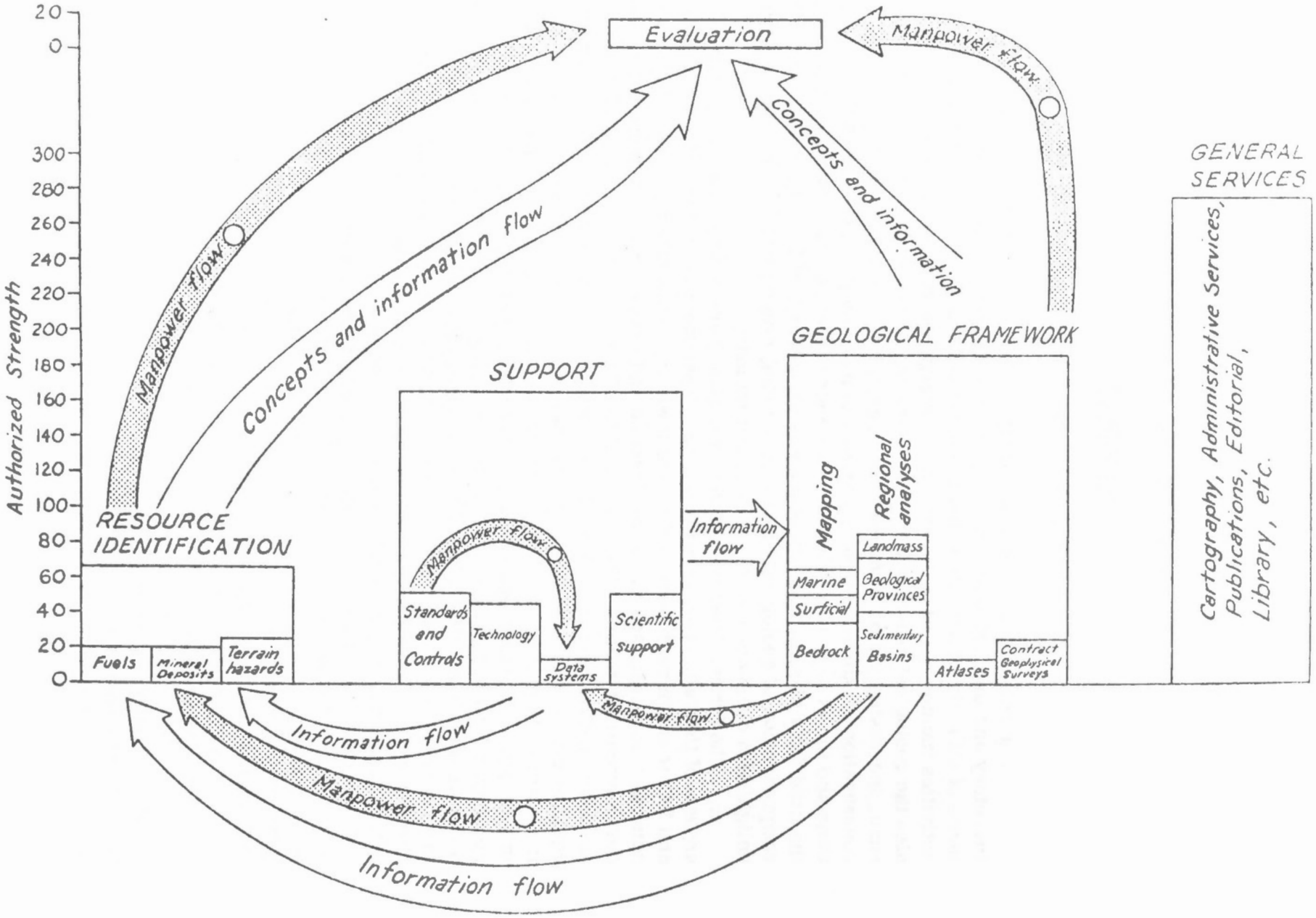
INTRODUCTION

D.J. McLaren, Director

The role of the Geological Survey of Canada is to provide a comprehensive inventory and understanding of the geological framework of Canada interpreted in terms of all national activities that make use of or are affected by geology. These activities include not only the search for energy sources and mineral deposits but also the geological aspect of those activities concerned with land use, urban development, increasing yields in forestry and agriculture, engineering projects and the conservation of our natural environment, to name only a few. Expanding populations and the ever growing demands for energy and natural resources have heightened the need for a more precise knowledge of the geology of Canada and for a greater comprehension of geological processes for long range planning and as a basis for enlightened decisions by government and industry.

The formal objectives of the Geological Survey comprise the geological aspects of the authorized programs of the Department of Energy, Mines and Resources and follow seven main thrusts directed towards: ascertaining Canada's and energy mineral resources; facilitating exploration and development; encouraging regional development; promoting effective use of the Canadian terrain; identifying and assessing natural hazards; identifying geological features affecting enironmental equilibrium, and disseminating information on Canada's landmass and the resources it contains. In pursuance of these objectives the Survey carries out investigations in geology, resource geophysics, geochemistry, geomorphology and physical geography for the landmass of Canada, including the continental shelves and adjacent ocean floors. In addition to systematic mapping and comprehensive topical studies, these investigations require the formulation of nationally consistent standards for chronology and stratigraphic correlation and are dependent on paleontological, petrological and mineralogical studies. In certain other fields such as geophysics and geochemistry, there is a continuing need for the design, development and testing of methods and equipment appropriate for Canadian needs. New fields embrace shipborne geological and geophysical studies, application of statistics to estimation and prediction of mineral potential, regional limno-geochemistry and researches into geotechnics and the application of geoscience to engineering planning.

As the Department of Energy, Mines and Resources has become more and more involved in policy development, increasing demands have been made on the Geological Survey for evaluation of Canada's mineral and fuel resources. The rapid expansion of government and private industry into areas possessing a relatively fragile environment, especially the North, has resulted in demands by government for assessments of terrain hazards, land sensitivity and related topics.


Evaluation
Manpower flow
Concepts and information flow
Concepts and information
GENERAL SERVICES
Cartography, Administrative Services, Publications, Editorial, Library, etc.
Authorized Strength
20
0
300
280
260
240
220
200
180
160
140
120
100
80
60
40
20
0
RESOURCE IDENTIFICATION
Fuels
Mineral Deposits
Terrain hazards
SUPPORT
Standards and Controls
Technology
Data systems
Scientific support
Manpower flow
Information flow
GEOLOGICAL FRAMEWORK
Mapping
Regional analyses
Marine
Surficial
Bedrock
Landmass
Geological Provinces
Sedimentary Basins
Atlases
Contract Geophysical Surveys
Information flow
Manpower flow
Manpower flow
Information flow

Implementation of federal-provincial agreements in the field of earth science will require extensive monitoring by experienced staff members who will thus be diverted from their present activities. In line with government policy, use of contract services is being expanded but such services must be monitored to ensure quality results and staff will have to be diverted to meet this need.

The siphoning off of experienced scientists to meet the Geological Survey's response to the new issues and concerns that face the department is causing erosion of the basic and fundamental activities related to developing the geological framework on which all other activities depend. The professional and technical support staff of the branch has increased only slightly during the past four years.

The Figure illustrates the disposition of the Geological Survey's total authorized strength (704 man-years in 1972-73). The critical evaluation activities depend on data obtained and synthesized by two principal activities - Resource Identification and Geological Framework. These activities are in turn nurtured by the work carried out by the Support activity which includes such aspects of geoscience studies as paleontology, mineralogy, geochronology, development of methods and instruments and a small Data Systems component. There are, of course, also some direct links between Resource Identification and Geological Framework. The Administrative and Technical support activity includes stenographic, cartographic and administrative support aspects of the branch's work.

The division of staff and the accompanying erosion of our traditional activities has been the concern of Branch Management for some time and during the past year the problem was emphasized in our "B"-budget presentation to the Department.

In 1973-74 our authorized strength was 773 man-years (including summer assistants and term employees) and the budget was 19.6 million dollars.

This report is for departmental use only and is not intended for public distribution. It presents a general overview of the objectives of each division and highlights of their 1973-74 activities followed by more detailed narratives and data for each sub-division and section. Data on meetings attended, lectures presented and membership on committees are included. Two published reports, The Annual Index and the Volume of Abstracts list published reports by Survey staff; in this report only those reports which, although accepted for publication either in a GSC series or in an outside journal, remained unpublished by 31 March 1974 are included.

Prior to 1958 brief reports of Geological Survey activities formed part of the departmental Annual Report but in that year the format of the departmental report was changed and the present style of interval report was initiated. The data that can now be included are essential to management in meeting many of the inquiries received and in addition the series is an invaluable record of our achievements.

DIRECTOR'S OFFICE

The appointment of Dr. D. J. McLaren as fourteenth Director of the Geological Survey was announced in April. Dr. McLaren was formerly Director of the Survey's Institute of Sedimentary and Petroleum Geology in Calgary and succeeded Dr. Y. O. Fortier who assumed the position of Senior Adviser, Earth Sciences, to the Department.

Dr. J. O. Wheeler, Chief of the Regional and Economic Geology Division, was appointed to the new position of Deputy Director in October. The Deputy Director has overall responsibility for the planning, co-ordination, development and implementation of the Branch scientific program and for assuring its effectiveness. He is also responsible for the internal management of the Branch and for advising the Director on needs and opportunities for Branch evolution, organization, funding and staffing requirements. He acts for the Director in the latter's absence.

Dr. J. G. Fyles, Chief of the Terrain Sciences Division, was assigned to the Director's office as Environment-Engineering Co-ordinator. Dr. R.J.W. Douglas (Special Projects) worked on a number of Branch projects and as senior adviser on geological and tectonic compilations; he was especially concerned with the co-ordination of the 1:1-million atlas series of geological maps of Canada.

Mr. E. Hall continued as Scientific Executive Officer.

Dr. S. C. Robinson, one-time Chief of the former Economic Geology and Geochemistry Division and more recently a senior executive and adviser to the Director's office, retired in September.

Dr. G. M. Wright, staff Geologist and Planning Officer, died in November. Dr. Wright, who joined the permanent staff in 1950, was by training and interest a Precambrian geologist and took part in several of the Survey's pioneer helicopter surveys. His abilities as an administrator were recognized early and he served as head of the Western Shield Section and from time to time as Acting Chief Geologist. From this latter position it was natural that he should be placed in charge of the Planning Office when it was established.

D. J. McLAREN

Attendance at Meetings, Conferences and Courses

Fondation Française d'Etudes Nordiques 5th International Congress "Arctic Oil and Gas: Problems and Possibilities", Le Havre, May 1973.

Mines Ministers' Conference, Victoria, B. C., October 1973.

42nd Annual Convention of Prospectors and Developers Association, Toronto, Ontario, March 1974.

The Association of Exploration Geochemists 5th International Geochemical Exploration Symposium, Vancouver, B.C., April 1974.

Board Meeting, International Geological Correlation Program, Vienna, Austria, April 1974.

Special Talks or Lectures

"The Geological Background and Petroleum Potential of Arctic North America", to Fondation Française d'Etudes Nordiques, Le Havre, May 1973.

"Mineral Potential of Canada's North", to the British Columbia and Yukon Chamber of Mines, 62nd Annual Meeting, Vancouver, B. C., January 1974.

"The Need for Mineral Resource Evaluation in Canada", to the Prospectors and Developers Association, Toronto, Ontario, March 1974.

"Welcome Address", to 5th International Geochemical Exploration Symposium, Vancouver, B. C., April 1974.

Membership on Committees

Chairman, Commission on Stratigraphy of IUGS

Chairman, Silurian-Devonian Boundary Committee of the Commission on Stratigraphy of IUGS

Member, Board of International Geological Correlation Program, UNESCO, IUGS

Member, Canadian Geoscience Council

Honours

Elected Corresponding Member of the Geological Society of France

J. O. WHEELER

Attendance at Meetings

Geological Society of America Annual Meeting, Dallas, Texas, November 10-14, 1973

Northern Geoscience Forum for Mineral Exploration, Whitehorse, Yukon (Dec. 10-11) and Yellowknife, N.W.T. (Dec. 12-13, 1973)

Geological Association of Canada, Cordilleran Section Meeting, Vancouver, B.C., February 9-10, 1974

Prospectors and Developers Association Annual Meeting, Toronto, March 11-13, 1974

Lectures and Talks

"Tectonics of the Canadian Cordillera", U.S. Geological Survey, Denver, Colorado, April 2, 1973

"Role of the Geological Survey of Canada in Mineral Resource Studies in the North", Northern Geoscience Forum, Whitehorse, Yukon (Dec. 10, 1973) and Yellowknife, N.W.T. (Dec. 12, 1973)

"Summary and Future Implications" in Symposium on Mineral Resource Evaluation at Prospectors and Developers Meeting, Toronto, March 12, 1974

Membership on Committees

Councillor, Geological Society of America

Director, Canadian Geological Foundation

Director, Centre for Precambrian Studies, University of Manitoba

R.J.W. DOUGLAS

Membership on Committees

Canadian delegate to the Commission for the Geological Map of the World

J.G. FYLES

In November 1973, J.G. Fyles transferred to the Director's office from the Terrain Sciences Division and took on the duties of Environmental-Engineering Co-ordinator. In this new position he provides co-ordination of those activities of the Branch that relate to environment, engineering, and land use; represents the Branch and Department in various liaison functions involving the application of geoscience to environmental engineering, and land use questions; and provides advice to the Branch and Department on these fields. In this position he also continued to co-ordinate Branch and Departmental inputs to interdepartmental cooperative programs including Mackenzie Highway; Environmental-Social Program, Northern Pipelines (both Mackenzie and Arctic Islands Areas); and Beaufort Sea Environmental Program.

At the beginning of February, 1974, Dr. Fyles was seconded to the Environmental-Social Program, Northern Pipelines, to set up and lead a "Pipeline Application Assessment Group" which is engaged in review and appraisal of the Canadian Arctic Gas Mackenzie Valley Pipeline Application, in terms of the environmental and socio-economic implications of this proposed project in the Northwest Territories and the Yukon Territory. This Assessment Group consists of specialists from various parts of the government service and is to produce a public report. This assessment report is designed to be generally useful to government agencies, both federal and territorial, and also to contribute to the public hearings under the Territorial Lands Act and of the National Energy Board.

Meetings Attended, Talks at Meetings

CREEL Permafrost Symposium, Hanover, New Hampshire, May 1973; presented informal talk on permafrost research relating to pipeline planning in Northern Canada.

Churchill Arctic Corridor Conference, Churchill, Manitoba, May 1973; presented paper on "Environmental and Land Use Considerations in Northern Development" (Proceedings pp 161-169).

Geological Association of Canada Arctic Geology Symposium, Saskatoon, May 1973; presented talk on "Environmental Concerns in Northern Resource Exploration and Development".

Mackenzie Valley - Arctic Islands Field Trip, Advisory Committee on Pipeline Financing, August 1973; served as technical guide and contributed to guide book.

C.P.A. - A.P.O.A. Arctic Seminar, Yellowknife, October 1973; presented a display of G.S.C. terrain maps for the Mackenzie Valley area.

National Conference on Environmental Impact Assessment, Winnipeg, November 1973.

Symposium on Permafrost Hydrology and Geophysics, Calgary, February 1974.

Committee Membership

Associate Committee on Geotechnical Research.

Mackenzie Highway Committee.

Mackenzie Highway Environmental Working Group.

Mackenzie Highway Technical Working Group.

Organizing Committee, Glacial Till Conference.

Gas Pipeline Sub Group, Canada-U.S.S.R. Gas Working Group.

Ad Hoc Interdepartmental Committee on Terrain Surveys and Integrated Mapping.

ATLANTIC GEOSCIENCE CENTRE

B. D. Loncarevic

Introduction

Marine investigations by Centre expeditions studied six areas. During the study of the continental margin transition zone off Nova Scotia and Newfoundland, the seismic refraction work was completed. The area of the detailed survey of the quiet magnetic zone was doubled. The emphasis will be shifted next to the margin east of the Grand Banks. On the Grand Banks, south of Newfoundland and in Sydney Basin, surficial geology, bedrock sampling and gravity measurements were completed for two new map sheets. Northeast of Newfoundland, a joint operation with the Canadian Hydrographic Service has added 10,000 miles to the detailed gravity and magnetic mapping of the east coast offshore areas.

Further north, comprehensive study of the Labrador Shelf continued with seismic refraction lines, gravity reconnaissance and detailed surficial geology studies of Hamilton Bank. Arctic studies were continued in Lancaster Sound in preparation for a major operation there in 1974.

An intensive study of the environmental marine geology of Canso Strait during the summer of 1973 made use of all the techniques and talents of the Centre. The changes caused by the construction of the causeway in 1956 and subsequent industrialization were noted. This was a model study of requirements for environmental impact statements in sensitive or highly stressed areas.

The backlog of shipboard gravity and magnetic data collected since 1964 has been processed and prepared for release in January, 1974. The data processing was carried out by contract with CDP, Calgary. With the publication of 72 charts for Eastern Canada offshore, new data for large parts of Scotian Shelf, Gulf of St. Lawrence and the Grand Banks will become available.

During the bedrock investigations south of Newfoundland a shallow electric rock core drill was used extensively. As a joint venture with a Canadian company, it is planned to undertake systematic sea bed sampling in the Arctic in the summer of 1974. This will be a part of a complex expedition to the eastern Arctic on board several Canadian scientific ships.

The sampling of the top few hundred metres of the sea floor is beyond the range of the B.I.O. electric drill. The material from these layers is not recovered by oil exploration drilling and thus there is a gap in our geological knowledge. The Centre is now investigating contracting a commercial drill ship as part of a new program. Pending final approval and providing that contracts can be arranged, it is hoped that some twenty locations on the Nova Scotia and Grand Banks Shelves could be sampled in 1974.

The Centre has a responsibility for developing knowledge of sub-surface geology of Eastern Canada. This knowledge is obtained primarily by analysis of data from wells drilled during exploration of sedimentary basins. The data for each well is catalogued on cards. The work has started on the development of a GSC computer file for well data. When in operation, this file will enable quick retrieval of data for any particular well and, more importantly, it will make it possible to study cross-correlation between wells. The data on all unclassified wells will be made available to the public for further study.

During the year, the Centre was involved in contributing material and commenting upon drafts of several major government documents. There is a continuing participation in the evaluation of the geological basis for the estimation of the potential hydrocarbon reserves; the new Ocean Science Policy provides fresh opportunities for marine programs; and Make or Buy Policy requires re-evaluation of the research management styles of government research laboratories. While these activities sometimes distract from on-going research activities of the laboratories, nevertheless they represent a valid and necessary input for shaping the environment within which Canadian Science operates.

Personnel Notes

Mr. R. A. Eden was appointed an Administrative Assistant on June 1, 1973, and became the Administrative Officer in September 1973 when Mr. T. S. Hillis left AGC. In September 1973 Mrs. D. Campbell was appointed the Financial Officer of the Division. During the latter part of the Report year, Mrs. F. MacAusland was engaged in preparation of the typescript for the two volumes of papers on the Geology of Eastern Offshore Canada.

Attendance at Meetings

B. D. Loncarevic

"The Oceans and National Economic Development", Seattle, Wash. July 17-19, 1973

"The Earth Sciences in Canada" Inaugural Symposium of the Canadian Geophysical Union, Ottawa, February 22, 1974

B. R. Pelletier

Geological Association of Canada, Saskatoon, May 23-27, 1973

Geological Society of America, Dallas, Texas, November 12-14, 1973

Annual Meeting of American Commission on Stratigraphic Nomenclature, Dallas, Texas, November 11, 1973

Semi-Annual Meeting of the Geoscience Working Group of the Canadian Advisory Committee on Remote Sensing, Saskatoon, May 22, 1974

Annual Meeting of the Geology Subcommittee of the Atlantic Provinces Inter-University Committee on the Sciences, Halifax, November 3, 1973

Departmental Basin Analysis Review, ISPG, Calgary, January 15-17, 1973

Seminar on Law of Sea Conference for 1974, BIO, Dartmouth, September 28, 1973

Meeting of the Atlantic Subcommittee on Oceanography (of Canadian Committee on Oceanography), Halifax, November 20, 1973

Special Talks

B. D. Loncarevic

"Energy Crisis and Arctic Pipelines", BIO Seminar, Dartmouth, April 25, 1973

"Mineral Resources from the Deep Ocean - HMS CHALLENGER and Now", Nova Scotia Museum of Science, Halifax, June 21, 1973

"Oceans and the Mining Industry", Annual Meeting, Mining Association of Canada, Ottawa, February 27, 1974

B. R. Pelletier

"Arctic Marine Geology", University of Saskatchewan, Saskatoon, January 18 & 19, 1973

"Lithologic Ratios and the Hydrodynamic Sedimentary Environment", University of Saskatchewan, Saskatoon, January 18 & 19, 1973

"Prograding Clastic Sediments", University of Saskatchewan, Saskatoon, January 18 & 19, 1973

"HUDSON 70 Cruise and Arctic Marine Geology", Dawson Club, Dalhousie University, Halifax, November 26, 1973

"Marine Geological Exploration and Technology", Farribault Club, St. Francis of Xavier University, Antigonish, N.S., December 5, 1973

"Marine Science Atlas of the Beaufort Sea", Geological Association of Canada, Saskatoon, May 23, 1973

"Marine Clastic Sedimentation", full-year seminar course at Acadia University, Wolfville, N.S., academic years 1972/73, 1973/74

"Bay of Fundy Sedimentation", Atlantic Oceanographic Laboratory, BIO, Dartmouth, March 9, 1974

"Utilization of Fundy Tidal Power", panel discussion for Nova Scotia Institute of Science, Halifax, February 1973

Membership on Committees

B. D. Loncarevic

Bedford Institute of Oceanography Directors Coordination Committee

Atlantic Subcommittee on Oceanography - Canadian Committee on Oceanography

National Research Council Advisory Committee on Geodesy and Geophysics

Editorial Board - "Marine Geophysical Researches"

Editorial Board - "Science Forum"

Canadian Geophysical Union - Program and Publicity

B. R. Pelletier

Atlantic Subcommittee on Oceanography of CCO - Secretary

Subcommittee on Geology - Atlantic Provinces Inter-University Committee on the Sciences - Past Chairman

Working Group on Geoscience - Canadian Advisory Committee on Remote Sensing

Intergovernmental Committee on Submersibles

National Advisory Committee for Research in the Geological Sciences

Steering Committee for the Institute of Environmental Studies - Dalhousie University and Nova Scotia Technical College

American Commission on Stratigraphic Nomenclature - Commissioner

Faculty Committee on Graduate Studies, Dalhousie University

Organizing Committee, Symposium on Coastal and Shelf Processes, Beaufort Sea, Arctic Institute of North America

Manuscripts Approved for Publication

B. D. Loncarevic

"Oceanographers as Miners" for GEOS (#66, Feb. 1974)

"New Canadian Geophysical Union" for SCIENCE FORUM, Toronto; NATURE, London, and GEOSCIENCE-CANADA, Hamilton

B. R. Pelletier

"Marine Science Atlas of the Beaufort Sea" for Geological Association of Canada Proceedings of Annual Meeting, Abstract

"A Re-examination of the Use of the Silt/Clay Ratios as Indicators of Sedimentary Environments: A Study for Students" for MARITIME SEDIMENTS (vol. 9, no. 1, April 1973)

EASTERN PETROLEUM GEOLOGY SUBDIVISION

B. V. Sanford

Introduction

Eastern Petroleum Geology Subdivision carries out geoscientific programs over some 1,700,000 square miles of the potential petroleum provinces of Eastern Canada. Active individual projects are currently in progress in the Hudson Platform, the St. Lawrence Platform, the Atlantic Provinces, Gulf of St. Lawrence and the basins that lie along the continental margins of Eastern Canada from Georges Bank to Baffin Bay. Various geological disciplines and numerous sources of scientific data are employed in the EPGS program.

A stratigraphical and sedimentological framework of onshore and offshore basins is provided by studies of well sample cuttings, cores, outcrop samples, mechanical logs, seismic profiles, marine surveys and other data acquired in the exploration for oil and gas. A major part of the program is to determine the fundamental tectonic styles and identify potential hydrocarbon plays, of each of the sedimentary basins. Petroleum geophysical studies of seismic data acquired by government surveys, by purchase from participation industry or by loan from other government agencies, complemented by refraction, gravity and magnetic data wherever available, fulfills this part of the program. All geoscientific programs rely heavily on a time stratigraphic framework for dating of rock sequences, tectonic events, and local, regional and intercontinental correlations. Biostratigraphic, as well as paleoclimatic and paleoecologic studies are carried out on rocks that range in age from Ordovician to Tertiary, using chitinozoa, scolecodonts, spores, pollen, dinoflagellates, foraminifers, ostracods and nannoplankton.

Individual and cooperative scientific programs at Eastern Petroleum Geology Subdivision are synthesized and condensed to a form which demonstrates the origin and evolution and conditions as the presently exist in the various sedimentary basins of Eastern Canada. This data is used in cooperation with scientists from other government agencies to prepare inventories of potential hydrocarbon resources of Canada.

Activities

P. Ascoli completed biostratigraphic internal reports of five wells from the Canadian Atlantic Shelf, two of which are to be published. A contribution to GSC Paper 73-30 was prepared with G. L. Williams, entitled, "Biostratigraphy of the Mesozoic-Cenozoic Sediments of the Scotian Shelf and Grand Banks". In this paper, twenty-two foraminiferal divisions or zones ranging in age from Middle Jurassic to Middle-Late Miocene, and ten ostracod divisions or zones extending from Middle Jurassic to latest Cretaceous have been recognized. Paleoenvironments have been reconstructed for each stratigraphic unit in each well and their mutual environmental relationships outlined and compared. A second paper, entitled, "North Atlantic Plate Tectonics and Microfossils", was completed with F. M. Gradstein, W. A. M. Jenkins and G. L. Williams.

M. S. Barss has continued palynological studies in the Upper Paleozoic of the Atlantic Provinces and offshore regions of the Gulf of St. Lawrence and Grand Banks. Biostratigraphic zonation of four wells was completed. Cross sections and isopachous maps of the Upper Paleozoic rock groups of the Atlantic Provinces and offshore Eastern Canada were prepared for publication with R. D. Howie. Contributed to compilation for publication of basement and geological maps on 1:2,000,000 scale of Eastern Canada, including offshore areas.

F. M. Gradstein is studying foraminifers and ostracods in drilling samples from the Labrador Shelf and Grand Banks of Newfoundland. A biostratigraphic zonation is established and paleoecological interpretations are given. Reconstructions are attempted of the local and regional depositional history based on chronostratigraphy, paleobathymetry and sediment accumulation. Micropaleontological data will be processed digitally and stored in a data bank.

A. C. Grant was assigned to the EPG Subdivision in June 1973, to assist in the analysis of deep reflection seismic data from the Labrador and Newfoundland Shelf. These analyses contributed to the Departmental Hydrocarbon Inventory program and to the preparation of 1:2,000,000 bedrock geology and basement maps of Eastern Canada. During August, 1973, Grant participated in a helicopter reconnaissance survey by Eastcan Exploration Limited off the Labrador coast from the Gilbert River north to Hopedale. He also participated in Phase 4 of M.V. MINNA Cruise 73-019 to assist in evaluating the feasibility of including routine seismic measurements in future MINNA surveys.

I. A. Hardy: A project for setting up a subsurface data system at the Atlantic Geoscience Centre was formalized as project number 740007 in early 1974. Two sets of files are currently being constructed: (i) an index data file containing information on drilling operations and performance of wells; and (ii) the geological data file containing the name, age and lithology of geological formations encountered in each well. During the fiscal year, intense research has been carried out pertaining to the various computer systems available and in use at present. Intense library research has provided several up-to-date articles dealing with this type of project. During the same period, project number 730084, "Depositional History and Facies Distribution of the Tertiary System on the Scotian Shelf", has been continued and to date, of the eleven wells studied, evidence suggests that the Banquereau Formation may now be broken down into four units, informally proposed in the manuscript for GSC Paper 74-30. Detailed lithostratigraphical studies of the Banquereau Formation are continuing on the Scotian Shelf.

I. M. Harris is preparing a regional synthesis of the Late Precambrian and Paleozoic stratigraphy and tectonic development of Eastern Canada to facilitate the economic evaluation of the Paleozoic sedimentary basins of the onshore-offshore areas of this region. The synthesis outlines tectonic and depositional evolution of parts of the Appalachian, Caledonian and Variscan orogenic belts and adjacent cratonic areas in Eastern Canada, northeastern United States, western Europe and northwestern Africa, in keeping with the new concepts of global tectonics. A contribution on the subject of iceberg activity in the Labrador Shelf region was specially prepared for a volume on the "Offshore Geology of Eastern Canada" (GSC Paper 74-30).

R. D. Howie has for a number of years conducted surface and subsurface studies of the Upper Paleozoic sediments in the Atlantic Provinces, Gulf of St. Lawrence and Bay of Fundy. This study has been extended to include the continental shelf off Cape Breton and Newfoundland. A basement map of the Acadian orogen and a series of isopach maps of the Horton, Windsor, Canso-Riversdale, and Cumberland-Pictou Groups and cross sections with data obtained from wells, surface exposures and geophysical data, indicate the Upper Paleozoic sediments may vary in thickness up to 30 thousand feet and display a variety of structures due to tectonism and migration of Windsor Group salt. The presence of diapiric structures in the Magdalen Islands area of the Gulf of St. Lawrence and on land in Nova Scotia, Prince Edward Island and New Brunswick may enhance the economic potential of the region as a possible trapping mechanism for petroleum and natural gas.

L. F. Jansa has continued lithostratigraphic and sedimentological research of the Mesozoic of Eastern Canada's continental margin, concentrating on wells located at the central and southern part of the Scotian Shelf and the southwestern part of the Grand Banks. Lithostratigraphic units were established for individual wells and applied in well to well correlation. The study has been extended to the Grand Banks, where the Mesozoic sequence was subdivided into informal lithostratigraphic units. These were correlated to the Scotian Shelf, even though the Middle Jurassic, Upper Jurassic (in part) and Lower Cretaceous (in part) have different development in both regions. Facies maps of the Jurassic, which were constructed for the Scotian Shelf, have been extended to the Grand Banks. The detailed study of carbonates is in progress; development, porosity and possibilities of reservoir development in carbonate formations of the Scotian Shelf is in progress. Reconnaissance field work in coastal Mesozoic basins of Morocco was initiated by studying the Jurassic sequences of the Essaouira Basin, to obtain geological and paleontological data for the reconstruction of Early Mesozoic continental margins, basin configurations, reservoir, source rock, and continental drift.

W. A. M. Jenkins began dating Mesozoic-Tertiary sequences on the Grand Banks, using dinoflagellates and spores; currently compiling a lithostratigraphic and biostratigraphic report on Amoco IOE Puffin well drilled on the southwestern edge of the Grand Banks (with Ascoli, Williams, Jansa and Gradstein). From time to time, dated Early Paleozoic rocks from the Labrador and Morocco for B.V. Sanford and L.F. Jansa.

B. V. Sanford continued regional studies of the Paleozoic rocks of Eastern Canada on the basis of field investigations and subsurface data acquired from wells drilled in exploration for oil and gas. In cooperation with other scientific staff of Eastern Petroleum Geology and Regional Reconnaissance Subdivisions, B.V. Sanford coordinated the preparation of suites of maps on 1: 2,000,000 scale, illustrating bedrock geology, basement contours and physiographic elements of the onshore-offshore sedimentary basins of Eastern Canada. These represent the first maps of this kind to be constructed embracing all of the offshore regions of Eastern Canada.

J. A. Wade has worked on regional subsurface studies of the sedimentary basins offshore from Nova Scotia and Newfoundland, continuing with the interpretation and intergration of an additional 3,000 miles of deep reflection seismic data and 15 exploratory wells. Particular emphasis of the interpretation was on the tectonic history of the region. Major tectonic elements and a number of subprovinces

were delineated and described. Revised interpretation of basement configuration and other key seismic horizons was prepared at a scale of 1:1,000,000. Basement configuration at a scale of 1:2,000,000 was prepared for publication. A significant use was made of subsurface data in assessing the hydrocarbon potential of the sedimentary basins of Eastern Canada.

G. L. Williams conducted detailed palynological analyses of samples from ten wells; seven on the Scotian Shelf, one on the Grand Banks and three on the Labrador Shelf. This has provided biostratigraphic control in the Mesozoic-Cenozoic sediments of the continental margins of Eastern Canada. Twenty-eight palynomorph zones are recognised ranging from the Early Jurassic to Plio-Pleistocene. Increasing provincialism characterises the palynomorph assemblages throughout the Late Mesozoic and Cenozoic.

Personnel Notes

During the report year the following scientific and technical staff joined the Subdivision: Dr. I. M. Harris, research scientist, May 10, 1973; Mr. P. Girouard, sedimentology technician, July 7, 1973; Dr. W. A. M. Jenkins, research scientist, December 10, 1973; Mr. G. L. Cook, compiler-draftsman, December 17, 1973; Dr. A. C. Grant, physical scientist, January 1, 1974; Dr. F. M. Gradstein, research scientist, January 3, 1974 and Mr. B. Deonarine, palynology technician, February 2, 1974. These additions brought the total staff to 12 scientific, 4 technicians, 2 draftsmen, 1 clerk-typist and five microfossil pickers on professional contract.

A considerable professional and personnel loss was experienced by Eastern Petroleum Geology Subdivision with the sudden, unexpected death of David F. Clark on February 5, 1974. Dave had been conducting studies of nannofossils from the Mesozoic and Cenozoic sequences of the Scotian Shelf.

Attendance at Meetings

P. Ascoli

Symposium on the Jurassic-Cretaceous Boundary (Lyon-Neuchatel, France-Switzerland), September 7-16, 1973.

Atlantic Geoscience Society Colloquium on the

Geological Evolution of the Eastern Seaboard of Canada, Fredericton, New Brunswick, January 18-19, 1974.

M. S. Barss

Managerial Grid Course, Cornwall, Ontario, October 21-26, 1973.

Annual Meeting of Geological Survey of Canada Palynologists, Dartmouth, Nova Scotia, December 10-11, 1973.

Atlantic Geoscience Society Colloquium on the Geological Evolution of the Eastern Seaboard of Canada, Fredericton, New Brunswick, January 18-19, 1974.

F. M. Gradstein

Atlantic Geoscience Society Colloquium on the Geological Evolution of the Eastern Seaboard of Canada, Fredericton, New Brunswick, January 18-19, 1974.

VIth African Micropaleontological Colloquium, Tunisia, March 21 - April 4, 1974.

A. C. Grant

53rd Annual Meeting of American Geophysical Union, Washington, D. C., April 17-21, 1973.

Interdepartmental Subcommittee on Geological Potential, Ottawa, Ontario, November 8-9, 1973.

Interdepartmental Subcommittee on Geological Potential, Calgary, Alberta, January 13-18, 1974.

Interdepartmental Subcommittee on Geological Potential, Dartmouth, Nova Scotia, January 28-February 1, 1974.

I. A. Hardy

Atlantic Geoscience Society Colloquium on the Geological Evolution of the Eastern Seaboard of Canada, Fredericton, New Brunswick, January 18-19, 1974.

R. D. Howie

Atlantic Geoscience Society Colloquium on the Geological Evolution of the Eastern Seaboard of Canada, Fredericton, New Brunswick, January 18-19, 1974.

L. F. Jansa

American Association of Petroleum Geologists (East Coast Section) Annual Meeting, Atlantic City, United States, April 23-25, 1973.

B. V. Sanford

Interdepartmental Subcommittee on Geological Potential, Ottawa, Ontario, November 8-9, 1973.

Interdepartmental Subcommittee on Geological Potential, Calgary, Alberta, January 13-18, 1974.

Interdepartmental Subcommittee on Geological Potential, Dartmouth, Nova Scotia, January 28-February 1, 1974.

J. A. Wade

American Association of Petroleum Geologists (East Coast Section) Annual Meeting, Atlantic City, United States, April 23-25, 1973.

Nova Scotia Mining Society Annual Meeting, Ingonish, Nova Scotia, June 28-29, 1973.

Interdepartmental Subcommittee on Geological Potential, Ottawa, Ontario, November 8-9, 1973.

Interdepartmental Subcommittee on Geological Potential, Calgary, Alberta, January 13-18, 1974.

Interdepartmental Subcommittee on Geological Potential, Dartmouth, Nova Scotia, January 28-February 1, 1974.

G. L. Williams

American Association of Petroleum Geologists (East Coast Section) Annual Meeting, Atlantic City, United States, April 23-25, 1973.

American Association of Stratigraphic Palynologists, Anaheim, United States, October 16-19, 1973.

Annual Meeting of Geological Survey of Canada Palynologists, Dartmouth, Nova Scotia, December 10-11, 1973.

Atlantic Geoscience Society Colloquium on the Geological Evolution of the Eastern Seaboard of Canada, Fredericton, New Brunswick, January 18-19, 1974.

Laboratory Activities

The micropaleontology-picking laboratory has completed (for Geological Survey of Canada) the picking of 35 wells from the Scotian Shelf, Labrador Shelf and the Grand Banks, providing 3387 picked samples and 3934 picked slides, covering a footage of 325,078 feet. Twenty-three of these wells have also been picked for Resource Management and Conservation Branch, with 2072 additional samples and 2120 additional picked slides being provided. This makes a total of 5459 samples and 6054 slides picked in the report year. All wells now released from confidentiality have been thoroughly processed and picked, and a double set of picked slides of the cuttings and cores have been made available to Geological Survey of Canada for scientific study and to Resource Management and Conservation Branch for public examination. In addition, 16 wells to be released after April 1, 1974 have been completely picked for Geological Survey of Canada and Resource Management and Conservation Branch.

The palynology laboratory has completed processing of 11 wells for nannoplankton, comprising 988 samples and 1980 slides. These wells are now available for public examination. Processing of palynology samples from 33 wells, 20 shallow core holes, 73 outcrop and reference sections has been completed to date in this laboratory. Thirty of the 33 wells are no longer confidential and are available for public examination. A total of 2800 samples and 11,200 slides have been prepared.

A sedimentology technician was hired and trained to prepare petrographic thin sections. These are prepared from cores and well cuttings on a routine basis in support of lithostratigraphical and sedimentological studies of the offshore regions of Eastern Canada.

Special Talks

P. Ascoli

"Foraminiferal and Ostracod Biostratigraphy of

the Mesozoic and Cenozoic of the Scotian Shelf and Grand Banks", presented at the Atlantic Geo-Science Society Colloquium on the Geological Evolution of the Eastern Seaboard of Canada, Fredericton, New Brunswick, January 18-19, 1974.

A. C. Grant

"Geology of Labrador Sea and Baffin Bay", presented to the Interdepartmental Subcommittee on Geological Potential, Ottawa, November 8-9, 1973 and Dartmouth, January 28-February 1, 1974.

I. A. Hardy

"The Tertiary System of the Scotian Shelf", presented to the Atlantic Geoscience Colloquium on the Geological Evolution of the Eastern Seaboard of Canada, Fredericton, New Brunswick, January 18-19, 1974.

I. M. Harris

"Sedimentology and Tectonic Setting of the Meguma Group, Nova Scotia", invited talk at Mount Allison University Geology Department, Sackville, New Brunswick, March 28, 1974.

R. D. Howie

"Carboniferous Basins of Eastern Canada", by R. D. Howie and M. S. Barss, presented at the Atlantic Geoscience Society Colloquium on the Geological Evolution of the Eastern Seaboard of Canada, Fredericton, New Brunswick, January 18-19, 1974.

L. F. Jansa

"Comparisons of the Mesozoic Deposition on the Continental Margin off Nova Scotia and Morocco and its Bearing on Hydrocarbon Occurrences", presented to Direction des Mines et de la Geologie, Du Service Geologique du Maroc, Rabat, Morocco, October 22, 1973.

"Geological History of the Continental Margin off Nova Scotia in Mesozoic Time", presented to Department of Geology, Oxford University, England, October 29, 1973.

"Geology and Stratigraphy of the Continental Margin

off Eastern Canada", with J. A. Wade, presented to the Atlantic Geoscience Society Colloquium on the Geological Evolution of the Eastern Seaboard of Canada, Fredericton, New Brunswick, January 18-19, 1974.

B. V. Sanford

"Review of Eastern Petroleum Geology Subdivision Scientific Program", presented to Mme. Jeanne Sauve et al, during visit to Bedford Institute of Oceanography, Dartmouth, Nova Scotia, February 11, 1974.

J. A. Wade

"Geology of the Scotian Basin", presented to the Nova Scotia Mining Society Annual Meeting, Ingonish, Nova Scotia, June 29, 1973.

"Interdepartmental Hydrocarbon Inventory", presented to Mme. Jeanne Sauve et al, during visit to Bedford Institute of Oceanography, Dartmouth, Nova Scotia, February 11, 1974.

"Geology and Hydrocarbon Potential of Sedimentary Basins of Eastern Canada", presented to senior personnel of Department of Energy, Mines and Resources and Department of Indian Affairs and Northern Development, Ottawa, Ontario, March 1, 1974.

G. L. Williams

"Palynological Analyses of Mesozoic-Cenozoic Sediments of the Grand Banks of Newfoundland", presented to American Association of Petroleum Geologists (East Coast Section) Annual Meeting, Atlantic City, United States, April 24, 1973.

"Biostratigraphic Zonation of the Shell Oneida O-25 Well Offshore Nova Scotia", presented to American Association of Stratigraphic Palynologists, Anaheim, United States, October 19, 1973.

"Palynological Analyses of Mesozoic-Cenozoic Sediments of the Grand Banks and Scotian Shelf, Atlantic Continental Margin, Canada", presented to American Association of Stratigraphic Palynologists, Anaheim, United States, October 19, 1973.

"Biostratigraphy of the Scotian Shelf and Grand

Banks", presented to the Atlantic Geoscience Society Colloquium on the Geological Evolution of the Eastern Seaboard of Canada, Fredericton, New Brunswick, January 18-19, 1974.

Membership on Committees

P. Ascoli

Member, International Paleontological Union Working Groups on Tethyan Ostracoda.

M. S. Barss

Member, several working groups of the Commission Internationale de Microflore du Paléozoique.

A. C. Grant

Member, Panel of Association Editors, Regional and Structural Geology, Canadian Society of Petroleum Geologists.

Member, Bedford Institute of Oceanography Library Committee.

R. D. Howie

Member, Bedford Institute of Oceanography Library Committee.

L. F. Jansa

Member, Dalhousie University Thesis Committee.

Member, Bedford Institute of Oceanography Seminar Committee.

B. V. Sanford

Member, Interdepartmental Subcommittee on Geological Potential.

J. A. Wade

Member, Interdepartmental Subcommittee on Geological Potential.

G. L. Williams

Councillor, American Association of Stratigraphic

Palynologists.

Secretary-Treasurer, Atlantic Geoscience Society.

Manuscripts Approved for Publication

I. M. Harris

"Iceberg Marks on the Labrador Shelf"; Geol. Surv. Can., Paper 74-30, v. 1, (in press).

L. F. Jansa

"Trace Fossils from the Cambro-Ordovician Cow Head Group, Newfoundland and their Paleobathymetric Implications"; Palaeogeography, (in press).

"Uraloporella Korde in the Devonian of Alberta"; Can. J. Earth Sci., with R. Riding, (in press).

"Jurassic Sedimentation on Continental Shelf Off Nova Scotia, Canada"; Abstract in AAPG-SEMP Proceedings, Annual Meeting, 1974.

B. V. Sanford

"The Geology of Southampton, Coats and Mansel Islands, District of Keewatin, NWT"; Geol Surv. Can., Memoir, with W. W. Heywood, (in press).

"Devonian Stratigraphy of the Hudson Platform"; Geol. Surv. Can., Memoir, with A. W. Norris, (in press).

"Physiographic Regions of Eastern Canada"; Geol. Surv. Can., Map Series, with G. M. Grant.

ENVIRONMENTAL MARINE GEOLOGY SUBDIVISION

D.E. Buckley

Introduction

The perspective of geology is well suited to the requirements of environmental study because this philosophy is founded on the principle of uniformity in the order of nature. It is therefore logical that the environmental geologist should examine the contemporary relationships between physical processes and the resulting environment, and to then use these principles in a reconstruction of paleoenvironments. The collection, analysis, and application of geologic data and principles to aid in the solution of problems created by human occupancy and use of the physical environment is also an obligation of the environmental geologist.

The Environmental Marine Geology Subdivision, which was established as part of the Atlantic Geoscience Centre in 1973, is responsible for developing and applying a knowledge of the geological processes which are controlling our present day environment. This knowledge is obtained by observing the relationships between dynamic physical, chemical and biological processes and the imprint of these processes on the sedimentological, geochemical, and ecological quality of the marine environment. This knowledge is then applied to problems of interpreting paleoenvironments of ancient marine sediments, and to measuring the impact of man's activities on the quality of the contemporary environment as well as providing a basis for assessing the impact of future developments.

Activities

The scientific program of the Subdivision is carried out by a combination of short and long term research projects which are designed to gain basic knowledge of principles as well as field applications of that knowledge to the solution of specific problems. The program included 15 active projects in the fiscal year 1973/74. The research was carried out by 10 scientists and 7 technical support staff, as well as 2 to 5 casual and seasonal assistants.

The paleoecology group, consisting of 4 scientists and 2 technicians is concerned with the ecostratigraphy, geochronology and neotology of marine Pleistocene and Holocene sediments in eastern Canadian and Arctic coastal zones. Efforts are made to correlate the distribution of fossil forming invertebrates (mainly foraminifera and molluscs) with selected physical and chemical parameters of natural or anthropogenic origin in the marine environment. Methods are developed for monitoring and recording the interaction of benthic organisms with their environment. Methods are also developed and applied in experimental paleontology to verify the environ-

mental factors responsible for the distribution of fossil forming marine invertebrates.

During 1973/74, G. Vilks and F.J.E. Wagner continued work on sediment samples from the Beaufort Sea and Northwest Passage in order to reconstruct the paleooceanography of the Arctic Archipelago. In addition, G. Vilks participated in an oceanographic cruise on the Labrador Shelf in order to collect sediment cores which could provide information on sedimentary environments of the glacial and post-glacial periods and in order to identify areas of possible Mesozoic-Tertiary outcrops. This project, which was carried out in co-operation with scientists in the Regional Reconnaissance Subdivision, has resulted in the discovery of anomalous accumulations of dry gas (methane) in post-glacial unconsolidated sediments. These accumulations have been attributed to bacterial degradation of organic material of marine origin under conditions of rapid sedimentation of fine-grained detritus which causes the gases to be trapped.

Marine geological studies in the Bay of Chaleur were continued on a laobratory basis only in 1973 because of field commitments of all staff to the Canso Strait and Chedabucto Bay studies. Work by C.T. Schafer and F.E. Frape on sediments from the Bay of Chaleur have emphasized the influence of local environmental conditions on the distribution of benthonic foraminifera species, in particular relationships have been established between the concentration of pulp mill wastes and species number and diversity. These findings have demonstrated the potential usefulness of foraminifera as environmental quality indicators. Detailed laboratory studies by D.A. Walker and G. Vilks of the ultrastructure of foraminifera by means of scanning electron microscopy are helping to resolve taxonomic problems of species classification and are also revealing subtle influences of the environment on the test structure and preservation. Other laboratory developments by D.A. Walker, A. Linton and C.T. Schafer have improved the methods of distinguishing living from empty tests of foraminifera in recent marine sediments.

Organic geochemistry and inorganic geochemistry are the two sub-groups of marine geochemistry. Organic geochemistry, which includes a staff of 2 scientists, 3 technicians and one casual, is responsible for analyses of hydrocarbons in ancient sediments obtained from east coast exploration wells in order to assess the hydrocarbon potential of the off-shore deposits. Organic carbon and gaseous hydrocarbons (C_1-C_4) are determined from canned well cutting samples in order to evaluate the maturity of organic facies at various stratigraphic and lithologic horizons. During the past year, more than 4,000 canned samples of well cuttings from 17 exploration wells were analyzed for organic carbon and gaseous hydrocarbons. This work, under the supervision of J.D. Leonard, has resulted in geo-chemical-stratigraphic records which are now being correlated with lithologic and structural data in order to improve the inventory of hydrocarbon potential in the eastern Canadian offshore. Heavy hydrocarbons are also extracted from selected well samples under the direction of M.A. Rashid. This research is conducted to improve the techniques of identifying zones of thermal maturation and conversion of organic matter to petroleum, and

develop criterion for the recognition of distinct sedimentary environments, such as those of marine and non-marine accumulation. Detailed analyses of extracted high molecular weight compounds may be useful in indicating strata in which horizontal or vertical hydrocarbon migration has taken place. Other fundamental research by M.A. Rashid on recent organic compounds in marine sediments has continued with emphasis during 1973/74 on the effect these compounds might have on the geotechnical (engineering) properties.

Inorganic geochemistry research is directed toward understanding the principles of metal equilibrium in sea water and marine sediments. This research has resulted in the development of highly sensitive methods for the detection of trace elements. Such methods are being applied to the study of mechanisms of metal migration and precipitation which can assist in understanding why certain metals accumulate in potentially economically important concentrations such as in feromanganese deposits. This research is also being applied in environmental studies in order to assess the potential hazards of metal dispersion from urban and industrial waste disposal. The geochemical equilibrium of sea water is of fundamental importance to marine scientists because the natural buffering capacity determines the ecology and environmental quality. Progress in the development of analytical methods for the detection of trace elements in natural waters by G.V. Winters, D.E. Buckley and R.E. Cranston has lead to new means of evaluating hydrolysis and complexation. Other research conducted by R.E. Cranston has demonstrated that suspended particulate matter (silicates), in nearshore, low salinity waters can significantly effect the pH of sea water which is otherwise controlled by the carbonate equilibrium. These two facets of research are somewhat related as has been demonstrated by some preliminary data which has shown a high correlation between the nature and concentration of suspended particulate matter (as determined by wavelength selective attenuation of collimated light from an in situ attenuance meter) and the concentration of certain trace metals such as iron and manganese. The concentration and natural variability of total mercury in the North Atlantic has been reported by R.A. Fitzgerald and R.E. Cranston and represents the continuing research on the nature and reactivity of this environmentally important metal.

Development of a strong capability for research in the dynamics of coastal zone sedimentation was recognized as the highest priority of Environmental Marine Geology, and considerable effort was expended to recruit an expert staff. E.H. Owens continued his studies of the coastal geomorphology and sedimentary resources of the southern Gulf of St. Lawrence in order to define coastal environments in terms of their hydrodynamic and geomorphic characteristics. Some detailed studies of the interaction of wind, tides and ice and the resultant transport of sediments were carried out during the winter of 1973/74. These studies were in addition to the commitments of E.H. Owens to the coastal studies of the Chedabucto Bay area which was part of the multidisciplinary investigations of the marine geology of Canso Strait and Chedabucto Bay.

During the summer of 1973, R.J. Knight completed field studies of

dynamic sedimentology of a section of the Minas Basin near Noel, Nova Scotia. Tides and tidal currents were measured and related to the mechanisms of bedform migration. In addition, surveys of the subsurface sedimentary structures were undertaken in order to determine the nature and degree of preservation of buried bedform features.

The comprehensive multidisciplinary study of the environmental marine geology of the Canso Strait and Chedabucto Bay area consumed more than half of the research and survey resources of the Subdivision during 1973/74. This ambitious project also involved more than 30 other scientists and technicians from other subdivisions, departments and institutions. Through the analyses of more than 120,000 variables in field and laboratory observations through a period of 9 months, an assessment of the impact of man on the marine environment was obtained. This assessment included studies of the ecology and paleoecology of several benthonic organisms; the geochemistry of water, suspended particulate matter, bottom sediments, and oil residues; and the sedimentology of the Strait and coastal beach environments. The results of this study have demonstrated the immediate and potential long term effects of the Canso causeway construction on the sedimentology and ecology of the Strait. Urban and industrial effects have been detected in the anomalous accumulation of anthropogenic metal and organic carbon in bottom sediments and the impact of these developments are evident from the distribution patterns of benthonic organisms. Oil residues still remain on coastal beaches of Chedabucto Bay as a result of the spill from the tanker ARROW in 1970, although some physical and geochemical disintegration is taking place on beaches exposed to high energy wave attack.

The Marine Science Atlas of the Beaufort Sea being compiled by B.R. Pelletier was nearing completion. This Atlas will include results from past and continuing projects on a wide variety of marine aspects of the Beaufort Sea. Illustrations will include maps, graphs and photographs depicting oceanographic, biological, geological and socioeconomic data. Data will be plotted on a scale of 1:500,000 for reduction to atlas size of 15 X 12 inches. In addition to this work, B.R. Pelletier has continued research on the interpretation of hydrodynamic environments from textural qualities of recent marine and lacustrine sediments.

Personnel Notes

During the summer of 1973, R.G. Fanjoy and K.W. LeBlanc joined the staff of the organic geochemistry subgroup to provide technical assistance in the hydrocarbon analyses projects. G. Vilks completed all requirements for the Ph.D. degree in Oceanography at Dalhousie University with the submission of his dissertation entitled: "A Study of *Globorotalia pachyderma* (Ehrenberg) = *Globorotalia pachyderma* (Ehrenberg) in the Canadian Arctic.

Attendance at Meetings, Conferences and Courses

D.E. Buckley

Clay Mineral Society Annual Meeting, Banff, Alberta, October 7-14, 1973

Eastern Passage Advisory Committee Meeting, Nova Scotia Research Foundation, Dartmouth, Nova Scotia, December 3, 1973

R.E. Cranston

4th International Conference on Atomic Spectroscopy, Toronto, Ontario, October 27 - November 4, 1973

J.D. Leonard

International Organic Geochemistry Conference, Rueil Malmaison, France, September 18-21, 1973

Canadian Stratigraphic Service Ltd., Sample Logging School, Calgary, Alberta, February 11-19, 1974

E.H. Owens

2nd International Estuarine Research Conference, Myrtle Beach, South Carolina, October 15-18, 1973

C.T. Schafer

AAPG Meeting in Anaheim, California, May 11-20, 1973

G. Vilks

Symposium on Beaufort Sea Coastal and Shelf Research, San Francisco, California (Convenor of Marine Biology Session), January 6-10, 1974

D.A. Walker

6th Annual Scanning Electron Microscopy Symposium and Workshop, Chicago, Illinois, April 23-26, 1973

G.V. Winters

C.I.C. Symposium on Water Quality Parameters, Burlington, Ontario, November 19-22, 1973

Special Talks or Lectures

D.E. Buckley

"Distribution and Nature of Suspended Particulate Matter as Determined by an Optical Beam Attenuance Meter", Bedford Institute of Oceanography, Dartmouth, N.S., April 27, 1973

"Man's Influence on the Environmental Marine Geology of the Strait of Canso and Chedabucto Bay, Nova Scotia", Logan Club, Geological Survey of Canada, March 6, 1974

"Environmental Marine Geology at the Atlantic Geoscience Centre", Geology Department, McMaster University, Hamilton, Ontario, March 7, 1974

R.E. Cranston

"Chelation-Solvent Extracting Atomic Absorption as a Method of Evaluating Trace Metal Hydrolysis", 4th International Conference on Atomic Spectroscopy, Toronto, Ontario, October 27 - November 4, 1973

E.H. Owens

"The Investigation of Form and Processes in the Coastal Zone", Bedford Institute of Oceanography, Dartmouth, N.S., December 14, 1973

Four lectures on "Shoreline Processes, Sediments and Morphology" to advanced sedimentology course, Department of Geology, Dalhousie University, Halifax, N.S., January 18-25, 1974

C.T. Schafer

"Multidisciplinary Study of Environmental Marine Geology", Smithsonian Institute, Washington, D.C., March 22, 1974.

G. Vilks

"A Study of *Globorotalia pachyderma* (Ehrenberg) in the Canadian Arctic", Dalhousie University, Halifax, N.S., September 10, 1973

Membership on Committees

D.E. Buckley

Member, Nova Scotia Research Foundation Advisory Committee on Dredging Operations

C.T. Schafer

IEEE Program Committee for "Ocean 74"

F.J.E. Wagner

Associate Committee on Quaternary Research, N.R.C.

Production Statistics

1973/74 (Hydrocarbon Projects)

Type of Analysis	No. of Samples Analyzed
1. Gaseous hydrocarbons	4200 core cuttings
2. Organic carbon	4000 " "
3. Extraction of high molecular weight (C_{15}^{+}) fractions	220 " "
4. Fractionation of C_{15}^{+}	130 " "
5. Gas chromatographic analysis of n-alkanes	25 " "
6. Complete tabulation of C_1-C_4 data	17 wells

Completed Manuscripts

Bewers, J. Michael; Macaulay, Ian D.; Sundby Bjørn and Buckley, Dale E.
in press: Data are for looking at or quality control through interpretation; ASTM Bulletin.

Buckley, D.E.
1973: Environmental Marine Geology of the Strait of Canso and Chedabucto Bay, Port Hawkesbury, Nova Scotia; Field Report No. 73-022, Bedford Institute of Oceanography, Dartmouth, N.S.

Buckley, D.E., Owens, E.H., Schafer, C.T., Vilks, G., Cranston, R.E., Rashid, M.A., Wagner, F.J.E. and Walker, D.A.
1974: Canso Strait and Chedabucto Bay: A multidisciplinary study of the impact of man on the marine environment; Geol. Surv. Can. Paper 74-30, Volume 1.

Owens, E.H.

in press: Size analysis data of surface samples from the coastal zone of the southern Gulf of St. Lawrence; Bedford Institute of Oceanography Data Rept. 74-1, 106 p.

1974: A framework for the definition of coastal environments in the southern Gulf of St. Lawrence; Geol. Surv. Can. Paper 74-30, Volume 1.

Rashid, M.A.
in press: Absorption of metals on sedimentary and peat - humic acids; Chemical Geology.

in press: Degradation of Bunker C oil under different coastal environments of Chedabucto Bay, Nova Scotia; Estuarine and Coastal Marine Science.

1974: Humic compounds of sedimentary environment - Their chemical nature and geochemical significance; Geol. Surv. Can. Paper 74-30, Volume 1.

Schafer, C.T.
in press: Sedimentary deposition and lithogenesis on Mid-Atlantic Ridge mountain tops; Can. Journ. of Earth Sci.

Schafer, C.T. and Frape, F.E.
1974: Application of benthonic foraminifera distributions to the differentiation of local nearshore environments; Geol. Surv. Can. Paper 74-30, Volume 1.

Vilks, G.
1974: The distribution of planktonic foraminifera in the sediments and water of the Northwest Passage and northern Baffin Bay: A tool for paleooceanographic synthesis; Geol. Surv. Can. Paper 74-30, Volume 1.

Vilks, G., Rashid, M.A. and van der Linden, W.J.M.
in press: Methane in Recent sediments of the Labrador Shelf; Can. Jour. Earth Sci.

Walker, D.A., Linton, A. and Schafer, C.T.
in press: Sudan Black B: A superior stain to Rose Bengal for distinguishing living from non-living foraminifera; Journ. Foraminiferal Res.

REGIONAL RECONNAISSANCE SUBDIVISION

D. I. Ross

Introduction

The new concepts of global geology, which are rapidly evolving, are continuously changing the framework within which our data and observations are interpreted. At the same time the increasing demand for energy resources has placed a new urgency on the mapping of our offshore territories and the interpretation of these maps in terms of potential resources and the environmental dangers associated with exploiting these resources.

The geological framework for the eastern continental shelf and margin of Canada is known only in a general outline. It is the responsibility of Regional Reconnaissance Subdivision to carry out field programs in key areas so that the new knowledge thus gained will advance our understanding most effectively. The work is centered around expeditions within three broad sub-programs (i) surficial and bedrock mapping, (ii) regional geophysical surveys and (iii) ocean margin and basin studies.

Activities

(i) Surficial and bedrock mapping

A geological map of the Scotian Shelf and adjacent areas has been completed and is in final stages of printing. Field work has continued on the southern Grand Banks and the compilation of a sub-Pleistocene geological map has begun. A paper on the stratigraphic interpretation of the Central Grand Banks has resulted. A two month cruise on C.S.S. DAWSON, accompanied during part of the time by CNAV SACKVILLE, has resulted in a large amount of new data in the Labrador Shelf and margin. Compilation of sample data, bathymetry, high resolution seismic and sidescan data in the Hamilton Bank area has resulted in the preparation of accurate sediment and morphological maps. Sidescan data showed a very high incidence of ice-scouring. Assistance in the compilation of surficial geology maps was provided by Geomarine Associates.

A seismic profiling and bottom sampling program was carried out with support from Terrain Sciences Division on the Hydrographic Survey in Lancaster Sound between 87°W and 90°W longitude. The high resolution seismic data obtained was intepreted under contract by Huntec '70 Ltd. to provide bedrock topography and sediment thickness maps.

(ii) Regional geophysical surveys

The program of geophysical surveys carried out as a joint program with Canadian Hydrographic Service as part of their continuing Offshore Survey program was continued in the northeast Grand Banks using the charter vessel M.V. MINNA. Together with the field work completed in 1972, this has resulted in the completion of seventy-six new Natural Resource Maps at a scale of 1:250,000. The maps are computer drawn under contract and will be published in 1974 by the Canadian Hydrographic Service. In addition to the gravity and magnetic data some seismic profiling was completed. Interpretation of earlier data in the Gulf of St. Lawrence, southern Grand Banks is largely completed and ready for publication. Additional magnetic and gravity data was obtained in the St. Lawrence Estuary as part of the Hydrographic survey on C.S.S. BAFFIN. This data will be incorporated in the regional maps of the Gulf of St. Lawrence. Underwater gravity measurements were carried out on the southwestern N.S. shelf with the Earth Physics Branch underwater gravity meter and underwater and surface meter measurements in the southern Grand Banks. These gravity measurements enabled gaps in the coverage obtained on the hydrographic program to be filled in.

(iii) Ocean margin and basin studies

A major field project completed during 1973 was the first phase of the geophysical study of the ocean-continent margin off Nova Scotia and southern Grand Banks. The work has confirmed a rather different crustal structure along the southern Grand Banks margin, presumably formed by transform faulting during the opening of the Atlantic Ocean, to that observed on the rifted margin of Nova Scotia. The work has provided baseline data for comparisons with other continental margins as well as fundamental new information on the structure of passive continental margins. The project has included a study of the Quiet Magnetic Zone east of the N.S. margin. This work has shown the zone to be underlain with essentially normal oceanic crust formed during a time of few reversals in the Earth's magnetic field. Crustal studies conducted on the northern Labrador continental margin have provided information on the ocean-continent boundary in the northern area for comparison with the N.S. margin. This work will continue in 1974 on the Labrador and Baffin Island margins.

Laboratory and field work on the improvement of seismic techniques has continued. The main result has been the development of a PDP-11 computer for on-line processing of deep seismic reflection data. In water depths of 400 m or more the system provides data comparable to that obtained by commercial multi-trace facilities and has much greater versatility in the heavy ice conditions encountered in the Arctic.

Seismic velocity measurements on rocks drilled by Dalhousie University in Bermuda and the Azores have been carried out under contract

by Dalhousie University. This work has resulted in the establishment of the equipment and methods for rock velocity measurements at high pressures to be used in the analysis of rock samples obtained on Leg 37 of the JOIDES deep sea drilling project.

Personnel Notes

Miss Patricia Solowan, Secretary to the Subdivision left in May, 1973 to take up a position at Dalhousie University and was replaced by Miss Janet Myers. Miss Ruth Jackson joined the Subdivision in July 1973. Dr. R. A. Folinsbee completed his P.D.F. in December and took up a permanent position with the Subdivision in January 1974. Dr. R.H. Fillon joined the Subdivision in February 1974 after completing a P.D.F. at Woods Hole Oceanographic Institute. Mr. H. Josenhans left to continue his studies at Dalhousie University in September and was replaced by Mrs. Jane Latremouille in February 1974. Dr. I.M. Harris transferred to E.P.G. Subdivision in May 1973 and Dr. A.C. Grant in November 1973.

Attendance at Meetings

D. L. Barrett

54th Annual Meeting, American Geophysical Union, Washington, D.C. April 16-21, 1973.

R. H. Fillon

Geological Society of America Northeastern Meeting, Baltimore, Md., March 20-23, 1974

R. T. Haworth

Atlantic Geoscience Society Colloqium, Fredericton, N.B., January 18-19, 1974.

Symposium on Grenville Province, University of Ottawa, February 19-23, 1974.

N.R.C. Sub-Committee Meetings, Ottawa, February 20, 1974.

A. Jackson

Computer Course, Halifax, N.S. January 14-16, 1974.

C.E. Keen

Canadian Society of Exploration Geophysicists, Calgary, April 4-7, 1973

54th Annual Meeting, American Geophysical Union, Washington, D.C. April 17-18, 1973.

L. H. King

Atlantic Geoscience Society Colloqium, Federicton, N.B. January 18-19, 1974.

A.A.P.G. Meeting, Atlantic City, N.J. April 23-25, 1973.

B. MacIntyre

Computer Course, Halifax, N.S. January 14-16, 1974

R. F. Macnab

Canadian Hydrographic Service Annual Planning Meeting, Ottawa. October 30-31, 1973.

Canadian Hydrographic Conference, Burlington, Ontario March 4-7, 1974.

D. I. Ross

JOIDES Planning Committee Meeting, Lamont Doherty Geological Observatory, New York, June 11-14, 1973

Geological Association of Canada, Arctic Symposium, Saskatoon, Sask., May 23-26, 1973.

European Geophysical Society Meeting and JOIDES Planning Committee Meeting, Zurich, Switzerland, September 25-28, 1973.

Management Course for Research Managers, Montebello, P.Q. November 4-16, 1973 and February 3-8, 1974.

A.A.P.G. Meeting, Atlantic City, N.J. April 23-25, 1973.

N.R.C. Sub-committee Meeting, Ottawa, February 20, 1974

S.P. Srivastava

Symposium on Grenville Province, University of Ottawa, February 19-23, 1974.

54th Annual Meeting, American Geophysical Union, Washington, D.C. April 16-21, 1973.

International Association of Geomagnetism and Aeronomy, Kyoto, Japan, September 9-21, 1973.

W.J.M. van der Linden

Symposium on Grenville Province, University of Ottawa, February 19-23, 1974.

54th Annual Meeting, American Geophysical Union, Washington, D.C. April 16-21, 1973.

Special Talks

D. L. Barrett

"Deep Drill 1972: Elastic Properties of the Rocks and Inferred Oceanic Crustal Model", 54th Annual Meeting, American Geophysical Union, April 17-18, 1973.

R.H. Fillon

"Foraminiferal Paleo-ecology of the Champlain Sea in the Champlain Valley", Geological Society of America Northeastern Meeting, Baltimore, Maryland, March 20-23, 1974.

C.E. Keen

"Baffin Bay", Canadian Society of Geophysicists, April 4, 1973.

"Magnetic Lineations in the Quiet Zone", 54th Annual Meeting, American Geophysical Union, Washington, D.C., April 17-18, 1973.

"Changes in the Crustal Properties Near the Continental Margin", 54th Annual Meeting, American Geophysical Union, Washington, D.C., April 17-18, 1973.

L. H. King

"Interpretation of Seismic Reflection Profiles - Central Grand Banks", Atlantic Geoscience Society Colloqium, Fredericton, N.B., January 18-19, 1974.

R. F. Macnab

"Mapping Canada's Eastern Continental Margin", Nova Scotia Branch of the Canadian Institute of Surveying, Bedford Institute of Oceanography, February 1974.

D. I. Ross

"Baffin Bay" American Association of Petroleum Geologists", East Coast Offshore Symposium, Atlantic City, N.J., April 24, 1973

"Baffin Bay" , Geological Association of Canada, Saskatoon, Sask. May 22-27, 1973.

"Geophysical Studies of Baffin Bay and the Adjacent Continental Margins", Earth Physics Branch, Ottawa, March 1974.

S.P. Srivastava

"Geophysical Investigations of the Labrador Continental Margin", 54th Annual Meeting, American Geophysical Union, Washington, D.C. April 17-18, 1973.

"Magnetic Measurements and Anomalies at Sea", Kyoto Symposium, Tokyo, Japan, September 8, 1973.

"Magnetic Anomalies Associated with the Continental Margin of Eastern Canada", University of British Columbia, Vancouver, B.C. September 25, 1973 and Kyoto Symposium, Kyoto, Japan.

W.J.M. van der Linden

"The Offshore Extension of the Grenville Front", University of Ottawa, Feburary, 1974.

Membership on Committees

R. T. Haworth

Subcommittee on Gravity, Advisory Committee on Geodesy and Geophysics. National Research Council.

C. E. Keen

Subcommittee on Seismology and Physics of the Earth's Interior, Advisory Committee on Geodesy and Geophysics, National Research Council.

Commission on Geodynamics (Working Group 8), International Union of Geodesy and Geophysics.

Editorial Board "Geoscience Canada".

L.H. King

Subcommittee on Quaternary Geology, National Advisory Committee on Research in Geological Science. National Research Council.

Editorial Board "Geoscience Canada".

D. I. Ross

Subcommittee on Seismology and Physics of Earth's Interior, Advisory Committee on Geodesy and Geophysics, National Research Council.

JOIDES Planning Committee.

Canadian Subcommittee for Geodynamics.

S.P. Srivastava

Subcommittee on Geomagnetism and Aeronomy, Advisory Committee on Geodesy and Geophysics, National Research Council.

International Association of Geomagnetism and Aeronomy, Division I (4).

W.J.M. van der Linden

Editorial Board, AGC Volume, Offshore Geology of Eastern Canada.

Manuscripts Approved for Publication

R. T. Haworth

"Gravity and Magnetic Natural Resource Maps (1972) Offshore Eastern Canada Philosophy and Technique in Preparation by Computer" in International Hydrographic Review, 51, #1, pp. 131-155. (#39, May 1973).

"A Marine Gravity - Data Processing Technique" (with B.D. Loncarevic) for Geophysics. (#59 December 1973).

C. E. Keen

"Some Aspects of the Ocean-Continent Transition at the Continental Margin of Eastern North America",(with M.J. Keen, D.L. Barrett and D.E. Heffler), for Journal of Geophysical Research, (#47 August 1973).

"Baffin Bay: A Small Ocean Basin Formed by Sea Floor Spreading", (with D.I. Ross, M.J. Keen and M. Lack). for A.A.P.G. Special Bulletin. (#63 January 1974).

"Variations in Geologic Style Beneath the Margins of Eastern Canada and Baffin Bay", (with M.J. Keen), for Penrose Volume 1973 (#71 March 1974).

L.H. King

"Map - Geology Scotian Shelf and Adjacent Areas" (with B. MacLean) for Marine Science Paper #7, (#74 March 1974).

R. F. Macnab

"Meso-Morph Map. The Mapping of Medium-Scale Morphology from Echograms" (with D. Monahan), for Proceedings of 13th Canadian Hydrographic Conference in Burlington. (#72 March 1974).

S.P. Srivastava

"Measurement of Variations in the Total Magnetic Field of the Earth at Sea Off Nova Scotia, Canada", (with R.A. Folinsbee) for Canadian Journal of Earth Sciences. (#68 February 1974).

SCIENTIFIC AND TECHNICAL SUPPORT SUBDIVISION

K. S. Manchester

Introduction

The support required for the division's marine and field projects covers a broad range. In the early stages of project planning this involves equipment and technical personnel assignment and equipment acquisition, design and modification. In later stages of the project equipment and supplies must be assembled and loaded on the ship or transported to the field site. Ship fitting and modifications are carried out, liaison with other agencies established, and final equipment installations and calibrations are completed. During the operation, equipment has to be maintained and operated, special services such as seismic shooting, scuba diving, etc. provided, watch-keepers allocated, and data processed. Following the operation, equipment has to be dismantled, refurbished and prepared for storage, maintenance and overhaul, contracts raised, damaged equipment repaired or new equipment ordered, and data and samples classified and sent for analysis. This subdivision is responsible for a whole range of field support services as illustrated above.

The subdivision also has the continuing responsibility to maintain a central geoscience data file so that information is easily available, to curate all samples collected, and maintain and publish data indexes and sample inventories. The subdivision is actively engaged in planning all field projects and in carrying out instrument and methods developmental projects on request by division scientists. The subdivision also co-ordinates and arranges all AGC building construction and laboratory and office space allocation and facilities in co-operation with the other Bedford Institute Laboratories.

Activities

There has been a total of 1,063 man days at sea and in the field expended in support of AGC Geoscience projects by subdivision personnel. The ship projects were: 1. HUDSON, early April - mid July, Eastern Canada shelf and margin; 2. BAFFIN, mid May - mid June, multidiscipline survey, Gulf of St. Lawrence; 3. MINNA, mid June - mid October, multidiscipline survey, Grand Banks; 4. SACKVILLE, mid August - mid September, Labrador Shelf Project; 5. DAWSON, mid August - early October, Labrador Shelf Project; 6. DAWSON, mid November - end November, Grand Banks; and 7. HUDSON, mid February - end February, Caribbean, equipment test and development cruise.

There were numerous field projects supported, the major one being the Canso project in which a charter vessel, the VILMA L, was arranged for and equipped for work in the Strait of Canso area for forty-five days. A landing barge was equipped and transported to Minas Basin for a sediment dynamics study project during the June - August period. During the fall and winter a number of short duration (1 - 7 days) sampling operations in the Gulf of St. Lawrence area were supported.

The purchase and installation of two 600 sq. ft. office units was completed for EPG and a new 2400 sq. ft. geological sample storage building was designed and construction started with completion in June, 1974.

The Data Systems Section tested the HP2100 DOSM system and all production programs were converted to run on the new system. The system was used for processing and displaying marine geoscience data on this year's cruises. The geoscience data collected on all the AGC cruises was processed and entered in the Geofile Data Storage and Retrieval System.

A new EAI 430 flatbed plotter was acquired by AGC to replace the older EAI plotter. Display programs are now being developed and existing programs modified for use by the new plotter.

A computer based seismic data index system was set up for displaying the data in various ways. One file has data provided by R.M.C.B. and the other has all the data recorded by AGC.

An additional system has been added to the Geofile system for storing and displaying station data. This includes grab, dredge, sediment core, drill core, plankton tow and water sample station data.

Project 740007 has been started and a system for storing and retrieving well data information has been developed. One file is the index data containing information on drilling operations and performance of wells. The second one contains the geological data including the names, age and lithology of the geological formations encountered in each well.

Personnel Notes

Mr. B.D. Vardy, ENG-2, joined on May 22, 1973. Mr. B.F. Inkpen, EL-3, joined on January 22, 1974. Seven casual employees were hired for a total of 38 man months and one summer student was hired to work on the geological data systems.

Attendance at Meetings

K.S. Manchester

"Offshore Technology Conference", Houston, Texas, April 29 - May 3.

Completed Manuscripts

K.G. Shih

Shipboard Computer Systems for Processing and Displaying Bathymetric, Gravity and Magnetic Data at Sea. BIO Technical Report BI-R-73-13.

- and C.E. Keen, B.L. Johnston, M.J. Keen. Geophysical Data Collected in the Northwestern Atlantic Ocean. HUDSON 72-031. BIO Data Report BI-D-73-06.

- and K.S. Manchester. Visual Information on the Ocean Floor at the Mid-Atlantic Ridge near 45°N: An Application of Underwater Photography Data Storage and Retrieval System. BIO Data Report BI-D-73-09.

R. Sparkes

- and B.L. Johnston, D.L. Barrett. Bathymetric and Magnetic Data in Davis Strait, Lancaster Sound, and Jones Sound, Labrador, 65-022, BIO Data Report BI-D-73-04.

CENTRAL LABORATORIES AND TECHNICAL SERVICES DIVISION

J.A. Maxwell, Chief
R.J. Traill, Assistant Chief

The laboratories and staff of this Division provide chemical, mineralogical, instrumental and technical services, support and advice requested by Branch scientists and scientific projects. They also provide mineralogical information and advice to the public including the preparation of guidebooks and sets of representative rocks and minerals.

The activities of the Division largely involve the analysis and study of a wide variety of rocks and minerals, using techniques that range from classical wet chemical analysis to the use of the electron microprobe and the laser microprobe for the analysis of mineral grains. Proceeding hand-in-hand with the provision of services is a program of method and instrument development, adaptation and modification to ensure that the operations of the laboratories will be carried on in an efficient, advanced and scientifically reliable fashion. Back-up support to the Division and Branch includes mechanical and electronic design, adaptation and maintenance of existing and new scientific instrumentation. National Standards are served through the development and maintenance of the Reference Series of the National Mineral Collection, the National Meteorite Collection and the Branch ore collection. The chemical laboratories have taken a leading role in the international study and certification of rock and mineral standard samples.

The Division has played an active role for many years in aiding the efforts of the Department to encourage a greater interest in Canada's rock and mineral resources by Canadians, through the preparation and sale of sets of rocks and minerals, the free mineralogical examination of specimens submitted by the public and the preparation and publication of guidebooks for those Canadian mineral areas of most interest to amateur mineral collectors.

CENTRAL LABORATORIES AND TECHNICAL SERVICES DIVISION

J.A. Maxwell, Chief
R.J. Traill, Assistant Chief

Personnel Notes

Serge Courville returned to the chemical laboratories, to work on special analyses and method development.

Linda Seymour continued to work in the spectrographic laboratories. Jean Gravel and Richard Charbonneau left the chemical laboratories to return to their former posts in the Mineralogy Section.

Gary Vickers resigned his position in the chemical laboratories to return to university, and was replaced by René Guillas, who had been working as a casual employee for over a year.

William Rice, Maureen MacDonald and Vincent Clancy, of Algonquin College, and Keith Bottnell and Fred Morin, of Carleton University, worked in our laboratories as summer students.

Ahmed Hamud (from Somalia), Getachew Kifle Mariam (from Ethiopia) and Daw Lwin Lwin Kyan (from Burma) worked in our laboratories for varying periods as foreign trainees.

Dani di Credico worked here as a casual employee for a short period.

Elvira Gasparrini left the staff of the electron microprobe laboratory in December, 1973 to take up a position with the National Institute for Metallurgy in Johannesburg, South Africa.

André Cregheur took on supervisory responsibility for the Instrument Development Shop.

Gary Harrington terminated his employment in the Instrument Development Shop at the end of March.

O.L. Coté joined the Electronic Services and Equipment Development unit on March 25, to work on instrumentation servicing and development.

R. Upton worked with the unit during the summer to provide an excellent curve fitting program for the direct-reading optical emission spectrometer.

Marilyn McLean joined the Division as Secretary in July, but resigned in December. Maryann Petre continues to fill in admirably on a term casual basis.

J.A. Maxwell was appointed as both Branch and Sector Language Requirements Coordinator in August, and as Branch Liaison Officer with the Geological Survey of the Federal Republic of Germany in February.

Stephen Plummer assisted J.H. Lapp in the Division Office, May through August.

Attendance at Meetings, Conferences and Courses

J.L. Bouvier, W.H. Champ, K.A. Church, J.G. Sen Gupta, Sydney Abbey (Chairman of one session, Vice-Chairman of another)	:	Canadian Spectroscopy Symposium and International Conference on Atomic Spectroscopy, Toronto, October 29 - November 2.
M. Bonardi	:	Colloquium Spectroscopicum Internationale XVII, Florence, Italy, September.
E. Gasparrini	:	Canadian Electron Probe Users Group, Toronto, June 6.
G.R. Lachance	:	Canadian Electron Probe Users Group, Toronto, June 6.
		Canadian Spectroscopy Symposium, Toronto, November 1.
A.G. Plant	:	Canadian Spectroscopy Symposium, Toronto, November 1.
		Electron Probe Analysis Society of America Conference, New Orleans, August.
		Lunar Science Conference, Houston, March.
		French Language Training, Ottawa, 9 weeks, May - November - February.
H.R. Steacy	:	Tucson Gem and Mineral Show, Tucson, February.
Ann P. Stenson	:	MAC-GAC Annual Meeting, Saskatoon, May.
R.J. Traill	:	MSA-GSA Annual Meeting, Dallas, November.
G.A. Meilleur	:	International Machine Tool Exposition (IHA '73) in Hanover, Fed. Republic of Germany, September 19-21, followed by visits to manufacturers of machine tool equipment in Switzerland, France and England.
		Society of Manufacturing Engineers, Quarterly Meetings in Toronto/Montréal.
A.Y. Cregheur	:	Departmental training course on safety and fundamentals of accident prevention, November.

F.W. Jones : Annual Meeting, Institute of Electrical and Electronic Engineers, New York, March 26.

J.A. Maxwell : Coordinating Committee Training Course, Language Requirements of Positions, Algonquin College, July 16-20.

Geological Survey of the Federal Republic of Germany, Hanover, September 6-23, with visits to State Surveys in Freiburg and Krefeld, Preussac AG (Borkhöpen), the Technical University of Braunschweig and the University of Göttingen.

Special Talks or Lectures

J.G. Sen Gupta — The determination of noble and common metals in native gold by atomic absorption spectrometry. (At Canadian Spectroscopy Symposium and International Conference on Atomic Spectroscopy, Toronto, November)

A.G. Plant gave invited lectures on lunar mineralogy to the Ottawa Valley Mineral Association and the Ottawa Chapter of the Institute of Electrical Engineers.

H.R. Steacy acted as host to several groups visiting Logan Hall. He also addressed a meeting of the Ottawa Valley Mineral Association.

J.A. Maxwell spoke on the work of the CLTS Division to the staff of the Atlantic Geoscience Centre in January.

Membership on Committees

J.L. Bouvier : Ad hoc committee on selection of a new X-ray fluorescence spectrometer.

Serge Courville : Safety Officer, Central Laboratories and Technical Services Division.

Ad hoc committee on selection of a new X-ray fluorescence spectrometer.

J.G. Sen Gupta : Executive Committee, Ottawa Section, Spectroscopy Society of Canada.

Organizing Committee, Canadian Spectroscopy Symposium, Ottawa, October, 1974.

Sydney Abbey : Executive Committee, Canadian Certified Reference Materials Project.

Co-ordinator of Task Force on Rock Samples, Canadian Certified Reference Materials Project.

G.A. Meilleur	:	Branch Parking Committee.
A.G. Plant	:	Mineralogical Association of Canada representative on the International Mineralogical Association Committee for Cosmic Mineralogy.
G.R. Lachance	:	Branch Computer Services Committee. Chairman, ad hoc committee on selection of a new X-ray fluorescence spectrometer.
H.R. Steacy	:	Vice-President, Mineral Museums Advisory Council GAC representative on Youth Science Foundation. Branch Exhibits Committee.
Ann P. Stenson	:	Treasurer, Mineralogical Association of Canada.
R.J. Traill	:	Associate Committee on Meteorites, National Research Council. Branch Classification Evaluation Committee, Operational Category.
J.A. Maxwell	:	Departmental Co-ordinating Committee, Official Languages Requirements. Associate Committee on Meteorites, National Research Council. Branch Classification Evaluation Committee, Technical Category.

Analytical Chemistry Section Activities

Sydney Abbey, Head

General

It was a year of increased activity on all fronts. Output of analyses resulted in a pronounced reduction in the backlog of unfinished work. Encouraging progress was made on a number of new analytical techniques and reports on some were published. In the studies of proposed standard reference materials, much of the emphasis shifted from samples originating in other countries to those originating in Canada. Requests for information and visits between our laboratories and others increased considerably, the latter mainly as a result of the Fourth International Conference on Atomic Spectroscopy, held in Toronto at the end of October.

Among general improvements in all laboratories was the installation of new vibration-resistant balance tables, but operations were hampered by

interruptions in electric power and water supplies, and in the air-conditioning system. Painting of the laboratories not only disrupted productive work, but also produced some undesirable effects.

International Reference Samples

Again, our contributions to collaborative analysis of proposed international reference samples were limited by pressure of regular scientific support work. Samples were received from, and some collaborative analysis done for the Mines Branch, Ecole Polytechnique de Montréal, Ministère des richesses naturelles du Québec, Department of Mines, Resources and Environmental Management of Manitoba, and from similar institutions in France, East Germany, Czechosolvakia and Japan.

Under the Canadian Certified Reference Materials Project, a Task Force on Rock Samples was instituted with a view to providing acceptable compositional values on three proposed reference rocks - two syenites from the Bancroft area and a gabbro from Mount Royal. Collaboration was solicited from 90 laboratories all over the world. At this writing, nearly 60 laboratories, located in 20 different countries, have agreed to participate.

Consultations, Visits, etc.

Requests for advice and information on equipment, analytical methods and reference samples were received from four Canadian universities (Dalhousie, Ottawa, Queen's and Guelph), three provincial government agencies (New Brunswick, Québec, Manitoba), two Canadian commercial laboratories, a Canadian cement manufacturer and other institutions in the United States, Guyana and Argentina.

Visitors who toured our laboratories, and exchanged information with us, came from the Department of National Defence, seven Canadian universities and colleges (Algonquin, Carleton, Ottawa, Toronto, Laval, New Brunswick and Dalhousie), two provincial departments (Québec and British Columbia), and various groups in Great Britain, France, Norway, Czechoslovakia, Italy, Dahomey, India and Australia.

J.L. Bouvier spent some time installing and modifying equipment in the laboratories of the Geology Department at Dalhousie University. R.J. Traill (Mineralogy Section), W.H. Champ and Sydney Abbey visited the laboratories of the Geology Department of the University of Ottawa, in response to their request for advice on analytical equipment. In the course of personal travels, Sydney Abbey visited the laboratories of the Geological Survey of Israel and discussed problems with staff of the Hebrew University of Jerusalem and the Technion Institute in Haifa.

Chemical and X-ray Fluorescence Laboratories

Production Analysis

A large increase in the number of analyses completed was due mainly to an even greater increase in the number of determinations done by X-ray fluorescence. Coupled with a reduction in the number of samples received (compared to 1972-73), these increases led to a substantial reduction in the backlog of work.

Although more X-ray fluorescence analysis was possible than in the preceding year, the instrument continued to suffer breakdowns and to develop other defects, with the result that a firm decision was taken to replace it (see below).

Greatly increased use was made of the "neo-classical" analytical scheme, utilizing the two atomic absorption spectrophotometers. Difficulties developed with the apparent presence of impurities in the acetylene gas supply, a problem which appears to have been brought under control at this writing.

Method Development and Special Analyses

An ad hoc committee was appointed to study available replacements for the existing X-ray fluorescence spectrometer. Samples of typical rocks were distributed among those equipment manufacturers who expressed interest in attempting to analyse them. Results of these test analyses were examined and purchase of one type of instrument was recommended. Meanwhile, the X-ray analytical system in use was adapted for use either with mini-computer facilities in other laboratories, or with the main facilities at Departmental headquarters. A procedure was also worked out for preparing cast discs from sample fusions, for possible use with the new instrument.

The Govindaraju screw-rod technique was adapted to our larger atomic absorption instrument and applied to the determinations of potassium, rubidium, cesium and lithium.

The Karl Fischer titration method has been applied to the determination of water in rocks, using either induction heating or a conventional Penfield tube to extract the water.

Difficulties were finally overcome in the differential colorimetric determination of silica, as part of the lithium fluoborate analytical scheme. A workable procedure was developed and described in part of a publication (see below).

Developmental work was begun on methods for the determination of individual rare-earth elements, over a broad range of concentrations, in a variety of sample types. The final methods will probably involve chemical pre-concentration, followed by determination by a combination of atomic absorption, flame emission and X-ray fluorescence.

Spectrographic Laboratories

Production Analysis

Although analytical output was down from the preceding year, it was still sufficient to keep up with the demand, resulting in a significant drop in the already small backlog. Much of that backlog involves methods on which developmental work is required.

The initial sample weight was increased in order to minimize inhomogeneity effects, but some difficulties developed in adapting the changes to existing equipment. Problems also developed with inconsistencies in pre-weighed charges of buffers.

A "clean room" was installed for the preparation of synthetic standard mixes and other contamination-free work. A new water-cooling system was installed in the darkroom.

Method Development and Special Analyses

Output of the direct-reading spectrometer was adapted for data processing by means of either the on-line mini-computer or the main facilities at Departmental headquarters. Attempts at preparing synthetic standard mixes by automated or mechanized means yielded disappointing results. Plans are well advanced for revision and updating of the method for determination of volatile elements and the method for iron-base samples.

One sample of lunar rock from the Apollo 16 mission was analyzed.

Components were received for the installation of additional channels in the direct-reading spectrometer, with a view to extending the usefulness of that instrument.

A great deal of time was spent on the manuscript for a comprehensive description of analytical methods used in the laboratory.

Statistics

1. Samples Processed

	Chemical and XRF	Spectrographic
Carried from 1972-73	2,796	950
Received, 1973-74	2,021	2,199
	4,817	3,149
Completed, 1973-74	3,338	2,463
	1,479	686
Withdrawn, 1973-74	2	0

Divisional Breakdown of Backlog

CLTS Division	0	1
REG Division	1,398	503
RGG Division	70	162
Others	9	20
	1,477	686

2. Comparison with Preceding Year

	1972-73	1973-74
Samples Received		
Chemical and XRF	4,026	2,021
Spectrographic	3,532	2,199
Samples Completed		
Chemical and XRF	1,895	3,338
Spectrographic	3,523	2,463
Individual Spectrographic Analyses		
Qualitative	12	43
Semi-quantitative	26	61
Quantitative	3,933	3,095
Determinations		
Chemical	16,497	18,646
X-ray Fluorescence	4,848	26,400
Spectrographic (semi-quantitative)	1,153	1,660
(quantitative)	69,685	58,596
Spectrographic Exposures		
Photographic	4,372	3,097
Direct Reader	2,818	2,861

Mineralogy Section Activities

R.J. Traill, Head

Electron Probe Microanalysis (A.G. Plant, G.R. Lachance and Elvira Gasparrini)

There were 26 requisitions for analytical data in support of 18 Branch projects and 2 projects of the Earth Physics Branch. As in previous years, these ranged from the analysis of isolated mineral grains to the examination of complex assemblages. These bare statistics, however, do not reflect the progress that has been made during the past year. The appointment of an additional analyst in January 1973 and the success of the energy dispersive analysis (EDA) techniques have enabled the backlog of samples to be eliminated and account for a production of approximately 2500 silicate analyses, most of which are the average of 3-5 individual analyses. Each analysis includes determinations for the 10 elements: Na, Mg, Al, Si, K, Ca, Ti, Mn, Cu and Fe. R.A.F. Grieve (Earth Physics Branch), for example, has completed 950 analyses of pyroxenes, amphiboles, feldspars, olivines, biotites, spinels, garnets, glasses and broad beam bulk analyses in his study of the Mistastin impact crater.

Other laboratories are now purchasing or planning to purchase EDA systems, and we have had enquiries from university and industrial laboratories in Canada and the U.S.A., several of which are considered to be centres of excellence. G.R. Lachance described our technique in a paper given at the meeting of the Canadian Probe Users Group in Toronto in June 1973, and A.G. Plant gave presentations to the Geochemistry Branch, NASA, Houston (July, 1973), at the meeting of the Electron Probe Analysis Society of America in New Orleans (August 1973) and at the Canadian Spectroscopy Society Symposium in Toronto (November 1973).

Some studies were made on the application of EDA to the non-silicates, in particular, carbonates, spinels and the Fe, Co, Ni sulphides, but the interpretation of the spectrum of minerals containing elements of atomic number > 30 is considerably more complex than for silicates. Progress has been delayed by the resignation of Miss Gasparrini in December 1973 and by the transfer of G.R. Lachance to the XRF project on an almost full-time basis since October 1973.

Instrument malfunction and downtime have been almost negligible during the past year.

X-ray Diffraction and General Mineralogy (R.J. Traill, M. Bonardi, R.N. Delabio and G.J. Pringle)

The following data were provided in support of 40 Branch and 2 outside projects:

2,615 powder pattern identifications
41 mineral assemblages identified by diffractometer
44 pyrrhotite compositions by diffractometer
71 Gandolfi camera identifications
3 unit cell determinations

A technique was established for determining pyrrhotite compositions using a small powder sample and digital microdensitometer measurements. Thirteen standard pattern films were prepared and read on the microdensitometer. Two single crystals were oriented and photographed on the precession camera. A small sample of concrete aggregate was examined for the Department of Transport for evidence of expansive reaction. Twenty-four ceramic sherds excavated from the site of Fort Beauséjour were examined, described and compared for the National and Historic Parks Branch of the Department of Indian and Northern Affairs.

Frequent breakdowns of the laser microprobe and the need for optical re-alignment of the instrument hampered the analytical operations. Nevertheless about 100 emission spectra, including 65 standards for the elements, were obtained on photographic plates. Fifteen qualitative analyses were provided in support of Branch projects. Techniques for qualitative and semi-qualitative analyses of emission spectra on photographic plates were developed, using a computer-controlled microdensitometer.

A method of X-ray diffraction pattern recognition by laboratory computer was perfected using a magnetic tape file of our standard reference data. The computer program will be listed in our forthcoming catalogue of X-ray Diffraction Patterns and Specimen Mounts on file at the Geological Survey of Canada.

Clay mineral analyses were made on 45 samples. Mineralogical studies of 168 rocks and mineral concentrates from rocks were completed in support of the Branch age determination projects.

X-ray Fluorescence Analysis (G.R. Lachance and R.J. Gravel)

2,515 quantitative and 757 qualitative X-ray fluorescence analyses were made in direct support of 12 Branch projects, and indirectly in support of many others through provision of analyses of samples for age determination. The elements most commonly requested were Sr(938), Rb(850), Si(502) and K(123). Mr. C. de la Fuente of Ottawa University was given one week's instruction on XRF theory and operation.

Extraterrestrial Materials (R.J. Traill, A.G. Plant and H.R. Steacy)

A study of the mineralogy and petrology of a suite of lunar rocks and regolith samples from the Apollo 15 mission to the Hadley-Apennine region was completed, and comparison studies of samples from the Apollo 16 and 17 missions were started.

The National Meteorite Collection was improved by the addition of 18 specimens representing 14 meteorites. Of these, 13 were new to the Collection, raising the total representation to 333 different meteorites. Meteorite research was supported by the provision of 19 specimens to 9 institutions in Canada, United States and Japan. Thirteen specimens were loaned to the Museum of Natural Sciences for display. The meteorite pamphlet was revised and re-issued in the form of a poster. Several suspected meteorites were examined for the public.

Mineralogy for Rockhounds (Ann P. Stenson)

Two guidebooks in the series, "Rocks and Minerals for the Collector" were written and submitted for publication. The areas covered were Cobalt-Belleterre-Timmins and Kirkland Lake-Val d'Or. During the summer, field work was completed in the Magdalen Islands and Newfoundland and the data gathered at that time, together with subsequent laboratory studies, are being incorporated in a guidebook scheduled for completion in 1974. Forty-five requests from the public for specific information on mineral localities were answered.

Mineral and Ore Collections (H.R. Steacy and H.G. Ansell)

The Geological Survey's collections of minerals and ores were further improved by the addition of specimen material from Canada and abroad. Accessions to the mineral collection - the reference portion of Canada's National Mineral Collection - totalled 248, strengthening the collection's position as one of the finest reference collections in Canada and improving its assistance to Branch projects. The accessions included 17 species new to the collection, raising the total representation to about 1,670 species. Important Canadian accessions included the type specimens of the minerals berryite, caysichite, mattagamite, michenerite and tellurantimony. Additionally, a moderate amount of specimen material was collected from localities in Ontario and Québec for study and exchange. A major acquisition of the ore collection was the gift by the Mineral Resources Branch of some 550 ore samples from Canadian mines.

A reorganization and general overhaul of the mineral collection was completed during the report period. This included the regrouping of the silicates and the insertion of accumulated specimens and has put the collection in better working shape and thus increased its effectiveness. Office projects of the Geological Survey and applied programs of other government agencies and of universities and industry were assisted by the compliance with 69 individual requests for mineral and ore specimens. These involved the selection and provision of 430 specimens. The time required to fill each request varied, but ranged up to more than a day. Additionally, 77 specimens were provided on long loan to the National Museum of Natural Sciences for display use in their Hall of Geology.

The general public was assisted by Mr. Ansell's examination of 355 specimens, with the results being incorporated in 136 individual reports mailed to the submitters. Also, verbal identifications and casual assistance were provided from time to time to Survey officers and to the public. A larger portion of project time than heretofore was devoted to studies of new and unusual minerals and associations. Mr. Steacy continued to provide mineralogical assistance to the Survey's uranium program, and for seven days was occupied with field and laboratory studies on a confidential project (reports on file). Messrs. Ansell and Steacy visited the Smithsonian Institute, Washington, to study the methods employed there in computerizing their mineral collections, with a view to implementing a similar program here.

Mineral Sets Preparation Unit

J.M. Larose, J. Turpin, T.H. Racine and D. Robertson prepared and shipped 7,528 Prospector's Sets of Rock and Mineral Chips. The distribution of these throughout Canada was as follows:

Alberta	957
British Columbia	1,443
Manitoba	50
New Brunswick	264
Newfoundland	100
Nova Scotia	355
Northwest Territories	156
Ontario	1,336
Prince Edward Island	16
Québec	885
Saskatchewan	581
Yukon	540
Ottawa Office	659
Minister's Office	12
Others	174

Sales of the 120-specimen collection of minerals, rocks, ores and fuels representing the raw materials of the Canadian mineral industry amounted to 286. A collection of 80 samples of minerals, rocks, ores and fuels was prepared for Mr. R.B. Code, Senior Personnel Adviser, EMR. A large boulder of jasper conglomerate was collected for the Ministry of State for Science and Technology to be mounted and presented at the diplomatic level to the International Institute for Applied Systems Analysis in Austria. At the request of the National Film Board, 100 special collections were supplied

to accompany Earth Sciences film-strip kits.

From May 15 to October 15, more than 31 tons of rocks, minerals, ores and fossils used in various collections produced by the Geological Survey of Canada were collected from 80 localities in Newfoundland, Nova Scotia, New Brunswick, Québec, and Ontario. Over 16,000 miles were covered. During the field season, Mr. Larose was ably assisted by Mr. B. Machin from the Mineral Separation Unit. The total revenue from the sale of sets and collections amounted to $22,506.

Mineral Separating Unit

J.C. Paris, B. Machin, R. Charbonneau, A. Brown and M. Huot processed 4,835 samples and prepared 407 concentrates of minerals. These services were used directly by 12 Branch projects and indirectly by all projects serviced by the Analytical Chemistry and Geochronology Sections. The following numbers of operations were performed: crushing, grinding and sizing - 4,829; heavy liquid separations - 2,364; Frantz magnetic separations - 1,427; Carpco magnetic separations - 986; Stearns magnetic separations - 4; Superpanner separations - 692; and Wilfley Table separations - 85. A series of tests were made to evaluate an Australian-made Ledir Multi-Mill on loan from the Fisher Scientific Company. Information was furnished and assistance rendered to the following organizations: Mines Branch, Ottawa; Ontario Department of Mines; Manitoba Department of Mines.

Mechanical Services and Instrument Development Shop Activities

G.A. Meilleur, Head

During 1973-74, the section continued to organize and provide scientific support to the Branch in such areas as mechanical engineering, drafting, fabrication, inspection, maintenance of instruments and equipment, as required in support of both laboratory and field projects.

The demand for the construction and development of laboratory equipment, along with the design and fabrication of field equipment, has maintained a growth percentage which is comparable to that of previous years, thus maintaining a persistent backlog of work which is not being processed and completed in time to provide the full efficiency and achievement expected. It was necessary to establish a priority list of work to be done.

Summary of Work Orders

REG Division	40%
RGG Division	24%
CLTS Division	21%
TS Division	7%
GIP Division	6%
Others	2%

The following is a partial list of development work which was carried on during the year:

- completion of a high-pressure vessel fabricated from a super nickel

alloy R-41 specially developed for severe high temperature and high pressure applications (Dr. Currie);

- work on the development of new components required to study physical properties of rock and other materials (e.g. electrical conductivity) (Dr. Katsube);

- fabrication of new components for atomic absorption spectrometers (J.-L. Bouvier);

- fabrication, modification and repair of instrumentation for age determination, such as mass spectrometers, including major vacuum system modifications (Dr. Wanless);

- design and development of a number of pieces of measuring and sampling equipment intended for specific field applications.

Electronic Services and Equipment Development Activities

F.W. Jones, Head

The laboratory instrumentation throughout the CLTS Division is now ninety per cent of solid state design and this year has shown a marked decrease in time and cost of servicing. A further improvement can still be made, however, if care is taken when purchasing new equipment to ensure either the availability of local service and parts or, at least when purchases are made in the U.S.A., that the suppliers can provide price lists of available replacement parts and service information at the time of purchase.

A Nova 1220 computer was purchased for the Jarrell-Ash direct reading spectrometer and the phase 1 stage of installation has been completed, which includes a curve fit program for twenty-two elements. A completely automatic (computer-controlled) scanning system has also been built and tested in operation with twenty-four channels. This scanner will not be put into use in its present form, however, as the direct reader is being modified to cover more channels and at least a thirty-two channel scanner will ultimately be required. This has been a major item of development work.

The Nova 1200 computer in Room 661 (electronic service laboratory) has been in full use and much experience has been gained in interface techniques. It has also been used by staff from the Analytical Chemistry Section for running Basic Language programs. A certain amount of time is made available on this computer to aid in training with Basic and also for staff especially concerned with Datagen assembly language programming.

Completed Manuscripts

The following manuscripts were accepted and approved by the Division:

J.G. Sen Gupta: Analysis of native gold by atomic absorption spectrometry. Anal. Chim. Acta.

Hogarth, D.D., Chao, G.Y., Plant, A.G. and Steacy, H.R.
: Caysichite, a new silico-carbonate of yttrium and calcium. Can. Mineral., v. 12.

Steacy, H.R., Plant, A.G., and Boyle, R.W.
: Brannerite associated with native gold at the Richardson Mine, Ontario. Can. Mineral., v. 12.

In addition to the above, the scientific staff of the Division had 8 manuscripts published in the GSC Paper Series, and 4 manuscripts in outside journals.

GEOLOGICAL INFORMATION PROCESSING DIVISION

Peter Harker

Introduction

Successful completion of research in any field requires the communication of the results to those who need to make use of them. It also requires means of storing all the associated information necessary for an active research program. Such are the basic responsibilities of the Geological Information Processing Division which plays an important role in support of the objectives of the Geological Survey of Canada.

By acting as the publishing arm of the Geological Survey, the division offers a comprehensive in-house publication program comprising Memoirs, Bulletins, Economic Geology Reports, Miscellaneous Reports, Papers and various categories of maps. All have a long publication record and are firmly established in the world literature of the earth sciences. During the year more than 90 printed reports were issued, ranging from a few pages to several hundred pages in length, many of them extensively illustrated with photographs, text figures and maps. In addition, some 50 geological maps were published, more than half of them in full colour. 400 geophysical maps were issued and a further 300 were published by the Survey as the results of overseas operations funded by the Canadian International Development Agency. A complete change of format was introduced during the year for printed reports; the larger pages accommodate more text and larger text figures. Aside from advantages in production, this will help to offset ever rising publication costs. Many reports and maps are placed on open file at the principal offices of the Survey as this is the fastest way of placing results in the hands of the user. Open files may anticipate formal publication; they may also be used for large and bulky data compilations not normally published by other means. 76 open files were released during the year. The Survey publication program encourages publication in scientific journals; 123 papers were published in this way constituting a significant part of the total research output and complementing the in-house program.

Maps and illustrations for reports are prepared by the Geological Cartography Section which provides a comprehensive service to the branch. In addition to the preparation of edited manuscript material for printing as multicoloured final maps, uncoloured preliminary maps and figure illustrations, the Section - with its well equipped Photomechanical Unit - provides base maps on which field officers plot and compile their data and prepare manuscript geological maps. The section also performs a great variety of drafting, display and reproduction services for the branch.

In cooperation with Surveys and Mapping Branch, a pilot project in auto-cartography has been initiated; a nucleus of staff has been trained in digitizing and a digitizer and associated equipment has been acquired. The principal advantage of automation in geological cartography is in the production of colour separations, a difficult and laborious task with complex multi-coloured maps. One experimental map was prepared and printed during the year as a preliminary to the drafting of the 1:1,000,000 series maps by automated methods. The computer programming requirements for geological maps are more complex than for topographic maps and further development work is required before full advantages can be taken of the new technology.

All maps and reports are released through the Publications Distribution Section and a monthly information circular announcing all publications and open files is mailed to several thousand addresses in Canada, the United States and overseas. Over the counter sales facilities are maintained in Ottawa, Calgary and Vancouver.

The Library of the Geological Survey is the principal earth science data base for the branch and it contains a large and nationally important collection of books and periodicals on geology and related sciences, occupying more than two miles of shelving. It comprises over 125,000 volumes as well as a number of microfilms and microfiche. As a result of long standing exchanges with foreign scientific institutes, many unique sets of serials are held. An extensive map library is part of the main library and there are branch libraries at Dartmouth, Calgary and Vancouver. In addition to providing a bibliographic service for the research program of the Survey, its resources are used by the scientific community at large and over 6,000 interlibrary loans were processed during the course of the year. The Library is responsible for release of information on open file, for the operation of several data files, for data storage and retrieval and for keypunching into the Departmental computer system as a service to branch scientists. It also provides the data base for a computerized information dissemination service (CAN/SDI) operated in cooperation with the National Science Library.

The division provides geoscience information on a wide variety of topics through a technical enquiries telephone listing and by correspondence, and on many occasions the division staff form the first contact between the Department and the enquiring public.

Personnel Notes

Mr. L. P. St. Pierre left this division to join Surveys and Mapping Branch, and Mr. Yvon Claude is our new Administrative Officer.

Courses, Meetings, Conferences

P. Harker attended the Association of Earth Sciences Editors' Annual Meeting, held in Ottawa.

P. Harker passed LKE (French) at level appropriate to position.

Membership on Committees

P. Harker
- GSC History Committee
- Chairman, Departmental Committee on Scientific and Technical Information
- Departmental representative on NRC Committee on Scientific and Technical Information
- Principal adviser to Treasury Board negotiations for Physical Sciences Group and co-signer of the final contract.

SCIENTIFIC EDITING

R. G. Blackadar

The accompanying table shows the volume of work processed during the report period. No backlog of unedited manuscripts exists either in this office or in the hands of the two scientific editors who work in the Institute of Sedimentary and Petroleum Geology and the Terrain Sciences Division. As noted in previous reports, those delays that do occur are in areas over which we have little or no control, namely printing of texts and printing of maps.

During the report period it was decided to use a larger format for most of our publications. Commencing with Paper 74-1, Part A, Report of Activities, April to October 1973, an 8½- by 11-inch page size was adopted. This permits two columns of type and larger illustrations, thereby increasing significantly the number of words per page and reducing somewhat the need for pocket illustrations. The introduction of magnetic card typewriters for use in preparing printer's copy for our Paper Series reports (and some bulletins) has added to the already high quality of work produced by members of the Secretarial Services Unit. The greater flexibility possible with the new format has been well received by the scientific staff. This was well illustrated by the large increase in the number and size of the reports submitted, both for Paper 74-1, Pt. A and more surprisingly for Paper 74-1, Pt. B, the companion volume which was being processed as this report was being compiled.

Mrs. M. J. Connelly (formerly Miss M. J. McLean) resigned from her position of editorial assistant. Mrs. J. Copeland was transferred from her position in the Library to assist in the editorial work.

Talks or Lectures

R. G. Blackadar attended the October 1-3 Annual Meeting of the Association of Earth Science Editors and presented a paper, "Publication Procedures at the Geological Survey of Canada".

Membership on Committees

R. G. Blackadar - GSC History Committee

- EMR Scientific and Technical Information Committee

STATUS OF GEOLOGICAL MANUSCRIPTS ON MARCH 31, 1974
WITH COMPARABLE FIGURES FOR 1971-72 and 1972-73

Type of Report	In Process[1]			Published During Year		
	73-74	72-73	71-72	73-74	72-73	71-72
Memoirs	6	13	11	7	2	6
Bulletins	25	20	11	10	8	22
Economic Geology Reports	2	2	2	1	1	1
Miscellaneous Reports	3	0	0	0	4	0
Multicolour Maps	32	11	30	26	32	31
P. S. Maps	4	9	10	20	16	19
Papers	33	42	30	57	44	59
Open File Reports	0	0	0	59	56	31

[1] Includes I.S.P.G. and T.S. editorial units

GEOLOGICAL CARTOGRAPHY SECTION

E. P. Nunn

PERSONNEL

Total 58 positions.

Mr. K. Bencik resigned to accept a position with the Regional and Economic Geology Division. Mr. R. Allard and Mr. R.G. Lewis were added to the staff as draftsmen at the DD 1 level. Mrs. M. de la Fontaine was made permanent during 1973.

Mr. C.E. McNeil, Superintendent of Cartography retired as of November 1, 1973.

Mr. C.E. McNeil took part in a panel discussion on Canadian Mapping at a meeting of the Ottawa area unit of the Association of Canadian Map Libraries on May 10, 1973.

MEMBERSHIP ON COMMITTEES

C.E. McNeil	- Member, Classification Evaluation Committee - Member, E.M. & R. Advisory Board of Draftsmen and Compilers
J.B.F. Williams	- Board of Directors, Ontario Institute of Chartered Cartographers
J.G.E. Gagnon	- Member, Cartography Suggestions Award Sub Committee
B. Mainville	- Member, Cartography Suggestions Award Sub Committee

PRODUCTION DATA

Maps and illustrations completed by the Cartography Section:

	1972-73	1973-74
Multicoloured geological maps	29	26
Preliminary geological maps	37	28
Figure illustrations (pocket)	101	51
Figure illustrations (page)	233	299
Multicoloured maps reprinted	15	14
Preliminary maps reprinted	11	14
Aeromagnetic maps reprinted	145	127
Indexes to Publications revised	25	10

Miscellaneous drafting totalled 216 illustrations and 83 slides. Miscellaneous jobs such as plotting projections, assembling base maps, preparing open file items, preparing displays etc. along with the miscellaneous drafting accounted for approximately 25% of our total man year.

Maps and illustrations in progress at the end of fiscal year:

	1972-73	1973-74
Multicoloured geological maps	26	32
Preliminary geological maps	9	4
Figure illustrations	213	254

Maps and illustrations received, 1973-74:

Multicoloured geological maps	14	32
Preliminary geological maps	34	23
Figure illustrations	348	398

Work completed in Photomechanical Unit:

Mapping Camera	1972-73	1973-74
Film negatives and positives	8,729	8,183
Contact Processes		
Film negatives and positives	16,098	17,598
Colour keys on film	892	1,085
Peelcoats	389	273
Scribetches	41	47
Colour proofs	92	72
Whiteprints	13,790	5,810
Xerox prints	311,638	222,438

LIBRARY SERVICES

Mrs. D. M. Sutherland

Statistics

I Acquisitions (received by purchase, exchange or gift)

Periodicals and serials	18,394
Books	656
Maps	894
CTF Reports	500
Open Files	56

II Circulation

(a) Loans

Books, periodicals, etc. to GSC staff	25,501
To individuals other than GSC staff	3,153
To other libraries	1,400
Articles Xeroxed in lieu of loan	3,040
Books borrowed or Xeroxed, obtained from other libraries for use of staff	525
Maps	750
CTF Reports	225

(b) Open files examined 237

(c) Registrations (Borrowers who registered during this fiscal year):

Government officials	136
Industry	39
University (professors and students):	
Carleton	53
Ottawa	51
Others	15

III Cataloguing

Books, periodicals, serials	993
Analytics	1,388
Maps	398

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Library Statistics - Continued

IV Clerical

Letters		528	
Catalogue cards printed		20,000	(approx)
Pages Xeroxed		86,310	
Requisitions and purchase orders - for library		953	
" " " " - " divisions		61	
Total subscriptions - for library		859	
- " divisions		17	

V Reference and Interlibrary Loans

Library enquiries (estimate)		8,736
CTF enquiries		131
Interlibrary loan requests received:		
by form	4,222	
by telex or letter	1,084	
by telephone	1,270	6,576

VI Translations

Prepared by Secretary of State Dept.	102	
Photocopies sold	193	

VII Data Processing Unit

Cards punched by DPU staff	286,896	
" " " GSC users	181,895	
Retrievals from GEODAT file	53	
Analyses entered into GEODAT file	4,843	
Data sets processed	221	(7 months)

VIII CAN/SDI Unit

Requests for Information	82
Total GEOREF Profiles	140
Total Profiles Coordinated by the GSC Search Centre	168

Personnel

Two students were hired in the summer and one casual staff member for three months in the winter to assist in the library during the absence of permanent staff and to carry out special tasks.

Mr. B. Butler resigned in January and a temporary clerk was hired until staffing could be completed. Mrs. J. Copeland was transferred to the editorial office of the division in February.

Miss Mary LaHam joined the staff as CAN/SDI search editor.

Attendance at Meetings

D. M. Sutherland — Geological Information Society Annual Meeting, Dallas, November 1973.

M. LaHam — Annual Meeting, Geological Survey of America, Dallas, November 1973. The purpose of the trip, sponsored by the Association, was to interview participants in a G.S.A. Pilot project using GSC's GEO/REF facilities.

Special Libraries Association workshop entitled, "Naming to Networks" held at Sir George Williams University in Montreal for one day in January and one day in February, 1974. These sessions involved librarians occupied with mechanized information storage and retrieval.

A trip to Calgary in March 1974 permitted visits to the Institute of Sedimentary and Petroleum Geology, the University of Calgary and an informal meeting of petroleum librarians. By extending the journey to Vancouver, Miss LaHam was able to visit the GSC office there as well as the University of British Columbia. In all cases the main purpose of the discussions was the extension of information among scientists and librarians about GEO/REF.

In addition, monthly meetings of the Heads of CAN/SDI Search Centres are held. Participating organizations are GSC, National Science Library, National Library and Agriculture Canada.

Since CAN/SDI is a cooperative venture, participation has called for involvement in two-day Search Editor seminars sponsored by the National Science Library to acquaint librarians and other users with the CAN/SDI system.

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Library Services - Continued

Special Talks

D. M. Sutherland	"Geoscience document distribution in Canada", presented at G.I.S. meeting in Dallas.

Membership on Committees

D. M. Sutherland	Member of Branch Computer Facilities Committees
	" " Standing Committee of Chief Librarians of Energy Mines and Resources.
M. LaHam	Conferee - G.S.A. Ad Hoc Study Group on Bibliographic Information Dissemination.

PUBLICATIONS DISTRIBUTION OFFICE

J. L. L. Touchette

The following publications were received and made available for distribution during the year:

Economic Geology Series	1
Economic Geology Series (reprinted)	2
Memoirs	7
Memoirs (reprinted)	5
Bulletins	10
Preliminary Papers	57
Preliminary Papers (reprinted)	5
Miscellaneous Geology	16
Open Files	3
Departmental Annual Reports (2 E, 1 F)	3
Misc. Report Series (reprinted)	2
Maps - "A" Series	26
Maps - "A" Series (reprinted)	13
Preliminary Maps	20
Preliminary Maps (reprinted)	11
Aeromagnetic Maps	409
Aeromagnetic Maps (reprinted)	103
Aeromagnetic Maps - foreign	308
Indices to GSC Maps (revised)	10
Indices to Aeromagnetic Maps (revised)	4

Distribution Data

Maps	148,135
Reports	81,312
Indices, listings, pamphlets, etc.	42,288
Total distribution (free & paid)	271,735

Publications Distribution - Continued

Other Data

Requests for information, publications, rock and mineral sets	18,391	
Visitors (Cash sales 1,673 Others 3,048	4,721	
Notification Lists	31	
Total publications advertised	549	

Revenue

Cash received from sales of reports, maps, rock and mineral sets, photographs, etc.		$ 80,189.21
Sales charged to deposit accounts	$ 14,709.43	
Rock sets and publications supplied to Sales Offices:		
Calgary	49,787.35	
Vancouver	42,812.50	
Quebec	3,480.82	
Yellowknife	6,468.00	
Whitehorse	5,476.50	122,734.60
TOTAL SALES VALUE		$202,923.81

PHOTOGRAPHIC SERVICES

J. W. Kempt

During the course of the 1973-74 fiscal year, we have been required to provide more slides and duplicates than in previous years for seminar presentation. The time allowed us to complete these assignments becomes increasingly shorter. Work presented must arrive at least three days ahead of deadlines.

There is also a great increase in the number of colour slides given to us for black and white negatives and prints. This is due to field personnel through facility restricting themselves to one camera and one type of film.

Requisitioned processing is another type of work that is on the increase. Due to the workload on the colour laboratory, this is being sent out to commercial firms at the present time.

Personnel Changes

Mr. Charles H. Skuce retired after 12 years of service.

We have added two new members to our staff:

Mr. Blayne Chapman has come to us from "Historic Sites" and is actively pursuing academic qualifications at Algonquin College with extension courses.

Mr. Carl Hodge has arrived from London, Ontario, after graduation in Photographic Arts from Sheridan College in Toronto.

Both are interested in their work, excellent workers and are a distinct asset to our Section.

G.S.C. Photographic Section
Production Report

1973 - 1974

Photographs Produced	B/W Negs	Colour Negs	Colour Transp.	Totals Exposed
Equip't-labs-Portraits-Passport	192			192
Con. tone-maps-charts	1355		2093	3448
Line copies	939			939
Rock&mineral Specimens	146		105	251
Fossil&Macro fossil Specimens	2506			2506
Macro-Micro-Thin&Polished Spec.	1062		60	1122
Auto-Radiographs	262			262
Req. Processing B&W Rolls / Col. Rolls	592		1560	
Field Photos. B&W Rolls / Col. Rolls	5703	180	3108	
Total Processed	12165	180	5365	8719

Prints&Enlargements	Exposed	Processed	Dried	Totals
Black&White	31948	31948	31948	
Colour				
	31948	31948	31948	95844

Prints&Enlargements Numbered&Stamped	31948	
Prints&Enlargements to outside Agencies	744	
Colour Slides	2893	
B&W Slides	675	
Slides mounted	4216	
Negatives Opaqued	1210	
Negatives retouched	50	
Prints spotted	100	
SUB/TOTALS:	41836	68265

By Government Photo Centre		
By Commercial Photo Services	Prints & Enlargements	2341
	Grand total	166450

(J.W.Kempt)
Supervisor
May 23, 1974

INSTITUTE OF SEDIMENTARY AND PETROLEUM GEOLOGY

D. F. Stott

INTRODUCTION

The Institute of Sedimentary and Petroleum Geology is responsible for the description and interpretation of the bedrock geology of the western Canada and Arctic sedimentary basins. Its area of responsibility lies between the Canadian Shield and the Rocky Mountain Trench and between the 49th Parallel up to and including the Arctic Archipelago. The division's programs, in addition to contributing to geoscience surveys, standards, controls, and references, provide geological information related to the occurrence of hydrocarbons, coal and other minerals, and are directed toward the exploration for, development and assessment of those resources.

Most of the mainland area for which the Institute has responsibility has been mapped at a scale of 1:250,000; many areas in the Foothills and Rocky Mountains have been mapped at 1:50,000. Reconnaissance maps, mainly at a scale of 1:1,000,000, are available for all of the Arctic Islands; maps of parts of the western islands have been published at 1:500,000; much of the Queen Elizabeth Islands, Axel Heiberg Island, and significant parts of Ellesmere Island are now mapped at 1:250,000. Upgrading of maps in other areas is continuing. In addition to the geological maps, many detailed reports have been published on various aspects of sedimentary geology.

Geological techniques and methodology are being developed for the determination of potential hydrocarbon reserves. Potential resource data on petroleum and gas was provided for the department report "An Energy Policy for Canada - Phase I". Resource evaluation is an on-going exercise and the resource data is being revised regularly. Related research in geochemistry, geophysics, clay chemistry and mineralogy is directed toward the determination of the presence or absence of petroleum source rock, degree of thermal alteration, depth of burial, and other parameters related to the development and accumulation of hydrocarbons and migration of fluids within sedimentary rocks. Data obtained from boreholes drilled throughout the Arctic Archipelago and northern mainland region will continue to be compiled and a synthesis of total geology prepared. At present, the Mackenzie Delta, Beaufort Sea, and Sverdrup Basin are important regions for long-term, multidisciplinary investigations because of recent discoveries of oil and gas.

Investigations related to other minerals such as lead, zinc, and copper are becoming of increasing importance in the Yukon and Northwest Territories. The recognition of the relationships of mineralization to the carbonate-shale facies opens vast areas in the eastern Cordillera and Arctic Islands for exploration.

Coal is once again assuming an important place in Canada's energy resources, and increasing emphasis is being given to the determination of potential reserves, quality, and distribution. A joint federal-provincial drilling program, undertaken in Saskatchewan during the last two years, has outlined areas of significant seam development and permitted better estimates to be made of the total coal resources.

Research in paleontology and biostratigraphy forms a major component of the Institute's activities. Such investigations provide standards, controls, and reference materials to ensure consistent terminology, description, and correlation for the systematic and uniform presentation of geology.

The activities of the Institute are supported by the maintenance of capabilities and facilities in scientific editing, cartography, technical photography, and library services. A distribution office sells departmental publications and maps, and also serves as a western outlet of the National Air Photo Library.

In addition to its research responsibilities, the Institute is responsible for the custody of drilling cores, samples, and other data resulting from both onshore and offshore exploration activities by industry in Yukon Territory, Northwest Territories, including the Arctic Islands, and for samples from all provinces and continental shelves of western Canada. Some 8 million samples are stored at the Institute, and this number increases by about 300,000 each year. With the exception of samples from wells in Alberta, all are available to the public for free examination. Files are maintained of all the logs and other data related to the more than 50,000 wells drilled in western and Arctic Canada.

The Institute building houses, in addition to the Division's staff, units from other divisions and branches of the Department of Energy, Mines and Resources. These include members of the Terrain Sciences Division, the Mining Research Centre of the Mines Branch, and the field office of the National Energy Board. The Institute also provides services to the Western Research Section of the Hydrologic Sciences Division of the Department of the Environment.

A major expansion of existing facilities, completed during the summer at a cost of 1.6 million dollars, added a total of more than 30,000 square feet of usable space to the Institute building. Two main wings, those containing (1) the research facilities and (2) publications distribution and library, were extended. The exteriors of these match that of the original building. The enlargement of the publications distribution area provides an additional 2,800 square feet of storage area and an attractive public and office area on the main floor, plus 1,780 square feet of basement storage. A separate entrance permits the public to gain access to the distribution office without having to enter the main laboratory building. The relocation of the airphoto examination facilities to this area permitted the expansion of cartography and development of a confidential file

and project area for energy assessment. Library stack space was increased by 1,940 square feet or approximately 100 per cent, and an office for the librarian was included. In the research wing, thirty-two new offices were added and the net usable space for laboratories and project rooms increased by 6,240 square feet. New storage areas developed in the basement provide 10,720 square feet of space. This expansion allowed the relocation of several laboratories from the original building, thereby freeing areas for renovations and enlargement of existing laboratory facilities.

Personnel Notes

Dr. D. J. McLaren, Director of the Institute since its inception in 1967, was appointed Director of the Geological Survey of Canada in June, 1973. When he left Calgary to take up his new duties in Ottawa, Dr. D. F. Stott took over the leadership of the Institute as Acting Director.

Dr. Stott, former Head of the Regional Geology Subdivision, was appointed Director of the Institute of Sedimentary and Petroleum Geology, Calgary, on September 4, 1973.

Attendance at Meetings, Conferences and Courses

D. F. Stott

Canadian Institute of Mining and Metallurgy, 75th Annual General Meeting, Vancouver, British Columbia, April 15-17, 1973.

Geological Association of Canada Annual Meeting, Saskatoon, Saskatchewan, May 23-26, 1973.

Field Seminar, Arctic Pipeline Testing Sites, Canadian Gas Study Limited, August 7-9, 1973.

Oil Sands Symposium, Canadian Society of Petroleum Geologists, Fort McMurray, Alberta, September 8-9, 1973.

Oil and Gas Forum, Department of Indian Affairs and Northern Development and Department of Energy, Mines and Resources, Yellowknife, Northwest Territories, December 10-11, 1973.

Seminar on In-situ extraction techniques for Crude Oils, Jasper, Alberta, sponsored by Alberta Research Council and Alberta Department of Mines and Minerals, February 26-March 1, 1974.

Special Talks or Lectures

D. F. Stott

"Lower Cretaceous Coal Measures of west-central Alberta and northeastern British Columbia" to the Coal Section, Canadian Institute of Mining and Metallurgy, 75th Annual General Meeting, Vancouver, British Columbia, April 17, 1973.

"The Cretaceous System, northeastern British Columbia" to Colloquium on the Cretaceous, Geological Association of Canada, Annual Meeting, Saskatoon, Saskatchewan, May 24, 1973.

"Geological Survey of Canada's Operations in the Northern Territories" to Oil and Gas Forum, Department of Indian Affairs and Northern Development and Department of Energy, Mines and Resources, Yellowknife, Northwest Territories, December 10, 1973.

Membership on Committees

D. F. Stott

Member, Science Policy Committee, Canadian Society of Petroleum Geologists.

Institute Committees

Library Committee:

E. W. Bamber (Chairman)
R. Thorsteinsson
N. W. Rutter
M. Jones (Secretary)
R. W. Macqueen
T. G. Powell

Exhibits Committee:	D. W. Gibson (Chairman) A. R. Cameron W. P. Vermette E. J. W. Irish (ex officio) D. K. Norris
Nomenclature Committee:	R. W. Macqueen (Chairman) F. G. Young E. J. W. Irish (ex officio) A. R. Sweet
Committee on Clay Mineralogy and Geochemistry:	R. M. Procter (Chairman) A. E. Foscolos D. G. Cook Geochemistry Section Head
Committee on Curation of Rocks and Fossils:	J. D. Aitken (Chairman) E. W. Bamber K. J. Roy N. L. Ball W. S. Hopkins
Committee on Photography:	A. E. H. Pedder (Chairman) W. S. Hopkins G. R. Davies
Safety Committee:	B. A. Latour (Chairman) G. M. Peterkin M. Northcott T. F. Birmingham
Tour Committee:	L. L. Price (Chairman) A. D. Miall G. K. Williams
McConnell Club:	G. R. Davies (President) K. J. Roy (Secretary)

GEOLOGICAL INFORMATION SUBDIVISION

E. J. W. Irish

The Subdivision provides scientific editing as well as cartography, photography and library services for the Institute. It is responsible, also, for the distribution of publications of the Geological Survey and of other branches of the Department of Energy, Mines and Resources. A major activity is the processing for publication of all scientific manuscripts in order to promote and maintain high quality standards for reports

and maps presenting the results of the research of the Institute. After preparation, manuscripts are either forwarded to Ottawa for printing and publication in the appropriate report series of the Geological Survey or to the editorial staff of one of the scientific journals.

All maps and illustrations required by the Institute staff for publication by the Geological Survey, or in scientific journals and guidebooks, are prepared in the Cartographic Section; the work includes all drafting for black and white and multicolour illustrations as well as photomechanical and reproduction work. The unit also handles a large amount of miscellaneous drafting for slides, displays and open files.

A photographic laboratory provides general and specialized photographic services for the Institute staff.

All publications of the Geological Survey, publications west of the Canadian Shield of the Surveys and Mapping Branch, and various miscellaneous departmental publications are sold and distributed from the publications office. The unit includes, also, an order office of the National Air Photo Library. Aerial photographs may be viewed and ordered through this office.

From a small beginning, the library continues to grow and now contains an important collection of scientific books, journals and documents relating to the mission of the Institute. It serves the scientists in their research and also offers services to oil and mining company personnel, staff members of the University of Calgary, and the general public. Enquiries have not only increased in number, but in complexity, and the very excellence of the collection has placed heavy demands on the staff. The library also provides an outlet for the Geological Survey open file system, a valuable means of releasing data and information to the user public with the least possible delay.

During the fiscal year, expansion of both the I.S.P.G. Library and of the Distribution and Air Photo facilities was completed. Both units are now utilizing the extra space provided to the best advantage.

Additional space for the Photographic Section, now comprising two photographers, is presently under way.

Personnel Notes

During the year, Tina Matiisen resigned her position with the I.S.P.G. library to accept a position as librarian with the National Museums in Ottawa. June C. Graff and Margaret McKenzie joined the I.S.P.G. library staff as assistant librarian and library clerk respectively.

Clarence G. Elias joined the Cartographic Section in November, 1973, as a cartographic draftsman. One summer student was employed in the Photomechanical and reproduction unit from May until August, 1973. Two people

were given work under the winter works program from October, 1973 until the end of the fiscal year.

W. A. Rhoades resigned from Distribution and Air Photo Section in February, 1974 to accept a position with the Department of Lands and Forests, Alberta. His position has not been filled.

Bryan C. Rutley joined the Photography Section on April 1, 1974.

Attendance at Meetings, Conferences and Courses

D. A. Sime

Financial Accounting II, Southern Alberta Institute of Technology; April 3 to June 18, 1973.

Geology IB, Southern Alberta Institute of Technology; January 21 to April 8, 1974.

J. C. Graff

Search Editor's Course, Ottawa, Ontario; in connection with the CAN/SDI program at the National Science Library, Ottawa, October, 1973.

"An Introduction to Basic Programming"; a series of lectures held at the Institute in November, 1973.

Annual Meeting of the Foothills Library Association; Calgary, Alberta, April, 1974.

"Introductory physical and historical geology"; evening credit course at the University of Calgary, Calgary, Alberta.

M. McKenzie

"An Introduction to Basic Programming"; a series of lectures held at the Institute in November, 1973.

Annual Meeting of the Foothills Library Association; Calgary, Alberta, April, 1974.

Production Data (Manuscripts Processing)

1973 - 1974

Manuscripts processed and forwarded to printer

GSC Bulletins	7
GSC Memoirs	1
GSC Papers	8
Maps (A Series)	3
Outside Papers	5

Open File items initiated 17

Manuscripts being processed for publication

GSC Bulletins	6
GSC Memoirs	1
GSC Papers	6
Maps (A Series)	3
Outside Papers	0

Publications printed

GSC Bulletins	2
GSC Memoirs	1
GSC Papers	9
Maps (A Series)	5
Outside Papers	16

Geological Cartography Section

L. MacLachlan

Activities

The Section continues to be responsible for all the drafting of maps and illustrations required by the Institute staff for publication by the GSC and by various scientific journals and guidebooks throughout the world. A large amount of miscellaneous drafting is done of displays, special bases, slides, signs, forms, open file material, etc.

The drafting and photomechanical areas have both been expanded allowing more efficient operation and much needed layout and storage space. The addition of a "flip-top" type platemaker in the photomechanical areas has streamlined operations in that area to some extent but, the work load in the photomechanical area is so heavy that it has become necessary to hire casual help on a fulltime basis.

Production Data

Maps and figure illustrations prepared by the Cartographic Section and sent to Ottawa for printing during the period of April 1, 1973 to March 31, 1974:

	1972-1973	1973-1974
Multicoloured geological maps.....	8	5
Preliminary geological maps.....	0	0
Figure illustrations (page).....	345	327
Figure illustrations (pocket).....	40	46

Miscellaneous drafting - which took up approximately 25% of our total drafting time - amounted to 1,119 separate items including 257 slides and 65 illustrations for outside publications.

Manuscripts received	1972-1973	1973-1974
Multicoloured geological maps.....	4	2
Preliminary geological maps.....	0	0
Figure illustrations (page).....	368	174
Figure illustrations (pocket).....	15	24

Maps and illustrations in progress at March 31, 1974		
Multicoloured geological maps.....	3	2
Preliminary geological maps.....	0	0
Figure illustrations (page).....	187	71
Figure illustrations (pocket).....	13	21

Backlog of maps and illustrations in the Section		
Multicoloured geological maps.....	1	0
Preliminary geological maps.....	0	0
Figure illustrations (page).....	66	65
Figure illustrations (pocket).....	5	3

Reproduction services		
Diazo prints.....	5,950	5,859
Photostat prints.....	1,116	786

Photomechanical services		
Film (sheets, negative and positive)..	1,820	1,723
Drafting keys on scribe.....	56	62
Blueline on Cronaflex.....	155	257
Colour proofs.....	51	13
Peel coats.....	127	78
C1 prints.....	243	706
KC5 prints.....	294	776

Photographic Section

D. G. Lawrence

Activities

The section is responsible for providing all general and specialized photographic services for the Institute staff.

Production Data

	1973 - 1974
Total number of negatives produced.....	2,781
Total number of prints produced.....	9,103
Total number of 8" x 10" line negatives produced.....	387
Total number of colour negatives and prints.....	398
Total number of rolls (35 mm colour transparency film)..	110
Total number of rolls (35 mm black and white film).....	109
Total number of contact sheets for files.....	742
Total number slides mounted.....	450
Total number of GSC duplicate negatives produced.....	68
Total number of requisitions processed.....	398
Total operations for the 1973 - 1974 fiscal year	14,546

Publications and Air Photo Section

M. H. Brooks

Activities

All publications of the Geological Survey, publications of Surveys and Mapping Branch west of the Shield, gravity maps of the Earth Physics Branch and some miscellaneous Departmental publications continue to be distributed. The Section includes an order office of the National Air Photo Library; aerial photographs may be viewed and ordered through this office. Also, many informative brochures are available to the public.

Distribution Data

Office statistics	1972-1973	1973-1974
Visitors to office.....	4,100	4,316
Letters received.....	3,600	3,096
Telephone calls.....	8,640	9,100

Distribution

Year	Items Received	Items Sold	Value of Items Sold
1972 - 1973	88,381	45,463	$36,055.55
1973 - 1974	101,125	43,441	43,216.95

Breakdown of deposits by percentage: (percentages were changed every 4 months.)

	1972-1973	1973-1974
Surveys and Mapping	$ 9,910.13	$16,067.83
Mineral Resources	363.10	415.71
Rock Sets	497.84	989.27
GSC publications	16,304.09	16,933.19
GSC maps	9,223.79	7,191.09
Gravity maps	55.09	415.71
Total Receipts:	$36,354.04	$42,012.80

Breakdown of accounts	1972-1973	1973-1974
Credit sales	$18,382.70	$22,852.60
Cash sales	16,969.61	19,821.85
Received on account	19,384.43	22,750.80

Charge accounts not total 294.

I.S.P.G. Library

M. Jones

Activities

The library extension was completed in the spring of 1973 and, during the following summer, the entire collection was moved and re-shelved.

The number of scientists at the Institute increased substantially during the year. The changing emphasis of the research program necessitated acquiring material on energy resources on a world-wide basis, as well as literature on geochemistry and geophysics not previously held in the library. Thus, there were heavy demands on the library budget and on the acquisition and cataloguing routines.

A list of serial holdings in the library was completed and published in January, 1974. This was circulated to other government libraries, and to university and local industry libraries.

Considerable emphasis was placed on providing improved information services to the scientific staff. Participation in the GEOREF program increased and assistance was given to several staff members in compiling profiles and providing references generated by this program. Requests for information searches increased and several bibliographies were compiled at the request of the scientific staff.

A tour of the library and the Institute was held for about 30 local librarians in January, 1974.

Statistics

Acquisitions

Books, etc. acquired by purchase (excluding periodicals)	1,633
Books, etc. acquired by gift or exchange	4,000 est.

Circulation

Books and periodicals (to staff only)	13,313
Interlibrary loans	
Borrowed from GSC Ottawa	269
Borrowed from other libraries	330
Loaned	103
Xerox copies provided (through Riley's DataShare)	227

References

Books, periodicals, etc. consulted in library (by other than staff)	1,700
Inquiries (less than five minutes)	4,807
Information searches (more than five minutes)	2,470

PALEONTOLOGY SUBDIVISION

B. S. Norford

The Subdivision conducts scientific studies in paleontology and biostratigraphy in support of exploration for and assessment of the non-renewable resources of western and northern Canada. The program in closely co-ordinated with those of the other Subdivisions of the Institute, with similar programs of the Atlantic Geoscience Centre, the Regional and Economic Geology Division and with those of a number of universities in Canada, the United States, France and the United Kingdom. A significant and increasing portion of the program of the Subdivision in conducted by consulting companies and by university scientists.

The Subdivision presently consists of a permanent staff of fourteen scientists (including a vacancy), six technicians and a secretary, a number of temporary assistants (involving a total manpower of 4 man-years in 1973-1974), diverse paleontological laboratories and extensive reference collections of fossils. Three scientists are stationed in Ottawa where Dr. Frebold (retired) continues his distinguished career with the Survey. In addition, a postdoctoral fellow, three doctoral students and three E.M.R. Research Agreements were supported by the Subdivision.

In 1973, members of the Subdivision carried out field studies in the Districts of Franklin and Mackenzie, the Yukon Territory, Alberta, British Columbia and Manitoba. Such investigations and associated laboratory and office studies establish and refine models of biostratigraphic zonation and paleoenvironments for application throughout most of western and northern Canada.

A large component of the program involves dating, correlation and determination of depositional environments of rocks in the subsurface of northern Canada by means of detailed studies of macrofossils, palynomorphs and other microfossils recovered from the cores and cuttings derived from wells drilled in the Yukon and Northwest Territories in search of petroleum and natural gas. GSC Paper 74-11 was compiled in 1973, presenting data and scientific conclusions on 34 wells.

Manuscripts completed during the year include major monographs of international significance on the Triassic ammonoids of Canada and on the Carboniferous ammonoids and stratigraphy of the Arctic Islands. Both set finely calibrated standards for the biostratigraphic correlation of the Triassic and Carboniferous rocks of Canada.

Personnel Notes

W. V. Sliter resigned from the Survey in August and no appointment was made to his position during the year. T. T. Uyeno was appointed Head of the Micropaleontology Section in July. In August, S. Carbone and D. F. Haden respectively were assigned administrative and supervisory responsibilities for the Macropaleontology Laboratories and Curating Facilities and the Micropaleontological Laboratories. S. A. Pickering joined the Micropaleontological Laboratories in October and I. J. Garner joined the Subdivision office in December.

Dr. K. P. Bender completed the tenure of his postdoctoral fellowship during the year. H. M. Johnson completed Geology 595 (Palynology) at the University of Calgary and L. L. Ruddy, Geology 381 (Stratigraphy and Sedimentation) and Geology 391 (Paleontology).

Attendance at Meetings, Conventions and Courses

B. S. Norford

Geological Association of Canada - Canadian Society of Petroleum Geologists Meetings, Saskatoon, May 23-26, 1973.

North Atlantic Treaty Organization Symposium on evolution and morphology of the Trilobita, Trilobitoidea and Merostromata, Oslo, July 1-8, 1973.

Canadian Society of Petroleum Geologists Symposium on oil sands, Calgary, September 5-9, 1973.

Membership on Committees

B. S. Norford

Overseas Representative (Canada), Palaeontological Association.

Chairman, Paleontology Division, Canadian Society of Petroleum Geologists.

Manuscripts Completed

C. R. Barnes, B. S. Norford and others

"Biostratigraphic determinations of fossils from the subsurface of the Northwest and Yukon Territories"; Geol. Surv. Can., Paper 74-11, 28 p., 6 textfigs.

Macropaleontology Laboratories and Curating Facilities

S. Carbone
R. D. Michie

Curating Facilities

The functions of the curating office include the recording of all geological and geographical data relating to individual fossil collections, the proper storage and retrieval of these samples and the maintenance of routine office procedures. Approximately 6,000 new collections were recorded and stored in the past year. One hundred and fifty parcels of fossils were shipped and received.

The office also is responsible for curating surface and subsurface palynological and micropaleontological samples processed both within and outside the I.S.P.G. Macrofossils extracted from well cores together with the previously mentioned material are made available to outside concerns, notably the oil exploration companies. A complete list of all subsurface paleontological material is periodically compiled and made available to the public. In the past year over 25 requests from organizations and private interests who wished to examine several thousand prepared microfossil slides were attended to by this office.

Production Statistics

The macropaleontology laboratories provide services that prepare fossils for study. One of the main functions of the laboratories is to produce precisely oriented thin-sections showing the internal structures of fossils. Over 2,000 sections of corals, fusulinids and smaller foraminifers were prepared in the past year. Other services include chemical and mechanical extraction techniques, casting and moulding, grinding, sawing, and polishing of rocks and fossils.

The program of sampling well cores for macrofossils also was continued by laboratory staff. During the year cores from 10 northern wells were examined.

Micropaleontology Laboratories

D. F. Haden
H. M. Johnson
S. A. Pickering
L. L. Ruddy

Production Statistics

During the year laboratory personnel processed and curated the following samples:

Surface (outcrop)	266
Subsurface (well cuttings, core)	1,186
Total	1,452

1,623 samples were picked for microfossils by outside contract. Services performed as direct scientific support included photomicrography, drafting, log plotting, microfossil lists and distribution chart compilation. Other duties included supervision of three technicians and casual employees in the micropaleontological laboratories, equipment purchasing

and maintenance, and investigation and development of new laboratory procedures and techniques.

D. F. Haden and one student assistant spent one month in the field collecting microfossil samples in the Sverdrup Basin.

One student and one casual assistant were instructed in foraminiferal preparation and supervised for approximately 4 months during the year.

Palynology

The laboratory processed a total of 1,420 samples for palynomorph study this year; 1,135 for miospore study and 285 for megaspore study. Of these samples, 1,050 were prepared for projects led by Drs. Brideaux, Hopkins, and Sweet; and 370 for other GSC projects. These preparations were made from clastic and coal samples obtained from the Arctic Islands, District of Mackenzie and eastern and western Canada.

Duties of the technicians include processing and mounting of samples, development of new laboratory techniques and procedures, photomicrographic services, and general maintenance of the laboratory and darkroom (Rm. 219).

Conodonts

During the year approximately 350 lots of samples were processed, picked and recorded as follows:

109 - Research Projects - Dr. Uyeno
43 - Research Projects - Dr. Bender
20 - (Residues) heavy liquid separation and picking for Dr. Thorsteinsson
182 - Research Projects led by other scientists.

Steve Perry assisted in the laboratory during the summer months during the absence of the Conodont Technician. Part time picking assistance was given by Elsie O'Keefe and Wendy Findlay during the later part of the year.

Reports

The Subdivision produced a total of 135 reports in 1973 for direct quotation in publications, identifying and dating 5,974 lots of fossils as follows:

Bamber	7	reports on	17 lots
Brideaux	13	reports on	278 lots
Chamney	10	reports on	62 lots
Frebold (retired)	8	reports on	88 lots
Hopkins	20	reports on	143 lots
Jeletzky	10	reports on	181 lots
Nassichuk	2	reports on	2 lots
Norford	18	reports on	79 lots
Norris	1	report on	1 lot
Pedder	5	reports on	13 lots
Sliter	2	reports on	27 lots
Sweet	9	reports on	39 lots
Tozer	6	reports on	31 lots
Uyeno	12	reports on	99 lots
Scientists in universities	4	reports on	36 lots
Scientists in industry	8	reports on	4,878 lots

Macropaleontology Section

A. W. Norris

Activities

The Section is responsible for research in biostratigraphy and invertebrate macropaleontology in the western provinces, Yukon Territory, and Districts of Mackenzie and Franklin. The establishment and continued refinement of biochronological zonation of the Phanerozoic sediments is an essential part in the exploration of the natural resources of the rocks of this vast region. Activities of the Section are closely integrated with other sections of the Institute, and the Division of Regional and Economic Geology, particularly in stratigraphic and paleoecological studies. Some of the projects are conducted also in collaboration with other government agencies, universities and industry.

Current stratigraphic and biostratigraphic studies include the Devonian rocks in southern Manitoba, Yukon Territory, District of Mackenzie and Ellesmere Island; Carboniferous ammonoids of the Canadian Arctic Archipelago; Carboniferous and Permian rocks in southwestern Alberta; Carboniferous and Permian rocks in northeastern British Columbia and southeastern Yukon Territory; and Upper Paleozoic rocks in the Canadian Arctic Archipelago. Several members of the Section were actively involved in international committees and commissions on problems of faunal correlation and stratigraphy.

Attendance at Meetings, Conventions and Courses

E. W. Bamber

Geological Society of America, Regional Meeting, Stillwater, Oklahoma, March 14-16, 1974.

A. W. Norris

Canadian Society of Petroleum Geologists Oil Sands Symposium and Field Trips, Calgary and Ft. McMurray area, Alberta, September 5-9, 1973.

Canadian Arctic Geology Symposium, Geological Association of Canada/Alberta Society of Petroleum Geologists/Mineralogical Association of Canada, Saskatoon, Saskatchewan, May 23-26, 1973.

Organizational meeting of Subcommission on Devonian Stratigraphy, Marburg, Federal Republic of Germany, December 10-11, 1973.

Membership on Committees

W. W. Nassichuk

Secretary-General, International Union of Geological Sciences, Commission on Stratigraphy.

Vice-Chairman, International Union of Geological Sciences, Subcommission on Permian Stratigraphy.

A. W. Norris

Field Excursion Committee, Canadian Society of Petroleum Geologists, Athabasca Oil Sands Symposium, September, 1973.

Member, Canadian Society of Petroleum Geologists Medal of Merit Committee.

Regular (voting) member, Subcommission on Devonian Stratigraphy, International Union of Geological Sciences.

Organizing member (with G. Klapper and W. A. Oliver, Jr.), North American Devonian Study Group.

A. E. H. Pedder

Member, Organizing Committee, Second International Symposium on Corals, Paris, 1974.

Completed Manuscripts

C. R. Barnes, A. W. Norris, A. E. H. Pedder and others

"Biostratigraphic determinations of fossils from the subsurface of the Northwest and Yukon Territories"; Geol. Surv. Can., Paper 74-11, 28 p., 6 textfigs.

W. W. Nassichuk

"Carboniferous ammonoids and stratigraphy in the Canadian Arctic Archipelago"; Geol. Surv. Can., Bull., 340 Ms. p., 57 textfigs., 18 pls.

A. W. Norris

"Paleobiogeography of the Devonian Period in the Western Hemisphere"; *in* Moore, R. C., and Teichert, C., editors, Treatise on Invertebrate Paleontology, Introductory vol., Part A. (manuscript updated).

"Devonian stratigraphy of the Hudson Platform"; Geol. Surv. Can., Mem. 379, 545 Ms. p., including appendices, 22 figs., 19 pls. (with B. V. Sanford; manuscript updated).

Micropaleontology Section

T. T. Uyeno

Activities

The Section is responsible for research in the paleontology of microfossils, and in biostratigraphy and interpretation of depositional environment and geography by the use of microfossils. Proper understanding of depositional history and precise dating of strata are mandatory for correct evaluation of potential hydrocarbon deposits. Microfossils are particularly useful in subsurface studies owing to their durability and minute size. Studies are conducted in close liaison with other geologists of the Survey, industry, and universities.

Scientists of the Section conducted field studies on Cretaceous and Tertiary rocks of Ellef and Amund Ringnes Islands, and on Jurassic and Cretaceous rocks of western District of Mackenzie and southeastern British Columbia. Subsurface collections include samples from wells drilled on the Mackenzie Delta and Banks Island, and coal seams from a well in southern British Columbia. Other current studies of the Section include Devonian rocks of southern Ontario, southern Manitoba, and

western District of Mackenzie, and Siluro-Devonian rocks of the Arctic Islands; Jurassic and Cretaceous rocks of southern Alberta; and Cretaceous rocks of the James Bay Lowlands and Yukon Territory.

Attendance at Meetings, Conferences and Courses

W. W. Brideaux

American Association of Stratigraphic Palynologists, Annual Meeting, Anaheim, California, October 17-19, 1973.

Geological Survey of Canada Palynology Workshop, Bedford Institute of Oceanography, Dartmouth, December 9-13, 1973.

T. P. Chamney

University of London, England, Winter 1973-1974.

Geological Survey of Canada Micropaleontology Workshop, Bedford Institute of Oceanography, Dartmouth, May 7-9, 1973.

W. S. Hopkins, Jr.

Geological Survey of Canada Palynology Workshop, Bedford Institute of Oceanography, Dartmouth, December 9-13, 1973.

A. R. Sweet

Geological Survey of Canada Palynology Workshop, Bedford Institute of Oceanography, Dartmouth, December 9-13, 1973.

Canadian Arctic Geology Symposium and Colloquium on Cretaceous System, Geological Association of Canada - Alberta Society of Petroleum Geologists, Saskatoon, May 23-26, 1973.

T. T. Uyeno

Geological Survey of Canada Micropaleontology Workshop, Bedford Institute of Oceanography, Dartmouth, May 7-9, 1973.

Consultations and Study of Comparative Material

T. P. Chamney

University of London, England.

Membership on Committees

W. W. Brideaux

Vice-President, American Association of Stratigraphic Palynologists.

Member, Organizing Committee for American Association of Stratigraphic Palynologists meeting in Calgary (October 1974).

W. V. Sliter

Editor, Journal of Foraminiferal Research.

Completed Manuscripts

C. R. Barnes, W. W. Brideaux, T. P. Chamney, W. S. Hopkins, Jr., W. V. Sliter, T. T. Uyeno and others

"Biostratigraphic determinations of fossils from the subsurface of the Northwest and Yukon Territories"; Geol. Surv. Can., Paper 74-11, 28 p., 6 textfigs.

W. W. Brideaux

"Status of Mesozoic and Tertiary dinoflagellate studies in the Canadian Arctic"; Amer. Assoc. Strat. Palynol., Contr. Series (in press).

W. V. Sliter

"Upper Cretaceous foraminifers from the Vancouver Island area, British Columbia"; J. Foram. Res., v. 3, p. 167-186.

A.R. Sweet

(with L.V. Hills and J.E. Klovan): "*Julgan eocinera* n. sp., Beaufort Formation (Tertiary), southwestern Banks Island, Arctic Canada"; Can. J. Botonay, 1974, v. 52, no. 1, p. 65-90.

(with L.V. Hills): "A detailed study of genus *Azollopsis* Hall, 1968"; Can. J. Botany (in press).

(with L.V. Hills and B.I. Chi): "The genus *Ocksisporites* Chaloner"; Rev. Palaeobot. and Palynology (in press).

T.T. Uyeno

(with D. Mason): "New Lower and Middle Devonian conodont apparatus from northern Canada"; J. Paleontol. (in press).

"Conodonts of the Hull Formation, Ottawa Group (Middle Ordovician), of the Ottawa-Hull area, Ontario and Quebec"; Geol. Surv. Can. Bull. (in press).

"Conodonts of the Waterways Formation (Upper Devonian), northeastern and central Alberta"; Geol. Surv. Can. Bull. (in press).

Ottawa Paleontology Section

E.T. Tozer

Activities

This unit consists of scientists specialized in studies of the macropaleontology and biostratigraphy of the Mesozoic rocks of northern and western Canada, which provide significant reservoirs for oil and gas. J.A. Jeletzky spent five weeks conducting stratigraphic and biochronologic studies on Jurassic and Cretaceous rocks in the northern Yukon and adjacent District of Mackenzie and spent four weeks in Western Europe and England studying Cretaceous and Jurassic paleontological collection in museums. E.T. Tozer spent two weeks on comparative studies of the Austrian Triassic.

Attendance at Meetings, Conferences and Courses

J.A. Jeletzky

Geological Association of Canada - Canadian Society of Petroleum Geologists Meetings, Saskatoon, Saskatchewan, May 23-26, 1973.

International Colloquium on the Jurassic-Cretaceous boundary, Lyon and Neuchatel, France, September 6-16, 1973.

Geological Society of America and Paleontological Society, Annual Meetings, Dallas, U.S.A., November 12-14, 1973.

Special Talks or Lectures

J.A. Jeletzky

"Biochronology of Jurassic-Cretaceous boundary beds in Canada: the present status"; Int. Coll. Jr.-Cret. Boundary, Lyon and Neuchatel.

"Jurassic and Lower Cretaceous paleogeography of Porcupine Plateau and adjacent areas of northern Yukon"; G.A.C.-C.S.P.G. Symp. on Geol. of Canadian Arctic, Saskatoon, (Prog. and Abst. p. 14-15).

Membership on Committees

J.A. Jeletzky

Royal Society of Canada, Miller Medal Committee. Member Cretaceous Subcommission, Commission on Stratigraphy, International Union of Geological Sciences. Member Working Group on Jurassic-Cretaceous Boundary, Comm. on Stratigraphy IUGS.

E.T. Tozer

Vice-President, Organizing Committee, Subcommission for Triassic Stratigraphy, Commission on Stratigraphy, International Union of Geological Sciences.

Completed Manuscripts

C.R. Barnes, J.A. Jeletzky, E.T. Tozer and others

"Biostratigraphic determinations of fossils from the subsurface of the Northwest and Yukon Territories"; Geol. Surv. Can., Paper 74-11, 28 p., 6 textfigs.

J.A. Jeletzky

"Stratigraphy, facies and paleogeography of Jurassic and Cretaceous rocks of northern Yukon and District of Mackenzie"; Geol. Surv. Can., Paper 74-1, Part A, p. 393.

"Contributions to Cretaceous and Jurassic geology of northern Yukon and Mackenzie District, N.W.T.", Geol. Surv. Can. Paper 74-10 (in press).

"Jurassic and Lower Cretaceous paleogeography and depositional tectonics of Porcupine Plateau, adjacent areas of North Yukon, etc., "Geol. Surv. Canada Paper 74-16, 140 ms. pages, 22 textfigs (in press).

E. T. Tozer

"Canadian Triassic ammonoids"; Geol. Surv. Can. Bull. (in press), 950 Ms. p., 136 Pl., 114 textfigs.

REGIONAL GEOLOGY SUBDIVISION

G. C. Taylor

Personnel of this Subdivision conduct studies of the geology of the sedimentary basins of western and northern Canada. The program includes surface geological studies of the Innuitian Orogen of the Arctic Islands, and of the eastern and northern Cordilleran Orogen of mainland western Canada; subsurface studies within the undeformed terrane of the Arctic and Interior Platforms; and geological and geophysical studies of Arctic offshore areas. These studies seek an improved understanding of the nature, origin, and history of Proterozoic and Phanerozoic sedimentary suites of western and northern Canada. Such ongoing studies are essential to appraisals of the potentialities of these sedimentary suites, both as reservoirs for and sources of oil and gas, and as hosts for other economic mineral deposits including coal, potash, lead, zinc, and copper.

Some of the more important projects currently active within the Subdivision include bedrock geologic mapping of the northern Arctic Islands and Sverdrup Basin of the Innuitian Orogen, and detailed structural and stratigraphic studies in the Cordillera of the Yukon, Northwest Territories and northeastern British Columbia. Data from these projects are integrated with subsurface studies within the Basin Analysis Program. New special studies underway include investigation of the geology of zinc-lead mineralization in carbonate rocks; the geology of coal, including occurrence, distribution, and quality; and geological and geophysical studies of Arctic offshore areas, studies of particular interest to the oil and gas evaluation program of the Energy Subdivision.

Included in the Subdivision are twenty research scientists, five physical scientists, three technicians, and a variable number of casual employees.

During the year, the research of four Ph.D. candidates, L. D. Dyke, I. A. MacIlreath, D. W. Morrow, and G. Mossop, was supported in part by the Subdivision.

Personnel Notes

The outstanding Arctic Islands geological work of Dr. R. Thorsteinsson was recognized further, in 1973, when he was awarded the Willet G. Miller Medal by the Royal Society of Canada and, in addition, was the recipient of an Achievement Award in Excellence, granted by the Government of Alberta.

For his fine paper on the structural evolution of the lower Kicking Horse River region of the Rocky Mountains, published during 1972 in the Bulletin of Canadian Petroleum Geology, H. R. Balkwill was awarded Honourable Mention for the Medal of Merit of the Canadian Society of Petroleum Geologists.

In mid-1973, D. F. Stott, former Head of the Regional Geology Subdivision, was appointed Director, I.S.P.G. Shortly thereafter, G. C. Taylor was appointed Subdivision Head for Regional Geology, and R. W. Macqueen became Section Head for the Southern Mainland.

D. G. Wilson joined the Arctic Islands Section in February, 1974, and is working on subsurface geology of the Sverdrup Basin under the direction of K. J. Roy.

Eight scientists (Aitken, Christie, Cook, Kerr, Ollerenshaw, Taylor, Trettin, and Young) of the Subdivision participated in a highly successful field trip to the Coronation Geosyncline in July, 1973, led by Paul Hoffman.

G. Busson of the Laboratoire de Géologie du Muséum National d'Histoire Naturelle (Paris, France) continued his studies on the sedimentology of evaporite and carbonate lithofacies in selected areas of the Middle Devonian Elk Point Basin. Busson is a Research Associate of I.S.P.G., and will be spending four months on the project in Canada during 1974.

J. C. Beauvilain returned to France in March, 1974, following completion of service of his military option at I.S.P.G. During his tenure at I.S.P.G., he completed a research project on coal stratigraphy.

J. C. Trenchant, also a student from France, currently is studying Middle Devonian lithostratigraphy of Zama and Rainbow areas, Elk Point Basin, Northern Alberta, under the general guidance of G. R. Davies.

Attendance at Meetings, Conferences and Courses

G. C. Taylor

Managerial Grid Seminar, Public Service Commission, October 21-26, 1973, Cornwall, Ontario.

E.M.R./D.I.N.A. Oil and Gas Forum, Yellowknife, N.W.T., December 10, 11, 1973.

Canadian Society of Petroleum Geologists Conference: Oil Sands, Fuel of the Future; Calgary, September 5-9, 1973.

Coronation Geosyncline field trip led by Paul Hoffman, Yellowknift region, N.W.T., July 27-August 1, 1973.

Special Talks or Lectures

G. C. Taylor

"Geological Survey of Canada Mainland Programs, Interior Platform and Cordilleran Orogen, north of 60°N latitude"; E.M.R./ D.I.N.A. Oil and Gas Forum, Yellowknife, N.W.T., December 11, 1973.

Northern Mainland Section

D. G. Cook

Activities

Research interests of scientists concerned with studies in the Northern Mainland pertain to stratigraphic and structrual studies in the Interior Plains, the Mackenzie Delta, and the thrust and fold belt of the Cordillera, between 64 degrees north latitude and the Arctic Ocean. Research during 1973-74 included both surface and subsurface studies, aimed at energy and mineral resource evaluation in conjunction with the establishment of a sound geoscience data base. Surface studies included field work carried out in northern Yukon Territory, compilation of stratigraphic reports on Proterozoic and Paleozoic stratigraphy, and compilation of geological maps and reports of northern Yukon Territory, northern Mackenzie Mountains, and northern Interior Plains. Subsurface studies dealt primarily with Mesozoic and Cenozoic strata in Mackenzie Delta, and Paleozoic and Mesozoic strata in the northern Interior Plains including Porcupine Plateau.

Attendance at Meetings, Conferences and Courses

D. G. Cook

Canadian Society of Exploration Geophysicists, First National Convention, Calgary, April 4-6, 1973.

Geological Association of Canada, Canadian Society of Petroleum Geologists, and Mineralogical Association of Canada Joint Annual Meeting, Saskatoon, May 23-26, 1973.

Coronation Geosyncline field trip led by Paul Hoffman, Yellowknife region, N.W.T., July 27-August 1, 1973.

J. D. Aitken

Geological Association of Canada, Canadian Society of Petroleum Geologists, and Mineralogical Association of Canada Joint Annual Meeting, Saskatoon, May 23-26, 1973.

Field Symposium on the Precambrian-Cambrian boundary, Eastern Siberia, June 28-July 13, 1973, hosted by the Geological Institute of the Soviet Academy of Sciences.

Belt Symposium, University of Idaho, Moscow, Idaho, September 17-22, 1973.

Coronation Geosyncline field trip led by Paul Hoffman, Yellowknife region, N.W.T., July 27-August 1, 1973.

H. R. Belyea

Geological Association of Canada, Canadian Society of Petroleum Geologists, and Mineralogical Association of Canada Joint Annual Meeting, Saskatoon, May 23-26, 1973.

Second International Symposium on Coral Reefs held on Great Barrier Reef, Australia, June 22-July 2, 1973.

D. W. Myhr

Geological Association of Canada, Canadian Society of Petroleum Geologists, and Mineralogical Association of Canada Joint Annual Meeting, Saskatoon, May 23-26, 1973.

D. K. Norris

Canadian Society of Exploration Geophysicists, First National Convention, Calgary, April 4-6, 1973.

Quantitative models in Geology, University of Calgary Graduate Course Geology 603, September-December, 1973.

F. G. Young

Canadian Society of Exploration Geophysicists, First National Convention, Calgary, April 4-6, 1973.

Geological Association of Canada, Canadian Society of Petroleum Geologists, and Mineralogical Association of Canada Joint Annual Meeting, Saskatoon, May 23-26, 1973.

Belt Symposium, University of Idaho, Moscow, Idaho, September 17-22, 1973

Applied Petroleum Geology School, Calgary, Alberta; given by Oil and Gas Consultants International, October 15-26, 1973.

Coronation Geosyncline field trip led by Paul Hoffman, Yellowknife region, N.W.T., July 27-August 1, 1973.

Special Talks or Lectures

J. D. Aitken

"Chronostratigraphy of the type 'Macdougal Group', Mackenzie Mountains, N.W.T.", co-authored with R. W. Macqueen (speaker); Symposium on the Geology of the Canadian Arctic, Geological Association of Canada/Canadian Society of Petroleum Geologists Joint Annual Meeting, Saskatoon, May 24, 1973.

"Proterozoic of Western Canada"; talk delivered during Field Symposium on the Precambrian-Cambrian boundary, Eastern Siberia, June 28-July 13, 1973.

"Field Symposium on the Precambrian-Cambrian boundary, Eastern Siberia"; talk delivered twice at I.S.P.G., once at Geology Department, University of Calgary.

D. K. Norris

"Structural Geometry and Geological History of the northern Canadian Cordillera"; Canadian Society of Exploration Geophysicists First National Convention, Calgary, April 5, 1973.

"Structural and Stratigraphic Framework of the Foothills and Front Ranges in the vicinity of Crowsnest Pass, Alberta and British Columbia"; University of Calgary Field School, September 15, 1973.

"Structural and Stratigraphic Framework of the Cordilleran Orogenic System at the Latitude of Kicking Horse Pass, Alberta and British Columbia"; University of Calgary Field School, September 29-30, 1973.

"Structural Geometry and Stratigraphic Framework on the northern Cordillera of Canada"; P. S. Warren Geological Society, University of Alberta, November 29, 1973.

"Stratigraphy, structure and mineral occurrences in the northern Cordillera of Canada"; Regional Review of the Mineral Potential of the Cordilleran Orogenic System, I.S.P.G., Calgary, February 6, 1974.

F. G. Young

"Mesozoic epicontinental, flyschoid and molassoid depositional phases of Yukon's north slope"; Symposium on the Geology of the Canadian Arctic, Geological Association of Canada/Canadian Society of Petroleum Geologists Joint Annual Meeting, Saskatoon, May 23-26, 1973.

"The Windermere Supergroup of the southeastern Canadian Cordillera"; Belt Symposium, University of Idaho, Moscow, Idaho, September 17-22, 1973.

"Trace fossils: their value to sedimentology and stratigraphy"; Canadian Society of Petroleum Geologists, Paleontology Group Meeting, February 17, 1974.

Membership on Committees

J. D. Aitken

Councillor, Geological Association of Canada (term ended May, 1973).

Chairman, Symposium on Geology of the Canadian Arctic, Geological Association of Canada/Canadian Society of Petroleum Geologists Joint Annual Meeting, Saskatoon, May, 1973; and Scientific Editor of the Proceedings volume (now published).

D. W. Myhr

Member, Canadian Society of Petroleum Geologists, Geological Highway Map and Signs Committee.

F. G. Young

Member, Research and Graduate Students Awards Committee, Canadian Society of Petroleum Geologists.

Completed Manuscripts

D. G. Cook

"Structural Style influenced by lithofacies, Rocky Mountain Main Ranges, Alberta - British Columbia"; Geol. Surv. Can., Bull. 233.

"Carcajou Canyon Map-area (96D), District of Mackenzie, Northwest Territories"; Geol. Surv. Can., Paper 74-13, with map 1390 A (co-authored with J. D. Aitken).

J. D. Aitken

"Carcajou Canyon Map-area (96D), District of Mackenzie, Northwest Territories"; Geol. Surv. Can., Paper 74-13, with map 1390 A (co-authored with D. G. Cook).

D. K. Norris

"Structural geometry and geological history of the northern Canadian Cordillera"; *in* Proc. First National Convention, Canadian Society of Exploration Geophysicists, 1973 (in press).

F. G. Young

"The Windermere Supergroup of southeastern Canadian Cordillera"; Belt Symposium, 1973, University of Idaho and Idaho Bureau of Mines and Geology, Moscow, v. 1, p. 181-203 (co-authored with R. B. Campbell and T. P. Poulton).

"Upper Cretaceous stratigraphy, Yukon Coastal Plain and northwestern Mackenzie Delta"; Geol. Surv. Can., Bulletin Ms, 206 p. typescript, 1 map, 32 figs. (open file).

Southern Mainland Section

R. W. Macqueen

Activities

Stratigraphic, sedimentological and structural studies in the eastern Cordilleran Orogen and southern Interior Platform of Alberta and British Columbia continue to improve knowledge of the nature, origin, and deformational history of the sedimentary suites involved, and their economic potential. Improved understanding is achieved, in part, by synthesis of both surface and subsurface data for the Basin Analysis Program. During 1973-74, subsurface studies of Cambrian strata in west-central Alberta and northeastern British Columbia were completed, as were surface and subsurface studies of Triassic rocks of northeastern British Columbia and west-central Alberta. A number of new detailed geologic maps and cross-sections from the southern Cordillera were published, resulting from a major helicopter-supported study carried out several years ago. Detailed geologic studies of the Foothills of southwestern Alberta were continued, and include areas in which there is renewed interest in coal and hydrocarbon occurrence. Compilation and interpretation of field data on structural styles in the Cordillera of northeastern British Columbia were continued. In the same area, new studies were undertaken with the objective of refining knowledge of Paleozoic carbonate to shale transitions, and defining the relationship between such transitions and the zinc-lead occurrences recently discovered in the area, as well as the structural style of this region of the eastern Cordillera.

Attendance at Meetings, Conferences and Courses

R. W. Macqueen

Geological Association of Canada, Canadian Society of Petroleum Geologists, and Mineralogical Association of Canada Joint Annual Meeting, Saskatoon, May 23-26, 1973.

Queen's University Symposium, Trends in the Mineral Industry in the Next Decade; Kingston, Ontario, October 26, 1973.

Geological Society of America Annual Meeting, Dallas, Texas, November 12-14, 1973.

D. W. Gibson

Geological Association of Canada, Canadian Society of Petroleum Geologists, and Mineralogical Association of Canada Joint Annual Meeting, Saskatoon, May 23-26, 1973.

N. C. Ollerenshaw

Coronation Geosyncline field trip led by Paul Hoffman, Yellowknife region, N.W.T., July 27-August 1, 1973.

G. K. Williams

Geological Association of Canada, Canadian Society of Petroleum Geologists, and Mineralogical Association of Canada Joint Annual Meeting, Saskatoon, May 23-26, 1973.

Special Talks or Lectures

R. W. Macqueen

"Chronostratigraphy of the type 'Macdougal Group', Mackenzie Mountains, N.W.T.; co-authored with J. D. Aitken; Symposium on the Geology of the Canadian Arctic, Geological Association of Canada/Canadian Society of Petroleum Geologists Joint Annual Meeting, Saskatoon, May 24, 1973.

"Origin and significance of some lower and middle Paleozoic shelf and basinal sediments, northeastern Cordilleran Orogen"; talk given to P. S. Warren Geological Society, University of Alberta, November 22, 1973.

Membership on Committees

R. W. Macqueen

Director, Canadian Society of Petroleum Geologists, 1973.

Councillor, Geological Association of Canada, 1973-75.

Associate Editor, Geoscience Canada (publication of Geological Association of Canada).

Member, American Commission on Stratigraphic Nomenclature, 1973-75 (representing I.S.P.G.). Member of A.C.S.N. Subcommittee on magnetic reversal stratigraphy, Precambrian correlations, and comparison of Code of A.C.S.N. with Guide published by the International Subcommission on Stratigraphic Classification.

D. W. Gibson

Member, International Union of Geological Sciences Subcommission on Triassic Stratigraphy.

Completed Manuscripts

R. W. Macqueen

"Magnesium distribution in living and fossil specimens of the echinoid *Peronella lesueuri* Agassiz, Shark Bay, Western Australia; J. Sediment. Petrol., v. 44, p. 60-69, 1974 (co-authored with E. D. Ghent and G. R. Davies).

"Sedimentology of Silurian-Devonian Boundary Bed #20, Klonk, Bohemia"; internal report (co-authored with G. R. Davies).

D. W. Gibson

"Triassic Rocks of the Rocky Mountain Foothills and Front Ranges, Northeastern British Columbia and West-Central Alberta"; Geol. Surv. Can., Bull. 247.

N. C. Ollerenshaw

"Fallentimber Creek West", Geol. Surv. Can., geological map and structure cross-section, 1:50,000, Map 1387 A.

G. K. Williams

"Geological structure on top of Precambrian surface, Slave River Map-area", Geol. Surv. Can., open file report.

Arctic Islands Section

R. Thorsteinsson

Activities

Work in the Arctic Islands is directed mainly toward the interpretation of the stratigraphic and structural history of Phanerozoic sedimentary rocks of the Arctic Archipelago, and the evaluation of the economic potential of these strata. A secondary objective is research on the relationship of tectonic features of the Arctic Islands to continental and oceanic structures and history. Progress toward the solution of these problems is attained by means of investigation of bedrock geology of the Arctic Islands and the adjacent mainland coasts. The results of such investigations are published as interpretive geological maps and regional reports that describe all aspects of bedrock geology. In addition, the section, in conjunction with other sections of the Institute, carried out and reported on special studies in stratigraphy, paleontology, sedimentology, sedimentary petrology, structural geology, and petroleum geology. Such studies are directed particularly toward understanding the principal processes involved in the formation of sedimentary rocks and accumulation of petroleum. Current field work by members of the section includes one continuing air-supported project on the Ringnes Islands and Cornwall Island, together with several other smaller field operations in various parts of the Arctic Islands.

Attendance at Meetings, Conferences and Courses

R. Thorsteinsson

Royal Society of Canada, Annual Meeting, Kingston, June, 1973.

H. R. Balkwill

American Association of Petroleum Geologists and Society of Economic Paleontologists and Mineralogists Annual Meeting, Anaheim, California, May 14-16, 1973.

Geological Association of Canada, Canadian Society of Petroleum Geologists, and Mineralogical Association of Canada Joint Annual Meeting, Saskatoon, May 23-26, 1973.

E.M.R./D.I.N.A. Oil and Gas Forum, Yellowknife, N.W.T., December 10, 11, 1973.

R. L. Christie

Geological Association of Canada, Canadian Society of Petroleum Geologists, and Mineralogical Association of Canada Joint Annual Meeting, Saskatoon, May 23-26, 1973.

Sixth National Northern Development Conference, Edmonton, October 31-November 2, 1973.

Coronation Geosyncline field trip led by Paul Hoffman, Yellowknife region, N.W.T., July 27-August 1, 1973.

G. R. Davies

Fourth International Symposium on Salt, Houston, Texas, April 8-12, 1973.

Geological Association of Canada, Canadian Society of Petroleum Geologists, and Mineralogical Association of Canada Joint Annual Meeting, Saskatoon, May 23-26, 1973.

Penrose Conference on Water and Carbonate Rocks, Geological Society of America, Vail, Colorado, September 16-21, 1973.

Applied Petroleum Geology School, Calgary, given by Oil and Gas Consultants International, October 15-26, 1973.

J. W. Kerr

Geological Association of Canada, Canadian Society of Petroleum Geologists, and Mineralogical Association of Canada Joint Annual Meeting, Saskatoon, May 23-26, 1973.

Coronation Geosyncline field trip led by Paul Hoffman, Yellowknife region, N.W.T., July 27-August 1, 1973.

Co-leader of Field Workshop on Earth Science Education, Banff area-Golden area, Rocky Mountains; August 15, 16, 1973.

A. D. Miall

Canadian Society of Exploration Geophysicists, First National Convention, Calgary, April 4-6, 1973.

Geological Association of Canada, Canadian Society of Petroleum Geologists, and Mineralogical Association of Canada Joint Annual Meeting, Saskatoon, May 23-26, 1973.

Quantitative Models in Geology, Geology Department, University of Calgary, November, 1973.

K. J. Roy

Canadian Society of Exploration Geophysicists, First National Convention, Calgary, April 4-6, 1973.

American Association of Petroleum Geologists and Society of Economic Paleontologists and Mineralogists Annual Meeting, Anaheim, California, May 14-16, 1973.

Geological Association of Canada, Canadian Society of Petroleum Geologists, and Mineralogical Association of Canada Joint Annual Meeting, Saskatoon, May 23-26, 1973.

Canadian Society of Petroleum Geologists Conference: Oil Sands, Fuel of the Future; Calgary, September 5-9, 1973.

H. P. Trettin

Geological Association of Canada, Canadian Society of Petroleum Geologists, and Mineralogical Association of Canada Joint Annual Meeting, Saskatoon, May 23-26, 1973.

Coronation Geosyncline field trip led by Paul Hoffman, Yellowknife region, N.W.T., July 27-August 1, 1973.

Membership on Committees

H. R. Balkwill

Director, Canadian Society of Petroleum Geologists, 1974.

Member, Advisory Committee on National Conference on Earth Science.

Associate Editor, Bulletin of Canadian Petroleum Geology.

G. R. Davies

Chairman, Link Award Committee, Canadian Society of Petroleum Geologists, 1973.

Chairman, Technical Program Committee, Canadian Society of Petroleum Geologists, 1974.

J. W. Kerr

Member, Professional Affairs Committee, Association of Professional Engineers, Geologists, and Geophysicists of Alberta.

A. D. Miall

Member, Stratigraphic Nomenclature Committee, Canadian Society of Petroleum Geologists.

Member, Link Award Committee, Canadian Society of Petroleum Geologists, 1973.

Chairman, Exhibits Committee, Canadian Society of Petroleum Geologists Offshore Symposium, September, 1974.

K. J. Roy

Member, Borehole subcommittee on metrication, Canadian Petroleum Association.

Member, Subcommittee on geological potential, Department of Energy, Mines and Resources.

H. P. Trettin

Member, Canadian Geodynamics Subcommittee, National Advisory Committee on Research in the Geological Sciences.

Special Talks or Lectures

H. R. Balkwill

"Structure and Tectonics of Cornwall Anticlinorium, Cornwall and Amund Ringnes Islands, Arctic Archipelago"; Symposium on the Geology of the Canadian Arctic, Geological Association of Canada/Canadian Society of Petroleum Geologists Joint Annual Meeting, Saskatoon, May 25, 1973.

"Arctic Islands Programs, Geological Survey of Canada"; E.M.R./D.I.N.A. Oil and Gas Forum, Yellowknife, N.W.T., December 11, 1973.

"Geological Framework, Arctic Islands"; P. S. Warren Geological Society, University of Alberta, Edmonton, February 15, 1974.

G. R. Davies

"Paleozoic evaporites of the Arctic Islands"; (by invitation) Fourth International Salt Symposium, Houston, Texas, April 8-12, 1973.

"Upper Paleozoic carbonate mounds of the Sverdrup Basin, Arctic Canada"; Symposium on the Geology of the Canadian Arctic, Geological Association of Petroleum Geologists Joint Annual Meeting, Saskatoon, May 24, 1973 (co-authored with W. W. Nassichuk).

"Composition and diagenesis of Upper Paleozoic carbonates, northern Sverdrup Basin, Arctic Islands"; Canadian Society of Petroleum Geologists, luncheon meeting, November 28, Calgary.

J. W. Kerr

"Tectonics of the Western Margin of the Boothia Uplift and Cornwallis Fold Belt"; Symposium on the Geology of the Canadian Arctic, Geological Association of Canada/Canadian Society of Petroleum Geologists Joint Annual Meeting, Saskatoon, May 25, 1973.

A. D. Miall

"Boothia Uplift: Devonian Tectonism and Sedimentation within the Arctic Platform"; Symposium on the Geology of the Canadian Arctic, Geological Association of Canada/Canadian Society of Petroleum Geologists Joint Annual Meeting, Saskatoon, May 24, 25, 1973.

"Regional Geology of the Northern Yukon"; Symposium on the Geology of the Canadian Arctic, Geological Association of Canada/Canadian Society of Petroleum Geologists Joint Annual Meeting, Saskatoon, May 24, 25, 1973.

K. J. Roy

"Cretaceous and Jurassic Stratigraphy of Amund Ringnes and Cornwall Islands, Arctic Archipelago"; Symposium on the Geology of the Canadian Arctic, Geological Association of Canada/ Canadian Society of Petroleum Geologists Joint Annual Meeting, Saskatoon, May 26, 1973 (co-authored with H. R. Balkwill).

H. P. Trettin

"Pearya Geanticline: an early Paleozoic orogenic welt in the present offshore region"; Symposium on the Geology of the Canadian Arctic, Geological Association of Canada/Canadian Society of Petroleum Geologists Joint Annual Meeting, Saskatoon, May 24, 25, 1973.

"Early Paleozoic Hazen Trough of northern and central Ellesmere Island"; Symposium on the Geology of the Canadian Arctic, Geological Association of Canada/Canadian Society of Petroleum Geologists Joint Annual Meeting, Saskatoon, May 24, 25, 1973.

"Flysch sedimentation in the early Paleozoic Hazen Trough, Ellesmere Island"; Carleton University, Geology Department, February 19, 1974.

Completed Manuscripts

H. R. Balkwill

"Structure and Tectonics of Cornwall Arch, Amund Ringnes and Cornwall Island, Arctic Archipelago"; *in* Proceedings of the Symposium on the Geology of the Canadian Arctic, ed. J. D. Aitken, D. J. Glass, published by Geological Association of Canada and Canadian Society of Petroleum Geologists, 368 p. (p. 39-62), 1974.

"Franklin Bay Map-area (97C) and Malloch Hill Map-area (97F), District of Mackenzie"; Geol. Surv. Can., Paper 74-16 (co-authored by C. J. Yorath and R. W. Klassen).

G. R. Davies

"Paleozoic evaporites of the Canadian Arctic Archipelago"; IVth Intern. Salt Symp., Proceedings, in press.

"Sedimentology of Silurian-Devonian Boundary Bed #20A, Klonk, Bohemia"; internal report (co-authored by R. W. Macqueen).

"Submarine cementation, fracturing and internal sedimentation in Pennsylvanian-Permain carbonate buildups, Arctic Archipelago" (Abs.); Bull. Am. Assoc. Petrol. Geologists, v. 58 (in press).

"Magnesium distribution in living and fossil specimens of the echinoid *Peronella lesueuri* Agassiz, Shark Bay, Western Australia"; J. Sediment. Petrol., v. 44, no. 1, p. 60-69, 1974 (co-authored by R. W. Macqueen and E. D. Ghent).

J. W. Kerr

"Cape Storm Formation, a new unit of Silurian Age in the Canadian Arctic Islands"; Bull. Can. Petrol. Geologists (in press).

"Tips on organizing Arctic geological field work"; Geol. Surv. Can., Paper 74-12 (in press).

A. D. Miall

"Paleocurrent analysis of alluvial sediments: a discussion of directional variance and vector magnitude"; J. Sediment. Petrol. (in press).

"Computer applications in the study of a sedimentary basin"; ms submitted to T. M. Gordon (GSC, Ottawa), March, 1974, to be published in a GSC paper on computer applications within the Geological Survey of Canada.

K. J. Roy

"The geological background and petroleum potential of arctic North America" (abs.); Fondation Francaise d'Étude Nordiques, 5th International Congress, Le Havre, May 2-5, 1973 (D. J. McLaren, *et al.*).

"Energy Reserves and potential resources (A) oil and gas"; Chapter 2, p. 31-56 *in* An Energy Policy for Canada, Phase 1, v. 11 - Appendices; prepared by D. J. McLaren, R. M. Procter, K. J. Roy and C. J. Yorath (1973).

"Compilation of data from reports on geological and geophysical studies conducted in the Arctic Islands by industry and submitted to D.I.N.A."; Internal Report (confidential) May, 1973 (K. J. Roy, *et al.*).

Co-ordinator - Marine Geology

C. J. Yorath

Activities

Marine geological activities of the Institute in the Arctic are the responsibility of the Co-ordinator for Marine Geology. These responsibilities include advising management with regard to marine bedrock geological and geophysical activities in the Arctic, planning and conducting such studies in conjunction with the Northern Mainland and Arctic Islands Sections of the Institute and co-ordinating these programs with other Divisions of the Geological Survey. During August and September, 1973, the GSC participated with the U.S. Geological Survey in a marine reflection seismic program in the Beaufort Sea, extending from Pt. Barrow, Alaska, to the Mackenzie Delta. In August of 1974, a marine bedrock coring and seismic program will be conducted in Lancaster Sound using the CSS Hudson.

Attendance at Meetings, Conferences and Courses

C. J. Yorath

Canadian Society of Exploration Geophysicists, First National Convention, Calgary, April 4-6, 1973.

Geological Association of Canada, Canadian Society of Petroleum Geologists, and Mineralogical Association of Canada Joint Annual Meeting, Saskatoon, May 23-26, 1973.

Arctic Marine Planning Group - attended two meetings (Ottawa, and Atlantic Geoscience Centre, Dartmouth, N.S.).

Field Season, 1974, Planning Meetings - Atlantic Geoscience Centre, Dartmouth, N.S.

Membership on Committees

C. J. Yorath

Member, Technical Program Committee, Canadian Society of Exploration Geophysicists Convention, Spring, 1975.

Chairman, Education and Applications of Geology Committee, Canadian Society of Petroleum Geologists.

Editor, special volume resulting from the International Symposium on Canada's Continental Margins and Offshore Petroleum Exploration, Canadian Society of Petroleum Geologists Convention, Calgary, September - October, 1974.

Completed Manuscripts

C. J. Yorath

"Franklin Bay Map-area (97C) and Malloch Hill Map-area (97F), District of Mackenzie"; Geol. Surv. Can., Paper 74-16 (co-authored by H. R. Balkwill and R. W. Klassen).

"Energy reserves and potential resources (A) oil and gas"; Chapter 2, p. 31-56 *in* Energy Policy for Canada, Phase I, v. II - Appendices; prepared by D. J. McLaren, R. M. Procter, K. J. Roy and C. J. Yorath.

Sedimentological Laboratories

Production Data

These laboratories provide lapidary services for the geological staff. Heavy mineral separations, mineral staining and insoluble carbonate residues are also done on a routine basis. The laboratories have a staff of two: Mr. W. O. McEwan and Mr. J. L. Rees.

ENERGY SUBDIVISION

R. G. McCrossan

The Energy Subdivision is responsible for the Institute's programs on energy resource evaluation for the sedimentary basins of Western Canada and for conducting research into the mode of origin and occurrence of the relevant commodities; programs that provide the necessary background for the evaluation studies. The research programs are being designed and modified, where necessary, to support this end. At the same time, investigation of more fundamental problems and publication of basin information designed to stimulate and increase efficiency of resource development is continuing. These goals are all interrelated and a minimum of disruption should result from any shift in priorities in the future.

The Subdivision's program of resource evaluation (hydrocarbons, coal) is closely interrelated with other programs of the Subdivision and the Division, leading to common goals, and is co-ordinated with the work of other agencies within the Federal Government. The Subdivision is responsible for the petroleum and coal inventory and the basin analysis programs which depend, largely, on basic geological work supplied by the Regional Geology Subdivision of the Institute. There is a responsibility, also, for the security and control, with the Branch, of confidential information provided by the resource administration agencies within the Federal Government.

The principal accomplishment within the Subdivision during the last year was the development, within the Subdivision, of the first detailed petroleum assessment on a probabilistic basis. The assessment team, made up of members from Indian Affairs and Northern Development, Resource Management and Conservation Branch, and Atlantic Geoscience Centre and the I.S.P.G., worked together at various centers across the country over a six-month period, to complete this task; the Energy Subdivision co-ordinated the work. Another important contribution to the assessment of Canada's energy resources was a detailed study of the lignite deposits of Saskatchewan made by the Coal Section in conjunction with the Saskatchewan government. Major new programs have commenced in both the Geochemistry and the Geophysics Sections following the appointment of section heads late in 1973.

It is anticipated that these programs will lend strong support to the resource evaluation program. The 720 page volume entitled "Future Petroleum Provinces of Canada", published by the Canadian Society of Petroleum Geologists, was completed and released under the direction of the head of the Subdivision.

The Subdivision has been successful in augmenting its own work through joint international projects with the Institut Francais du Pétrole in the geochemistry of the Western Canada sedimentary basins and a study of worldwide petroleum occurrences.

Personnel Notes

A senior petroleum advisor has been added to the Subdivision staff.

Attendance at Meetings, Conferences and Courses

R. G. McCrossan

Oil Sands Conference, Canadian Society of Petroleum Geologists, Calgary (and field trip), September 5-9, 1973.

Symposium on Energy Resources, Royal Society of Canada, Ottawa, October 15-17, 1973.

Economic Society of Alberta, March 27, 1974.

Special Talks or Lectures

R. G. McCrossan

"Future Petroleum Provinces of Canada"; talk to Logan Club, GSC, Ottawa, May 10, 1973.

"The Geochemistry of McMurray Oil of Alberta"; paper presented at Conference entitled Oil Sands, Fuel of the Future, Canadian Society of Petroleum Geologists, Calgary, September 7, 1973.

"Origin and Geological Environment of the Mineral Energy Resources"; paper presented at Royal Society of Canada Symposium on Energy, Ottawa, October 16, 1973.

Membership on Committees

R. G. McCrossan

Academic Advisory Committee, American Association of Petroleum Geologists.

Chairman, The Interdepartmental Petroleum Resources Committee, Canadian Government, Subcommittee on Geological Potential.

Completed Manuscripts

R. G. McCrossan

"Future Petroleum Provinces of Canada, their Geology and Potential"; Canadian Society of Petroleum Geologists, published December 1973 (editor).

"The Geology and Petroleum Potential of Canadian Sedimentary Basins - A Synthesis"; co-authored with J. W. Porter, *in* Future Petroleum Provinces of Canada, Canadian Society of Petroleum Geologists, p. 589-720.

"The Origin and Geological Environment of the Mineral Energy Resources"; *in* Symposium on Energy Resources, Royal Society of Canada, December 1973, p. 3-16.

"The Geochemistry of McMurray Oil of Alberta"; co-authored with G. Deroo, B. Tissot, and F. Der, *in* Symposium on Oil Sands, Fuel of the Future, Canadian Society of Petroleum Geologists, Memoir 3 (in press) to be published June 1974.

Geology of Petroleum Section

R. M. Procter

Activities

The Geology of Petroleum Section is primarily responsible for assessment of Canada's potential petroleum resources, and conducting research on the habitat of oil and on methods of resource evaluation. A secondary responsibility if the development and maintenance of computer data-files related to well data, oil and gas pool data and others. Much of the work of the Section involves co-ordination of related activities both within the Institute's Basin Analysis Program and with scientists at Halifax (AGC) and Ottawa (RMCB and Department of Indian Affairs).

During 1973 significant improvements in resource evaluation techniques were implemented with the development and introduction of a prototype computer program capable of combining probabilistic curves of the oil and gas potential associated with individual plays. This Monte Carlo Simulation technique was used extensively in the annual evaluation of potential which was completed in March 1974.

Two new computer-based information systems were designed and compilation of data was begun. One is a northern well information file, containing all the relevant data on all wells north of Latitude 60 degrees (including Northwest Territories and Arctic Islands) such as location, formation tops, cored intervals, drill-stem test data, production test data, logs run, etc. This file is mainly for internal use. The second file is a comprehensive compilation of all the geological, geochemical and production data of the major hydrocarbon producing zones in Canada. This file is being built in conjunction with Institut Francais du Pétrole which is putting together a data file on all the major hydrocarbon producing zones in the world.

Personnel Notes

C. G. M. Gusa resigned as Geological Files Technician in June. He was replaced by G. W. Drake, who joined the staff in August.

Dr. K. J. Roy was attached to the Section from August 1973 to April 1974 to assist in development of evaluation methodology and the annual assessment of potential petroleum resources.

Attendance at Meetings

R. M. Procter

American Association of Petroleum Geologists Convention, Anaheim, California, May 14-16, 1973.

American Association of Petroleum Geologists Oil and Gas Pool Data Bank of North America Committee, Denver, Colorado, August 6, 7; Norman, Oklahoma, August 19-22, 1973.

Canadian Society of Petroleum Geologists Oil Sands Symposium, Calgary, Alberta, September 5-8, 1973.

Oil and Gas Forum, D.I.N.A., Yellowknife, N.W.T., December 10, 11, 1973.

Economics Society of Alberta, March 27, 1974.

N. L. Ball

American Association of Petroleum Geologists Convention, Anaheim, California, May 14-16, 1973.

American Association of Petroleum Geologists Oil and Gas Pool Data Bank of North America Committee, Denver, Colorado, August 6, 7; Norman, Olkahoma, August 19-22, 1973.

Concepts in Qualitative Geology, A Canadian Society of Petroleum Geology Seminar Course, Calgary, Alberta, November 14, 15 and 16, 1973; December 12, 13 and 14, 1973.

Canadian Society of Petroleum Geology Oil Sands Symposium, Calgary, Alberta, September 5-8, 1973.

F. Der

Arctic Symposium, Cretaceous Colloquium, Saskatoon, Saskatchewan, May 23-26, 1973.

Canadian Society of Petroleum Geology Oil Sands Symposium, Calgary, Alberta, September 5-8, 1973.

Joint Symposium on Permafrost-Hydrology and Geophysics, Calgary, Alberta, February 26-28, 1974.

Membership on Committees

R. M. Procter

Secretary - Subcommittee on Geological Potential (Departmental).

Member Research Committee, American Association of Petroleum Geologists.

Canadian Chairman - American Association of Petroleum Geologists Oil and Gas Pool Data Bank of North America Committee.

N. L. Ball

American Association of Petroleum Geologists Oil and Gas Pool Data Bank of North America.

Completed Manuscripts

F. Der

"Geochemistry of the McMurray Oil of Alberta"; joint author with B. Tissot, G. Deroo, and R. G. McCrossan, presented at Oil Sands Conference.

"Differentiation of Natural Gas Hydrates from Permafrost in Exploratory Boreholes"; internal report.

Geology of Coal Section

B. A. Latour (Acting)

Activities

This newly-formed section is responsible for the planning and conducting of some, and for the assessment of all, scientific studies concerned with depositional and structural history, and with environments of the sedimentary complexes within which coal occurs in Canada. Data generated from these studies are used in order to make knowledgeable evaluations of Canada's coal resources.

Coal Evaluation

The joint Federal-Provincial Program for the evaluation of coal in southern Saskatchewan was continued and Phase II was successfully completed. This involved the drilling and geophysical logging of 501 boreholes, spaced on a one-mile grid and totalling nearly 110,000 feet. These holes were located within areas which has been delineated as having significant coal-seam development by Phase I (1972) of the Program. Compilation of data made available by these field operations has commenced and a preliminary evaluation of the coal resources of southern Saskatchewan is expected to be ready by the fall of 1974.

Coal Petrology

Petrology studies provide data on the petrographic composition and rank (metamorphism) of coal as well as carbonaceous matter dispersed

throughout a sedimentary rock series. The data are used to interpret geological history, to assist in establishing seam correlations, to aid in the solution of mining and utilization (coking) problems and for application in the search for oil and gas.

The build-up of data from petrographic studies was continued, especially for coking coals of western Canada. One study investigated the use of petrographic data to make predictions of coke strength and indications are that this method could be used to give at least a semi-qualitative indication of coking properties of western Canadian coals. Samples of coal and dispersed carbonaceous matter from boreholes in Alberta and Northwest Territories were studied to establish profiles of rank change with depth and its influence on the occurrence of oil and gas.

As part of the joint Federal-Provincial Program in Saskatchewan, detailed petrographic analyses were made of some 80 samples and these showed a concentration of certain constituents in the seams toward the bottom of the coal-bearing section. This phenomenon probably has depositional significance and may be useful in correlation.

Personnel Notes

P. A. Hacquebard, A. R. Cameron and T. F. Birmingham, all members of the Coal Petrology Unit, were transferred from Ottawa to Calgary.

J. R. Donaldson transferred from the Geological Survey to the Mines Branch in June. He was replaced by P. R. Gunther in October.

Attendance at Meetings, Conferences and Courses

P. A. Hacquebard

International Commission for Coal Petrology, Lille and Verneuil-en-Halatte, France, September 10-14, 1973.

Colloquia on dispersed organic matter, sponsored jointly by International Congress on Organic Geochemistry and International Commission for Coal Petrology, Paris, France, September 15-17, 1973.

J. A. Irvine

Canadian Institute of Mining and Metallurgy, Vancouver, April 16-18, 1973.

B. A. Latour

Canadian Institute of Mining and Metallurgy, Vancouver, April 16-18, 1973.

Special Talks or Lectures

P. A. Hacquebard

"Pre- and Post-deformational Coalification and its Significance for Oil and Gas Exploration", colloquia on dispersed organic matter, Paris, France, September 16, 1973.

Membership on Committees

A. R. Cameron

Member, Industrial Applications Subcommittee of International Commission for Coal Petrology.

Member, Brown-coal Working Group, International Commission for Coal Petrology.

Member, Subcommittee D5-18, American Society for Testing Materials.

Member, Canadian Advisory Committee on Coal Research.

P. A. Hacquebard

Member, Nomenclature Subcommittee of International Commission for Coal Petrology.

Member, Subcommittee for Petrography of Organic Matter in Sediments and Application to Geology, International Commission for Coal Petrology.

Member, 1970 Symposium Committee of Coal Geology Division of Geological Society of America.

Member, Pennsylvanian Stratigraphy Committee of Coal Geology Division of Geological Society of America.

Member, Canadian Advisory Committee on Coal Research.

Completed Manuscripts

P. A. Hacquebard and J. R. Donaldson

"Rank Studies of Coals in the Rocky Mountains and Inner Foothills Belt, Canada"; Geol. Soc. Am. Special Paper 153.

P. A. Hacquebard

"Pre- and Post-deformational Coalification and its Significance for Oil and Gas Exploration"; Proc. Symposium on Dispersed Organic Matter in Sediments in Relation to Oil and Gas Potential, Centre National de la Recherche Scientifique, Paris.

"A Composite Coalification Curve of the Maritime Region and its Value for Petroleum Exploration"; Geol. Surv. Can., Paper 74-1, Part B.

A. R. Cameron, P. R. Gunther, P. A. Hacquebard and T. F. Birmingham

"Relation of Predicted to Experimentally Determined Coke Stabilities for Western Canadian Coals"; Geol. Surv. Can., Paper 74-1, Part B.

D. W. Myhr and P. R. Gunther

"Lithostratigraphy and Coal Reflectance of a Lower Cretaceous Deltaic Succession in the Gulf-Mobil Parsons F-09 Borehole, N.W.T."; Geol. Surv. Can., Paper 74-1, Part B.

Geochemistry Section

T. G. Powell

Activities

Inorganic Geochemistry, Mineralogy and Clay Mineralogy

During 1973-74, the inorganic geochemistry, mineralogy and clay mineralogy group continued to provide scientific services to the I.S.P.G. scientific staff, universities and other government agencies; to develop, adapt and publish analytical techniques in X-ray diffractometry, X-ray fluorescence spectroscopy and analytical chemistry; and to carry out research in the field of diagenesis related to the oil generating potential of source rocks.

A. E. Foscolos produced a total of 69 reports for I.S.P.G. staff, Canada Department of Environment, University of Calgary and the Department of Mineral Resources, Government of Saskatchewan: 49 reports in mineralogy and clay mineralogy involved 3,790 analyses and 20 reports in chemistry involved 2,766 determinations.

Mineralogy and Clay Mineralogy Laboratories

A. G. Heinrich

The mineralogy and clay mineralogy laboratories determine qualitatively and semi-quantitatively clay minerals in sedimentary rocks, evaluate the degree of sediment diagenesis by a thorough study of clay minerals, carry out basic research in the field of clay mineralogy and perform X-ray fluorescence analyses.

During the report year, 515 rock samples were processed for I.S.P.G. staff yielding 3,346 mineral determinations and 444 elemental identifications.

In addition 1,000 mineral identifications, 100 clay mineral separations, 300 clay mineral identifications, 35 diffractograms of mixed layer clays and 216 X-ray studies on pure clay minerals have been performed in relation to various projects using clay mineralogy.

One student and two casuals were employed during the year in Mineralogy and Clay Mineralogy Laboratories.

Inorganic Geochemistry Laboratories

R. R. Barefoot

The inorganic geochemistry laboratories determine the elemental composition of sedimentary rocks and quantitizes minerals by differential dissolution, differential fusion, wet chemical analyses and thermal techniques.

The production for I.S.P.G. staff is summarized as follows:

1.	Wet chemical analyses by atomic absorption spectroscopy	1,147
2.	Determination of carbon	453
3.	Sulphur determinations	78
4.	Thermal analyses	52
5.	Mineral analyses	838
6.	Miscellaneous determinations/conductivity measurements/pH/phosphate, etc.	198
	Total analyses	2,766

In addition 2,500 chemical and mineralogical analyses and 21 thermal analyses were performed for various projects.

During 1973-74, one student and two casuals were employed. In addition 3 university technicians, 3 technicians from the Canada Department of Environment and 1 post-graduate student were trained in analytical procedures used in the analysis of sedimentary rocks, sediments and soils.

Attendance at Meetings, Conferences and Courses

A. E. Foscolos

Clays and Clay Mineral Conference, 22nd National Clay Conference, Banff, Alberta, October 7-10, 1973.

A. G. Heinrich

30th Annual X-ray Diffraction Clinic, Polytechnic Institute of Brooklyn, June 4-15, 1973.

Special Talks or Lectures

A. E. Foscolos

"Clay Minerals as indicators of the degree of sediment diagenesis and oil generating potential in shales"; National Institute of Geological and Mining Research, Athens, Greece, August 28, 1973, Invitation by Greek Government.

"The physical, chemical and physiochemical study of clay minerals and its use in geosciences"; College of Agriculture, Athens, Greece, September 13, 1973, Invitation by the College of Agriculture.

"The application of Fourier transform and Fourier synthesis in the study of interstratified clays and bonds in silicates"; National Institute of Geological and Mining Research, Athens, Greece, September 19, 1973, Invitation by Greek Government.

"Diagenesis of clay minerals from Lower Cretaceous shales of northeastern British Columbia"; 22nd Clay Mineral Conference, October 7-11, 1973, Banff, Alberta.

"Diagenesis of Buckinghorse Formation and its potential for hydrocarbon production prior to uplift"; Chevron Research Laboratories, La Habra, California, December 27, 1973, Invitation by Chevron Oil Co.

"The use of X-ray diffraction, X-ray fluorescence spectroscopy, wet chemistry, thermal analysis, electron microscopy and Mossbauer spectroscopy in the study of clays"; Department of Civil Engineering, University of Calgary, February 19, 1974, Invitation of the University of Calgary.

"Clay minerals as indicators of the degree of diagenesis and oil generating potential of shales prior to uplifting"; Department of Civil Engineering, University of Calgary, February 21, 1974, Invitation by the University of Calgary.

"Methods of studying binary and ternary mixed-layer silicates by the peak migration technique and one dimensional Fourier analysis"; Department of Civil Engineering, University of Calgary, March 7, 1974, Invitation by University of Calgary.

Membership on Committees

A. E. Foscolos

Chairman of two committees for the 22nd National Clay Conference held in Banff, October 7-11, 1973.

Completed Manuscripts

A. E. Foscolos

"Diagenesis of Clay Minerals from Lower Cretaceous Shales of Northeastern British Columbia", *in* Clays and Clay Minerals Journal (in press; co-authored with H. Kodama).

Organic Geochemistry

The main activity of this unit is concerned with the determination of potential petroleum source rocks and level of organic maturation in sediments of the Arctic Islands and District of Mackenzie, N.W.T. Geochemical models of the Sverdrup Basin and Arctic Islands Fold complex have been revised and updated and data collection has commenced for the Mackenzie Delta.

Attendance at Meetings, Conferences and Courses

L. R. Snowdon

Alberta Society of Petroleum Geologists, Short Course on Organic Geochemistry and Fluid Dynamics, Banff, April 1973.

Geology 381, Stratigraphy and Sedimentation, University of Calgary, September 1973 - December 1973.

Geology 441, Structural Geology, University of Calgary, September 1973 - December 1973.

Geology 577, Petroleum Geology, University of Calgary, January 1974 - April 1974.

Organic Geochemistry Laboratory

Saturated hydrocarbon gas analyses and organic and total carbon analyses were run on samples of drill cuttings from 32 wells in the Northwest Territories, Arctic Islands and East Coast offshore. Approximately 7,000 gas analyses and 14,000 carbon analyses were made. Gas logs of all wells were plotted and levels of thermal diagenesis estimated. About 130 solvent extractions were completed on samples in which there was an appreciable amount of hydrocarbon gas.

Personnel Notes

T. G. Powell joined the staff of the Subdivision in February as Section Head of the Geochemistry Section.

D. A. Humphries joined the Geochemistry Section in December as a third technician in the Organic Geochemistry Laboratory.

L. Bevington joined the Geochemistry Section in February as a second technician in the Clay Mineralogy Laboratory.

Geophysics Section

R. G. Walker

This unit is responsible for the compilation, analysis and interpretation of geophysical data and information to prepare regional studies of the geophysical framework of the sedimentary basins of western and northern Canada in support of petroleum resource evaluation and basin analysis programs.

Activities

On December 3, 1973, the Geophysics Section of the I.S.P.G. became functional. The main activities of this unit are devoted to the acquisition, cataloguing and interpretation of the available seismic and velocity data of Northern Canada.

Correlation of about 2,000 miles of seismic data in the Beaufort Sea and the Arctic Coastal Plain have been completed.

Attendance at Meetings, Conferences and Courses

R. G. Walker

Petroleum Evaluation Meeting, I.S.P.G., Calgary, January, 1974.

Meeting in Ottawa with Department of Indian and Northern Affairs to discuss the geophysical evaluation of Canada's north, January, 1974.

DIVISION OF REGIONAL AND ECONOMIC GEOLOGY

J.E. Reesor, Chief

The responsibilities of the Division encompass all aspects of the geological framework of Canada excluding the western Canada and Arctic Sedimentary Basins but including the Pacific Continental Shelf. Elements of the Division are responsible for the integration of the regional geological framework with mineral deposit data and using the results in projecting the mineral resource potential of the country.

The objectives of the division are: to provide a systematic geological framework across the country to standards consistent with the needs for mineral resource discovery and evaluation; to establish the geological settings favourable to the occurrence of mineral deposits and fuels; to establish the potential abundance and probable distribution of mineral resources of Canada; to provide standards, controls, and reference material to ensure consistent correlation and uniform presentation of the geology of Canada.

A central activity of the Division is geological mapping with portrayal and publication of the results on maps at 1:1,000,000, 1:500,000 and 1:250,000 scales. The regional reconnaissance on at least 1:500,000 for the entire country is now virtually complete and has served to define the major configuration of the geological framework. Using this reconnaissance as a basis, three major tectonic units in the Canadian Shield have been chosen for further mapping at 1:250,000 scale in order to investigate their potential for mineral resources. Current work in the Bear-Slave province has shown extensive deposits of Aphebian ash flow tuffs in the Bear province that are of potential interest in uranium exploration. Work in the Foxe Fold Belt in Melville Peninsula and southwest from Committee Bay outlined a continuous belt of volcanic and ultrabasic rocks more than 200 miles long. Rocks of this type are known to be hosts for base metal deposits. Further work in the Rankin-Ennadai Belt southwest from Rankin Inlet has outlined a previously unknown extension of an Archean volcanic belt containing some acid volcanics of great significance in locating volcanic centres that in turn are sources for massive sulphide deposits.

Studies such as these are directed toward understanding the development of the tectonic units from their early sedimentary and volcanic history through deformation and metamorphism as a sophisticated basis for mineral potential assessment and for mineral exploration.

Similarly, such regional studies in the Cordillera are concentrated toward completing regional mapping at 1:250,000 as well as identifying and continuing studies directed toward understanding the nature of geological processes with particular reference to the origin and concentration of mineral deposits. Paleontological and biostratigraphic studies combined with regional mapping have served to provide a basin analysis of the deposition of lower Paleozoic strata in Yukon Territory. This has resulted in delineation of facies units in which extensive stratabound sulphide occurrences are found.

The economic geology group within the Division concentrates their studies on major mineral commodities and their relationship to the geological setting. This activity leads into regional metallogeny, the study of the character and distribution of mineral deposits within a region and their relation to geological evolution. The more sophisticated the knowledge of the mineral deposits and the geological framework, the greater the level of confidence that can be put on the resulting assessments of resource potential. An important aspect of the work of this group is in the development of techniques for qualitative and quantitative evaluation of resource potential. Current experiments in 'Project Appalachia' have been directed toward classification of both geological and mineral deposit data in the Canadian Appalachians such that it can be introduced into the computer for processing. This project has now reached the stage at which automatic processing can begin for testing of quantitative methods of resource potential evaluation.

An important activity of the Division, that of correlation and standards, lies at the basis of all geological synthesis and deals with time. It is an essential in establishing and understanding geological processes in the evolution of a tectonic unit of the Earth's crust and its contained mineral deposits. Within the Phanerozoic, paleontological methods are used extensively, but within the Precambrian, isotopic geochronology is the only available approach. The efforts of the Geochronology group with the Division are currently directed toward the utilization of Zircon Pb–U methods particularly in the employment of even smaller amounts of zircon to speed results for use during a mapping project and for ongoing regional synthesis and metallogenic studies.

Members of the staff continue to be involved in CIDA projects such as the Omo River project in Ethiopia and in evaluating a future project in southwestern Algeria.

Personnel Notes

During the year J.O. Wheeler left the Division to become Deputy Director, Geological Survey of Canada, and J.E. Reesor became Chief, Regional and Economic Geology Division. On the retirement of S. Duffell, I.M. Stevenson became Assistant Division Chief, acting.

The Division at present has a staff of 136, including 95 professional scientists and 41 support staff.

During the year, members of the Division submitted for publication 48 internal and 64 external manuscripts. They also presented a total of 119 talks to various meetings and institutions involving, in all, 173 audiences.

Membership on Committees

J.E. Reesor
- Chairman, Metamorphic Map of North America
- Member, Ad Hoc Branch Committee on Research Scientist, Appraisal

Completed Manuscripts

The following manuscripts were accepted and approved by the Division.

J.E. Reesor

(in press): The nature and setting of granitic plutons in the central and eastern parts of the Canadian Cordillera; Pacific Geology (with H. Gabrielse).

ECONOMIC GEOLOGY SUBDIVISION

G.B. Leech

The Economic Geology Subdivision identifies and interprets through field and laboratory investigations the geological characteristics of mineral deposits and their relationships to features of their geological environments. It develops and applies metallogenic and geomathematical methods for the evaluation of the mineral resources of Canada. It provides information to government agencies and industry in support of the management and development of these resources.

The objectives of the Subdivision are: to relate the genesis of economic concentrations of mineral commodities to the evolution of the geological framework of Canada; to determine regional and local geological features favourable to the occurrence of mineral deposits and geological guides to their discovery; to identify new types of mineral resources; to develop and apply metallogenical and geomathematical methods to estimate the distribution, character and amount of undiscovered resources.

The Subdivision integrates four main types of activities toward these objectives. The first is commodity metallogeny, the comprehensive study of all aspects of the geology of specific mineral commodities and groups of naturally related ones. The second activity, now getting underway, is regional metallogeny which relates the distribution and character of the mineral deposits within a region to the evolution of its geological features. The third activity is the development of geomathematical methods for the quantification, statistical analysis and interpretation of geoscience data, especially that related to mineral resources. The fourth activity is the development and operation of data banks and computer-based data management systems for the storage and retrieval of the data required for and generated by the other activities.

Metallogenic studies and regional mineral resource evaluations integrate data and interpretations derived from a wide range of the Geological Survey's activities. To facilitate this interchange, a series of seminars was held this year in which specialists in the geology of the respective regions of Canada co-operated in discussing them with the economic geologists. The seminars were generally successful in their triple purpose: to provide regional geological information to economic geologists; to alert other geologists to current metallogenic concepts and to the range of data required in resource evaluation; and to expose data-gaps.

Project Appalachia is an intra-divisional co-operative effort by members of the Mineral Deposits Geology, Geomathematics and Appalachian sections to combine regional geological, metallogenic and geomathematical data and concepts in the development and application of computer-based methods of regional mineral resource appraisal. It has now achieved a level of data-input that enables analyses to proceed.

Requests for advice and data in support of activities of other groups impose considerable pressures on members of the Subdivision. Within the Department, for example, our involvement in the Mineral Area Planning Study

(Mineral Development Sector) continued, as did geomathematical advice to the Institute of Sedimentary and Petroleum Geology for the evaluation of energy resources. Informal interchanges with experts in the mineral industry and universities are important.

Liaison and co-operative action with staffs of provincial and other governments concerned with mineral resource evaluation increased during the year. In this regard, there was concrete administrative recognition that to evaluate potential Canadian resources, selected experts should gain firsthand knowledge of certain types of mineral deposits that are economically important overseas. For this purpose one economic geologist studied nickel deposits and conferred with experts in Australia and Africa and another studied lead-zinc deposits in Eire and conferred in the field with specialists in France.

Attendance at meetings, conferences and courses

G.B. Leech
- International Symposium on Volcanism and Associated Metallogenesis; Bucharest, Roumania, September, 1973.
- Geological Association of Canada, Cordillera Section; Vancouver, February, 1974
- Prospectors and Developers Association, Toronto, March, 1974

F.D. Anderson
- Prospectors and Developers Association, Toronto, March, 1974

Special talks or lectures

G.B. Leech
- "Mineral Resource Evaluation Methodologies", Prospectors and Developers Association, Toronto, March, 1974

Membership on committees

G.B. Leech
- Working Group on Global Tectonics, Commission for the Tectonics of Ore Deposits (International Association for the Genesis of Ore Deposits)
- Committee for the Metallogenic Map of North America (Subcommission for the Metallogenic Map of the World)
- Society of Economic Geologists - Publications Committee
- Committee on the History of the Geological Survey (chairman)

Special Projects

The Special Projects group conduct the Uranium Program (H.W. Little) and the Iron and Manganese project (C.R. McLeod, acting). All available personnel of the Special Projects group attended through the winter in-house workshops held in Ottawa that comprised regional reviews of the Appalachian Orogen and the Canadian Shield. These were successful in integrating economic and regional geology through mutual exchange of information and concepts.

Uranium Program

The principal activity in the uranium program was the collection of geological data on uranium deposits and occurrences and their environments for updating reserve figures and resource estimates. Field trips were made by H.W. Little to Nova Scotia, New Brunswick, Prince Edward Island, Quebec, Ontario, Manitoba and Saskatchewan, and by A. Boyer to Quebec, Ontario, Manitoba and Saskatchewan. In February, Dr. Little Attended the GSC regional review workships in Calgary and Vancouver, which dealt with the geology of the Arctic Islands, Interior Platform, and Cordilleran Province. The balance of the year was spent in laboratory investigations and preparation of manuscripts for publication. An increase in consultation by exploration geologists was noted during the year.

Iron and Manganese Project

G.A. Gross continued to head the Commonwealth Geological Liaison Office in London, England.

C.R. McLeod continued the collection and compilation of data on iron and manganese deposits, with particular emphasis on the composition of iron-formation. He also made brief visits to mines and occurrences in Superior and Grenville Provinces. In connection with manganese deposits, which includes mineral resources on the ocean floor, Mr. McLeod attended a two-day meeting and a one-day course on marine mineral exploration.

Attendance at meetings

H.W. Little
- Canadian Institute of Mining and Metallurgy, Vancouver, April, 1973
- Geological Association of Canada, Cordillera Section, February, 1974

C.R. McLeod
- Fourth Underwater Mining Institute, Milwaukee, Wisconsin, April, 1973

Membership on committees

H.W. Little
- International Atomic Energy Agency (Working Group No. 2)

Special talks

H.W. Little - "Uranium Deposits in Canada", Canadian Institute of Mining and Metallurgy, Annual Meeting, Vancouver, April, 1973

Geomathematics Section

F.P. Agterberg

The objective of the section is to carry out a program of research in order to develop mathematical methods for the quantification, statistical analysis and integration of geoscience data of various types. Attempts are made to correlate patterns of occurrence of various types of mineral deposits with combinations of parameters systematically quantified for the geological framework in selected regions of Canada.

During the year, several existing projects of data acquisition and development of data management systems were completed or nearing completion. A new approach is that the data on mineral deposits and geological framework, to be used for statistical analysis, are now obtained in closer collaboration with regional and mineral deposit geologists.

Several multivariate statistical models were tested. The purpose of this activity is to improve predictions based on the assumption that every geological environment, as quantified for relatively small cells, has a probability, ranging from zero to one, that it contains one or more deposits of a specific type. By assuming that deposits discovered in the past constitute a fraction of all deposits of the same type, these models attempt to estimate the number of undiscovered deposits in a study region.

A project by the Section dealing with the spatial distribution of sulphur in coal of the new Lingan Mine near Sydney, Nova Scotia, was finalized. It will, however, be continued by the Cape Breton Development Corporation which has hired a geostatistician to attempt to predict sulphur content of blocks of coal before mining.

Personnel notes

A.G. Fabbri was granted 9 months leave of absence, starting in August, 1973, to work at GEOTECNECO, a company of the ENI Group located in San Lorenzo in Campo, Italy. He organized the storage and retrieval of field data for GEOTECNECO's environmental and economic geology projects.

A.M. Kelly was transferred to Planning and Evaluation at Energy, Mines and Resources Headquarters in October, 1973. He was on loan during the remainder of the year.

R.M. Laramee was made permanent staff during the year after being with the section as a casual employee since 1971.

A.C. Bartlett-Page, casual employee, left in July, 1973 to return to University.

R.R.S. Divi, C. McCann, and A.S. Wong were on staff as casual employees during the year, mostly working on Project Appalachia.

Dr. J.S. Springer, Thornhill, Ontario, completed her work on contract for the Section in March, 1974, thereby terminating a period of collaboration that had lasted 4 years.

Attendance at meetings, conferences and courses

F.P. Agterberg
- Canadian Institute of Mining and Metallurgy, Annual Meeting, Vancouver, April, 1973
- Mining Symposium, Pribram, Czechoslovakia, October, 1973
- Second Chautauqua on Geologic Data Analysis with Computers, University of Syracuse, New York, November, 1973

C.F. Chung
- Sampling: Theory and Method, and Advanced Design of Sampling Surveys, Carleton University, Ottawa, 1973, 1974
- Second Chautauqua on Geologic Data Analysis with Computers, University of Syracuse, New York, November, 1973

A.G. Fabbri
- Mining Symposium, Pribram, Czechoslovakia, October, 1973

A.M. Kelly
- Geological Association of Canada, Annual Meeting, Saskatoon, May, 1973

R.M. Laramee
- American Management Research (AMR International), seminar on Data Base Design, Toronto, March, 1974

Special talks or lectures

F.P. Agterberg
- "Geomathematical prediction of sulphur in coal, New Lingan Mine area, Sydney Coalfield, Nova Scotia", Paper presented at Canadian Institute of Mining and Metallurgy, Annual General Meeting, Vancouver, April, 1973 (with C.F. Chung)
- "Probabilistic models to evaluate regional mineral potential", Invited paper presented at Pribram Mining Symposium, Pribram, Czechoslovakia, October, 1973
- " 6 lectures on geomathematical subjects in Italy, October, 1973, sponsored by University of Milano and ENI (Milano); EURATOM (Ispra); GEOTECNECO (San Lorenzo in Campo); University of Rome; and Comitato Nazionale Energia Nucleare (Santo Maria Galeria)
- "Automatic contouring of geological maps to detect target areas for mineral exploration", Invited paper presented at 2nd Chautauqua on Geologic Data Analysis with Computers, University of Syracuse, November, 1973
- "Statistics in Geology", Course GEO 3100 University of Ottawa (21 lectures), January-April, 1974
- "Methodology of Geomathematics", lecture at Geology Department, Univ. of Ottawa, March, 1974

A.G. Fabbri
- 3-day Seminar on: "Utilization of Computer programs for statistical analysis of laboratory data in paleomagnetism, sedimentology and structural geology", Laboratory of Marine Geology, Consiglio Nazionale delle Ricerche, Bologna, Italy, March, 1974

A.K. Kelly
- "Designing and Building Computer-based Mineral Deposits Files", Geological Association of Canada, Saskatoon, May, 1973 (with K.L. Gunn and G.D. Williams)

Membership on committees

F.P. Agterberg
- Associate Editor, Canadian Journal of Earth Sciences
- Computer Applications and Process Control Committee of Canadian Institute of Mining and Metallurgy (Representative of CIM Geology Division)

C.F. Chung
- Branch Computer Facilities Committee (since October, 1973)

A.G. Fabbri
- Secretary, Commission on the Tectonics of Ore Deposits (IUGS-sponsored)

A.M. Kelly
- Branch Computer Facilities Committee (until October, 1973)
- Mineral Deposits Working Committee (sponsored by Canadian Centre for Geoscience Data)

Completed manuscripts

The following manuscripts were accepted and approved by the Division.

Agterberg, F.P.

(in press): Automatic contouring of geological maps to detect target areas for mineral exploration; J. Mathematical Geol.

Mineral Deposits Geology Section

D.F. Sangster

Charged with the responsibility of attaining a broad knowledge of all major types of Canadian mineral deposits, this Section comprises 13 geologists (9 Research Scientists, 4 Physical Scientists) and one Precision Worker. Studies are currently underway on the geology of 17 elements (metallic and non-metallic) and the rare earths; in addition, two projects have been concerned with detailed mineralogical aspects of certain types of mineral deposits, chiefly nickel and porphyry copper.

The Section program can be expressed in terms of the following activities:

1) comprehensive geological studies of all aspects of selected elements and the manner in which these are concentrated in the Earth's crust;
2) metallogenic studies of large geological segments of Canada to relate the distribution and nature of mineral deposits within the geological framework of these segments;
3) a geologically-oriented merging of the above activities as the basis for estimations of the mineral potential of selected regions or the nation as a whole;
4) provision of advice and geological information on Canada's mineral deposits for mineral policy, socio-economic assessments, land-use studies and related matters.

Significant accomplishments during 1973-74 were the following:

a) the Section actively participated in and contributed to 16 days of Regional Geology Reviews in conjunction with other members of the Branch. The purpose of these sessions was to review the geology and mineral deposits of selected regions in Canada in order to assist in the planning of future geological mapping and to bring to commodity geologists a new awareness of the geology and metallogeny of these areas;

b) members of the Section made major contributions to an intra-Departmental Mineral Area Planning Study initiated by the Mineral Development Sector and participated in the early stages of the Non-Renewable Resource Evaluation Program portion of the Western Economic Opportunities Conference in conjunction with other Branches of the Department as well as the Manitoba Department of Mines;

c) some Section members continued their input of mineral deposits expertise into Project Appalachia, an intra-Divisional research project aimed at machine-integration of geological and mineral deposits data of the Canadian Appalachian region. The objective of this program is broadly aimed at improved methodology of mineral resource evaluation.

Personnel notes

Dr. J.L. Jambor's contribution to the field of mineralogy was recognized by having a mineral, jamborite, named in his honour. Jamborite has the chemical formula (Ni, Co, Fe) $(OH)_2$ (OH,S,H_2O) and is described in detail in Amer. Mineral., 1973, v. 58, p. 835-839.

Dr. T. Sato, a member of the Geological Survey of Japan, joined the Section in March, 1974 as a Visiting Scientist for one year. His objective is to compare and contrast the metallogeny of the Miocene Green Tuff region of Japan with a Canadian Archean greenstone belt. His presence in our group will also enrich the professional breadth of our staff.

Dr. O.R. Eckstrand was appointed Canadian Institute of Mining and Metallurgy Visiting Lecturer for 1973-74 and, in this capacity, addressed university student groups at Waterloo, Windsor, Western Ontario, Lakehead and Toronto.

Dr. D.F. Sangster was designated Canadian Institute of Mining and Metallurgy Distinguished Lecturer for 1973-74 and appeared before 13 Branches of the Institute across Canada.

Attendance at meetings, conferences and courses

K.R. Dawson - Geological Association of Canada, Cordillera Section, Vancouver

O.R. Eckstrand - Canadian Institute of Mining and Metallurgy, Annual Meeting, Vancouver

J.L. Jambor - Geological Association of Canada - Mineralogical Association of Canada, Annual Meeting, Saskatoon

R.V. Kirkham - Geological Association of Canada, Cordillera Section, Vancouver
- Canadian Institute of Mining and Metallurgy, Annual Meeting, Vancouver
- Prospectors and Developers Association, Annual Meeting, Toronto

R. Mulligan
- Canadian Institute of Mining and Metallurgy, Annual Meeting, Vancouver

J.Y.H. Rimsaite
- Clay minerals Society, 10th meeting, Banff
- II Congreso Latinoamericano de Geologia, Caracas, Venezuela

E.R. Rose
- Tenth Rare Earth Research Conference, Carefree, Arizona

D.F. Sangster
- Geological Association of Canada - Mineralogical Association of Canada, Annual Meeting, Saskatoon
- Manitoba-Saskatchewan Review of Field Activities, Winnipeg and Regina
- Geological Association of Canada, Cordillera Section, Vancouver
- Canadian Institute of Mining and Metallurgy, Annual Meeting, Vancouver
- Prospectors and Developers Association, Annual Meeting, Toronto

R.I. Thorpe
- Society of Economic Geologists, Annual Meeting, Dallas, Texas
- Government-Industry "Geoscience Forum", Yellowknife
- Geological Association of Canada, Cordillera Section, Vancouver
- Prospectors and Developers Association, Annual Meeting, Toronto

Special talks or lectures

O.R. Eckstrand
- "Archean ultramafic volcanic rocks and nickel deposits in the Abitibi Orogenic Belt", McQuarrie Univ., Sydney, Australia
- "Serpentinization and nickeliferous opaque mineral assemblages", Mineral Exploration Group, Kalgoorlie, Western Australia
- "Archean ultramafic volcanic rocks and nickel deposits", Canadian Institute of Mining and Metallurgy, Visiting Lecturer, University of Waterloo, Windsor, and Lakehead University
- "Serpentinization and nickeliferous opaque mineral assemblages", Canadian Institute of Mining and Metallurgy, Visiting Lecturer, Universities of Western Ontario and Toronto

R.V. Kirkham
- "Porphyry deposits in the Canadian Shield; a preliminary evaluation", Canadian Institute of Mining and Metallurgy, Ann. Meeting, Vancouver
- "Environments of formation of concordant and penecon-cordant copper-deposits in sedimentary sequences", Geological Association of Canada, Ann. Meeting, Saskatoon, and Toronto Discussion Group, Toronto

- "Sulphide deposits formed in volcanic terranes", Geological Association of Canada, Cordillera Section, Vancouver

J.Y.H. Rimsaite
- "Origin of jarosite and Ni-goethite in the oxidation zone of a Canadian nickel deposit", 10th Clay Minerals Society Conf., Banff
- "Application of micas to the study of the age and genesis of mineral deposits", II Congreso Latinoamericano de Geologia, Caracas, Venezuela
- "Effects of Rb-metasomatism on Rb/Sr and $^{87}Sr/^{86}Sr$ ratios in pegmatitic minerals and host rocks", II Congreso Latinoamericano de Geologia, Caracas, Venezuela

D.F. Sangster
- "Lead and zinc mineralization in sedimentary rocks: ore and protore", Geological Association of Canada, Ann. Meeting, Saskatoon
- "Isotopic studies of ore-leads of the circum-Kisseynew volcanic belts of Manitoba and Saskatchewan", Geological Association of Canada, Ann. Meeting, Saskatoon
- "Modern Canadian views on the geology of zinc and lead deposits in limestone and dolomite", Irish Mining and Quarrying Society, Nenagh, Ireland
- "Canadian Precambrian volcanogenic massive sulphide deposits", B.R.G.M., Orleans, France
- "Stratabound lead-zinc deposits: All in the family or just good friends?", Toronto Discussion Group, Toronto
- "An inquiry into the formative environments of volcanogenic massive sulphide deposits" - Adams Geology Club, McGill Univ., Montreal
- "Relationship between stratabound lead-zinc ores and their host rock lithologies" - Canadian Institute of Mining and Metallurgy, Distinguished Lecturer, presented to the following Branches: Calgary, Ottawa, Winnipeg, Lynn Lake, Flin Flon, Snow Lake, Quebec City, Cobalt, Kimberley, Edmonton, Pine Point, Victoria and Thunder Bay
- "An example of a national mineral appraisal: lead and zinc", Prospectors and Developers Association, Ann. Meeting, Toronto

R.I. Thorpe
- "Lead isotope evidence on the genesis of the silver-arsenide vein deposits of the Cobalt and Great Bear Lake areas, Canada", Society of Economic Geologists, Dallas, Texas
- "Genetic models for certain deposits in the Precambrian of Mackenzie and Keewatin districts", Government-industry Geoscience Forum, Yellowknife

Membership on committees

O.R. Eckstrand	- Associate Editor, Geoscience Canada - Mineral Deposits Section representative, Departmental discussion group on Deep Ocean Mining
J.L. Jambor	- Executive Committee member, Mineralogical Association of Canada
C.R. McLeod	- Mineral Deposits Section representative, Departmental discussion group on Deep Ocean Mining
D.F. Sangster	- Age Dating Committee, Geological Association of Canada - Chief Treasurer, International Association on the Genesis of Ore Deposits - Editorial board, Economic Geology

Production statistics

Mineral Deposits Laboratory

C.R. McLeod

Preparation of polished sections:

Regional and Economic Geology Division	
Economic Geology Subdivision	126
Correlation and Standards Subdivision	79
Precambrian Subdivision	89
Resource Geophysics and Geochemistry	24
Central Laboratories and Technical Services	6
Institute of Sedimentary and Petroleum Geology	2
Total	326

Specimens cored	67
Large specimens slabbed	406
Large specimens polished	227

Completed manuscripts

The following manuscripts were accepted and approved by the Division.

Jambor, J.L.
(in press): Trace element variations in porphyry copper deposits, Babine Lake area, B.C.; Can., Geol. Surv., Paper 74-9.

Mulligan, R.
1974: Geology of Canadian tin deposits; Can., Geol. Surv., Econ. Geology Rept.

Thorpe, R.I.
(in press): Lead isotope evidence on the genesis of the silver-arsenide vein deposits of the Cobalt and Great Bear Lake areas, Canada; Econ. Geol.

Mineral Data Bank

D.R.E. Whitmore

The Mineral Data Bank is the repository for, and secondary source of geological data on mineral deposits in the Geological Survey of Canada. For the principal mineral commodities it works with the Mineral Deposits Section in the collection of data and the standardization and computerization of files. For the rest, it maintains watching briefs to provide data for mineral potential or other studies on request.

Assistance to the Mineral Deposits Section involves reviewing and keeping abreast of current exploration and economic geological literature to bring pertinent data to the attention of the commodity geologists. At the same time data related to watching briefs are extracted and filed.

A review of newly discovered and currently active mineral deposits with their location and geological background, is circulated via the internal report UPDATE. Computer assistance in its preparation, attempted during the year, was discontinued at the year end as being too time consuming without back-up files of geological and locality data. When these back-up files are available, use of the computer may become efficient and will be reconsidered. One such back-up file began development during the year. It is the OPSEP test file covering some 100 of the 700 deposits considered in the mineral potential study, Operation September. The OPSEP file is designed to provide basic geological data in a form that can be retrieved and manipulated in future studies of this type. To this end it is linked with related files (MEPI, RESERVES) in the Mineral Development Sector.

Personnel notes

Mrs. P. Moyd joined the staff of the unit early in 1974. She brings a background of experience in the geology of industrial minerals that is valuable in the maintenance of watching briefs in this area.

Mr. D. Rose took several computer courses in the Department in connection with the work on UPDATE. To further his familiarity with mineral deposits in the field he assisted Dr. K.R. Dawson in the examination of barite and fluorite deposits for a short period in May, 1973.

Attendance at meetings, conferences

D. Rose - New England Intercollegiate Geological Conference, Fredericton, October, 1973.

CORRELATION AND STANDARDS SUBDIVISION

J.E. Reesor

The Subdivision comprises Geochronology, Eastern Paleontology and Petrology Sections, with responsibility to provide correlation of geological events and measurement of geological time as essential to regional geological and economic studies in the Division. The Petrology Section provides Canada-wide studies of particular rock-types such as alkaline rocks and anorthosites as well as specialized and regional studies of metamorphism.

At present, one of the main 'thrusts' of the Subdivision is in the field of isotope geochronology employing K/Ar, Rb/Sr and Pb/U/Th techniques under the direction of R.K. Wanless. The zircon method has received particular attention in the past year with development of refined laboratory techniques combined with automation of mass-spectrometers that allows very small amounts of ziron to be used in age determination. Because of this, smaller samples are required with resulting increased productivity such that zircon determinations are available to the field geologist in time to influence and guide work in the following field season.

In Eastern Paleontology Section, W.T. Dean continued his specialized stratigraphic and faunal studies in Newfoundland. Trilobite assemblages in Newfoundland have been related to Pacific, 'Tethyan' and British Ordovician assemblages and are of great significance in deciphering the tectonic development of the Canadian Appalachian region.

T.N. Irvine, currently on leave from the Petrology Section with the Geophysical Laboratory in Washington, D.C., participated in an operation in north central British Columbia undertaken by the Cordilleran and Pacific Margin Subdivision. In cooperation with the members of that unit he studied ultrabasic rocks of the Takla Group in which he recognized the occurrence of small ultrabasic masses as being associated with the volcanic assemblages and possibly indicating volcanic centres. If this proves to be so, locating such centres has wide application in mineral exploration; thus the broad theoretical study of ultrabasic rocks can have immediate application.

Personnel notes

The Correlation and Standards Subdivision was formed in March, 1973. D.G. Benson joined the Subdivision as staff geologist after many years of work in the Appalachian Section. In February, 1974, J.E. Reesor assumed duties as Chief, Regional and Economic Geology Division.

Attendance at meetings, conferences and courses

D.G. Benson - Computing Science Course, Carleton University, Ottawa, April, 1973

Membership on committees

D.G. Benson - Interdepartmental Committee for Diving Safety, National Research Council of Canada

Petrology Section

E. Froese

The Petrology Section studies the processes and conditions of formation of igneous and metamorphic rocks. The work seeks to integrate results obtained by field observation, experiment and theory.

Field-oriented projects, some carried out in direct cooperation with geologists in other sections, contribute to an understanding of geological problems including relationships of ores to host rocks. Experiments calibrate phase relations observed in rocks, and theory provides a logical framework for both observation and experiment. Theory also allows consistency checks, helps in the guidance of further work and permits calibration by means of calculations.

The geologists of the Petrology Section are available for consultation and the laboratories are accessible to other investigators. The Petrology Section maintains for the Branch the lapidary facilities, a general petrology laboratory, and a representative rock collection (curator: W.U. ter Haar Romeny).

Attendance at meetings

K.L. Currie
- Northeastern Intercollegiate Geological Conference, Fredericton, October, 1973
- Trans-Newfoundland Field Trip, May, 1973

R.F. Emslie
- Symposium on Evolution of the Grenville Province, University of Ottawa, February, 1974

T.M. Gordon
- COGEODATA Meeting, Paris, November, 1974

T.N. Irvine
- American Geophysical Union Meeting, Washington, April, 1973
- Chromium Conference, Geophysical Laboratory, Washington, January, 1974

Membership on committees

K.L. Currie
- International Union of Geological Sciences, Subcommittee on lamprophyre nomenclature

R.F. Emslie
- Organizing Committee for Symposium on Evolution of the Grenville Province

T.M. Gordon
- Branch Computer Working Group
- Branch Age Determination Committee
- Working Group on Field Data of the Subcommittee on Computer Applications of the National Advisory Council on Research in Geological Sciences

Special talks

R.F. Emslie
- "Anorthositic rock suites and their tectonic implications", McGill University, November 1973
- "Anorthosites and related rocks of the Grenville Province", University of Ottawa, February, 1974

E. Froese
- "Applications of thermodynamics in metamorphic petrology", University of Goettingen, October, 1973

T.M. Gordon
- "Applications of linear programming to problems in petrology", Carleton University, March, 1974

T.N. Irvine
- "Petrology of the Duke Island ultramafic complex", University of Pennsylvania at Philadelphia and George Washington University
- "Petrology of the Muskox Intrusion", University of Wisconsin; University of Milwaukee; Geophysical Laboratory, Washington

Completed manuscripts

The following manuscripts were accepted and approved by the Division.

Currie, K.L.
(in press): Notes on the petrology of nepheline gneisses from Copeland Mountain, B.C.; Can. Geol. Surv., Bull.

Irvine, E., Emslie, R.F. and Park, J.K.
(in press): Paleomagnetism of the Morin Complex; J. Geophys. Res.

Petrology laboratory

M. Turay

The petrology laboratory provides equipment and help for petrographic investigations and certain mineral separations. Petrographic services carried out on request include specific gravity, mineral composition determinations, mineral staining, special petrographic studies, determination of optical properties of minerals and development of new petrographic techniques.

The laboratory also provides occasional help for the classification of samples in the representative rock collections (Curator, W.U. ter Haar Romeny).

The chemistry laboratory, room 741 is used for wet chemical work (mineral staining etc.) and for mineral separation.

Work performed during the report year

mineral staining: 146
separation: 4
X ray powder diffraction: 52
petrographic determinations: 134

The petrographic determinations included 42 artifacts and 2 rock painting support walls for the National Museum of Canada. The other determinations are part of a study of volcanic rocks in collaboration with Dr. E. Cameron and C. Durham.

The laboratory is currently involved in the preparation and evaluation of standard curves for quantitative analysis of basic volcanic rocks by X ray diffraction.

M. Turay attended a course in X ray diffraction instrumentation offered by Philips Electronic Instruments in Mount Vernon, New York, and a work-shop in fission track dating given by the Extension Division, Carleton University, Ottawa.

Lapidary Services

A.E. Whitehead

The lapidary has a three man staff consisting of A.E. Whitehead (Supervisor), Y. Demers and M. Beaulne.

Work Report for 1973-74

(1)	Standard thin sections with small, large and no cover slips	2780
(2)	Standard oriented thin sections with small, large and no cover slips	73
(3)	Large oriented thin sections, with or without cover slips	201
(4)	Polished thin sections	111
(5)	Oil thin sections with small, large and no cover slips	17
(6)	Stained thin sections with large cover slips	44
(7)	Grain thin sections with small, large and no cover slips	82
	Total	3308

Man Hour Jobs 1973-74

(1)	Large and small polished surfaces	431 = 66 1/2 hrs.
(2)	Trim saw cuts	3002 = 50 3/4 hrs.
(3)	Other duties	580 =142 hrs.
	Total	4013 =259 1/4 hrs.
(4)	Slab saw cuts	493 =211 3/4 hrs.

Special jobs

(1) Four ceramic discs were resurfaced for Mr. Lavergne. These discs could then be re-used, resulting in considerable saving.
(2) Twenty-one ceramic crucibles were ground and levelled for J. Paris.
(3) Samples of jade were prepared for the Economic Geology, Embassy and National Film Board Collections.
(4) Coal pieces were squared off to 5 mm thick, squared rods 1.5 cm were made from rough samples, and a 5 mm thick slice was prepared for Dr. Katsube for electrical rock properties studies.
(5) Mounted grains were polished for Dr. Emslie.
(6) Samples were prepared for auto-radiographs, and a glass was ground to fit a camera slot.
(7) Numerous samples were stripped of weathered surfaces prior to chemical analysis and staining.
(8) Bubbles were removed from a microscope gauge for Dr. Wanless.
(9) Twelve rock samples were polished for A. Stenson to be used for her publication on Newfoundland.
(10) 26 heavy, and 26 light grain sections were ground for J. Clague for his post-doctorate research.
(11) One cube was made from a rough rock sample and one surface was polished for Dr. Ermanovics.

(12) A series of slices were cut and ground to 3 mm thickness for Dr. Jackson.
(13) Mr. Steacy requested a piece of labradorite polished for a publication.
(14) For G. Lachance we ground a square glass circular to fit a microscope adapter.
(15) We made difficult sections requested by the Department of Indian Affairs from artifacts; International Airport Halifax, N.S. submitted by the Department of Transport from cement taken from the airport runway; and grain mounts requested by Dr. Sims, Mount Allison University.
(16) We did 40 thin sections from polished mounts from R. McLeod's laboratory for Dr. Gasparrini. This was the first of this kind of a section which was mounted on a standard glass slide and later transferred to a 1" circular slide with the polished surface up.
(17) Ridge Williams, Museum of Man, requested material slabbed, ground and polished for new exhibits in the Museum to be opened in 1974. We polished 13 large samples 3/4" thick for a wall mural and extremely large samples of iron ore, ground a 3 section drill core and a very large iron ore sample to fit a special stencil all for display purposes.

Plaques and Mementos

Book Ends

We made a set of book ends from porphyry requested by Surveys and Mapping Branch for Dr. J. Hodgson on retirement.

Plaques

(1) Plaques for 25 years service were made from Bruce Mines Conglomerate with the G.S.C. crest and name plates for 10 employees.
(2) K. Pollitt requested an engraved plate be obtained for the "Red Feather Trophy", to be presented to the winning division at the Christmas party.
(3) A plaque from lepidolite was made for Geodetic Survey for M.E. Neidd on his retirement.
(4) A plaque from granite with 2 bench marks was made for Legal Surveys for C.M. Duncan on his retirement.

Paper Weights were presented to Elaine Stephenson, F. Cooke, R.H. Ahrens, Bev Richard, Bonnie Evans, J. Stauffer, M. Koops, M. McAllister, Mrs. Louis Doubois-Rochon, and Dr. B. Collins on their departures. We also made 4 paper weights to be presented to guest speakers of the Logan Club.

Other activities

Consultations

(1) Lapidary techniques were discussed with the author of an article for the Lapidary Magazine.

Experiments

(1) We aided the chemistry division in their experiments by grinding and polishing 5 aluminum and 2 stainless steel 2" discs; we reduced the diameter of 4 combustion chambers to be used in an induction furnace.
(2) We ground and polished some sections for Dr. Frisch on 1" circular slides.

Geochronology Section

R.K. Wanless

The Geochronolgy Section undertakes isotopic determinations in support of geochronological investigations and stable isotope studies. Specifically, it is responsible for the development of techniques and measurement apparatus, the application of K-Ar, Rb-Sr and U-Th-Pb dating methods to geochronological investigations, and the determination of stable isotope ratio variations of sulphur, carbon and lead.

The K-Ar dating method provides a relatively rapid and inexpensive means of obtaining information pertaining to the age and/or metamorphic history of rocks and finds application in all regions of the country. During the past year, 210 determinations have been reported and one publication containing 163 age reports has been published.

The Rb-Sr whole-rock dating technique finds application in terranes where ages based on the K-Ar method reflect younger geological events that have affected the rocks. This method has been utilized to identify and precisely date supracrustal rocks in the Churchill Structural Province and to illustrate that Archean rocks are extensively distributed within this vast region originally believed to be primarily made up of rocks 800 m.y. younger. Last year 25 suites of rocks, for the most part from the shield areas of Canada, have been successfully dated using this technique and 7 other suites were tested for suitability and rejected because the elemental abundance distribution was inadequate. A Geological Survey of Canada publication incorporating the results of several of these investigations is currently being prepared and one major paper dealing with a detailed geochronological investigation in the District of Keewatin has been submitted for publication in a scientific journal.

As indicated above it is often impossible to apply the Rb-Sr technique because the rocks do not possess appropriate concentrations of rubidium and strontium. Some rocks falling in this category do, however, contain sufficient quantities of the mineral zircon, which can be dated by employing the U-Th-Pb analytical techniques. This method is particularly useful when attempts are being made to identify and precisely date basement formations. Significant improvement in analytical techniques has resulted from a major 'thrust' made in this area during the year. Very small samples of zircon (1 to 3 mg) may now be processed routinely, thus drastically reducing the quantity of rock that must be collected and transported to Ottawa for crushing and processing, and simultaneously extending the possible application of the technique. In addition the 'blank' lead contamination, arising from laboratory air and in

reagents, has been markedly reduced to a level of 1 to 2 x 10^{-9} grams per extraction. This accomplishment has also expanded the applicability of the method and has increased the precision of the resulting age calculations. Thirty extractions have been completed and at the current rate of production we anticipate approximately one hundred determinations will be undertaken during the coming year.

The U-Pb ages obtained have in some instances served to confirm earlier age assignments made on the basis of Rb-Sr studies but in other locations much older ages have been found. For example, in southern British Columbia rocks as old as 1900 m.y. have been identified within the Mesozoic Sushwap Metamorphic Complex and other units of the Complex have yielded mid-Paleozoic ages. Further, on Vancouver Island, zircons collected from the Westcoast Crystalline Complex have yielded an age of 265 m.y. and thus provide the first isotopic evidence of late Paleozoic basement rocks in the area.

Stable isotope analyses of sulphur and carbon bearing materials are undertaken for the Mineral Deposits Section and the Radiocarbon Laboratory respectively. The former are applied to the study of ore bodies and their host rocks whereas the latter are used to provide a correction to radiocarbon age measurements. This year 110 sulphur and 210 carbon isotopic analyses were completed.

The Geochronology Section is also responsible for the development of specialized high vacuum apparatus and extraction techniques required to sustain the research projects being undertaken. In addition to the improvements (noted above) realized in the lead extraction procedures, a new method has been developed for filling glass tubes with enriched argon-38 gas. This apparatus comprises a stainless steel vacuum vessel and a calibrated stainless steel valving system designed to precisely apportion very small quantities of the enriched argon-38 gas used to determine the concentration of radiogenic argon in rock and mineral samples. The laboratory computer facility has now been expanded through the addition of a disc storage system and additional core memory. Programs have been prepared to handle all routine isotopic abundance and age calculations and good progress has been made with the design of interconnecting units required to interface the six operating mass spectrometers with the computer. It is anticipated that it will be possible to simultaneously transfer all analytical data directly to the computer for manipulation and final calculation within the next six months.

Personnel notes

A new permanent technician position for the Rb-Sr sample preparation laboratory was established and Mrs. Sharon Lindsay was appointed on August 27, 1973.

Mr. M. Côté was hired as a technician in the stable isotope laboratory on December 27, 1973.

Membership on committees

R.K. Wanless
- Secretary, Subcommittee on Isotope Studies and Geochronology, National Research Council Associate Committee on Geodesy and Geophysics
- Member, Geological Survey of Canada Age determination committee

Production statistics

Argon extractions	197
Argon isotopic analyses	257
Potassium isotope dilution determinations	203
K-Ar ages reported	210
Rubidium isotopic analyses	184
Strontium isotopic analyses	234
Rb-Sr isochron projects	25
Lead isotopic analyses	137
Uranium isotopic analyses	39
Thorium isotopic analyses	12
Zircon-sphene analyses completed	30
SO_2 isotopic analyses	110
CO_2 isotopic analyses	210

Eastern Paleontology Section

W.T. Dean

The work of the Section's four research scientists deals with the study, description and biochronological evaluation of Paleozoic faunas and floras, mostly from eastern Canada but also from western and arctic Canada and elsewhere. Support is provided by a technical and laboratory staff of four who are responsible for the extraction and preparation of both marco- and microfossils, and for the cataloguing of collections of Canadian fossils obtained by geologists of the Geological Survey of Canada in the course of their field work. Twenty-six scientific reports on 231 lots of fossils were written for and with members of both Geological Survey of Canada and research institutions in North America and Europe.

M.J. Copeland continued investigation of Ordovician to Devonian ostracode faunas of Yukon Territory, Northwest Territories and Appalachian Canada, partly in association with officers of the United States Geological Survey.

W.T. Dean carried out investigations of Cambro-Ordovician rocks and fossils in Newfoundland, as well as related problems in the Taurus Mountains of southern Turkey, in collaboration with geologists of the Université de Paris-Sud, the latter work being initiated under the France-Canada scientific exchange programme.

W.H. Fritz continued work on the stratigraphy and faunas of Cambrian rocks in the Yukon, and examined comparative Cambrian stratigraphic sequences in California.

D.C. McGregor returned from a one-year assignment with the United Nations Office of Technical Co-operation at the Bolivian Government's Centro de Tecnologia Petrolera in Santa Cruz, Bolivia.

Attendance at meetings, conferences and courses

M.J. Copeland
- Discussions at United States Geological Survey on ostracode biostratigraphy of Yukon Territory and Alaska, Washington, D.C., April, 1973
- Discussions on preparation of earth science educational publications in United States Geological Survey, Washington, D.C., January, 1974

W.T. Dean
- Symposium on Trilobita and Trilobitoidea, Oslo, Norway, July, 1973

W.H. Fritz
- Cordilleran Section, Geological Society of America, Las Vegas, March, 1974

Special talks or lectures

M.J. Copeland
- "Ordovician stratigraphy and paleontology of the Ottawa area, Ontario and Quebec", Earth Science Editors Meeting, Ottawa, October 2, 1973
- "Ordovician stratigraphy of the Ottawa region", Canadian Institute of Mining Metallurgy, Ottawa chapter field trip, October 20, 1973
- "Collection of minerals and fossils", seminar of Canadian Government Travel Bureau, Information Services, Ottawa, December 13, 1973

W.T. Dean
- "Cambrian and Ordovician correlation and trilobite distribution in Turkey", Oslo, Norway, July, 1973

Membership on committees

M.J. Copeland
- Chairman, Branch Earth Science Education Committee

D.C. McGregor
- Commission Internationale de Microflore du Paleozoique, contributing member and North American secretary for Stratigraphic Palynology
- International Union of Geological Sciences, regular member of Subcommission on Devonian stratigraphy
- American Association of Stratigraphic Palynologists, member of Committee for International Affairs

Production statistics

Paleontology Preparation Laboratory Services

Name	Saw Cuts	Thin Sections	Polished Sections	Rubber Molds	Plaster Casts	Rubber Casts	Mech. Prep.
Bolton, T.	464	236	1	10	31	3	44
Copeland, M.J.	12	8	1	19	35		50
Dean, W.T.	179			6	12		1
Frebold, H.	38			161	206	64	82
Fritz, W.H.							189
Jeletzky, J.A.				16	32	2	
Tozer, E.T.	10			60	120	6	
Divisional & Branch Services							
Benson, D.	1						
Marriott, R.	242						
Rheinhardt, W.	184						
Jackson, G.D.							3
Experimental Farm	63						
Tipper, H.W.				173	206		10
Poulton, T.				3	6	5	
Harker, P.	- Retirement Plaque						
National Museum of Canada				15	30		
TOTAL	1193	244	2	463	678	80	379

Parcels received 258
Parcels shipped 374
Fossil localities recorded
Invertebrates (GSC #89779 to 91048)..... 1269
Plants (GSC #9110 to 9250) 140

The Technical Curator, B.J. Botte coordinated six Standard First Aid Training Courses within the Department. He also attended a three-day Industrial Accident Prevention conference in Toronto, and various other meetings in Ottawa on Occupation Health and Safety sponsored by the Department.

Micropaleontology Laboratory Services

50 Ordovician rock samples were processed for the recovery of conodonts. 44 Silurian/Devonian samples were examined for ostracodes.

Paleopalynology Laboratory Services

401 samples were prepared by technician P. Higham for recovery of miospores, megaspores, acritarchs, chitinozoa and miscellaneous palynomorphs. From the resulting residues 1055 assemblage slides were prepared and megaspores were picked from 50 samples.

Type Fossil Collection

Thomas E. Bolton continued as Curator of the National Type Collection of Invertebrate and Plant fossils. A total of 1,915 type specimens described in both Survey and outside publications was added to the collection in 1973. Publications in which these types were reported are as follows:

GSC Bull. 215 -	Brachiopods, Silurian, Nova Scotia	399 types
221 -	Palynomorphs, Devonian, Ontario	133
222 -	Contrib. Can. Paleontology	130
223 -	Trilobites, Ordovician, Yukon	46
GSC Paper 72-28 -	Bryozoans, Interglacial, Arctic	8
72-43 -	Ostracodes, Ordovician, Quebec	216
73-24 -	Trilobites, Cambrian, N.W.T.	114
		1,046

Types in Outside Publications:

Barnes, C.R. and Poplawski, M.L.S. (Univ. Waterloo) J. Pal., 47:4	160
Berdan, J.M. (USGS) and Copeland, M.J. (GSC), USGS Prof. Paper 825	86
Brideaux, W.W. (GSC), Bull. Can. Petrol. Geol., 21:3	13
Copper, P. (Laurentian Univ), J. Pal., 47:1 and 47:3	9
Davis, G.R. and Nassichuk, W.W. (GSC), J. Pal., 47:2	4
Drahovzal, J.A. (USSR), Proc. Pal. Union	1
Edhorn, A.S.(Brock Univ.), Proc. Geol. Assoc. Can., 25	35
Frebold, H. and Tipper, H.W. (GSC), Can. J. Earth Sci., 10:7	34
Jackson, D.E. (Open Univ.), Palaeontology, 16:4	4
Jackson, D.E. (Open Univ.) and Lenz, A.C. (Univ. Western Ontario), Palaeontology, 15:4	54
Jeletzky, J.A. (GSC), Can. J. Earth Sci., 10:3	24
Johnson, J.G. (Oregon State Univ.), J. Pal., 47:3	23
Kennedy, H. (Ottawa), Fossils and geological features in the Ottawa Lowlands	7
Legault, J.A. (Univ. Saskatchewan), Can. J. Earth Sci., 10:5	7
Lenz, A.C. (Univ. Western Ontario), Can. J. Earth Sci., 10:9	23
Mamet, B.L. (Univ. Montreal), Rev. Micropaleont., 15:2	8
McGregor, D.C. (GSC), Palaeontographica, Abt. B, 142/1-3	130
Petryk, A.A. (INRS) and Mamet, B.L. (Univ. Montreal), Can. J. Earth Sci., 9:7	122
Rigby, J.K. (Brigham Young Univ.), Can. J. Earth Sci., 10:10	3
Rigby, J.K. (Brigham Young Univ.) and Nitecki, M.H. (Field Museum) Fieldiana Geol., 33:1	4
Rigby, J.K. and Terrill, F.M. (Brigham Young Univ.), Can. J. Earth Sci., 10:9	9

Sprinkle, J. (Univ. Texas), Mus. Comp. Zool. Harvard, Sp. Publ. ..... 30 types
Thusu, B. (Bristol Univ.), Palaeontology, 16:4 65
Waterhouse, J.B. (Univ. Toronto), Pal. J., 4 14

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Completed manuscripts

The following manuscripts were accepted and approved by the Division.

Copeland, M.J.

(in press): Biostratigraphic zonation of Devonian and Mississippian Ostracoda from Canada: a summary account; Int. Symposium on Micropalaeontological Limits, Namur, Belgium.

(in press): Ordovician Ostracoda from southwestern District of Mackenzie; Can., Geol. Surv., Bull. 244.

Dean, W.T.

(in press): Cambrian and Ordovician correlation and trilobite distribution in Turkey; Fossils and Strata, Oslo.

(in press): The trilobites of the Chair of Kildare Limestone (Upper Ordovician) in eastern Ireland. Pt. II; Palaeontogr. Soc., Monogr.

Fritz, W.H.

(in press): Lower and early Middle Cambrian formations near Mount Robson, British Columbia and Alberta; Can. J. Earth Sci.

Appalachian Section

W.H. Poole

Objectives of the Section are to define the composition of the rocks of the Appalachian geosyncline and their stratigraphy and structure; to determine their mode of origin and evolution; to provide information for the evaluation of the implication of these geological features on the mineral resource potential; and to publish the results in maps, reports and scientific papers. Owing to the small size of the Section, much of the information required to meet these objectives

is derived from monitoring the work of the provincial departments, universities and mining exploration companies.

Geological Field studies by the Section were mainly of a stratigraphic and structural nature. H. Williams, Memorial University, under contract to the Department, completed mapping of the Hare Bay klippe in Great Northern Peninsula, Newfoundland. H.H. Bostock completed a map and report of Precambrian rocks in the Strait of Belle Isle region, and L.M. Cumming continued preparation of a map and report on Paleozoic platformal rocks in the same region. These three studies will be integrated and published by the Geological Survey. The last area in Newfoundland to be examined under the Reconnaissance program will be that of Southern Avalon Peninsula; this study will be carried out by H. Williams, under contract, during 1974 and 1975. W.H. Poole spent much of the 1974 field season in Newfoundland visiting geological field parties of the provincial department, Memorial University and industry.

No field work by the Section was carried out elsewhere in the Appalachian region. W.H. Poole conducted H.H. Bostock and K.L. Currie (Petrology Section) through much of the area to familiarize them with regional occurrences of granitic and volcanic rocks, in preparation for projects to begin in 1974.

Advice and project evaluation were provided by W.H. Poole to mineral development programs in four eastern provinces, funded in part by the Departments of Regional and Economic Expansion, and Energy, Mines and Resources. In addition, he edited geological input data to Project Appalachia, a geomathematical analysis of geology and mineral deposits to determine the mineral potential of the Canadian Appalachian region.

Throughout the year, members of the Section were consulted by geologists and others from the mining and petroleum industries regarding potential resources in Eastern Canada, and by federal, provincial and consulting professionals regarding possible engineering works.

Personnel notes

On May 1, 1973, H.H. Bostock was transferred from Precambrian Subdivision to Appalachian Section. On June 1, 1973, Ralph Skinner was transferred from Appalachian Section to Precambrian Subdivision, to assume duties as staff geologist to the Subdivision.

Attendance at meetings, conferences and courses

H.H. Bostock
- Northeastern Intercollegiate Geological Conference, Fredericton, October 11-15, 1973
- Tertiary and Recent volcanoes, Iceland, July 22 - August 13, 1973.

L.M. Cumming
- Northeastern Intercollegiate Geological Conference, Fredericton, October 11-15, 1973
- Meeting, Engineering aspects of study regarding hydroelectric link across Strait of Belle Isle, Montreal December 4, 1973

W.H. Poole

- Northeastern Intercollegiate Geological Conference, Fredericton, October 11-15, 1973
- Central Canada University Geological Conference, Guelph, October 26, 1973
- International Geological Correlation Program, Correlation of Caledonian Stratabound Sulphide Project, organizational meeting, Stockholm and Oslo, November 26-29, 1973
- Symposium on Metavolcanic Massive Sulphides, McGill University, Montreal, November 30, 1973
- Atlantic Geoscience Society, Annual Meeting, Fredericton January 18-19, 1974
- Symposium on Tectonics of the Quebec Appalachians, University of Montreal, Montreal, March 7, 1974
- Atlantic Provinces; several meetings to discuss federal-supported mineral development programs being carried out by provincial departments of mines
- Public Service Commission, French Language School, Hull, March 27 - April 13; October 15 - November 2, 1973; January 21 - February 8, 1974

Special talks and lectures

L.M. Cumming

- "Geology of Gros Morne National Park, Western Newfoundland", Mount Allison University, Sackville, October 10, 1973
- "Abraham Gesner - Pioneer Geologist", Mount Allison University, Sackville, October 10, 1973
- "Ordovician strata of the Hudson Bay Region", Mount Allison University, Sackville, October 11, 1973
- "Geological Mapping in Gros Morne National Park and the occurrence of bedrock landslides in the Lookout Hills region", Parks Canada Headquarters Staff, Ottawa, January 31, 1974
- "Mathematics and Geology", Sir Winston Churchill Public School, Ottawa, March 6, 1974

W.H. Poole

- "Opportunities for geology graduates at the bachelor degree level in government", Central Canada University Geological Conference, Guelph, October 26, 1973
- "Geology of Canadian Appalachians", Bedford Institute of Oceanography, Dartmouth, June 22, 1973
- "Stratabound sulphide deposits and geology of Canadian Appalachians", International Geological Correlation Program, Correlation of Caledonian Stratabound Sulphides, organizational meeting, Oslo, Norway, November 27, 1973
- "Stratigraphic framework of volcanogenic massive sulphide deposits, northern Appalachian Orogen", Symposium on Metavolcanic Massive Sulphides, McGill University, Montreal, November 30, 1973
- "Geology and mineral deposits of Newfoundland", Geological Survey of Canada, Ottawa, November 16, 1973

- "Geology and mineral deposits of southern Quebec and Maritime Provinces", Geological Survey of Canada, Ottawa, December 14, 1973
- "Summary of Society annual meeting", Atlantic Geoscience Society, Fredericton, January 19, 1974
- "A plate tectonic model of the Canadian Appalachians", Symposium on Tectonics of the Quebec Appalachians, University of Montreal, Montreal, March 7, 1974

Membership on committees

L.M. Cumming	- Member, Executive and Programme Committees, Canadian Institute of Mining and Metallurgy, Ottawa Branch - Chairman, Logan Club - Chairman, Division Noticeboard Committee - Member, Branch Earth Science Education Committee
W.H. Poole	- Member, Branch Exhibits Committee - Member, Division Noticeboard Committee

Completed manuscripts

The following manuscripts were accepted and approved by the Division.

Cumming, L.M.

(in press): Ordovician strata of the Hudson Bay Lowlands; Can., Geol. Surv., Paper 74-28.

Cumming, L.M. and Grant, D.R.

1974: Bedrock landslides of postglacial age in the Lookout Hills region of the Gros Morne National Park; internal report to Parks Canada.

Leech, G.B., Agterberg, F.P., Fabbri, A.G., Kirkham, R.V., Poole, W.H. and Sangster, D.F.

PRECAMBRIAN SUBDIVISION

W.F. Fahrig

This unit comprises 27 officers who are engaged exclusively in Precambrian studies, 5 officers who carry on paleomagnetic and rock magnetic studies on rocks of all ages and a draftsman. The personnel engaged in Precambrian studies are responsible for carrying out geological research in the Canadian Shield and describing this work with appropriate geological maps, and various reports and scientific papers. One of the long-term objectives of providing reconnaissance geological data for the entire shield has approached realization. In 1973, the last two unmapped areas (northern Quebec and northern Melville Peninsula) were completed; publication of maps covering those areas and central Baffin Island will complete map coverage at a scale of 1:1,000,000 for the entire Canadian Shield. Most of the work of the Subdivision is concentrated north of 60 degrees North Latitude and consists of more detailed studies that will update previous reconnaissance work. The studies have been concentrated in three areas which form natural geological entities and which should, in the future, be amenable to regional tectonic synthesis. The three areas are the Bear-Slave Structural Provinces, the Foxe fold belt that trends across the south part of Melville Peninsula and Baffin Island, and the Ennadai belt of southern District of Keewatin. Fourteen staff members took part in field operations in 1973. W.R.A. Baragar carried out stratigraphic mapping and sampling for geochemical study in three lines across the volcanic rocks of the Cape Smith belt, New Quebec. F.H.A. Campbell refined the mapping of sedimentary paragneisses in parts of the Prince Albert Group. K.E. Eade and F.W. Chandler completed stratigraphy and structural studies necessary in revising the geology of Watterson and Ferguson Lakes map-areas. W.L. Davison and W.W. Heywood completed reconnaissance mapping of Northern Melville Peninsula. T. Frisch continued the study of the Prince Albert Group, surrounding gneisses, and overlying late Precambrian sedimentary rocks in western Melville Peninsula. The updating of two adjacent map sheets (Calder River and Sloan River) was begun by J.C. McGlynn and P.F. Hoffman, with particular emphasis on volcanic stratigraphy of the Aphebian strata. R.A. Frith completed the remapping of Indin Lake map-area and H. Helmstaedt completed a special structural study in the Chalco-Ranji Lake area that lies within the Indin Lake area. The remapping of Hearne Lake area was completed, with a detailed study by M. Lambert of the volcanic rocks. Operation Nuvilik, manned by F.C. Taylor, T.M. Gordon and J.B. Henderson, completed reconnaissance mapping of northern Quebec. M. Schau continued the remapping of volcanic rocks of the Prince Albert Group southwest of Committee Bay, District of Keewatin.

J.C. McGlynn, K.E. Eade and W.W. Heywood presented talks describing recent geological work by the Precambrian Subdivision in Districts of Keewatin and Mackenzie at a workshop organized by the Department of Indian Affairs and Northern Development and held in Yellowknife. A series of informal regional geological reviews covering the Bear-Slave Provinces, the Circum-Ungava fold belt, the western Superior Structural Province, the Ennadai fold belt and the Southern Structural Province was held during the winter of 1973-74.

L.P. Tremblay and K.E. Eade monitored and reported on C.I.D.A. projects in Algeria and Ethiopia respectively. A. Davidson continued on leave of absence as Project Leader of the C.I.D.A. Omo River Project in Ethiopia.

R.H. Ridler acted as guide on a University of Arizona and University of Western Ontario field trip to the Kirkland Lake area of Ontario.

Personnel changes

E.W. Reinhardt, a distinguished metamorphic petrologist who joined the staff in 1965, died in January, 1974. R. Skinner was transferred from the Appalachian Section in June, 1973 to take up duties as staff geologist with the Precambrian Subdivision. W. Karvinen joined the staff in December, 1973.

Attendance at meetings

W.R.A. Baragar	- Associate Committee on Geodesy and Geophysics, Ottawa, February, 1974 - Geological Association of Canada, Cordillera Section, Vancouver, February, 1974 - Grenville Symposium, Ottawa, February, 1974 - Ultramafic Flow, field trip, Timmins, October, 1973 - Volcanology Subcommittee, National Research Council of Canada, and Field Trip, Princeton and Campbell River, British Columbia, May 30 - June 4, 1973
F.H.A. Campbell	- American Association of Petroleum Geologists - Society of Economic Paleontologists and Mineralogists, Pacific Section, Anaheim, California, May, 1973
F.W. Chandler	- Manitoba and Saskatchewan, Summary of Field Work, Winnipeg and Regina, November, 1973 - Grenville Club Field Trip, Timiskaming Area, May, 1973
K.E. Eade	- Geoscience Forum, Yellowknife, December, 1973

I.F. Ermanovics	- American Geophysical Union, Washington, D.C., April, 1974 - Manitoba and Saskatchewan, Summary of Field Work, Winnipeg and Regina, November, 1973 - University of Toronto, Geotraverse Project Review, Toronto, January, 1974
W.F. Fahrig	- Grenville Club Field Trip, Timiskaming Area, May, 1973
M.J. Frarey	- University of Toronto, Geotraverse Project Review, Toronto, January, 1974
J.A. Fraser	- Arctic Geology Symposium, Geological Association of Canada, Annual Meeting, Saskatoon, May, 1973
R.A. Frith	- American Geophysical Union, Washington, D.C., April, 1973
J.B. Henderson	- American Association of Petroleum Geologists - Society of Economic Paleontologists and Mineralogists, Pacific Section, Anaheim, California, May, 1973 - University of Toronto, Geotraverse Project Review, Toronto, January, 1974
W.W. Heywood	- Geoscience Forum, Yellowknife, December, 1973
P.F. Hoffman	- Belt Symposium, Moscow, Idaho, September, 1973 - Geological Association of Canada, Cordillera Section, Vancouver, February, 1974 - Geological Society of America, Annual Meeting, Dallas, Texas, November, 1973 - Geological Society of America, Cordillera Section, Las Vegas, Nevada, March, 1974
G.D. Jackson	- Grenville Club Field Trip, Timiskaming Area, May, 1973
W.O. Karvinen	- Conference on Experimental Mineralogy, Petrology and Economic Geology, McGill University, Montreal, February, 1974 - Grenville Symposium, Ottawa, February, 1974
M.B. Lambert	- Geological Association of Canada, Cordillera Section, Vancouver, October, 1973 - Royal Canadian Geographical Society, Annual Meeting, Ottawa, March, 1974 - Archean Continental Development and Related Mineral Deposits, Winnipeg, March, 1974

	- Volcanic Geology and Mineralization in the Canadian Cordillera, Vancouver, February, 1974 - University of Toronto, Geotraverse Project Review, Toronto, January, 1974
J.C. McGlynn	- Geological Society of America, Annual Meeting, Dallas, Texas, November, 1973 - Geoscience Forum, Yellowknife, December, 1973 - Northwest Territories Coordinating Committee, Yellowknife
R.H. Ridler	- Geological Association of Canada, Annual Meeting, Saskatoon, May, 1973 - Geological Association of Canada, Cordillera Section, Vancouver, February, 1974 - Porphyry Copper, field course, British Columbia, Department of Mines, April, 1973 - Prospectors and Developers Convention, Toronto, March, 1974
M. Schau	- Geological Association of Canada, Cordillera Section, Vancouver, February, 1974 - Ultramafic Flow, field trip, Timmins, October, 1973
F.C. Taylor	- Geological Association of Canada, Newfoundland Section, St. John's, February, 1974 - Latin American Geological Congress, Caracas, Venezuela, November, 1973 - Prospectors and Developers Convention, Toronto, March, 1974
L.P. Tremblay	- Geological Association of Canada, Annual Meeting, Saskatoon, May, 1973 - Ultramafic Flow, field trip, Timmins, October, 1973

Membership on committees

W.R.A. Baragar	- Chairman of Subcommittee on Volcanology, National Research Council of Canada - Member of Associate Committee on Geodesy and Geophysics, Canadian National Committee for the International Union of Geodesy and Geophysics
M.J. Frarey	- Chairman of Branch Committee on Precambrian Nomenclature - Member of Federal-Provincial Committee on Huronian Stratigraphy

W.W. Heywood
- Chairman of Air Charter Subcommittee of Departmental Equipment Committee
- Member of Executive Committee, Ottawa Branch, Canadian Institute of Mining and Metallurgy

P.F. Hoffman
- Commissioner of Commission on Stratigraphic Nomenclature
- Associate editor of Geoscience Canada
- Correspondent to Subcommission on Precambrian Stratigraphy, International Union of Geological Sciences

J.C. McGlynn
- Member of subcommittee on Precambrian Stratigraphy, International Union of Geological Sciences
- Member of Northwest Territories Coordinating Committee on work in the North
- Member of Interdepartmental committee on Hiring Native People in the North

R.H. Ridler
- Member of Branch Age Committee
- Member of Ph.D. Thesis Defense Committee for J.H. Koo, University of Saskatchewan
- Supervisor of Master's Degree Programme, L. Covello, Carleton University, Ottawa

M. Schau
- Member of Departmental Data Base Management Committee
- Steward and alternate executive member of Scientific Research Group, Professional Institute of the Public Service of Canada
- Member of Branch Labour Management Consultation Committee

F.C. Taylor
- Chairman of Branch Age Committee
- Chairman of Departmental Field Equipment Committee

L.P. Tremblay
- Member of Branch Committee on Precambrian Nomenclature

Special talks or lectures

W.R.A. Baragar
- "Volcanism and Tectonics of the Canadian Shield", Ecole Polytechnique lecture series, Montreal
- "Coppermine River Magmatic Province", University of Toronto
- "Evolution of Coppermine River Lavas", University of Saskatchewan
- "Classification of Volcanic Rocks and their Tectonic Implications", Geological Association of Canada, Vancouver
- "Mafic Rocks as Possible Evidence of pre-Grenville Rifting", Grenville Symposium, Ottawa

- "Kirkjufel Eruption, Iceland", Ottawa High Schools

F.H.A. Campbell - "Super-Proximal Turbidites in the Archean of Manitoba", American Association of Petroleum Geologists - Society of Economic Paleontologists and Mineralogists special symposium on sedimentary tectonics

F.W. Chandler - "Huronian Supergroup and Whitewater Group", Regional review of geology of Canada, Geological Survey of Canada, Ottawa

K.E. Eade - "Geological Mapping in Southern Keewatin", Geoscience Forum, Yellowknife, Northwest Territories

I. Ermanovics - "Geology of Northwestern Superior Province", Regional review of Geology of Canada, Geological Survey of Canada, Ottawa

M.J. Frarey - "General Geology of the Southern Province", Regional review of Geology of Canada, Geological Survey of Canada, Ottawa

J.A. Fraser - "Geology of Bear Province", Regional review of Geology of Canada, Geological Survey of Canada, Ottawa

R.A. Frith - "Pre-Kenoran Tonalites in the Western Slave Province of the Canadian Shield", American Geophysical Union, Washington, D.C.
- "The Evolution of Greenstone Supracrustal Rocks of the Western Slave Province of the Canadian Shield", University of Ottawa

J.B. Henderson - "Archean Sediments at Yellowknife, Northwest Territories", Precambrian Seminar, University of Toronto
- "Stratigraphy and Sedimentology of the Yellowknife Supergroup, Slave Province", Regional Review of Geology of Canada, Geological Survey of Canada, Ottawa

W.W. Heywood - "Geological Mapping on Melville Peninsula" - Geoscience Forum, Yellowknife, Northwest Territories

P.F. Hoffman - Talks, some or all (1) "Aulocogens"
(2) "Stromatolites"
(3) "Great Bear Batholith"
at University of Manitoba; United States Geological Survey, Denver; University of Texas at Austin; University of British Columbia; Universite de Montreal;

John Hopkins University; State University of New York at Albany; University of California at Santa Barbara; Canadian Society of Petroleum Geology, Calgary; Geological Association of Canada, Vancouver; Colorado School of Mines; Union Oil Company, Brea, California; Geological Society of America, Cordilleran meeting, Las Vegas

G.D. Jackson
- "Geology of Belcher Islands, Northwest Territories", Review of Geology of Canada, Geological Survey of Canada, Ottawa
- "Geology of Baffin Island, Northwest Territories", Geology students, Bell High School, Ottawa

W.O. Karvinen
- "Molybdenite Deposits in the Grenville Province", Conference on Experimental Mineralogy, Petrology and Economic Geology, McGill University, Montreal

M.B. Lambert
- "The Iceland Eruption, 1973", Caribou College, Kamloops, British Columbia; University of Calgary, Calgary; University of Alberta, Edmonton; Royal Canadian Geographical Society Annual Meeting, Ottawa; Geological Association of Canada, Vancouver
- "The Bennett Lake Cauldron Subsidence Complex", Geological Association of Canada, Symposium on Volcanic Geology and Mineralization in the Canadian Cordillera; Caribou College, Kamloops; University of Calgary, Calgary; University of Alberta, Edmonton

J.C. McGlynn
- "Archean Supracrustal Rocks of Slave Province", Ecole Polytechnique, Montreal
- "Geology of the Slave-Bear Province as of 1973", Geoscience Forum, Yellowknife, Northwest Territories

R.H. Ridler
- "Exploration for Archean Polymetallic Sulfide Deposits in Permafrost Terrains: Kaminak Lake area, District of Keewatin, Northwest Territories", Geological Association of Canada, Saskatoon; Geological Staff, Hudson Bay Mining and Smelting Co., Flin Flon, Manitoba
- "Archean Volcanism and Metallogeny - Are there Cordilleran Analogues?", Geological Association of Canada, Cordilleran Section, Symposium on Volcanic Geology and Mineral Deposits of the Canadian Cordillera, Vancouver
- "Mineral Potential of the Rankin Inlet-Ennadai Belt", (with W.W. Shilts), Prospectors and Developers Meeting, Toronto
- "Nature and Use of Archean Exhalites", and
- "Archean Gold Metallogeny", University of Arizona, Tempe

- "Volcanic Stratigraphy of the Kirkland Lake area", and
- "Volcanic Stratigraphy of the Kaminak Group", University of Montreal Seminar on Volcanism
- "Geology of the Central Churchill Province", and
- "Geology of the Greenstone Belts of the Western Superior Province", Regional Review of the Geology of Canada, Geological Survey of Canada, Ottawa

M. Schau
- "Volcanogenic Rocks of the Prince Albert Group" Ecole Polytechnique lecture series on Volcanism and Tectonics of the Canadian Shield, Montreal
- "Kirkjufel Eruption, Iceland", University of British Columbia; University of Manitoba, Brandon and Winnipeg; Nordic Club, Ottawa; and Iceland Society, Winnipeg

F.C. Taylor
- "Geology of Labrador", Geological Association of Canada, Newfoundland Section, St. John's
- "Geology of the Cape Smith Belt", Ecole Polytechnique, Montreal

Completed manuscripts

The following manuscripts were accepted and approved by the Division.

Baragar, W.R.A.
(in press): Volcanology report; (Editor), Can. Geophys. Bull.

Chandler, F.W.
(in press): Lower Huronian sandstones, correlation problems, and uranium, Morin Township, Ontario; Can. J. Earth Sci.

Ermanovics, I.
(on file): Chemistry of granitic rocks; internal report to Deputy Director.

(in press): Geology of Bloodvein National Park; Manitoba Mines Branch.

Fraser, J.A.
(in press): The Epworth Group, Rocknest Lake Area; Can. Geol. Surv., Paper.

Frisch, T.
(in press): Minor intrusions of the Rapakivi Suite in Southwest Greenland; Contributions to Mineralogy and Petrology (with D. Bridgwater).

Henderson, J.B.
(in press): Sedimentology of the Yellowknife Supergroup at Yellowknife, N.W.T.; Can., Geol. Surv.. Bull.

Hoffman, P.F.

(in press): Shallow and deepwater stromatolites in a Proterozoic platform-to-basin facies transition, Great Slave Lake, Canada; Amer. Assoc. Petrol. Geol., Bull.

(in press): Environmental diversity of Lower Proterozoic stromatolites; in "Interpreting Stromatolites" (M.R. Walter, Ed.), Elsevier.

(in press): Stromatolite Morphogenesis in Shark Bay, Western Australia; in "Interpreting Stromatolites", Elsevier.

(in press): Aulacogens; in Reviews of Earth and Planetary Sciences, Science Reviews Inc., Palo Alto, California.

Jackson, G.D.
(in press): Bylot Island map-area; Can., Geol. Surv., Paper (with final map), (with A. Davidson).

(in press): Pont Inlet map-area; Can., Geol. Surv., Paper (with final map), (with A. Davidson and W.C. Morgan).

(in press): Aphebian halite and sulphate indications in the Belcher Group, N.W.T.; Can. J. Earth Sci. (with R.T. Bell).

Morgan, W.C.
(in press): Geology of the Precambrian Ramah Group and basement rocks in the Nachvak Fiord-Saglek Fiord Area, North Labrador; Can., Geol. Surv., Paper.

Ridler, R.H.
(in press): Exploration for Archean polymetallic sulfide deposits in permafrost terrains: An integrated geological-geochemical technique; District of Keewatin, Kaminak Lake area; Can., Geol. Surv., Paper 73-34 (with W.W. Shilts).

(in press): Mineral potential of the Rankin Inlet-Ennadai Belt; Can. Mining J. (with W.W. Shilts).

Schau, M.

(in press): Heterogeneous glass from a Recent tephra; Can., Geol. Surv., Paper 74-1, Part B (with E. Gasparrini).

(in press): Magnetic fabric of a Recent bomb; Can. Geol. Surv., Paper 74-1, Part B.

Skinner, R.
(in press): Geology of the Tuadook Lake Map-Area, New Brunswick; Can., Geol. Surv., Paper and final map.

Taylor, F.C.

(in press): Reconnaissance Geology of part of the Precambrian Shield, Northern Quebec and Northwest Territories; Can., Geol. Surv., Paper and map.

Tremblay, L.P.
(in press): The Northwestern corner of the Contwoyto Lake Area; Can., Geol. Surv., Mem.

(in press): La stratigraphié archeénne garde jalousement ses secrets; GEOS, Dept. Energy, Mines and Resources.

Paleomagnetism Section

E.J. Schwarz

The Section is concerned with the study of magnetic properties of rocks and minerals useful in the solution of geological and geophysical problems. The Section also carries out measurements and helps in interpretation on request by individuals from other Sections or Divisions.

Instrumentation

The Section operates and maintains magnetometers (of both spinner and automated astatic type), alternating field demagnetization equipment, a thermal demagnetization unit, a thermomagnetic balance, ballistic magnetometer and instrumentation for the accurate determination of magnetic susceptibility and its anisotropy. A large proportion of the laboratory equipment was designed and built within the Section in the past ten years. In addition, the Section maintains field collecting equipment. No substantial new additions to the equipment list were made during 1973.

Programs

The major research programs are centred around: (1) more precise determination of the polar wandering curve relative to Canada since early Precambrian, (2) magnetic reversal stratigraphy in Paleozoic sediments, (3) magnetic properties of sulphides and (4) application of paleomagnetics to solution of Cordillera tectonic problems. Achievements during 1973 are as follows.

Program 1. This work is directed towards the understanding of the geological framework of the Precambrian Shield. Emphasis was placed on

the Grenville Structural Province and its relation to other provinces. The Mealy Mountain project was completed and the paleomagnetism of the Lac St. Jean and Sept-Iles anorthosite was studied. A major new project was initiated on the basalt series of the Cape Smith belt near the boundary of the Churchill and Superior Structural Provinces in northern Quebec. A substantial number of samples of Early Precambrian rocks in Greenland were studied, for comparison and correlation with samples from the coast of Labrador. The project on the Hopedale dykes of Labrador was essentially completed.

Program 2. Work on this program has been unable to resolve difficulties in isolating stable magnetizations by alternating field demagnetization in the great majority of sediments sampled. Work on the Trenton limestone was partially successful. Thermal demagnetization studies were initiated.

Program 3. Studies on relevant basic magnetic properties of iron sulphides (pyrrhotites) were completed and practical applications were attempted for four ore deposits near Sudbury and two sulphide deposits near Timmins. The objectives were to obtain criteria for the selection of magnetic anomalies in exploration, and to evaluate the possibility of carrying out paleomagnetic studies on sulphide ore deposits. Pyrrhotites are being recognized as rock constituents in extensive areas of Precambrian and Paleozoic rocks of Canada and elsewhere.

Program 4. This group of studies was initiated by D.T.A. Symons, while working for the Geological Survey. Dr. Symons returned for the summer of 1973 and completed paleomagnetic studies on several intrusions in British Columbia (see publication list). The main objective is to investigate the tectonic evolution of a part of the Cordillera by applying paleomagnetic techniques.

Assistance in other projects

Measurements were carried out on collections of samples for Chevron Standard Oil Limited and Branch personnel (M. Schau, J. Henderson, L. Kornik, P. McGrath and I. Ermanovics). Instrumentation was designed for a project on quality control of asbestos by the Mines Branch (A. Winer).

Personnel notes

W.F. Fahrig took up his duties as Head of the Precambrian Subdivision. E.J. Schwarz spent $2\frac{1}{2}$ months at the Geophysical Institute of the University of Tokyo working on basic properties of remanent magnetization of rocks.

Attendance at meetings

J.H. Foster - American Geophysical Union, Washington, D.C.

E.J. Schwarz - International Association Geomagnetism and Aeronomy, Kyoto, Japan

Membership on committees

E.J. Schwarz
- International Association of Geomagnetism and Aeronomy, Working Group III
- Geomagnetism Subcommittee of the Associate Committee on Geodesy and Geophysics, National Research Council of Canada

Special talks

E.J. Schwarz
- "Magnetic properties of pyrrhotites", Geophysical Institute, University of Tokyo
- "Magnetic properties of pyrrhotites and application to geological and geophysical problems", Geological Survey of Japan, Tokyo
- A series of three lectures on "Rock magnetism as applied to exploration geophysics", Ecole Polytechnique, Montreal

Completed manuscripts

The following manuscripts were accepted and approved by the Division.

Symons, D.T.A.

(in press): Paleomagnetic results from the Tertiary Mt. Barr and Hope plutonic complexes, British Columbia; Can., Geol. Surv., Paper 73-19.

(in press): Unit correlations and tectonic rotation from paleomagnetism of the Triassic Copper Mountain intrusions, B.C.; Can., Geol. Surv., Paper 73-19.

(in press): Paleomagnetic zones in the Oligocene East Sooke gabbro, Vancouver Island, British Columbia; J. Geophys. Res.

CORDILLERAN AND PACIFIC MARGIN SUBDIVISION

H. Gabrielse

The Cordilleran and Pacific Margin Subdivision comprises a Geological Research Unit and an Information Service Unit.

Geological Research Unit

This unit, comprising 15 officers, 3 technical support staff and five non technical support staff, is based in the Sun Tower Building, Vancouver, British Columbia and conducts geological research in the Cordilleran Orogen. It publishes maps, reports and scientific papers that describe the general composition, structure, origin and geological development of the Cordillera and relates these to the mineral deposits to help in assessing the mineral potential, to guide mineral exploration and to provide aid for planning of the orderly development of land utilization in the region. The Marine Geology Group is conducting a long range program of geological and geophysical studies of the Pacific Continental Shelf and Slope to provide information on hydrocarbon and other resource potential. The investigations are supplemented by, or supplement, related cooperative activities by other Subdivisions and Divisions of the Geological Survey of Canada and the Mineralogical Branch of the British Columbia Department of Mines and Petroleum Resources. In addition, the Subdivision supports research carried on in the Cordillera by graduate students from various universities. Current activities of the Subdivision are directed towards two interrelated objectives: the completion of the reconnaissance phase of regional investigations to provide a broad geological and tectonic framework for the Cordilleran region, and detailed studies of specific problems to further the understanding of the nature and sequence of geological processes, with particular reference to the formation and localization of mineral deposits. Reconnaissance studies were carried out in southwestern Yukon Territory, north-central British Columbia, and southern Vancouver Island. Detailed investigations were concerned with the relationships of mineral deposits to stratigraphy and structure in southeastern Yukon Territory, Tertiary volcanic rocks in southwestern Yukon and northwestern British Columbia, late Paleozoic and early Mesozoic volcanic and related rocks in north-central British Columbia, low to high grade metamorphic rocks bordering and lying within the Shuswap Metamorphic Complex, and detailed sampling and drilling of hot springs to determine geothermal energy potential. The Marine Geology Group took part in a multigeophysical survey of Queen Charlotte Sound and conducted further seismic profiling of Winowna Basin west of Vancouver Island.

Three projects of the Subdivision are directly concerned with energy resources of the Cordilleran region. Studies of the Pacific Continental Shelf and Slope and of successor basins are designed to provide information for assessment of hydrocarbon and uranium energy potential. The geothermal program, in conjunction with a project carried out by the Earth Physics Branch provides data relating to possible geothermal energy sources. Projects in north-central British Columbia and southeastern Yukon Territory are in areas

of highly active mineral exploration. There, the Subdivision's mapping is critical because of the close relationship between stratigraphy and mineral deposits.

Twelve members of the Subdivision undertook field work in 1973. D.L. Tiffin and R. Currie took part in a multigeophysical survey of Queen Charlotte Sound. This project, carried out in conjunction with the Department of the Environment and the Earth Physics Branch provided bathymetric, gravimetric, magnetic, and seismic data. D.L. Tiffin also took part in a cruise that obtained further seismic profile data in Winowna Basin off Vancouver Island. R.B. Campbell and G.H. Eisbacher made a preliminary study of the geology in St. Elias Mountains in preparation for a major project in 1974. J.G. Souther completed his investigations of Tertiary volcanic rocks on Mount Edziza and in the Spectrum Range of northwestern British Columbia and also conducted initial studies of Tertiary volcanic rocks in St. Elias Mountains. D.J. Tempelman-Kluit began a detailed investigation of stratigraphy, structure, and metallogeny in Pelly Mountains and adjacent Yukon Plateau. T.A. Richards completed the reconnaissance mapping of Hazelton E 1/2 (93 M E 1/2) map area with emphasis on the relationship of Mesozoic stratigraphy to mineral deposits. Support was given to T. Poulton who is completing a doctoral thesis on Jurassic trigonids. H. Gabrielse and C.J. Dodds continued reconnaissance mapping in the Omineca and Northern Rocky Mountains. The project includes support for J.L. Mansy a doctoral candidate on the Canada-France exchange program, who is studying Precambrian and Cambrian strata in the region. J.E. Muller began reconnaissance mapping in the Victoria (92 B) map-area as the final phase of this scale of work on Vancouver Island. In addition, he examined the geology of Pacific Rim National Park for the Parks Branch, Department of Indian and Northern Affairs. A.V. Okulitch, under contract to the Subdivision, carried out detailed studies of the Mount Ida Group bordering and lying within the Shuswap Complex. J.W.H. Monger completed a study of Upper Paleozoic rocks in the Pinchi Lake and Manson Creek Belts in north-central British Columbia. J.G. Souther supervised sampling of hot springs in the Cordillera and with the Earth Physics Branch carried out a drilling program on a hot spring area near Vancouver.

The remainder of the staff was engaged in office and laboratory studies.

Five members of the Subdivision took part in a two-day meeting at Menlo Park, California with members of the United States Geological Survey and various universities to discuss correlations of tectonic elements throughout the length of the North American Cordillera. The Subdivision played a significant role in the annual meeting of the Cordilleran Section of the Geological Association of Canada held in Vancouver during February, 1974. As in past years, most of the organization for this meeting, with an attendance exceeding 700, has been done by Subdivision personnel. Four members took part in a Government-Industry symposium in Whitehorse, discussing the role of the Geological Survey of Canada in Yukon Territory. Many talks were given to a wide variety of audiences and a continued heavy load of discussions with industry was maintained.

The Subdivision benefitted greatly from technical and other support provided by the Federal Government's Winter Works program. This support has greatly speeded up compilation of data and the processing of some information that would otherwise have been impossible with the limited support staff available.

Personnel changes

During the year Mrs. B. Russell left the Information Services Unit to take a position with the Department of National Revenue. Mrs. G.R. Heather was appointed as the Subdivision Secretary and Mr. G.R. Dumas was appointed as draughtsman.

Attendance at meetings

S.L. Blusson
- Canadian Institute of Mining and Metallurgy, Vancouver, April, 1973
- Federal Government-Industry Meeting, Whitehorse and Yellowknife, December, 1973
- Geological Association of Canada, Cordillera Section, Vancouver, February, 1974

R.B. Campbell
- Belt Symposium, Moscow, Idaho, September, 1973
- Conference on Cordilleran Geology, Menlo Park, California, November, 1973
- Federal Government-Industry Meeting, Whitehorse, December, 1973
- Geological Association of Canada, Cordillera Section, Vancouver, February, 1974

R. Currie
- Pacific Northwest Meeting, American Geophysical Union, Missoula, Montana, October, 1973

G.H. Eisbacher
- Continental Sedimentation, Deutsche Geol. Ges., Bochum, West Germany, March, 1974
- Geological Association of Canada, Cordillera Section, Vancouver, February, 1974
- Symposium on the Grenville Province, Ottawa, February, 1974

H. Gabrielse
- Belt Symposium, Moscow, Idaho, September, 1973
- Conference on Cordilleran Geology, Menlo Park, California, November, 1973
- Federal Government-Industry Meeting, Whitehorse, December, 1973
- Geological Association of Canada, Cordillera Section, Vancouver, February, 1974

W.W. Hutchison
- Circum-Pacific Plutonism Project, Santiago, Chile, September, 1973

J.W.H. Monger
- Conference on Cordilleran Geology, Menlo Park, California, November, 1973
- Geological Association of Canada, Cordillera Section, Vancouver, February, 1974
- Symposium on the Grenville Province, Ottawa, February, 1974

J.E. Muller
- Geological Association of Canada, Cordillera Section, Vancouver, February, 1974

T.A. Richards
- Geological Association of Canada, Cordillera Section, Vancouver, February, 1974

J.A. Roddick
- Circum-Pacific Plutonism Project Meeting, Santiago, Chile, September, 1973
- Geological Association of Canada, Cordillera Section, Vancouver, February, 1974

J.G. Souther
- Geological Association of Canada, Cordillera Section, Vancouver, February, 1974
- North Atlantic Treaty Organization, planning meeting on Geothermal Energy, Leverncore, El Centro, San Diego, California, October, 1973

D.J. Tempelman-Kluit
- Conference on Cordilleran Geology, Menlo Park, California, November, 1973
- Federal Government-Industry Meeting, Whitehorse, December, 1973
- Geological Association of Canada, Cordillera Section, Vancouver, February, 1974

D.L. Tiffin
- American Geophysical Union, Annual Meeting, San Francisco, California, December, 1973
- Geological Association of Canada, Cordillera Section, Vancouver, February, 1974

H.W. Tipper
- Conference on Cordilleran Geology, Menlo Park, California, November, 1973
- Geological Association of Canada, Cordillera Section, Vancouver, February, 1974

Special talks

S.L. Blusson
- "Regional geology and mineralization in the Godlin Lake and Bonnet Plume areas", Mining and Exploration Geology Group, Vancouver, November, 1973
- "Regional setting of basemetal deposits in Selwyn-Mackenzie Mountains", Government-Industry Geoscience conference Whitehorse and Yellowknife, December, 1973

B.E.B. Cameron	- Outside lecturer in Micropalaeontology, Department of Geological Sciences, University of British Columbia
R.B. Campbell	- "Saint Elias project", Whitehorse, December, 1973
G. Eisbacher	- "Paleodrainage pattern and late-orogenic basins of the Canadian Cordillera", American Association of Petroleum Geologists-Society of Economic Paleontologists and Mineralogists, Anaheim, California, May, 1973 - "Evolution of Successor Basins", Alberta Association of Petroleum Geologists, Calgary, and Edmonton Geological Society, Edmonton, April, 1973 - "A new model of Rocky Mountain subsurface structure", Institute of Sedimentary and Petroleum Geology, Calgary, April, 1973 - "Geological Surveys and Park Planning", Department of Geography, Simon Fraser University, Vancouver, October, 1973 - "Canadian Geological Maps - a history", Department of Geography, Simon Fraser University, Vancouver, January, 1974 - "Late-orogenic sedimentation and tectonic evolution of the Canadian Cordillera", University of British Columbia, January, 1974, and Logan Club, Ottawa, February, 1974 - "Molasse Fazies der kanadischen Kordillere", Deutsche Geol. Ges., Bochum, West Germany, March, 1974
H. Gabrielse	- "Precambrian of the Canadian Cordillera", Belt Symposium, Moscow, Idaho, October, 1973 - "Summary of Tectonic Elements in the Canadian Cordillera", Cordilleran Correlation Meeting, Menlo Park, California, November, 1973 - "Programs of the Cordilleran Subdivision in Yukon Territory", Federal Government-Industry Meeting, Whitehorse, December, 1973 - "Arc Type Volcanic Rocks in the Canadian Cordillera", Cordilleran Section, Geological Association of Canada, Vancouver, February, 1974
J.W.H. Monger	- "Upper Paleozoic rocks of the Western Cordillera", Logan Club, Geological Survey of Canada, Ottawa, February, 1974 - "Evolution of the Canadian Cordillera" and "Upper Paleozoic rocks of the Western Cordillera", Queen's University, Kingston, February 25, 1974, University of Saskatchewan, February 26, 1974, and Washington State University, Pullman, Washington, March, 1974

- "Distribution of oceanic volcanic rocks in the Canadian Cordillera", Geological Association of Canada, Vancouver, February 8, 1974

T.A. Richards
- "The relationship between low grade metamorphic mineral assemblages and stratigraphy of the Jurassic Hazelton Group, Central, B.C.", Geological Association of Canada, February, 1974

J.A. Roddick
- "Setting of the Coast Plutonic Complex", Circum-Pacific Plutonism Project, Santiago, Chile, September, 1973 (with W.W. Hutchison)
- "A review of the Coast Crystalline Belt", Geological Association of Canada, Vancouver, January, 1974

J.G. Souther
- "Geothermal Energy - the outlook for Canada", Public Lecture, Victoria, November 2, 1973
- "Overview of Volcanic Environments, Styles and Processes that lead to Sulfide Segregation", Geological Association of Canada, Symposium, Vancouver, February, 1974

D.J. Tempelman-Kluit
- "Yukon Crystalline Platform in the light of findings from Operation Snag", with different emphasis to the following groups - Cordilleran geology meeting, Menlo Park, California; Government-Industry meeting, Whitehorse, and Mining and Exploration Geologists group, Vancouver, March, 1974

H.W. Tipper
- "Geology of Central British Columbia", British Columbia Forest Service, Cariboo District, Williams Lake, February, 1974

Membership on committees

B.E.B. Cameron
- Graduate Committees for two students at University of British Columbia, supervised the production of two graduating theses in micropaleontology within the Department of Geological Sciences, and served on the cirriculum committee at the University

R.B. Campbell
- Vice-chairman and program chairman, British Columbia Section, Canadian Institute of Mining and Metallurgy

G.H. Eisbacher
- Associate Editor: Geoscience Canada; Geological Association of Canada

H. Gabrielse
- Chairman, Committee on Penrose Conferences, Geological Society of America
- Co-editor, Pacific Geology
- Associate Editor, Canadian Association of Petroleum Geology

Completed manuscripts

The following manuscripts were accepted and approved by the Division.

Campbell, R.B.

(in press): Paleodrainage and late orogenic basins in the Canadian Cordillera; Soc. Econ. Paleontol. Mineral., Spec. Publ. 20 (with G.H. Eisbacher and M. Carrigy).

Currie, R.

(in press): Preliminary results of a shipborne magnetic survey in Amundsen Gulf, N.W.T.; Can., Geol. Surv., Paper 74-1, Part B (with D.L. Tiffin).

Eisbacher, G.

1974: Deltaic sedimentation in the northeastern Bowser Basin, B.C.; Can., Geol. Surv., Paper 73-33.

(in press): Paleodrainage pattern and late-orogenic basins of the Canadian Cordillera; Soc. Econ. Paleontol. Mineral., Spec. Publ. 20 (with M. Carrigy and R.B. Campbell).

(in press): Deformationsmechanik eines offenen Konglomeratgefuges; Tscherm. Min. Pet. Mitt.

(in press): Vancouver Geology - A Short Guide; Geol. Ass. Can., Spec. Publ., Cordilleran Section.

Gabrielse, H.

(in press) The nature and setting of granitic plutons in the central and eastern parts of the Canadian Cordillera; Pacific Geology (with J.E. Reesor).

Monger, J.W.

(in press): Upper Paleozoic rocks of the Atlin Terrane, northwestern British Columbia and south-central Yukon; Can., Geol. Surv., Paper.

Muller, J.E.

1974: Geology and mineral deposits of Alert Bay - Cape Scott map-area; Can., Geol. Surv., Paper 74-8 (with K.E. Northcote and D. Carlisle).

Roddick, J.A.

1974: Circum-Pacific Plutonism and Volcanism; Encyclopedia of Earth Sciences, New York.

Souther, J.G.

1974: Volcanic Rocks of the Canadian Cordillera, coloured map and notes; Geol. Ass. Can. (Abstracts), Symposium on Volcanic Geology and Mineral Deposits of the Canadian Cordillera.

(in press): Aenigmatite from Mt. Edziza, B.C.; Amer. Mineral. (with K. Yagi).

Tempelman-Kluit, D.J.
(in press): Reconnaissance Geology of Snag Aishihik Lake and part of Stewart River Map-areas, West Central Yukon; Can., Geol. Surv., Paper 73-41.

Tiffin, D.L.

(in press): Preliminary results of a shipborne magnetic survey in Amundsen Gulf, N.W.T.; Can., Geol. Surv., Paper 74-1, Part B (with R. Currie).

Tipper, H.W.
1974: Distribution of terrestrial volcanic suites in space and time in the Canadian Cordillera; Geol. Ass. Can. (Abstract), Cordillera Section, Vancouver.

INFORMATION SERVICES UNIT

S. Leaming

The Information Services Unit is mainly concerned with the public but provides services to the Geological Research Unit, the Explosives Division, the Terrain Sciences Division, and the Winter Works Program. The services include typing, telephone answering, shipping and receiving, attendance records, mail service, customs, etc.

The personnel and percentage of time spent in the Information Services Unit is as follows:

Mr. S. Leaming	90
Mrs. Alet Marble	80
Miss Linda Harvie	95
Miss Judith Velker	90
Mr. Peter Dnistransky	35

The monthly business statistics are shown on the appended page. Although the number of visitors remained essentially the same as last year, the dollar value of the main items of sale increased notably because of the price increases on both topographical and geological maps; topographical map sales were up 34 per cent and Geological Survey publications were up 47 per cent. Total value of all sales amounted to $54,130.84.

MONTH	VISITORS	TOPOGRAPHIC MAPS NO.	TOPOGRAPHIC MAPS $	G.S.C. PUBLICATIONS NO.	G.S.C. PUBLICATIONS $	ROCK & MINERAL SETS @ $2	MINERAL SETS @ $25	PHOTOCOPIES NO.	PHOTOCOPIES $	MINES BRANCH NO.	MINES BRANCH $	B.C. DEPT. OF MINES $	I.G.C.* $
Apr.	810	4839	2050.30	1023	924.61	26.00	156.00	-	380	37.00	1	.50	175.50	-
May	895	4814	3218.05	650	1348.25	54.00	64.00	75.00	411	75.00	10	7.65	220.54	-
June	880	5628	3018.25	670	749.65	34.00	50.00	50.00	318	47.70	6	14.50	166.85	-
July	914	5906	3484.70	568	899.65	14.00	26.00	-	279	41.85	4	7.00	186.85	-
Aug.	909	4612	2951.35	1209	1481.50	214.00	216.00	100.00	264	39.60	6	7.25	163.00	-
Sept.	760	4303	2566.20	364	605.35	76.00	178.00	-	157	25.66	11	29.00	86.00	-
Oct.	764	4116	2565.15	606	984.95	152.00	242.00	-	123	18.45	17	42.25	79.50	-
Nov.	528	3037	1958.15	494	1017.95	80.00	56.00	-	177	26.55	12	32.85	101.00	-
Dec.	500	2633	1582.85	1262	1989.15	88.00	96.00	25.00	274	41.10	16	31.15	56.00	-
Jan.	689	2825	1807.15	1345	2242.20	58.00	162.00	25.00	624	93.55	28	58.50	95.50	-
Feb.	560	3715	2214.55	1456	2059.56	58.00	154.00	25.00	261	39.15	13	6.25	130.50	169.50
March	784	4324	2725.17	3486	4212.45	46.00	40.00	175.00	112	16.90	15	13.00	252.55	23.00
	8,993	50,752	$30,141.87	13,133	$18,515.27	$900.00	$1,440.00	$475.00	3,380	$502.51	139	$249.90	$1,713.79	$192.50

* International Geological Congress Publications

Activities

Mr. Leaming spent approximately 6 weeks in the field with the following objectives:

(1) To keep in touch with the jade industry and especially to study in situ deposits for purposes of a publication on Cordilleran occurrences;
(2) to collect rocks and minerals of interest to "rockhounds" and to obtain further information on localities;
(3) to increase personal knowledge of access to new areas of British Columbia for recreational purposes to provide information to members of the general public;
(4) to collect photographs of natural resources and geological phenomena as illustrative material for talks to various groups;
(5) to visit mining properties to get first hand information on mineral development.

Another in situ jade deposit, in the Cry Lake map-area of north-central British Columbia, was added to the list of Cordilleran occurrences. Repeat visits were made to the Dease Lake deposit and the Bridge River Lake area.

RESOURCE GEOPHYSICS AND GEOCHEMISTRY DIVISION

A. G. Darnley, Chief

INTRODUCTION

The Resource Geophysics and Geochemistry Division works towards the broad objectives of the Geological Survey through a wide range of specialized activities. The Division facilitates geological mapping, mineral resource evaluation and exploration, and terrain investigations: by research and development into improved or new geophysical or geochemical techniques; by evaluation of techniques under operational conditions; by developing new methods of interpreting and presenting data; by providing detailed specifications for the execution of surveys by commercial contractors; by monitoring and inspecting geophysical and geochemical work carried out under contract. The very extensive aeromagnetic surveys of Canada are being and largely have been acquired through commercial contracts. As a consequence of this over the past several years the Division has played a substantial role in designing and monitoring various types of airborne geophysical surveys on behalf of CIDA.

The Division is essentially geared to method development, and small scale pilot projects, rather than to production of large quantities of data or to the provision of interpretation and support services for routine geological mapping. As geoscience methods develop, become established, and begin to be valued by the geological community at large, the need for routine production, interpretive and support services increases in proportion to the area to be covered. Resources have never been available to allow support services to be expanded in proportion to the potential need, and so this area of work has been neglected to a considerable extent because personnel and equipment trained and experienced in developing methods and technology are not equipped and not always orientated towards providing a direct support role for general geological mapping. To some extent it is possible to extend the provision of routine surveys and routine interpretation services by contracting to industry with the financial support of various federal/provincial regional economic development programs. However, as contracted services expand, it is necessary to draw increasingly upon the time of scientists and technicians in order to prepare and monitor contracts. This involvement is one more incursion upon the time of these personnel, reducing the time that is available for the in-house research and development activities. This is detrimental in several ways to the long term technical competence of the organization; it delays or dilutes internal projects and lowers the morale and hence the motivation of individual scientists, reducing their awareness of external developments.

The main media headlines of the year have been concerned with energy, and two groups of projects within the Division have a direct bearing on

this subject. One group of projects is concerned with the development of methods to map the distribution and depth of permafrost. There is an urgent necessity to do this in order that transportation routes for Arctic oil and gas developments can be planned and the engineering difficulties anticipated. At the present time, the only certain method of mapping permafrost is by drilling; this is prohibitively expensive as a means of gathering information along transportation routes. Both seismic and electrical methods are applicable to the problem; at the moment seismic methods provide the more certain results for both on-shore and off-shore applications, but electrical methods are of great potential interest because of their suitability for airborne operations. Winter and summer test work has been undertaken at three sites in the Mackenzie Valley and at Tuktoyaktuk, concurrently with laboratory experimentation in Ottawa. Part of this experimentation involving radar is being carried out in cooperation with the Communications Research Centre.

The second major involvement of the Division with energy matters concerns future supplies of uranium. High sensitivity gamma-ray spectrometer reconnaissance surveys have continued in the district of Mackenzie and in Saskatchewan. The airborne portion of this work is evolving along similar lines to the aeromagnetic program. GSC has now been flying these radiometric surveys for five years, and demonstrated to the technical public that they are both practical and valuable. However, whereas aeromagnetic surveys were undertaken by GSC for about fifteen years before they became established as a federal/provincial program carried out under contract, there are indications that the probation period for gamma-ray spectrometer surveys may be shorter as a result of public concern over future energy supplies. With the completion of the Marian River radioactivity survey area during the summer of 1973 the western edge of the Shield, an area of sixteen 1:250,000 sheets, has been covered from Great Bear Lake to northern Alberta. The release of this data at the end of the fiscal year and the release of the shared-cost northern Saskatchewan survey in November, resulted in the immediate staking by major companies of ground around prominent anomalies. Of lesser immediate importance, but possibly of considerable long-term significance to geological science is the unexpected pattern of regional radioactive element distribution that is revealed by compilation of the results at a scale of 1:1,000,000.

Public concern about the future availability of energy supplies will probably be followed within a short time by concern about other non-renewable resources. As part of activities to enable the results of geochemical and geophysical surveys to be used as part of a national resource inventory program, detailed work was carried out in 1973 to further investigate geochemical anomalies revealed by Operation Bear-Slave in 1972. A pattern of lake sediment and soil anomalies was recognized which led to the discovery of lead, zinc, copper and probable gold mineralization. The release of the results of this field work led to extensive staking in the vicinity of the anomalies. Within the same Bear-Slave area, a separate project involving systematic geochemical sampling of acidic rocks developed criteria based on the distribution of analytical values for pinpointing other areas of

high mineral potential. In further anticipation of future trends and requirements, initial steps have been taken to set up a joint GSC-industry research and development project relating to the provision of technology to make fuller use of boreholes for sub-surface exploration purposes. At first attention is being focussed on electrical methods as these have the highest probability of indicating the presence of mineralization at a distance. Four major mining companies are participating in this joint venture which is initially modest in scope but has important implications.

Production of aeromagnetic maps has been a staple item of the Division for many years. 340 new 1" to 1 mile aeromagnetic maps were published in 1973, plus thirty-two 1" to 4 mile reductions. The maps, in order of quantities produced, relate to Keewatin, Quebec, British Columbia, Mackenzie and Labrador. One topical area for which maps were released was the James Bay development area. During the year high resolution aeromagnetic maps produced and compiled by automated data reduction methods by GSC personnel were published for the Baraute and Abitibi areas of Quebec, and Timmins, Ontario.

The most significant high resolution survey conducted during the year involved test flying over a 700 square mile area south of Kamloops, B.C. to show that this type of equipment flown at constant barometric altitude and 1 mile line spacing provides equivalent information to earlier surveys flown at lower altitude and closer line spacing. This can lead to future cost savings over areas of high relief.

With each successive year, an increasing part of the time of the Division's senior scientists is taken up with advisory and consulting work for other government agencies in Canada, and in particular for CIDA. Whereas time spent with Canadian and foreign scientific visitors is frequently rewarding, advisory work of a technical administrative nature is often time-consuming, frustrating and scientifically only marginally productive. Problems often arise because of the inadequate technical backgrounds of counterpart personnel involved. However, from time to time projects do arise which by their nature are ambitious and challenging. The Goias project in Brazil, financed by the Inter-American Development Bank with Canadian funds, is in this category. It has provided a stimulating opportunity for multi-disciplinary involvement in the design and planning of the first phases of a major mineral exploration project with a total budget (combined Canadian-Brazilian funds) of $11.5 million. The project is to cover an area of 375,000 square kilometers. The preparation of detailed technical specifications to a high standard, for execution by Canadian contractors, has required a pooling of the Division's operational experience in several specializations. It is important to recognize that the ability of the Division's staff to advise on a project of this magnitude is only possible because of the direct involvement of these personnal in related work in Canada.

The extent to which the Division's continuing involvement in the planning and management of CIDA geoscience aid projects generates new data

for international use is indicated by the fact that in 1973/74 267 airborne geophysical maps of various types were printed and accepted on behalf of governments of Upper Volta, Niger, Cameroun and Guyana. The volume of overseas work being handled is comparable to that relating to Canada. In the case of Guyana, a comprehensive interpretation of the aeromagnetic data was undertaken, and a report issued jointly by GSC and the Contractor and photogeological interpretation reports were prepared for both Niger and Cameroun.

The ability of the Division's staff to maintain a position of scientific and technical leadership, both nationally and internationally, is reflected both by the number of visitors and by the requests for training assistance. This leadership over a surprisingly wide range of activities is maintained only because some time is still found to do original scientific work, because a sufficient number of the staff are still actively engaged in field operations and because the majority of staff are devoted to their specializations in the face of a not-always encouraging environment for government science. Strong motivation of the staff must be cherished and preserved as the only long term guarantee of worth while productivity and innovation.

Meetings Attended by A. G. Darnley

Symposium on Electromagnetic Exploration Methods, Toronto, May 2-4, 1973.

Society of Exploration Geophysicists, Mexico City, October 21-25, 1973

Canadian Institute of Mining & Metallurgy, April 1973

Canadian Society of Exploration Geophysicists, Calgary, April 1973

GSC-CIDA Mission to Washington (Brazil Goias Project) June 1973

Prospectors & Developers Convention, Toronto, March 1974

GSC-CIDA Mission to Brazil (Goias Project) March 1974

Course Attended

Senior Management Training Course, May-June, 1973

Membership on Committees

EMR-CIDA Liaison Sub-Committee

Canada Centre for Remote Sensing - Geoscience Working Group

PAIT Management Committee

CIMM - Vice Chairman, Ottawa Branch.

SPECIAL PROJECTS

R. W. Boyle

R. W. Boyle has completed the manuscript for a work which will be titled "The Geochemistry of Gold and its Deposits". This represents the culmination of several years' work.

B. E. Manistre

Mr. Manistre joined the division during the year as Geoscience Aid Coordinator relating to CIDA projects. His connection with Canadian aid projects goes back to the Colombo Plan in Pakistan in 1953-55. Subsequently he has been concerned with photogeological interpretation and geophysical surveys in Africa, North and South America, including residence for three years in Chile and Argentina.

CONTRACT SURVEYS SECTION

A. Larochelle

This section is primarily responsible for the acquisition and publication of conventional aeromagnetic data over the Canadian landmass. This includes the planning and monitoring of regional aeromagnetic survey contracts which are let to air survey companies either by the Department independently, or by the Department jointly with Provincial Departments of Mines. Similar attention is given to airborne geophysical surveys funded by CIDA and carried out in developing countries. Storage and retrieval of archival survey recordings and map manuscripts is an ancillary service provided to potential users. Finally the section collaborates with other units in the compilation of high sensitivity aeromagnetic and gamma-ray spectrometer data.

A summary of the progress achieved on surveys carried out in Canada and monitored by the Section is given in Table 1.

TABLE I: Aeromagnetic Surveys in Canada

Survey Area	Miles Flown 1973-74	Maps Published in 1973-74 1 mile/inch	4 mile/inch
Southern B.C. **	--	69	8
MacKenzie-Keewatin Districts	58,871	154	12
Southern Labrador	21,062	11	-
Northern Quebec *	11,733	88	12
Ungava Peninsula	48,152	-	-
Melville Peninsula	18,182	-	-
	158,000	322	32

** Publication completed

* Survey completed

In addition, 24 high sensitivity aeromagnetic maps covering an area in Quebec and 18 similar maps covering an area in Ontario were published at a scale of 1:25,000. Participation of the section in this work was limited to the late printing phase.

Compilation of data acquired during the course of surveys carried out during previous years in Cameroon, Niger and Upper Volta respect-ively was completed during the 1973-74 fiscal year. The following Table II summarizes the yearly publication of maps related to these surveys.

TABLE II: Aeromagnetic Surveys Funded by CIDA

Country	Aeromagnetic Maps Published in 1973-74		Radiometric Maps Published in 1973-74	
	1:50,000	1:200,000	1:50,000	1:200,000
Cameroon	41	13	-	-
Niger	-	3	31	13
Upper Volta	77	10	-	-
Totals	118	26	31	13

Another combined aeromagnetic/radiometric survey involving 470,000 line km of flying was initiated in Ivory Coast in December 1973. Survey progress as of April 1, 1974 sums up to a total of 131,754 line km.

Preliminary layout and specification drafting of a combined radiometric/aeromagnetic survey in Brazil required extensive participation of the section during the past fiscal year.

Compilation of aeromagnetic data acquired during a survey carried out in Guyana was brought to completion under the monitoring of the section during the fiscal year. The published maps included 51 sheets at scale 1:50,000, 14 sheets at scale of 1:200,000, 14 interpretation sheets and one anomaly map at scale of 1:1,000,000.

Attendance at Meetings

A. Larochelle - attended the CIMM annual general meeting in Vancouver, April 1973.

- attended "Symposium on the Methods of Mineral Exploration in Developing Countries" held in Orleans la Source France, 22nd to 24th November, 1973, under the sponsorship of O.E.C.D. (chaired airborne survey session).

DIGITAL COMPILATION SECTION

M. T. Holroyd

The ADAM (Aeromagnetic Data Automatic Mapping) computer software system created by this section is now fully operational. One hundred and six 1:25,000 scale high resolution aeromagnetic map sheets were produced by the system and have been or are about to be published in the geophysical series. A similar number of map sheets are currently within the system. Documentation of the system is in progress and the programs and system manual will be released this year. The system was extended to the data bank level and the digital data sets of all published surveys are available to the public.

Facilities for the production of special processed maps were incorporated into the system employing digital filters designed by the Magnetic Methods Section. A test area in British Columbia was surveyed and a processed map produced from the total field data by means of a low-pass first vertical derivative filter. Work also began on a geochemical data bank system.

Membership on Committees

M. T. Holroyd - Branch Computer Users Committee.

Attendance at Courses

M. T. Holroyd - attended a 3 day tutorial seminar in Rochester, N.Y. on "Coherent optics in mapping".

S. D. Dods & I. Butt - attended a one week course on CDC assembler language programming provided by the Computer Science Centre, E.M.R.

ELECTRICAL METHODS SECTION

L. S. Collett

This section is responsible for developing and testing new ground, airborne and borehole survey instrumentation and techniques to facilitate the discovery of mineral and energy resources of Canada, and the mapping of near-surface earth materials, including permafrost, for engineering purposes. Associated with any electrical methods is an understanding of the electrical properties of earth materials over a broad frequency spectrum and how these electrical characteristics are modified by the inclusion of conducting minerals, such as sulfides, and by temperature as in the case of frozen ground and ice inclusions. Knowledge of these electrical parameters is necessary for data interpretation and theoretical studies.

Perhaps more than in any other discipline, the use of electrical survey techniques has to consider a greater number of variables both in hardware and in theoretical investigations. Not all the possible variables can be covered by a small group of research workers, hence priorities have to be set.

For the field investigations, the main thrust during 1973-1974 has been in experimentation with the use of higher frequency methods for sounding in permafrost regions in the Mackenzie Valley and Arctic Coast. Four test sites have been designated with the help of geologists in the Terrain Sciences Division near Fort Simpson, Willowlake River, Norman Wells and Tuktoyaktuk. Besides the DC resistivity techniques, VLF (Very Low Frequency) Radiohm method, ground and airborne E-Phase techniques at VLF (15-25 KHz) and higher frequencies (100-500 KHz) are being tested on an experimental basis. Field tests of a recently developed radar system by Geophysical Survey Systems Inc. North Billerica, Massachusetts has also been conducted with some success to assess its usefulness in permafrost regions. Control information on these sites is obtained through the cooperation of Terrain Sciences Division by the drilling of boreholes. These field investigations are carried out in close cooperation with the Seismic Section. Some DC resistivity tests were conducted recently working over ice in Kugmallit Bay. Permafrost was detected beneath the surface of the Bay. This preliminary work has provided information for planning future marine resistivity surveys in the area to detect the top of permafrost beneath the sea floor and its possible thickness.

During the year, a contract was awarded to Scintrex Ltd. to test the 3-frequency airborne Tridem System (500, 2000 and 8000 Hz, in-phase and quadrature) for thickness of overburden mapping. Selected sites were chosen at Hawkesbury and near Timmins, Ontario. Tests will be completed as soon as the noise levels of the system have been reduced to an acceptable figure.

In support of the field surveys, the work in the Electrical Rock Properties laboratory is continuing. The frequency of the measurements is being extended to 10^9 Hz and facilities to make measurements at temperatures below 0^oC are nearing completion. In cooperation with Communications Research Centre, radar systems are being evaluated for application to sounding in soils and frozen terrain. Soil moisture determinations could be a by-product of these investigations which is of interest to remote sensing specialists. Theoretical studies have been completed on five types of electromagnetic systems (coil configurations) over multi-layered earth. Work is continuing on the use of EM systems for sounding over frozen terrain taking into account the displacement currents (these currents are always neglected in mineral exploration work) and extending the frequency to 1 MHz. These theoretical studies are very essential to planning the design of new instrumentation for specific purposes.

The Section during the year is entering a new phase of investigation, namely, borehole logging techniques for mineral exploration. A project has been organized in cooperation with mining ex-

ploration companies to compare existing EM, IP equipment and 3-component magnetometers in boreholes supplied by the companies. The holes are chosen near massive sulphide bodies and in copper porphyry deposits. The objectives of the project are to stimulate the use of borehole logging techniques in mineral exploration and to encourage new developments in borehole logging including seismic and nuclear techniques.

Personnel Notes

Ahrens, R. H. - Retired May 17, 1973

Collett, L. S. - Principal Investigator, NASA, for one year period commencing February 1, 1974.

Davis, J. L. - Joined staff September 28, 1973 (PC 1)

Dufour, R. R. - Joined staff December 17, 1973 (DD 3)

Katsube, T. J. - Co-investigator, NASA, for one year period commencing February 1, 1974.

McAllister, M.E. - Left staff October 12, 1973.

Stauffer, W. J. - Retired December 7, 1973.

Attendance at Meetings, Conferences and Courses

Butterfield, D.C.- October 10-12, 1973: Scope 3.3 and 3.4, Computer Science Centre.

Collett, L. S.
- April 4, 1973: DREE/ARDA meeting, Quebec City.
- April 30-May 1, 1973: Meeting on Permafrost, Cold Regions Research and Engineering Laboratory, Hanover, N.H. (presented paper).
- May 2-4, 1973: Symposium on Electromagnetic Methods, University of Toronto, Toronto (co-authored paper)
- May 9, 1973: Advise PAIT, Dept. Industry, Trade and Commerce re Crone Geophysics Ltd.
- May 14-15, 1973: Canadian Aeronautics and Space Institute, Edmonton (sat on Panel on "Remote Sensing of Soil Moisture").
- May 17, 1973: DREE/ARDA Meeting, Ottawa.
- June 26, 1973: Classification Board, Geophysics Position, IPSP.
- September 20, 1973: PAIT, Department of Industry, Trade and Commerce, Scintrex Ltd., Concord, Ont.
- November 28, 1973: DREE/ARDA Meeting, Quebec City.
- December 18, 1973: IRAP, National Research Council, SOQUEM Limited.

- December 19, 1973; DREE/Gaspe, Quebec City.
- January 4, 1974: INPUT Seminar, Geoterrex, Ottawa.
- February 18, 1974: EMR Agreements.
- February 26-28, 1974: Symposium on Permafrost, Calgary (presented paper and organized geophysics program).
- March 2-9, 1974: Goias Project, Inter American Development Bank, Geophysical Pilot Study, Rio de Janeiro, Brazil.
- March 21, 1974: PAIT, Department of Industry, Trade and Commerce, Scintrex Ltd., Concord, Ontario.

Davis, J. L.
- February 4-6, 1974: Meeting at CRREL, Hanover, N.H. and Geophysical Survey Systems, Inc., North Billerica Mass.
- February 26-28, 1974: Symposium on Permafrost, Calgary, Alberta.

Dufour, R. R.
- Spring Term, 1974: Math MIIIC (Computer Programming) Algonquin College.

Dyck, A. V.
- May 2-4, 1973: Symposium on Electromagnetic Exploration, University of Toronto, Toronto, Ontario.
- October 22-26, 1973: Society of Exploration Geophysicists, Mexico City (presented paper).
- January 4, 1974: INPUT Seminar, Geoterrex Ltd. Ottawa

Frechette, J.
- Spring Term, 1973: Math MIIIC (Computer Programming) Algonquin College.

Gauvreau, C.
- Courses at Algonquin College:

  Spring Term/73: Math MVA (Differential Equations)
  Fall Term/73: Linear Circuits I
  Spring Term/74: Linear Circuits II
- September 11, 1973: Scope 3.4, Computer Science Centre, E.M.R.
- March 25-28, 1974: Institute of Electrical and Electronic Engineers, New York, N.Y.

Katsube, T. J.
- April 1, 1973: Grid Course, Cornwall, Ontario.
- May 2-4, 1973: Symposium on Electrical Exploration, University of Toronto, Toronto, Ontario (presented paper).
- June 25-30, 1973: Meetings at University of Utah, Salt Lake City; Minneapolis Honeywell, Minneapolis; University of California, Berkeley.

- September 17-18, 1973: Meetings at University of Toronto, Cominco Ltd. and McPhar Geophysics, Toronto.
- October 22-25, 1973: Annual Meeting Society of Exploration Geophysicists, Mexico City (presented paper).
- November 12-14, 1973: Meeting of American Standards for Testing Materials, Pittsburgh, Pa.
- November 15, 1973: Visited Dr. W. B. Westphal, MIT, Cambridge, Mass.

Scott, W. J.

- May 25-26, 1973: GAC/MAC Meeting, Saskatoon, Sask. (presented paper).
- June 13-22, 1973: completed French Course, Berlitz, Ottawa.
- October 2, 1973: Course on Scope 3.4, Computer Science Centre, EMR.
- November 7-8, 1973 and February 4-6, 1974: Meeting at Geophysical Survey Systems Inc. (GSSL) North Billerica, Mass., and at Cold Regions Research and Engineering Laboratory (CRREL) Hanover, N.H.
- December 20, 1973: Attended P.M. Bolduc's M.Sc. Thesis oral, Ecole Polytechnique, Montreal.
- February 26-28, 1973: Symposium on Permafrost, Calgary, Alberta (presented 2 papers and co-authored a third paper).

Sinha, A. K.

- May 2-4, 1973: Symposium on Electromagnetic Exploration, University of Toronto, Toronto (presented paper).
- July 17, 1973: Meeting at Cold Regions Research and Engineering Laboratory, Hanover, N.H.
- September 11, 1973: Course on Scope 3.4, Computer Science Centre, EMR.
- October 22-26, 1973: Annual Meeting of Society of Exploration Geophysicists, Mexico City.
- February 25, 1974: PERT Workshop, EMR.
- March 10-19, 1974: Meetings with scientists in the following organizations:
  (a) University of California, Berkley;
  (b) Kennecott Exploration Inc., Salt Lake City, Utah;
  (c) University of Utah, Salt Lake City, Utah;
  (d) U.S. Geological Survey, Denver, Colorado
  (e) Colorado School of Mines, Boulder, Colorado;
  (f) University of Colorado, Boulder, Colorado.

Special Talks and Lectures

Collett, L. S. - May 1, 1973: Permafrost Symposium at CRREL, Hanover, N.H. presented talk on "Recent Developments in Electrical Measurements on Permafrost".

Katsube, T. J. - May 8, 1973: General talk on "Electrical Rock Properties" to GSC and Mines Branch, EMR, Ottawa.

- March 7, 1974: Speaker at monthly meeting of Spectroscopy Society of Canada, Ottawa Valley Section, on "Low Frequency Spectroscopy for Mineral Exploration".

Scott, W. J. - October 10, 1973: B.C. Geophysical Society, Vancouver, B.C. on "Geophysical Studies of Permafrost Areas" with Dr. J. A. Hunter.

- February 15, 1974: Ecole Polytechnique - McGill Seminar, Montreal, on "EM Pulse Survey Method in Permafrost".

Sinha, A. K. - Presented talk on"Oscillating Magnetic Dipoles in Mapping of Earth Strata" to Seminar, University of Utah, Salt Lake City (March 14, 1974) and to Denver-Boulder Chapter of I.E.E.E., Dept. of Electrical Engineering, University of Colorado and Cooperative Institute for Research in Environmental Sciences (March 18, 1974).

Membership on Committees

Collett, L. S. - Member, Associate Committee on Geodesy and Geophysics, National Research Council.

- Member, Classification Evaluation Committee, Technical Category, GSC.

- Liaison Officer, PAIT (Program for the Advancement of Industrial Technology, Dept. ITC (Scintrex Ltd.)

- Liaison Officer, IRAP (Industrial Research Assistance Program) NRC (SOQUEM).

Katsube, T. J. - Member of Committee of American Society for Testing Materials, Section D-9; Electrical Insulating Materials.

- Secretary, Spectroscopy Society of Canada, Ottawa Valley Section.

Scott, W. J. - Member Working Group on Computer-based Storage, Retrieval and Compilation of Geologic Field Data (Project No. 710098).

- Secretary, Exploration Geophysics Subdivision, Canadian Geophysical Union, GAC-CAP.

Manuscripts accepted and approved by the Division

Katsube, T. J., 1974
Depth of penetration study for high frequency EM soundings: Geol. Surv. Can., Paper 74-1B.

Sinha, A. K., 1974
Electromagnetic sounding in permafrost regions: Geol. Surv. Can., Paper 74-1B.

Sinha, A. K., 1974
Determination of sea-ice thickness by electromagnetic means: Geol. Surv. Can., Paper 74-1B.

Williams, D. C., Scott, W. J., and Dyck, A. V., 1974
Cavendish Township geophysical test range: 1973 diamond drilling: Geol. Surv. Can., Paper.

Katsube, T. J., and Collett, L. S., 1974
Electrical and EM propagation characteristics of igneous rocks: Submitted to geophysics, Feb. 22.

GEOCHEMISTRY SECTION

E. M. Cameron

This section is responsible for research on geochemical processes; for obtaining data on the geochemical composition of Canada; and for the application of geochemistry to the needs of the Canadian Government.

In 1972 the section carried out the first large-scale geochemical survey of the northern Shield, sampling lake sediments over an area of 36,000 square miles of the Bear and Slave Provinces. In 1973 follow-up studies were carried out in two parts of the 1972 survey area to aid in the interpretation of data from the Bear-Slave Operations and similar surveys. E. M. Cameron and C. C. Durham found that certain anomalous major and trace element distributions in the eastern part of the Slave Province were caused by exhalative-type mineralization associated with a previously unrecognized belt of metavolcanic rocks. Release of this information has prompted much staking activity. In the western part of the Bear Province R. G. Garrett studied the geochemistry

of acid volcanic complexes. These data correlate well with the 1972 results and further add to our development of methods of resource appraisal. On the basis of this year's work we feel that lake sediment geochemistry is firmly established as a geochemical reconnaissance and resource appraisal tool in the northern Shield. Since so much of the section's effort has gone into the development of this method, we hope that it will now be applied on a routine basis.

R. J. Allan and M. Timperley worked to extend the methods of lake sediment geochemistry to the southern Shield. The presence of organic matter on these southern lakes presents difficulties not met with in the north. With the completion of this summer's work, good progress was being made on developing suitable methods.

E. H. W. Hornbrook, jointly with P. H. Davenport of the Province of Newfoundland, carried out a lake sediment survey in western Newfoundland. This project has been sponsored by D.R.E.E. to introduce new exploration methods to the province and, hopefully, stimulate employment. As a result of this work a large amount of Crown Land has been staked and a major exploration effort is likely for this area.

W. Dyck carried out work on the use of such gases as He, Ni, Ar, Rn, H_2, CH_4, H_2S, W_2, O_2 and CO_2 in mineral exploration. At this time work is being orientated to the possible Energy Program of the department to develop methods of discovering deeply buried uranium mineralization.

I. R. Jonasson further investigated the previous finding that metals migrate upwards into snow. This phenomenon is of considerable practical and theoretical interest. It appears that metals that migrate as anionic species or complexes are absent in snow strata and melt waters. There is some evidence that these species migrate downwards into ground waters. He also continued to collaborate with D. F. Sangster on the trace element chemistry of sulphides. This work has proved to be of considerable interest to the Department of Environment, as well as the GSC's studies on geochemical exploration and ore genesis.

Q. Bristow was transferred during the year to administrative duties in the Division office. However, he was able to complete with G. Gaumont the automation of the Section's atomic absorption spectrometers. These are now controlled by a minicomputer, including the sample feed and data computation.

The above paragraphs outline only the principal activities of the Section. In addition specifications were prepared for overseas development programs and training given to geochemists and technicians from developing countries. R. Garrett, E. H. W. Hornbrook and J. J. Lynch spent the latter part of the year preparing a program and specifications for the first Federal-Provincial geochemical survey. This is to be carried out under contract in Saskatchewan in 1974. In preparation for the Energy Program of the Department, R. J. Allan, W. Dyck and I. R. Jonasson collaborated on the preparation of a review on geochemical methods of exploration for uranium. Assistance was provided to the Cape Breton development program.

Since the manpower resources of the Section have not increased for a number of years, the trend towards routine survey, service and consultative functions, has greatly reduced the time available for research. This Section is not unique in this regard, but if carried to its logical conclusion, a few years hence only the less mission-orientated parts of the Branch will be engaged in active research.

Applied geochemistry is used on a vastly greater scale in the U.S.S.R. Because of the similarity of the environments of the two countries, this Section has been making some effort to import Soviet technology in this field. To this end R. J. Allan and R. G. Garrett visited the U.S.S.R., with the aim of developing a regular program of exchange.

Personnel Notes

Guy Gaumont - accepted a promotion to EL 5 at the Department of Agriculture early in 1974.

Dr. M. Timperley - returned to New Zealand in the fall, after completing a very useful Post Doctorate Fellowship.

Attendance at Meetings, Conferences and Courses

R. J. Allan - C.I.M.M. Vancouver; M.A.C. Saskatoon; Permafrost Conference, Yakutsk, U.S.S.R.; Prospecting in Glacial Terrain, Trondheim, Norway.

G. Aslin - Fourth International Conference on Atomic Spectroscopy.

W. Dyck - A.I.M.E., Dallas

I. R. Jonasson - Heavy metals in the aquatic environment, Nashville.

Talks

G. Aslin - "Ultratrace analysis and the problem of complete vapourization of refractory elements with a carbon rod atomizer in atomic absorption spectroscopy" (with C. L. Chakrabarti at Int. Conf. on Atomic Spectroscopy).

R. J. Allan - "Uranium distribution by lake sediment geochemistry and gamma-ray spectrometry: a comparison of reconnaissance techniques" (with K. Richardson, C.I.M.M. Vancouver).

"Distribution of uranium on the crust of the northwestern Canadian Shield as shown by lake sediment analysis" (with E. M. Cameron, M.A.C. Saskatoon).

"Geochemistry at the G.S.C." at Institute of Geochemistry, Irkutsk and I.M.G.R.E., Moscow.

E. M. Cameron - "Geochemical Reconnaissance in the northern Shield" (N.W.T. Chamber of Mines, Yellowknife).

"Geochemical Exploration for massive sulphides". Queen's University, Department of Geology.

I. R. Jonasson - "A discussion of field observations on the transport of heavy metals by sediments" (at Conf., Heavy Metals in the Aquatic Environment).

Membership on Committees

Q. Bristow - Chairman, Algonquin College Advisory Council on Electronic Technology.

E. M. Cameron - Vice President, Association of Exploration Geochemists.

- Editor-in-Chief, Journal of Geochemical Exploration.

R. G. Garrett - Chairman, Branch Computer Facilities Committee.

E.H.W. Hornbrook - Subcommittee on Canada-Newfoundland Mineral Development Program.

Completed Manuscripts

The following manuscripts were accepted and approved by the Division.

Allan, R. J., Cameron, E. M., and Jonasson, I. R.
1974 Mercury and arsenic contents of lake sediments from selected areas of the Canadian Shield. Abs. to Proc. First Inter. Cong. on Mercury, 1974.

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1974 The formation and detection of metal dispersion halos in organic lake sediments. Jour. Geochem. Explor. V. 3 (in press).

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GEOCHEMISTRY LABORATORIES

J. J. Lynch, Chief Analyst

During the past fiscal year, quite a substantial number of additional services has been added to the existing inventory of methods and techniques. A small water analysis laboratory was set up to provide for Dr. J. G. Souther who is presently doing geothermal studies in British Columbia. The constituents in water which can now be determined include Ca, Mg, Na, K, Li, Rb, Sr, Ba, Mn, SiO_2, As, CO_3, HCO_3, Cl, SO_4, Zn, Cu, Pb, Ni, Co, Ag, Cd, F and U. In addition, wet chemical methods for the determination of Ca, Mg, Al, SiO_2, Cl and F in rocks have been put into routine use. Investigations into the determination of Ba and Sr by atomic absorption spectrophotometry are presently under investigation.

The productivity of the Sample Preparation, Trace Element and Direct Reading Spectrometer Laboratories is tabulated in Tables 1, 2 and 3 respectively. The rather large carry-over in Table 2 is due mainly to a large batch of samples for which only two elements are required. It is expected that these samples will be completed early in the new fiscal year. R. Horton and W. Nelson devoted most of their time during the past year doing major and trace element analyses by wet chemical methods and hence the productivity of the Direct Reading Spectrometer Laboratory is very substantially reduced.

TABLE I

Sample Preparation Laboratory

	1972-73	1973-74
Samples carried over	0	0
Samples received	5049	4610
Samples completed	5049	4610
Samples carried forward	0	0
Sizing	4206	1505
Crushing	434	3405
Grinding	426	3405
Ball Milling	402	3105
Superpanner	384	360
Frantz	381	200
Heavy Liquid	19	100
Hand Picking	30	25

TABLE II

Trace Element Laboratory

	1972-73	1973-74
Samples carried over	2840	4334
Samples received	16069	6141
Samples completed	14575	7140
Determinations	77092	88889
Samples carried forward	4334	3335

TABLE III

Direct Reading Laboratory

	1972-73	1973-74
Samples carried over	1081	80
Samples received	6497	122
Samples completed	7498	202
Determinations	216451	6838
Samples carried forward	80	0

RADIATION METHODS SECTION

K. A. Richardson

This Section is responsible for development and evaluation of geophysical instrumentation and techniques utilizing in particular gamma-ray, visible, infrared and radar portions of the electromagnetic spectrum.

In the summer of 1973, high sensitivity airborne gamma-ray spectrometry data were collected over the northern part of Saskatchewan, as a cost shared project with the Saskatchewan government and also over an area of approximately 50,000 square km in the Northwest Territories. The release of results from these two surveys as GSC Open Files was followed by the acquisition of significant acreage of mining claims and permits by the uranium exploration industry.

Ground investigations were made of several anomalies found in previous years by airborne gamma-ray spectrometry in the Northwest Territories. The results of these investigations, in addition to aiding in the interpretation and evaluation of airborne data, indicated the presence of previously unreported uranium occurrences.

Theoretical studies aimed at improving the accuracy of uranium quantification by airborne measurements continued, and have produced better factors for correlating airborne measurements with ground concentrations of the radioelements.

Multispectral photowork emphasized colour photography for specific applications, 1) recognition of gossans or other characteristics indicative of mineralization, and 2) the environmental effects of strip mining of coal in S.E. British Columbia and S.W. Alberta.

With the cooperation of Canadian Armed Forces and the Surveys and Mapping Branch of EMR, SLAR imagery was obtained over the Hearne Lake area, NWT (Map sheet 85I) and mosaiced, for evaluation of the geological value of this type of imagery.

The GSC reference collection of ERTS imagery supplied by the Canada Centre for Remote Sensing and maintained by the Section has grown to about 3000 sets of images.

Personnel Notes

Dr. Patrick G. Killeen - joined the Section in August, 1973 following a year as Post Doctoral Fellow at the Mineralogisk-Geologisk Museum, University of Oslo, Norway.

Attendance at Meetings, Conferences, Courses

K. A. Richardson - Canadian Institute of Mining & Metallurgy, Vancouver April 1973.

- Prospectors and Developers Association, Toronto March 1974.

V. R. Slaney - Western Inter University Geological Conference, Calgary, February 1974.

- Evolution of the Grenville Province, Ottawa, Feb.1974.

R. L. Grasty - Society of Exploration Geophysicists, Mexico City, October 1973

- Snow and Ice Symposium, Monterey, Cal. Dec. 1973.

- Eastern Snow Conference, Ottawa, Feb. 1974

P. G. Killeen - Midwest Superior Geotraverse Project Meeting, Toronto, January 1974.

Mrs. B. E. Elliot and J. J. Parker - Minicomputer Operating Systems Course, Hull, Mar.1974.

Special Talks or Lectures

R. L. Grasty - Measurement of Uranium by Airborne Gamma-ray Spectrometry: at Society of Exploration Geophysicists, Mexico City, October 1973.

- An experimental gamma-ray spectrometer snow survey over Southern Ontario: at US/IHD Interdisciplinary Symposium on Advanced Concepts and Techniques in the Study of Snow and Ice Resources, Monterey, California, DEc. 1973.

V. R. Slaney - Remote Sensing for Geological Exploration: at Western Inter University Geological Conference, Calgary, February 1974.

- Remote Sensing: at Evolution of the Grenville Province, Ottawa, February 1974.

Completed Manuscripts

Killeen, P. J., and Hobson, G. D. 1974 Project EGMA Seismic Survey - Timmins, Ontario to Val d'Or, Quebec. GSC Paper

EXPERIMENTAL AIRBORNE OPERATIONS

P. Sawatzky

This section is responsible for (a) the design and testing of various new and improved airborne geophysical and navigational systems, (b) experimental airborne geophysical survey operations in which the two GSC aircraft are used.

During the winter of 1973/74 work continued on the design and construction of the vertical gradiometer system for the Queen Air. At this time the additional tail boom has been installed and extensive vibration tests have been conducted to ascertain whether abnormal vibrations could be produced in flight that would destroy or weaken the aircraft structure. It is anticipated that the first flight tests will begin in June 1974, as soon as MOT issues an Experimental Flight Permit. To assist in the pre-flight evaluation, several critical points in the aircraft have been instrumented with sensitive accelerometers. The accelerometer data will provide a quantative base in deciding whether the modifications that have been made to the aircraft are structurally sound.

Upon completion of the above phase, self-orienting high resolution magnetometers and compensators are to be installed in each boom. Because an inboard high resolution vertical gradiometer has never before been constructed it is anticipated that difficulties will occur in compensating both magnetometers simultaneously to remove the manoevre signals generated by the aircraft. It is anticipated that a considerable amount of flying may be required before all systems are operating satisfactorily. In order that we may record the real-time difference between the two magnetometers, an arithmetic unit has been designed, built and installed in the digital data acquisition system. This unit is designed to calculate the arithmetic difference between the field values from the two magnetometers comprising the gradiometer system.

Another project that has been active was concerned with the problem of flight path recovery. A slow scan video-recording system is in the process of being designed, built and installed in the Queen Air aircraft. This should eliminate the need for film processing in the field which has always proved to be a delaying factor in flight path verification. To speed this up still further, a VLF (Very Low Frequency)

navigation system is to be added to both the Skyvan and the Queen Air. This navigation system should make it possible to survey anywhere in the world with an acceptable accuracy. The main advantage of such a navigation system is that the aircraft position could be recorded directly as latitude and longitude on magnetic tape together with the other pertinent survey data.

SEISMIC METHODS SECTION

G. D. Hobson

This section is responsible for seismic programs directed towards research in both land and marine shallow seismic methods for engineering purposes, and survey work in conventional refraction and reflection methods applied to geological problems throughout Canada.

Seismic refraction profiling was continued in the Sverdrup Basin of the Arctic Archipelago to determine the velocity-depth structure of the sedimentary section. An east-west survey line begun during the field season of 1972 from Melville Island through to Amund Ringnes Island was completed to Axel Heiberg Island. The project involved most of the section's personnel for the spring field season. The data is being interpreted by A. Overton.

The interpretation of seismic reflection records obtained near Flin Flon, Manitoba, has been completed by A. Overton. The objective of the project was to attempt to identify reflected events associated with geological boundaries in Precambrian rocks. A publication will be forthcoming.

A literature survey of the application of seismic and acoustic methods to mineral exploration was carried out by A. Overton. This work was performed as part of a cooperative program between Resource Geophysics and Geochemistry Division and participants from the mining industry.

A new project under the supervision of J. A. Hunter was generated to investigate the seismic properties of earth materials in permafrost conditions. This project has special application to mapping of permafrost along highway and pipeline routes in the Mackenzie Valley as well as the occurrence of sub-seabottom permafrost in the Beaufort Sea. Test areas in various types of permafrost conditions are presently under study. Field programs at sites near Fort Simpson, Willowlake River, Norman Wells and Tuktoyaktuk, N.W.T. have been carried out jointly with W. J. Scott of the Electrical Methods section. Shallow marine refraction profiling in the Beaufort Sea was successfully undertaken. Although the seismic survey was reconnaissance in nature, the existence of sub-seabottom permafrost was interpreted over widely scattered portions of the Shelf area. Winter drilling on the sea ice of Kugmallit

Bay by the Terrain Sciences Division along one of the seismic lines confirmed the presence of permafrost. The marine refraction technique is being further developed and future surveying in the Beaufort Sea is planned.

A cooperative program with the Geophysics Department of the University of Western Ontario was undertaken to investigate reflection coefficients from the base of the permafrost layer. Studies were initiated to determine the amplitude dependence of such variables as type of material, temperature gradient and frequency content of the initial seismic pulse, on a velocity gradient boundary model. This work is designed to obtain basic characteristics of reflected waves as an aid to field interpretation of engineering seismic data as well as an aid to record interpretation in seismic exploration for oil and gas in permafrost regions.

Hammer seismic surveys were carried out near Tilbury Ontario, by R. M. Gagne to map the occurrence of an ancient preglacial bedrock river channel connecting Lake St. Clair and Lake Erie. The work to date has outlined most of the southern end of the channel. Future work is planned to complete the delineation. Hammer seismic surveys were also carried out near Willowlake River in the Mackenzie Valley to test the applicability of this system to surveying in discontinuous permafrost conditions.

The investigation of the "Total Time Method" of depth estimation for "valley-like" structures was continued by H. A. MacAulay in cooperation with shallow seismic surveys underway near Norman Wells. Unfrozen "talik" zones associated with a road bed in continuous permafrost were mapped by the method.

Personnel Notes

G. D. Hobson continued as acting coordinator of the Polar Continental Shelf Project. In his absence the section head duties were shared by A. Overton and J. A. Hunter.

Attendance at Meetings, Courses

G. D. Hobson

- Attended the Canadian Society of Exploration Geophysicists meeting in Calgary, April 4-7, 1973. Author of paper presented at the technical session.
- Attended the Geological Association of Canada meeting at Saskatoon May 23-26, 1973 as session chairman and co-chairman of the Arctic Symposium.
- Attended the IInd International Conference on Permafrost, Yakutsk, Siberia, U.S.S.R. July 8-Aug. 1,1973. Co-authored theme paper with O. Ferrians, U.S.G.S.

- Attended the Society of Exploration Geophysicists meeting in Mexico City. Member of the mining committee.
- Attended the Arctic Institute's Beaufort Sea Symposium, San Francisco, Jan. 7-10, 1974. Co-authored paper with J. A. Hunter.
- Attended NRC Permafrost Workshop, Calgary, Feb. 25-28, 1974. Author of paper, co-author of paper with J. A. Hunter.

J. A. Hunter
- Attended IInd International Conference on Permafrost Yakutsk, Siberia, July 8 - August 1, 1973. Author of paper.
- Attended the Arctic Institute Beaufort Sea Symposium San Francisco, Jan. 7-10, 1974. Co-author of paper with G. D. Hobson.
- Attended the NRC Permafrost Workshop, Calgary, Feb. 25-28, 1974. Co-author of paper with G. D. Hobson. Co-author of paper with W. J. Scott.

Membership on Committees

G. D. Hobson
- Society of Exploration Geophysicists mining committee.
- Co-ordinating Committee on Availability of Canadian Flag Vessels, M.O.T.

J. A. Hunter
- Subcommittee on Seismology and Physics of the Earth's Interior, of the Associate Committee on Geodesy and Geophysics, N.R.C.

Lectures Given

J. A. Hunter
- Talk on "Geophysical Methods Applied to Permafrost" to B.C. Geophysical Society, Vancouver; co-authored with W. J. Scott, October 10, 1973.
- Talk on "Geophysical Methods Applied to Permafrost" to Marine Research Group, D.R.B., Victoria, B.C.
- Talk on "Geophysical Methods Applied to Permafrost" to C.I.M.M. Schefferville, P.Q., October 17, 1973.

Papers Presented at Meetings

Ferrians, O. J. and G. D. Hobson
"Mapping and Predicting Permafrost in North America: A Review 1963-1973": presented at the IInd International Permafrost Conference at Yakutsk, Siberia, U.S.S.R.

Hobson, G. D.
"An Update of Government Geophysics in the Sverdrup Basin": presented to Canadian Association of Exploration Geophysicists, Calgary.

Hunter, J. A. and G. D. Hobson
"A Seismic Refraction Method to Detect Sub Seabottom Permafrost": presented at the Beaufort Sea Symposium, Arctic Institute of North America, San Francisco.

Hunter, J. A. and G. D. Hobson
"A Seismic Refraction Method to Detect Sub Seabottom Permafrost": presented at the N.R.C. Permafrost Symposium, Calgary.

Scott, W. J. and J. A. Hunter
Seismic and Electrical Methods in Permafrost Detection": presented at the N.R.C. Permafrost Symposium, Calgary.

MAGNETIC METHODS SECTION

P. J. Hood

This section is responsible for developing new magnetic survey instrumentation and techniques, conducting and interpreting special aeromagnetic surveys over land and sea; devising new techniques for the treatment and interpretation of aeromagnetic survey data, and demonstrating the usefulness of magnetic survey data in geological mapping.

During 1973, P. J. Hood and M. E. Bower continued the co-operative ocean aeromagnetic project with the National Aeronautical Establishment. In April 1973, NAE's North Star aircraft returned to the Davis Strait area to complete the reconnaissance survey commenced in 1972 and also to carry out further navigation experiments. Approximately 3200 line miles of data were acquired. The GNS-200 navigation system was again used for the survey, and proved to be the best method tried to date of navigating the North Star aircraft over water. The GNS-200 has been modified to include a clock reference, which is a rubidium frequency standard against which the phase of the stations is measured. This allows navigation to be done in a range-range mode instead of the hyperbolic mode involving pairs of stations. Range-range navigation is inherently more accurate, and can be done with only two stations. The computer navigation program has also been modified to do both range-range and hyperbolic calculations. This system was also flown off the coast of Vancouver Island and on numerous local flights during 1973. One peculiar problem has been observed - a transmitter being too powerful. In the Ottawa area the signal from Maine tends to swamp some of the other stations, even although they transmit on different frequencies. This seems to be caused by a basic design weakness in the receivers, probably a matter of economics; the problem diminishes as the distance from Maine increases.

The opportunity was also taken during the 1973 survey of carrying out an aeromagnetic reconnaissance of Cumberland Sound. In the central part of Cumberland Sound the profiles are quite smooth indicating that the depth to the crystalline rocks of the Precambrian basement is great and that an extensive sedimentary cover exists. Moreover the succession of U-shaped anomalies in the central part of the Sound is definite evidence for the existence of a graben which is about 20 km wide filled with at least 5 km of sediments. It is apparent from the aeromagnetic profiles that it will be possible to delineate the extent of the offshore basalt on both sides of Davis Strait much more precisely as a result of the 1973 survey.

A magnetic anomaly map of the Atlantic Provinces has been compiled from the existing aeromagnetic and shipborne magnetic data which covers most of the land and adjacent continental shelf areas. The sea magnetometer data incorporated in the map was compiled by R. T. Haworth of the Atlantic Geoscience Centre in Dartmouth, Nova Scotia. Dwight Reveler removed the IGRF field from the aeromagnetic data using a graphical technique devised by P. J. Hood.

The magnetic anomaly map has been obtained by removing the earth's main magnetic field, which has its origin in the earth's core, using the 1965.0 International Geomagnetic Reference Field corrected for the secular variation in order to emphasize those magnetic anomalies which are related to crustal geology. The resultant 1:1,000,000 map, the first such map for Canada, has been compiled using six (6) colours each representing a 200-gamma interval with intermediate 100-gamma contours. The magnetic anomaly map of the Atlantic Provinces contains anomalies mostly having two distinct wavelengths. The longer wavelength of the order of 200 km is due to deep-seated crustal effects, whereas the shorter wavelength anomalies, usually less than 10 km wide, are due to individual rock formations which outcrop or are overlain by sediments. Many well-known geological features are apparent on the map together with some features which were previously unknown. For instance, the southern part of the Gulf of St.Lawrence which is underlain by a considerable thickness of sediments is paradoxically a regional magnetic high area.

The construction of the vertical gradiometer system for the GSC Queenair aircraft proceeded in co-operation with the Experimental Airborne Operations Section and additional details are given in their annual report. Progress in this project has been slower than expected due to the fact that considerable modifications to the original design for the second boom had to be made subsequently.

During 1973, the Geological Survey Queenair B80 aircraft, which is equipped with a digital-recording rubidium-vapour magnetometer, was used to carry out experimental surveys in the following areas:

1. Amundsen Gulf, N.W.T.
2. Kamloops, B.C.
3. Bathurst Mining Camp, New Brunswick

In addition a series of base line loops were flown in the Maritimes to be used in the compilation of the magnetic anomaly map for that area in which the contribution due to the main earth's field is removed using the International Geomagnetic Reference Field. The base lines will enable the various aeromagnetic surveys in the Maritimes which were flown over a twenty-year period to be tied to a common datum. This is particularly important for those aeromagnetic surveys flown during the fifties using fluxgate magnetometer, all of which were compiled using an arbitrary datum.

About 2500 line miles of data resulted from the aeromagnetic survey of the Amundsen Gulf which was carried out during April/May 1973. This was a Decca-controlled survey flown at 2000 feet above mean sea level. Unfortunately production was limited severely by excessive diurnal variations of the earth's magnetic field which occurred during the survey.

When it became apparent that the original survey planned could not be completed because of the excessive diurnal activity, it was decided to concentrate on delineating the Darnley Bay anomaly. The

feature was originally discovered as a result of a gravity survey carried out by the Gravity Division of the Earth Physics Branch. In the 1973 aeromagnetic survey, the anomaly peaked at about 1,500 gammas above the background values. The dip of the earth's field is 84^{o} in this location, so that the amplitude of the vertical and total field anomalies will be almost the same. Thus the anomaly only falls off by a factor of about 2 in going from 2,000 feet to 11,500 feet ASL. This is indicative of the fact that the top of the body is deeply buried being at least several kilometres below the surface.

The second experimental survey was carried out to ascertain the efficacy of high resolution aeromagnetic surveys flown at a constant barometric elevation over areas of rugged topographic relief. There are considerable operational problems in flying fixed wing aeromagnetic surveys at a mean terrain clearance of 1,000 feet over such areas, and in recent years use has been made of helicopters to carry out the surveys.

Approximately 790 line miles were flown during the Kamloops test between May 17-21, 1973. The flying height was 6,500 feet above sea level because mountain peaks in the survey area reach 6,000 feet. Fifteen east-west lines and three double tie lines were flown, the base of operations being Kamloops. The party chief for the operation was D. Olson.

A comparison of the earlier standard sensitivity survey with the 1973 high resolution aeromagnetic survey and the surface geology clearly shows that high resolution aeromagnetic surveys at constant barometric elevation are useful in areas of rugged terrain. It is also clear because of the low noise level in the high resolution data, that digital filters can be used effectively to improve the resolution of near surface sources. Our experience with low sensitivity data indicates that the geological information obtained by the process of derivation is often masked by the larger noise level in this type of magnetic data. This is especially true for the higher derivatives. Hence high resolution surveys using fixed wing aircraft at constant barometric elevations supply a viable alternative in mountainous regions to aeromagnetic survey with helicopters.

An annual review of mineral exploration techniques and equipment was again prepared by P. J. Hood and published in the February 1974 issue of the Canadian Mining Journal. Tabulations of commercially available airborne electromagnetic and ground resistivity and self-potential equipment was also compiled. Reprints of these articles are sent not only to mining companies but also to most geological surveys in the world and also such agencies as CIDA and the UN in order to keep their geophysical personnel abreast of the latest techniques. The annual review article has in fact become a standard reference for exploration personnel.

During the year, the 652-page proceedings volume on the Earth Science Symposium on Offshore Eastern Canada held in Ottawa was published. The main objective of the volume, which was edited by P. J. Hood,

was to summarize the present knowledge of the continental shelves and slopes of eastern Canada. This exercise should serve as a model for similar multi-disciplinary assaults on areas of the continental crust in Canada and elsewhere.

On November 28, 1973, the interpretation report and maps which resulted from the 1971/72 aeromagnetic survey of Guyana were officially presented by the Canadian High Commissioner, Mr. O. Dier, to the Minister of Energy and Natural Resources for Guyana, Mr. H. Jack in Georgetown, Guyana. The aeromagnetic maps cover an area of about 37,000 square miles of central and northern Guyana which was funded through CIDA and surveyed by Terra Surveys Ltd. of Ottawa. P. J. Hood who acted as the Inspector for the survey (assisted by W. Knappers) was also present at the presentation ceremony. The resultant maps were published at scales of 1:50,000 and 1:200,000 together with interpretation maps at a scale of 1:200,000. An additional end product of the survey was a 1:1,000,000 residual magnetic anomaly map of Guyana which incorporated the aeromagnetic data from a previous UNDP survey with the CIDA-funded survey. The map appears to be the first of its kind in South America and was compiled to assist in the study of the regional geology of the Guiana Shield. An interpretation of the map was presented in a joint paper by P. J. Hood and I. Tyl of Terra Surveys Ltd. to the Second Latin American Geological Congress in Caracas, Venezuela during November 1973.

The interpretation of the Guyana aeromagnetic survey data carried out by Terra Surveys was checked by G. W. Cameron who was employed for the purpose under a CIDA contract. In general, the results obtained using the GSC automatic least-squares multi-model computer method checked reasonably well with those obtained by Terra Surveys using the ITI method developed by Compagnie Generale de Geophysique in France.

P. J. Hood was a member of an EMR task force on Multiparameter Marine Surveys convened during the Fall of 1973; other members were J. O. Wheeler, B. D. Loncarevic and J. Tanner. A report was prepared and submitted to the Assistant Deputy Minister (Science & Technology) as a position paper for negotiations with the Canadian Hydrographic Service.

P. J. Hood also prepared a brief on Geophysical Surveys Technology for the Prime Minister's visit to China during October 1973. Subsequently P. J. Hood acted as a geophysical consultant to the Department of Industry, Trade and Commerce in connection with preparations for the Canadian Electronics and Scientific Instruments Exhibition to be held in Shanghai, China during April 1974. A review paper entitled "Mining geophysics; an introduction to Canadian equipment and techniques" was prepared and submitted to Industry, Trade and Commerce for translation into Mandarin for the Shanghai trade fair.

During 1973, G. W. Cameron modified existing computer programs which retrieve and plot aeromagnetic flight line data stored on tapes. The programs were modified to include one-dimensional bandpass and low-pass vertical derivative digital filters designed by P. H. McGrath.

Filtering was applied to some of the flight line data from the 1971 Abitibi area high-sensitivity survey flown by the Queenair aircraft. Initial results indicate better resolution of the near-surface sources of magnetic anomalies is possible. However, with a non-dimensional filter anomalies due to sources parallel to the flight lines may be filtered out, so that the application of two-dimensional filters appears to be desirable.

G. W. Cameron, with P. J. Hood as co-author, prepared the first draft of a paper correlating magnetic anomalies over the Meguma Group of Nova Scotia with known gold deposits in an attempt to illustrate how magnetic data, when combined with known geological and structural data, can be used to indicate areas where further prospecting for gold might be profitable. G. W. Cameron also carried out an interpretation of the Kelsey Lake magnetic anomaly in Saskatchewan. The study was carried out to establish whether a sufficient tonnage of ore was indicated for the Kelsey Lake Iron Ore project proposed as part of DREE's Iron and Steel Agreement with Saskatchewan. It was concluded that although a large tonnage of low-grade iron formation was present, the main belt of anomalies did not appear to be produced by ore of a sufficiently high tenor. It was recommended that further studies should be confined to the anomaly in the vicinity of Kelsey Lake itself.

L. J. Kornik and P. H. McGrath have continued their evaluation of the application of high resolution aeromagnetic surveys to detailed geological mapping programs. In 1972, a test range was established near Timmins, Ontario and aeromagnetic and ground surveys were carried out. The aeromagnetic data were obtained using the high resolution optical absorption magnetometer system installed in the GSC Queenair aircraft. First, second and third vertical filter operations have been applied to the data as well as upward and downward continuation techniques. Also band pass filters have been used alone and in combination with other methods. First vertical derivative data appear to be the most useful in defining local anomalies related to small scale geological features. A paper describing the status of the study was presented at the SEG meeting in Mexico City in October 1973.

A derived magnetic susceptibility map of a portion of the Timmins high resolution aeromagnetic survey flown in 1968/69 was prepared under contract by Paterson, Grant and Watson Ltd. in order that that particular technique might be evaluated.

P. H. McGrath has derived a set of guidelines for use in establishing the specifications of digitally-recorded total magnetic field and gradiometer survey parameters. The guidelines are based on the assumption that the magnetic field at the level of the closest magnetic source to the sensor can be represented by white noise. For any given distance of upward continuation of the white noise it is possible to arbitrarily define the highest frequency component which is contained in the resultant data. Hence equations defining sampling parameters for magnetic surveys at any altitude above magnetic basement can be derived. Also the effects of averaging readings over a finite distance along the flight line was examined. A paper presenting these guidelines is almost ready for submission for publication.

P. H. McGrath has also designed a one-dimensional low-pass first vertical derivative operator which was used on a portion of the Timmins high sensitivity data. A map of the resultant derivative data established the usefulness of the technique to enhance the small scale anomalies caused by near surface sources. However, all of the dyke anomalies parallel to the flight line direction were removed from the original data by the operator. This occurred because in using a one-dimensional operator, one assumes that anomalies extend to infinity perpendicular to the flight direction. At the present time P. H. McGrath is designing a two-dimensional first vertical derivative operator to overcome this difficulty.

Over the past two years S. Washkurak has been responsible for the development of a small portable APT system to receive weather satellite data over the entire North American continent including the Arctic Islands. Geological Survey field parties can now check ice break up and snow conditions from imagery received daily at Ottawa prior to departing for the field. During the past summer an experimental station named George was installed and operated at Resolute Bay, N.W.T. for the Polar Continental Shelf Project. From the ESSA 8 and NOAA II satellite, each picture received covered an area measuring approximately 1,200 miles square. Because of the northern location of the station every satellite orbit (2 hours) could be received so that over a 24 hour period it was possible to prepare a composite image showing the entire Arctic region including the Great Lakes and Siberia. On completion of the aircraft ice patrol the APT station was moved to the Atmospheric Environment Service (AES) Meteorological office for convenience of meteorologists at Resolute through the winter months.

The repetitive global coverage of satellite imagery in the different visible and infrared spectral bands has provided a wealth of image tonal patterns. Some of these tonal patterns can be recognized at first inspection and mapped for what they represent. For instance snow fields, changing pack ice boundaries of the entire Arctic, Barnes Ice Cap can be identified and mapped. However, there are many tonal patterns which do not seem to correlate with any feature depicted in conventional maps.

The meteorological usefulness of satellite imagery obtained at Resolute can best be illustrated by the following incident that transpired. A pilot from Alert Airways requested that a weather prognosis for a flight planned from Alert on Ellesmere Island to Meighen Island and on to Resolute. From a recent satellite picture it was observed that Meighen was cloud-free but a small frontal cloud condition existed between Meighen and Resolute. By radio, the meteorologist was able to direct the pilot around the cloud bank and inform him that clear weather conditions would persist at Resolute for his estimated time of arrival (ETA).

The daily line mile cost to survey the entire country including the Arctic Islands in the visible and infrared with a ground resolution of 5 miles is approximately 0.002 cent per line mile ($20 per day).

In spite of the fact that NASA down link calculation predicted the requirement of an 18-foot parabolic antenna to receive NOAA II data, S. Washkurak has proven that the reception of VHRR visible and infrared imagery is possible with a manually-controlled 8-foot antenna. Ground coverage from Baffin Island to Florida is presently being received at the satellite receiving station located at Blackburn Hamlet, Ottawa.

Scintrex have completed the design of a multiple resonance magnetometer (MRM-1) based on Wesemeyer's Canadian patent #706,520. Two major design improvements were incorporated in the instrument for which Scintrex have submitted a patent application that does not affect the status of the GSC with regard to the payment of a line mileage royalty. The dispersion component of the NMR signal to stabilize the frequency of a voltage-controlled oscillator is used which offers an improvement on the signal-to-noise ratio and the synthesis of an alternate nitroxyl free radical tetra methyl piperidone oxylidine has been found. The original objective of producing a royalty-free continuous-reading Overhauser magnetometer with a resolution of 0.03 gamma has therefore been realized.

Personnel Notes

Dr. K. Ogawa of the Geological Survey of Japan returned to Japan in September 1973 after spending a year's educational leave with the Magnetic Methods Section.

G. W. Cameron completed his CIDA contract at the end of June, 1973 and commenced a term appointment on July 1, 1973.

Attendance at Meetings, Conferences and Courses

P. J. Hood

- Second Latin American Geological Congress, Caracas, Venezuela, Nov. 11-17, 1973. Presented a paper entitled "Residual magnetic anomaly map of Guyana and its regional interpretation" with I. Tyl of Terra Surveys Ltd. as co-author.
- 43rd Annual International Meeting, Society of Exploration Geophysicists, Mexico City, Oct. 21-25, 1973. Presented a paper entitled "Aeromagnetic reconnaissance of the Labrador Sea and Baffin Bay" with Margaret Bower as co-author.
- Grenville Symposium, Ottawa University, Feb. 20-21, 1974. Presented a paper "Aeromagnetic surveys of the Grenville Province".
- Inaugural meeting, Canadian Geophysical Union, Ottawa, February 22, 1974.
- Prospectors and Developers Meeting, Toronto, March 10-14, 1974.

G. Cameron - attended departmental MARS computer course from Nov. 19-23, 1973.

L. J. Kornik - 43rd Annual International Meeting, Society of Exploration Geophysicists, Mexico City, Oct. 21-25, 1973. Presented a paper entitled "Evaluation of high resolution aeromagnetic surveys in the Canadian Shield" with P. H. McGrath, M. T. Holroyd and P. J. Hood as co-authors.

Special Lectures

P. J. Hood - Aeromagnetic surveys in Guyana, Atlantic Geoscience Centre, January 11, 1974 preparatory to the CHS Baffin carrying out bathymetric and marine geophysical surveys on the continental shelf of Guyana.

Membership on Committees

P. J. Hood - Chairman, Subcommittee on Exploration Geophysics, N.R.C. Associate Committee on Geodesy and Geophysics. This committee was dissolved on February 19 and was reconstituted the same day as the nucleus of the Exploration Geophysics Subdivision of the Canadian Geophysical Union.

- Chairman, Exploration Geophysics Subdivision, Canadian Geophysical Union.
- Member, NRC Associate Committee on Geodesy and Geophysics.
- Member, Committee for Co-operation with Government Agencies, Society of Exploration Geophysicists, Tulsa.
- Member, Working Group 3 (Geomagnetic Instruments and Standards), Division 5, (Observatories, Instruments, Indices and Data) of International Association of Geomagnetism and Aeronomy.
- Member, Advisory Council, Canadian Mining and Aggregate Equipment Exhibition, Toronto, November 20-22, 1973.

P. H. McGrath -Secretary, Logan Club, 1973-74.

Completed Manuscripts

The following manuscripts were accepted and approved by the Division:

Hood, P. Mining Geophysics, an introduction to Canadian equipment and techniques; paper prepared for the Canadian Electronics and Scientific Instruments Exhibition, Shanghai, China, April, 1974.

Hood, P. (Chairman) Exploration Geophysics, Can. Geophys. Bull., NRC, v. 26 (in press).

McGrath, P. H ., Holroyd, M. T. and Hood, P. J. An experimental high resolution aeromagnetic survey in the Kamloops area, British Columbia; Geol. Surv. Can., Paper 74-1, pt. B (submitted April 1974).

TERRAIN SCIENCES DIVISION

J.S. Scott, A/Chief

INTRODUCTION

The Terrain Sciences Division provides geological, geomorphological and geotechnical information on terrain and its performance in order to promote effective use of the terrain, to identify and assess natural hazards, and to facilitate maintenance and restoration of the physical environment. The divisional program deals with surface and near-surface earth and rock materials, landforms, and associated stability relations and dynamic processes, and is designed to build up a geologically based fund of centralized knowledge and expertise concerning the terrain of Canada to meet ongoing national information requirements and to contribute to a variety of programs of the Government of Canada.

Scientific and support staff of the Division are involved in a wide diversity of projects throughout Canada. These projects include systematic mapping of surficial geology in the southern, boreal forest and arctic regions of Canada, development and evaluation of techniques for utilization of glacial drift as a prospecting medium, evaluation of landslide hazards, applications of geology to the development of the urban environment, studies of sedimentary processes in coastal regions and various studies concerning the behaviour of earth materials under the influence of mineral and petroleum development and engineering construction.

A major part of the activities of the Division was centered in the Mackenzie Valley as a result of continued interest by government and industry in the social and economic development of this region based on energy resources. Substantial support for Divisional projects in the Mackenzie Valley and adjacent coastal regions has been provided by funding through the interdepartmental Environmental-Social Program, Northern Pipelines and from the Environmental Working Group, Mackenzie Highway. Work in this region has been focussed on surficial geology and landform mapping, evaluation of the thermal properties of unconsolidated materials through use of a cold room laboratory facility, studies of ground ice development and related geomorphic processes in a permafrost environment and the documentation of "case histories" of terrain reaction to various of man's activities in northern regions.

Data and information required during these studies combined with the expertise of the project leaders have been effectively utilized both by industry and by interdepartmental teams responsible for assessment of the environmental impact of pipeline and highway construction in the Mackenzie Valley.

The Division, in co-operation and liaison with various provincial government agencies and other federal government departments has continued systematic mapping of surficial geology in the Maritime region, Ontario, Manitoba, Alberta and British Columbia. This work is complemented by the work of the Division's radiocarbon laboratory and by staff scientists specialized in palynology, paleoentomology, paleobryology and paleontology.

Computerized data storage and retrieval and data processing utilizing automated cartographic techniques are integral parts of several projects in the Division. Computerized data processing methods have been particularly effective in handling the massive quantity of urban geological and geotechnical data previously collected for the major cities of Canada. It is anticipated that computerized urban geology data banks in addition to traditional geological maps will be significant components of the information system required by urban planners and engineers.

REPORTS ON SUBDIVISIONS AND SECTIONS

DIVISIONAL HEADQUARTERS

During the year Divisional Headquarters underwent major organizational changes occasioned by the appointment in December of Dr. J.G. Fyles to the Director's office as Environment-Engineering Co-ordinator and by continued demand for participation by staff of the Division in activities related to the Environmental-Social Program, Northern Pipelines and Environmental Working Group, Mackenzie Highway. In December Dr. J.S. Scott was appointed Acting Chief of the Division and Dr. B.G. Craig was appointed as Assistant Chief of the Division. These appointments thus focussed Divisional management within the headquarters unit as opposed to the subdivisional mode previously utilized.

Divisional Headquarters includes a Technical Services Unit providing editorial, photogrammetric and cartographic services to scientists of the Division; an Administration and Financial Services Unit under an Administrative Officer, Mr. L.A. Jackson who with clerical support provides the Division with essential accounting and personnel services; and a Clerical and Secretarial Unit under Miss L.S. Morency, Clerical Assistant to the Division Chief, who, with stenographic support provides these services to Divisional Headquarters and to whom credit is due for the compilation of much of the subsequent material in this report. A Special Projects Unit described separately below is also included with Divisional Headquarters.

Personnel Notes

M.J.J. Bik: transferred to the Department of Environment in October.

T.A. De-Vreeze: transferred to the Department of National Health and Welfare in April.

H. Dumych: was appointed Divisional Scientific Editor in March.

D.J. Egan: joined the permanent staff in December as a Compiler Draftsman after having worked with the Division as a term casual.

D.M. Payment: joined the permanent staff in March as a Secretary after having worked with the Division as a term casual.

Attendance at Meetings

B.G. Craig: attended the joint meeting of the G.A.C., A.S.P.G., and M.A.C. in Saskatoon, Saskatchewan in May 1973.

J.G. Fyles: attended the joint meeting of the G.A.C., A.S.P.G., and M.A.C. in Saskatoon, Saskatchewan in May 1973.

G.M. Mizerovsky: attended the 66th Annual Convention of the Canadian Institute of Surveying in Ottawa in April 1973.

J.S. Scott: attended the Conference on Urban Terrain Engineering Problems in Montreal, P.Q. in May 1973, attended and presented a paper at the Executive Meeting of the International Association of Engineering Geologists in Hannover, Germany, visited field areas of the Institute of Geological Surveys in Dorset-Essex, England in September 1973, attended and presented a paper at the 26th Annual Canadian Geotechnical Conference in Toronto in October 1973, and attended the Symposium on Permafrost Hydrology and Geophysics in Calgary, Alberta in February 1974.

Special Talks or Lectures

J.S. Scott: gave a talk in September at the I.A.E.G. Symposium in Hannover, Germany on occurrence of karst features in Canada.

Membership on Committees

L.A. Jackson
- Alternate Chairman, Administrative Support Classification and Evaluation Committee
- Member, Administrative Support Appraisal Committee
- Member, Branch Safety Committee
- Member, Branch Parking Committee

J.S. Scott
- Vice-President, North America, International Association of Engineering Geologists
- Member, Mines Branch, Pit Slope Project Selection Committee
- Member, Subcommittee on Foundations, Canadian Advisory Committee on Rock Mechanics
- Chairman, Departmental Committee on Radioactive Waste Disposal
- Member (ex officio), Subcommittee on Urban Engineering Terrain Problems, Associate Committee on Geotechnical Research
- Member, Working Group on Engineering Geology of Karst Terrain, International Association of Engineering Geologists
- Member, Granular Materials Working Group, Mackenzie Highway
- Member, Panel on E.B. Burwell, Jr. Award, Engineering Geology Division, Geol. Soc. Amer.

SPECIAL PROJECTS UNIT

During the year five of the Division's senior staff were grouped into a special projects unit reporting directly to the Division Chief. Some members of this unit have been assigned to regional compilations of surficial geology such as the Quaternary geology of the Lower Fraser Valley in British Columbia and the Quaternary stratigraphy of the Prairie region. Work is continuing on a map portraying the thickness of ice across Canada during the Wisconsinan stage. Others, are contributing their expertise to the Mackenzie Valley Pipeline Assessment Group and to the Department of Indian and Northern Affairs on matters pertaining to the Mackenzie Highway.

In addition to their participation in projects or assignments for which they are uniquely qualified by reason of expertise, these senior staff members also serve as advisers on various project matters to the scientific staff and management of the Division.

Personnel Notes

J.E. Armstrong: completed active duties as Secretary General, 24th International Geological Congress and joined the staff of the Division as a senior scientist located in Vancouver.

Attendance at Meetings

J.E. Armstrong: attended and presented a paper at the Geological Association of Canada, Cordilleran Section Symposium in Vancouver in February 1974.

O.L. Hughes: presented a paper (with N.W. Rutter) at the joint meeting of the G.A.C., A.S.P.G., and M.A.C. in Saskatoon, Saskatchewan in May 1973.

E.B. Owen: visited the northern city of Norilsk, U.S.S.R. to view previous winter and summer pipeline construction along the Norilsk-Messovakhi pipeline in September 1973.

V.K. Prest: attended the National Conference on Urban Engineering Terrain Problems in Montreal, P.Q. in May 1973, the Mid-West Pleistocene Field Conference in Wisconsin, U.S.A. in June 1973, the meetings of the Royal Society of Canada in Kingston, Ontario in June 1973, and attended the 9th International Congress on Quaternary Research (INQUA), and participated in pre- and post-conference field excursions in Christchurch, New Zealand in November-December 1973.

A.M. Stalker: attended the Eastern Friends of the Pleistocene Conference and participated in field trip in Binghamton, N.Y. in May 1973, the joint meeting of the G.A.C., A.S.P.G., and M.A.C. and participated in pre-convention field trip C in Saskatoon, Saskatchewan in May 1973 and attended and presented a paper at the 9th International Congress on Quaternary Research (INQUA) and participated in pre- and post-conference field trips in Christchurch, New Zealand in November-December 1973.

Special Talks or Lectures

E.B. Owen: gave a talk in October to the engineers in Norilsk, U.S.S.R. on construction of a buried gas pipeline.

Membership on Committees

J.E. Armstrong	- Secretary-General, 24th International Geological Congress - Secretary-Treasurer, 24th International Geological Congress Inc.
O.L. Hughes	- Member, Permafrost Subcommittee, National Research Council
A.M. Stalker	- Branch representative, Interdepartmental Committee on Salvage Archaeology

Completed Manuscripts

The following manuscripts were accepted and approved by the Division:

Hughes, O.L., Veillette, J.J., Pilon, J., Hanley, P.T., and van Everdingen, R.O. 1973: Terrain evaluation, Mackenzie Transportation Corridor, central parts; Information Canada Cat. No. R72-11873.

Quaternary Discussion Group

The Quaternary Discussion Group was chaired by R.J. Mott prior to the appointment of J.E. Harrison in December. The following papers were given during April 1973 to March 1974.

Dr. V.N. Rampton, Terrain Sciences Division - Ice-cored topography in the region adjacent to Mackenzie Delta.

Dr. J.V. Matthews, Jr., Terrain Sciences Division - Quaternary environments in Beringia.

Dr. J. Westgate, University of Alberta - The art of tephra chronology with specific reference to the 60,000 year old Wascana Creek volcanic ash of Saskatchewan.

Dr. J.T. Andrews, University of Colorado - Geomorphology and Quaternary history - Cumberland Peninsula.

Dr. O.L. White, University of Waterloo - Shoreline erosion on the Great Lakes.

Dr. P.E. Hare, Carnegie Institution of Washington - Amino acid dating.

GEOTECHNICAL SUBDIVISION

B.C. McDonald (A/Head)

The program of the Geotechnical Subdivision is directed towards provision of use-hazard information on surface and near-surface earth and rock materials. This information includes the relationship of geotechnical properties to the materials and geologic setting, the determination of active geomorphic processes that bear on terrain performance and geochemical characteristics of surface materials, and other terrain attributes that influence man's use of the landmass.

During the year considerable effort was devoted to provision of terrain information and assessment of proposed development related to transportation systems in the Mackenzie Valley and Arctic coastal region. Work continued on environmental aspects of coal mining in Alberta, and environmental geology of Canadian urban centres. A long-term project was initiated related to problems of radioactive waste disposal and its subsequent recovery. Reports were released on newly discovered base-metal anomalies in unconsolidated sediments in northern Canada. The program to use surface sediments as a prospecting medium is being expanded to aid in the search for new mineral deposits.

Personnel Notes

Dr. B.C. McDonald: began managerial training under the Career Assignment Program in September. In December he returned to the Division for an initial CAP assignment as Acting Head, Geotechnical Subdivision. At the request of the Assistant Deputy Minister, Science and Technology Dr. McDonald's duties were expanded in February to include those of Departmental Co-ordinator, Environmental-Social Program, Northern Pipelines, Chairman, Departmental Committee on Environmental Matters and principal Branch contact with the Environmental Working Group, Mackenzie Highway.

SEDIMENTOLOGY AND MINERAL TRACING SECTION

W.W. Shilts (Head)

This activity is concerned with the study of active geomorphological and sedimentological processes and with the development of mineral prospecting and techniques that use glacial drift as the prospecting medium. Laboratory and computer functions that support these and other analytical and technical requirements of the Division are also located in this Section.

Field work on drift prospecting and genesis of structures in the active layer was carried out in the District of Keewatin. Models were developed for the distribution of trace elements in drift from permafrost areas and for the genesis of patterned ground. Cu-Zn-Ni anomalies and mineralized erratics were found in areas of known and previously unknown mineralization.

Field study of geomorphic processes and distribution of permafrost was continued on the Beaufort Sea coast in the vicinity of the Mackenzie River delta. These reconnaissance studies have led to delineation of areas of permafrost occurrence in estuarine and nearshore environments and to definitions of the implications of environmental disturbance on the coast. This program was supported primarily by the interdepartmental Environmental-Social Program, Northern Pipelines.

Analysis and tests in support of sedimentology and engineering geology studies are undertaken in two laboratories. The majority of testing is carried out at the Spencer Street laboratory in Ottawa were facilities are the most extensive. Another laboratory in Ottawa is used to process raw samples for chemical and mineralogical analyses required for drift prospecting programs.

Personnel Notes

D.M. Campbell: joined the permanent staff in November after having worked with the Division as a term casual, took courses in crystallography, mineralogy, petrology, and mathematics at Carleton University, and supervised the training of personnel and establishment of a temporary field laboratory in Rankin Inlet, N.W.T.

D.E. Field: attended a one week course "Fundamentals of Supervision" given by the Department.

R.G. Kelly: conferred in March with laboratory technicians at C.C.I.W. in Burlington on rapid grain-size analysis techniques.

C.P. Lewis: joined the permanent staff in October after having worked with the Division as a term casual.

W.W. Shilts: was designated Section Head in February.

Attendance at Meetings

C.P. Lewis: attended and presented papers at the 9th Canadian Hydrology Symposium in Edmonton, Alberta in May 1973 and the Symposium on Beaufort Sea Coastal and Shelf Research in San Francisco, U.S.A. in January 1974.

B.C. McDonald: attended and presented a paper at the 9th Canadian Hydrology Symposium in Edmonton, Alberta in May 1973.

M. Patterson: attended the Canadian Institute of Surveying Convention in Ottawa, Ontario in April 1973.

D.A. Proudfoot: attended the Data Base Design Seminar in Toronto, Ontario in March 1974.

W.W. Shilts: attended the meetings of the Yukon and Northwest Territories Chambers of Mines in Yellowknife in December 1973, the Symposium on Permafrost Hydrology and Geophysics in Calgary, Alberta in February 1974, and attended and presented a paper at the Prospector's and Developer's Convention in Toronto, Ontario in March 1974.

Special Talks or Lectures

W.W. Shilts: gave a two-day field course in glacial geology and drift prospecting for graduate geochemistry students in Eastern Quebec in October, a talk to G.S.C. personnel and interested outsiders in December on glacial geology and geochemical drift prospecting, and presented a paper on processes and land use problems related to permafrost conditions at Guelph University in March.

Membership on Committees

B.C. McDonald
- Chairman, Departmental Committee on Environmental Matters
- E.M.R. Co-ordinator, Environmental-Social Program, Northern Pipelines
- E.M.R. Co-ordinator, Beaufort Sea Project
- Member, Hydraulic Design Task Force for Mackenzie Highway Environmental Working Group
- Member, Mackenzie Highway Environmental Working Group

W.W. Shilts
- Member, Permafrost Subcommittee of the Associate Committee on Geotechnical Research

Sedimentology-Engineering Geology Laboratories

D.E. Lawrence, W.W. Shilts

Analysis and tests are undertaken in three laboratories. The majority of testing is carried out at the Spencer Street laboratory where facilities are the most extensive. In Calgary, a similar facility on a smaller scale exists to serve members of the Division stationed there.

The Booth Street laboratory, supervised by D.M. Campbell, is used to develop sedimentological and soil analysis techniques as well as to process large numbers of samples for the drift prospecting program. It also has been used for various tests of the physical and chemical properties of eastern arctic soils.

Increased production this year was mainly a function of improved sample preparation techniques and an increase in the number of technicians employed at the Spencer Street laboratory, under the supervision of R.G. Kelly. Production of the laboratories is summarized as follows:

SPENCER STREET LAB

Operation		No. samples 1973-74	1972-73	1971-72
Grain-size analysis,	sieve only (2mm-64μ)	243	492	64
,	complete sieve + pipette (2mm-2μ)	754	516	395
,	sand, silt, clay ratios by rapid sediment analyser (4mm to 50μ only)	748	675	600
,	pipette or hydrometer	258	-	364
,	shape parameters	725	-	357
Moisture content		2011	1928	598
Atterberg Limits		518	208	108
Carbonate Analysis,	(Chittick) Calcite dolomite ratio	121	3	780
,	Total and organic carbon (ashing)	220	56	36
Heavy minerals,	separations	50	80	101
,	slides	126	-	70
Clay minerals,	slide preparation	152	860	824
,	analyses (by X-ray mineralogy section)	53	8	8
,	<2μ material recovered	-	123	205

pH		56	142	16
Bulk density		-	288	-
Specific gravity		52	181	6
Sample pre treatment,	$HCl - H_2O_2$	1949	-	131
,	Freeze drying	-	1213	596
,	Pebble washing	-	384	-

BOOTH STREET LABORATORY

Operation		No. samples 1973-74
Clay Minerals,	Separation by centrifuge for chemical analysis	2600
,	grinding	2600
,	slides for X-ray	30
Sieving,	to -250 mesh	2355
,	other	1150
Sample drying,	disaggregation, description, splitting	3000+
Heavy Minerals,	separation	200
,	slides	200
,	grinding and magnetic separation	200
Atterberg Limits		390
Moisture Contents		480
pH determinations		560
Timothy planting and growing		75

Completed Manuscripts

The following manuscripts were accepted and approved by the Division:

Koster, E.H.
Flume studies of isolate gravel fabric on a sand bed; Geol. Surv. Can., Paper 74-1, Pt. B (submitted).

McDonald, B.C., and Lewis, C.P.
1973: Rivers and coast, Yukon Coastal Plain; Information Canada Cat. No. R72-12173.

Banerjee, I., and McDonald, B.C.
Nature of esker sedimentation; to be published by Soc. Econ. Paleontol. Mineral.

ENGINEERING AND ENVIRONMENTAL GEOLOGY SECTION

P.A. Carr (Head)

This Section undertakes studies of the physical and engineering properties of the soil and rock materials in order to evaluate the geological processes that are hazardous to man and to the terrain and to recommend the best environmental use of the terrain.

Geological information concerning the Mackenzie Valley Transportation Corridor has assumed considerable importance, as large-scale engineering projects are planned or in progress in this area. Their effects, especially on permafrost and hence the response of the soil, must be accurately assessed. Geotechnical data from the entire length of the Corridor is being compiled into a data bank, and the relationships between various geological and geotechnical parameters are being ascertained. Also, at specific locations within the Mackenzie Valley, studies were made of the distribution of ground ice, the thermal properties of soils, and the effects of natural and man-made disturbances to the terrain. This experience is now being applied to an engineering and environmental assessment of the alignment and the geotechnical design of the Mackenzie Highway for the Department of Indian and Northern Affairs.

Other activities were oriented mainly towards the hazards of landslides. As part of a continuing, co-operative study with the Quebec Department of Natural Resources involving landslide-hazard potential, the limits of the late-glacial marine submergence in the St. Lawrence River drainage basin were mapped at a scale of 1:250,000. In the East Kootenay area of British Columbia, the environmental impact of mining coal in mountainous terrain is being studied which involves extensive geological and geotechnical investigation of the coal dumps, landslides and related land use problems.

Personnel Notes

P.A. Carr: transferred from the Department of Environment in October to join the staff as Section Head of the Engineering and Environmental Geology Section.

P.J. Kurfurst: joined the permanent staff in October after having worked with the Division under a Personal Service Contract.

R.L. Monroe: completed an assignment under a Personal Service Contract and accepted continuing employment in September with the Department of the Environment.

Attendance at Meetings, Conferences and Courses

P.A. Carr: attended the GRID course in Cornwall, Ontario in October 1973, the 9th Canadian Symposium on Rock Mechanics in Montreal, P.Q. in December 1973, and the Workshop Seminar on Permafrost-Hydrology and Geophysics in Calgary, Alberta in February 1974.

N.R. Gadd: attended the conference "le quaternaire du Québec II" in Montreal, P.Q. in October 1973.

J.E. Harrison: attended and presented a paper at the International Conference on Land for Waste Management in Ottawa, Ontario in October 1973.

J.A. Heginbottom: attended the II International Conference on Permafrost, and participated in the post-conference field tour, in Yakutsk, U.S.S.R. in July 1973, the International Conference on Land for Waste Management in Ottawa in October 1973, and the Symposium on Permafrost-Hydrology and Geophysics in Calgary, Alberta in February 1974.

R.M. Isaacs: attended the 9th Canadian Symposium on Rock Mechanics in Montreal, P.Q. in December 1973, and the Workshop Seminar on Permafrost-Hydrology and Geophysics in Calgary, Alberta in February 1974.

P.J. Kurfurst: attended the annual meeting of the Geological Association of Canada in Saskatoon in May 1973, the 9th Canadian Symposium on Rock Mechanics in Montreal, P.Q. in December 1973, and attended and presented a paper at the Symposium on Permafrost-Hydrology and Geophysics in Calgary, Alberta in February 1974.

D.E. Lawrence: attended the Rock Mechanics Conference in Montreal, P.Q. in December 1973.

Special Talks or Lectures

N.R. Gadd: gave a talk to the Geology Club, Carleton University in Ottawa on the Chelsea landslide in October and to the Department of Earth Sciences, University of Waterloo on the Champlain Sea in November.

J.E. Harrison: gave a talk at the University of B.C. on geological aspects of the reclamation of coal mining lands, and to the Research Workshop in Edmonton on the summary of work on coal waste reclamation in March.

J.A. Heginbottom: gave a talk to the Ottawa Geotechnical Society in February on effects of surface disturbance on permafrost active layer at Inuvik.

Membership on Committees

P.A. Carr - Member, Departmental Committee for Radioactive Waste Disposal

N.R. Gadd - Chairman, Branch Committee on Displays
- Member, Departmental Committee on Displays - E.M.R. Tower

J.E. Harrison - Member, Selection Committee, Revegetation Project (Mines Branch)

J.A. Heginbottom - Member, Environmental Working Group, Mackenzie Highway, and the Consolidation and Future Studies Subgroups

Completed Manuscripts

The following manuscripts were accepted and approved by the Division:

Code, J.A.
1973: Stability of natural slopes in the Mackenzie Valley (with maps); Information Canada Cat. No. R72-10573.

Gadd, N.R.
Glacial and postglacial history of Ottawa map-area, Ontario; Geol. Surv. Can. (submitted).

Limits of late-glacial marine submergence in the St. Lawrence Basin; Geol. Surv. Can., Open File (submitted).

Gell, A.
A contact between massive ice and wedge ice, Tuktoyaktuk coast, N.W.T. (107 C); Geol. Surv. Can., Paper 74-1, Pt. B (submitted).

Harrison, J.E.
Geological aspects of coal mine waste disposal; to be published by the International Conference on Land for Waste Management.

Heginbottom, J.A.
1973: Effects of surface disturbance on permafrost; Information Canada Cat. No. R72-9573.

Terrain performance, Pointed Mountain gas pipeline; Geol. Surv. Can., Paper 74-1, Pt. B (submitted).

Isaacs, R.M.
Geotechnical studies of permafrost in the Fort Good Hope-Norman Wells region, N.W.T.; Report for the Environmental-Social Program, Northern Pipelines (submitted).

Kay, B.D.
Specific heats of components of frozen soil; Geol. Surv. Can., Paper 74-1, Pt. B (submitted).

Kurfurst, P.J.
1973: Terrain disturbance susceptibility, Norman Wells area; Information Canada Cat. No. R72-9373.

Local variability of ground ice occurrence at selected sites in the Mackenzie Valley; Environmental-Social Program, Mackenzie Highway, Final Report.

Lawrence, D.E.
Granular resource inventory with maps; scale 1:125,000 for Fort Norman, Blackwater Lake, Mahony Lake, Carcajou Canyon, Norman Wells, Sans Sault Rapids, Fort Good Hope, Upper Ramparts, Martin House, Ontaratue River, Lac Belot, Canot Lake, Travaillant Lake, Arctic Red River, Fort McPherson, Bell River, Demarcation, Aklavik, Mackenzie Delta, Stanton, Cape Dalhousie and Malloch Hill map-areas. Maps and reports prepared for Granular Materials Working Group, Mackenzie Highway, Department of Indian and Northern Affairs.

Identification of representative prehistoric stone artifacts and samples of unworked stone from Fort Coteau du Lac, Quebec; paper prepared for publication in Historic Sites Bulletin.

Mackay, J.R., and Lavkulich, L.M.
Ionic and oxygen isotopic fractionation in permafrost growth; Geol. Surv. Can., Paper 74-1, Pt. B (submitted).

Mackay, J.R.
Measurement of upward freezing above permafrost with a self-positioning thermistor probe; Geol. Surv. Can., Paper 74-1, Pt. B (submitted).

Performance of a heat transfer device, Garry Island, N.W.T.; Geol. Surv. Can., Paper 74-1, Pt. B (submitted).

Matyas, E.L., White, O.L., and LeLievre, B.
A study of shoreline erosion in western Lake Ontario; Geol. Surv. Can., Paper 74-1, Pt. B (submitted).

Smith, M.W., and Williams, P.J.
Analysis of characteristics relating to ground surface stability in a cold region; Geol. Surv. Can., Paper 74-1, Pt B (submitted).

URBAN PROJECTS SECTION

N.W. Rutter (Head)

The Section is involved in investigation of land capability and geological hazards and resources of urban areas, and development of methods of data presentation for urban planning. At the present time, investigations are being carried out in Ottawa-Hull, Hamilton, and Victoria.

Surficial geology of the Ottawa-Hull area (at a map scale of 1:125,000) compiled from 1:50,000 scale maps, is nearing completion. This, as well as computer-produced, special-use environmental maps will be included in an urban geology atlas of the Ottawa-Hull Region.

For the Hamilton area, work so far has been concentrated in acquiring from potential users of geoscientific information the kind of information they require, and the best system of data presentation. Specific-use environmental maps and a data bank of engineering properties of materials for use as a reference library were most requested. At the present time, available geotechnical information is being compiled, including data from the Urban Geology Information System, developed earlier by this section. Field work is being planned to supplement existing information.

The Victoria project is more specific than those described above. The objective is to determine the feasibility of creating a data bank of engineering geology data that would be useful to city engineers. During the past year, several hundred data points on near-surface materials were compiled. Currently, this information is being edited and transferred to punch cards in order to produce detailed engineering maps that can be routinely updated.

Personnel Notes

N.W. Rutter: was designated as Head, Urban Projects Section in December. During the year Dr. Rutter was elected as a Fellow, Arctic Institute of North America.

D.A. St-Onge: resigned from the Geological Survey in September to accept an appointment as Assistant Head, Department of Geography at the University of Ottawa.

Attendance at Meetings, Conferences and Courses

N.W. Rutter: presented a paper (with O.L. Hughes) and was Co-Chairman of two Sessions at the joint meeting of the G.A.C., A.S.P.G. and M.A.C. in Saskatoon, Saskatchewan in May 1973, and attended and was Co-Chairman of the General Sessions and field trip leader at the 22nd Clay Minerals Conference in Banff, Alberta in October 1973. Also attended the GRID course in Cornwall, Ontario in October 1973, and the Annual Meeting of the Geological Society of America in Dallas, U.S.A. in November 1973.

D.A. St-Onge: attended the N.R.C. Urban Terrain Engineering Problems Conference in Montreal, P.Q. in May 1973, and the annual meeting of the Canadian Association of Geographers and bi-annual meeting of the Canadian National Committee for Geographers in Thunder Bay, Ontario in May 1973.

Special Talks or Lectures

N.W. Rutter: taught a course in Soils and Quaternary Environments at the University of Calgary.

Membership on Committees

N.W. Rutter
- Member, Faculty of Environmental Sciences External Advisory Committee, University of Calgary
- Member, Geological Advisory Committee, Research Council of Alberta
- Member, Organizing Committee, 22nd Annual Clay Minerals Conference
- Member, Library Committee, G.S.C., Calgary
- Member, Technical Committee, Canadian Societies of Petroleum Geologists and Exploration Geophysicists Joint Convention, 1975
- Member, various theses committees, University of Calgary

Completed Manuscripts

The following manuscripts were accepted and approved by the Division:

Rutter, N.W.
Surficial geology maps, Lake Williston area, British Columbia; Geol. Surv. Can., Map 1381A, 1382A, and 1383A (submitted).

Rutter, N.W., Boydell, A.N., Savigny, K.W., and van Everdingen, R.O.
1973: Terrain evaluation, Mackenzie Transportation Corridor, southern part; Information Canada Cat. No. R72-10373.

St-Onge, D.A.
Geomorphology of the Swan Hills area; Geol. Surv. Can., Memoir 74-26 (submitted).

Quaternary geology map of the Whitecourt area at 1:250,000; Geol. Surv. Can., Map 1367A (submitted).

QUATERNARY SUBDIVISION

REGIONAL PROJECTS SECTION

R.J. Fulton (Head)

The activities of this Section are largely directed toward providing a Canada-wide inventory of the unconsolidated deposits and landforms and establishing their stratigraphic and environmental history. Mapping projects are undertaken at various scales chosen on the basis of the present state of knowledge and potential use. This information is of value to forestry, agriculture, engineering, construction and the mineral industry and is used in land use and environmental impact studies.

A major inventory mapping program was carried out on Melville Island. This is a start at coverage of areas in the Arctic Islands which may be affected by gas pipeline construction. The project, directed by D.M. Barnett, will result in maps which will have vegetation and wildlife aspects integrated with surficial geology information.

R.W. Klassen extended mapping in northern Manitoba and now has covered more than one-third of the area north of Lake Winnipeg. This includes the parts of northern Manitoba of immediate interest as it covers the main areas of the Nelson and Churchill River basins which are currently being developed.

Although field work in the Mackenzie Valley has been completed, work continues on report and map preparation. In addition O.L. Hughes and N.W. Rutter devoted much time to discussing the results with interested agencies and to providing additional information for highway and pipeline assessment teams.

The Section program for providing geomorphological input to the Canada Land Inventory-financed, Soils and Land Inventory of British Columbia was continued. This work was done by N.F. Alley (on contract) who has been stationed in Kelowna for the past two years.

Additional inventory mapping projects were carried out in Newfoundland, Nova Scotia, the James Bay development area of Quebec, the District of Keewatin and on Ellesmere Island.

In order to provide subsurface information predominantly in permafrost terrain, the Section has developed a unique expertise in shallow drilling and sampling of frozen materials using light-weight portable equipment. This technique has broad application to various projects of the Section and to other projects of the Division.

Personnel Notes

A.N. Boydell: joined the permanent staff in October after having worked with the Division under a Personal Service Contract.

O.L. Hughes: joined the Special Projects Unit of the Division in February.

G.V. Minning: resigned from the Geological Survey in June to accept employment in private industry in Calgary.

V.K. Prest: joined the Special Projects Unit of the Division in February.

N.W. Rutter: joined the Urban Projects Section of the Division as Head in December.

R.G. Skinner: was seconded to the Department of External Affairs on February 1, 1974 as staff scientist in Scientific Relations and Environmental Problems Division.

J.J. Veillette: joined the permanent staff in January after having worked with the Division as a term employee.

Attendance at Meetings

D.M. Barnett: attended the Guelph Symposium in May 1973, and attended and presented a paper at the regional meeting of the Canadian Association of Geographers in London, Ontario in January 1974.

D.R. Grant: attended and presented a paper at the 9th International Congress on Quaternary Research (INQUA) in Christchurch, New Zealand in November–December 1973.

E.P. Henderson: attended the Eastern Friends of the Pleistocene Conference and participated in the field trips in Binghamton, N.Y. in May 1973.

R.W. Klassen: attended the joint meeting of the G.A.C., A.S.P.G., and M.A.C. in Saskatoon, Saskatchewan in May 1973.

V.N. Rampton: attended and presented a paper at the Guelph Symposium in May 1973, attended the joint meeting of the G.A.C., A.S.P.G., and M.A.C. in Saskatoon, Saskatchewan in May 1973 and attended and presented a paper at the Symposium on Permafrost Hydrology and Geophysics in Calgary, Alberta in February 1974.

R.G. Skinner: attended the Canadian Hydrotechnical Conference in Edmonton, Alberta and the Muskeg Conference in Edmonton in May 1973.

Special Talks or Lectures

R.J. Fulton: gave a talk in January to the Archaeology-geology group, University of Calgary on late Quaternary stratigraphy.

D.R. Grant: gave a talk in January to the staff of Ottawa Headquarters, Parks Canada on surficial geology of Gros Morne National Park, and two talks in March (1) to staff and students of Dalhousie University on programs and projects of the G.S.C. pertaining to Quaternary geology, and (2) to students in Pleistocene course at Dalhousie University on proposals for promising Pleistocene projects in Nova Scotia.

R.W. Klassen: gave a talk in October to the Manitoba Government personnel in Winnipeg on surficial geology mapping and classification, and in February at the Graduate Student Seminar, University of Calgary on Quaternary stratigraphy.

Membership on Committees

R.J. Fulton - Member, Subcommittee on the Classification of Landforms of the Canada Soil Survey Committee

D.R. Grant - Secretary, Subcommittee for the Americas, INQUA Shorelines Commission

Completed Manuscripts

The following manuscripts were accepted and approved by the Division:

Alley, N.F.
Terrain mapping and Quaternary geology, southern Vancouver Island, British Columbia; Geol. Surv. Can., Paper 74-1, Pt. B (submitted).

Rutter, N.W., Boydell, A.N., Savigny, K.W., and van Everdingen, R.O.
1973: Terrain evaluation, Mackenzie Transportation Corridor, southern part; Information Canada Cat. No. R72-10373.

Brookes, I.A.
Surficial geology and glacial geomorphology, Stephenville map-area; Geol. Surv. Can., Paper 73-40 (submitted).

Churcher, C.S.
Studies on Quaternary sites at Wellsch Valley and Lancer, Saskatchewan, and Heather Coulee, near Irvine, Alberta; Geol. Surv. Can., Paper 74-1, Pt. B (submitted).

Fulton, R.J., and Walcott, R.I.
Lithospheric flexure as shown by deformation of glacial lake shorelines in southern British Columbia; to be published by Geol. Soc. Amer. Krumbein Memoir.

Fulton, R.J.
Nicola-Vernon map-area; Geol. Surv. Can., Memoir 380 (submitted).

Fulton, R.J., Hodgson, D.A., and Minning, G.V.
Inventory of Quaternary geology, southern Labrador: an example of Quaternary geology-terrain studies in undeveloped areas; Geol. Surv. Can. (submitted).

Grant, D.R.
Prospecting in Newfoundland and the theory of multiple shrinking ice caps; Geol. Surv. Can., Paper 74-1, Pt. B (submitted).

Henderson, E.P.
Surficial geology of the Avalon Peninsula; Geol. Surv. Can., Memoir 368 and Map 1320A (submitted).

Surficial geology of Kingston north half map-area, Ontario; Geol. Surv. Can., Paper 72-48 (submitted).

Hills, L.V., and Matthews, J.V., Jr.
A preliminary list of fossil plants from the Beaufort Formation, Meighen Island, District of Franklin; Geol. Surv. Can., Paper 74-1, Pt. B (submitted).

Hodgson, D.A., and Haselton, G.M.
Reconnaissance glacial geology, northeast Baffin; Geol. Surv. Can., Paper 74-20 (submitted).

Karrow, P.F.
Till stratigraphy in parts of southwestern Ontario; to be published by Geol. Soc. Amer.

Klassen, R.W.
Quaternary geology and geomorphology of Assiniboine and Qu'Appelle Valley, Manitoba-Saskatchewan; Geol. Surv. Can., Bull. 228 (submitted).

Occhietti, S.
Dépôts et faits quaternaire du Bas Saint-Maurice, Québec; Geol. Surv. Can., Paper 74-1, Pt. B (submitted).

Rampton, V.N.
The influence of ground ice and thermokarst upon the geomorphology of the Mackenzie-Beaufort region; to be published in the Proceedings of the 3rd Guelph Symposium on Geomorphology Research in Arctic and Alpine Geomorphology.

Rampton, V.N., and Walcott, R.I.
The detection of ground ice by gravity profiling; to be published in Proceedings of the Symposium on Permafrost Hydrology and Geophysics, Calgary, February 26-28, 1974.

Rampton, V.N.
Periglacial processes and environments - review of paper by A.L. Washburn; to be printed in GEOLOG.

Richard, S.H.
Surficial geology mapping: Ottawa-Hull area (parts of 31 F,G); Geol. Surv. Can., Paper 74-1, Pt. B (submitted).

Ryder, J.
Terrain inventory and Quaternary geology of the Ashcroft map-area, British Columbia; Geol. Surv. Can. (submitted).

Hughes, O.L., Veillette, J.J., Pilon, J., Hanley, P.T., and van Everdingen, R.O. 1973: Terrain evaluation, Mackenzie Transportation Corridor, central parts; Information Canada Cat. No. R72-11873.

PALEOECOLOGY AND GEOCHRONOLOGY SECTION

W. Blake, Jr. (Head)

This unit comprises Quaternary Paleoecology and Radiocarbon Laboratory. It provides analyses of fossil materials (especially pollen, diatoms, insects, wood, seeds and mosses) and radiocarbon dates as a service to other units and individuals; a particular effort is made to identify all materials dated by the radiocarbon laboratory. The unit also determines variations in radiocarbon content of modern materials as background for other research, and investigates the chronology of fossil-bearing deposits. Research on changes in environment and in the distribution of plants, insects and marine invertebrates during the Quaternary is being conducted. A program of dendrochronological investigations, both applied and in the development of techniques, was supported between 1967 and 1970 and is being continued elsewhere in co-operation with various members of Terrain Sciences Division.

Field Work

Field work by two members of the section (R.J. Mott and S. Federovich) was carried out in Alberta and in addition Mott worked in Ontario and Quebec. T.W. Anderson carried out sampling on Prince Edward Island and participated in two cruises from C.C.I.W., one to Georgian Bay and one to Lake Superior. J.V. Matthews, Jr. carried out field work on Meighen Island, N.W.T., in conjunction with L.V. Hills (Univeristy of Calgary), and he also collected on Banks Island and at Yellowknife. W. Blake, Jr. made collections for radiocarbon dating on the Kola Peninsula and in the Estonian S.S.R. M. Kuc carried out field work at the Viking site at L'Anse aux Meadows, Newfoundland in support of studies by the National Historic Parks and Sites Branch.

Personnel Notes

J.V. Matthews, Jr.: joined the permanent staff in October 1973 after having spent a year with the Section as a Postdoctoral Fellow.

Attendance at Meetings

T.W. Anderson: attended the 16th Conference on Great Lakes Research in Huron, Ohio in April 1973 and the Canadian Botanical Conference in London, Ontario in June 1973.

W. Blake, Jr.: attended the II International Conference on Permafrost in Yakutsk, U.S.S.R. in July 1973 and participated in an excursion to northeastern Yakutia. He also visited radiocarbon dating laboratories in the Soviet Union and in Finland. In February 1974 he attended the Inaugural Symposium of the Canadian Geophysical Union in Ottawa.

Special Talks or Lectures

W. Blake, Jr.: conducted two seminars at the Institute for Quaternary Studies, University of Maine, Orono, Maine in February 1974; one seminar concerned the glacial history of the Barents Sea area, the other dealt with the glacial history of Arctic Canada. In addition a public lecture was given about the Ice Age in the Arctic.

J.V. Matthews, Jr.: gave two lectures at the Ohio State University, Columbus, Ohio, in May 1973. The talks were entitled "The Cape Deceit site and evolution of the tundra ecosystem", and "A 27 m core in organic silts from Interior Alaska". The lecture dealing with Cape Deceit was repeated at the Institute for Quaternary Studies at the University of Maine, Orono, Maine, in May 1973.

Membership on Committees

W. Blake, Jr. - Chairman, Geological Survey Radiocarbon Dating Committee

J.A. Lowdon - Geological Survey Radiocarbon Dating Committee

J.V. Matthews, Jr. - Beringian Committee

Production Statistics

Paleoecology

Organization and maintenance of the Pleistocene Palynology Laboratory is under the supervision of R.J. Mott, and he is assisted by L. Wilson.

T.W. Anderson carried out palynological work in support of field projects by C.F.M. Lewis and P.F. Karrow (University of Waterloo), as well as for the staff of C.C.I.W., Burlington. S. Federovich continued palynological laboratory investigations (3 reports on 16 samples) in support of field projects by W. Blake, Jr., O.L. Hughes, R.G. Skinner as well as for R.M. Koerner and

W.S.B. Paterson of the Polar Continental Shelf Project. R.J. Mott carried out palynological work (1 report on 1 sample) in support of a field project by D.A. Hodgson, but devoted most of his time to working on cores he had collected previously in various field areas.

Work was continued by S. Federovich in building up a collection of reference material for the identification of diatoms, and samples collected by R.G. Skinner and W. Blake, Jr. were studied (8 reports on 22 samples). In conjunction with J.V. Matthews, Jr., work on building up a reference collection of seeds and other macrofossils has continued, and T.W. Anderson is also building up a reference seed collection in Burlington. Federovich and Matthews produced 6 plant macrofossil reports on samples submitted by Blake.

During the year M. Kuc made 31 bryological reports, which included data on vascular plants and other organic remains as well as on mosses.

R.J. Mott and L. Wilson produced 61 reports on the identification of 86 samples of wood, mainly material that was submitted to the Radiocarbon Laboratory.

J.V. Matthews, Jr. produced 6 fossil arthropod reports, based on 8 samples submitted by C.R. Harington (National Museum of Natural Sciences), O.L. Hughes, and W. Blake, Jr., as well as a suite of samples he collected himself on Meighen and Banks Islands.

Radiocarbon Dating

Laboratory: The Radiocarbon Dating Laboratory, under the supervision of J.A. Lowdon, has at its disposal three proportional counters, any two of which may be used at the same time. The 1-L counter was operated for one month; the 2-L for eight months; and the 5-L for ten months, including three months at "high pressure" so as to handle very old samples. Because of continuing problems with the stability of results from the 2-L counter, due to voltage fluctuations resulting from temperature and humidity changes in Room B-50, considerable down time was experienced.

Age calculations are now being carried out monthly by a C.D.C. 6400 computer which has replaced the C.D.C. 3100 used previously from January 1963 through December 1972; all radiocarbon age determinations reported by the Radiocarbon Laboratory quoted an age error which included an error term to account for the average variation of ±1.5% in the C^{14} concentration of the atmosphere over the past 1100 years. Recent work on bristlecone pine by laboratories at the University of Arizona and the University of Pennsylvania, among others, have now furnished sufficient data to provide a conversion table from radiocarbon years to tree ring (calendar) years for the last 7500 years. This data takes into account

the variations in the C^{14} concentration (up to 15%) in the atmosphere during this period. Thus, since January 1973, no correction factors for fluctuations of the atmospheric C^{14} concentration are being applied.

In addition to the continuing program of monitoring atmospheric fluctuations of radiocarbon at Ottawa and Vancouver another research project involves testing the validity of dates obtained from bone apatite as opposed to bone collagen. Reference samples for cross-checking purposes continue to be supplied to new laboratories which are starting up, and during the past year one check sample was supplied to the Ocean Chemistry Radiocarbon Laboratory (c/o B.C. Research) and two samples were sent to Ministère des Richesses Naturelles, Québec. Also, check age determinations were carried out on samples previously dated by: Brock University, St. Catharines, Ontario; Gakushuin University, Tokyo, Japan; the Radiological Dating Laboratory, Trondheim, Norway; the British Museum, London, England; and the University of Groningen, Groningen, The Netherlands. New samples for cross-checking purposes were collected in the Estonian S.S.R., and the age of one bone sample which had been given varying pretreatments at G.S.C. was determined by a different method at the University of Uppsala, Uppsala, Sweden.

Program: Samples for age determination in the Radiocarbon Dating Laboratory were selected by an informal committee, headed by W. Blake, Jr., in consultation with J.A. Lowdon and with other members of the staff as appropriate to the samples under consideration. Most of the samples analyzed were selected to provide data for current research projects in the field of Quaternary chronology and related glacial events, to shed light on crustal movement, and to provide information on the rates of geological processes such as sedimentation and solifluction. A total of 156 age determinations were carried out; of these 146 were on geological samples, 10 were on samples from archaeological sites (mostly submitted by the National Museum of Canada), and in addition 11 analyses were carried out on geochemical samples. One hundred and forty-four samples of CO_2 gas were submitted for C^{13}/C^{12} determinations in order to determine the possible effects of carbon isotope fractionation in various materials; i.e. wood charcoal, peat, gyttja, soil, bone, and shell. These analyses were carried out by the Geochronology Section, Regional and Economic Geology Division, under the supervision of Dr. R.K. Wanless.

Results of age determinations from the laboratory are no longer being published first in Radiocarbon and then reprinted by the Geological Survey in the Paper series. Instead, starting with list XII (1972), laboratory results are being published directly as G.S.C. Papers, so as to permit the information to be made available more rapidly and to allow more leeway in the presentation of data. List XIII (G.S.C. Paper 73-7) reports 152 age determinations on 146 geological samples.

Completed Manuscripts

The following manuscripts were accepted and approved by the Division:

Karrow, P.F., Anderson, T.W., Clarke, A.H., Delorme, D.L., and Sreenivasa, M.R.
Stratigraphy, paleontology, and age of Lake Algonquin sediments in southwestern Ontario, Canada; submitted to Quaternary Res.

Blake, W., Jr.
Periglacial features and landscape evolution, central Bathurst Island, N.W.T.; Geol. Surv. Can., Paper 74-1, Pt. B (submitted).

Ford, D.C., and Schwarz, H.P.
Radiometric age studies of speleothem; Geol. Surv. Can., Paper 74-1, Pt. B (submitted).

Hills, L.V., and Matthews, J.V., Jr.
A preliminary list of fossil plants from the Beaufort Formation, Meighen Island, District of Franklin; Geol. Surv. Can., Paper 74-1, Pt. B (submitted).

Kuc, M.
Calliergen aftonianum Steere in late Tertiary and Pleistocene deposits of Canada; Geol. Surv. Can., Paper 74-24 (submitted).

The interglacial flora of Worth Point, western Banks Island; Geol. Surv. Can., Paper 74-1, Pt. B (submitted).

Lichti-Federovich, S.
Palynology of two sections of late Quaternary sediments from the Porcupine River, Y.T.; Geol. Surv. Can., Paper 74-23 (submitted).

Mott, R.J.
Modern pollen spectra from Labrador; Geol. Surv. Can., Paper 74-1, Pt. B (submitted).

MARINE AND COASTAL SECTION

C.F.M. Lewis (Head)

Activities of the Division concerning the seafloor and coasts of the Pacific region, Great Lakes region and Arctic Island channels and liaison activities with other groups and agencies undertaking related work are the responsibility of this Section. Projects within the Section are designed to contribute inventory information about the seafloor and coast, their stratigraphic sequence and environmental history and to develop regional understanding of geodynamic, geomorphic, sedimentary and geochemical processes and the engineering attributes that control the stability and character of coastline, seafloor and sediments. Such information may be utilized in offshore and coastal engineering planning for pipeline and cable routes, anchoring and wellhead completion problems; environmental and ecological studies; dredging and waste disposal management; mineral resource estimates including aggregate sources; fishery management; and in defence considerations.

A new program of environmental marine geology was launched in the Pacific region from the Vancouver office of the Geological Survey. An exhaustive inventory of existing marine surficial geology and related studies was prepared and distributed as an Open File report. Scientific studies of Fraser Delta sedimentation and Quaternary geology of northern Strait of Georgia were initiated with field work to commence in 1974. An assessment of Fraser Delta sediments and sedimentary processes and their interaction with benthic fauna and biological productivity was prepared for the Department of Environment in support of its concern with development pressures on the Delta.

Studies of Great Lakes sediments were continued by palynological investigations of sediment sequences and buried marsh zones, stratigraphic coring, core description and X-radiography. Much of this work was done at Burlington, Ontario, co-operatively with staff and facilities of Canada Centre for Inland Waters. Collaborative paleomagnetic studies by university personnel revealed an instability of the earth's magnetic field 12,000 to 17,000 years ago that may have significance for history of the geomagnetic field and as a regional time horizon in the Great Lakes area.

Offshore studies in the Arctic were co-ordinated with Canadian Hydrographic Service operations aboard CSS Parizeau and CSS Baffin. They provided new information on sediments, bedrock topography and Quaternary geology in Amundsen Gulf and Lancaster Sound respectively. Compilation of previous Beaufort Sea work continued with scientific presentations on sediment thickness, stratigraphy, shelf morphology, scour by floating ice and evidence of an Holocene transgression across a previous land surface.

Field studies of sedimentary and geomorphic processes in the coastal zone were initiated within the Arctic Island channels at eastern Melville Island and northern Somerset Island. These studies involved

considerable experimentation with techniques for study of coastal ice movement and provided information on sediment type, permafrost, drift-ice phenomena and coastal stability in support of potential gas pipeline concerns.

Personnel Notes

J.L. Luternauer: joined the staff in October and is located in the Vancouver office.

J.M. Shearer: resigned from the Geological Survey in June to accept employment for a term in private industry in Montreal. He rejoined the Geological Survey in March 1974 as a term employee.

R.B. Taylor: joined the permanent staff in February after having worked with the Division as a term casual.

Attendance at Meetings

C.F.M. Lewis: attended and chaired session of Symposium on Beaufort Sea Coastal and Shelf Research in San Francisco, U.S.A. in January 1974.

J.M. Shearer: attended and presented a paper at the joint meeting of the G.A.C., A.S.P.G. and M.A.C. in Saskatoon, Saskatchewan in May 1973.

Special Talks or Lectures

J.L. Luternauer: gave a talk in November to the Physical Oceanographers, Biologists and Geologists in Nanaimo, B.C. on deltaic sedimentation, and in January at the Institute of Oceanography, University of B.C. on sedimentation.

Membership on Committees

C.F.M. Lewis
- Member, E.M.R. Task Force on Eastern Offshore Geoscience Program
- Member, E.M.R. Western Offshore Program Committee
- Member, Program Committee for Arctic Institute, Symposium on Beaufort Sea Coastal and Shelf Research
- Working Member, Preliminary Meeting of G.S.C. Arctic Marine Geology Program Committee

Completed Manuscripts

The following manuscripts were accepted and approved by the Division:

McLaren, P.
Arctic diving observations at Resolute Bay, N.W.T. and the North Pole; Geol. Surv. Can., Paper 74-1, Pt. B (submitted).

Ricker, K.E.
Inventory of marine surficial geology, sedimentology, geomorphology, Quaternary paleontology and paleoecology, geochemistry, and related studies of the Pacific waters of Canada; Geol. Surv. Can., Paper 74-1, Pt. B (submitted).

Effects of the Burrard Inlet oil spill on various geologic intertidal environments; Geol. Surv. Can., Paper 74-1, Pt. B (submitted).

Taylor, R.B., and McCann, S.B.
Sea and nearshore ice: its effects on coastal processes in the Canadian Arctic Archipelago; to be published in the Symposium on Geological Action of Drift Ice, and in the J. Glaciol.

CANADIAN CENTRE FOR GEOSCIENCE DATA

C. F. BURK, JR., National Coordinator

The goal of the Canadian Centre for Geoscience Data is development of a national system for storage and retrieval of geoscience data, following a model proposed in 1967 by the National Advisory Committee on Research in the Geological Sciences (NACRGS). To achieve this goal CCGD set the following objectives for the report period:

1. Continued expansion and improvement of the Canadian Index to Geoscience Data, a computer-based inventory of data resources,

2. Development of standards and other tools to assist in the building of compatible and effective computer-based data files, and

3. Coordination of data-related activities among Canadian workers in government, industry and the universities.

During the last quarter, the Centre was asked to develop a proposal for establishment in 1974-75 of an Earth Resources Data System (ERDS), which would be operated by CCGD as a service facility of the Science and Technology Sector to enable ready access to its growing collection of computer-based data files, and to facilitate access to outside files of interest to departmental staff.

Canadian Index to Geoscience Data

The Index continued to receive input from nine Canadian agencies and the file grew to about 40,000 titles, mainly from provincial and federal sources. Improvements to the RAID system, which controls the file, enabled increased production of custom indexes to governmental and industrial clients, including products later distributed to the public by the Ontario Division of Mines and the Department of Indian and Northern Affairs. Experimental work leading to on-line access from terminals located anywhere in Canada was commenced, and programs were completed to produce indexes directly in microform.

Standards for Mineral Deposit Data

The Centre continued to provide logistical and other assistance to the Mineral Deposits Working Committee (NACRGS), Chairman R. V. Longe, to enable completion of its work in developing standards for content and notation for

computer-based mineral deposit data files. A draft report was prepared for public discussion at the annual meeting of the Geological Association of Canada, and by year's end the final report was nearing completion.

Standards for Paleontological Data

Work under a research contract by the Department of Invertebrate Palaeontology, Royal Ontario Museum explored methods of standardized quantitative measurement for ammonites and other Mollusca. Sponsorship of the work was transferred to an EMR Research Agreement at mid-year.

Data-Base Management System

The Centre continued sponsorship of a project to enhance and further develop the SAFRAS system developed at the Department of Geology, University of Western Ontario. Work continued under A. M. Kelly, Geomathematics Section, Geological Survey of Canada, and under contract by Miss Ann Bartlett-Page, University of Alberta. The basic system modules were completed and tested during the year, a user's manual nearly completed, and experimental use of the new system (tentatively called GDMS) commenced.

Geological Field Data Systems

The Centre convened one meeting of the Canadian Field Data Working Committee (NACRGS), W. D. McRitchie Chairman, and contributed to organizing an international seminar on this topic at Unesco Headquarters, Paris, under co-sponsorship of COGEODATA (International Union of Geological Sciences) and Unesco, Division of Earth and Environmental Sciences. Material for a summary publication reporting on available systems and experience was assembled and edited by CCGD.

International Liaison

Staff of CCGD were active in several international committees and projects related to achieving its objectives. Principal among these were COGEODATA (International Union of Geological Sciences), CODATA (International Council of Scientific Unions), Working Group on a Multilingual Thesaurus (IUGS/AB and IUGS), AGI/GSA Steering Committee on GEO.REF (American Geological Institute/Geological Society of America), and Committee on Publications (Geological Society of America).

Bibliography

Burk, C. F., Jr. 1973. Evolution of Canadian system for geoscience data, 1964-73; Proc. First Open Conf. on Information Science in Canada, Montebello, Quebec., Can. Assoc. Infor. Sci., p. 138-147.

Burk, C. F., Jr. 1973. Computer-based storage and retrieval of geoscience information: bibliography 1970-72: Can. Centre for Geoscience Data, Geol. Surv. Can. Paper 73-14, 38 p.

Gunn, K. L. 1973. MINDEX: a survey of mineral deposit data files in Canada (Abstract): Geol. Assoc. Canada, Program and Abstracts, 23-24 May 1973, p. 61.

Kelly, A. M., Gunn, K. L., and Williams, G. D. 1973. Computer data files on mineral deposits: case histories (Abstract): Geol. Assoc. Canada, Program and Abstracts, 23-26 May 1973, p. 63.

Personnel Notes

Mr. B. A. McGee, Index Supervisor, resigned 1 July 1973 to assume the position of Manager, GEO.REF Project, American Geological Institute, Washington, D.C., U.S.A.

Miss K. L. Gunn assumed the position of Systems Coordinator on 19 November 1973. She was formerly with the Mineral Development Sector.

Attendance at Meetings, Conferences and Courses

C. F. Burk, Jr.:

1. Geological Society of America, Spring Council Meeting, Boulder, Colorado, 7-8 May 1973.

2. Canadian Association for Information Science, First Open Conference on Information Science in Canada, Montebello, Quebec, 14-15 May 1973.

3. Geological Association of Canada, Annual Meeting, Saskatoon, Saskatchewan, 24-26 May 1973.

4. AGI/GSA Steering Committee on GEO.REF, Washington, D.C., U.S.A., 12-13 June 1973.

5. First Canadian Conference on Information and Communication Systems and Services, World Trade Centre, New York, N.Y., U.S.A., 27 June 1973.

6. Man-machine Communications for Scientific Data Handling, ICSU Committee on Data for Science and Technology (CODATA), Frieburg, Federal Republic of Germany, 23-27 July 1973.

7. Geological Society of America, Committee on Publications, Boulder, Colorado, U.S.A., 13-14 August 1973.

8. AGI/GSA Steering Committee on GEO.REF, Washington, D.C., U.S.A., 20-21 August 1973.

9. American Mining Congress, Denver, Colorado, U.S.A., 10-11 September 1973.

10. Geological Society of America, Committee on the Budget, New York, N.Y., U.S.A., 14-15 September 1973.

11. AGI/GSA Steering Committee on GEO.REF, Boulder, Colorado, U.S.A., 20 September 1973.

12. Conference of Provincial Ministers of Mines, Victoria, B.C., 30 September - 2 October 1973.

13. Seminar on the Use of Computer-based Techniques in Geological Field Work and Geological Data-base Management, IUGS Committee on Storage, Automatic Processing and Retrieval of Geological Data (COGEODATA), and UNESCO, Division of Earth and Environmental Sciences, Paris, France, 5-9 November 1973.

14. Geological Society of America, Annual Meeting, Dallas, Texas, U.S.A., 11-14 November 1973.

15. Canadian National Committee for CODATA, Ottawa, Ontario, 10 December 1973.

16. Mineral Deposits Working Committee (NACRGS), Editorial Committee, Vancouver, B.C., 23-25 January 1974.

17. Prospectors and Developers Association, Annual Meeting, Toronto, Ontario, 11 March 1974.

18. National Federation of Abstracting and Indexing Services (NFAIS), Annual Meeting, Chicago, Illinois, U.S.A., 12-13 March 1974.

19. Information Industry Association Annual Meeting, Washington, D.C., U.S.A., 19-21 March 1974.

B. A. McGee:

1. Thesaurus Committee, Canadian Index to Geoscience Data, Ottawa, Ontario, 9-11 May 1973.

2. Canadian Association for Information Science, First Open Conference on Information Science in Canada, Montebello, Quebec, 14-15 May 1973.

3. Geological Association of Canada, Annual Meeting, Saskatoon, Saskatchewan, 24-26 May 1973.

K. L. Gunn:

1. Advisory Committee to the Canadian Index to Geoscience Data, Ottawa, Ontario., 5-7 December 1973; and 11-12 February 1974.

2. Course on use of Systems Dimensions Limited services STS/INFO and STS/WYLBUR, 18-20 February 1974.

3. Prospectors and Developers Association, Annual Meeting, Toronto, Ontario, 11-13 March 1974.

4. Arctic Waters Support Services Seminar (Ministry of State for Science and Technology), Montreal, Quebec, 13-14 March 1974.

Special Talks or Lectures

C. F. Burk, Jr.:

1. "Evolution of Canadian System for Geoscience Data, 1964-73", to First Open Conference on Information Science, Montebello, Quebec, 15 May 1973.

2. "Mineral Deposit Information - Commercial Use and Future Importance of International Trade", to First Canadian Conference on Information and Communication Systems and Services, Canadian Consulate General in New York, World Trade Centre, New York, N.Y., U.S.A., 27 June 1973.

3. "Data-base Management for Large Data Files", to Man-Machine Communication for Scientific Data Handling, CODATA Task Group on Computer Use,

Frieburg, Federal Republic of Germany, 24 June 1973.

4. "Computer-based Mineral Deposit Data Files", to American Mining Congress, Denver, Colorado, U.S.A., 11 September 1973.

5. "Computer-based Information Services Available to Canadian Geoscientists", to Carleton University Geology Club, Ottawa, Ontario, 21 November 1973.

B. A. McGee:

1. "Inventory of Geoscience Data Resources for Arctic Canada", to Geological Association of Canada, Saskatoon, Saskatchewan, 26 May 1973.

Membership on Committees

C. F. Burk, Jr.:

1. Member, NACRGS Subcommittee on Computer Applications.

2. Ex officio member, NACRGS Working Committees on Mineral Deposits Data and Geological Field Data.

3. Ex officio member, Advisory Committee on the Canadian Index to Geoscience Data (formerly Thesaurus Committee).

4. Secretary, IUGS Committee on Storage, Automatic Processing and Retrieval of Geological Data (COGEODATA), International Union of Geological Sciences.

5. Member, Committee on Publications, Geological Society of America, and Chairman ad hoc Study Group on Bibliographical Information Dissemination.

6. Chairman, AGI/GSA Steering Committee on GEO.REF, Geological Society of America (May - November 1973).

7. Member, Committee on Publications, American Geological Institute.

8. Member, GSC Review Committee for EMR Research Agreements.

9. Member, Interdepartmental Committee on Environmental Statistics (since December 1973).

10. Member, Study Group for Establishment of a "Resources-Environmental Functional Centre" at EMR Computer Science Centre (since February 1974).

11. Member, Editorial Board, Geoscience Documentation.

12. Associate Editor, Bulletin of Canadian Petroleum Geology (since December 1973).

B. A. McGee:

1. Chairman, Thesaurus Committee, Canadian Index to Geoscience Data (to July 1973).

2. Member, ICSU/AB - IUGS Working Committee for a Multilingual Thesaurus (to July 1973).

K. L. Gunn:

1. Chairman, Advisory Committee to the Canadian Index to Geoscience Data (since November 1973).

2. Member, NACRGS Working Committee on Mineral Deposits Data.

3. Member, ICSU/AB - IUGS Working Committee for a Multilingual Thesaurus (since January 1974).

National Advisory Committee on Research in the Geological Sciences

Thomas E. Bolton, Secretary

The annual compilation of current research projects in the geological sciences in Canada for 1972-73 was published in December, 1973 (Geol. Surv. Can., Paper 73-5). It records information on current research by the universities, federal and provincial Department of Mines, Research Councils and Museums, and a few petroleum companies and private consultants. Compilation of data supplied for the period 1973-74 is underway.

The Twentieth Annual Report of the Advisory Committee covering the period September 1, 1969 to August 31, 1972 was prepared and submitted for publication as Geol. Surv. Can., Paper 72-6.

Support for extramural research and development within established Canadian research organizations is provided through the Departmental Research Agreement program. Projects are evaluated according to their relevancy and contribution to the Department's objectives. The Survey reviewed 130 applications to the 1974-75 program; support was recommended for 53 ($403,000 available) Research Agreements. Bolton continued as Secretary of the Departmental Grants Review Committee.

The National Research Council of Canada annually awards grants-in-aid of geological research to Canadian universities on a more substantial scale. As a representative of the Survey and Department, Bolton acted as an observer at the February, 1974, Earth Sciences Grant Selection Committee.

During the year, Bolton contributed toward the regional detailing of the Ordovician and Silurian biostratigraphy within the Hudson Bay-Foxe Basin sedimentary basins through two weeks field work in August, 1973, during which

fossils were collected from the Ordovician rocks of Melville Peninsula, District of Franklin, completed and submitted for publication Volume V of The Catalogue of Type Invertebrate Fossils of the Geological Survey of Canada, maintained the standing record of all Canadian stratigraphic names published during the year, and acted as a guide on field excursions in the Ottawa area for Professor B. Mamet, University of Montreal, and during the 7th Annual Conference of the Association of Earth Science Editors. In May, 1973, he attended the annual meeting of the Geological Association of Canada at the University of Saskatchewan, Saskatoon.

SECRETARIAL SERVICES

Juanita L. Metz

Summary of work executed by the Secretarial Services Section for the year 1973/74.

Letters from stenorette	6
Letters from manuscript	2,091
Letters (French)	102
Pages of reports from stenorette	158
Pages of reports from manuscript	9,454
Pages of reports (French)	187
Pages of preliminary reports	9,047
Tabulated pages	1,114
Envelopes and labels	3,520
Cards and forms	2,324
Secretarial relief supplied (days)	221
Daily time factor for corrections, proofreading, cutting and assembling of preliminary reports, and setting up tables	25%

Approximate assessment of work:

Letters - 45 to 50 lines of single spacing, 1-inch margin, 6½ x 8-inch type area, including address and salutation.

Reports - 32 to 36 lines of double spacing, 1-inch margin, 6½ x 9-inch type area.

Preliminary reports - 60 to 64 lines of single spacing, 1-inch margin, 9 x 11½-inch type area.

Tabulated pages - numerical statistics, correlation tables etc.

Cards and forms - IBM type cards, geological records, bibliographies.

Turnover in staff decreased considerably in the past year; hopefully as a result of a better work environment.

Deadlines were kept on target through the strong support of our staff and the quality of work improved tremendously.

The installation of new office furniture, as well as IBM Selectric II typewriters had a very good impact on morale and increased the quality of work produced.

Mrs. A. Koops has been promoted to Assistant Supervisor and has been performing very effectively in the execution of her duties.

Miss J. Crump successfully completed the IBM Mag Card Typewriter course and now is in full swing along with Mrs. S. Parnham in producing final reports for publication on the Mag Card Executive Typewriters.

APPENDIX I

STAFF LIST

Geological Survey of Canada

(as supplied by reporting units; June 15, 1974)

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Birtch, Mrs. E.J., Secretary
Fyles, Dr. J.G.
Hall, E.

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Douglas, R.J.W.

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Bolton, T.E., Secretary

Data Base Management System Development

Hutchison, Dr. W.W.
Scaga, T.

International Geol. Congress

Moyd, Mrs. P.

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Bigras, Mrs. D.B., Secretary

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Cooke, W.E.
Nicolo, Miss C.
Deslauriers, Mrs. I.

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Lajoie, L.J.

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Rozon, R.
Salter, I.C.

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Bourque, J.R.
Charlebois, G.J.
Moreau, V.
Davidson, D.O.
St. Dennis, D.J.
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Moerman, E.P.W.
Ganim, T.

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Koops, Mrs. A.F.V.
Parnham, Mrs. S.J.
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Carson, Mrs. L.E.
Del Rio, Mrs. R.
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Campbell, Mrs. D., Accounts
Henderson, T.
McMullin, Miss E.

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Pelletier, B.R.

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Sibley, R., Drafting

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Owens, E.H.
Gregor, D.J.

Marine Geochemistry

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Cranston, R.
Winters, G.
Fitzgerald, R.A.
Leonard, J.D.
Robertson, K.R.
Fanjoy, R.
LeBlanc, K.W.G.

Paleoecology

Schafer, C.T.
Vilks, G.
Walker, D.
Wagner, F.
Frape, F.
Baker, B.J.

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Trapnell, Mrs. M.

Drafting

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Cook, G.

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Barss, M.S.

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Deonarine, B.

Sedimentology Lab

Clattenburg, D.A.
McLeod, S.

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Jenkins, W.A.M.
Hardy, I.A.
Williams, G.L.
Gradstein, F.
Jansa, L.
Ascoli, P.
Girouard, P.

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Grant, A.
Harris, I.
Jackson, A.

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