CANADA

DEPARTMENT OF ENERGY,

MINES AND RESOURCES

GEOLOGICAL SURVEY OF CANADA

ANNUAL REPORT

APRIL 1, 1983 TO MARCH 31, 1984

FOR DEPARTMENTAL USE ONLY

OTTAWA

1984

CANADA

DEPARTMENT OF ENERGY, MINES AND RESOURCES

GEOLOGICAL SURVEY OF CANADA

ANNUAL REPORT

APRIL 1, 1983 TO MARCH 31, 1984

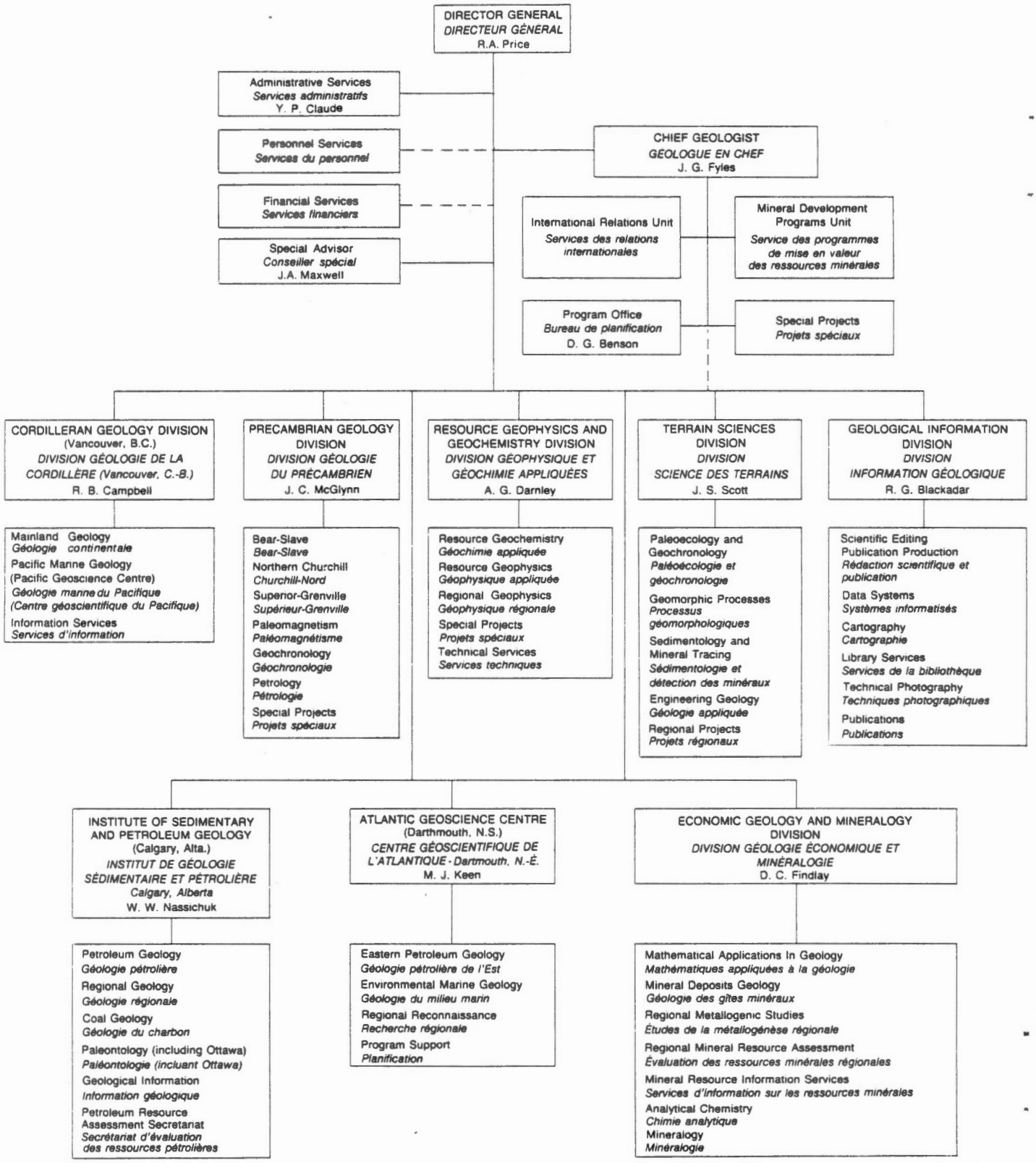
This report is reproduced directly from material submitted by the reporting units. This report is intended for Departmental use and record.

OTTAWA

1984

CONTENTS

GEOLOGICAL SURVEY OF CANADA
COMMISSION GÉOLOGIQUE DU CANADA



GEOLOGICAL SURVEY OF CANADA
PROGRAM STRUCTURE

During 1983-84 the Geological Survey of Canada continued to function within the Earth Sciences Sector of the Minerals and Earth Sciences Program.

The Geological Survey's activity continued to comprise ten sub-activities, conducted by the nine divisions of GSC and the branch headquarters. Resources utilized during the year are as follows:

	Resources*	
Sub-Activity (Division)	PY	$000
Cordilleran Geology	50.1	3,406
Sedimentary & Petroleum Geology	144.5	10,939
Precambrian Geology	74.5	4,141
Atlantic Geoscience	109.4	8,958
Terrain Sciences	68.4	4,511
Economic Geology	54.4	2,578
Resource Geophysics & Geochemistry	97.5	7,578
Geological Information	99.6	4,170
Central Laboratories & Technical Services	48.6	2,391
Activity Management & Support (Branch HQ)	52.3	6,306
Total	799.3	54,978

*as of June 15, 1984. Totals include funds received from other departments.

The following major items are included in the expenditures above:

	$000
Energy Research and Development	5,335
Atomic Energy of Canada Limited	989
Nova Scotia Minerals Program	1,006
Newfoundland Minerals Program	1,478
Gaspé-Lower St. Lawrence Program	209
Bilateral Maritime Boundary Disputes	626
	9,643

The summer program of the Geological Survey was enhanced by 139 students provided with person-years by the Summer Canada Program.

OFFICE OF THE DIRECTOR GENERAL

Early in 1984 the Office of the Director General was expanded to include an International Relations Unit staffed by Dr. A.R. Berger and Mr. Bernard Manistre, with B. Collis as Secretary, and at the end of the fiscal year Mr. Manistre was transferred from the Resource Geophysics and Geochemistry Division. Concurrently the Mineral Development Programs Unit was established to coordinate the work to be undertaken by GSC under the Mineral Development Agreements (1984-89) that were being negotiated with a number of provinces under the Economic and Regional Development Agreements (ERDAs). Dr. W.H. Poole was transferred from the Economic Geology Division to direct this office. The Gaspé-Lower St. Lawrence Program (coordinated by Dr. Y. Maurice who was transferred from the RGG Division) and the Eastern Townships Program (coordinated by Dr. F.D. Anderson, part-time employee) were included under the Mineral Development Program Office.

Early in the fiscal year Mr. George Cameron was loaned to the Director General's Office from the RGG Division as a special assistant; he was formally transferred at the end of the year. In November Dr. D. Picklyk returned to GSC following secondments to the Office of the Assistant Deputy Minister, Earth Sciences, and the Strategic Planning Branch of the Corporate Planning Group. He has been assigned pro tem to the Director General's Office.

During the last quarter of the fiscal year Dr. Price put in place organizational changes to take effect at the beginning of fiscal year 1984-85, involving discontinuation of the CLTS Division by transfer of the Chemical and Mineralogy Laboratories to Economic Geology and Technical Services to RGG. Dr. J.A. Maxwell, Director of CLTS, has taken on the role of Special Advisor to the Director General with particular responsibilities with regard to analytical laboratories.

National Geological Surveys Committee Meetings

The NGSC, under the co-chairmanship of R.A. Price and W.D. McRitchie, met January 17, 1984 in Ottawa, immediately preceding the GSC Current Activities Forum.

Decade of North American Geology

Good progress was made during the year on the new edition of Geology and Economic Minerals of Canada, and contributions to the Decade of North American Geology, under the coordination of J.O. Wheeler.

R.A. Price

Attendance at Meetings, Conferences and Courses

Cornell Program for the Study of the Continents, Cornell University, Ithaca, New York, April 12-13, 1983. Speaker - "The Cordilleran Foreland Thrust and Fold Belt of Southern Canada".

Colgate University, Hamilton, New York, April 14, 1983. Speaker - "The Cordilleran Foreland Thrust and Fold Belt of Southern Canada".

Lieutenant Governor of Ontario's Luncheon for Members of the Scientific Community in Ontario, Queen's Park, Ontario, May 3, 1983.

Canadian Society of Petroleum Geologists' Symposium on "The Mesozoic of Middle North America", Calgary, Alberta, May 8, 1983. Speaker - "Mesozoic Geotectonic Setting of Western Canada Sedimentary Basin".

GAC/MAC/CGU Annual Meeting, Victoria, B.C., May 9 -12, 1983. Speaker - "Robert J.W. Douglas - an Appreciation"; Douglas Symposium. Speaker - "The Rocky Mountain Belt of Canada: Thrust Faulting, Tectonic Wedging and Delamination of the Lithosphere".

Earth Sciences Sector Industrial Advisory Committee Meeting, Sidney, B.C., May 13, 1983.

International Symposium on Continental Intraplate Tectonics, Karlsruhe, Federal Republic of Germany, May 17-18, 1983. Speaker - "Listric Normal Faulting and Ductile Necking of Continental Lithosphere".

Royal Society of Canada Annual Meeting, Vancouver, B.C., May 29 to June 1, 1983.

Branch Management Committee Meeting at the Atlantic Geoscience Centre, Dartmouth, N.S., June 15-16, 1983.

Mineral Exploration Technology Meeting, Toronto, July 7, 1983.

Visit with field parties of P. Hoffman and M. St.-Onge - Great Slave Lake area of the Northwest Territories, July 18 - 27, 1983.

IUGG General Assembly, Hamburg, Federal Republic of Germany, Aug. 11 –28, 1983. President, Annual Meeting at Inter-Union Commission on the Lithosphere.

Visit to Bundesanstalt für Geowissenschaften und Rohstoffe (Federal Institute for Geosciences and Natural Resources), Hannover, FRG.

Branch Management Committee Meeting, Ottawa, Ont., Sept. 14 - 15, 1983.

Visit to ISPG, Calgary, Alberta, Sept. 20, 1983.

47th Meeting of the Canadian Geoscience Council, Saskatoon, Sask., Sept. 21 - 22, 1983.

Canadian Delegation to Discussions on S&T Cooperation with the U.K. London, U.K., Oct. 16 - 18, 1983.

Briefing on Earth Sciences Sector science programs for Petroleum Exploration Industry Representatives, at ISPG, Calgary, Alberta, Nov. 6 - 8, 1983.

Planning Meeting for the Special Program of the Inter-Union Commission on the Lithosphere at the 27th International Geological Congress, Moscow, USSR, Nov. 14 - 19, 1983.

ICSU Meeting on proposed Geosphere-Biosphere program on Global Change, Paris, France, Nov. 20 - 23, 1983.

Meeting of the Canadian Geoscience Council, Ottawa, Ont., Nov. 28 - 29, 1983.

Ontario Geological Survey's Open House, Toronto, Ontario, Dec. 6 - 7, 1983.

Meeting with Quebec officials to discuss proposed Quebec/Canada Mineral Development Agreement, Quebec City, P.Q., Jan. 12, 1984.

Discussions with British Geological Survey (formerly Institute of Geological Sciences), Nottingham, U.K.; on Canada-UK cooperation in geoscience; followed by a meeting of the Board of Electors, Woodwardian Professorship, Cambridge University, Cambridge, U.K., Jan. 26-28, 1984.

Cordilleran Workshop, Carleton University, Ottawa, Ont., Feb. 10 - 12, 1984.

CSPG Annual Dinner, Calgary, Alberta, Feb. 22, 1984. Awarded R.J.W. Douglas Medal.

Visit to ISPG, Calgary, Alberta, Feb. 23, 1984.

Lithoprobe Workshop at the University of Toronto, Toronto, Ont., March 10-12, 1984.

Lithoprobe Steering Committee Meeting, at the University of Toronto, Toronto, Ont., March 13, 1984.

CHIEF GEOLOGIST

J.G. Fyles

Attendance at Meetings, Conferences and Courses

Seabed Sulphides Workshop, PGC, Sydney, B.C., May 9-11, 1983.

Branch Management Committee Meeting, AGC, Dartmouth, N.S., June 15 and 16, 1983.

Fourth International Conference on Permafrost, Fairbanks, Alaska, July 17-22, 1983.

Visit to Northern Field Parties, B.C., July 22 to August 6, 1983.

Meeting at Ontario Geological Survey, Toronto, Ont., to discuss STAMP, September 22, 1983.

Program Review, AGC, Dartmouth, N.S., September 26-27, 1983.

Meeting with Manitoba officials, Winnipeg, Manitoba, re federal-provincial agreement, October 20, 1983.

Meeting with Industry Officials, Calgary, Alberta, November 7, 1983.

Open House, St. John's, Newfoundland, November 2, 1983.

Meeting with Newfoundland officials, St. John's, Newfoundland, to discuss mineral development agreement, November 3, 1983.

Meeting at Ontario Geological Survey, Toronto, Ont., to discuss Canada-Ontario mineral development agreement, November 22, 1983.

Meeting with Saskatchewan officials, Regina, Sask., to discuss mineral development agreement, November 22, 1983.

Meeting with Newfoundland officials, St. John's, Newfoundland, to discuss mineral development agreement, November 24, 1983.

Program Review, AGC, Dartmouth, N.S., November 25, 1983.

Program Meeting with officials of B.C. Government, Victoria, B.C., December 8, 1983.

Program Review, PGC, Sydney, B.C., December 9, 1983.

Program Review Meeting, ISPG, Calgary, Alberta, January 5, 1984.

Meeting with Newfoundland officials, St. John's, Newfoundland, to discuss mineral development agreement, January 12, 1984.

Management Committee Meeting for Canada-Manitoba mineral development agreement, February 22, 1984.

Prospectors and Developers Association meeting, Toronto, Ont., March 5, 1984.

Meeting with Saskatchewan officials re mineral development agreement, Regina, March 6, 1984.

SPECIAL PROJECTS

T.E. Bolton

Attendance at Meetings, Conferences and Courses

Geological Association of Canada, Annual Meeting, Victoria, B.C., May 1983.

Canadian Paleontology and Biostratigraphy Seminar, Toronto, Ont., September 1983.

Geological Society of America, Annual Meeting, Indianapolis, Indiana, October 1983.

Northeastern Section, Paleontological Society, Annual Meeting, Providence, Rhode Island, March 1984.

Membership on Committees

Secretary, Earth Sciences Grants Committee, Natural Sciences and Engineering Research Council of Canada.

Secretary, Northeastern Section, Paleontological Society.

Chairman, Canadian Society of Petroleum Geologists, Lexicon Committee, Central Canada and St. Lawrence Lowlands.

Member, International Committee for the Study of Fossil Cnidaria, International Paleontological Association.

Member, 1983-84 Billings Medal Committee, Paleontology Division, Geological Association of Canada.

Member, International Paleontological Association, Select Committee for a World Directory of Paleontological Collections.

Corresponding Member, IUGS Subcommission on Silurian Stratigraphy.

Corresponding Member, IUGS Ordovician-Silurian Boundary Working Group.

A.V. Okulitch

A. V. Okulitch's primary assignment is editing and coordinating the Geological Atlas of Canada Program. During his second year as coordinator, additions and amendments were made to standards and format of the atlas, particularly those of Phanerozoic and Precambrian time scales, geotectonic correlation charts and legends. Standards for mineral deposits were revised. All changes have been incorporated into a new guide for compilers. Initial compilation has been completed for three maps from Ontario; work continues on adjoining maps and several from the Cordillera and the Arctic Islands. Cooperative agreements with staff of the British Columbia Ministry of Energy,

Mines and Petroleum Resources and the Nova Scotia Department of Mines and Energy have been made to produce at least two maps. About 15 maps are in various stages of production. Because of other responsibilities (see below) completion of the first maps will likely be delayed until 1985.

Field studies of structure of the Arctic Platform in southern Ellesmere Island continue. Data analysis and contributions to the final report (project leader, U. Mayr, ISPG) will be done in 1985.

Contributions to the Decade of North American Geology project in the form of first drafts of a 1:5,000,000 scale map of the Arctic Islands (with H.P. Trettin) and parts of correlation charts for rock units in southeastern British Columbia have begun.

Attendance at Meetings, Conferences and Courses

Geological Association of Canada, Annual Meeting, Victoria, B.C., May 1983.

Discussion of atlas program with staff, Cordilleran Division and Pacific Geoscience Centre, May 1983.

Belt Symposium II, Missoula, Montana, October 1983.

Coordination of Atlas map production, Ottawa, November 1983.

Coordination of Atlas map production, Dartmouth, December 1983.

Report on Atlas program to Branch Management Meeting, December 1983.

Coordination of Atlas map production, Ottawa, February 1984.

Cordilleran Tectonics Workshop, Carleton University, Ottawa, February 1984.

Cordilleran Section, Geological Association of Canada, Vancouver, February 1984.

Federal-Provincial cooperative agreement meeting, Victoria, February 1984.

Membership on Committees

Member, Ad Hoc Committee, 1:1,000,000 National Earth Science Series.

Chairman, Structural Geology and Tectonics Division, Geological Association of Canada.

Talks

"The Shuswap Metamorphic Complex: Its Role in Cordilleran Tectonics", at ISPG, Calgary, March 1984.

INTERNATIONAL RELATIONS UNIT AND EPISODES SECRETARIAT

Following completion of a survey by A.R. Berger and B. Manistre of the international activities of GSC, both officers were designated, late in the year, as members of a new GSC International Relations Unit with responsibility to monitor and advise on such activities. Manistre's other activities are described under the Resource Geophysics and Geochemistry Division.

The EPISODES Secretariat, headed by Dr. A.R. Berger (Editor) is responsible for publishing and distributing EPISODES, the quarterly newsmagazine of the International Union of Geological Sciences (IUGS), and other IUGS publications, as well as for public relations and promotion work for IUGS, particularly in North America. During 1982-83 the Geological Survey of Canada continued to support approximately half of the cost of operating the Secretariat, the other half being covered by the Union itself and the revenues generated by sales of EPISODES.

Much effort was directed throughout the year to generating high quality contributions to EPISODES and promoting sales and distribution. As a result, many new subscriptions were received. Displays were mounted at several national and international conferences. A major task was the preparation and publication, in March 1984, of a special issue on the Geology of the U.S.S.R. to celebrate the 27th International Geological Congress being held in Moscow in mid 1984.

The EPISODES Secretariat continues as the main distribution point for the New Publication Series of IUGS. This continued to gain recognition and a record number of sales were handled. The EPISODES staff consisted of Mrs. Barbara Collis (Executive Secretary) and Mrs. Jeanne Spencer as Bookkeeper, Circulation Manager and Graphic Artist, and Mrs. Jean Jenness as Editorial Assistant from January 1984. Ms. Pat Revelle left her post as Production Supervisor at the end of 1983. Dr. J. Gravesteijn (BRGM, France) continued to provide the information for the Maps Available column. Scientific reviewers and advisers on publication policy provided useful assistance.

Attendance at Meetings, Conferences

A.R. Berger

GAC/MAC Annual Meeting, Victoria, May 1983.
International Conference on Scientific Publishing, Philadelphia, May 1983.
CGC Meetings, Victoria (May), Saskatoon (September), Ottawa (December).
Association of Earth Science Editors Annual Meeting (Houston, October).
Geological Society of America Annual Meeting (Indianapolis, October)
IUGS Executive Meeting, Blois, France (February 1984)

Membership on Committees

A.R. Berger

Editor, EPISODES
Member, IUGS Advisory Board for Publications.
Foreign Secretary, Canadian Geoscience Council.
Vice President, Association of Geoscientists for International Development.
Member Mineral Industries Panel of Intermediate Technology Development Group.

MINERAL DEVELOPMENT PROGRAMS OFFICE

Cooperative Programs - Nova Scotia and Newfoundland (W.H. Poole)

Two co-operative mineral programs - EMR and Nova Scotia Department of Mines and Energy, and EMR and Newfoundland Department of Mines and Energy - completed their second effective year. The GSC's geoscience components of the two programs were organized and managed by W.H. Poole.

Within the program in Nova Scotia, GSC implemented 11 projects using 5 contracted persons, 3 provincial employees, 2 GSC staff (J.R. Henderson, Prec., structural and K.A. Richardson, RGG, Skyvan) and one GSC-awarded contract (P.J. Hood, RGG, gradiometer). Total O&M budget of $1 155 k was underspent by about 130 k. Contracts amounted to 72% of O&M. Nine short reports were published in GSC Current Research, Part A, 1984, and one will be published in Part B. Some final maps and reports will be published, once received, using $200 000 carried over into 1984-85. Other projects will be completed in the anticipated ERDA Mineral Development Agreement.

Scientific highlights:

1. Revision mapping of Antigonish Highlands is supporting the contention that most of the rocks are Hadrynian and thus part of the Avalon zone (J.B. Murphy, contract).

2. In eastern Cobequid Highlands, epithermal U-Th-Mo ± Ag ± F mineralization with intense alkali-metasomatism occurs in high level stockworks and collapse breccias in a Devonian rhyolite dome (A.K. Chatterjee, NSDME).

3. Bedding-parallel gold-bearing quartz veins of the Meguma (Goldenville) terrane are older than the Devonian granites, the regional metamorphism and most of the folding. The veins may have formed by hydraulic fracturing by a progressive crack-seal mechanism during diagenesis and incipient pressure-solution cleavage development (J.R. Henderson, GSC-Prec).

4. Studies of the Yava sandstone-Pb deposit have outlined several distinct patterns of mineralization, in which the galena is associated with kaolin (P.D. Vaillancourt, contract).

5. More extensive northward glacier flow across the Cobequid Highlands has been recognized (R.R. Stea, NSDME).

6. Gold grains separated from glacial till near a gold-quartz vein deposit are suprising irregular and not comminuted as viewed by a scanning electron microscope (I.J. MacEachern, contract).

7. Airborne gradiometer surveys have demonstrated an 'incredible' usefulness to structural and stratigraphic mapping in the Meguma terrane. Thick, otherwise unsubdivided formations such as the Halifax and Goldenville display an internal "magnetic" stratigraphy (contract c/o P.J. Hood, GSC-RGG).

8. Airborne gamma-ray surveys record high concentrations of U, Th and K and are very useful in mapping distinctive plutons (K.A. Richardson, GSC-RGG).

Within the program in Newfoundland, GSC implemented 11 geoscience projects using 8 contracted persons, 5 provincial employees (of which two were on Interchange Canada), 4 GSC staff (P.G. Killeen and his group, RGG, ground geophysics; K.A. Richardson, RGG, Skyvan geophysics; P.J. Hood, RGG, Queenair geophysics; R.A. Klassen, surficial geology), one GSC-awarded contract (E.H. Hornbrook, RGG, geochemistry) and one CANMET staff (J.L. Jambor). Total O&M budget of $1 602 k was underspent by about $90 k. Contracts amounted to about 67% of O&M. Fifteen short reports were published in GSC Current Research, Part A, 1984, and one will be published in Part B. One final report and map is in press with GSC Editorial. Other final reports and maps, once received, will be published by GSC using $200 000 carried over into 1984-85. Other projects will be completed under the ERDA Mineral Development Agreement.

Scientific highlights:

1. In northern Labrador, early Archean rocks (>3.0 Ga) of the Nain Province near Hebron Fiord are faulted against granulites of Churchill Province to the west. The Churchill rocks may be reworked, deep-level Archean crust (A.B. Ryan, Nfld. DME).

2. In southwestern Labrador, probable Aphebian paragneiss, orthogneiss and plutonic rocks have yielded Paleohelikian ages (1650-1700 Ma) to U-Pb zircon, well within the Grenville Province (about 200 km south of the Front) (A. Thomas, Nfld. DME and G.A.G. Nunn, Nfld. DME on Interchange Canada).

3. Within the Grenville Province of eastern Labrador, the Lake Melville terrane paragneiss has been thrust north upon paragneiss and orthogneiss which has yielded Paleohelikian zircon ages (C.F. Gower, Nfld. DME).

4. Metallogenic study of the Ordovician island arc belt in Notre Dame Bay region concluded that four base metal deposits lie on the north flank of a volcanic edifice to the south. Two deposits comprise stockwork and massive sulphide systems and two consist of only stockwork systems (H.S. Swinden, contract).

5. The south flank of the Devonian Ackley Batholith in southeastern Newfoundland contains tin-bearing quartz-topaz greisen veins, as well as the long-known molybdenite mineralization (J. Tuach, contract).

6. The Siluro-Devonian North Bay Granite in south-central Newfoundland has a one-kilometre wide northeastern border of foliated granite which may represent a south-westerly directed thrust zone (W.L. Dickson, Nfld. DME on Interchange Canada).

7. Airborne gradiometer survey of the Buchans and Badger map-areas is in colour proof and may be of some help to Abitibi-Price, owners of the Buchans mine and mineral rights of surrounding region. The company has been granted pre-publication release of parts of the area. Buchans mine will close permanently during August 1984 when the last of ore has been exploited. (P.J Hood, GSC)

8. Airborne gamma-ray survey was carried out over the Strange Lake rare element prospect area in northern Labrador. Results are in preparation. (K.A. Richardson, GSC)

Plan de Developpement Economique, Canada/Gaspesie et Bas St-Laurent, Volet Mines (Y.T. Maurice, Co-ordonnateur)

L'année fiscale 1983-1984 s'est achevée avec la réalisation de deux projets:

1° La mise au point et à l'essai d'un système de gradiomètre. Les travaux d'adaptation du gradiomètre à l'hélicoptère ont été effectués à l'automne dans les ateliers de "Les Relevés Géophysiques Inc" de Québec. Deux compagnies se sont qualifiées pour la phase de la mise à l'essai: Les Relevés Géophysiques Inc. de Québec et Geotech de Toronto. Cette phase comprenait deux étapes: a-survol d'une zone contrôle établie par le Ministère de l'Energie, des Mines et des

Ressources et b-survol d'un terrain accidenté reproduisant les conditions existantes en Gaspésie. Les deux compagnies ont complété avec succès ces deux étapes et seront invitées prochainement à soumissionner pour un contrat de gradiomètre héliporté en Gaspésie qui s'effectuera en 1984-1985.

2° Inventaire des ressources minérales de la Gaspésie et du Bas St. Laurent. Ce projet a permis de rassembler toute l'information sur les gîtes minéraux de la région et d'identifier des indices devant faire l'objet d'études détaillées en 1984-85. Un rapport sera rédigé à la fin du programme (1988) sous forme d'une synthèse métallogénique.

W.H. Poole

Attendance at Meetings, Conferences and Courses

CIM Excursion, Gold deposits in the Meguma Terrane of Nova Scotia, October 17-21, 1983.

Open House, Newfoundland Department of Mines and Energy, St. John's, November 3, 1983.

Open House, New Brunswick Department of Natural Resources (Mineral Resources) and meeting of NBDNR Advisory Committee on Exploration-related Projects, Federation, November 28 and 29, 1983.

Open House, Nova Scotia Department of Mines and Energy, Halifax, November 30 and December 1, 1983.

Geological Society of America, Northeastern Section, Providence, Rhode Island, USA, March 15-17, 1984. Co-chairman, Symposium on Geology of the Meguma Terrane of Nova Scotia.

Membership on Committees

International Geological Correlation Programme, Project 27 – Caledonide Orogen, Canadian Working Committee, secretary.

Geological Survey of Canada Liaison Officer to government geological surveys of New Brunswick, Nova Scotia and Newfoundland.

Canada-Nova Scotia Co-operative Mineral Program 1981-84, Liaison Committee, member.

Deep Seismic Reflection Profile Quebec and Maine (W.H. Poole)

A VIBROSEIS seismic survey along 130 miles from Lac Megantic into Maine was a co-operative project of United States Geological Survey, GSC, Earth Physics Branch, Maine Geological Survey and several universities including Laval. Planning and monitoring of the project were carried out by American and Canadian scientists in a very agreeable manner. USGS awarded the contract to Geophysical Systems Corporation, California for $758,212.00 US. Field data was acquired during October through December 1983, and computer processing of the data was continuing as of April 1984. R.M. Gagné of Resource Geophysics and Geochemistry Division carried out shallow seismic surveys over parts of the Quebec line to aid in processing of the VIBROSEIS data. GSC purchased the VIBROSEIS data in Quebec and adjacent Maine for about $77,900.00 US. GSC involvement was managed by W.H. Poole. All involved are pleased with the VIBROSEIS data and with the healthy attitude and constructive efforts of the contractor.

Preliminary interpretation of the data clearly shows a nearly continuous reflector from about 9 km depth beneath Lac Megantic to about 24 km depth in Maine along 45 miles of profile. The reflector at the moment is best interpreted as a thrust, in which case all these rocks, including the Precambrian (Grenvillian) Chain Lakes massif along the Quebec-Maine boundary are allochthonous. First-release publication of the data is planned for Geology early in 1985 by many authors.

PROGRAM OFFICE

Program Office evaluates the work of the Branch from the viewpoint of its effectiveness and efficiency in meeting Branch objectives, the Program Office Head, being a senior staff adviser to Branch Management.

The Project Management System is carefully monitored and reviewed on behalf of the Chief Geologist. A complete catalogue of scientific and technical projects is prepared and published each year, as well as lists of proposed field work in the Provinces and Canada Lands. Annual reports are prepared for the EMR Annual Report, the publication on Government Activities in the North, and on statistical data for MOSST and STATSCAN. The status of mapping by the GSC is presented on a map sheet, published biennially, that shows the status of bedrock, surficial, airborne gamma-ray spectrometry, regional geochemical, aeromagnetic and shipborne magnetometer coverage.

The Branch Program, the preliminary and revised estimates, and the strategic objectives and long term plans are reviewed on a division by division basis with the Chief Geologist and the individual divisions. This information and the divisional performance plans and reports are used to prepare the Branch submissions to the ADM, Earth Sciences.

D.G. Benson

Attendance at Meetings, Conferences and Courses

AGC Program Review, Dartmouth, November 25, 1983.

ISPG Program Review, Calgary, January 6, 1984.

B.C.-Yukon Open House, Vancouver, January 25, 1984

IGCP-CNC Ninth Annual Meeting, Toronto, March 5, 1984.

BRANCH FINANCIAL SERVICES

The Branch Financial Services in the Geological Survey consists of the Branch Finance Office and the Accounting Operations Office, both of which are the responsibility of the Branch Financial Comptroller.

The Branch Finance Office coordinates the annual Multi Year Operational Plan and Main Estimates exercises, coordinates and reviews the forecasting of expenditures, ensures that Treasury Board guidelines and departmental procedures are implemented as they apply to financial matters, provides the link with the Financial Management Branch, and generally provides functional guidance to divisions on all financial matters.

The Accounting Operations Office is the most visible unit of Branch Financial Services. The staff is responsible for making travel arrangements, auditing and processing field accounts, travel and removal claims for all divisions of the GSC and the payment of all invoices for the Director General's office and Branch administration. The payment of

such items as freight, express, telephone and taxis are also handled by this group.

The following staff changes took place in Financial Services during the 1983-84 year:

Toal, Trixi: June 1983 - retired
Adettu, Thomas: October-December, 1983 - term accounts payable clerk
Eastham, Angie: February 1983 - returned from Language training.

ADMINISTRATIVE SERVICES

Administrative Services in the Geological Survey is comprised of four units, namely the Procurement, Chemicals and Stationery Stores; Building Maintenance, Inventory and Vehicle Services; Branch Records and Messenger Services; and the Word Processing Centre. The responsibility of these sections is to provide administrative support to the Ottawa based Divisions as well as functional guidance and advice to the Regional Offices.

Administrative Services also provides administrative guidance and advice to the Geological Survey on all administrative matters by assessing the implications of new and changing Treasury Board policies and guidelines and departmental directives upon the administrative support staff and the operational Divisions and implementing them as they relate to the GSC. The Units also coordinate and administer the accommodation plans; the Energy Conservation Program; Security/Safety and Emergency Disaster programs; Field logistic requirements; and controls the Branch Parking allocation.

Attendance at Meetings, Conferences and Courses

Departmental Administrative Forum Committee
Departmental Safety Committee
Departmental Parking Committee
Departmental Suggestion Award Committee
Departmental Cafeteria Committee
GSC Branch Management Committee
GSC Administrative Officers' Committee
GSC Emergency Organization
Departmental Field Equipment Committee
Capital Acquisition and Replacement Plan Committee
Contract Review Board

This year's highlights includes the continuation of the NATO codification System conversion; a common identification system for identifying all Capital equipment. This project is being carried out in preparation for the implementation of the New Computerized Inventory System and a Capital Acquisition and Replacement Plan, both of which are presently under development. Also, a review of all GSC records holdings was carried out this year with a view of adopting a new common Classification System, indexing all holdings and centralizing all records.

Personnel Notes

Staff changes include: Arrivals - Daniel Chenier to the Shipping and Receiving area of the Procurement Unit. Departures - Michel Bradley from the Building and Vehicle Services; Christine Parkinson and Claudia Clarke from the Word Processing Centre.

BRANCH PERSONNEL UNIT (K. Fracke)

The Personnel Unit of the Geological Survey of Canada is responsible for the classification of positions; the recruitment, selection and appointment of staff; the interpretation of collective agreements and the resolution of problems relating to pay, conditions of work, discipline and grievances; and the co-ordination of employee performance appraisals.

Following is a breakdown of staffing and classification actions completed in the fiscal year 1983-84.

Staffing

Appointments from outside the Public Service:

Scientific and Professional	18
Administrative and Foreign Service	4
Technical	18
Administrative Support	20
Operational	1
Total	61

Appointments from within the Public Service:

Scientific and Professional	8
Administrative and Foreign Service	4
Technical	8
Administrative Support	10
Operational	0
Total	30

Staffing – Students

COSEP	115
Summer Canada	149
Total	264

Classification

Indeterminate	200
Term	328
Total	528

REPORT ON THE 1984 CURRENT ACTIVITIES FORUM

January 17-19, 1984

Chairman:	J.S. Scott
General Co-ordinator:	P.J. Griffin
Poster Sessions Co-ordinator:	C.C. Durham
Technical Session Co-ordinator:	S. Green
Registration Co-ordinator:	K. Gareau
Visits Co-ordinator:	G. LeCheminant

The format for this year's Forum was similar to previous years with 17 talks and 38 poster sessions. The only significant change in the program structure was on the closing afternoon (January 19) when 15 Survey laboratories at 601 Booth were opened to Forum participants. In general the number of visitors ranged from 15 to about 35 in each laboratory.

Although originally scheduled to be held at the Westin Hotel, the Forum was pre-empted for a state dinner organized by the Prime Minister's Office for January 17. The Forum was moved to the new "Congress Centre" adjoining the Westin.

The Forum opened on the evening of January 17 with a public lecture by R.L. Grasty on "Radiation in Canada - Its Nature and Origin". The presentation, which included a short film, was well received by the 300 people who attended. The poster sessions were open before and after

the lecture. Both the formal presentations and poster sessions were well attended and well received. External registration this year was 322 an increase over last year's 266. A detailed breakdown of registrants for all three years is presented in Table 1. The cost for this year's Forum was $4,120.79 considerably lower than 1983 because the Westin Hotel covered the cost of the room rental. Table 2 presents the Forum costs for 1983 and 1984. Many favourable comments were received about this year's facilities at the Congress Centre.

TABLE 1

	1984		1983		1982	
	No.	%	No.	%	No.	%
Industry	90	28	90	34	105	54
Prov. Agencies	34	10	23	9	12	6
Federal Agencies	44	14	37	14	24	12
Universities	132	41	100	37	45	23
Unassigned	22	7	16	6	10	5
Sub Totals	322	100	266	100	196	100
GSC Staff Attending	189		175		146	
TOTALS	511		441		342	

TABLE 2

FORUM COST FOR 1983 and 1984

	1984	1983
Rental of Rooms	—	1967.56
Hospitality (Coffee)	1165.94	963.80
Audio Visual	1549.50	550.00
Extra Lighting	—	725.00
Truck Rental	124.35	82.50
Advertising (paid by Comm. EMR, 1984	—	156.80
Display Boards	81.00	285.80
Printing Costs (paid by GID)	—	—
Rental of Tables	1200.00	—
TOTALS	4120.79*	4730.66

*Does not include about $1800. in repairs to rented truck; with repairs included, new total is $5920.79.

ATLANTIC GEOSCIENCE CENTRE

M. J. Keen

The Division objectives are to ensure the availability of geological information and expertise on that area of Canada comprising the Atlantic and Arctic offshore regions and the sedimentary basins of the Appalachian region, for the identification of the resource base, the formulation of energy and mineral policy, to facilitate exploration of Canadian resources and to contribute to the nation's intellectual base in the Earth sciences.

We meet these objectives by: undertaking geological, geophysical and geochemical research; including surveys; regional interpretation and synthesis; establishment of appropriate national and international standards for geological chronology, correlation, reference materials and surveys; identification of the characteristics and probable locations of occurrence of coal, oil and gas resources and estimates of their abundance; identification of the characteristics of the terrain offshore for its safe and proper use; development of methods and technologies to improve the effectiveness of marine geoscience surveys, discovery of resources and the determiation of terrain properties; the dissemination of information.

The Division is organized into five Subdivisions: Administration, Eastern Petroleum Geology, Environmental Marine Geology, Regional Reconnaissance and Program Support. The staff consists of one EX, four Senior Managers, 43 Research Scientists, Physical Scientists, Engineers and Computer Scientists, 41 Scientific and Technical Support staff, 11 Administrative, Secretarial and Clerical staff.

ADMINISTRATIVE SUBDIVISION

The objectives of the Administration Subdivision are to provide efficient and effective financial, personnel and general administrative guidance and support to the Atlantic Geosience Centre. The Subdivision consists of the Director's Office, Personnel Office and Finance Office, with each section supplying the general administrative support necessary to ensure a smooth operation.

Personnel Notes

The Subdivision consists of a permanent staff of a Director and secretary; an Administrative Officer, two Financial Clerk, a Personnel Clerk and a secretary.

During the year, Mrs. Carol Racine, who was participating on the WIN Program, became our Administrative officer, replacing Pat Stewart who left AGC to move to Edmonton.

Attendance at Meetings, Conferences and Courses

M. J. Keen

GAC Newfoundland Section meeting, St. John's, Nfld., April 8, 1983

Ocean Drilling Program meeting, Washington, D.C., April 19-21, 1983

GAC/MAC/CGU Joint Annual meeting, Victoria, B.C., May 9-13, 1983

NRC Research Committee meeting, Ottawa, June 7, 1983

National Science Foundation meeting, Ottawa, June 8, 1983

GSC Branch Management Committee meeting, Ottawa, June 15-16, 1983

EMR Coordinating Committee on Marine Geoscience Research meeting, Ottawa, June 22, 1983

Interdepartmental Committee on Oceans meeting, Ottawa, June 28, 1983

JOIDES Executive Committee meeting, London, England, August 29 - September 1, 1983

Seabed II Steering Committee meeting, Ottawa, September 7-8, 1983

GSC Branch Management Committee meeting, Ottawa, September 14-15, 1983

GSC/COGLA Meeting, Ottawa, September 26, 1983

CGC meeting, Ottawa, October 19-20, 1983

Canadian Science Writers Seminar, Ottawa, October 24-25, 1983

Canadian Committee on Oceanography meeting, Toronto, November 1, 1983

Ocean Drilling Program Executive Committee meeting, Texas, November 9-10, 1983

CGC meeting, Ottawa, November 29, 1983

GSC Branch Management Committee meeting, Ottawa, November 30-December 1, 1983

Canadian Ocean Drilling Program Executive Committee meeting, Ottawa, December 2, 1983

DFO/EMR Guiding Committee on Offshore Surveys meeting, Ottawa, December 8, 1983

GSC Current Activities Forum, Ottawa, January 18-19, 1984

Executive Development Course, Touraine, February 13-24, 1984

Ocean Drilling Program Executive Committee meeting, Washington, D.C., March 5-6, 1984

CGC Marine Geosciences Committee meeting, Ottawa, March 14, 1984

EMR Coordinating Committee on Marine Geoscience Research meeting, Ottawa, March 14, 1984

Workshop on Ocean Issues, Ottawa, March 19-20, 1984

GSC Branch Management Committee meeting, Ottawa, March 21-22, 1984

Ocean Drilling Program Canadian Executive Committee meeting, Ottawa, March 28, 1984

Membership on Committees

M. J. Keen

DFO/EMR Joint Guiding Committee on Offshore Surveys

BIO Directors' Committee

Dalhousie University, Adjunct Professor

Canadian Geological Foundation, President (resigned during year)

Atlantic Regional Interdepartmental Committee on Environmental Issues

Canadian Geophysical Union, Past-President

OSS (Atlantic) Management Committee (observer)

Canadian Geoscience Council: Chairman, Marine Geoscience Committee

Chairman, BIO Safety Committee (terminated during year)

Canadian Executive Committee for Ocean Drilling Program (secretary)

EMR Coordinating Committee on Marine Geoscience Research (secretary)

Alternate Canadian Member, Executive Committee, Ocean Drilling Program

EASTERN PETROLEUM GEOLOGY SUBDIVISION

G.L. Williams

The objectives of the Eastern Petroleum Geology Subdivision are: to increase our knowledge of subsurface geology of the sedimentary basins of offshore eastern Canada and contiguous areas; and to interpret the hydrocarbon potential of these basins and undertake periodic appraisals of such resources. These studies also generate predictive, qualitative models for passive continental margins. The Subdivision also has an obligation to study the Upper Paleozoic basins of the Atlantic provinces.

The Subdivision's studies of the Atlantic continental margin are based primarily on industry generated, multichannel seismic and the approximately 220 wells drilled to date. About 1,000,000km of multichannel seismic are now available for examination. Well data studied include logs and samples. Areas where hydrocarbon exploration has been active in the last year include: the Labrador Shelf, the Grand Banks, and the Scotian Shelf. The data base for the Upper Paleozoic investigations includes surface sections, coal, salt and potash mines, and some core holes.

Offshore eastern Canada encompasses an area stretching from 44°N to 76°N. Specific areas include: Baffin Bay, Davis Strait, Hudson Bay and Hudson Strait, the Labrador Shelf, Northeast Newfoundland, the Grand Banks, the Gulf of St. Lawrence, the Scotian Shelf, and the Bay of Fundy. Contiguous areas studied by the Subdivision's scientists include the North Atlantic (DSDP sites), western Europe (surface sections), and the U.S. Atlantic continental margin (wells).

The twenty-four scientific projects in the Subdivision can be placed into one of four programmes: basin analysis and petroleum geology; resource appraisal; biostratigraphy; and data bases. Basin analysis and petroleum geology includes three disciplines: petroleum geology, geophysics, and lithostratigraphy. The three subprogrammes in resource appraisal are: resource appraisal - oil and gas; resource appraisal -coal; and source rock evaluation. Biostratigraphy includes palynology and micropaleontology. The major data bases under development are: WELLSYS, BIOSTRAT, KREMPFILE, LOGFILE, and ROCKFILE. Although the data base programme is treated separately, it spans all the scientific studies. Discussions of highlights in the following section will be according to programme.

Industry's activity offshore has a bearing on the Subdivision's workload. The Venture and Hibernia discoveries have focussed attention on the Scotian Basin and East Newfoundland Basin. This has resulted in a marked increase in the number of wells drilled and seismic surveys conducted during the past few years. Accompanying this has been a slowdown in drilling in other east coast areas such as the Labrador Shelf.

A major phase of the Subdivision's studies, the resource appraisal programme, is part of the interdepartmental assessment. This is carried out in collaboration with the federal regulatory agency, Canada Oil and Gas Lands Administration (COGLA),

which now has regional offices in Halifax and St. John's. COGLA is responsible for the curation of all industry data on the offshore east coast. The well samples are stored at Bedford Institute, where they are available for study to any interested party after lapsing of the confidential period.

Highlights

Basin Analysis and Petroleum Geology

The Upper Paleozoic rocks of the Gulf of St. Lawrence are the focus of a study which commenced during the fiscal year. A preliminary appraisal of the multichannel seismic data has been completed. This will be integrated with the well data to produce isopach plots of key lithostratigraphic units.

The continuing study of the East Newfoundland Basin has resulted in a detailed integration of the regional geology and geophysics with the biostratigraphy. This has led to recognition of hiatuses, previously unsuspected, in the Hibernia structure. The recent Terra Nova discovery confirms the prophetic statement we made last year that: "Other parts of the East Newfoundland Basin may hold more promise (for oil and gas discoveries) than originally suspected".

"Base event" maps are being compiled from interpretations of the multichannel seismic data in the East Newfoundland Basin. The 1:250,00 maps nearing completion include: "Flemish Pass", "Flemish Cap", "Grand Banks East", and "Orphan Basin". Basement, Jurassic and Cretaceous maps are also in preparation for the "Flemish Pass" map sheet.

To understand the maturation history of the offshore sedimentary basins, it is necessary to regard each as representing a unique set of circumstances. This has been the motivation behind two separate studies: the first of the Scotian Shelf; the second of the East Newfoundland Basin. Both studies have involved the reevaluation of the available geochemical and maturation data and the development of hydrocarbon generation models.

The Scotian Shelf project necessitated the extrapolation of bottom hole temperature data for about 65 wells to equilibrium, and the recalculation and mapping of geothermal gradients. Time temperature Indices (TTI) were calculated and then calibrated with vitrinite reflectance, thermal alteration indices (TAI), and cuttings gas analyses and temperature data.

The hydrocarbon generation model proposed indicates that, on the Scotian Shelf, the onset of maturation occurs at an Ro of about 0.5%, with relatively small amounts of gas and condensate being produced. When the Ro increases to 0.7%, there is some generation of light oil if hydrogen rich components are present. Peak generation is at 0.9% Ro, which is usually a zone of concentration of terrigenous organic matter.

The synthesis of the maturation data for the East Newfoundland Basin is based on 23 wells, including seven on the Hibernia structure. Preliminary results indicate that some wells pass through the oil window so that at total depth they are in the overmature phase. This is a different hydrocarbon generation model to that for the Scotian Shelf, in part reflecting the differences in relative percentages of organic matter types. This presumably resulted from preservation of the marine organic matter in a basin with semi-restricted circulation.

The study of volcanic rocks of the Scotian Shelf was extended to Montaignais I-94. The samples yielded an absolute age of 55 Ma ± 1, which is much younger than expected. This indicates that volcanic activity on the Canadian margin spans a long interval of time, namely Permian to Paleocene.

Chemical and petrographic analysis have been completed on volcanic rocks from the Grand Banks' wells. The volcanics are dominantly alkaline and Early Cretaceous in age. This suggests that the time and mode of emplacement may be related to movement along the transform margin of the southern Grand Banks. Preliminary studies of volcanics from Baltimore Canyon wells also indicate that these are alkaline in composition.

A revised report was completed on the subsurface geology of the Georges Bank Basin. To ensure continuity in correlation of the section with the Scotian shelf, the Subdivision undertook biostratigraphic analyses of the COST G-1 and G-2 wells from the Georges Bank Basin. This permitted precise comparison with key Scotian Shelf wells including Mohawk B-93.

Two reports are nearing completion on the Windsor salt of the Minas and Cumberland subbasins. In addition, most of the compilation is finalized for a major work on the evaporite deposits in Atlantic Canada. This will outline the paleogeography, present distribution, facies, thickness, purity, depth of burial, and tectonic readjustments of the salts of the Horton and Windsor groups. It should be a definitive work on these very important, economic deposits.

The Paleozoic play in offshore eastern Canada received a boost with the drilling of PetroCan St. Paul P-91. The well, located just off St. Paul Island, did not encounter any hydrocarbons, but did further our knowledge of the Carboniferous. The uppermost 1500m are terrestrial deposits which appear to correlate with the Morien Group of the Sydney coalfield. The absence of coal seams suggests that the section encountered in the well probably represents the lower part of the group.

A new Mesozoic time scale has been adopted for the project, Decade of North American Geology. This is based on: the assignment of new radiometric ages to key stage boundaries; a detailed biostratigraphic framework for DSDP sites, with calibration of the magnetostratigraphy and chronostratigraphy; interpolation of the Mesozoic chronostratigraphic scale in linear time using constancy of seafloor spreading, equal duration of zones, and key ages concepts; and numerical interpolation of radiometric ages at stage boundaries. The time scale has found wide acceptance.

Resource Appraisal

A major accomplishment was the publication of GSC Paper 83-31, "Oil and Natural Gas Resources of Canada". The paper - coauthored by R.M. Procter,

G.C. Taylor, and J.A. Wade - systematically evaluates the six petroleum regions of the country. The Subdivision's contributions covered eastern Canada offshore and Paleozoic basins - eastern Canada.

Eastern Canada offshore is subdivided into: Georges Bank; Scotian Shelf; Grand Banks (south); East Newfoundland Shelf; East Newfoundland Basin; Labrador Shelf; and Baffin Bay-Lancaster Sound. Collectively, the areas are estimated to contain almost 1900 million cubic metres of oil and more than 2400 billion cubic metres of gas (average expectation). The greatest oil potential is believed to be in the East Newfoundland Shelf and Basin areas, with prospects decreasing both north and south. Gas potential appears to be greatest on the Labrador and Scotian shelves. The estimates for recoverable oil reserves at Hibernia are believed to be between 200 and 400 million cubic metres.

Paleozoic platforms - eastern Canada - includes: the St. Lawrence lowlands; Hudson Platform; and Maritimes basins. The St. Lawrence Lowlands extend from southern Ontario to northwestern Newfoundland. The Hudson Platform encompasses four shallow depressions or basins: the Foxe Basin; the Hudson Strait-Ungava Bay depression; the Hudson Bay Basin; and Moose River Basin. The Maritimes basins offshore include the Magdalen, Sydney, and Fundy basins. Collectively, the area contain an estimated 167 million cubic metres of oil and 190 million cubic metres of gas (average expectations).

In conjunction with COGLA, a reappraisal of the Scotian Shelf oil and gas resources is now completed. This delineates seven plays, six of which were previously recognized. The major, new play is related to a zone of abnormal subsurface pressures and substantially increases the gas potential of the Scotian Shelf. The report will be published later this year.

Source rock evaluation studies have continued in the fields of fluorescence and vitrinite reflectance. Fluorescence analyses of a further nine offshore wells have been completed. This includes four of the Hibernia wells and one Venture well. The last named helped resolve some inconsistencies in the vitrinite reflectance analyses.

The vitrinite reflectance programme was enhanced when the Zonax microcomputer-photometric microscope became fully operational. With this increased analytical capability, the Subdivision was able to complete analyses of 14 offshore wells, including several in the Hibernia and Venture fields.

The results of the vitrinite reflectance studies of five Scotian Shelf wells indicate that the oil window is much shallower than previously thought. It also appears that the maturation window is deeper towards the depocentre of the Scotian Basin and shallower on the LaHave Platform. Relating the data to lithology shows that the onset of maturation may occur as high as in the Logan Canyon Formation or as low as in the Mohican Formation. The oil window was penetrated in only one well. This again confirms that the presence of predominantly gas on the Scotian Shelf reflects the nature of the organic material.

Samples of detrital vitrinite have been analyzed from the Yava Mine of Cape Breton. The values obtained vary between 0.8 and 1.35% Ro. These can be related to temperatures ranging from 110-150°C, if one assumes an effective heating time of 60 m.y. The temperatures are much higher than expected, suggesting that the vitrinite may have been reworked or oxidized during the mineralization process. The study was carried out to obtain data on paleotemperatures existing at the time the lead-zinc was deposited in the host rock. Other maturation studies being carried out on the deposits include visual kerogen analysis.

Biostratigraphy

The objectives of this programme are to develop and implement a detailed biostratigraphic and paleoecologic microfossil zonation for the Upper Paleozoic, Mesozoic and Cenozoic rocks of the sedimentary basins of eastern Canada, onshore and offshore, and contiguous regions. It is also a prerequisite to develop qualitative and quantitative biostratigraphic, paleoecologic, paleobiogeographic, and paleooceanic models for passive continental margins and the adjacent oceanic basins.

Within the biostratigraphic programme, the two major disciplines are palynostratigraphy and micropaleontology.

During the report year, the emphasis has been on the development and refinement of foraminiferal and palynologic zonations for the Jurassic-Cretaceous of the East Newfoundland Basin. A recent report presents a Ranking and Scaling (RASC) zonation for the foraminifera of nine wells. The author recognizes twelve zones spanning the Kimmeridgian-Cenomanian. The wells analyzed include five Hibernia wells, Ben Nevis I-45, Flying Foam I-13, Dominion O-23, and Hebron I-13. The depositional environments varied from marginal marine to outer shelf.

The above study and more detailed palynologic studies have led to a major refinement of our biostratigraphic control in the East Newfoundland Basin. The palynological studies of the Early Cretaceous are nearing completion with analyses of the Hibernia K-18, Hibernia I-46, and Hebron I-13 wells. There is now precise age control on the Avalon and middle Cretaceous unconformities and delineation of previously unsuspected hiatuses.

The successful discovery of the Hibernia field has sparked interest in earlier wells drilled in the Jeanne d'Arc Basin. This includes the two Egret wells K-36 and N-46, which have previously defied correlation. A detailed palynologic reappraisal and new seismic data have led to a better understanding of the local geology. It is now apparent that there are several hiatuses in both Egret wells, with most of the Lower Cretaceous being absent in N-46. Such interdisciplinary approaches are resolving many previously unresolvable problems of correlation in the offshore sedimentary basins.

The Epistominids are proving to be key index fossils across the Jurassic-Cretaceous boundary. The presence of a more or less continuous marine section in the Kimmeridgian-Valanginian interval of downdip wells of offshore eastern Canada has proved invaluable. Because of this, the proposed Epistominid

zonation should provide the basis for a worldwide foraminiferal zonation across the Jurassic-Cretaceous boundary. Integration with the worldwide calpionellid and the regional ostracod zonations is further refining our control in the east coast, offshore wells.

Regional Cenozoic zonations are now being refined through the application of quantitative biostratigraphic techniques. The palynologic data from 13 Labrador Shelf-Davis Strait wells have been run on the RASC programme. The resultant sort gave the optimum sequence for 43 key taxa. A basic requirement for the taxa selected was that they occur in five wells. The "new" zonation showed close agreement with the exist ing zonation but has provided a new insight into the stratigraphic significance of several species. The second phase will involve elimination of those taxa whose ranges are distorted because of reworking.

The Cenozoic zonation of the East Newfoundland Basin based on foraminifera has also been refined using the RASC programme and its successor, the CASC programme. The stratigraphic ranges of taxa from 16 wells provided the data base. The optimum sort has yielded more precise control, particularly in the Paleogene.

Our understanding of the lateral extent of onshore, non-marine Cretaceous deposits has undergone a major change during the last twelve months. Palynological studies of the Musquodoboit Valley Clay and a core from Diogenese Brook, Cape Breton, have proved conclusively that the clays are Early Cretaceous. The Diogenese Brook core is Berriasian in its lower part, Aptian-Albian in its upper part. The Musquodoboit Clay is Aptian-Albian. These findings, plus the discovery of Aptian sediments at Gays River, suggest that Lower Cretaceous rocks are widespread in mainland Nova Scotia and Cape Breton. Whether this is also true of the other Atlantic provinces should be confirmed in the next few months.

Data Bases

The objectives of this programme are to develop and maintain major data bases covering all aspects of subsurface studies conducted or used by the Subdivision. Those now operational are WELLSYS, BIOSTRAT, RASC, KREMPFILE, LOGFILE, and LEXFILE. Presently undergoing development is ROCKFILE, a lithologic data base. Together these data bases constitute OCTOPUS, the data management programme of the Subdivision.

WELLSYS, the well (although sometimes it may have a cold) data base, contains geographic, geologic, and engineering data on all offshore, east coast wells. It now lists geographic and engineering data on 205 wells. The data source includes well history reports on file with COGLA, EPG internal reports, and a few publications by EPG staff and COGLA. A major effort is now underway to load all relevant publications.

BIOSTRAT is one of the data bases developed by the biostratigraphers. It includes detailed palynological analyses of more than 80 wells, plus formation picks, ages, visual kerogen, and vitrinite reflectance data. The foraminiferal data are now being loaded. One singular advantage of BIOSTRAT is that it will produce sophisticated range plots using a relative time scale. Using this capability, it has been possible to produce a range chart of about 430 dinoflagellate taxa. The latest binomial combination for each taxon was also generated through BIOSTRAT, which features a taxonomic dictionary that is periodically updated. This dictionary now produces alphabetic listings according to genus or species, and with author and date.

The worldwide range plot for the 430 dinocyst taxa formed the nucleus of a plot of 213 taxa. The latter was then compared with a plot of the same taxa generated from KREMPFILE, the palynologic data base which includes only published information. The results were startling and have had a major impact on development of KREMPFILE. Because of our findings and the changes which resulted, the quality of KREMPFILE will be significantly upgraded over the next few months.

One of the most important contributions to IGCP Project 148 has been the development and application of computer programmes in the ranking and scaling of biostratigraphic events. The Ranking and Scaling Programme (RASC) provides an optimum sequence for the stratigraphically useful species and estimates the spacing or relative distance between events. This provides a relative time scale. Other aspects of the programme highlight deviations of taxa ranges from the normal or standard in individual wells. The successor to RASC is CASC, Correlation and Subsidence Curves. CASC is intended to provide linear time correlation of wells and sedimentation plots. It has considerable potential with regard to probabilistic geohistory analysis.

LEXFILE contains information on formal, informal, and abandoned, lithostratigraphic and lithodemic units of Atlantic Canada. The approximately 2000 entries can be grouped according to age, location, or hierarchical ranking. LEXFILE has been developed from the Lexicon on eastern Canada.

Personnel Notes

The Subdivision has a permanent staff of 13 scientists, six technicians, two draftsmen, and one secretary.

Sebastian Bell, Petroleum Geologist, joined the Subdivision in June, 1983 and has assumed responsibility for the resource appraisal project.

Bernard MacLean, formerly with COGLA, joined the Subdivision in February, 1984. He will be initially concerned with the Scotian Shelf.

Mark Williamson, a visiting fellow, was seconded to the Subdivision in August, 1983. He is studying the Late Jurassic-Early Cretaceous foraminifera of the East Newfoundland Basin.

Peter Hacquebard continues to reap honours and awards. At the annual meeting of the Mining Society of Nova Scotia in June 1983, he received the Society's medal, in recognition of "exceptional services rendered to the mining industry in the Province of Nova Scotia". In 1984, Peter was one of the CIMM's Distinguished Lecturers. This necessitated giving talks in various cities across Canada.

Attendance at Meetings, Conferences and Courses

P. Ascoli

International Symposium, "Benthos '83", Pau, France, April, 1983.

M.P. Avery

Workshop on improved microphotometric techniques for maceral measurements, Houston, Texas, April 1984.

M.S. Barss

Meeting of the Kremp Steering Committee, San Francisco, California, October 24, 1983.

Annual Meeting, American Association of Stratigraphic Palynologists, October 25-29, 1983.

Annual Meeting of the Geological Survey of Canada's Palynologists, Dartmouth, Nova Scotia, November 17-18, 1983.

S. Bell

Departmental Meeting for Resource Appraisal, Halifax, Nova Scotia, September 15-16, 1983.

NSERC Committee on Grants and Scholarships and the Earth Sciences Grant Selection Committee, Ottawa, Ontario, November 21-25, 1983.

Advanced Ocean Drilling Program, Downhole Measurements Panel Meeting, Scripps Institution of Oceanography, San Diego, California, January 12-13, 1984.

Colloquium, "Current Research in the Atlantic Provinces", Atlantic Geoscience Society, Amherst, Nova Scotia, January 20-21, 1984.

Canadian Committee on the Dynamics and Evolution of the Lithosphere, Ottawa, (EPG) February 13, 1984.

NSERC Committee on Grants and Scholarships and the Earth Sciences Grant Selection Committee, Ottawa, Ontario, February 13-17, 1984.

NSERC Committee on Grants and Scolarships, March 26-27, 1984.

G.L. Cook

Course, "Dynamics of Supervision", Halifax, Nova Scotia, October, 1983.

E.H. Davies

Canadian Paleontology and Biostratigraphy Seminar, Toronto, Ontario, September 23-25, 1983.

IGCP Project 148, Quantitative Stratigraphic Correlation Techniques, Biochronology and Stratigraphic Correlation, Dalhousie University, Halifax, Nova Scotia, October 11-12, 1983.

Annual Meeting of the Geological Survey of Canada's Palynologists, Dartmouth, Nova Scotia, November 17-18, 1983.

F.M. Gradstein

Annual Meeting, American Association of Petroleum Geologists, Dallas, Texas, April, 1983.

Annual Meeting, Deep Water Benthics, Woods Hole Oceanographic Institution, Woods Hole, Mass., May, 1983.

IGCP Project 148, Quantitative Stratigraphic Correlation Techniques, Biochronology and Stratigraphic Correlation, Dalhousie University, Halifax, Nova Scotia, October 11-12, 1983.

IGCP Project 148, Quantitative Stratigraphic Correlation Techniques, Seventh International Meeting, Kharagpur, India, December 12-17, 1983.

IGCP Project 148, Quantitative Stratigraphic Correlation Techniques, Sixth Annual Meeting of Canadian Working Group, Geological Survey of Canada, Ottawa, Ontario, March 15-16, 1984.

Fortran Programming, EMR, Ottawa, March, 1984.

P.A. Hacquebard

Annual Meeting, Canadian Institute of Mining and Metallurgy, Winnipeg, Manitoba, April 17-20, 1983.

Annual Meeting, Mining Society of Nova Scotia, Ingonish, Nova Scotia, June, 1983.

Carboniferous Stratigraphy and Geology, Tenth International Congress, Madrid, Spain, September 12-17, 1983.

Meeting of the American Coal Petrologists Group, Illinois, Chicago, November 16-22, 1983.

R.D. Howie

Core Show, Halifax, Nova Scotia, September 20-21, 1983.

Workshop, "Oil Shales", Waterloo, Ontario, September 22-23, 1983.

L.F. Jansa

IGCP Project 148, Quantitative Stratigraphic Correlation Techniques, Biochronology and Stratigraphic Correlation, Dalhousie University, Halifax, Nova Scotia, October 11-12, 1983.

Penrose Conference, "Eustatic Sealevel Changes and Carbonates", El Paso, New Mexico, October 17-21, 1983.

Advanced Ocean Drilling Program, Atlantic Regional Panel, Paris, France, January 23-27, 1984.

Advanced Ocean Drilling Program, Indian Ocean Panel, Washington, D.C., March 19-20, 1984.

P. Lake

Colloquium, "Current Research in the Atlantic Provinces", Atlantic Geoscience Society, Amherst, Nova Scotia, January 20-21, 1984.

W. MacMillan

Colloquium, "Current Research in the Atlantic eeevinces", Atlantic Geoscience Society, Amherst, Nova Scotia, January 20-21, 1984.

D. McAlpine

Departmental Meeting for Resource Appraisal, Calgary, Alberta, April 26-29, 1983.

Course, "Seismic Stratigraphy", Calgary, Alberta, September 19-23, 1983.

Departmental Meeting for Resource Appraisal, Bedford Institute, Dartmouth, Nova Scotia, October 25-26, 1983.

F.C. Thomas

IGCP Project 148, Quantitative Stratigraphic Correlation Techniques, Biochronology and Stratigraphic Correlation, Dalhousie University, Halfiax, Nova Scotia, October 11-12, 1984.

J.A. Wade

Meeting of Petroleum Resource Assessment Committee re Beaufort Sea, ISPG, Calgary, April 27-29, 1983.

Meeting of Petroleum Resource Assessment Committee re Scotian Shelf, BIO, Dartmouth, October 25-26, 1983.

G.L. Williams

Meeting of the CSPG National Liaison Committee, Toronto, Ontario, April 15, 1983.

IGCP Project 148, Quantitative Stratigraphic Correlation Techniques, Biochronology and Stratigraphic Correlation, Dalhousie University, Halifax, Nova Scotia, October 11-12, 1983.

Atlantic Universities Geological Conference, Fredericton, New Brunswick, October 15, 1983.

Meeting of the CSPG National Liaison Committee, Calgary, Alberta, November 4, 1983.

GSC-Industry Meeting, ISPG, Calgary, Alberta, November 7, 1983.

Meeting of the Advisory Committee to the Mineral Technology Programme, College of Cape Breton, Sydney, Nova Scotia, November 19, 1983.

Council Meeting, Geological Association of Canada, Ottawa, Ontario, December 9, 1983.

Geological Survey of Canada, Current Activities Forum, Ottawa, Ontario, January 18-19, 1984.

Colloquium, "Current Research in the Atlantic Provinces", Atlantic Geoscience Society, Amherst, Nova Scotia, January 20-21, 1984.

Council Meeting, Geological Association of Canada, Fredericton, New Brunswick, March 2, 1984.

M.A. Williamson

IGCP Project 148, Quantitative Stratigraphic Correlation Techniques, Biochronology and Stratigraphic Correlation, Dalhousie University, Halifax, Nova Scotia, October 11-12, 1983.

Colloquium, "Current Research in the Atlantic Provinces", Atlantic Geoscience Society, Amherst, Nova Scotia, January 20-21, 1984.

IGCP Project 148, Quantitative Stratigraphic Correlation Techniques, Sixth Annual Meeting of Canadian Working Group, Geological Survey of Canada, Ottawa, Ontario, March 15-16, 1984.

Membership on Committees

P. Ascoli

Member of the I.U.G.S. Working Group on the Jurassic-Cretaceous Boundary.

Member of the Organizing Committee of "Benthos '83" (2nd International Symposium on Benthonic Foraminifera).

M.S. Barss

G.S.C. representative on Steering Committee, Kremp Palynological Computer Research Project.

A.G.C. Data Management Advisory Committee.

President, Canadian Association of Palynologists.

J.S. Bell

Member, N.S.E.R.C. Grants and Scholarships Committee.

Member, N.S.E.R.C. Steacie Fellowship Committee.

Member, N.S.E.R.C. Northern Logistics Committee.

Member, A.O.D.P. Downhole Measurements Panel.

Member, Canadian Committee on the Dynamics and Evolution of the Lithosphere.

Member, Canadian National Committee, World Petroleum Congresses.

E.H. Davies

Member, Seminar Committee, Bedford Institute of Oceanography.

Member of the I.U.G.S. Working Group on the Jurassic of the Circum Pacific.

Member of the I.U.G.S. Working Group on the Jurassic-Cretaceous Boundary.

F.M. Gradstein

Chairman of the Canadian Working Group, I.G.C.P. Project 148, Quantitative Stratigraphic Correlation Techniques.

Member, A.O.D.P. Indian Ocean Panel.

Associate Editor, Micropaleontology.

Adjunct Professor, Department of Geology, Dalhousie University, Halifax.

Chairman, A.O.D.P. Labrador Sea Working Group.

Chairman, Nominating Committee, North American Micropaleontological Association.

P.A. Hacquebard

Past President, Mining Society of Nova Scotia.

R.D. Howie

Member of the Federal/Provincial workshop on the New Brunswick Albert Formation oil shale -- a National Energy Program (N.E.P.) under the office of Energy Research and Development (O.E.R.D.).

Chairman, A.G.C. Open House Committee.

Member, B.I.O. Open House Committee.

Chairman, A.G.C. Core Show Committee

L.F. Jansa

Member, A.O.D.P. Atlantic Regional Panel.

Member, A.O.D.P. Labrador Sea Working Group.

Member, IGCP No. 171 (Circum Pacific Jurassic).

Member, Examination and Advisory Committee for Graduate School, Dalhousie University.

W.C. MacMillan

Secretary, Atlantic Geoscience Society.

G.L. Williams

Chairman, C.S.P.G. National Liaison Committee.

Associate Editor, Marine Micropaleontology.

Member of Mineral Technology Advisory Committee for College of Cape Breton.

Member of the Advisory Committee to the Petroleum Resources Technology Programme, Nova Scotia Institute of Technology.

Associate Editor, Bulletin of Canadian Petroleum Geology.

Chairman, G.A.C. Special Projects Committee.

Special Talks, Lectures, and Poster Sessions

P. Ascoli

"Epistominid biostratigraphy across the Jurassic-Cretaceous boundary on the northwestern Atlantic shelf", Benthos '83, Pau, France, April 1983.

M.S. Barss

Poster Session, "Palynological aids at the Atlantic Geoscience Centre, Dartmouth, Nova Scotia", Annual Meeting, American Association of Stratigraphic Palynologists, San Francisco, California, October, 1983.

J.S. Bell

"Lithoprobe - oil industry interest", Science Writers Workshop, Ottawa, Ontario, September 14, 1983.

E.H. Davies

Poster Session, "Palynological aids at the Atlantic Geoscience Centre, Dartmouth, Nova Scotia", Canadian Paleontology and Biostratigraphy Seminar, Toronto, Ontario, September, 1983.

Poster Session, "Composite standard techniques and range sorting applied to Grand Banks stratigraphy", IGCP Project 148, International Meeting, Halifax, Nova Scotia, October, 1983.

F.M. Gradstein

"Paleobathymetry of Late Cretaceous-Paleogene agglutinated Foraminifera faunas and a modern analogue", AAPG, Dallas, April, 1983.

"Taxonomic atlas of deep water agglutinated Foraminifera in Late Cretaceous and Paleogene Basins", Woods Hole Oceanographic Institution, Woods Hole, Mass., May, 1983.

"Advances in ranking, scaling and normality testing, and a bio-, chrono- and seismostratigraphic application", and Poster Session, "Ranking and Scaling in Exploration Micropaleontology", IGCP Project 148, 6th International Meeting, Halifax, Nova Scotia, October, 1983.

"The Jurassic time scale", Symposium on "Recent developments in stratigraphic correlation", Kharagpur, India, December, 1983.

"Sequencing methods for exploration biostratigraphy", IGCP Project 148, Canadian Meeting, Ottawa, Ontario, March, 1984.

P.A. Hacquebard

Course of 12 lectures on: "Composition, origin and geology of coal", Dalhousie University, Halifax, Nova Scotia, September 1983- December 1983.

L.F. Jansa

"Mesozoic paleocirculation", Bedford Institute of Oceanography, Physical Oceanography Division, Dartmouth, Nova Scotia, July 21, 1983.

"Worldwide evidence for sea-level changes", Penrose Conference, El Paso, New Mexico, September, 1983.

F.C. Thomas

Poster session, "Ranking and scaling in exploration micropaleontology", IGCP Project 148, 6th International Meeting, Halifax, Nova Scotia, October, 1983.

G.L. Williams

"Multiple quantitative and qualitative Labrador biostratigraphy - a preliminary outlook", IGCP Project 148, International Meeting, Halifax, Nova Scotia, October, 1983.

"Maturation studies and hydrocarbon occurrences, offshore eastern Canada", GSC Forum, Ottawa, Ontario, January, 1984.

"BIOSTRAT: son of Rangefile", Atlantic Geoscience Society Colloquium, Amherst, Nova Scotia, January, 1984.

"Data base management in the Eastern Petroleum Geology Subdivision", IGCP Project 148, Canadian Meeting, GSC, Ottawa, Ontario, March, 1984.

M.A. Williamson

"Benthic foraminiferal assemblages on the continental margin off Nova Scotia: their response to oceanography", Atlantic Geoscience Society Colloquium, Amherst, Nova Scotia, January, 1984.

"A quantitative zonation for the Hibernia oil field", IGCP Project 148, Canadian Meeting, GSC, Ottawa, Ontario, March, 1984.

The Subdivision staff produced 1 GSC Paper, 4 Contributions to GSC Current Research, 13 outside papers, 1 book on Deep sea Drilling Results and 13 "abstract only" manuscripts during 1983-1984. In addition, 21 biostratigraphic reports on wells, core holes and outcrop samples, 14 reports on vitrinite reflectance, and 6 reports on fluorescence were completed during the same period.

Laboratory Statistics

Drafting

Original Figures	169
Revisions in man hours	346
Exhibition Displays in man hours	350

Micropaleontology

Samples picked	1434
Slides prepared	1403
S.E.M. photographs	342
Aristophot photographs	70

Coal Petrology

Reflectance analyses	144
Maceral analyses	31

Palynology

Fine fraction samples reprocessed	776
Samples processed	1223
Organic matter samples	1089
Slides prepared	4153

Sedimentary Petrology

Thin sections	300
Photographs	135
Compilations (figures)	8

REGIONAL RECONNAISSANCE SUBDIVISION

Ron Macnab (Acting Head)

The objective of the Regional Reconnaissance Subdivision is to understand the structure and evolution of the continental margins and adjacent ocean basins of eastern Canada and the Arctic; and to make a contribution to global understanding of margins and basins. To do this, geophysical and geological data are collected from BIO ships on a regional basis from Nova Scotia, north as far as northern Baffin Bay, and from ice camps in the Arctic Basin. Detailed studies are carried out in key areas. Scientists interpret this acquired data and integrate it with data from other sources such as offshore oilwells, cruises of other institutions, and publications. International contacts and joint work are an important part of the work.

The Subdivision, comprising fourteen scientists, four scientific support technicians, and a secretary, is divided into sections organized according to both geography and discipline. The Baffin Bay-Labrador Sea Studies section is a geographically defined section because of the logistical problems in mounting operations in the North. The Ocean Basins and Margins section is concerned with determining the structure of the present continental margin, and those processes within the ocean basins that control its development. Systematic geological mapping of the continental margin of Atlantic Canada is carried out by the Scotian Shelf-Grand Banks Studies section, while the Geophysical Surveys section primarily carries out its mapping in conjunction with surveys of the Canadian Hydrography Service.

Highlights

Deep Structure and Crustal Processes

Major ocean bottom seismicity experiments were carried out in cooperation with the Earth Physics Branch in the seismically active area at the mouth of the Laurentian Channel. Nine Ocean Bottom Seismometers were deployed, each capable of recording continuously for 28 days. Two seismic events were detected, which will give useful structural information for improving hypocentre location by the land network.

AGC participation in CESAR (Canadian Expedition to Study the Alpha Ridge) involved geologic sampling and geophysical measurements from a platform situated on the polar ice pack. Analysis of the cores for the most part reveals slow sedimentation of 1mm/1000 years under environmental conditions similar to the present. Seismic reflection data show a faulted and intruded basement with irregular topography. The entire data set suggests the Alpha Ridge is an oceanic plateau.

A comprehensive analysis of magnetic and seismic reflection data in the Labrador Sea has shown a relationship between the magnetic quiet zone and roughness of seismic basement in the central part of

the region. This has been interpreted as a result of ridge fragmentation caused by numerous small and oblique transform faults.

An investigation of plate kinematics of the North Atlantic resulted in a series of paleogeographic reconstructions that largely account for known patterns of magnetic lineations and fracture zones in the Labrador Sea, the Eurasian Basin, the Norwegian-Greenland Sea, and the North Atlantic.

Crustal cross-sections have been completed for four regions of the eastern Canadian margin, along with a major paper discussing regional tectonics and development of the margin. Model studies have demonstrated the complex nature of crustal motion during rifting, which resulted in the sorts of unconformities that are presently observed on continental margins. The driving mechanism for rifting remains poorly understood: convection will not produce the kind of observables required by the data, but other secondary effects are recognized, such as uplift and spreading of the lithosphere under its own weight.

Geophysical Surveys and Mapping

Acceptance tests for a state-of-the-art digital marine gravimeter have been completed, and the device is now available for routine deployment on systematic geophysical surveys in the East Coast offshore. When coupled to a suitable navigation system, the meter can measure sea-surface gravity from a moving vessel to an accuracy of .3 milligal.

A one-month multiparameter survey on the southwest Scotian Margin resulted in the densification of data collected on previous surveys, as well as detailed surveys of some of the New England Seamounts.

The consolidation of large sets of existing potential field data continued with the preparation of a variety of maps for publication in a number of forms: commemorative volumes for the Decade of North American Geology, Labrador Sea Atlas, North Atlantic Atlas, and National Earth Science Series. Discussions and preliminary design work have been undertaken for the implementation of a joint data base that will serve as a management and research facility for all marine potential field data collected by or for federal agencies.

Surficial and Bedrock Geology Program

SEABED II is the name of a project involving industry-government partnership in the development of an advanced tool for the acoustic exploration of the morphology and shallow sediments of the ocean floor to water depths of 2000 metres. A prototype towed body was field-tested in 1983. When fully operational, the device is expected to greatly expand our capabilities for detailed mapping in waters adjacent to the Canadian landmass.

A major synthesis has been prepared to summarize the past 15 years of data collection and interpretation relative to the surficial geology of the continental shelf southeast of Canada (eastern Gulf of Maine, the Scotian Shelf, and the Grand Banks of Newfoundland). New models and ideas have been developed to describe glacial mechanisms and their effect on modern day sediment distribution over the entire region.

Substantial progress has been made in studies on the surficial geology, geomorphology, and glaciology of the Labrador Sea. An important compilation has pulled together all relevant Labrador Shelf data (seismic interpretation, sample positions and descriptions, track charts, and surface features) for presentation in a series of compatible 1:250,000 maps. Based largely on this body of information, a 1:2,000,000 map of the surficial geology of the Labrador Shelf has been prepared.

A significant milestone in the study of surficial sediment distribution on the southeast Baffin Shelf was reached with the preparation of 1:500,000 maps and interpretive reports.

Personnel Notes

After fourteen years at the Bedford Institute of Oceanography (the last three as Head of the Regional Reconnaissance Subdivision of the Atlantic Geoscience Centre), Richard Haworth joined the British Geological Survey at Keyworth as Chief Geophysicist. He was replaced on an acting basis by Ron Macnab.

Suzanne Cronk was confirmed in her position as permanent Secretary to the Subdivision.

Iris Hardy was appointed Curator for AGC, leaving the Regional Reconnaissance Subdivision in January of 1984 to take up her new duties with the Program Support Subdivision.

S. P. Srivastava travelled to the Woods Hole Oceanographic Institution to begin a four month change of work assignment with the Geology and Geophysics Department.

Claudia Blakeney transferred into the Baffin Bay-Labrador Sea Studies Section from the Environmental Marine Geology Subdivision.

Attendance at Meetings, Conferences and Courses

G. B. Fader

Environmental Assessment Panel Meeting on the Venture Development Project - Halifax, October 4, 1983.

Departmental Committee on Ocean Mining Meeting, Victoria, May 2-4, 1984 at Pacific Geoscience Centre.

Atlantic Geoscience Society Symposium, Amherst, Nova Scotia, January 20-21, 1984.

Seabed II Technical Management Committee Meeting, Toronto, January 9, 1984

St. John's Ambulance, Safety Oriented First Aid Course, February 6-7, 1984, Bedford Institute of Oceanography.

Residence Toxicity and Debris from Offshore Well Site Steering Committee Meeting, June 22, 1983

ICEI Venture EIS Working group meeting. September 13, 1983, Queen Square, Dartmouth, N.S.

Seabed II Steering Committee Meeting, Ottawa, April 3, 1983.

Canadian Offshore Resources Exposition, September 13, Halifax, Nova Scotia.

I. A. Hardy

Preparing for Competitions by Floralove Katz of the Conservation and Renewable Energy Office (CREO), Ottawa, April 20, 1983

Third International Short Course: New Concepts and Methods in Stratigraphy by Dr. F. Gradstein and Dr. F. Agterberg, GSC, October 13-14 1983

H. R. Jackson

International Union of Geodesy and Geophysics 18th General Assembly, Hamburg, Germany, August, 1983.

H. Josenhans

Geotechnical Practice on Offshore Engineering, Austin, Texas, April 27-29, 1983.

Atlantic Geoscience Colloquium, Amherst, N. S. January 22, 1984.

Institute of Arctic and Alpine Research, Boulder, Colorado, March 15, 1984.

C. E. Keen

Geological Association of Canada, Victoria, B.C., May, 1983.

International Union of Geodesy and Geophysics 18th General Assembly, Hamburg, Germany, August, 1983.

Invited Seminar - Toronto, December, 1983

Canadian National Committee on Lithosphere Program, Ottawa, February 1984

Invited Seminar - Montreal, February, 1984.

Logan Club, Invited talk, Ottawa, February, 1984.

Lithoprobe Workshop, Toronto, March, 1984.

B. D. Loncarevic

International Union of Geodesy and Geophysics 18th General Assembly, Hamburg, Germany, August, 1983.

Third Working Conference on Ocean Data Systems, Woods Hole, Massachusetts, October, 1983.

B. MacLean

Atlantic Geoscience Society Colloquium, Amherst, Nova Scotia, January, 1984, Poster.

Institute of Arctic and Alpine Research, University of Colorado, Boulder, Co., March, 1984, Poster.

R. Macnab

Canadian Hydrographic Service Centennial Conference, Ottawa, April, 1983.

International Union of Geodesy and Geophysics 18th General Assembly, Hamburg, Germany, August, 1983.

R. O. Miller

North American Cartographic Information Society, Milwaukee, October, 1983.

B. Nichols

Society of Exploration Geophysicists, Las Vegas, November, 1983.

I. Reid

American Geophysical Union Fall Meeting, San Francisco, December, 1983.

Lithoprobe Workshop, Toronto, March 1984.

S. P. Srivastava

Geological Association of Canada, Victoria, B.C., May, 1983.

Special Talks and Lectures

G. B. Fader

"Marine Geology of the Scotian Shelf", Dalhousie University Graduate Class in Marine Geology, May, 1983.

"Seabed II Mapping System", International Press Study Tour, Bedford Institute, June 14, 1983.

"The Seabed II Project", Press Conference, CSS HUDSON, July 8, 1983.

"Interpretation of Sidescan Sonograms", Huntec '70 Ltd., January 7, 1984.

"Wisconsinan Glaciation of the Southeast Canadian Continental Shelf", Invited Keynote Address at the Atlantic Geoscience Symposium, January 21, 1984.

"Regional Bedrock and Surficial Geology of the Grand Banks of Newfoundland", OERD, Hibernia-Sable Offshore Geotechnics Committee, Bedford Institute, February 3, 1984.

I. A. Hardy

"Stratigraphy of Late Quaternary Sediments in Groswater Bay, Labrador Shelf" given at Dalhousie University, Halifax, March 31, 1983.

H. R. Jackson

"Logistics and Science involved in CESAR", Invited Speaker - to both EPB and to the Honourable Judy Erola, Minister of E.M.R., et al, in Ottawa in July of 1983; at the Amherst Rotary Club, Amherst, N.S. in July of 1983; at PGC in October, 1983; at St. Mary's University and at the Atlantic Geoscience Society, Dalhousie University, Halifax, N.S. in November of 1983; and at the Sackville, N.B. Rotary Club in December, 1983.

H. Josenhans

"Pockmarks on the Labrador Shelf Triggered or caused by Iceberg Scouring", at the Conference on Geotechnical Practice in Offshore Engineering, April 27-29, 1983, Austin, Texas.

"Surficial Geology and Seafloor Dynamics on the Labrador Shelf", Memorial University, St. John's, Newfoundland, January 4, 1984.

"The Glacial and Post Glacial History of the Labrador Shelf - Hopedale Saddle Region", Atlantic Geoscience Colloquium, Amherst, N. S., January 22, 1984.

"The Glacial History of the Labrador Shelf", GSC Quaternary Discussion Group, GSC, Ottawa, March 12, 1984.

"The Glacial History of the Labrador Shelf", Institute of Arctic and Alpine Research, Boulder, Colorado, March 15, 1984.

S. P. Srivastava

"Evolution of Eurasian Basin and its implication to movement of Greenland along Nares Strait", WHOI, May 1, 1984; and University of Rhode Island on May 8, 1984.

Membership on Committees

G. B. Fader

Departmental Committee on Ocean Mining

SEABED II Technical Management Committee

ICEI Venture Gas Development Working Group

Steering Committee on Residual Toxicity and Debris from Offshore Wellsites

Venture E.I.S. Review Committee (Chairman)

SEABED II Steering Committee (observer)

Nova Scotia Quaternary Association (Secretary)

Canadian Coordinating Committee for 1985 Symposium of Underwater Mining Institute

I. A. Hardy

QUPEC/QPEC - Quaternary Paleoceanography of Eastern Canada Working Group

Organizing Committee for the Arctic Land-Sea Interaction (A.L.S.I.) Workshop to be held at BIO, November, 1985

Ad hoc review committee for all age dating submissions and archival sample requests for AGC

H. R. Jackson

International Commission on the Lithosphere, Arctic Sub-Committee

H. Josenhans

Departmental Committee on Continental Shelf Mineral Resources

C. E. Keen

Commission on Marine Geology, IUGS

Canadian National Committee on the Lithosphere

Ocean Drilling Project, Passive Margins Panel

Canadian Geoscience Council, Lithoprobe Steering Committee

Canadian National Committee of IUGG and IGCP

Canada and USA Geodynamics Committee, Continental Margin Transect Working Group

B. D. Loncarevic

Editor in Chief, Marine Geophysical Researches

B. MacLean

SEABED II Technical Management Committee

S. P. Srivastava

Working Group I-1 (Analysis of the Main Field and Secular Variations) of the International Association of Geomagnetism and Aeronomy

Working Group I-4 (Magnetic Anomalies on Land and Sea) of the International Association of Geomagnetism and Aeronomy

J. M. Woodside

Board of Directors, Bureau Gravimetrique International

Subdivision Manuscripts

During the fiscal year April 1, 1983 to March 31, 1984, the Subdivision staff were involved in the production of seventeen manuscripts for outside publications, twenty-three for inside publications, two open file reports, and fourteen abstracts of oral papers.

ENVIRONMENTAL MARINE GEOLOGY SUBDIVISION

J.P.M. Syvitski for
David J.W. Piper

The subdivision is concerned with marine geological processes, both contemporary and in the late Quaternary, that contribute to near-surface marine geology.

Geographically, our work is concentrated on the coast and shelf of Eastern and Arctic Canada, but also includes international areas of interest to Canada. The purpose of these studies is to provide improved knowledge of recent geological processes, and to provide timely and accurate advice concerning the rational management of the marine environment in the identification, conservation and development of natural resources.

Scientific projects in the subdivision are grouped into eight programs, and for administrative purposes, the subdivision is divided into three discipline-oriented sections.

The subdivision participates in several programs partly funded by agencies outside the G.S.C.: notably work under the Conventional Energy R&D Task of the Office of Energy Research and Development (OERD), and studies of seabed disposal of nuclear waste with Atomic Energy of Canada Limited (AECL).

The subdivision provides most of the expertise within A.G.C. for environmental advice and assessment to regulatory agencies and other levels of government.

HIGHLIGHTS

Sedimentology Section

Coastal mapping continued to focus on the Island of Newfoundland under Don Forbes to assess variability and stability of Newfoundland coast. Site surveys have now been completed at 79 sites, of which 54 are monumented for resurvey, 23 have been resurveyed one or more times, and 23 include multiple survey lines for assessment of alongshore transport. Site network in Newfoundland covers wide variety of cliff, beach, barrier, estuarine, tidal flat, boulder barracade, and boulder cluster features. Nearshore survey at St. Mary's Bay and Harbour included vibracoring and Huntec DTS. Initial interpretation include a till unit (including apparent lift-off moraines) overlying the acoustic basement, glaciomarine deposits, and postglacial muds, with high gas concentrations. Bob Taylor completed aerial video tape coverage of 1135 km of the Jones Sound coast, N.W.T., including limited ground surveys. Nearshore surveys and sampling suggest that some glaciers once stood 7 km further seaward and are still receding. The glaciers are fringed by a narrow ice-proximal shelf and sediment gravity flows are active across the shelf foreslope. A two week coastal and fjord survey along eastern Baffin Island and eastern Bylot Island, N.W.T., extended former coastal surveys south to 70°N latitude and resurveyed shore stations established farther north.

The second year of the Canadian Coastal Sediment Study (C^2S^2) continued in carrying out the objectives: to sponsor the development of instrumentation to measure instantaneous sedimentation rates in the nearshore zone and to carry out field experiments to evaluate existing engineering procedures for estimating sediment transport rates; to provide intercalibration of different instruments; and to further scientific understanding of sediment transport processes in the nearshore zone. The study is managed by NRC under the guidance of a steering committee (of which David Piper is EMR representative) and is funded by EMR, DFO (Small Craft Harbours), Public Works Canada, and NRC.

Surveys and resurveys of Pte. Sapin, N.B., included bathymetric and beach surveys, side scan and seismic surveys. In addition, the multiprobe RALPH package was moored over two fall periods.

Consulting advice on the physical environment of the coastal zone included advice for: 1) the Cape Breton Highlands National Park; 2) the Terrain subcommittee of Sable Island Environmental Advisory Committee; 3) N.S. Land Survey Institute; 4) the Annapolis Tidal Power Project; 5) ACROSES; 6) Ontario Department of Public Works; 7) Department Committee on Ocean Mining; and 8) the Miramichi Channel Dredging Evaluation. In addition, 92 ocean dumping permit applications were processed.

A 3-D photo package for the measurement of in situ particle density, particle spacing, settling velocity, particle characteristics and variability is now in the user mode stage of development. Trial tests in local waters and the Saguenay Fjord, Quebec, will be conducted soon by Jim Syvitski. Research on suspended particulate matter in the prodelta environment has led to the development of predictive algorithms for the time-averaged settling velocity of SPM. These experimental results indicate the a particles' velocity changes during the course of its sedimentation history. Attenuance data have been successfully calibrated by Gary Winters from water samples collected by stable arctic water masses.

Jim Syvitski and Charles Schafer led the second cruise to the Baffin Island Fjords under the "Sedimentology of Arctic Fjords Experiment" (SAFE). The cruise included the coordination of the mothership CSS HUDSON, helicopter, two launches and two whalers, in an integrated sampling network including piston and LeHigh cores, CTD-SPM profiles, water samples (particles, nutrients and dissolved oxygen), bottom photographs, plankton hauls, grab samples, high and low frequency Huntec, airgun, sidescan sonar, bathymetric surveys, ice samples, delta samples, weather stations, oceanographic and sediment trap moorings, and DART submersible surveys. Scientific highlights include: 1) development of a placer model that can be used to predict deposits of heavy minerals near uplifted prodelta cliffs subjected to aeolian and wave reworking; 2) documenting the movement of coarse sand down the prodelta slope via erosive gravity flows; 3) the extensive reworking of hemipelagic deposits by macrobenthos; 4) documentation of paleomagnetic reversals in sediments younger than 30,000 BP; 5) Holocene sedimentation rates of 30 to 50 cm per 1000 years in deep fjord basins compared to Pleistocene sedimentation rates of

greater than 400 cm per 1000 years; 6) on-board susceptibility measurements provide a rapid and efficient method for evaluating lithologic and sedimentologic variations in cores and surface sediments; 7) the development of an empirical relationship between C^{14} dates on total organic matter and those on shell material; 8) a bioenvironmental model based on modern calcareous foraminifera assemblages has been developed to predict paleocirculation and sedimentological affects that may have occurred throughout the Quaternary; 9) fjords with extensive sills contain the greatest accumulation of sediment and are believed to filter 90% of the transfer to fine-grained sediment from landmass to shelf, compared to 40% of fjords without sills where accumulation is considerably less; 10) a seismostraphic model was formulated and describes one complete, albeit complex, glacial infilling cycle; and 11) bulk geotechnical properties vary with facies, lithology and geographical location within the fjords. The project involves both government and university research scientists from Canada, the U.S.A., the U.K., the Netherlands, and Norway. Jim Syvitski has completed the first half of the text Fjords: Processes and products with coauthors from Alaska and Norway.

Carl Amos completed with others a synthesis of core data and seismic surveys in Chignecto Bay, Bay of Fundy. Experiments were conducted to demonstrate that the resistance to erosion is much greater than previously thought, for marine sediments that are exposed to air by the action of tides. Two Nimbus 7 overpasses of the Bay of Fundy were successfully calibrated.

A project on the stability and transport of sediment on Continental Shelves progressed by the development of 2-D numeric models for the simulation of shelf sediment transport. The model allows the sediment transport rate and direction to be predicted under actual storm events. The model is presently being set up to run for the 1:1 yr, 1:10 yr and 1:100 yr return storms. A short cruise to Sable Island Bank carried out a seismic and vibrocoring program including a joint side scan sonar survey and bottom photography with a sister cruise. A later cruise to Sable Island Bank detected active bedform migration along the proposed pipeline route from Venture. Terminology and diagnostics of shelf bedforms were synthesized and reviewed.

On a recent CSS HUDSON cruise to the N.E. Newfoundland Shelf and Grand Banks, Mike Lewis and others took cores of Quaternary units, mapped new 1983 iceberg scours, encountered puzzling 5 m deep depressions (iceberg wallows? gas vents? faults?), discovered a buried channel at Hibernia, measured near-surface velocity profiles for correlation with weathered top of Tertiary (Hibernia), sampled low sea-level terrace, and photographed transects of mobile Hibernia sediment facies.

Cruises to the continental slope, led by David Piper, employed piston coring, SeaMARC sidescan sonar and high resolution seismic reflection profiling. Many disturbed sediment zones once thought as debris flows are reinterpreted as slumps. Slumps are widespread on St. Pierre slope. The Eastern Valley of the Laurentian fan is floored by gravel waves. Data suggests that the 1929 subaqueous failure was 300 m thick. A 25 m thick composite sequence in terms of litho - and biostratigraphy has been established for the Scotian slope.

Work on cores and seismic profiles from the Lomonosov Ridge, Arctic Ocean, continued under Steve Blasco and others. Based on preliminary analyses, there appears to be a stratigraphic correlation between specific units formed in LOREX, CESAR and T-3 cores. If this proves true, the results would suggest periodic uniform deposition over wide areas of the Arctic Basin during the late Pleistocene.

Shallow seismic profiles, sidescan sonar and bathymetric surveys were combined with coring and grab sampling on the Mackenzie Bay - Beaufort Continental Shelf under the leadership of Steve Blasco. A shelf edge mosaic revealed a field of pingo-like features associated with a fault trace on the seabed. A series of 20 m boreholes were collected along a potential pipeline route in the nearshore zone at North Head to define the stratigraphy and geotechnical properties of the sediments. Only two boreholes encountered subsea permafrost. During the late Quaternary the sea level of the Beaufort Shelf has risen from 140 m below sea level over the past 30,000 years.

Paleoecology Section

Activities of Gus Vilks, Peta Mudie and Charles Schafer have emphasized aspects of the paleoceanography of the Northwest Atlantic, Labrador Sea and Baffin Bay during glacial to interglacial transitions. Microfossil analyses of gravity and piston cores suggest that glacial maxima in northeastern Canada were preceeded by the advection of relatively warm Atlantic Water and that changes in sea surface temperatures preceeded onshore climatic changes by about 2000 years during the Pleistocene - Holocene transition. Dinoflagellate data from Baffin Bay cores confirm that carbonate dissolution cycles based on fossil foraminiferal asemblage observations are related to high primary productivity during interglacial intervals.

Micropaleontological results from southern Groswater Bay (inner Labrador shelf) demonstrate that late glacial conditions terminated in that area approximately 10,000 years BP. These observations are consistent with results obtained from cores collected in deep offshore environments on the Newfoundland continental slope and rise near 49°30'N. Oceanographic conditions during late glacial time at this latitude are marked by the reestablishment of the Western Boundary Undercurrent (WBU) between 13,600 and 12,600 years BP and by comparatively intense productivity of zooplankton species. During the Holocene interval there is evidence for an intensification of the WBU about 1000 - 2000 year BP that may be related to a regional cooling effect that is evident in the paleoceanographic record of marine sediments at several localities along the eastern Canadian continental margin. Other major intra-Holocene paleoceanographic variations off Labrador appear to be related to spatial east-west shifts of the axis of a northern arm of the North Atlantic Current which flows in a northerly direction at the latitude of the Flemish Cap.

Foraminiferal studies in Baffin Island fjords and in basins on either side of the Lomonosov Ridge indicate strong watermass - assemblage relationships. In the Arctic Ocean, deep water calcareous species dominate the assemblages in the Makarow Basin while agglutinated species predominate in the deeper and colder water of the Fram Basin. Foraminiferal assemblages show pronounced local variations in ten east coast Baffin Island fjords investigated during 1982. In the deeper fjord basins the calcareous species often reflect passive transport processes. Calcareous species percentages and diversity are anamalous near the mouth of Cambridge fjord and may indicate the influence of comparatively warm bottom water. In most cases, diverse calcareous assemblages observed in the fjords are restricted to water depths shallower than 200 m.

The Saguenay fjord paleoclimatological study has yielded a quantitative annual record of depositions for the 20th century. Several of the highest maximum mean-monthly discharges of the Saguenay River can be correlated to textural anamalies observed in Pb-210 dated cores. Comparatively high spring discharge events are often related to relatively large volumes of precipitation stored as snow during the winter months. The record of major landslides that have occurred in Saguenay valley is highly resolved in Saguenay fjord cores because the slides usually involve the introduction of large volumes of raised marine sediments that contain a unique allochthonous foraminiferal assemblage. Results from land-based surveys near St. Jean Vianney indicate the occurrence of two major slides that are believed to have occurred in 1663, and which are believed to be associated with a major earthquake. However, sediment core data for that period suggests that the slides could have occurred as much as ten years apart which may reflect the possibility of an alternative (e.g. climatologically-related) triggering mechanism.

Geochemistry Section

Work in the Geochemistry Section was focussed on completing geochemical analyses of sediment cores collected from the Nares Abyssal Plain in 1982. This project is coordinated with an international study of deep sea sediments, and is designed to evaluate the feasibility of the concept of using these sediments as a national barrier to confine high level nuclear waste buried within the sediments. Dale Buckley and Ray Cranston have identified pelagic and turbidite seidment zones where apparent sedimentation rates and redox discontinuities are linked. Geochronology methods include oxygen isotopes and Th/Pa analyses in conjunction with cocolith biostratigraphy done by Gus Vilks. Ray Cranston has determined that vertical pore water advection is not significant as an ion transport mechanism in the upper 10 m sediment column of the Nares area. As part of an international experiment sediments from the Eastern Atlantic Ocean as well as clay from the Nares are being distributed from the section to many countries in order to determine if isotopes derived from high level nuclear waste would be contained by these sediments. Initial results suggest that clay sediments are superior as an isotope barrier for all significant nuclides. Mathematical models have been developed to link the core length required to estimate a minimum pore water advection rate.

Dale Buckley, Ray Cranston, Patricia Stoffyn-Egli and Gary Winters studied natural diagenetic processes and products in the sediment column to understand elemental budgets and to identify local anamalies. Some authigenic minerals appear to be sensitive to alterations and should be further studied to determine the effect of nuclear waste canister emplacement where temperature, redox, pH, and permeability would be altered. Efforts were made to identify zones where mineral precipitates form, with a possibility of naturally encasing the nuclear waste canisters and postponing the isotope release rate. Aluminum or lead casings may be much superior to the proposed metals titanium or iron presently being proposed as a covering material for glass-encased high level waste.

As part of the "Sedimentology of Arctic Fjords Experiment" (SAFE) project, Bob Fitzgerald and Gary Winters continued to analyse samples and interpret water column and sediment data collected from the Arctic Fjords in 1982 and 1983. Iron appears to be the most dynamic metal in the fjord sediment systems.

PERSONNEL NOTES

The subdivision now has a permanent staff of 14 scientists, 10 technicians and one secretary. In addition, during the year there was two postdoctoral fellows, three professional and two technical term positions.

Mrs. Cecilia Middleton resigned in March 1984 to remain home with her family.

Membership on Committees

C.L. AMOS

Member, Placentia Bay Flood Study Committee

Member, Departmental Committee on Ocean Mining

S.M. Blasco

Chairman, Joint APOA/government Beaufort Sea Seabed Synthesis Ad Hoc Working Group.

Member, Joint APOA/government Ad Hoc Working Group on Permafrost and Hydrates Research.

Member, Joint APOA/government Ad Hoc Working Group on Ice Scour Research.

Chairman, NEP-OERD Offshore Geotechnics Program

Member, NEP-OERD Marine Engineering Program Technical Advisory Committee.

Technical Advisor, Arctic Waters Advisory Committee (DIAND).

D.E. Buckley

Member, BIOMAIL, Technical Review of Industrial Research Proposals

Member, Miramichi Channel Dredging Advisory Committee

Representative, Regional Committee on Problems in Long Range Transport of Air Pollutants

Member, BIO Chemical Safety and Radioisotope Committee

Member, Nuclear Energy Agency, Seabed Working Group

Member, Site Selection Task Group, NEA-SWG

Member, Regional Environmental Emergencies Team

R.E. Cranston

Canadian Delegate, Nuclear Energy Agency - Seabed Working Group

Member, Interdepartmental Laboratory Co-ordinating Committee for Atlantic Region

D.L. Forbes

Member, National Research Council, Associate Committee for Research on Shoreline Erosion and Sedimentation (ACROSES)

Member, Organizing Committee, Canadian Coastal Coastal Conference 1985.

C.F.M. Lewis

Member, NRC Subcommittee on Marine Geotechnical Engineering

Member, NRC (U.S.A.) Marine Board Committee on Arctic Seafloor Engineering

Member, Joint Industry/Government Working Group on Ice Scour Research

Member, ESRF Scour Committee

Member, ESRF Seabottom Ice Scour Committee

K.M. Moran

Member, Ocean Engineering Committee, Association of Professional Engineers of Nova Scotia

Member, Joint APOA/government Beaufort Sea Seabed Synthesis Ad Hoc Working Group

Scientific Authority to ESRF Contract "Documentation of Iceberg Groundings"

Member, Canadian Standard Association Subcommittee on offshore Foundations.

P.J. Mudie

Member, Canadian Geoscience Council Committee on Canadian Quaternary Geoscience

Chairman, Paleoclimates and Glacial History Session, 6th International Palynological Conference, Calgary 1984

Member, Steering Committee, American Association of Stratigraphic Palynologists, Boston Meeting 1986

Member, BIO Library Committee

Member, Canadian Advanced Ocean Drilling Program Steering Committee (AODP)

Canadian representative (alternative), Sediment and Ocean History Panel, Ocean Drilling Program (ODP)

D.J.W. Piper

Member, Intergovernmental Environmental Advisory Committee on Annapolis Tidal Power

Member, Canadian Coastal Sediment Study Steering Committee

Chairman, ESRF Bottom Sediment Transport Committee

Chairman, Membership Committee Geological Association of Canada Council

Chairman, Atlantic Provinces Council on the Sciences Geology Committee

Member, Organizing Committee INQUA 87

Editoral board member for Sedimentology, Geomarine Letters, and Canadian Journal of Earth Sciences

K.R. Robertson

Member, College of Cape Breton, Environmental Technology Advisory Committee

Member, College of Cape Breton, Chemical Technology Advisory Committee

Member, BIO Laboratory Safety Committee

C.T. Schafer

EMR Representative Canadian Committee on Climate Fluctuations and Man

AGC Representative - BIO Open House Committee

AGC/BIO Representative Canadian Task Force on Proxy Climate Data

Member, Working Group for Point Lepreau Environmental Monitoring

AGC Representative, Nova Scotia Climate Advisory Committee (AES)

J.P.M. Syvitski

Co-Chairman, SAFE Symposia and Workshop (Fall, 1984; BIO)

Member, BIO Fish Lab Committee

Technical Chairman, Arctic Land-Sea Interactions Conference (Nov. 6-8, 1985; BIO)

R.B. Taylor

Chairman, Terrain Subcommittee of Sable Island Environmental Advisory Committee

Member, Organizing Committee for Arctic Land-Sea Interaction Conference Nov. 1985, Dartmouth, N.S.

G. Vilks

Chairman, 14th Arctic Workshop Steering Committee

LABORATORY STATISTICS

Sedimentology Laboratory	1982-83	1983-84
Manual Sieve Analyses	N/A	76
Sieve & Pipette Analyses	385	101
Settling Tube Analyses	496	859
Sodigraph Analysis	N/A	489
Coulter Counter Analyses	414	1064
Organic Carbon Analyses	2700	2200

Geochemistry Laboratory	1982-83	1983-84
Elemental Analyses Organic	N/A	400
Elemental Analysis Inorganic	N/A	29000
Radiographic Laboratory		
X-Ray Diffraction Analyses	193	950
X-Radiographs of Sedimentary Cores	1900	1998
Ocean Dumping Permits processed	103	82

SUBDIVISION MANUSCRIPTS

The Subdivision staff produced 74 outside papers and G.S.C. Open File Reports, 11 "abstract only" manuscripts, one catalogue and 1 book review.

PROGRAM SUPPORT SUBDIVISION

K.S. Manchester

The objectives of the Program Support Subdivision are directed towards providing an efficient central technical support facility for the Division. This support is organized in three sections.

The Data Management Section is responsible for co-ordinating the requirements and planning of efficient use of the Institute computer facilities by Division staff. It is responsible for assisting in the maintaining of permanent data files for the Division's research purposes and filling individual requests for data. Special programs and data file catalogues and output routines are produced and maintained for AGC use.

This section also, in co-operation with Canadian Oil and Gas Lands Administration, provides curation for the Division and for core, dredge, grab and other marine geological samples. It also manages a contract for routine soft sediment analysis for the Division and provides regional sample repository for marine geological samples collected by University and Industrial concerns that are donated to the Division.

The Marine Geoscience Technical Services Section is responsible for providing, operating and maintaining all the marine geoscience, geophysical, seismic refraction and reflection instruments, side scan sonar survey systems, and magnetic and gravity instruments as well as marine geological sampling equipment such as pistons, gravity, rock and vibrocorers; Shipek, Van Veen and Echman grab samples and rock dredges. This section also provides the Division's primary logistic and storage support for all field projects and equipment by providing field vehicles, ATV's, trailers, launches, boats and freight and laboratory containers.

The Marine Geoscience Instrument Development Section is responsible for developing, designing, and testing equipment and instruments or updating and/or modifying present instruments and equipment to meet new or special Division's specific objectives. This is accomplished by initial discussions with Division staff as to requirements, formulating proposals to meet the requirements, the designing, constructing, documenting and testing of these in the field to ensure they meet the desired requirements.

Highlights

Ocean Bottom Seismometers

Major ocean bottom seismicity experiments were carried out in co-operation with EPB (Ottawa and Victoria) in the seismically active area at the mouth of the Laurentian Channel. This used the nine OBS's with new 28 day continuous recording capabilities.

RALPH

RALPH (the AGC Sediment Dynamics Monitor) was deployed at Martinque Beach, Nova Scotia, in June and produced excellent results. Time lapse photographs of several bedform types can be related to measured waves and currents.

RALPH was also deployed for the Canadian Coastal Sediment Study (C^2S^2) at Pte. Sapin, New Brunswick and produced high quality data which is still being processed.

Jones Sound

AGC participaed on an Hydrographic Cruise with BAFFIN to Jones Sound to collect bottom sediment data and high resolution seismics with airgun, ORE 3.5 KHz, and Huntec DTS systems. A hydrographic launch was also fitted with the Huntec Hydrosonde seismic system, Klein Sidescan System and smaller hand operated sediment sampling equipment.

C.E.S.A.R.

After having transported several tons of scientific equipment to Resolute Bay in the fall and winter of 1982/83, it was time to mobilize the ice camp and assemble the hundreds of devices for scientific monitoring. AGC was responsible for airgun seismics, piston-coring, bottom sampling and assisting other scientists in heat flow, chemistry and seismic refraction data collection.

A mobile camp was built and manned by AGC personnel to study certain areas of the Alfa-Ridge. This portable camp contained high resolution seismics (ORE 3.5 KHz) gravity coring and refraction seismics. An oil-fired ice hole melter was developed and built at AGC which saved enormous amounts of time in cutting holes in the ice for sampling.

C.T.D.

Electronics were designed and built to integrate a standard Rosette CTD system with attenduance meter to be used in the 6000m water depth areas of the Nares Abyssal Plain later in 1984.

GSC/USGS Drilling Project

The complete equipment, technical and logistics, support necessary to meet the Branchs' Committments in a joint GSC/USGS Drilling Project on the Juan de Fuca Ridge in September 1983 was provided largely by contract. The BIO Rockcore Drill was the primary tool for the project along with the recently AGC acquired deep-tow winch for handling the drill umbilical cable and the newly containerized shipboard drilling euipment laboratory and storage facilities. The Atlantic Oceanographic Laboratory of DFO at BIO and Dalhousie University provided professional and technical assistance to the project at sea. An additional result is that the BIO Rockcore facilities are now a totally portable and

logistically simple system that can be easily installed and handled from any ship that meets the minimum size, power and handling facilities necessary for its use at sea.

Timberland-Winch

The necessary modifications to the stern areas of CSS HUDSON to allow deep tow surveys to 6000m water depth were completed. A new, large Timberland Equipment Ltd. 10,000 meter capacity deep tow winch was designed, manufactured, delivered and installed on CSS HUDSON. A new large Hampton Engineering Ltd. hydraulic pedestal crane for handling the deep-tow equipment on deck and leading the tow cable over the stern was specified by AGC and provided as a deliverable to AGC from the Huntec Ltd,. SEABED II project.

The winch, crane and ship modification design specification, installation and testing supervision were all provided very efficiently by a consulting engineering contract to Whitman Benn & Associates Ltd. of Halifax, Nova Scotia.

The ship, with the installed deep-tow facilities was used very successfully on a two week cruise in June 1983 on the Laurentian Fan using a SeaMarc I system leased from Columbia University on a joint project and for a one week initial sea trial cruise of the Huntec Ltd. 2,000m SEABED II project system.

The result of this effort is that AGC/GSC has a deep-tow survey capability on CSS HUDSON capable of handling deep-tow systems with a capacity of up to 6000 meter water depths.

Assistance to PGC

AGC has provided significant assistance to PGC since December 1983 that will continue into 1984 to acquire a second deep-tow winch and cable identical to our previous one by providing the specifications for and arranging for the supply, performance testing, and installation of it on the CFAV ENDEAVOUR by June 1984. This, along with our arranging for the supply by contract of the Columbia University SeaMarc I system to the ship, will enable a four week deep-towing survey to be carried out by PGC staff on the Juan de Fuca Ridge area during June/July 1984.

Ship Track Atlas

An AGC "Ship Track Atlas" covering all the cruises on which marine geoscience data have been collected on BIO ships or by AGC staff covering the period 1963 to late 1983 has been systematically compiled, digitally plotted, and reproduced by commercial printing contract. The 137 cruises covered in the atlas are plotted at a 1 to 10,000,000 mercator scale.

The Atlas will be up-dated yearly with the plans being to release it on the GSC Open File System soon prepare additional Atlas' for each major type of data collected such as seismic data, sidescan sonar data, potential field data and also an Atlas showing location of all Marine Geological samples AGC has collected and/or curated.

Curator

The subdivision has refilled the position of fulltime Curator that has been vacant for a number of years by an internal AGC transfer of Iris Hardy into this position. The amount of data and samples that position. The amount of data and samples that have been collected over the last 20 years is very large and valuable and with the increasing rate of acquisition and requests for data or sample retrieval it has become necessary to commit more resources to this task.

A major task over the next years will be to jointly, with COGLA, plan and justify allocation of funds for a major increase in curation storage space which will be required within the next three to four years.

Data Management Advisory Board

An AGC Data Management Advisory Committee has been officially set up with representatives of all AGC subdivisions to advise the Head, Program Support Subdivision and AGC Management as to future requirements for data management services, relative priorities of requests for services, and any other factors that are or will affect the quantity or quality of Data Management and Curation services provided by the Data Management Section.

Bibliography

A Bibliography of 1,252 documents by AGC authors has been printed in preliminary form. It is indexed by Authors and GSC projects. It was produced with approximately 20 hours work from the Publications Database of AGC. The Database represents perhaps as many months of work by Librarians, programmers, authors and staff. All approved publications are included and earlier publications by authors have, in most cases, been included too. The database has a keyword index from words automatically extracted from abstracts and titles. However, a classification by subject area is being considered too. A final bibliography for public release is being planned for this 1984.

Biostratigraphic File

One of the major working databases, the Biostratigraphic file for subsurface geology, has been widened to support Quaternary study. The Taxonomic dictionary is shown by both groups, and now includes planktonic species and molluscs. Owing to the different nature of sampling and observations, the file for analyses and reporting programs are separate and modified. Quaternary palynologists are now giving data reports within a few weeks, and are able to concentrate on interpretation. The previous observations of other scientists are now available for comparative use.

Georges Bank Work

A striking use of available BIO database software enabled AGC to excell in bibliographic support to studies in the Georges Bank area. The file was kept simple and flexible, and served as a scratch pad for the project Librarian. It enabled

her to produce selected, organized bibliographies at one day's notice, from a potential file of about 1,000 references. What might otherwise have involved co-ordinating three or four people was done as only part of one expert's job.

Memberships on Committees

A. Fricker

University of New Brunswick Computer Science Co-Operative Education Advisory Committee
International Association of System 2000 Users Technical Exchange
Micro Computer Sub-Committee
Atlantic Geoscience Society

I. Hardy

GSC Ad hoc Committee to Study the Baillie Report

D. Heffler

BIO Instrumentation Development Review Committee

M. Hughes

BIO Safety Subcommittee

K. Manchester

BIO Ship Users Committee
Huntec SEABED II Technical Committee
NORDCO Core Development Technical Committee

A. Sherin

BIO Computer Users Advisory Committee
BIO Computer Graphics Subcommittee
Data Management Advisory Committee
GSC Ad hoc Committee to Study the Baillie Report

Personnel Notes

I. Hardy joined the Program Support Subdivision as Curator. Ms. Hardy was in Regional Reconnaissance Subdivision, Atlantic Geoscience Centre before joining us in January 1984.

Attendance at Meeting, Conferences and Courses

A. Fricker

ASTUTE, Austin, Texas
ASTUTE, Montreal, Quebec
AGS Annual Colloquium, Amherst, N.S.
APICS Educational Conference, Charlottetown, PEI

K. Manchester

Polymetallic Sulphides
GAC, May 1983
Seafloor Hydrothermal Studies, May 1983
Review of Juan de Fuca Research, PGC March 1984

A. Sherin

ASTUTE, Montreal, October 1983
GAC, Victoria, May, 1983

Special Talks and Lectures

D. Heffler

RALPH - International Hydraulics Labratory, Holland.

CENTRAL LABORATORIES AND TECHNICAL SERVICES DIVISION

J. A. Maxwell, Director

As in previous years, the Division continued to provide scientific and technical support services to all GSC Divisions except the Atlantic Geoscience Centre, through its Analytical Chemistry, Mineralogy and Technical Services Sections and their associated chemical, atomic absorption spectroscopy, optical emission spectroscopy, X-ray fluorescence (wavelength- and energy-dispersive), X-ray, electron microprobe and scanning electron microscope laboratories, the instrument development shop, the electronics services, and the sample preparation and mineral separation unit.

Again, the Division continued to carry out a concurrent program, as time allowed, of instrument and method development designed to provide the facilities and expertise required to meet the support needs of Branch projects, and to contribute to the national and international body of geoscientific knowledge.

Services were again provided to the Canadian public through the preparation and sale of sets of rocks and minerals, the free mineralogical examination of specimens, and the preparation and publication of guidebooks to Canadian mineral areas as an aid to mineral collectors, and tourism in general.

Highlights of the year's activities are given in the following Section reports.

Membership on Committees

J. A. Maxwell

Branch Management Committee
Branch Offical Languages Coordinator
Canadian Geoscience Coordinator, Canada/Federal Republic of Germany Scientific and Technical Exchange Agreement
Treasury Board Committeeto review EG ESS classification Standards (Departmental Representative)
Departmental Merit Award Committee (Sector Representative)

ANALYTICAL CHEMISTRY SECTION

G. R. Lachance

The various analytical techniques used to provide compositional data range from a number of classical chemical methods for unusual samples to instrumental techniques such as atomic absorption (flame and graphite furnace); infra-red, optical emission (direct reading and photographic), X-ray fluorescence (wavelength and energy dispersive) spectrometry. As much as possible, instruments are programmed to provide a suite of elements automatically with a minimum of operation input. Conversely, some method development must be carried out, often concurrently with request for analyses of materials for which the Section does not have established methods.

Highlights

Mr. Wang Mohui, a visiting scientist from the People's Republic of China, has worked in the chemical laboratory since July 1983. He will transfer to CANMET in July 1984 for the second year of his posting to Canada.

Dr. J.G. Sen Gupta submitted 2 papers (Analysis for rare-earths by atomic absorption) for publication in Talanta. A third paper is awaiting Division approval prior to submission for publication.

Dr. R.M. Rousseau submitted 2 papers (corrections for matrix effects in X-ray fluorescence) for publication in X-ray Spectrometry.

G.R. Lachance presented papers on X-ray fluorescence in Halifax and Chicago.

Attendance at Meetings, Conferences and Courses

G. R. Lachance

Atlantic Provinces Analytical Meeting, Halifax, May.

Society for Applied Spectroscopy, Chicago, U.S.A., May.

X-ray Clinic, SUNY, Albany, U.S.A., June

Membership on Committees

J. G. Sen Gupta

Branch Safety Committee
United Way Campaign Canvasser

J. Watson

Branch Christmas Party Committee
United Way Campaign Canvasser

Manuscripts Submitted

Manuscripts for three papers for outside publication were approved by the Division.

Laboratory Notes

Chemical Laboratories

The analytical services component is now under the supervision of Peter G. Belanger and continued to provide quantitative data for CO_2, H_2O, S, FeO, C, F, Cl on most samples submitted plus Cu, Pb, Zn, Co, Ni, Cr (and on occasion V, Li, Cs) on approximately half of the samples submitted. The development and special analyses component of the Section continued to provide data on a large number of non-routine materials, i.e. sulphides, arsenides, barites, etc. and was often called upon to help with the regular analyses in order to reduce the perennial backlog of samples. The graphite furnace, acquired during 1982-83 for the purposes of extending the range of a number of trace elements to lower concentrations, continues to present problems. While it is more sensitive, it is also much more subject to matrix effects than the regular flame atomic absorption technique.

Optical Emission Spectrographic Laboratory

During the year, a number of less sensitive elements were dropped from method 12C-DR while the practice of reporting results that are the average of three

"shots" was established. This has resulted in improved precision for the constituents reported.

X-ray Fluorescence Laboratory (XRF)

Again the XRF laboratory was plagued with instrument downtime. The wavelength unit due to X-ray tube failure and the energy dispersive unit (4 months) in order to replace the detector and (1 month) to replace the X-ray tube. In spite of the problems the backlog of the X-ray laboratory decreased during the year and would have been almost nil under normal conditions. As part of the development component, R. Rousseau co-authored a paper with Mr. S. Abbey (formerly Head, Analytical Chemistry Section) comparing the "selected laboratories method" proposed by Mr. Abbey, and the "statistical method" proposed by Dr. Rousseau. The paper will be submitted for publication early in FY 1983-84.

Production Statistics FY 1983-84
Number of Samples Processed

	Submitter								
Section	CLTS	Cord	Econ	Prec	RGG	TS	Other	Total	FY-1
Carried over	47	135	1306	893	1068	100	83	3632	2494
Rec'd during FY	41	340	846	730	2283	825	96	5161(1)	5137
Rept'd during FY	88	395	1359	1149	3332	223	118	6664(1)	3999
Carried forward	0	80	793	474	19	702	61	2129	3632
Chem Labs.									
Carried over	36	10	1089	762	1065	100	0	3062	1986
Rec'd during FY	0	340	816	730	1648	825	96	4455(2)	5048
Rept'd during FY	36	270	1354	1181	2694	223	35	5813(2)	3972
Carried forward	0	80	551	291	19	702	61	1704	3062
Optical Spec.									
Carried over	11	96	301	566	330	0	69	1373	1732
Rec'd during FY	41	114	117	513	391	168	35	1379(3)	2082
Rept'd during FY	52	130	202	891	721	168	104	2268(3)	2441
Carried forward	0	80	216	188	0	0	0	484	1373
XRF Lab.									
Carried over	36	135	782	863	816	0	0	2632	1964
Rec'd during FY	0	227	707	708	420	311	96	2469(2)	3754
Rept'd during FY	36	282	1017	1097	1217	311	35	3995(2)	3072
Carried forward	0	80	472	474	19	0	61	1106	2646

(1) includes 520 subsequent cancellations
(2) includes 293 subsequent cancellations
(3) includes 217 subsequent cancellations

Technical Services Section

R. J. Thibedeau

This section is responsible for the design, fabrication, modification and maintenance of equipment in support of Branch laboratory and field projects and operations.

Highlights

Of the many jobs completed by the instrument shop in support of field and laboratory projects, the following items requiring 100 man-hours of shop time or more, all of which were successfully tested, are of particular note:

- a borehole ground water pump tested at the 1000' level;
- diffusion cells with sample and electrode holes;
- modification of aperture assembly for scanning electron microscope;
- abrasion sample preparation device;
- adjustable pistons for lake sediment coring;
- logging system assembly;
- battery housing for density logging;
- cable head assembly, battery housing and mechanical connectors.

Statistics

Instrument Development Shop

Work orders received during 83/84	192
Work orders carried over from 82/83	56
Total on hand during 83/84	248
Cancellations	3
Net amount	245
Work orders completed during 83/84	186
Work orders to be carried into 84/85	59

Electronic Shop

Work orders received during 83/84	24
Work orders carried over from 82/83	10

Total on hand during 83/84..... 34
Work orders completed during 83/84..... 26
Work orders to be carried into 84/85..... 8

Instrument Development Shop-Workload completed by Division:

RGG	27.2%
Prec	16.2
TS	14.4
CLTS	12.6
GID	8.0
Admin	6.0
EG	3.3
ISPG	2.0
DGO	0.1
Emergency repairs and maintenance	10.0

Of the 186 work orders completed by the instrument shop, 46 were for field projects and represented 38.2% of the total manhours for the year.

It should be noted that 564 overtime hours were worked during the fiscal year from October 1983 to March 31, 1984.

Mineralogy Section

A. G. Plant

The Mineralogy Section provides the facilities and expertise for mineralogical studies in support of many Branch projects. These include the specialized fields of X-ray diffraction, crystallography and electron microbeam analysis (electron microprobe and scanning electron microscope). The Section also provides sample preparation and mineral separating services; curation of major collections of rocks, minerals and meteorites; liaison with and assistance to mineral collectors; preparation and sale of rock and mineral collections; and a free service of mineral identification and information for use by the public.

Highlights

429 requisitions for X-ray diffraction, electron microprobe analysis, scanning electron microscopy, petrographic studies and general mineralogy were completed during the year.

A comprehensive study of the ore mineralogy of the Izok Lake deposit, Northwest Territories was completed and included a report on the mineral sources of silver and their distribution in the deposit.

A detailed examination of the mineralogy of gold in drill core selected from 14 holes representative of properties held by Noranda and International Corona in the Hemlo area, Ontario has been completed.

The mineral database of the Systematic Reference Series of the National Mineral Collection is now on-line with CHIN (Canadain Heritage Information Network). The system is managed by the National Museums Corporation and permits access to more than 10 000 records.

Demand for the Prospector's Sets of Rocks and Minerals continued at a high level and sales increased by 10 per cent over 1982-83.

A new electron mocroprobe, equipped with four fully automated wavelength spectrometers an automated stage and a data processing system to provide on-line quantitative analyses was delivered in early March and is currently undergoing acceptance tests. This instrument is a major asset for the Geological Survey of Canada and is expected to provide high quality quantitative mineralogical data in the support of research projects.

Attendance at Meetings, Conferences and Courses

H. G. Ansell

Tenth Annual Rochester Academy of Sciences Mineralogical Symposium, Rochester, New York, April 1983.

GSC Current Activities Forum, Ottawa, January 1984.

Tucson Gem and Mineral Show, Mineralogical Society of America/Friends of Mineralogy Symposium, Tucson, Arizona, February 1984.

EMR Pistol Training Course, February 1984.

PARIS Introductory Training Course, Canadian Heritage Information Network, Ottawa, March 1984.

M. Bonardi

Joint Meeting of Microbeam Analysis Society and Electron Microscopy Society of America, Phoenix, Arizona, August 1983.

R. N. Delabio

X-ray Powder Diffraction Course, State University of New York, Albany, June 20-July 1, 1983.

S. A. Frewen

EMR Rifle and Shotgun Training Course, May 1983.

D. C. Harris

GSC Current Activities Forum, Ottawa, January 1984.

R.K. Herd

Tenth Annual Rochester Academy of Sciences Mineralogical Symposium, Rochester, New York, April 1983.

Geological Association of Canada Newfoundland Section Meeting, St. John's April 1983.

Canadian Micromineral Association Meeting, Brock University, May 1983.

Lunar Planetary Institute Meeting, Ottawa, August 1983.

National Research Council of Canada Associate Committee on Meteorites, Ottawa, October 1983.

GSC Current Activities Forum, Ottawa, January 1984.

Tucson Gem and Mineral Show, Mineral Museums Advisory Council meeting and Mineralogical Society of America/Friends of Mineralogy Symposium, Tucson, Arizona, February 1984.

PARIS Introductory Training Course, Canadian Heritage Information Network, Ottawa, March 1984.

G.M. LeCheminant

GSC Current Activities Forum, Ottawa January 1984.

D. B. Machin

EMR First Aid Course, Ottawa, January 1984.

A. G. Plant

Canada/Federal Republic of Germany Seventh Science and Technology Consultative Meeting, Ottawa, May 1983.

Workshop on sea-floor hydrothermal sulphide deposits at Pacific Geoscience Centre, Sidney, B.C., May 1983.

Geological Association of Canada/Mineralogical Association of Canada Joint Annual Meeting, Victoria, May 1983.

Executive committee meeting of Spectroscopy Society of Canada, Ottawa, June 1983.

Management Development for Research, Managers Course, Touraine, September 26-October 7, 1983.

National Research Council of Canada Associate Committee on Meteorites, Ottawa, October 1983.

Meetings at University of Toronto to monitor progress in the establishment of the Ultra Sensitive Analysis Facility (Isotrace), November 1983 and January 1984.

Organizational meeting on sea-floor hydrothermal sulphite deposits, Pacific Geoscience Centre, Sidney, January 1984.

GSC Current Activities Forum, Ottawa, January 1984.

A. C. Roberts

Joint Committee on Powder Diffraction Standards, Swarthmore, Pennsylvania, October 1983.

A. P. Stenson

Geological Association of Canada/Mineralogical Association of Canada Joint Annual Meeting, Victoria, May 1983.

Meetings of the Executive of the Mineralogical Association of Canada, Victoria (May 1983) and Toronto (October 1983).

Joint Committee on Powder Diffraction Standards, Minerals Subcommittee, Swarthmore, Pennsylvania, October 1983 and March 1984.

D. A. Walker

Scanning Electron Microscopy Conference, Dearborn, Michigan, April 1983.

Membership on Committees

H. G. Ansell

Ad Hoc Committee on Baillie Report on GSC Collections.

Vice-President, Ottawa Valley Mineral Association.

R. G. Gordon

Chairman, Branch Christmas Party Committee.

D. C. Harris

Canadian representative on the Commission on New Minerals and Mineral Names, International Mineralogical Association.

Chairman, Membership Committee, Mineralogical Association of Canada.

R. K. Herd

Chairman, Ad Hoc Committee on Baillie Report on GSC Collections

National Research Council of Canada Associate Committee on Meteorites.

Sub-editor, Economic Geology and Ore Deposits, Mineralogical Abstracts.

A. G. Plant

Steering Committee for establishment of an Ultra Sensitive Analysis Facility (Isotrace) at the University of Toronto.

Past-President, Spectroscopy Society of Canada.

Branch Management Standing Subcommittee on New Technology for Data and Information Acquisition and Processing.

National Research Council of Canada Associate Committee on Meteorites.

A. P. Stenson

Treasurer and member of Finance Committee, Mineralogical Association of Canada.

Member and Mineralogical Association of Canada representative, JCPDS-International Centre for Diffraction Data.

Secretary, Minerals Subcommittee, JCPDS-International Centre for Diffraction Data.

W. U. ter Haar Romeny

Branch Safety Committee.

Special Talks and Lectures

R. K. Herd

"Metamorphic reactions and mineral intergrowths", Canadian Micro Mineral Association, Brock University, St. Catharines, May 1983.

"Mineral reactions in sapphirine/kornerupine-bearing rocks from the Limpopo mobile belt in Zimbabwe" at GSA/MSA Indianapolis and University of Chicago, November 1983.

"Sapphirine/kornerupine-bearing rocks and crustal uplight history of the Limpopo belt, southern Africa" at Precambrian High, GSC, Ottawa, December 1983 and at Harvard University, February 1984.

Manuscripts

Manuscripts for 3 GSC publications and 7 papers for outside journals were approved for publication by the Division.

Laboratory Statistics

X-ray Diffraction and General Mineralogy

X-ray diffraction analyses involved 1168 Debye-Scherrer camera mineral identifications; 3 Gandolfi camera mineral identifications; preparation of 60 reference standard patterns; and use of the X-ray diffractometer to examine clay minerals, fine grained rocks and mineral concentrates for a total of 378 diffractograms, including 108 mineral concentrates. In support of the geochronological research programs, XRD procedures were established using ultrasound disaggregation for the separation of illitic clays from indurated shale and measurement of 'illite crystallinity' from orientated clay slides. Studies of uranium mineral assemblages were completed in support of 5 Branch projects for the Economic Geology and Resource Geophysics and Geochemistry Divisions and included the preparation of 141 radioluxographs and numerous electron microprobe analyses. Mineral identification and mineralogical studies were carried out for research projects in Economic Geology, Precambrian Geology, Cordilleran Geology, Atlantic Geoscience Centre, Institute of Sedimentary and Petroeum Geology and Resource Geophysics and Geochemistry Divisions, and a few from industry.

Mineralogical studies of the ore minerals in the Izok Lake massive sulphide deposit located in the northern part of the Slave structural province in the District of Mackenzie, N.W.T. have been completed. A detailed report has been submitted to Kidd Creek Mines Ltd. for their records and discussions are underway on producing a joint report for outside publication. Mineralogical description of a new mineral, Izoklakeite has been completed and approved by the Commission on New Minerals and Mineral Names, I.M.A.

Mineralogical studies are progressing on the Hemlo gold deposits, Marathon area, Ontario. Detailed examination of the ore minerals in 14 drill holes from the properties of Noranda and Teck Corona International have been completed. The results of the studies have shown that the mineralization is more diversified than in most gold deposits in the world and unusual in that they are enriched in barium, molybdenum, vanadium and locally, in mercury and thallium. The enrichment in arsenic and antimony, however, is comparable to many of the major gold deposits of the Canadian Shield of Archean age.

Research on the mineralogy of the Francon quarry, Montreal, continued and the seventh new species, hochelagaite, from the locality was approved by the Commission on New Minerals and Mineral Names. International Mineralogical Association.

Sample Preparation and Mineral Separation

The productivity of samples prepared for chemical analysis is shown in the following table, together with sub-totals for each Division. This work resulted from 58 requisitions in support of 42 projects.

Productivity of samples prepared for chemical analysis

	PC	EG	RGG	CG	TS	Other	Total
Brought forward from 1982-83	332	10	0	0	0	0	342
Received during 1983-84	474	1538	380	156	195	45	2788
Completed during 1983-84	618	1360	380	143	195	25	2721
Carried forward to 1984-85	188	188	0	13	0	20	409

Sample preparation and mineral separation for geochronology included the following: 27 potassium-argon and 24 rubidium-strontium whole rock samples; 59 zircon, 59 monazite, 47 biotite, 34 amphibole, 9 muscovite and 18 other mineral concentrates. In addition, requisitions were completed for 54 miscellaneous mineral concentrates.

Electron Microbeam Analysis

Analytical studies were provided by the electron microprobe and scanning electron microscope laboratories in support of 35 Branch projects and 6 projects that originated outside of the Branch, and required 3807 hours of instrument time. As in previous years the analytical studies encompassed a very broad range of geological topics and included studies in economic geology, petrology, geochemistry,

sedimentology, mineralogy, paleontology and the nuclear waste disposal program.

In addition to the installation of the new electron microprobe noted in the Highlights, a new energy dispersive detector was installed on the Cambridge S-180 scanning electron microscope which, in combination with the backscattered electron detector, will provide greater versatility for the instrument.

With the assistance of personnel from the Computer Science Centre, further changes and improvements were incorporated into the programs for quantitative analysis of silicates using an energy dispersive spectrometer and the HP 1000 computer. The programs permit greater flexibility during the analytical session and provide final results in a tabulated format. In addition, a more general program for the quantitative analysis of a variety of element matrices was adapted and tested for use on the Cambridge S-180 scanning electron microscope.

Curation of Collections

Curation of the National Collections resulted in the addition of 161 mineral specimens to the Systematic Reference Series of the National Mineral Collection; including 54 species new to the collection, 80 bulk accessions, including 77 to the mineral collection and 2 suites of reference rocks, and two additions to the National Meteorite Collection; including the Wynyard, Saskatchewan, meteorite, the 46th recognized meteorite in Canada. Samples were collected by project personnel from 14 localities in the Yukon, British Columbia, Quebec and Ontario.

The mineral collection database is now on-line with the Canadian Heritage Information Network (CHIN), giving computer access to more than 12 000 records on catalogued specimens, with about 2 000 more ready to be entered.

In support of mineralogical research and reference rock material enquiries, over 250 specimens were selected and provided in response to over 70 requests from Branch personnel, other geoscience institutions, universities and industry. 18 exchanges of specimens were carried out with other institutions, collectors and mineral dealers.

Continuous care was provided for the rock collections at Tunney's Pasture Reference Collection Facility, including receipt of 1983 field collections, a special suite from Cyprus, and numerous retrievals from stored collections. Extensive re-allocation of storage areas at the facilty was begun following the allocation of an additional 4 000 square feet of storage area by Public Works; this will permit easier access to current collections and more secure storage of archival material.

Assistance to the Public

Information provided to the public by the Curatorial Services Unit required the identification of 261 rock and mineral samples, with results being communicated in 34 written and 58 oral reports. Miscellaneous information related to minerals and rocks was provided by telephone or in person on 8 separate occasions.

Enquiries on minerals and mineral occurrences were received by Mrs. Stenson as follows: 27 office visits, 59 telephonecalls and 33 letters. Identifications were provided for 226 specimens.

Preparation of Rock and Mineral Sets

6 622 Prospector's sets of Rocks and Minerals were prepared and shipped during the year, compared to 6 030 in 1982-83. The distribution of these across Canada was as follows:

	1982-83	1983-84
Alberta	769	1353
British Columbia	176	250
Manitoba	123	107
New Brunswick	66	80
Newfoundland	47	44
Nova Scotia	230	332
Northwest Territories	30	136
Ontario	1317	1089
Prince Edward Island	8	25
Quebec	371	548
Saskatchewan	135	392
Yukon	230	190
GSC offices	1825	1496
EMR offices	560	460
Others	143	120

Revenue from the sale of the sets, payable to the Receiver General was $26 488 ($24 245 in 1982-83). Budgetary restraints continued to prevent production of a revised economic collection to replace the 120 specimen collection which was discontinued in February 1982.

Special requests for specimens were filled for: Canadian Unity Information Office, Mobile Exhibit; Information Division, EMR for display at Canadian Pacific Exhibition, Vancouver; CANMET; Minister's office, EMR; Atlantic Geoscience Centre, Dartmouth; and Science North, Sudbury, Ontario. Displays were loaned to the Rock Hound Gemboree, Bancroft, Ontario and to the Musée minéralogique et d'histoire minière, Asbestos, Quebec.

Field work was undertaken at 49 localities in Newfoundland, Nova Scotia, New Brunswick, Ontario and Quebec. The work involved more than 24 000 km of travel and the collection of 23 tons of minerals, rocks, ores and fossils.

CORDILLERAN GEOLOGY DIVISION

R.B. Campbell

The Cordilleran Division is responsible for geological studies in most of the Canadian Cordillera and the adjacent offshore regions. These studies are aimed at increasing the knowledge of the composition, age, distribution and origin of regionally mappable rock units to assess mineral and hydrocarbon potential, to guide mineral exploration and to aid in the planning of the orderly development of land utilization.

The Division includes a Marine Geology Section based at the Pacific Geoscience Centre, Sidney, Vancouver Island. Its scientists carry out stratigraphic, biostratigraphic, sedimentological and structural studies of the Pacific Continental Shelf and adjacent areas with particular emphasis on assessing hydrocarbon potential; seismic and magnetic studies in conjunction with investigations by the Earth Physics Branch to determine the disposition of shallow to deep crustal layers on the Pacific continental shelf and slope; terrain sciences projects dealing with surficial sediments in the offshore areas and geomorphic processes along the coasts to aid in coastal management. Of recent importance are a variety of surveys and research studies of the Juan de Fuca Ridge system. The Vancouver based part of the Division is involved in a broad spectrum of research in those parts of the Cordillera mainly southwest and west of the areas of major hydrocarbon potential. Therefore, emphasis is placed on projects that are important for mineral exploration and assessment. Complementary to a study of Tertiary and recent volcanism is investigation of geothermal sources in the Cordillera. The Division maintains an excellent research library which is open to the public and operates a Sales Office where Departmental publications and maps are available. Gross sales in F/Y 1983-84 were approximately $118,000.

Highlights

Geothermal resource assessment was focussed on three Quaternary volcanic belts. The results of drilling and of resistivity and geochemical surveys have strengthened the conclusion that the Mount Cayley complex in the Garibaldi Volcanic belt is the centre of a high temperature hydrothermal system similar to that at Meager Mountain. Further mapping and isotopic dating adds credence to the concept of the easterly migration of the Anahim Volcanic Belt "hot-spot", additional support is provided by the definition of a magnetotelluric anomaly at the eastern end of the belt in the North Thompson River valley. Chemistry and isotopic composition of thermal water from the Stikine Volcanic belt indicates that the springs are leaking from a high temperature convective system. This combined with research on the petrogenesis of peralkaline rocks and modelling of chemical and isotopic data from Mountain Edziza suggests that a pre-requisite for the formation of these rocks is long residence time in crustal reservoirs. This model has important implcations in respect to potential geothermal energy sources and mineral deposits related to hydrothermal systems in the Stikine and Anahim belts.

Based on careful stratigraphic and paleontologic work the Middle Jurassic to Lower Cretaceous Bowser Lake Group can be subdividied into 3 mappable formations each with recognizable members; hopefully these formations may ultimately be carried through much of the basin which hitherto seemed to defy subdivision. This will have importance in coal exploration now underway. The newly recognized Lower Jurassic Spatsizi Group is a shaly time equivalent of the auriferous Toodoggone volcanics. The shale apparently underlies the Bowser Lake Group and volcanics are restricted to the basin margins. The position of coarse Bathonian clastic rocks along the northern and northeastern margins of the Bowser Basin is demonstrably closely related in time to the development of south and southwesterly directed thrust faults and folds that accompanied uplift of island arc and oceanic rocks along the King Salmon and related faults.

Studies of the Sylvester allochthon, one of a group of allochthons emplaced on rocks of the miogeocline along the length of the Canadian Cordillera, show that emplacement of the allochthon imprinted northeasterly directed structures onto southerly directed structures of the autochthon. The implication, although unprooved, is that the allochthon was emplaced after mid-Jurassic deformation and certainly before mid-Cretaceous plutonism.

Proterozoic strata north of Dawson City, Yukon Territory provide superb evidence of late Proterozoic rifting by north dipping listric normal faults and coincident trough deposition along the ancient continental margin. The region, which features magnificent exposures of relatively mildly deformed rocks is likely to become a classic "type" area in the North American Cordillera.

On the western margin of the Omineca Crystalline Belt in and near the Cariboo Mountains evidence now indicates that three distinctive stratigraphic packages (1. Cariboo-Kaza Groups, 2. Snowshoe Formation, 3. "Quesnellia" from east to west) are tectonically separated from one another and

that previous attempts to correlate stratigraphy from package to package were not meaningful. At least in part the enigmatic Snowshoe Formation may be equivalent to Proterozoic and Paleozoic rocks in the Kootenay Arc to the southeast.

Work in the Penticton and Ashcroft areas has shown that extension tectonics of early Tertiary age was a major structural episode that bears on models of the geological evolution and may be of importance to concepts related to the occurrence of mineral deposits.

Much work in the offshore was focussed on the Juan de Fuca Ridge system because of the recent discovery of hydrothermal vents and related metallic sulphide deposition and because part of the ridge is along a boundary with the United States which also devoted much research effort to the general area. Principal accomplishments included a "SeaBeam" survey (in cooperation with NOAA) from which detailed bathymetric maps were prepared and coverage of several sections of the ridge with a "SeaMark II" side-scan system that produced excellent sonar "pictures" of volcanic and structural features.

Investigation of modern micro-organisms from deep-sea cores from near spreading ridges off the coast have shown foraminiferids and ostracods that are apparently exotic in terms of either large size, tropical affinities, or because they include forms that were thought to have been extinct. Hot hydrothermal vents may be responsible for the existence of this unusual fauna.

Much new data pertaining to the formation of glauconite in recent sediments off the west coast was obtained by a staff scientist through the application of a wide range of analytical equipment at the University of Perpignan in France.

In January, 1984 a "show-and-tell" sponsored by the British Columbia and Yukon Chamber of Mines was shared by the Division with the Geological Branch of the B.C. Ministry and Energy Mines and Petroleum Resources and the DIAND geology group from Whitehorse. The event attracted an audience of 700, mainly from the exploration industry. The Division presented a one day program involving lectures and a program review in the morning and a poster session in the afternoon. The affair was successful and a repeat is planned for January 1985.

Personnel Notes

The Cordilleran Division has 42 full-time employees, 29 at Vancouver and 13 at Pacific Geoscience Centre. At Vancouver there are 15 scientisits and 14 staff in administration, sales office, library and technical support services. In addition, K.M. Dawson of Economic Geology Division and L.E. Jackson and J.J. Clague of Terrain Sciences Division are stationed at Vancouver. At Pacific Geoscience Centre the Pacific Marine Geology Subdivision staff consists of 7 scientists and 6 support and administrative staff. C.J. Yorath is the subdivision head.

Vancouver Office

P.T. Krauss was appointed micropaleontology laboratory technician in May, 1983.

L.E. Jackson of Terrain Sciences Division was transferred from Calgary in August, 1983.

A. Jamieson retired from his post as Administrative Officer in December, 1983. He will be succeeded by K. Wellar in May, 1984.

Pacific Geoscience Centre

Wynn Studsrud resigned her position of Accounts Clerk in July, 1983.

1983-84

Attendance at Meetings, Conferences, Courses

R.B. Campbell

Geological Association of Canada, Annual Meeting, Victoria, B.C., May 11-13, 1983.

Geological Survey of Canada, Current Activities Forum, Ottawa, January 18-19, 1984.

Geology and Exploration Roundup, B.C. and Yukon Chamber of Mines, Vancouver, B.C., January 25-27, 1984.

Cordilleran Workshop, Carleton University, Ottawa, February 10-12, 1984.

Geological Association of Canada, Cordilleran Section, Vancouver, B.C., February 20-21, 1984.

R.G. Currie

American Geophysical Union, Annual Fall Meeting, San Francisco, California, December 5-10, 1983.

G.H. Eisbacher

Geological Association of Canada, Victoria, May 1983.

H. Gabrielse

Geological Association of Canada, Annual Meeting, Victoria, B.C., May 11-13, 1983.

Geological Society of America, Annual Meeting, Indianapolis, Oct. 31-Nov. 3, 1983.

Short Course - Carbonate Facies Models Geological Association of Canada, Vancouver, November 17, 1983.

Cordilleran Workshop - Carleton University, Ottawa, Ontario, February 10-12, 1984.

Short Course - Structural Geology of Stratiform lead-zinc deposits, Geological Association of Canada, Vancouver, February 17, 1984.

Geological Association of Canada, Cordilleran Section Meeting, Vancouver, B.C., February 20-21.

S.P. Gordey

GAC-MAC-CGU Joint Annual Meeting, Victoria, May 11-13, 1983.

Alaska Geological Society Symposium (New Developments in the Paleozoic Geology of Alaska and the Yukon), Anchorage, Alaska, April 22, 1983.

Belt Symposium, Missoula, Montana, October 9-14, 1983.

Mineral Deposits of the Northern Cordillera, Yukon Geoscience Forum, Whitehorse, Yukon, December 5-7, 1983.

Cordilleran Section, Geologial Association of Canada, Short Course #2, Structural Geology by K.R. McClay, Vancouver, February 19, 1984.

Cordilleran Section, Geological Association of Canada, Annual Symposium (Cordilleran Geology and Mineral Exploration Status and Future Trends), Vancouver, February 20-21, 1984.

Cordilleran Section, Geological Association of Canada, Short Course #3, Application of Geothermal Research to Mineral Exploration and Ore Genesis, Vancouver, February 29, 1984.

Lithoprobe Workshop, Toronto, Ontario, March 10-12, 1984.

T.S. Hamilton

"Energy Mines and Resources Workshop on Seafloor Hydrothermal Studies in the Juan de Fuca - Explorer Ridge Areas of Canada" , Pacific Geoscience Centre, May 9-10, 1983.

Workshop on Spreading Centers of the North East Pacific, University of Washington, Seattle, April 30 - May 1, 1983.

Geological Association of Canada, Annual Meeting, Victoria, May 11-13, 1984.

P. McLaren

Departmental committee on Ocean Mining (DCOM), Ottawa, January 11-14, 1983.

1983 Oil Spill Conference, San Antonio, Texas, Febrary 28-March 3, 1983.

Geological Association of Canada, Annual Meeting, Victoria, May 11-13, 1984.

Coastal Mapping Workshop, PGC, Sidney, May 16-17,1984.

Canadian Coastal Sediment Study (C^2S^2), NRC, Ottawa, July 18, 1983.

J.W.H. Monger

Geological Association of Canada, Annual Meeting, Victoria, May 11-13,1983

Geological Society of America, Indianapolis, Oct. 31 - Nov. 3, 1983.

Geological Association of Canada, Cordilleran Section Meeting, Vancouver, February 20-21, 1984.

Geological Association of Canada, Victoria, May 11-13, 1983.

B.C. Chamber of Mines Meeting, Vancouver, January 25-27, 1984.

Pacific Northwest Regional Meeting of American, Geophysical Union, Bellingham, Washington, Sept. 29 - Oct. 1, 1983.

M.J. Orchard

Geological Society of America, North-Central Section, Wisconsin, April 28-29, 1983.

Geological Society of America, Rocky Mountains - Cordilleran Section, Salt Lake City, May 2-4, 1983.

Geological Association of Canada, Annual Meeting, Victoria, B.C., May 11-13, 1983.

Geological Association of Canada, Cordilleran Section Meeting, Vancouver, Feb. 20-21, 1984.

J.A. Roddick

Geological Association of Canada, Annual Meeting, Victoria, May 11-13, 1983.

Geology and Mineral Resources of Thailand and Organizational Meeting, IGCP, Project 220 on tin/tungsten granites in southeast Asia and the western Pacific Region, Bangkok, Thailand, Nov. 19-30, 1983.

Expo 86, First Symposium, Vancouver, January 5-6, 1984.

Fortune Users Group Meeting, Stanford University, Palo Alto, California, January 19, 1984.

Geological Association of Canada, Cordilleran Meeting, Vancouver, February 20-21, 1984.

J.G. Souther

Geological Association of Canada, Annual Meeting, Victoria, May 11-13, 1983.

Geological Association of Canada, Cordilleran Section Symposium, Vancouver, February 20-21.

Canadian Geothermal Resources Association, General Meeting and Technical Session, Vancouver, March 9, 1984.

L.C. Struik

Geology and Exploration Roundup, B.C. and Yukon Chamber of Mines, Vancouver, January 25-27, 1984.

Cordilleran Workshop, Carleton University, Ottawa, February 10-11, 1984.

Geological Association of Canada, Cordilleran Section, February 20-21, 1984.

Structure short course of Geological Association of Canada, Cordilleran Section by Ken McClay, February 19, 1984.

D. Tempelman-Kluit

Geological Association of Canada, Annual Meeting, Victoria, May 11-13, 1983.

Geology and Exploration Roundup, B.C. and Yukon Chamber of Mines, Vancouver, B.C. January 25-27, 1984.

Geological Association of Canada, Cordilleran Section Symposium, February 20-21, 1984.

R.I. Thompson

CSPG National Liason Committee Meeting, Calgary, November, 1983.

GAC Cordilleran Section Short Courses: 1. Carbonate Sedimentology for the Mineral Explorationist; November 17, 1983; 2. Structural Geology applied to the interpretation of Shale Hosted Base Metal Deposits, February 19, 1984; 3. Application of Geothermal Research to Mineral Exploration and ore Genesis, Vancouver, February 29, 1984.

GAC Cordilleran Section Symposium - Cordilleran Geology and Exploration: Status and Future Trends, Vancouver, February 20-21, 1984.

Lithoprobe Workshop - University of Toronto, March 10-12, 1984.

GAC National Meeting - Victoria, May 11-13, 1983.

H.W.T. Tipper

Geology and Exploration Roundup, B.C. and Yukon Chamber of Mines, Vancouver, January 25-27, 1984.

J.O. Wheeler

LITHOPROBE Steering Committee Meeting, Ottawa, May 5, 1983.

Canadian Geoscience Council Meeting (presented report on LITHOPROBE) Victoria, May 10, 1983.

Geological Association of Canada, Annual Meeting, Victoria, B.C. May 11-13, 1983.

Geological Society of America Centennial Project Steering Committee Meetings, Boulder, Colorado, May 17, 1983.

Geological Society of America, Annual Meeting, Indianapolis, November 1, 1983.

NSERC Strategic Grants Review Panel, Ottawa, June 2, and September 19-23, 1984.

LITHOPROBE Steering Committee Meeting, Ottawa, January 13, 1984.

NSERC Strategic Grants Committee Meeting, Ottawa, January 24, 1984.

Geological Association of Canada, Cordilleran Section, Annual Symposium, Vancouver, B.C., February 20-21, 1984.

LITHOPROBE Workshop and Steering Committee Meeting, Toronto, March 10-13, 1984.

G.J. Woodsworth

Geological Association of Canada, Annual Meeting, Victoria, B.C., May 11-13, 1983.

Geological Association of Canada, Cordilleran Section, Symposium, Feb. 1984.

Annual Meeting, Canadian Permanent Committee on Geographic Names, Ottawa, October 1983.

C.J. Yorath

Geological Association of Canada, Annual Meeting, Victoria, B.C., May 1983.

Current Activities Forum, Geological Survey of Canada, Ottawa, January, 1984.

Western Inter-University Geological Convention, Calgary, Alberta, January 1984.

Membership on Committees

R.B. Campbell

British Columbia and Yukon Chamber of Mines, Board Member.

R.G. Currie

DNAG Magnetic Anomaly Map Compilation Committee - Northeast Pacific Quadrant.

H. Gabrielse

Councilor, Geological Society of America, Term ended Nov. 1984.

Member, Education and Research Committee, Structure and Tectonics Division, Geological Society of America.

S.P. Gordey

B.C. and Yukon Chamber of Mines Safety Committee - member.

T.S. Hamilton

G.S.C. Representative to IOS Library Committee.

J.L. Luternauer

Scientific advisor to Federal, Provinical, Vancouver Municipal committees/study groups relating to A. Environmental impacts and route selection for proposed Vancouver Island gas pipeline and Iona Island Sewage Plant proposed pipeline across Fraser River Delta tidal faults and slope; B. Mechanisms and environmental impact of Fraser River Delta tidal flat erosion induced by major port development.

P. McLaren

International Geological Correlation Program (IGCP) - sea level changes.

Departmental Committee on Ocean Mining (DCOM).

J.W.H. Monger

Council of Geological Society of America.

Vice-Chairman, Working Group 2 "Phanerozoic Plate Motions and Orogenesis" of Inter-Union Commission on the Lithosphere.

Associate Editor, Canadian Journal of Earth Sciences.

J.A. Roddick

Editor, Internation Geological Correlations Project 220, Tin/Tungsten, Granites in Southeast Asia and Western Pacific Region.

J.G. Souther

Vice chariman and director of Canadian Geothermal Resources Association.

Member, Earthquake Prediction Evaluation Committee-organization.

Subproject manager, EMR Geothermal Research Program.

Associate Editor, Geological Society of America, Bulletin.

L.C. Struik

Member Library Committee Geological Survey of Canada, Cordilleran Division.

J.O. Wheeler

GSA Centennial Project Steering Committee LITHOPROBE Steering Committe (Chairman, 1982-84).

NSERC Strategic Grants Review Panel (Open) 1981-84 (Chairman, 1983-84.

G.J. Woodsworth

Canadian Permanent Committee on Geographic Names, member.

Advisory Committee on Glaciological and Alpine Nomenclature, member.

Program Committee, Geological Association of Canada, Annual Meeting 1983, member.

C.J. Yorath

Marine Geoscience Committee - Canadian Geoscience Council.

Technical Programme Chairman - GAC/MAC/CGU Annual Meeting, Victoria, B.C.

Canadian Committee on the Dynamics and Evolution of the Lithosphere.

Lithoprobe Phase 1 Investigation Team.

Management Committee - Pacific Geoscience Centre.

Special Talks or Lectures

B. Bornhold

"Surficial Geology on the Vancouver Island Continental Shelf", Univeristy of Victoria, Department of Physics.

R.B. Campbell

"Terrains of the Saint Elias Mountains" Geological Association of Canada, Annual Meeting, Victoria, B.C., May 11-13, 1983.

Introduction and Program Review, Geology and Exploration Roundup, B.C. and Yukon Chamber of Mines, Jauary 25-27, 1984.

R.G. Currie

"Viscous Remanent Magnetization and the offshore magnetic anomaly of the Leech River and Survey Mountain faults", GAC Annual Meeting, May 11-13, 1984, Victoria, B.C. (with J.M. Gilliland, W.T. Macfarlan & R.G. Currie)

"Cooperative systematic surveys over the northern Juan de Fuca Ridge system, 1983: a progress report", DNAGU, Bellingham, Washington, Sept. 30-Oct. 1, 1983. (with R.G. Currie, E.E. Davis, S. Hammond, D.M. Hussong, J.L. Karsten, A. Malahoff, R.P. Riddihough, D.A. Seemann)

"Bathymetric and hydrothermal characterization of the northermost Juan de Fuca Ridge", AGU, Fall Meeting, San Francisco, California, Dec. 5-10, 1983. (with S.R. Hammond, J. Karsten, E.E. Davis, R.G. Currie and A. Malahoff)

"High attitude side-scan imagery over the northern Juan de Fuca Ridge", AGU, Fall Meeting, San Francisco, California, Dec. 5-10, 1983. (with E.E. Davis, R.G. Currie, D. Hussong, V. Renard & J. Kosalos)

"Marine Geological and Geophysical Research at the Pacific Geoscience Centre", B.C. Yukon Chamber of Mines, Annual Meeting, Vancouver, B.C., January 25, 1984.

H. Gabrielse

"Anatomy of the Canadian Cordillera", Geological Association of Canada, Annual Meeting, Victoria, May 1983.

"The Omineca Crystalline Belt of the Canadian Cordillera: A Jurassic Megashear Zone", Geological Association of Canada, Annual Meeting, May 1983.

"Strike-slip faulting in north-central British Columbia", Pacific Geoscience Centre, November, 1983.

"Mid to Late Jurassic terrane collisions in north-central B.C." Cordilleran Workshop, Carleton University, Ottawa, February 1984 and Queen's University, February 1984.

S.P. Gordey

"The Selwyn Basin - What is it?", Alaska Geological Society Symposium, April 22, 1983, Anchorage, Alaska.

"What does a geologist do?"; a talk and discussion with Geography 12 class at Richmond Senior Secondary School, Dec. 12, 1983 as part of the school's 'Career Week'.

"The Canol Corridor", Lithoprobe Workshop, March 10-12, 1984, Toronto, Ontario.

T.S. Hamilton

"One Atmosphere Melting and Crystallization Experiments on level Mountain Lavas: Implications for the Petrogenesis of the Basalt-Comendite Suite" (w/C.M. Scarfe).

"Late Quaternary Sea Floor Displacement in the Strait of Georgia" (w/J. Luternauer).

"Speculations on the relationship of Seismicity and Volcanism in the southern half of the Canadian Cordillera" (w/D. Weichert) Geological Association of Canada, Annual Meeting, Victoria, 1984.

J.L. Luternauer

"Evolution and present sedimentary processes - Fraser River Delta, B.C.", Geography Department, Simon Fraser University.

"Sedimentation on the Stikine River Delta", Canadian Coastal Conference, Vancouver (w/L. Cuypers).

"Eviedence of Instability - Strait of Georgia, B.C." - GAC/MAC, Victoria, (w/T. Hamilton).

P. McLaren

"Sediment Trends on Shelves" Geological Association of Canada, Annual Meeting, Victoria, May 11-13.

Chaired the "Coastal Mapping Workshop", PGC, May 16-17.

"The mathematics of grain size distributons", presented to USGS, Denver, Colorado, May 19.

J.W.H. Monger

"Terrane accretion and Cordilleran Mountain Building", Geological Association of Canada, Annual Meeting.

"Evolution of the eastern Coast Mountains, near Lillooet, southwestern British Columbia", A.G.U. (with P. Van der Heyden, J.F. Mustard).

M.J. Orchard

"The distribution of conodonts in tectonostratigraphic terranes of Western Canada", Geological Society of America, Symposium on Suspect Terranes, April 1983.

"The conodont record in the terranes of Western Canada", Geological Association of Canada, Symposium on Suspect Terranes, May 1983.

"Conodont and their application in the Western Cordillera", Lecture at U.B.C., March 1984.

J.G. Souther

"Cenozoic volcanism and tectonics of the Cordillera", U.B.C. Seminar.

L.C. Struik

"Terrains of the Cariboo Mountains", Geology and Exploration Roundup, B.C. and Yukon Chamber of Mines, Vancouver, January 25-27, 1984.

D.J. Templeman-Kluit

"Counterparts of Alaskan Terranes in Yukon", Geological Association of Canada, Cordilleran Section Symposium, Vancouver, Feb. 10-12, 1984.

"Evolution of northern Canadian Cordillera and a collision model for Yukon", UBC, noon hour lecture.

"Ideas for the evolution of Okanagan Valley as an extension fault zone and relation to gold mineralization", Geology and Exploration Roundup, B.C. Yukon Chamber of Mines, Vancouver, January 25-27, 1984.

R.I. Thompson

"Late Proterozoic Rift Assemblages, West Central Yukon", Geology Department, University of British Columbia, November 1983.

"Geology and Mineral Occurrences in Dawson map area, Yukon", Geology and Exploration Roundup, B.C. & Yukon Chamber of Mines, Vancouver, January 25-27, 1984.

J.O. Wheeler

"Convenor - Symposium on Marine Geosicence in Canada", Geological Association of Canada, Annual Meeting, Victoria, B.C., May 13, 1983.

"Columbian and Pacific Orogens Revisited", Geological Association of Canada, Cordilleran Section Symposium, Vancouver, B.C., February 10-12.

"Omineca Crystalline Belt", University of British Columbia, March 16, 1984.

G.J. Woodsworth

"Mesozoic History of Coast Mountains", U.B.C, March 1984.
"Evolution of the Coast Plutonic Complex", invited talk at PGC, February 1984.

"Maps and names in the Coast Mountains", Learned Societies Conference, U.B.C., June 1983.

C.J. Yorath

"Subsidence and thermal history of Queen Charlotte Basin", Geological Association of Canada, Annual Meeting, Victoria, May 1983.

"Subsidence and thermal history of Queen Charlotte Basin", Western Inter University Geological Convention, Calgary, January 1984.

"Exploring the Juan de Fuca Ridge System", Geological Survey of Canada, Current Activies Forum, Ottawa, January 1984.

ECONOMIC GEOLOGY DIVISION

D.C. Findlay, Director

The Division has four main responsibilities:

1. To maintain a national information base on the nature, distribution and geological characteristics of Canada's non-hydrocarbon mineral resources;
2. To conduct research into the mechanisms of formation of mineral deposits;
3. To interpret the relationships of mineral deposits to the geological characteristics of Canada's principal geographic and geological regions;
4. To provide, through the integration of the results of 1 to 3 above, guidelines and models for use by the Canadian exploration industry and input to government policies in resource management and land-use planning activities.

Divisional activities directed at carrying out its responsibilities include:

1. The continuing investigation through field and laboratory studies of mineral deposits in all regions of Canada, with particular focus on major metal commodities such as copper, nickel, lead-zinc, gold, silver, iron, molybdenum and uranium, coupled with special investigations of other commodities such as tin, tungsten, chromium, platinum-group metals and rare-earth metals as strategic and economic priorities dictate;
2. The development and maintenance of national information files, both manual and computerized, on Canadian mineral deposits and mineral deposit types. As a part of the national data base the Division maintains and curates the Economic Geology Research Collections, an extensive collection of ore and host rock samples representing a wide variety of Canadian mineral deposits and localities, as well as reference materials from foreign deposits.
3. The application of specialized research techniques such as isotope studies, computer simulations and mathematical and statistical correlation methods as aids to the interpretation of ore-forming mechanisms;
5. The development and application of methods, including mathematical methods, to evaluate the potential of various geological regions to contain undiscovered mineral resources.

In all of these activities, interaction and cooperation with scientists in industry, the universities, other federal and provincial agencies is an important continuing component.

An October 1983 reorganization of the Division resulted in formation of the following operational groups: Mineral Deposits Geology Section, Regional Mineral Resource Assessment Section (new), Regional Metallogenic Studies Section (new), Mathematical Applications in Geology Section, Mineral Resource Information Service, and a Divisional Headquarters and Special Projects unit.

The Mineral Deposits Geology Section conducts national commodity studies and research on the genesis of mineral deposits (activities 1 and in part 3, above). The Regional Mineral Resource Assessment Section (including the former Uranium Resource Evaluation Section) conducts investigations of uranium deposit types and is responsible for regular appraisals of Canadian uranium and thorium resources additional to reserves for EMR-URAG (Uranium Resource Assessment Group) requirements. The Section also carries out multicommodity (deposit type) assessments as input to the interdepartmental (EMR-DINA-DOE) Northern Mineral and Energy Resource Assessment (MERA) process for evaluation of proposed national parks, ecological reserves and northern land use planning regions (parts of activities 1, 2, 4 and 5, above). The Regional Metallogenic Studies Section conducts investigations and interpretations of mineral deposits in regional (geographic and geological) settings (activity 4). The Mathematical Applications in Geology Section develops and applies methods for the quantification and statistical treatment of geoscience data in support of various projects throughout the Geological Survey. Within the Division its principal responsibility is the development and application of mathematical methods in resource evaluation (activity 5 and in part 3, above). The Mineral Resource Information Service Section is responsible for the construction, maintenance and assessing of the Division's computerized national mineral deposit index file (CANMINDEX) as well as other special purpose information files (parts of activity 2, above). It also provides computer-generated information bases for use in regional resource evaluation studies (activity 5). The Special Projects Unit undertakes responsibilities for a variety of divisional, branch and interbranch matters, including ocean mineral resources, curation of division reference collections, and the geology of Canadian iron and manganese deposits.

At the end of the report period the Division staff comprised the Director, 25 Research Scientists, 16 Physical Scientists (including 3 term employees) and 7 administrative and technical support personnel.

The Division supported 11 EMR Research Agreements, 6 outside research contracts and one post-doctoral fellowship in 1983-84.

Highlights
(Division Summary)

Highlights of the year's work for each of the Division Sections are presented under the relevant headings on the following pages. However, it should be noted that administrative Section boundaries tend to be ignored in interdisciplinary responses to both internal and external projects and demands. Examples as highlighted in the Section reports include the regional mineral resource appraisals, the application of statistical and mathematical methods and computer simulations to a variety of geoscientific problems, and the generation of

projects for federal-provincial cooperative programs (ERDAS).

Mineral deposit-related geoscience projects were designed for federal delivery under ERDA's (Economic Research and Development Agreements) in several provinces (Manitoba, Ontario, Saskatchewan, Quebec) as well as for federal initiatives in two provinces (Ontario, Quebec) that are independent of the ERDA process. The latter involved input for federal programs in Gaspe and Eastern Townships in Quebec and for STAMP (Sudbury-Timmins-Algoma Minerals Program) in Ontario.

Division staff have contributed actively to international projects such as ISMI (International Strategic Minerals Inventory) and the resultant ISMI reports in press on world-class chromium, manganese and nickel deposits; IGCP Projects 60 (Correlation of Caledonian Stratabound Sulphide Deposits), 148 (Quantitative Biostratigraphic Methods) 187 (Siliceous Deposits on the Seafloor), and 91 (Metallogeny of the Precambrian). Three scientists were involved in a UNESCO-COGEODATA planning meeting in Paris for a 10-year project on global models for mineral deposits and Third World technology transfer. Two Division Scientists participated in a 4-week exchange visit to the Peoples Republic of China where field examinations were made of major porphyry copper, tungsten and niobium-tantalum deposits.

In March preparations were made to accommodate the merger of the Analytical Chemistry and Mineralogy Sections of Central Laboratories and Technical Services Division within a new Division to be called Economic Geology and Mineralogy, effective April 1, 1984.

Personnel Notes

Dr. F.D. Anderson continued to provide valuable service and advice on a part-time (post-retirement) basis as Assistant Director.

C.R. McLeod was appointed Assistant (Acting) to the Director in October.

Mineral Deposits Geology Section
J.M. Duke

The major objectives of the Section are to develop and maintain mineral deposits expertise on a national basis and contribute to the success of exploration efforts by the mineral industry. These are accomplished by

a) acquiring and synthesizing data on Canadian mineral deposit types, other than uranium, so that their common characteristics and critical differences are more fully appreciated, and

b) developing and improving genetic models for major deposit types, and testing these models by further observation and research.

Highlights

Studies of volcanogenic sulphide deposits in Cyprus are being undertaken in conjunction with the International Crustal Research Drilling Group program on the Troodos ophiolite complex. Research on the relatively pristine Cyprus deposits is expected to contribute to the understanding of the origin of Canadian massive sulphide deposits. Important results reported during the year include the observation that ore deposition occurred both by the accumulation of large amounts of particulate sulphide as well as by open space filling in the porous and fractured sulphide mound so-formed, that copper in the upper part of the Mathiati orebody was deposited from oxidized groundwaters which circulated through underlying lavas, and that the individual sulphide deposits in Cyprus have been affected by at least four different hydrodynamic regimes.

Petrographic studies of the sandstone-hosted Yava lead deposit in Nova Scotia have shown that the distribution of lead is related to the grain size of the sandstone host rock, the composition of clay minerals, the distribution of secondary silica, and the occurrence of silicified coal.

Ongoing research on porphyry-type copper and molybdenum deposits has led to the conclusion that the metal contents of the deposits are largely a function of the magma composition of the host intrusion and therefore of its tectonic setting. This is contrary to the view that the metal ratios in such deposits reflect the local environment of ore deposition.

Studies of the Buchans polymetallic sulphide deposits in Newfoundland were carried out under contract as part of the Canada-Newfoundland Cooperative Mineral Agreement. Examination of the MacLean channel deposits has led to estimates of the paleoslopes and yield strengths of the subaqueous sulphide debris flows that were the major transport mechanism of the ores. These data may in turn be used to predict the location of the other debris flow sulphide deposits. Investigation of the Skidder prospect showed that unlike the other Buchans deposits, it has more in common with massive sulphide deposits associated with ophiolite successions than with Kuroko-type ores.

Studies of gold deposits hosted by iron formation indicate that different processes were responsible for the deposition of gold at Contwoyto Lake, NWT and at Geralton, Ontario. The ore at the Lupin Mine at Contwoyto Lake contains a significant proportion of syngenetic gold whereas deposits at Geralton contain only epigenetic gold.

A publication which reviews the classification, grade and size characteristics of 328 Canadian lead-zinc deposits was completed during the year.

Section personnel made important contributions to a short course on sediment-hosted stratiform lead-zinc deposits which was sponsored by the Mineralogical Association of Canada. One officer served as the course organizer and editor of the published handbook whilst another contributed to the volume an important paper which reviewed the chemical parameters controlling the origin and deposition of such deposits.

A study of the mineralogy and geochemistry of ultramafic rocks of the Malartic Group, northwestern Quebec was completed. Although the primary composition of these rocks has been altered by secondary processes, the evidence indicates that sulphide

saturation of the magma was not limited to the immediate vicinity of the one known nickel deposit. This suggests that other nickel sulphide deposits may occur within this suite of rocks.

Lead isotopic studies of galena and telluride minerals from Superior Province gold deposits indicate distinct age classes. A few deposits appear to be essentially synvolcanic with model ages of 2708 to 2740 Ma, but many have model ages in the range of 2656 to 2700 Ma and are therefore probably syn- to late tectonic. A few deposits have yielded model ages of 2800 to 3000 Ma. Lead isotope analyses of galenas are proving to be a useful means of identifying older terranes in advance of more precise, but slower and more costly zircon-uranium-lead geochronology.

Lead isotopic compositions of volcanogenic massive sulphide deposits in the Central Mobile Belt of Newfoundland have been studied in conjunction with the Newfoundland Department of Mines and Energy. The compositions reflect the proportions of mafic and felsic rocks in the host successions, and suggest a previously unsuspected relationship between volcanic rocks in the Notre Dame Bay area of Newfoundland and the Ascot-Weedon belt in the Eastern Townships of Quebec.

Mineral Deposits Laboratory
R.D. Lancaster

The Mineral Deposits Laboratory prepares specimens for study, provides facilities for microscopy, photomicrography, particularly with regard to opaque minerals, and for special mineral separations in preparation for analyses. Its services are available to all Divisions.

Specimens are slabbed (sawn) for three main purposes: to provide a flat, fresh surface for examination, to divide the sample for various further uses, e.g. chemical analysis, and as a step toward further preparation, e.g. by polishing.

Preparation of polished sections involves cutting, mounting, grinding, impregnation and regrinding and three stages of machine polishing of the ground surfaces. Sections are polished for conventional ore microscopy and for electron microprobe studies.

Production statistics for the year were:

Specimens slabbed for:

Economic Geology	3058
Resource Geophysics and Geochemistry	519
Central Laboratories and Technical Services	307
Precambrian Geology	179
Terrain Sciences	424
Total	4487

Specimens slabbed and polished for:

Economic Geology	628
Resource Geophysics and Geochemistry	378
Central Laboratories and Technical Services	1
Precambrian Geology	2
Total	1009

Polished sections prepared for:

Economic Geology	394
Resource Geophysics and Geochemistry	111
Central Laboratories and Technical Services	137
Precambrian Geology	2
Total	644

Mineral separations for:

Economic Geology	549
Resource Geophysics and Geochemistry	67
Total	616

Personnel Notes

A. Galley, D. Power-Fardy, P. Vaillancourt, and A. Heagy provided term support in the Section for parts of the year.

H. Jamieson began a Post-Doctoral Fellowship with the Section in June.

REGIONAL MINERAL RESOURCE ASSESSMENT SECTION
V. Ruzicka

The Regional Mineral Resource Assessment Section conducts non-renewable resource assessment studies of specific areas. These studies include resource appraisals of uranium-bearing areas and deposits and assessments of mineral resource potential for land use planning activities including national parks and other conservation areas. The assessments are based on regional metallogeny as well as on local studies of mineral deposits and their geological environments.

The uranium resource evaluation component encompasses a range from inferred extensions of reserves in identified deposits to prognosticated and speculative resources of less-explored areas. The assessment is conducted biennially in cooperation with industry, the provinces, the Department of Indian Affairs and Northern Development, CANMET (Canada Centre for Mineral and Energy Technology) and Uranium and Nuclear Energy Branch of Energy, Mines and Resources. The regular reports are submitted to the Uranium Resource Appraisal Group and used as an input to the management of Canada's uranium and nuclear energy policy.

The mineral resource assessments of northern areas encompass qualitative ratings of resource potential for mineral commodities in selected areas based on probabilities of their occurrence. The reports contain appropriate recommendations concerning land use planning for governmental organizations and other interested users including the general public.

In addition the Section participates in integrated metallogenic studies of specific geological ore-bearing environments, where its members have special expertise.

Highlights

The biennial appraisal of Canada's uranium and thorium Estimated Additional Resources (i.e. resources in the inferred and prognosticated categories) as of December 31, 1982 was completed for incorporation in the EMR publication "Uranium in Canada; 1982

Assessment of Supply and Requirements" (Report EP 83-3). An analysis of exploration activities and expenditures for uranium in Canada in 1982 was carried out and newly discovered deposits in Saskatchewan, Quebec and Nova Scotia were evaluated.

Work is in progress for a new edition of Geology of Uranium and Thorium Occurrences of Canada. Scheduled for completion in 1986, it will be published as a five-volume series.

Regional mineral resource appraisal work, required particularly in nothern Canada as input for planning of National Parks and other land use initiatives was continued in a number of areas. Reports were prepared on appraisals of (1) the proposed Bylot Island-Borden Peninsula National park area (North Baffin Rift zone); (2) the proposed East Arm Artillery Lake National park area where field work in 1983 discovered base metal mineralization, substantially changing the assessment of potential for mineral resources; and (3) the Mount Sedgwick area of the proposed Northern Yukon National Park (a Phase II follow-up appraisal). The assessment project completed early in the year on the Bathurst Inlet Region, NWT resulted in major changes to the plan to introduce a National Park in the Inlet area.

Office studies were begun for resource assessments of Banks and western Victoria Islands preparatory to 1984 field investigations.

Personnel Notes

Dr. C.W. Jefferson joined the Section on October 1, 1983 as Research Scientist responsible for studies of mineral resource potential in northern areas along with Dr. R.F. Jon Scoates. He also participates in integrated metallogenic studies of sediment-hosted mineral deposits. His previous activities include geological work for Cyprus Anvil and Canamax Resources Incorporated.

Dr. R.F. Jon Scoates joined the Section on November 15, 1983 as Research Scientist responsible for nonrenewable resource assesment studies in northern areas and for metallogenic studies of ultramafic and mafic rocks. He brought to the Section extensive experience from his previous assignments with the Manitoba Geological Survey.

M. St-Martin served as a term support geologist for the Section for part of the year.

Regional Metallogenic Studies Section
S.M. Roscoe

The Section objective is to carry out areally focussed investigations of the distribution of different types of mineral concentrations in terms of their relationships to geologic histories of distinctive domains within major tectonic units throughout Canada. These are required for:

(1) elucidations of the economic significance of features outlined in other geological publications;

(2) selection of desirable foci for geological mapping and other work;

(3) critical tests of alternate genetic hypotheses for the formation of mineral deposits, leading to refinements of conceptual models used in exploration;

and

(4) evaluations of mineral resource potential in designated areas.

Extensive field work and laboratory studies are required to:

(1) establish the characteristics of known mineral deposits;

(2) distinguish geological and other features that are genetically associated with the deposits from those that are merely coincidentally associated;

and

(3) seek documentation of occurrences of the most critical features in areas where related mineral deposits have yet to be discovered.

Highlights

The Booth River mafic complex was outlined along a 10 km length of the northwest flanks of the Burnside River synclinorium and similar rocks were found 50 km to the south along a 20 km length on the south-east flank. Mafic and anorthositic norite contains ilmenite - and magnetic-rich layers and minor pyrrhotite-bearing lenses that dip inward toward the centre of the synclinorium. Monzonite that forms the uppermost part of the sequence in the southern section was sampled in detail. A noritic intrusion in NTS 76K/12 contains layers with abundant to massive ilmenite.

A joint project with the USGS was completed to examine the composition and structure of the sulphide-bearing core of the southern Juan de Fuca ridge. Over 35,000 photographs, combined with 12 successful lowerings of the drill, enabled the definition of an unusual sea-floor structure. The axial zone associated with hydrothermal activity is composed of sheet flows, each of which is 6-10 cm thick and supported on basalt pillars. Individual sheets are separated by 1-2 m of void space, and are thought to represent the top and bottom of a drained-out sheet flow.

A major new Canadian project to study all aspects of the seafloor structure, hydrothermal activity and sedimentary geochemistry was initiated jointly with scientists from PGC and other divisions of GSC. Scientists from the EG and RGG divisions will have principal responsibility for studying the sulphide materials and related hydrothermal projects.

A joint program with scientists from the Republic of France to study hydrothermal activity and products associated with off-axis seamounts at 13° N on the East Pacific Rise resulted in several new discoveries, including a large, Cyprus-like massive sulphide deposit, and extensive manganese crusts. Off-axis hydrothermal activity seems to be predominantly of a low-temperature variety.

Sheelite-bearing calcic skarn assemblages in the Silence Lake tungsten skarn, Clearwater, B.C., reflect both the inhomogeneities in a pelite/carbonate protolith and the varying metasomatic influences of two plutons of Cretaceous and Early Tertiary age, the latter rich in SiO_2 and W.

Studies of the distribution and geological associations of barite in Cordilleran terranes indicate that the three principal types of barite deposits in the northern Canadian Cordillera are

(1) stratiform exhalative baritites hosted by Devonian-Mississippian clastic rocks;

(2) stratabound epigenetic barite-fluorite deposits occurring mainly in Devonian carbonate rocks;

and

(3) barite and polymetallic-barite veins, including the assemblages of ZnPbAgBa, UCuCoBa and AuAgBa(PbSb).

Metallogenic investigations of Cordilleran accreted terranes suggest that the western Canadian Cordillera is a tectonic mosaic of terranes possessing distinctive lithotectonic character and unique metallogeny. Preamalgamation deposits, of largely syngenetic origin, were redistributed and reconcentrated by mainly plutonic processes related to amalgamation and accretion of their host terrane. Accretionary deposits and processes were superceded by post-accretionary deposits related to late plate interaction. Mineral deposits therefore may be classified as pre-accretionary with respect to their host terrane.

Personnel Notes

Dr. K.H. Poulsen joined the Section in August as a regional metallogenist with particular responsibilities for the Central Shield and parts of the S.W. Canadian Shield. Dr. A.R. Miller began a one-year scientific exchange visit in July with the Bureau of Mineral Resources, Canberra, Australia, where he is investigating deposits in the Pine Creek uranium district and undertaking other field examinations in western Australia and Tasmania for comparative studies with regional metallogenic parameters in Keewatin District.

MATHEMATICAL APPLICATIONS IN GEOLOGY
F.P. Agterberg

The objectives of the Geomathematics Section are:

(i) to develop and apply probablistic methods of mineral resource estimation for land-use planning purposes;

(ii) to provide statistical expertise and services to projects throughout the Geological Survey;

and

(iii) to develop statistical exploration methods for use by the mineral industry.

These objectives are met by maintaining a long-range research programme on mathematics and statistics applied to solve geological problems. Geostatistical techniques and systems of computer programmes are prepared for use in projects normally carried out in collaboration with other Geological Survey staff. Documented computer programmes may be transferred to other Sections or to outside organizations.

Specific topics on which consultation is provided included:

(1) fitting of frequency distribution models;

(2) trend-surface analysis;

(3) multivariate statistics applied to geological data;

(4) image analysis of photomicrographs, remote sensing data, and map patterns;

(5) geostatistical contouring techniques including "Kriging".

(6) statistical analysis of directional features;

(7) quantitative stratigraphic correlation techniques;

(8) cluster analysis;

(9) computer simulation of geological processes;

(10) geostatistical crustal abundance models.

Highlights

A statistical model was developed for estimating the frequency distribution of number of mineral deposits per cell from the geographical locations of the deposits. The model allows for spatial clustering of deposits and permits the choice of different sizes and shapes of cells. It was applied to occurrences of gold deposits in the Abitibi Volcanic Belt of the Canadian Shield.

Stream sediment geochemical data for the Nahanni Lake area were statistically analyzed. Average background values were computed for individual catchment basins by multiple regression on rock types present. Computed anomalies with respect to average background can be used as guides in exploration for lead-zinc deposits in this area.

The problem of frequency distribution of composite sample data in geochemistry was studied. The effects of forming composite samples by diluting a single geochemically anomalous or mineralized sample unit with background or barren units of similar size were investigated for both the independent and autocorrelated situations.

A maximum likelihood method of estimating the age of chronostratigraphic boundaries from radiometric dates was developed. Cubic spline-curves were fitted to improve estimates of successive stage boundaries. These methods were applied to the Jurassic time scale.

The computer programme RASC (Ranking and Scaling) for automated ordering and zonation of (bio-)stratigraphic events was generalized on the basis of computer simulation experiments and applications to data bases contributed by participants in IGCP Project 148 (Quantitative Stratigraphic Correlation). An interactive graphic programme was added to RASC for automated correlation of most likely event positions in different stratigraphic sections. The possibility of isochron contouring with error bars was explored.

As a contribution to the Radioactive Waste Disposal Programme, a method was developed to separate porosity of granite, as measured by the mercury porosimetry method, into components. The components with lowest and highest pore sizes could be related to alteration and fracture flexibility, respectively.

By using image processing methods, two thin sections from granitic plutons located at Whiteshell, Manitoba, and Atikokan, Ontario, were analyzed in an attempt to obtain quantitative information about the relationship between grain texture and permeability.

Logistic discriminant analysis was used to distinguish between volcanic-associated sulphide deposits and sediment-hosted stratiform sulphide deposits on the basis of chemical compositions of host rocks.

Personnel Notes

S.N. Lew joined the section as scientific programmer (term position) in May 1983.

Dr. A.G. Fabbri resigned and returned to Italy in July 1983 after 14 years with the section.

Dr. A.N. Rencz joined the staff in February 1984 to work on mathematical applications in remote sensing and image analysis.

Mr. Haiquing Zou, Department of Mineral Exploration, Wuhan College of Geology, People's Republic of China, spent the second year of a two-year term with the Section, becoming familiar with harmonic, discriminant and image analysis computer based techniques.

Mineral Resource Information Services Section
D.F. Garson

The Section has overall responsibility for all commodity and metallogenic files of the Economic Geology Division.

Document files and related scientific materials are retained mainly by individual project Scientists in the Division. However MRIS (Mineral Resource Information Services) acts as the compiler and curator of the national computer-processable mineral deposits file (CANMINDEX) as well as providing programming services for other Division project files. The Section also provides Divisional library and reference services.

Personnel Notes

R. Bretzlaff and V. Matson provided term support for the Section for part of the year.

Special Projects

Highlights

A study is underway to compare the geochemistry and depositional environments of ancient metalliferous sediments and their modern analogues on the seafloor. Related to this is an investigation of the distribution of gold in various types and facies of iron formation.

A world map showing the distribution of various types of seabed mineral occurrences in relation to major tectonic features of the ocean floor was completed and will be published in 1984.

Work continued on the curation and management of Division collections of ores and host rocks, collectively known as the Economic Geology Research Collection. This collection represents a national inventory of a wide variety of Canadian mineral deposits and occurrences, and also includes research materials from world-wide foreign deposits.

Personnel Notes

Dr. W.H. Poole was transferred to the Director General's office in January as Branch Coordinator, Mineral Development Programs.

Dr. L.M. Cumming was assigned to Special Projects, in October with responsibility for curation and management of the Division's sample collections.

D. Ames provided term support for project work on the geology of iron and manganese deposits.

Attendance at Meetings, Conferences and Courses

F.P. Agterberg

Joint Statistical Meetings, Toronto, August 1983.

5th Annual Meeting, Canadian Working Group, International Geological Correlation Programme Project 198, Halifax, October 1983.

7th Meeting, International Working Group, International Geological Correlation Programme Project 198, Kharajpur, India, December 1983.

Geological Survey of Canada, Current Activities Forum, Ottawa, January 1984.

6th Annual Meeting, Canadian Working Group, International Geological Correlation Programme, Project 198, Ottawa, March 1984.

R.T. Bell

Prospectors and Developers Association, Annual Meeting, Toronto, March 1984.

Geological Association of Canada/Mineralogical Association of Canada/Canadian Geophysical Union, Joint Annual Meeting, Victoria, B.C., May 1983.

G.F. Bonham-Carter

NATO Advanced Study Institute, Lake Tahoe, California, September 1983.

Geological Survey of Canada, Current Activities Forum, Ottawa, January 1984.

Computer Applications in Mineral Exploration Conference, Toronto, 1984.

Society of Exploration Geochemists Annual Meeting, Reno, Nevada, March 1984.

J.J. Carriere

Geological Survey of Canada, Current Activities Forum, Ottawa, January 1984.

L.M. Cumming

Symposium on Correlation of Caledonian Stratabound Sulphides, Ottawa, September 1983.

Gold Deposits in the Meguma Terrane; Field Excursion to the Eastern Shore, Nova Scotia, October 1983.

Geological Survey of Canada, Current Activities Forum, Ottawa, January 1984.

Prospectors and Developers Association, Annual Meeting, Toronto, March 1984.

K.M. Dawson

Geological Association of Canada/Mineralogical Association of Canada/Canadian Geophysical Union, Joint Annual Meeting, Victoria, B.C., May 1983.

Mineralogical Association of Canada. Short course on Sediment hosted stratiform PbZn deposits, Victoria, B.C., May 1983.

Geological Association of Canada field trip to Vancouver Island deposits: Island Copper, Argonaut Iron and Western Mines, May 1983.

Mineral Deposits of the Northern Cordillera Symposium, (Canadian Institute of Mining/ Indian and Northern Affairs/Geological Association of Canada), Whitehorse, Y.T., December 1983.

Geological Survey of Canada/BCMEMPR/Indian and Northern Affairs/BC&YCM 'Cordilleran Geology and Exploration Round Up', Vancouver, January 1984.

A.G. Douma

Geological Survey of Canada, Current Activities Forum, Ottawa, January 1984.

In house French tutorial, October 1983 - March 1984.

J.M. Duke

Geological Association of Canada/Mineralogical Association of Canada/Canadian Geophysical Union, Joint Annual Meeting, Victoria, B.C., May 1983.

The Role of Earth Sciences Information in the Mineral Policy-Making Process, Washington, D.C., June 1983.

Manitoba Mineral Resources Division Annual Meeting, Winnipeg, Manitoba, November 1983.

UNESCO/IUGS Expert Meeting on Mineral Deposit Modelling, Paris, France, January 1984.

H.E. Dunsmore

Sixth International Symposium on Salt, Toronto, Ontario, May 1983.

O.R. Eckstrand

Ontario Geological Survey - Geoscience Research Seminar, Toronto, Ontario, December 1983.

D.C. Findlay

Public Disposition of Natural Resources, sponsored by Canadian Institute of Resources Law, Banff, Alberta, April 1983.

Third Natural Resources Workshop on People, Resources and the Environment North of 60°, Yellowknife, N.W.T., May 31-June 3, 1983.

International Strategic Minerals Inventory Meeting, Symposium on Bushveld Igneous Complex and Field Trips, Pretoria, South Africa, November 1983.

UNESCO-IUGS Expert Meeting on Mineral Deposit Modelling, Paris, France, January 1984.

J.M. Franklin

Canadian Institute of Mining and Metallurgy, Annual General Meeting, Winnipeg, Manitoba, April 1983.

Geological Association of Canada/Mineralogical Association of Canada/Canadian Geophysical Union, Joint Annual Meeting, Victoria, B.C., May 1983.

Seafloor Workshop, Pacific Geoscience Centre, May 1983.

Industrial Advisory Committee, Calgary, Alberta, November 1983.

S.S. Gandhi

Geological Association of Canada/Mineralogical Association of Canada/Canadian Geophysical Union, Joint Annual Meeting, Victoria, B.C., May 1983.

Geoscience Forum, Yellowknife, N.W.T., December 1983.

D.F. Garson

Computer Applications in Mineral Exploration, Toronto, Ontario, January 1984.

Geological Survey of Canada, Current Activities Forum, Ottawa, January 1984.

In house tutorial French, October 1983-March 1984.

G.A. Gross

Workshop on Marine Polymetallic Sulphide Deposits and the Mineral Policy-Making Process, Carnegie Institution of Washington, January 1983.

Marine Polymetallic Sulfides Workshop, sponsored by NOAA, the Office of Ocean Minerals and Energy, National Oceanic and Atmospheric Administration, Washington, D.C., January 1983.

Inter-Governmental Canadian Soviet Mixed Commission on Economic Industrial, Scientific and Technical Cooperation, Moscow, USSR, June 1983.

14th Annual Underwater Mining Institute, Madison, Wisconsin, U.S.A., November 1983.

M.N. Henderson

Geological Society of America, Northeastern Section, Providence, R.I., U.S.A., March 1984.

C.W. Jefferson

Mineral Deposits of the Northern Cordillera Symposium, (Canadian Institute of Mining/ Indian and Northern Affairs/Geological Association of Canada), Whitehorse, Y.T., December 1983.

J.A. Kerswill

Canadian Institute of Mining and Metallurgy, Annual General Meeting, Winnipeg, Manitoba, September 1983.

Geological Survey of Canada, Current Activities Forum, Ottawa, January 1984.

R.V. Kirkham

Geological Association of Canada/Mineralogical Association of Canada/Canadian Geophysical Union, Joint Annual Meeting, Victoria, B.C., May 1983.

R.D. Lancaster

Geological Survey of Canada, Current Activities Forum, Ottawa, January 1984.

R.M. Laramee

Architecture des ordinateurs (Universite du Quebec a Hull), Hull, May-June 1983.

Effective Use and Application of Microcomputers, (Control Data Corporation), Ottawa, Ontario, July 1983.

Geological Survey of Canada, Current Activities Forum, Ottawa, January 1984.

Langages de programmation, (Universite du Quebec a Hull), Hull, January-April 1984.

J.W. Lydon

Mineralogical Association of Canada, Short course on "Sediment-hosted stratiform Pb-Zn deposits", Victoria, May 1983.

Geological Association of Canada/Mining Association of Canada Annual Meeting, Victoria, May 1983.

CCSS Symposium, Ottawa, September 1983.

Canadian Institute of Mining/Department of Indian and Northern Affairs Symposium on "Mineral Deposits of Northern Cordillera", Whitehorse, Y.T., December 1983.

Geological Survey of Canada, Current Activities Forum, Ottawa, January 1984.

C.R. McLeod

Department Committee on Ocean Mining, Dartmouth, N.S., November 1983.

Geological Survey of Canada, Current Activities Forum, Ottawa, January 1984.

A.R. Miller

Field Workshop on Granitoids, Related Volcanics and Mineralisation, Thredbo, New South Wales, Australia, February 1984.

K.H. Poulsen

Saskatchewan Geological Survey, Regina, November 1983.

Manitoba Mines Branch, Open House, Winnipeg, November 1983.

Ontario Geological Survey, Geoscience Seminar, Toronto, December 1983.

S.M. Roscoe

Geoscience Forum, Yellowknife, N.W.T., December 1983.

Prospectors and Developers Association, Annual Meeting, Toronto, March 1984.

V. Ruzicka

Ontario Geological Survey Geoscience Seminar, Toronto, December 1983.

Canadian Uranium Producers' Metallurgical Committee 1983 Annual Meeting; Mississauga, Ontario, May 1983.

International Atomic Energy Agency/Nuclear Energy Agency Meetings of Steering Group and Working Party on Uranium Resources, Vienna, September 1983.

D.F. Sangster

Geological Association of Canada/Mineralogical Association of Canada/Canadian Geophysical Union, Joint Annual Meeting, Victoria, B.C., May 1983.

Prospectors and Developers Association, Annual Meeting, Toronto, March 1984.

R.F.J. Scoates

Ontario Geological Survey, Geoscience Seminar, Toronto, December 1983.

S.A. Scully

In house tutorial French, October 1983-March 1984.

American Sign Language, Level I, Ottawa, June-August 1983; Level II, January- March 1984.

W.D. Sinclair

Mineral Deposits of the Northern Cordillera Symposium, (CIM/INA/GAC), Whitehorse, Y.T., December 1983.

Geological Survey of Canada, Current Activities Forum, Ottawa, January 1984.

R.I. Thorpe

Geological Association of Canada/Mineralogical Association of Canada/Canadian Geophysical Union, Joint Annual Meeting, Victoria, B.C., May 1983.

Prospectors and Developers Association, Annual Meeting, Toronto, March 1984.

B. Williamson

Energy, Mines and Resources Scientific and Technical Writing Workshop, Ottawa, October 1983.

Geological Survey of Canada, Current Activities Forum, Ottawa, January 1984.

Special talks or lectures

F.P. Agterberg

"Use of Spatial Analysis in Mineral Resource Evaluation", Joint Statistical Meetings, Toronto, August 1983.

"CASC - Correlation and Subsidence Curves" (with J. Oliver and S.N. Lew), and "Statistical Problems of Constructing Time Scales", 5th Annual Meeting, Canadian Working Group, IGCP Project 198, Halifax, October 1983.

"Statistical Estimation of the Age of Chronostratigraphic Boundaries", and "Quantitative Stratigraphic Correlation", 7th Meeting, International Working Group, IGCP Project 198, Kharajpur, India, December 1983.

"Statistics in Geology", Course GEO 3100, Department of Geology, University of Ottawa, January-April 1984.

R.T. Bell

"Uranium Potential of the Canadian Cordillera", Geological Association of Canada/Mineralogical Association of Canada/Canadian Geophysical Union, Joint Annual Meeting, Victoria, B.C., May 1983.

G.F. Bonham-Carter

"Interpretation of Stream Sediment Geochemistry, Nahanni River Area", Institute of Geological Sciences, London, England, August 1983.

"Integration of Spatial Data Bases: Some Geological Examples", Seminar Series, Canada Centre for Remote Sensing, Ottawa, September 1983.

"Autocorrelation structure of stream-sediment geochemical data: interpretation of Zn and Pb anomalies, Nahanni River area, Yukon-N.W.T., Canada," NATO Advanced Study Institute, Lake Tahoe, California, September 1983.

"Geochemical anomaly maps using drainage basin data: a mathematical method applied to PB-Zn in the Selwyn Basin, Yukon", and "New drainage geochemical anomaly maps: interpretation of digitized bedrock and surficial geology, geochemistry, topography and mineral occurrences, with implications for exploration in the Yukon" (poster), Geological Survey of Canada, Current Activities Forum, Ottawa, January 1984.

"Drainage basin analysis of surficial geochemical data: a mathematical method for evaluating anomalies with applications to Pb-Zn in the Selwyn Basin, Yukon", and "Digital geochemical anomaly maps using drainage basin data" (Poster), Computer Applications in Mineral Exploration, Toronto, January 1984.

"Investigation of stream Zn and Pb as predictors of stratiform Zn-Pb deposits, Selwyn Basin, Yukon", (talk and poster), Geological Survey of Canada, Current Activities Forum, Ottawa, January 1984.

"Spatial Analysis of Multivariate Faunal Associations - Possible Methods and Tentative Ideas", at 6th Annual Meeting of Canadian Working Group, IGCP Project 148, Ottawa, March 1984.

L.M. Cumming

"Geology as a Career", Confederation High School, Nepean, November 1983.

K.M. Dawson

"The mineralogical and chemical zonation in the Silence Lake tungsten Skarn, Clearwater, B.C.," Geological Association of Canada/Mineralogical Association of Canada/Canadian Geophysical Union, Joint Annual Meeting, Victoria, B.C., May 1983.

Talks on the regional metallogeny of Sn and W deposits of the Canadian Cordillera, addressed to geologists at the Ministry of Geology and Mineral Resources, Beijing and staff geologists at several mines during a scientific exchange visit to China, October 1983.

"The relationship of regional metallogeny to the evolving tectonic concepts of the Canadian

Cordillera", University of British Columbia Department of Geological Sciences, Vancouver, B.C., November 1983.

"Barite deposits of the northern Cordillera", Canadian Institute of Mining and Metallurgy/ Indian and Northern Affairs/Geological Association of Canada Symposium - Mineral deposits of the northern Cordillera, Whitehorse, December 1983.

"The mineral deposits visited during the scientific exchange visit to China", Geological Survey of Canada Cordilleran Division and Optimist Club of the North Shore, Vancouver, November 1983.

"Geology, petrology, biostratigraphy and lead isotopes of Windy Craggy CuCo massive sulphide deposit, Tatshenshini Map Area, B.C. (114P/13)", Geological Survey of Canada/BCEMPR/Indian and Northern Affairs/BC&YCM, 'Cordilleran Geology and Exploration Round Up', Vancouver, B.C., January 1984.

"The metallogenesis of accreted terranes in the Canadian Cordillera", Geological Association of Canada Cordilleran Section Symposium 'Cordilleran Geology and Mineral Exploration Status and Future Trends', Vancouver, B.C., February 1984.

J.M. Duke

"Review of Geological Survey of Canada Activities in Manitoba", Manitoba Mineral Resources Division Annual Meeting, Winnipeg, November 1983.

"Finnish Chromite Deposits", Winnipeg Section, Geological Association of Canada, November 1983; Queen's University, Kingston, March 1984.

"Mineralogy and Geochemistry of Komatites of the Malartic Group, Northwestern Quebec", Geological Survey of Canada Current Activities Forum, (Poster), with O.R. Eckstrand and B. Williamson, Ottawa, January 1984.

"Models of Magmatic Sulphide Segregation Deposits", UNESCO/IUGS Meeting on Mineral Deposit Modelling, Paris, January 1984.

"Komatiites", Queen's University, Kingston, March 1984.

D.C. Findlay

"The GSC Role in the Northern Mineral and Energy Resource Assessment Process", Northern Mineral Advisory Committee, Whitehorse, Y.T., March 1984.

J.M. Franklin

"Relationship of Precambrian massive sulphide deposits to seafloor hydrothermal processes", Pacific Geoscience Centre, March 1984.

"Gold deposits of Central Canada", and "Geochemical signatures of gold deposits", Canadian Institute of Mining and Metallurgy Annual General Meeting, Winnipeg, April 1983.

Workshop on Seafloor Hydrothermal Research, Pacific Geoscience Centre, May 1983.

"Canadian research program on seafloor mineral deposits", Canadian Science Writers Association, October 1983.

"Mineral deposits research at Geological Survey of Canada", Industrial Advisory Committee, Calgary, November 1983.

"Gold deposits in Superior province", Timmins Geology Discussion Group, November 1983.

"Gold deposits in central Canada", University of Montreal, November 1983.

"Gold deposits in central Canada", Laval University, Quebec, November 1983.

"Gold deposits in central Canada", Universite de Quebec a Chicoutimi, November 1983.

"Gold deposit research in Canada", UNESCO/IUGS, Paris, January 1984.

S.S. Gandhi

"Petrochemistry of a differentiated quartz monzonite intrusion at Rainy Lake, Camsell River area, District of MacKenzie, and its implications to the metallogeny of the area", Geological Association of Canada/Mineralogical Association of Canada/Canadian Geophysical Union, Joint Annual Meeting, Victoria, B.C., May 1983.

"Mineral evaluations, East Arm-Artillery Lake area", Geoscience Forum, Yellowknife, N.W.T., December 1983.

G.A. Gross

"The metallogenetic significance of metalliferous sediments, Precambrian to Recent", 1984 Geological Survey of Canada Current Activities Forum, Ottawa, January 1984.

M.N. Henderson

"Primary and secondary textures in veins in the Goldenville Formation, Nova Scotia", (with J.R. Henderson), Geological Society of America, North eastern Section, Providence, R.I., March 1984.

C.W. Jefferson

"Tectonics, sedimentation and diagenesis of late Proterozoic stratabound copper deposits, with special reference to the Redstone, Mac-Kenzie Mountains, N.W.T.", Canadian Institute of Mining, Laurentian, Lakehead and Windsor Universities, March 1984.

J.A. Kerswill

"The Lupin gold deposit: Some observations regarding geological setting and gold distribution", Co-authors G.N. Woollett, D.M. Strachan and R. Moffett, Canadian Institute of Mining and Metallurgy, Annual General Meeting, Winnipeg, April 1983.

"Geological setting and gold distribution at the Lupin gold deposit, Contwoyto Lake area, N.W.T.", Co-authors G.N. Woollett, D.M. Strachan and J. Gardiner, Canadian Institute of Mining and Metallurgy, District 5 Meeting, Calgary, September 1983.

"Some thoughts on gold deposits hosted by iron-formation with particular reference to the Lupin mine, N.W.T. and to gold mineralization in the Geraldton camp, Ontario", Geological Survey of Canada, Current Activities Forum, Ottawa, January 1984, Co-author C.D. Anglin.

"The Lupin gold deposit, Contwoyto Lake area, N.W.T.; Styles of gold distribution and possible genetic models", Geoscience Seminar Series, University of Ottawa, March 1984.

R.V. Kirkham

"Distribution Patterns of Canadian Molybdenum Deposits", Geological Association of Canada/ Mineralogical Association of Canada/Canadian Geophysical Union, Joint Annual Meeting, Victoria, B.C., May 1983.

"Molybdenum Tectonics", Geological Survey of Canada, Current Activities Forum, Ottawa, January 1984.

"Global Distribution and Genesis of Sedimentary Copper Deposits" and "Sedimentary Copper Occurrence in Carboniferous Rocks of the Atlantic Provinces", Acadia University, St. Francis Xavier University, Mount Allison University and University of New Brunswick, March 1984.

J.W. Lydon

"Geology and geochemistry of some stratiform barite deposits of the MacMillan Pass area, Yukon Territory", Canadian Institute of Mining and Metallurgy Symposium "Mineral Deposits of Northern Cordillera", Whitehorse, December 1983.

"Comparison of a volcanogenic massive sulphide deposit of Cyprus with one of a Canadian Archean greenstone belt", Geological Association of Canada/Mineralogical Association of Canada/Canadian Geophysical Union, Joint Annual Meeting, Victoria, B.C., May 1983.

"Chemical Parameters controlling the origin and deposition of sediment-hosted stratiform lead-zinc deposits", Mineralogical Association of Canada short course, Victoria, B.C., May 1983.

"Effects of heterogenetic groundwater flow on sulphide deposits of Cyprus", Poster; Geological Survey of Canada, Current Activities Forum, Ottawa, January 1984.

"The Systematics of genetic modelling", Queen's University, Kingston, March 1984.

K.H. Poulsen

"Regional Structural Geology", Ontario Geological Survey Seminar on Geological Fundamentals of Gold, Toronto, March 1984.

S.M. Roscoe

"Mineral Evaluations, East Arm - Artillery Lake Area", Co-speaker with S.S. Gandhi, Geoscience Forum, Yellowknife, December 1983.

V. Ruzicka

"Canadian Uranium Deposits and Resources", 1983 Annual Meeting of the 'Canadian Producers' Metallurgical Committee, Sheridan Park, May 1983.

"Uranium mineralization in Canada in the world context" Seminar, University of Ottawa, March 1984.

D.F. Sangster

Series of 12 lectures at Institute of Mineral Deposits, Chinese Academy of Geological Sciences, Beijing, People's Republic of China, January 1984.

"Use of geological models in mineral exploration", Prospectors and Developers Association, Annual Meeting, Toronto, March 1984.

W.D. Sinclair

"Tin and tungsten deposits in Canada"; Ministry of Geology and Mineral Resources, Beijing, People's Republic of China, October 1983.

"Mo, W and Sn in the northern Cordillera of Canada and adjacent parts of Alaska"; Symposium (Geology Division), Canadian Institute of Mining and Metallurgy, Indian and Northern Affairs, Whitehorse, Yukon, December 1983.

"Tin and tungsten deposits in Southeast China", (Poster), Geological Survey of Canada, Current Activities Forum, Ottawa, January 1984.

R.I. Thorpe

"A lead isotope model based on the Superior Province paleoisochron and possible ages for gold deposits of the Canadian Shield", Geological Association of Canada/Mineralogical Association of Canada/Canadian Geophysical Union, Joint Annual Meeting, Victoria, B.C., May 1983.

"Review of lead isotope data for deposits in the Appalachians and the Scandinavian Caledonides", Correlation of Caledonian Stratabound Sulphides (IGCP Project 60), Ottawa, September 1983.

"Lead isotope models and their applications", University of Ottawa, January 1984.

"Isotope Seminar - Exploration Applications of Lead Isotopes" (with E.J. Brooker), Prospectors and Developers Association, Annual Meeting, Toronto, March 1984.

"Studies of ore mineralogy, especially of gold deposits, at the Geological Survey of Canada" and University of Quebec at Chicoutimi, March 1984.

"Modelling of lead isotope evolution and applications of lead isotope studies", University of Quebec at Chicoutimi, March 1984.

Membership on Committees

F.P. Agterberg

Commission on Tectonics of Ore Deposits Working Group No. 3, Chairman.

Computers and Geosciences, Editorial Advisory Board.

Geo-Processing, Editorial Board.

Global Tectonics and Metallogeny, Associate Editor.

Laboratory for Research in Statistics and Probability, Carleton University, Member.

University of Ottawa, Adjunct Professor and Graduate School member.

M.M. Braham

Department of Energy, Mines and Resources, Office of Equal Opportunity, Branch Representative for Geological Survey of Canada.

J.J. Carriere

CCSS (Correlation of Caledonian Stratabound Sulphides) Symposium, Project 60: IGCP, IUGS, UNESCO, 8th International Working Group Symposium, Registrar.

L.M. Cumming

Canadian Institute of Mining and Metallurgy (Ottawa Branch), Tours Committee Member for 86th Annual General Meeting.

Youth Science Foundation, Executive Committee, Member representing the Geological Association of Canada.

2nd Ottawa Regional Science Fair, Earth Science exhibits, Judge.

K.M. Dawson

Circum Pacific Map Project, Metallogenic Map Committee, Canadian Cordillera, representative.

Geological Association of Canada, Mineral Deposits Division, Newsletter editor.

Canadian Institute of Mining and Metallurgy/ Geological Association of Canada/Indian and Northern Affairs Symposium, Whitehorse: 'Mineral Deposits of the Northern Cordillera', GAC representative on organizing committee.

Geological Association of Canada Field Trip to Mexican silver deposits, organizer and leader; March 1983.

Geological Association of Canada, Mineral Deposits Division, Executive Nominating Committee, member.

IGCP Project 187: Siliceous Deposits, Canadian Working Group, Member of organizing committee.

J.M. Duke

International Geological Correlation Programme, Project 161, "Sulphide deposits in mafic and ultramafic rocks", participant.

Mineralogical Association of Canada, secretary.

Editorial Board, Economic Geology.

Mineralogical Association of Canada, Member of Finance Committee.

D.C. Findlay

Geological Association of Canada, Fellow.

Mineralogical Association of Canada, member.

Canadian Institute of Mining and Metallurgy, member; Geology Division, Vice-Chairman.

Canadian Institute of Mining and Metallurgy 1984 Annual General Meeting, Geology Division, Program Chairman, Ottawa.

Working Committee on Northern Mineral Resource Assessment, Co-chairman.

Centre for Scientific, Engineering and Learned Societies, Board of Directors, member.

Geological Survey of Canada Ad Hoc Committees: Research on the Origin of Mineral Deposits, Chairman; Methods in Resource Assessment, co-chairman.

Geological Survey of Canada representative on Energy, Mines and Resources ISMI (International Strategic Minerals Inventory Committee).

J.M. Franklin

Canadian Institute of Mining and Metallurgy, Geology Division, Chairman of the Research Committee and CGC representative.

Geological Association of Canada, Mineral Deposits Division, Councillor.

Geological Association of Canada, Councillor.

Study of Research and Development in the Exploration for Mineral Deposits; CGC Task Group, member.

Canadian Geoscience Council, member.

Workshop on Seafloor Hydrothermal Research, Pacific Geoscience Centre, May 1983, Chairman.

S.B. Green

Geological Survey of Canada Current Activities Forum, Ottawa, January 1984, Technical Coordinator.

Study of Research and Development in the Exploration for Mineral Deposits; CGC Task Group Assistant.

G.A. Gross

Canada-USSR Mixed Commission on Economic, Industrial Scientific and Technical Cooperation' Geology Working Group, Co-chairman and Coordinator.

Coordinating Committee on Ocean Mining for Department of Energy, Mines and Resources (DCOM); Member and Chairman of DCOM Working Group on Deep Ocean Mineral Resources.

Geological Survey of Canada-Energy, Mines and Resources Task Group on Submarine Metalliferous Hydrothermal Systems .

International Geological Correlation Programme, Project 91, Metallogeny of the Precambrian, Canadian Chairman and Coordinator; Project 132 Basins of Iron Formation Deposition (terminated in 1983), Canadian Chairman; Project 111, Genesis of Manganese Ore Deposits, Canadian Liaison and Coordinator; Project 187, Siliceous Deposits, Member.

Precambrian Research, Editorial Board.

R.V. Kirkham

Canada-Newfoundland Geoscience Co-operative Mineral Program, Coordinator of Buchans Projects.

Penrose Medal Committee, Society of Economic Geologists, 1983.

R.D. Lancaster

Branch Safety Committee, Member.

R.M. Laramee

Energy, Mines and Resources Computer Science Centre Data Management User's Group, Chairman.

J.W. Lydon

Ottawa Mineral Exploration Discussion Group, Geological Counsellor.

C.R. McLeod

Energy, Mines and Resources Committee for Ocean Mining, Working Group for Deep Ocean Mining, Member.

K.H. Poulsen

Eastern Ontario Subsidiary Agreement, Minerals Sub-committee, Branch Representative.

V. Ruzicka

Energy, Mines and Resources Uranium Resource Appraisal Subcommittee on Estimated Additional Resources, Chairman.

Steering Committee for Nuclear Energy (Organization for Economic Cooperation and Development Nuclear Energy Agency) Steering Group on Uranium Resources, Member.

Elsevier Scientific Publishing Company, Editorial Board of 'Uranium', Member.

Working Group of Project V, International Atomic Energy Agency (Lower Proterzoic Vein Type Deposits), Member.

Working Group of Project III; International Atomic Energy Agency (Uranium deposits in Proterozoic Quartz-Pebble Conglomerates); Member.

D.F. Sangster

Carleton University, Ottawa, Honorary Adjunct Professor.

International Geological Correlation Programme, Project 60 - Correlation of Caledonian Stratabound Sulphides, Canadian National Representative.

Mineralogical Association of Canada, Short Course Organizer for 1983 Annual Meeting.

Society of Economic Geologists, Publications Committee, member, Nominations Committee, Member.

R.F.J. Scoates

Geological Association of Canada, Winnipeg Section, Past President.

S.A. Scully

Assistant Registrar 1983 CCSS (Correlation of Caledonian Stratabound Sulphides) Symposium, Project 60: IGCP, IUGS, UNESCO, 8th International Working Group Symposium, September 1983.

Geological Survey of Canada Children's Christmas Party, Entertainment Committee.

Department of Energy, Mines and Resources Christmas Party, Entertainment Committee.

W.D. Sinclair

Canadian Institute of Mining and Metallurgy, Executive Committee, 1984 Annual General Meeting, (Chairman, Accommodations Committee).

Canadian Institute of Mining and Metallurgy, Geology Division, Secretary-Treasurer Elect.

Appalachian Metallogenic Map Working Group, Geological Survey of Canada representative (observer status).

Symposium on "Mineral Deposits of Northern Cordillera", sponsored by Geology Division, Canadian Institute of Mining and Metallurgy, Mineral Deposits Division, Geological Association of Canada and Geology Division Indian and Northern Affairs (Yukon), Member of Program Committee.

R.I. Thorpe

Mineralogical Association of Canada, Associate Editor.

Interdepartmental Working Committee on Northern Mineral and Energy Resource Assessments, Member.

B. Williamson

Geological Survey of Canada, Current Activities Forum, Ottawa, January 1984, Technical Operations Committee Member.

GEOLOGICAL INFORMATION DIVISION

R. G. Blackadar

The Geological Information Division is responsible for ensuring that the results of the Branch scientific programs are made available to users in a timely and effective manner; to maintain the Library of the Geological Survey as the principal earth science library in Canada; to manage the National GEOSCAN Centre, which co-ordinates the activities of a federal-provincial bibliographic data base; to provide advice to Branch management on the application of data systems; to provide comprehensive drafting and cartographic services; to provide a Branch public information service; and to maintain expertise and provide service in technical photography.

The division operated through six sections, Scientific Editing and Publication, Library, Data Systems Group, Cartography, Technical Photography, and Publications Distribution.

The stated activity objective of the Geological Survey is "to ensure the availability of a comprehensive knowledge base on the bedrock and surficial geology, and the energy and mineral resources of Canada". This is the rationale for all work carried out by the Branch. Inherent in this objective is the transmission of knowledge to users. The dissemination of scientific information is the objective of this division. Our users are diverse and include specialists in government, industry, and universities as well as the general public. Fields of interest are as varied as the disciplines studied by the operating divisions of the Branch. The published output of this reporting unit must recognize this diversity and yet do so in an economical manner.

Most of the manuscripts processed and published come from Branch scientists thus any major shifts in Branch activity have a direct effect on our program. Because manuscripts are not submitted regularly throughout the year but tend to bunch, backlogs sometimes develop but the staff allotted to the publication activity is adequate to meet the annual demand.

Written communication is still the most common way by which knowledge is transmitted and our publication program is our principal activity. This is supported by scientific and production editing, cartographic and photographic services. A corollary of this is the need to collect and make available to our research staff and others the published output of others. The Geological Survey library, a part of this division, is considered to be the principal earth science component of the National Library, and its collections and services are widely available.

Although written communication remains a prime method for information transfer in the world of science, data systems are becoming increasingly important. A bibliographic data base is managed on behalf of seven provinces, EMR and Indian and Northern Affairs by the National GEOSCAN Centre, a part of the Library.

The increasing use of data systems led the management of the Geological Survey to establish a Data Systems Group in 1974. This group was transferred to Geological Information Division in 1979. It provides specialist service to other divisions and advises senior management on computer use.

Although much of the drafting and cartography done in the division is in support of the publication program there is a continuing need for casual drafting services. These vary from preparing figures for publication in outside journals to preparation of slides for lectures or graphics needed for displays. Another support service provided is the preparation and printing of photographic materials. Custom service is offered in the preparation of photomicrographs of fossils, thin sections and polished sections. Many of these are used as illustrations in published reports.

The division acts as the focus for Public Information services. To facilitate access the Director's telephone number is listed in various directories. The service is maintained by the scientific editors and is strictly a subsidiary service which does not aim to provide the comprehensive public service available in some scientific agencies. However the arrangement, when coupled with the Reference Service provided by the Library and the information given to the public through the Publication Distribution Office, appears acceptable as no complaints have been received from the public.

In 1983/84 about 5 500 pages of text was forwarded for printing. This represented an increased of about 20 percent over the previous year but was accomplished with no increase in the publication budget. Although some of the reports published in 1983/84 involved the use of colour and expensive bindings, the overall reduction in cost-per-page appears to reflect the total switch to word-processing procedures for text preparation and more efficient processing procedures.

During 1983/84 the following we published:

4	memoirs
6	bulletins
1	Economic geology report
27	Papers
4	Miscellaneous Series reports
14	"A" Series maps
4	Preliminary maps

Personnel Notes

Dr. P.B. Charlesworth, Chief, Data Systems Section assumed these duties in April but was absent on French-language training from September to February.

Mr. J.G. Roberts, former Chief, Cartographic Section retired on 29 February having been in a SAPP position since 1 March 1983. During the past year Mr. Roberts completed a study of the Production Control and Costing System currently being used in Cartography Section and submitted a report and recommendations. He also prepared a short report on aspects of the automation of geological map production and participated in a study of the Classification Standards for the Drafting and Illustration Group.

Mrs. L.R. Mahoney, Head, Publication Production Unit, retired on 31 December after 28 years in the Public Service. M.J. Kiel was appointed acting head.

Mrs. F. Frappier, administrative Officer, retired on 31 December. Mrs. D. Poirier assumed the duties of Administrative Office on 3 January.

Mr. J. Bill was appointed Chief, Cartographic Section, in November 1983.

Attendance at Meetings, Conferences and Courses

R.G. Blackadar
DNAG Steering Committee; Boulder, Colorado May 18 1983
Geological Society of America; Indianapolis, November 1983
Data Processing Course, Ottawa, 4-5 May 1983

W.C. Morgan
Geological Association of Canada, Victoria, B.C. May 1983

P.J. Griffin
Association of Earth Science Editors, Houston, Texas; October 1983

Membership on Committees

R.G. Blackadar
- Branch Management Committee
- EMR Committee on Scientific Publications in Both Official Languages
- EMR Computer Policy Committee
- Earth Science Sector Communications Committee
- Steering Committee, Decade of North American Geology
- Chairman, GEOSCAN Management Subcommittee

P.J. Griffin
- Interdepartmental Committee, National Earth Science Series, 1:1 million maps.
- Ad Hoc committee to study Baillie Report.

DATA SYSTEMS GROUP

P.B. Charlesworth

During the year the Data Systems Section provided advice and assistance to branch scientists and administrators on everything from the implementaiton of the new departmental electronic information system (EIS) policy to microcomputer programming. A consistent effort was made to ensure that the new EIS policy, particularly with respect to procurement, was understood and followed throughout the branch so that the GSC would be above external criticism. The annual branch Information Technology and Systems Plan (ITSP) was compiled and submitted to the EIS secretariat for inclusion in the departmental plan in February after the revised requirements for the plan were worked out between the department and the Treasury Board.

The year's projects included the specification and contracting for the acquisition of the Hewlett Packard model 3000 computer system to be used primarily for GEOSCAN and library applications. The system has been installed at Systemhouse Ltd. for the exclusive use of the GSC, and will be managed for the Branch by Data Systems Section.

A fixed asset inventory system designed with CARP reporting requirements in mind has been developed within the section to run on the HP3000. This system will be implemented in a phased-in manner during the coming fiscal year as data is input.

Procedures were developed to link various microcomputers in order to transfer publications from scientific machines to word processors and to save rekeying of huge and complex programs. This method is also useful for transferring data and programs.

Personnel Notes

The position of section head was filled after being vacant for almost a year by the appointment of Dr. P.B. Charlesworth who spent 5 months of the year working at the Survey only half a day per week while on French language training.

Attendance at Meetings, Conferences and Courses

Phyllis Charlesworth
Auto Carto 6-International Conference on automated cartography, Ottawa, October 1983
Canadian Information Processing Society conference, Ottawa, 1983
James Martin seminar, Ottawa, January 1984

K. Gunn
Powerhouse course. A course describing the software product, Ottawa, February 1984

T. Scaga
Data Processing Institute conference, Ottawa, March 1984.

Membership on Committees

P.B. Charlesworth
- Chairperson, departmental Computer Users Committee
- Computer Policy Committee
- Branch Computer Management Committee.

LIBRARY SERVICES

A.E. Bourgeois

CURRENT YEAR ACTIVITIES

1. Library Administration

The G.S.C. Library's role is to provide library services in support of the research mandate of the Geological Survey and to maintain a national resource collection in earth sciences and related disciplines thus supporting Canadian research. The library continued to perform the activities required for the selection, acquisition, analysis and description, processing retrieval and circulation of literature which are required to meet demands for high quality and immediate information.

The G.S.C. Library System Co-ordinating Committee was created to ensure coordination of library services particularly in the development of automated services.

1. To develop a network of G.S.C. librairies.

2. To provide G.S.C. staff and the public with access to bibliographic data available within G.S.C. by producing and maintaining a universal database of G.S.C. library holdings.

3. To develop, introduce, maintain, review and evaluate operating mechanisms and procedures for the network.

4. To establish a working set of guidelines, and to define and coordinate G.S.C. library services and to resolve problems arising in the provision of service.

5. To investigate and assess new technologies and their application to G.S.C. information needs.

2. Information Services

The Library continued to provide a high level of service to its clientele by answering queries and delivering documents in a timely and satisfactory way, by selecting acquisitions to support geological research and by providing on-line searches.

In addition to its on-going activities the following projects were carried out:

- Compilation of an annotated list of computer journals held by the library.
- Preparation of library section of the G.S.C. employee's handbook.
- Inventory of Cutter monograph collection.
- Exhibition of Georef data base at "Computer Applications in Mineral Exploration", Toronto, January 1984, and at the G.S.C. Current Activities Forum.
- Library Open House for participants at G.S.C. Current Activities Forum.
- Presentation on Cataloguing of maps on UTLAS at Ontario Council of University Libraries Map Group annual meeting, Toronto.
- Indexing of map series on sheet indexes to provide quick access.
- Map current awareness service for Episodes for the New Maps column.

3. Technical Services

The Technical Services was still plagued by staff turn-over and new staffing actions during 1983/84. Despite these problems, the section was successful in meeting its targets.

The backlog of books to be catalogued has been eliminated.

A clean-up in acquisition has resulted in the updating of all ours orders, the claiming of missing issues and the consolidation of subscription orders through various agents.

Major steps were taken to increase the bilingual access to the collection:

- progressive addition of French subject headings to the collection
- a study to retrospectively convert French language serials cataloguing the bilingual and machine readable form was completed
- addition of a French language cataloguer to the staff.

The library acquired a MINISIS data base definition and was able to develop an acquisition data base. The system will be tested and fully implemented within the next year. The definition of fields for an on-line catalogue is now in progress and we anticipate an operational system by October 1984.

MINISIS software requirements for an on-line control and a printed index of theses were developed. This module will now form a part of the library's on-line catalogue. Awaiting the finalization, the theses records have been coded.

All 1982 and 1983 G.S.C. publications have been indexed for GEOSCAN data base. 10 000 geophysical series maps have been indexed and input into GEOSCAN.

4. National GEOSCAN Centre

The GEOSCAN data base increased in size by 25% during the year and two additional geoscience organizations began contributing index records to the system.

A batch method for entering data was implemented and an Indexer's Manual was prepared and distributed to participating agencies.

A major project to improve the quality of converted GEOSCAN records was initiated with significant progress made by the end of the year. A contract was signed with Systemhouse Ltd. to provide a dedicated HP300 minicomputer for G.S.C. use over a five year period which will result in stabilized and reduced operating costs for the GEOSCAN activity.

The following pieces of documentation were updated during 1983/84:

Terminal Operator's Guide to GEOSCAN/MINISIS

GEOSCAN Indexing Tools

GEOSCAN Conversion Documentation

A first draft of GEOSCAN Reference Manual and Indexer's Guide (i.e. GEOSCAN Indexing manual) was distributed to indexers in January 1984.

PERSONNEL CHANGES

Information Services

Michel Desjardins replaced Lori Mercer as photocopy clerk.

Technical Services

Jacques Bérubé joined the staff as the French language cataloguer.

Linda Carey joined the acquisitions unit as the Acquisitions Clerk.

Morris Mason was hired as cataloguing clerk.

National GEOSCAN Centre

Anthony Kopf-Johnson accepted the GEOSCAN Data Base Manager position and started work at NGC in July 1983.

Lori Mercer and Linda Carey worked at NGC on a term basis providing clerical and professional support.

COMMITTEE MEMBERSHIP

S.O. Alexander
- EMR Calatoguer's Working Committee
- Ottawa-Hull UTLAS User's Committee

A.E. Bourgeois
- Association of Chief Librarians of National Geological Surveys
- Steering Committee of the Council of Federal Libraries
- Committee on Collection Rationalization (Convener)
- EMR Standing Committee of Head Librarians (Chairperson)
- GSC Library System Coordinating Committee (Chairperson).

E. Frebold
- Committee on Conservation/Preservation of Library Materials, Council of Federal Libraries.

L.A. Frieday
- EMR Cataloguers' Working Committee
- Ottawa-Hull UTLAS Users' Committee

E. Klobouk
- National GEOSCAN Data Base Committee (NGDBC).

T. Naraynsingh
- UTLAS Users Group for Cartographic Materials, Association of Canadian Map Libraries
- Ontario editor, ACML Bulletin.

D.S. Reade
- Chairman of the National GEOSCAN Data Base Committee
- Ex-officio member of the GEOSCAN Management Subcommittee (subcommittee of the National Geological Surveys Committee)
- EMR representative at the MINISIS Users' Group.

W.P. Stark
- National GEOSCAN Data Base Committee.

R. Swan
- Ottawa On-Line Users' Group.

J. Wilks
- Ottawa On-Line Users' Group
- CAN/SDI Centres Committee.

CONFERENCES ATTENDED

Association of Canadian Map Libraries Annual Conference, 1983, Vancouver, B.C.;
Tara Naraynsingh

Canadian Association of Information Science, Annual Conference, 1983, Halifax, N.S.;
Judy Wilks

Canadian Library Association, Annual Conference, 1983, Winnipeg; Samuel Alexander

Geological Information Society (G.S.A.) Annual Conference 1983, Indianapolis, Indiana;
Elizabeth Frebold

MINISIS User Group Meeting, 1983, Ottawa;
Samuel Alexander, Wendy Stark

Ontario Library Association, Annual Conference, 1983, Toronto; Le'Anne Frieday

On-Line '83, Chicago, Illinois; Judy Wilks.

DESCRIPTIONS	1979-1980	1980-1981	1981-1982	1982-1983	1983-1984
1. A. Information Requests	3,845	5,809	7,941	11,366	13,034
B. Automated Searches	509	700	1,463	1,964	2,750
2. Document Delivery					
A. Lending	23,097	26,974	27,321	34,496	43,089
B. Borrowing	895	569	828	1,277	1,678
3. Collection Growth					
A. Monographs (Volumes)	1,095	1,304	1,291	813	1,862
B. Serials (Issues)	12,172	13,099	13,507	14,510	14,742
C. Serials (Title)	-	-	31	36	56
D. Maps (Sheets)	1,184	1,669	3,082	2,660	3,047
E. Microforms (reels/sets)	91	1,147	1,881	4,520	4,588
F. Total linear metres	-	83	99.4	103	126.3
4. UTLAS					
Records added to database	-	1,685	2,938	2,705	2,706
5. GEOSCAN					
A. Total records in database	-	-	-	69,127	86,443
Records added to database	-	-	-	3,625	17,316
B. Custom indexes	-	-	-	11	5
C. On-line retrievals	-	-	-	34	47

GEOLOGICAL CARTOGRAPHY SECTION

J. Bill

Objectives for the reporting year were generally met and productivity was comparable to previous year. Response time on short notice-high priority projects was excellent, with all deadlines being met. All jobs were put into production soon after receipt with no backlog of work in units. There was some improvement in over-all throughput time, but the goal of completing all jobs within twelve months of receipt in section remained elusive.

The photomechanical unit lost considerable production time due to extensive illnesses and a vacant supervisory position during part of the year. All priority requests were met, but turn-around time on some routine jobs did affect the section's overall throughput capability.

The Section Production Reporting System was expanded to include full recording of all photomechanical time and operations against individual projects.

The sediment section of the Marine Science Atlas of the Beaufort Sea was nearly complete at year end, and will be printed during summer of '84. The next section, Geology and Geophysics, is well into production and should be completed and printed later in fiscal year.

Work was nearly completed on the new bilingual edition of the Standards and Specifications Manual. Due to other higher priorities this has taken longer to complete than anticipated, but the end is in sight with publication scheduled for the summer of 1984.

Three in-house committees were formed during the year. The first to design and construct a formal cartography display to demonstrate to other members of the Branch some of Cartography's production processes. The second committee is to develop and eventually publish a technical manual dealing with cartographic production procedures and guidelines not covered in our Standards and Specifications manual. The third committee is to investigate procedures and develop guidelines for the quick production of multi-colour maps from author or cartographer prepared hand-coloured manuscripts, using camera colour-separation methods as an alternative to current peelcoat methods.

The problems encountered in recent years by the Surveys and Mapping Branch in meeting our typesetting requirements have generally been solved, and all our needs can now be met by their new Digitized Type Unit.

The installation of a new 4-colour press and extensive renovations in the press-room at Surveys and Mapping Branch resulted in some printing delays late in the year. This large format press, once fully operational late in 1984, will improve their capabilities and should result in a more streamlined operation with improvements anticipated in service and quality.

New Products

Direct colour prints and overhead transparencies

Cartography can now produce colour prints and transparencies directly from virtually any type of original, such as printed maps, map manuscripts, etc. These can be produced at any enlargement or reduction factor within the limits of output format. Up to 20" x 24" for paper prints of 10" x 12" for transparencies.

Attendance at Meetings, Seminars and Courses

Cartographic Workshops - Cartotechniques III - OICC - Lindsay, Ontario, May 1983

J. Bill, D. Brown, V. Foster, S. Junginger-Frohberg, F. Heney, E. Maahs, L. Renaud, R. Saffin, M. Sigouin

Genereral Graphic Arts - Graphic Arts International Union - Ottawa, Fall 1983 (evenings)

E. Belec, J. Ferguson, S. Junginger-Frohberg, M. Hudon, R. Saffin, M. St. Pierre

Graphic Arts - Expo '83 - Montréal, November 1983

G. McNeill, G. Wylie

Graphic Arts Seminar - Toronto, May 1983

M. de la Fontaine, G. Wylie

Auto-Carto Six - International Symposium on Automated Cartography - Ottawa, Hull - October 1983

J. Bill, R. Sauvageau

Managing Conflict - PSC - Ottawa 1983-84

J. Bill, R. Daugherty, V. Foster

Classification for Managers - EMR - Ottawa, May 1983

J. Bill

Staffing for Managers - EMR - Ottawa, March 1984

E. Dumbrell

Dynamics of Supervision - PSC - Ottawa, January 1984

J.P. Corriveau, J. Yelle

People Management - Tools and Techniques - Algonquin College - Ottawa, February-April 1984

R. Fairfield

Membership on Committees

J. Bill
- Board of Directors, Ontario Instituter of Chartered Cartographers
- EMR Interdepartmental Topographic Map Design Committee
- Treasury Board - Classification Standard Review Committee - Drafting and Illustration Group

S. Junginger Frohberg
- Board of Directors, and Secretary, Ontario Institute of Chartered Cartographers

J. Heney
- Branch Safety Committee.

Personnel Notes

Section strength is presently at 53 with no change in manpower functional disposition. There were 2 vacant supervisory positions at year end.

Newton McKenzie retired in June after 17 years of service with the G.S.C.

Norm Buck retired as Head of our Photomechanical Unit in October after 27 years of service with the Survey.

Vern Foster was promoted by competition to supervisor of Drafting Unit B in March 1984.

Paul St.Amour joined us on a lateral transfer from Terrain Sciences Division in June 1983.

PRODUCTION DATA

Automated digitizing		1982-83	1983-84
Line Mode	-Precambrian Division	0	6
	-Resource Geophysics & Geochemistry Division	0	2
	-Terrain Sciences Div.	0	7
	-Economic Geology Div.	5	0
Point Mode	-Resource Geophysics & Geochemistry Division	27	48
	-Terrain Sciences Div.	2	0
		34 Days	63 Days

Twenty-six projections at various scale have been prepared with the co-operative assistance of Surveys and Mapping Automation System.

Checking Unit	1982-83	1983-84
"A" Series maps checked at proof stage	22	18
"B" Series maps checked at proof stage	12	1
Pocket, page figures, miscellaneous	54	270
	88	289

There were 436 miscellaneous (Z numbered) drafting jobs completed during the year, which took 10,605 person hours; this included more than 30 book covers. In addition to the normal map production operations, the photomechanical unit processed 1,379 (X numbered) miscellaneous jobs for various authors and Divisions.

A total of 373 requisitions for Linofilm typesetting for Ottawa, Calgary and Dartmouth cartographers were processed through S & M Branch. There were 568 master topographic negatives requisitioned from S & M Branch for reproduction in Photomech for authors and cartographers in Calgary, Ottawa and Vancouver.

Maps and illustrations received during the fiscal year:

	1982-83	1983-84
Multicoloured geological maps	16	18
"B" Series Maps	0	7
Figure illustrations (pocket)	8	58
Figure illustrations (page)	161	335
Geophysical Maps and Indexes	48	153
Special Projects	30	26

Maps, illustrations and photomechanical work completed by the Cartography Section:

	1982-83	1983-84
Multicoloured geological maps	19	21
"B" Series maps	16	4
Figure illustrations (pocket)	7	8
Figure illustrations (page)	204	123
Geophysical Maps and Indexes	0	20
Multicoloured maps reprinted	8	4
Preliminary geological maps reprinted	1	1
Figure illustrations (pocket) reprinted	7	1
Indexes to Publications revised	25	30
Open File Maps and Profiles	0	242
Special Projects-Panels for Display	0	16
Camera	7,526	9,556
Contacts		
Film and papers	22,258	24,042
Colour Keys	604	711
Peelcoats	283	237
Transfers	31	59
Scribetches	1	5
Final Pre-Screen	-	478
Colour Proofs	92	137
Whiteprints	5,935	6,500

Carry-over of maps and illustrations in progress at the end of fiscal year:

	1982-83	1983-84
Multicoloured geological maps	31	27
"B" Series maps	4	7
Figure illustrations (pocket)	10	61
Figure illustrations (page)	34	363
Open File Maps and Profiles	13	150
Geophysical Maps and Indexes	48	99
Special Projects - Beaufort Sea	32	77
- Panels for Display	0	18

PUBLICATION/INFORMATION OFFICE

J.L.L. Touchette

The following publications were received during the year:

Economic Geology	1
Memoirs	4
Bulletins	6
Bulletins (reprinted)	2
Preliminary Papers	27
Preliminary Papers (reprinted)	1
Misc. Report Series	4
Misc. Geology	19
Open Files	3
Microfiche	20
Maps "A" Series	14
Maps "A" Series (reprinted)	3
Preliminary maps	4
Geophysical Maps	132
Geophysical Maps (reprinted)	87
Revised Indices to maps	25

DISTRIBUTION DATA

Maps	51,468
Reports	34,149
Indices, listings, posters, etc.	123,757
Total distribution (free and paid)	209,374

OTHER DATA

Requests for information,. publications, rocks and mineral sets, etc.	11,735
Visitors (cash sales 1084) (others 1973)	3,057
Notification Lists sent out	14

REVENUE

Derived from sales of reports, maps, rock and mineral sets, photographs, etc. * Unadjusted	* $116,710.85
($ value) Products supplied to regional offices	49,239.00
TOTAL SALES VALUE	**$ 165,949.85**

PHOTOGRAPHIC SECTION

J. Kempt

The photographic section of the Geological Survey of Canada provides a broad range of services in B&W and colour to the members of the Survey, at times, to other Government Departments and on occasion to private organizations, companies, and individuals who work in collaboration with the geologists of the Branch.

The photographic assignments, carried out by the staff of the photo section, may be broken down into work done by (1) the colour studio and darkroom (2) the fossil studio darkroom (3) the copy studio and darkroom (4) darkrooms for printing, enlarging, and processing.

Colour Studio

The colour studio provides for members of the Geological Survey the following services: the production of colour slides, duplicate slides internegatives, viewgraphs, photographs of rock and mineral hand specimens, drill core samples and photographic displays. Colour prints are provided from Kodak colour meterials and from Ciba colour materials.

Fossil Studio

The fossil studio supplies photographs of fossils. Rocks specimens are photographed to show their mineral content, thin sections of fossils, minerals, and rock specimens are also done in plain, and polorized light to show birefrengent material.

Sitting may be arranged for passport and publicity photographs.

The fossil studio is equipped, as well, with a background light table and accesories to provide access to reflective and incident light techniques.

Copy Camera Studio

Equipped with a 4" x 5" view camera, a 8" x 10" copy camera and a multiphot macro camera the studio produces, copies of documents, photographs, seismic records. Close ups of sandgrains, crystals, and tiny fossils are photographed by means of the multiphot macro camera at magnifications up to X30.

Specialized jobs such as reproduction of printed circuits and the use of ultra violet and infrared light to reveal hidden properties of specimens are carried out in copy studio as well.

Darkrooms

Printing and enlarging for the Geological Survey is carried out with the aid of Omega, durst, leitz, bessler enlargers. Two Gordon Morse printers which have been modified by the Geophysics and Geochemistry division to accept resin coated, as well as fibre based papers, provide the printing facilities.

Processing of prints and enlargements is done manualy or by means of an Ilford 2000 automated processor.

ACQUISITIONS

Bronica roll film camera has been obtained for use in the fossil studio.

RETIREMENT

Mr. W. Stafford has retired after more than 35 years of service.

G.S.C. PHOTOGRAPHIC SECTION

PRODUCTION REPORT

Month 12 Months Year 1983-1984

PHOTOGRAPHS PRODUCED	B/W NEGS	COLOUR NEGS	COLOUR TRANSP	TOTAL EXPOSED
Equipment-Labs-Portraits-Passports	224		251	475
Continuous tone maps-charts	917		4965	5882
Line copies	1295			1295
Rock & mineral Specimens	287		580	867
Thin Sections	251		456	707
Polished Specimens				
Auto-Radiographs	47			47
Requisition Processing COL. ROLLS (26)			778	778
Requisition Processing B/W ROLLS				
Duplicate Slides			979	979
B/W Negs from Colour Slides	818			818
Fossil Negatives	437			437
Reverse text slides			301	301
TOTAL PROCESSED	4276		8310	12586

PRINTS & ENLARGEMENTS	EXPOSED	PROCESS	DRIED	
Black and White	12324	12324	12324	
Colour	668	668	668	TOTAL
	12992	12992	12992	38976

Prints & Enlargements Numbered & Stamped	9678	
Prints & Enlargements to outside Agencies	863	
Colour Slides	6339	
B & W Slides	2372	
Slides mounted	7865	
Negatives Opagued	1790	
Negatives Retouched	355	
Prints spotted	173	
Prints from Gov't Photo Centre	823	
Colour Prints from Gov't Centre	20	
Slides from colour Negatives	72	
		TOTAL
	30422	55594

GRAND TOTAL 94570

INSTITUTE OF SEDIMENTARY AND PETROLEUM GEOLOGY

W.W. Nassichuk

I.S.P.G. is responsible for establishing a sound geoscience base for the sedimentary basins of western and Arctic Canada, which occupy one-third the area of the country and contain most of Canada's oil, natural gas, and coal resources. In addition, units of the Division are responsible for the appraisal of the hydrocarbon and coal resource potential of the country.

The geological framework is being broadly outlined by current mapping and topical studies. These studies, together with paleontological investigations, support exploration for, and assessment of the non-renewable resources of western and northern Canada. Emphasis on energy resources has resulted in development of evaluation programs in both petroleum and coal, each supported by petrological investigations. The geological evaluations contribute to the national inventories on the resources of petroleum and coal.

The Institute is organized into six subdivisions: Regional Geology, Paleontology, Coal Geology, Petroleum Geology, Geological Publications and Administration, each comprising several sections; together with the Petroleum Resource Assessment Secretariat.

Regional Geology carries out standard mapping, lithostratigraphic and sedimentological studies in the principal sedimentary basins of Western Canada, Northern Mainland, Arctic Islands and adjacent offshore areas. Paleontology ensures precise and consistent biostratigraphic correlation, by refinement, through detailed taxonomic and stratigraphic studies, of the biochronologic scale which serves as the basis for biostratigraphic correlation. The Coal Geology Subdivision is responsible for providing the estimates of Canada's coal resources, for development of the National Coal File by accumulation of data, and for the development of regional models of coal occurrence. The Petroleum Geology Subdivision objectives are to identify the oil and gas resource base of Canada and to determine the probable distribution and potential abundance of oil and gas resources. The Geological Publication Subdivision is concerned with processing, publication and dissemination of information on Canada's sedimentary basins and resources. Activities in the four scientific subdivisions at I.S.P.G., that is the Regional Geology, Paleontology, Petroleum Geology, and Coal Geology Subdivision reflect the four Strategic Objectives of I.S.P.G. as follows:

1. To map, describe and explain the bedrock geology of sedimentary basins in western and northern Canada.

2. To develop and modify biochronologic standards essential to correlation and comprehension of bedrock geology in the sedimentary basins of western and northern Canada.

3. To assess the probable distribution and potential abundance of the oil and gas resources of Canada.

4. To investigate the geology of coal deposits in western and northern Canada; to determine extent, quality and quantity of selected coal deposits; to develop a National Coal Data File as an integral part of the National Coal Inventory.

The Adminstration Office provides financial services, central registry, stationary and supplies, and office services including the Word Processing Centre. I.S.P.G. maintains and administers its building owned by the Department of Energy, Mines and Resources, and as a result building and engineering services are an important component within Administration.

The present establishment of the Institute is 151 person years including 80 scientific and professional positions, 8 operational, 35 technical, 3 administrative and 25 administrative support positions.

A repository is maintained for samples, core and other data resulting from both onshore and offshore exploration drilling by industry in the Yukon Territory, the Northwest Territories, including the Arctic Islands and for samples from all provinces and continental shelves of western Canada. Most of the material is available to the public for free examination and is used by the I.S.P.G. in research activities.

Attendance at Meetings Conferences and Courses

W.W. Nassichuk

Branch Management Committee Meeting, Halifax, June, 1983.

Oil and Gas Panel Meeting, Ottawa, June, 1983.

Liaison on collaborative research with U.B.C. Staff, Vancouver, June, 1983.

Branch Management Committee Meeting, Ottawa, September, 1983.

Meeting with COGLA, Ottawa, October, 1983.

Meeting with Kelowna Chamber of Commerce, Minerals and Mines, Kelowna, October, 1983.

Meeting with GSC, U.B.C. Personnel, Vancouver, November, 1983.

Oil and Gas Panel Meeting, Ottawa, November, 1983.

Branch Management Committee Meeting, Ottawa, December, 1983.

Meeting with B.C. Ministry of Energy, Mines and Petroleum Resources, Victoria, December, 1983.

Meeting with Alberta Geological Survey, Edmonton, December, 1983.

Branch Management Committee Meeting, Ottawa, January, 1984.

Branch Management Committee Meeting, Ottawa, March, 1984.

J. Andrechuk

Pitman Shorterhand Theory and Speed, Calgary, September, 1983 to May, 1984.

Roles and Functions of Supervision, Public Service Commission, Calgary, November 14-18, 1984.

Air Canada Seminar, Calgary, February 15, 1984.

Xerox Word Processing, Calgary, April 14-17, 1984.

Special Talks and Lectures

W.W. Nassichuk

"History of Exploration and Petroleum Potential in the Canadian Arctic Archipelago", Mines and Minerals Branch, Camoson College, Kelowna, October, 1983.

"Basin Analysis in the Geological Survey of Canada" I.S.P.G. Boardroom.

Membership on Committees

W.W. Nassichuk

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

Member, North American Working Group on Middle Pennsylvanian of North America.

Co-Chairman, Working Group on Permian Stratigraphy on Boreal Relations.

J.E. Brindle

Chairman, I.S.P.G. Ad Hoc Committee on Open House.

Chairman, I.S.P.G. Ad Hoc Committee on Space Allocation.

Member, Computer Service Committee.

Member, University Research Park Committee.

ADMINISTRATIVE SUBDIVISION

K.M. Cameron

The objectives of the Adminstrative Subdivision are directed toward providing efficient and timely adminstrative services to the Institute. This support includes the maintenance of the building, laboratory instrument repair and development plus the general housekeeping of the building and grounds.

The Subdivision is manned by a staff of 20. During the fiscal year 1983-84, the following staff changes occurred:

Promotions

Mrs. C. Thompson was promoted from a CR-03 to a SCY-02 on August 31, 1984.

Appointments

Mrs. D.K. Albert transferred from National Revenue, Customs and Excise to our Accounts and Finance Office in November 7, 1983.

Mrs. S.B. Alert was appointed to Central Registry on December 1, 1983.

Appointments

Miss M.L. Varalta was appointed to Word Processing on February 14, 1984.

Attendance at Meetings Conferences and Courses

D.K. Albert

Job Description Writing Course, Calgary, Alberta, January 17-18, 1984.

DSS: Data Input Requirements, Edmonton, Alberta, February 21, 1984.

P.C Broad

Introduction to Personnel Management, Edmonton, October 17-21, 1983.

Job Description Writing Course, Calgary, Alberta, January 17-18, 1984.

Leave Reporting Systems, Edmonton, Alberta, February 22, 1984.

P.L. Greener

Supervision and Management of Word Processing Operators, Calgary, Alberta, November 28, 1983.

M.A.T. Hennessey

Job Description Writing Course, Calgary, Alberta, January 17-18, 1984.

D.Y.H. Li

Registered Industrial Accountant Course, Calgary, Alberta, September 13 to December 16, 1983.

A.E. Oliver

Programming In Basic, Calgary, Alberta, September 21 to November 9, 1983.

A. Stadnyk

Power Conditioning Equipment for Computer Installations, Calgary, Alberta, October 5, 1983.

M. Stadnyk

Leave Reporting Systems, Edmonton, Alberta, February 22, 1984.

W.J. Williams

Hazardous Chemical Safety Course, Calgary, Alberta, May 10-13, 1983.

REGIONAL GEOLOGY SUBDIVISION

D.G. Cook

The objectives of the Regional Geology Subdivision are directed toward the increased understanding of the depositional and deformational history of Proterozoic and Phanerozoic sedimentary rocks of Western and Arctic Canada. The investigations provide the data base essential for the appraisal of the potentialities of these sedimentary suites, both as reservoirs for, and sources of oil and gas, and as host rocks for other economic deposits including coal, potash, lead, zinc and copper.

The Regional Geology Subdivision is organized along geographic lines, partly in response to similar geological problems and partly because of similar logistical problems. It comprises three sections. The Arctic Islands Section is responsible for the sedimentary areas of the Arctic Islands with geological investigations being concerned mainly with Proterozoic and Phanerozoic rocks of the Franklinian Geosyncline, Stable Platform, and Sverdrup Basin. The Northern Mainland Section is concerned with sedimentary regions of the Yukon and Mainland Northwest Territories, including the Mackenzie Delta and Beaufort Sea. The Southern Mainland Section is responsible for sedimentary rocks lying within the prairie provinces and eastern British Columbia.

The Institute is the repository for cutting samples, cores, and other data resulting from both onshore and offshore exploration drilling by industry in Yukon Territory, Northwest Territories, including the Arctic Islands and for samples from all provinces of Western Canada. Some twelve (12) million samples and 25,000 boxes of core are stored at the Institute; the number of samples 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 more than 70,000 wells drilled in Western and Arctic Canada.

Highlights

Mapping of the south flank of the Schei Syncline (North Kent Island to Dundas Harbour, southeast Ellesmere Island) has been completed. East of Starnes Fiord extensive, northeast trending strike-slip faulting caused folding and faulting in three vertically distinct, structural styles.

The stratigraphy and sedimentology of Mesozoic strata of western Axel Heiberg Island was clarified. Marked thickness variations in the strata demonstrate that salt diapirism occurred from Middle Triassic to Tertiary in the area.

Mapping and stratigraphic studies in Niddery Lake map-area (105-O) show that: 1) highly compressed strata (shortened to 20% of their original length) range in age from Lower Cambrian to Devonian; 2) these strata are detached from upper Proterozoic rocks which are mildly compressed (to 80% original length); 3) highly compressed strata form continuous sheets of stacked isoclinal folds and imbricate thrusts right across the entire Niddery Lake map-area thus representing about 150 km of shortening; 4) both the highly compressed rocks and underlying Proterozoic strata are refolded into east-west structures in the southern map-area.

A northeast-trending, Precambrian fault, recognized from subsurface data in Great Bear Plain, was seen to have influenced the level and style of Mesozoic deformation in the frontal Mackenzie Mountains. One of the ramifications of this discovery is that Leith Ridge Fault, a larger member of the same fault set, probably controlled the eastward offset in the latest Proterozic continental margin near the 60th parallel.

Documentation of thickness variations in the Early Paleozoic carbonate shelf sequence of the Northern Mackenzie Mountains has led to the identification of previously undescribed tectonic features such as the Godlin Salient. The differential tectonic movements that caused the development of these features may have played a role in localizing the carbonate-hosted Pb-Zn mineralization in part of this region.

A new model was developed for the deformation of the northern Franklin Mountains. Complexities including a variety of structural trends, and reversals in the sense of relative transport are attributed to regional shear acting in conjunction with shortening above a detachment zone in Upper Cambrian salt. The regional shear component is attributed to dextral re-activation of Precambrian faults beneath the detachment zone.

Available evidence on the Devonian of the southwestern part of McBride sheet (93H) suggests that the Devonian rock record is totally different from the Devonian in the northeastern part of McBride sheet, east of the Rocky Mountain Trench, both in terms of lithology and homotaxy. These relationships suggest that the Quesnel Highland was wrench-faulted into its present position.

The sandstone-rich Mattson Formation in southeastern Yukon, is a thick, coal-bearing deltaic unit that prograded southwestward over prodelta shale in the Golata and Besa River formations. Thick Platt-type braided-stream deposits dominate the Mattson fluvial facies. Two main sequences of delta plain deposits, separated by marine deposits occur. The level of thermal maturation for most of the Mattson is moderate and within the oil window.

Personnel Notes

Dr. Donald F. Stott was awarded the Willet G. Miller Medal of the Royal Society of Canada which is presented each year for outstanding research in earth sciences. The presentation was made in Vancouver in May 1983 at the Annual Meeting of the Royal Society.

Dr. Raymond Thorsteinsson was made a member of the Order of Canada in April, 1983.

Dr. Donald. F. Stott received a promotion to RES-4 effective April, 1984.

Dr. Ashton Embry returned to the ranks of Regional Geology in December, 1983 after approximately 2 years with Petroleum Geology on secondment.

Dan Northcott left the I.S.P.G. at the end of the fiscal year after a four and one-half month term working in Core and Sample.

Attendance at Meetings Conferences and Courses

I. Bannerjee

CSPG Mesozoic of Middle North America Conference, Calgary, May, 1983.

M.P. Cecile

GAC/MAC General Meeting, Victoria, May, 1983.

GSC Activities Forum, Ottawa, January, 1984.

B.C. and Yukon Chamber of Mines, Vancouver, January, 1984.

R.L. Christie

Meeting and Seminar on Canadian Cordilleran phosphates, GAC-CIM-BC Ministry of Energy, Mines and Petroleum Resources, Victoria, March, 1984.

D.G. Cook

CSPG Mesozoic of Middle North America Conference, Calgary, May, 1983.

GAC/MAC General Meeting, Victoria, May, 1983.

Rocky Mountain Association of Geologists Meeting, Denver, Colorado, October, 1983.

J. Dixon

CSPG Mesozoic of Middle North America Conference, Calgary, May, 1983.

A.F Embry

CSPG Mesozoic of Middle North America Conference, Calgary, May, 1983.

GSA Annual Meeting, Indianapolis, Indiana, October/November, 1983.

H.H.J. Geldsetzer

GAC/MAC General Meeting, Victoria, May, 1983.

International Carboniferous Conference, Madrid, Spain, August, 1983 (personal expense).

M.E. McMechan

CSPG Mesozoic of Middle North America Conference, Calgary, May, 1983.

GAC/MAC General Meeting, Victoria, May, 1983.

University of Montana Belt Symposium, Missoula, Montana, October, 1983.

N.C Meijer-Drees

CSPG Mesozoic of Middle North America Conference, Calgary, May, 1983.

D.W. Morrow

CSPG Mesozoic of Middle North America Conference, Calgary, May, 1983.

B.C. Richards

GAC/MAC General Meeting, Victoria, May, 1983.

D.F. Stott

CSPG Mesozic of Middle North America Conference, Calgary, May, 1983.

Royal Society Meeting, Vancouver, May, 1983.

GSA Penrose Conference on Cretaceous Paleoclimates, Florissant, Colorado, October, 1983.

H.P. Trettin

GAC/MAC General Meeting, Victoria, May, 1983.

Special Talks or Lectures

I. Banerjee

"Subsurface facies of the Cutbank Sandstone, Mannville Group, Southern Alberta", CSPG Mesozoic Conference, Calgary, May, 1983.

"Subsurface facies of the glauconitic sandstone, Mannville Group, Southern Alberta", CSPG Mesozoic Conference, Calgary, May, 1983.

M.P. Cécile

"Isotopic composition of western Canadian barites", GSC Activities Forum, Ottawa, January, 1984.

R.L. Christie

"Phosphogenic basins and phosphate economics in the Cordilleran region of western Canada", GAC/CIM/B.C. Ministry of Energy, Mines and Petroleum Resources meeting and seminar, Victoria, March, 1984.

D.G. Cook

"The role of dextral shear in forming the northern Franklin Mountains", GAC/MAC General Meeting, Victoria, May, 1983.

"Northern Franklin Mountains: A scale model of the U.S. Rocky Mountain foreland", CSPG Structure Division, June, 1983.

"Northern Franklin Mountains: a scale model of the U.S. Rocky Mountain foreland", RMAG Meeting, Denver, Colorado, October, 1983.

J. Dixon

"Late Jurassic to Albian paleogeography of the northern Yukon and northwestern District of Mackenzie, Arctic Canada", CSPG Mesozoic Conference, Calgary, May, 1983.

"Hydrocarbon potential of Jurassic and lower Cretaceous rocks in the Beaufort-Mackenzie Basin", McConnell Club, October, 1983.

"Hydrocarbon potential of Jurassic and lower Cretaceous rocks in the Beaufort-Mackenzie Basin", CSPG Luncheon Meeting, October, 1983.

"River-dominant deltas", University of Calgary, Department of geography Graduate Seminars on Deltaic Sedimentation, January, 1984.

A.F. Embry

"Lower Triassic stratigraphy of Sverdrup Basin", CSPG Sedimentology Division, April, 1983.

"Mesozoic stratigraphy - Sverdrup Basin", CSPG Mesozoic Conference, Calgary, May, 1983.

"Depositional sequences - fact or fiction?", McConnell Club, October, 1983.

"Depositional sequences - fact or fiction?, GSA Annual Meeting, Indianapolis, Indiana, October/November, 1983.

"Mesozoic stratigraphy - Sverdrup Basin", USGS, Menlo Park, California, February, 1984.

H.H.J. Geldsetzer

"The lower Carboniferous of Atlantic Canada: A Zechstein-like evaporite basin", International Carboniferous Conference, Madrid, Spain, August, 1983.

M.E. McMechan

"Changes in structural style between Peace River and Smoky River, Rocky Mountain Foothills, Alberta and B.C.", CSPG Structure Division, October, 1983.

D.W. Morrow

"Dolomitization - chemical control of dolomitization", University of Calgary, Geology Department Seminar on Sedimentary Geochemistry, May, 1983.

"Dolomitization - models of dolomitization", University of Calgary, Geology Department Seminar on Sedimentary Geochemistry, May, 1983.

B.C. Richards

"Conodont biostratigraphy and sedimentology of the lower Carboniferous of the Monkman Pass area, N.E. B.C.", CSPG Lunch Meeting, January, 1984.

D.F. Stott

"Cretaceous sequences of the Foothills of the Rocky Mountains", CSPG Mesozoic Conference, Calgary, May, 1983.

"Record of Late Jurassic-Early Cretaceous foredeeps", Royal Society Meeting, Vancouver, May, 1983.

"Cretaceous paleogeography and tectonic events in Western Canada Basin", GSA Penrose Conference, Florissant, Colorado, October, 1983.

H.P. Trettin

"Innuitian mobile belt of the Arctic: early Paleozoic link between Caledonian and Cordilleran belts", GAC/MAC Meeting, Victoria, May, 1983.

Membership on Committees

J.D. Aitken

Corresponding Member, Precambrian-Cambrian Boundary Working Group, International Union of Geological Sciences.

Member, Canadian Working Group on Precambrian Stratigraphy.

Co-editor, Sedimentary Cover of the North American Craton - Canada (DNAG; GSC Sp. Publ. No. 2).

Member, ISPG Committee on Guided Tours.

Member, GAC Membership Committee.

Member, GSA Committee on Nominations.

M.P. Cecile

Associate Editor, Geoscience Canada.

Chairman, CSPG International Liaison Committee.

Member, CSPG Continuing Education Committee.

Member, CSPG National Conference on Earth Science, Advisory Committee.

Chairman, CSPG Logan Day Committee.

Member, ISPG Exhibits Committee.

Director, CSPG Executive Committee.

R.L. Christie

Canadian Corresponding Member, Project 156 of International Geological Correlation program (phosphorites).

Canadian Representative (alternate), Working Group III, Young Phosphogenic Systems.

Member, ISPG Exhibits Committee.

D.G. Cook

ISPG Liaison Officer to Alberta Geological Survey.

Member, Earth Resources Sub-program Committee of the Alberta Research Council's Natural Resources Program.

Member, ISPG Computer Service Committee.

Member, CSPG International Liaison Committee.

Co-Chairman, Structure Session for CSPG/CSEG joint convention: Exploration Update '84.

J.D. Dixon

Editor, CSPG Bulletin.

Member, ISPG Stratigraphic Nomenclature Committee.

CSPG Senior Editor (ex-officio Executive Committee member).

Chairman, CSPG Publications Committee.

GAC/CSPG Paleontological Monograph Committee (CSPG Representative).

A.F. Embry

Chairman, ISPG Stratigraphic Nomenclature Committee.

Member, North American Commission on Stratigraphic Nomenclature.

M.E. McMechan

Secretary-Treasurer, Structural Geology Division, GAC.

Member, CSPG National Conference on Earth Science, Advisory Committee.

Member, CSPG Medal of Merit Committee.

Member, ISPG Library Committee.

N.C. Meijer-Drees

Co-Chairman, CSPG Sedimentology Division.

D.W. Morrow

Secretary, CSPG Executive Committee.

E.G. Snow

Member, CSPG Lexicon of Tectonic Terms Committee.

D.F. Stott

Chairman, 1983, CSPG Mesozoic Conference.

Editor, CSPG Memoir, "Mesozoic of Middle North America".

Co-editor, Sedimentary Cover of the North American Craton - Canada (DNAG; GSC Sp. Publ. No. 2).

Associate Editor, CSPG Bulletin (until December, 1983).

Member, ISPG Support Staff Field Trip Committee.

H.P. Trettin

Leader, Innuitian Volume (DNAG; GSC Sp. Publ. No. 2).

Member, Ph.D. Thesis Committee, University of Ottawa.

Lapidary

Thin sections, standard	820

Core and Sample Repository

Well Samples received:

Alberta	142,531
British Columbia	23,629
Saskatchewan	14,075
Manitoba	-
Offshore	6,000
Northwest Territories	31,050
	217,285

Mechanical logs received:

Alberta	29,445
British Columbia	1,060
Saskatchewan	3,789
Manitoba	820
Northwest Territories	400
	35,514

Territories Core Received: 1,138 boxes.

Visitors requiring core, samples, or related information: 2,250.

There are a total of 7356 boxes of core made available for examination and samples from some 850 wells were requested.

Approximately 12 million well samples and 25,000 boxes of core on active file and available for examination.

Cutting or core from about 35 wells were samples for various scientific purposes by 10 to 15 oil companies (estimate only) and our own scientific staff.

PALEONTOLOGY SUBDIVISION

E.W. Bamber

The Paleontology Subdivision is responsible for interpretation of the fossil record in Canada through studies in biostratigraphy, paleoecology and systematic paleontology. These investigations provide data that support regional mapping and stratigraphic studies, and exploration for hydrocarbons, metals and other non-renewable resources. Most of the Subdivision's activities are in northern and western Canada, but a significant number of projects deal with onshore basinal areas in eastern Canada. In all these areas, paleontology plays an important role in GSC basin analysis programs for evaluation of energy reserves.

The Subdivision develops and maintains biostratigraphic standards for regional and international correlation and carries out a continuing program for improvement of zonal schemes and more effective interpretation of paleo-environments. Most projects are directed toward well-known fossil groups that display rapid evolutionary changes and are therefore particularly useful for biostratigraphy, but relatively poorly known fossil groups are also being tested for biostratigraphic potential and application. A large part of the program involves dating and correlation by means of detailed studies of fossils recovered from cuttings and cores from northern and offshore wells.

The subdivision comprises the Micropaleontology Section, the Macropaleontology Section, the Ottawa Paleontology Section (including both Micropaleontology and Macropaleontology), and the ISPG Curation unit. Micropaleontological studies, mainly on palynomorphs, foraminifers, conodonts, and ostracodes, involve material from both surface and subsurface with emphasis on subsurface well material from frontier and offshore areas. Macropaleontological studies, on a wide variety of groups, deal mainly with surface material, but include some material from subsurface cores. In addition to paleontological studies, members of the subdivision conduct stratigraphic studies in cooperation with other units of the Geological Survey of Canada. The Curation unit is responsible for receipt, documentation, cataloguing, storage, retrieval and loans of GSC field and subsurface samples from the Calgary and Vancouver offices.

Research and service programs within the Subdivision are closely coordinated with those of other subdivisions of the ISPG, with similar programs in other divisions of GSC, and with programs of outside government agencies, universities, and industry in Canada and other countries. The function of the subdivision is conducted, in part, through contracts with consulting companies and university scientists, supervised by scientists within the subdivision. In addition, a number of EMR Research Agreements, arranged with scientists outside the Survey, are administered by the subdivision.

Paleontology Subdivision Highlights - 1983-84

Subdivision scientists and associated outside specialists completed 138 paleontological reports on 1,430 collections of fossils from outcrop and subsurface. These reports were prepared for direct quotation in publications and provided dating and correlation of rock units throughout Canada for use by the GSC and other EMR agencies, industry, the Department of Indian and Northern Affairs and Provincial Government agencies, such as the Alberta Geological Survey. In support of studies carried out by the ISPG Petroleum Geology Subdivision, a summary of Late Cretaceous and Tertiary paleontology for the Beaufort Sea-Mackenzie Delta region was completed for publication in a GSC Paper, "Petroleum Resources of the Mackenzie Delta -Beaufort Sea", and a major multidisciplinary study of the Canadian part of the Williston Basin was initiated, including biostratigraphic, paleoecologic and maturity assessments of Devonian, Carboniferous and Jurassic sections.

A synthesis and zonation of spores for the Silurian and Devonian Systems of North America and Europe was completed, jointly with staff of the British Museum of Natural History. The biostratigraphic framework thus established provides the first detailed basis for correlation between Canadian continental and marine rocks of these two systems, and contributes to the international definition of chronostratigraphic boundaries.

Scientists of the subdivision made important contributions as organizers and members of working groups within the IUGS Stratigraphic Commission. Major progress was made toward the establishment of several Stage and System boundaries, including an international agreement on the position of the Precambrian-Cambrian, Cambrian-Ordovician, Frasnian-Famennian, and Mid-Carboniferous boundaries. A paper was completed on the first reported occurrence (Wernecke Mountains, Yukon) of small, shelly fossils useful for locating the Precambrian-Cambrian boundary in the North American Faunal Province.

A detailed biostratigraphic and taxonomic study was completed on Visean (Lower Carboniferous) palynomorphs from Atlantic Canada. This work includes the recognition of three spore zones, the systematic description of new species, environmental interpretations, and a thermal maturation assessment based on colour alteration indices.

Significant progress was made in ongoing studies relating changes in the optical properties of fossils to thermal maturation levels in sedimentary rocks. Relationships were established between temperature-related color-changes in Upper Paleozoic conodonts and palynomorphs, and colour alteration indices of conodonts were correlated with vitrinite reflectance data from samples

at several stratigraphic levels in the Paleozoic. A pilot study relating variations in the optical properties of graptolite skeletal material to temperature changes determined by conodont colour alteration indices showed that graptolites may provide a useful tool for unravelling the post-depositional thermal histories of Lower Paleozoic rocks in deformed belts.

Personnel Notes

The subdivision includes 30 permanent positions (18 scientists, 8 technicians, 2 secretaries, 2 curators) and a number of temporary assistants. During the year, A.C. Higgins joined the Micropaleontology Section in Calgary and M.K. Vincent resigned from the Ottawa Paleontology Section. On October 11, 1983 A.C. Higgins was appointed Head of the Micropaleontology Section. He replaced J.H. Wall, who returned to full time research after 7 1/2 years of capable leadership in the Section.

Attendance at Meetings, Conferences and Courses

Canadian Society of Petroleum Geologists Conference "Mesozoic of Middle North America", Calgary, May 9-10.

T.P. Poulton
J.H. Wall
D.H. McNeil

International Conference on Benthonic Foraminifera - "Benthos '84', Pau, France, April.

D.H. McNeil

IUGS Subcommission on Devonian Stratigraphy, Field Conference, Montagne Noire, France, August

D.C. McGregor
A.E.H. Pedder

GSC Palynologists, Annual Meeting, Dartmouth, November

D.C. McGregor
A.R. Sweet
J.Utting
D.J. McIntyre

Tenth International Congress of Carboniferous Stratigraphy and Geology, Madrid, Spain, September 10-17, (included meeting of IUGS International Subcommission of Carboniferous Stratigraphy.)

A.C. Higgins

North-Central Section, Geological Society of America, meeting, Madison, Wisconsin, April 27-29.

T.T. Uyeno
G.S. Nowlan

American Association of Stratigraphic Palynologists, 16th Annual Meeting, San Francisco, October 25-29.

A.R. Sweet
D.J. McIntyre

Meeting of International Working Group on the Cambrian-Ordovician Boundary, People's Republic of China, October 25 - November 10.

B.S. Norford

Geological Association of Canada Annual Meeting, Victoria, May 11-13.

G.S. Nowlan
E.T. Tozer
D.H. McNeil

Canadian Paleontology and Biostratigraphy Seminar, Toronto, September 23-25.

G.S. Nowlan
E.W. Bamber

Meeting of Cambrian-Precambrian Boundary Working Group, Bristol, England, May.

W.H. Fritz

Fourth International Symposium on Fossil Cnideria, Washington, D.C., August 8-12.

E.W. Bamber

Canadian Society of Petroleum Geologists Short Course in "The Depositional Systems Approach to Stratigraphy", Calgary, November 21, 22.

J.H. Wall

Special Talks and Lectures

T.P. Poulton

The Jurassic of the Canadian Western Interior; CSPG Conference "Mesozoic of Middle North America, Calgary, May.

D.H. McNeil

Distribution of **Alveolophragmium** (R.) and **Cyclammina** in Paleogene shelf, slope, and rise facies, Beaufort Sea, Arctic Canada, Benthos '84, Pau, France, April.

A.C. Higgins

Three talks at the Xth International Carboniferous Congress, Madrid, Spain, September: Conodont provincialism in the Carboniferous; The Namurian of Europe; Recognition of a Mid-Carboniferous boundary in the Pennine Province, England.

Conodont biostratigraphy and sedimentology of the Lower Carboniferous of the Monkman Pass area, northeastern British Columbia (jointly with B.C. Richards) CSPG, Paleontology Division, Calgary, January 19.

B.S. Norford

Two talks at Meeting of Cambrian-Ordovician Boundary Working Group, Nanjing, P.R.C., October.

Review of activities of the International Working Group on the Cambrian-Ordovician Boundary; Potential stratotype sections for the Cambrian-Ordovician Boundary in Canada.

G.S. Nowlan

Phosphatic microfossils of Late Precambrian(?) age from the Vampire Formation, Wernecke Mountains, Yukon territory; Canadian Paleontology and Biostratigraphy Seminar, Toronto, September 24.

J. Utting

Palynology of the Lower Carboniferous of Canada, CSPG, Paleontology Division Meeting, Calgary.

W.H. Fritz

Precambrian-Cambrian boundary in the Canadian Cordillera; given before Precambrian-Cambrian Boundary Working Group, Bristol, England, May.

A.E.H. Pedder

Devonian biogeographical provinciality and its implications for Devonian biostratigraphy; CSPG Paleontology Division, Calgary.

Rugose corals and the Frasnian-Famennian boundary; N.E. Geological Society of America Meeting, Providence, R.I.

Membership on Committees

E.W. Bamber

Dinantian Working Group within International Subcommission on Carboniferous Stratigraphy.

North American Study Group, International Subcommission on Permian Stratigraphy.

Middle Pennsylvanian Working Group, Dinantian Working Group, International Subcommission on Carboniferous Stratigraphy.

M.J. Copeland

International Union of Geological Sciences, Subcommittee on Silurian Stratigraphy, Corresponding Member.

International Research Group on Paleozoic Ostracods, International Paleontological Association, President.

North American Paleontological Convention III, Committee Member and Editorial Committee.

Geological Survey of Canada, Education Committee, Chairman.

Geological Survey of Canada, Library Committee.

National Inventory Programme, Paleontology data base, National Museums of Canada.

Cultural Property Export and Import, Department of Communications, Expert Examiner, Paleontology.

W.H. Fritz

Precambrian-Cambrian Boundary Working Group, International Union of Geological Sciences, International Geological Correlation Program.

A.C. Higgins

Secretary, Mid-Carboniferous Boundary working group of IUGS Subcommission of Carboniferous Stratigraphy.

Corresponding Member, IUGS Subcommission of Carboniferous Stratigraphy.

Alternate Member to the Alberta Paleontological Advisory Committee.

Co-Editor Mid-Carboniferous Boundary Working Group proceedings, Xth Carboniferous Congress, Compte Rendu.

D.C. McGregor

IUGS Subcommission on Devonian Stratigraphy, Voting Member; member of working group on "Correlation of marine and non-marine facies"; North American Devonian study Group - Organizing Member.

IUGS Working Group on the Devonian-Carboniferous Boundary, Corresponding Member. Biostratigraphic Subcommittee of American Commission on stratigraphic Nomenclature, member.

International Commission for Palynology, Vice president, Member of Hystricospore Working Group.

Commission Internationale de Microflore du Paleozoique, member of executive committee.

American Association of Stratigraphic Palynologists, representative to International Commission for Palynology; member of committee for revision of by-laws; member of awards committee.

D.H. McNeil

Canadian Paleontological Monograph Series (GAC-CSPG), Associate Editor, Secretary of committee for Palaeontographica Canadiana.

ISPG Committee on Open House

ISPG Exhibits Committee.

B.S. Norford

Working Group on Cambrian-Ordovician Boundary, International Commission on Stratigraphy, Chairman.

Working Group on Ordovician-Silurian Boundary.

International Commission on Stratigraphy, Corresponding Member.

Palaeontographica Canadiana, Associate Editor.

Board of Directors Canadian Energy Research Institute

Chancellor, University of Calgary.

Canadian Geoscience Council Visiting Committee to the Geological Survey of Canada, Liaison officer.

Energy, Mines and Resources, Committee for Evaluation of Earth Sciences Services Program, Geological Survey of Canada.

A.W. Norris

Subcommission on Devonian Stratigraphy, International Union of Geological Sciences, Voting Member.

North American Devonian Study Group, Organizing member.

G.S. Nowlan

Chairman of the Joint Committee on Paleontological Monographs representing GAC.

IUGS Subcommission on Silurian Stratigraphy, Corresponding Member.

IUGS Ordovician-Silurian Boundary Working Group, Corresponding Member.

Publications Committee, Geological Association of Canada, Member (Editor, GEOLOG).

Advisory Committee for Ms. I. Munro, Ph.D. candidate, Ottawa University.

Member, North American Ordovician Chronostratigraphy Working Group, IUGS Subcommission on Ordovician Stratigraphy.

Member, Public Information Committee, Geological Association of Canada

Member, Billings Medal Committee, Paleontology Division, Geological Association of Canada

Special Series Editor, Geoscience Canada.

A.E.H. Pedder

International Association for the Study of Fossil Cnidaria, Council member.

Subcommission on Devonian Stratigraphy,

International Union of Geological Sciences, Corresponding Member.

North American Devonian Study Group

T.P. Poulton

ISPG Nomenclature Committee, Member.

Alberta Paleontological Advisory Committee

IUGS Jurassic Subcommittee; full member; Member of 2 working groups.

Canadian representative to IGCP Project 171 (Circum-Pacific Jurassic) and on 4 working groups.

A.R. Sweet

Sixth International Palynological Conference, organizing committee.

E.T. Tozer

IUGS Subcommission on Triassic Stratigraphy, Vice Chairman.

IUGS Commission on Stratigraphy, Working group on Permian-Triassic Boundary, Chairman.

J. Utting

International Commission for Palynology, Councillor representing Canadian Association of Palynologists.

International Palynological Conference - organizing committee.

IUGS Working Group on the Permian-Triassic boundary.

ISPG Tour committee

ISPG Safety Committee, Chairman.

T.T. Uyeno

North American Working Group on the Devonian System.

J.H. Wall

ISPG Library Committee, chairman

Journal of Foraminiferal Research, Associate Editor.

International Working Group on the Jurassic-Cretaceous boundary, correspondent member.

Member, University of Calgary Sigma Xi Chapter, Admissions Committee.

D.J. McIntyre

American Association of Stratigraphic Palynologists, Director.

Laboratory Statistics - Calgary

Foraminifer Laboratory

The laboratory processed 847 samples from outcrop and well material. Of these 781 were for scientific projects led by D.H. McNeil and J.H. Wall and the remainder were for projects led by other scientists.

Conodont Laboratory

The laboratory processed 374 samples from outcrop and well material. In addition the laboratory technician organized data and shipping and monitored results for processing of 460 samples on two separate, outside contracts. All samples are for study by T.T. Uyeno and A.C. Higgins.

Palynology Laboratory

The laboratory processed 1,573 surface and subsurface samples. Most of these were prepared at the request of geologists of the Coal and Regional Geology Subdivisions for miospore studies undertaken by D.J. McIntyre, A.R. Sweet and J. Utting. The preparations contained pollen, spores and dinoflagellates ranging in age from Devonian to Pliocene. One hundred and thirty two samples were prepared for service projects for palynologists outside of the ISPG to meet contractual committments undertaken by the Subdivision.

Macropaleontology Laboratory

The prime output consisted of 1,567 coral and foraminiferal thin-sections for study by A.E.H. Pedder, E.W. Bamber and B.S. Norford and paleontologists outside ISPG. Fossils were picked and sorted from 4 acid residues and 47 replicas were made by moulding and casting techniques.

Curation Statistics - Calgary

"C" Numbers Issued	11,000
New Collections (surface)	10,883
New Collections (subsurface)	1,700
Transferred from Ottawa	5,000

Fossils, rocks, and thin sections were loaned to, donated to, or processed for: 9 Canadian universities, 1 foreign university, 6 exploration companies, 6 Canadian government agencies. Total 22 agencies.

Laboratory Statistics - Ottawa

Lapidary Laboratory

Rock thin sections	
Standard, produced by laboratory	4,025
Oriented	100
Large	150
Polished, purchased by contract	1,338
Polished, produced by laboratory	50
Stained thin sections	5
Grain thin sections	5
Polished rock surfaces	150
Rock trim cuts	5,500
Levelled rock surfaces and saw cuts	3,710

Paleontology Laboratory

Preparation:

Thin sections	154
Plaster casts	96
Rubber moulds	2
Silcone Rubber moulds	14
Epoxy casts	28
Conglomerate Plaques	10
Other plaques	10

Curation:

Parcels received	52
Parcels shipped	123
Fossil collections curated	317
Collections received with Calgary numbers	181

Palynology Laboratory

In the Ottawa palynology laboratory, supervised by D.C. McGregor, 163 samples were processed and 825 slides were prepared.

Conodont Laboratory

In the Ottawa conodont laboratory, supervised by G.S. Nowlan, 352 samples were acidized and 450 samples were organized for picking on outside contract.

PETROLEUM GEOLOGY SUBDIVISION

N.J. McMillan

The Petroleum Geology Subdivision is responsible for generating, compiling and interpreting the geological information necessary for the evaluation of oil and natural gas for the sedimentary basins of Arctic and Western Canada. Research is also conducted into the mode of origin and occurrence of these commodities to provide necessary background for the evaluation studies. The Subdivision activities in resource evaluation are interrelated with other programs of the Division and are coordinated with the work of other agencies within Energy, Mines and Resources. Responsibility for these programs is divided among three sections.

The Petroleum Resources Section is primarily responsible for the geological and geophysical studies required to determine petroleum plays and parametric data required for resource assessment and the maintenance of computer data files related to well data, oil and gas pool data and other information. New concepts guiding directions for research can arise from this Section's activity. Much of the work of the Section is coordinated through the Petroleum Resource Assessment Secretariat with related activities within the Institute's programs and with the Canadian Oil and Gas Lands Administration.

The Geochemistry Section provides scientific services to the Division, develops and publishes analytical techniques in X-ray diffractometry, X-ray fluorescence and analytical chemistry, and carries out research in the field of diagenesis related to the oil-generating potential of source rocks and formation of authigenic minerals in sandstone reservoirs. Crude oil studies are also undertaken to determine oil-source relationships and to document geochemical changes in crude oil composition that occur in the reservoir. Most of these studies are carried out on material from the Arctic Islands, Mackenzie Delta region and the East Coast Offshore and provide data for the Petroleum Resource evaluation program.

The Data Management Section provides computer services to the Division.

Highlights

Considerable progress has been made on a "new" basement structure map for the Western Canada Sedimentary Basin. The last basement map was made in 1964. In conjunction with the basement map, a contour map or form-line map was made of the MOHO wherever refraction data is available. In the Arctic an assessment of oil and gas possibilities was made of the Awingak and Heiberg Formations. In addition, new stratigraphic studies were made in the upper Paleozoic and Cretaceous of the NW Sverdrup Basin. Paleomagnetic stratigraphy also was done in Cretaceous rocks.

Seismic interpretation continued in the Sverdrup Basin and Beaufort Sea. On the East Coast a Jurassic paleogeographic map was made for Kimmeridgian strata because these may yield the oil for Hibernia. A diagenetic analysis of the rocks at Cretaceous-Jurassic level was started for Hibernia.

A geological appraisal - to facilitate a geochemical appraisal - of the Bakken-Exshaw Formation was started.

Approximately half the Mackenzie River corridor geological compilation was done during the year. It is anticipated that the remaining work will be finished during 1984.

A geological and geochemical evaluation of the oil shale potential of the Boyne and Favel Formations within the prairie provinces was completed with two open file reports released to the public. A draft report on the Carboniferous deposits of Nova Scotia has also been written.

Initial geochemical analysis of samples from the pre-Cambrian(?) (non-fossiliferous) section between 60°N and 64°N have been completed. Total organic carbon contents were found to be quite low and the level of inferred thermal alteration high.

Pyrolysis logs have been run for several wells in the frontier basins. The results have confirmed previous interpretations based on other types of data.

An extensive coal analysis program continued to provide sulfur, carbon, hydrogen, nitrogren data as well as trace, minor and major metal concentrations and mineralogy of selected coal samples.

The central computer facility has been expanded with the acquisition of a new CPU and additional plotter. Implementation of the old software package on the new system has been essentially completed.

Personnel Notes

The Petroleum Geology Subdivision employs a permanent staff of 16 scientists, 10 technicians, and 1 secretary. A position as Petroleum Geologist is vacant. A. Embry has returned to Regional Geology Subdivision from his temporary assignment to Petroleum Geology.

T.G. Powell resigned as Head Petroleum Geology Subdivision.

C.A. Churchill resigned as technician in the organic geochemistry section.

B. Baker resigned as Secretary to Petroleum Geology.

W.S. Hopkins resigned as Research Geologist.

D. Skibo was transferred to Petroleum Assessment Secretariat.

N.J. McMillan was promoted to Acting Head, Petroleum Geology Subdivision.

C. Thompson joined as Secretary to Petroleum Geology.

P. Brooks joined as an Organic Geochemist.

R.A. Stephenson joined as Post Doctoral Fellow to Petroleum Resources Section.

Attendance at Meetings, Conferences and Courses

N.J. McMillan

11th World Petroleum Congress, London, England, August 27 - September 3, 1983.

Scotian Shelf Committee Meeting, Halifax, Nova Scotia, Oct. 24-26, 1983.

Joint Project Review (Alberta Geological Survey), Edmonton, Alberta, December 12, 1983.

T. G. Powell

CSPG Mesozoic, Calgary, May 8-13, 1983.

Banff Conference on Organic Geochemistry, Banff, Alberta, Sept. 12-16, 1983.

A.A. Densmore

C.S.E.G. Annual Meeting, Calgary, April 26-29, 1983.

Structural Geology, Calgary, Oct. 17-21, 1983.

J. R. Dietrich

C.S.E.G. Annual Meeting, Calgary, April 26-29, 1983.

Scotian Shelf Committee Meeting, Halifax, Oct. 24-26, 1983.

Practical Seismic Interpretation, Calgary, Oct. 3-7, 1983.

Structural Geology and Geometry applied to Petroleum Geology, Calgary, Jan. 18-20, 1984.

W. S. Hopkins

Basic Log Interpretations, Calgary, May 24-26, 1983.

M. Labonte

1983 HP3000 IUG Users Group, Montreal, April 24-29, 1983.

HP Transact 3000, Calgary, Feb. 6-10, 1984.

HP3000 IUG Training, Anaheim, California, Feb 25-Mar. 03, 1983.

K. G. Osadetz

GAC/MAC, Victoria, B.C., May 11-13, 1983.

Paleomagnetic Meeting, Vancouver, B.C., November 25, 1983.

L. R. Snowdon

Banff Conference on Organic Geochemistry, Banff, Alberta, September 12-16, 1983.

Scotian Shelf Committee Meeting, Halifax, Oct. 24-26, 1983.

R.A. Stephenson

Lithoprobe, Toronto, Ontario, March 9-12, 1984.

Special Talks and Lectures

N.J. McMillan

"Petroleum Geology of Northwest Atlantic" A three-hour course, University of Alberta, Geology Department, March 5, 1984

L.R. Snowdon and T.G. Powell

"Hydrocarbon generation models" and "Geochemistry of Canadian Frontier Basins", Banff Conference on Organic Geochemistry, Banff, Alberta, Sept. 12-16, 1983.

L. R. Snowdon

"Analytical Methods of the Oilshales" and "Geochemistry of the Collingwood Formation", Oilshale Workshop, University of Waterloo, Waterloo, Ontario, Sept. 20-23, 1983.

"Early Condensate Generation", Mobil Oil, Dallas, Texas, October, 1983.

Committee Membership

T. G. Powell

ISPG Computer Management Committee, Chairman.

M. Labonte

ISPG Computer Management Committee, Member.

N. J. McMillan

CSPG "Geolog" Committee, Member.

CSPG International Devonian Symposium, Editor.

CSPG Publications and Sales Committee, Member.

1983 CSPG Conference on Mesozoic of the Middle North America, Abstract Editor.

CSPG Banff Conference Committee, Advisor in 1983.

Geological Potential Subcommittee, Member.

L. R. Snowdon

ISPG Computer Management Committee, Member.

CSPG Bulletin, Associate Editor.

CSPG Geochemistry Division, Chairman.

M. O. Fuglem

CSPG, Cross Section Committee

Organic Geochemistry Laboratories

Analysis of light hydrocarbons and organic carbon:

	82/83	83/84
Light Hydrocarbon Analysis	0	0
Organic Carbon Analysis	3,690	3,720
Total Carbon	56	214

Extraction and Separation of hydrocarbon fractions:

	82/83	83/84
Extractions	188	36
Distillations	43	28
Separations	231	70
Gas Chromatographic Analysis	250	150

Kerogen Studies:

	82/83	83/84
Isolation	140	6
CHN Elemental Analysis	330	163

Source Oil Correlation Studies:

	82/83	83/84
Gasoline Range	380	441
Mass Spectrometry (Faman)	145	35
Capillary GC/MS Analysis	25	30
Pyrolysis Gas Chromatography	20	20

Rock-Eval Analysis:

	82/83	83/84
Whole Rock Analysis	1,560	4,650

SEM Lab Statistics

	82/83	83/84
Exposures:		
Paleontology Subdivision	306	100
Petroleum	1,003	1,040
Regional 269	1,273	
Coal	190	100
Others (Machine Shop, NEB, etc.)	255	1,176

Inorganic Geochemistry

	82/83	83/84
XRD Mineral Determinations	6,541	5,634
XRF Analysis	30,285	4,564
Infra-red Analysis 12	40	
TGA/DTA	385	2,401
Atomic Absorption Analysis	181	1,959
Low Temperature Ash	33	53
High Temperature Ash	32	53
Miscellaneous		
(C, P, S, Moisture, pH)	230	763

COAL GEOLOGY SUBDIVISION

D.K. Norris

The role of the Coal Geology Subdivision continues to be that of establishing a sound geoscience base in the coal measures throughout Canada and of providing and maintaining a resource evaluation of Canadian coal deposits in collaboration with the Provinces, with industry and with the Atlantic Geoscience Centre. These activities are designed to meet policy, regulatory and information requirements of the Department of Energy, Mines and Resources.

To fulfil this role, the Subdivision is organized into three sections. The Geology of Coal Section conducts stratigraphic and structural studies of Canadian coal deposits that assist in the establishment of a geoscience data base from which resource evaluations can be made. Because of the increased importance of the domestic and foreign use of coal for the generation of electrical power, a new thrust of the section is in the direction of the geology of low rank coal deposits in western and northern mainland Canada, and of the bituminous coals of Nova Scotia and New Brunswick. The Coal Technology Section is engaged mainly in studies of the petrographic character of coal seams and their application to seam identification, correlation and quality prediction. In addition, the section is studying the trace element content of coal and the maturation of coal and organic matter in fine-grained clastic rocks. The Resource Evaluation Section is responsible for building and maintaining an inventory of exploration data relating to Canada's coal deposits. This inventory, which presently contains lithologic, coal thickness and analytical data for 8500 boreholes in Alberta, Saskatchewan and British Columbia is utilized by the Section for detailed computer-based assessments of the geology, resource quantity, mineability and quality of these coal deposits.

Highlights

The Coal Geology Subdivision continued to amass geoscientific data on the coal deposits of Canada for the National Coal Inventory. From these data are arising important new relations between petrographic composition of these coals and their reactivity; genetic relations among plant tissues and certain elements; and interpretations of paleoenvironments of coal swamps. In addition, significant progress is being made in computer applications to the processing of basic geological data for resource calculations, the definition of the Cretaceous-Tertiary boundary in the central Foothills of the Rocky Mountains and the assessment of the coal resource potential in the Mackenzie Valley pipeline corridor.

Coal Geology Subdivision highlights are as follows:

1. Trace element analyses of Canadian coals reveal that only halogens show evidence of being genetically related to the plant tissues comprising carbonaceous matter in coal. The halogens, therefore, may be important paleoenvironment indicators.

2. Inertinite macerals in the Jura-Cretaceous Kootenay coals appear to be concentrated in the lower parts of the seams and to be more reactive in the coking process than has been generally believed.

3. New marine facies (e.g. subaqueous synerisis cracks) within the coal-bearing Gething Formation of northeastern B.C. have been recognized, thereby extending our knowledge of marine horizons within the Gething of that region.

4. Significant progress is being made in the designing of data bases and computer programs to allow input, storage and retrieval of structural, stratigraphic and quality data and the estimation of errors assigned to coal resource quantities.

5. Refinements in the stratigraphy of the Upper Cretaceous - lower Tertiary coal bearing sequence in the Central Foothills of Alberta have led to firm correlations within the Coal Valley Coal Zone and to the precise definition of the Cretaceous/Tertiary boundary there.

6. Stratigraphic and structural mapping of the Brackett Basin, N.W.T., will allow the calculation of speculative resources of low rank, thermal coals in the Mackenzie Valley pipeline corridor.

Personnel Notes

The Subdivision presently consists of a permanent staff of 11 scientists, 2 technicians and one secretary.

A.R. Cameron and W.D. Kalkreuth lectured at a short course on Coal Petrology in May, 1983. The course was sponsored by the Geological Association of Canada. Co-lecturers were D. Grieve of the B.C. Ministry of Energy, Mines and Petroleum Resources and M.R. Bustin of the University of British Columbia.

D.W. Gibson and D.K. Norris led a field trip in conjunction with the Canadian Society of Petroleum Geologists Conference "Mesozoic of Middle North America" to the Crowsnest Pass to examine the stratigraphy, sedimentology and structure of the coal-bearing Kootenay Group in May, 1983.

F. Goodarzi helped supervise thesis research activities of T. Gentzis, a graduate student at the University of Alberta whose thesis will deal with petrology of coal from Hat Creek, B.C.

F. Goodarzi visited several laboratories in Europe (Essen, W. Germany; Petten, Netherlands; Liege, Belgium) which use automated microscopic equipment. He also visited laboratories of Wild-Leitz and Carl Zeiss (microscope manufacturers) in W. Germany and the University of Newcastle in the U.K.

M. Hebert, a graduate student at the University of Sherbrooke (PQ), spent 4 months at the ISPG under the direction of W.D. Kalkreuth studying techniques of coal petrology and carrying out analyses on feed coals and liquifaction residues of various Canadian coals.

L. Hills and D.K. Norris led a field trip for the support staff of I.S.P.G. to examine the geology of the Foothills, Front and Main Ranges of the Rockies and to tour the Athabasca Glacier in the Columbia Icefield.

W.D. Kalkreuth, F. Goodarzi, and A.R. Cameron spent time during the year planning for the 1984 annual meeting of the International Committee for coal petrology which will be

held in Calgary. They continued co-operation with the Alberta Research Council (contacts M. DuPlessis and S. Parkash).

Attendance at Meetings Conferences and Courses

A.R. Cameron

North American Coal Petrologists - Merrillville Indiana, November 1983.

Geological Association of Canada, Annual Meeting, Victoria, B.C., May, 1983.

Canadian Coal Petrographers, Vancouver, B.C., December, 1983.

F.M. Dawson

Mesozoic of Middle North America Conference, C.S.P.G., May, 1983, Calgary.

Introduction to Computing Science, University of Calgary, July-August, 1983.

Statistics and Data Analysis in Geology, University of Calgary, January-March, 1984.

D.W. Gibson

Mesozoic of Middle North America Conference, C.S.P.G., May 1983, Calgary.

Tenth International Congress of Carboniferous Stratigraphy and Geology, September 1983, Madrid, Spain.

Annual Meeting I.G.C.P. Project 166 Correlation of Coal Bearing Formations, September 1983, Madrid, Spain.

F. Goodarzi

Canadian Coal Petrographers, Vancouver, B.C., December 1983.

T. Jerzykiewicz

Mesozoic of Middle North America Conference, C.S.P.G., May 1983, Calgary.

W.D. Kalkreuth

Geological Association of Canada Annual Meeting, Victoria, B.C., May 1983.

Canadian Coal Petrographers, Vancouver, B.C., December 1983.

D.K. Norris

Geological Association of Canada, Annual Meeting, Victoria, B.C., May 1983.

B.D. Ricketts

Mesozoic of Middle North America Conference, C.S.P.G., May 1983, Calgary.

Yellowknife Geoscience Forum, December 1983.

Special Talks or Lectures

A.R. Cameron

"Rank studies in Kootenay Coals" Canadian Coal Petrographers Meeting, Vancouver, December 1983.

"Status of Coal Petrology in Canada". North American Coal Petrographers, Merrillville, Indiana, November 1983.

F.M. Dawson

"Coal Exploration and Development Potential Southern Canadian Rocky Mountains; The Mesozoic of Middle North America", C.S.P.G. Conference, Calgary, May 1983.

D.W. Gibson

"Triassic Stratigraphy of the Rocky Mountain Foothills and Front Ranges in Western Canada", presented at C.S.P.G. Symposium Mesozoic of Middle North America, Calgary, May 1983.

Led field trip to examine stratigraphy and sedimentary environments of the Jurassic-Cretaceous Kootenay Group, Highwood Pass - Kananaskis Country, Alberta, for C.S.P.G., August 1983.

F. Goodarzi

"Petrological characteristics of graptolites and chitinozoa", Canadian Coal Petrographers Group, Vancouver, B.C., December 1983.

Lecture on "Coal Petrology" at University of Newcastle, U.K.

J.D. Hughes

"Objectives, Methodologies and Products of Canada's National Coal Inventory". CIMM District 5 Meeting, Calgary, September 1983.

Computer-based methods and products of Canada's National Coal Inventory; poster session presented at B.C.-Yukon Chamber of Mines meeting, Vancouver, January 1984.

T. Jerzykiewicz

Led field trip to examine structure, stratigraphy and sedimentary facies of the Paleocene and Lower Cretaceous coal-bearing strata in the Coalspur and Grande Cache areas, Alberta, for C.S.P.G., May 1983.

W.D. Kalkreuth

"Introduction to Coal Petrology and its Application to Coal Conversion". Lecture at University of Sherbrooke (PQ).

"Regional pattern of thermal maturation as determined from coal rank studies, Rocky Mountain Foothills and Front Ranges north of Grande Cache, Alberta" (with M. McMechan). Poster session C.S.P.G. Annual Meeting, Calgary, May 1983.

"Organic Petrology of some Canadian oil shales". Canadian Coal Petrographers Group, Vancouver, B.C., December 1983.

D.K. Norris

"Porcupine Virgation - the Structural Link among the Columbian, Innuitian and Alaskan Orogens", Geological Association of Canada Annual Meetings, Victoria, B.C., May, 1983; Structural Division of C.S.P.G., September 1983; McConnell Club, November 1983.

"The Northern Cordillera - its Structural and Stratigraphic Attributes", Geological Association of Canada, Annual Meetings, Victoria, B.C., May 1983.

B.D. Ricketts

"A summary of coal geology in the Canadian Arctic Archipelago", presented at Yellowknife Geoscience Forum, December 1983.

Sessional lecturer (Fall semester) at the University of Calgary, presenting a course of 32 lectures and one field trip (Waterton Park), on aspects of Precambrian geology.

Membership on Committees

A.R. Cameron

International Committee for Coal Petrology, member.

Chairman, Canadian Coal Petrographers Group.

Editorial Board, International Journal of Coal Geology (Elsevier, publisher).

F.M. Dawson

Chairman, Coal Group, Canadian Society of Petroleum Geologists.

D.W. Gibson

C.S.P.G. Mesozoic of Middle North America Organizing Committee, 1983, member.

D.W. Gibson

C.S.P.G. Mesozoic of Middle North America, Field Trips Committee, 1983, co-chairman.

I.G.C.P. Correlation of Coal-Bearing Formations Project 166, national representative.

EMR Departmental Coal Committee, member.

F. Goodarzi

International Committee for Coal Petrology, member.

Editorial Board of Fuel, member.

Library Committee, I.S.P.G., member.

W.D. Kalkreuth

International Committee for Coal Petrology, member.

B.D. Ricketts

C.S.P.G. Mesozoic of Middle North America, 1983, Registration Committee, Chairman.

I.S.P.G. Library Committee, 1983, member.

Associate Editor, Bulletin of Canadian Petroleum Geology, 1983.

G.G. Smith

Coal Division, Technical Programs Committee, Canadian Istitute of Mining and Metallurgy, member.

Coal Technology Laboratory

The number of pellets prepared during the year totaled 1177. These included about 400 samples of coal mainly from the Kootenay Group, which were submitted for mineral matter and trace element analyses. During the year the laboratory acquired an image analysis system (IBAS from Zeiss), which, when properly programmed, will result in much more rapid reflectance measurements.

PETROLEUM RESOURCE APPRAISAL SECRETARIAT

R.M. Procter

The Secretariat, which is a small staff group within ISPG, was created early in 1980. The Secretariat's major responsibility is for the preparation of estimates of Canada's potential oil and gas resources, including the provision and testing of methodology, convening of evaluation meetings, final responsibility for estimates and preparation of reports. The Secretariat provides functional direction to the GSC petroleum resource evaluation activities at ISPG and AGC and liaison with geologists and geophysicists in Canada Oil and Gas Lands Administration (COGLA).

The results of resource evaluation work done by GSC is communicated to a Petroleum Resource Appraisal Panel, chaired by the ADM Petroleum and consisting of ADM's in Energy, Science and Technology plus representatives from INA and NEB. Panel meetings are held every 6 to 8 weeks to review specific resource base topics, identify priorities in evaluations, and to discuss oil and gas resource activity in general.

An additional role of the Secretariat is the curation of all resource estimate data and files and provision of data to downstream cost and supply analysis groups.

Highlights

Highlights for Petroleum Resource Secretariat include:

1. June, 1983 - Oil and Natural Gas Resources of Canada - 1983. Presented draft of "Blue Book" to Petroleum Resource Appraisal Panel. Report open filed in December and published January 1984 as G.S.C. Paper 83-31.

2. November, 1983 - Presented major new assessment, Petroleum Resources of the Mackenzie Delta -Beaufort Sea to Petroleum Resource Appraisal Panel (Panel Report 83-03).

3. December, 1983 - Presented major new assessment Petroleum Resources of the Scotian Shelf to the Petroleum Resource Appraisal Panel (Panel Report 83-04).

4. February, 1984 - Presented report summarizing activity and developing trends entitled Exploration Highlights Panel (Panel Report 84-01).

5. March, 1984 - Completed documentation and installation of PRIMES, a linked multiprogram computer software system for petroleum resource assessment usage.

Personnel Notes

The Secretariat currently consists of an Executive Director, four scientists, and a secretary

R.M. Procter	-	Executive Director
G.C. Taylor	-	Senior Petroleum Geologist
P.J. Lee	-	Senior Geologist -Resource Evaluation Methodology
M. Raicar	-	Senior Heavy Oil and Enhanced Recovery Engineer
K.N. Nairn	-	Senior Resource System Engineer
D.N. Skibo	-	Rejoined the Secretariat to take on responsibility as Operations Geologist in evaluation activity
A.G. Foo	-	Secretary

Attendance at Meetings, Conferences and Courses

R.M. Procter

Participated in workshop on petroleum resource evaluation and continuing geological exchanges with USGS, May 16-20, Denver, Colorado.

Represented GSC at a meeting of the Basin Studies/Petroleum Resource Evaluation Committee of IUGS in Madrid, March 30, 1983 -April 6, 1984.

G.C. Taylor

Participated in workshop on petroleum resource evaluation and continuing geological exchanges with USGS, May 16-20, Denver, Colorado.

Advanced Petroleum Exploration Workshop, September 19-23, San Diego, California.

P.J. Lee

Discussions on methodology of petroleum resource evaluation, April 16-21, Dallas, Texas.

Patterns within the Devonian of Alberta Workshop, April 17, Dallas, Texas.

Participated in workshop on petroleum resource evaluation and continuing geological exchanges with USGS, May 16-20, Denver, Colorado.

Discussed methodology of petroleum resource evaluation with Professor G. Kaufman of M.I.T. and Professor J. Aichison of University of Hong Kong, Boston & Ottawa, August 9-12.

Scientific exchange between Germany and Canada regarding methodology of resource evaluation, October 14-23, Hannover, Germany.

K.N. Nairn

Training at University of Kansas on computer methods and the subsurface, November 7-11, Kansas City, Kansas.

HP 3000 User Group Computer Training, February 26 - March 3, 1984, Anahein, California.

A. Foo

Effective Secretary Seminar, September 6, 1983, Calgary, Alberta

Managing in the Middle, November 6-9, 1983, Banff, Alberta

Geology for Secretaries, February 1 - April 4, 1984, Calgary, Alberta.

Special Talks or Lectures

G.C. Taylor

Presented paper at G.A.C. - M.A.C. 's Annual Meeting, May 12, 1983, Victoria, B.C.

P.J. Lee

Presented methodology for petroleum resources evaluation at BGR, October 14-23, 1984, Hannover, Germany.

Presentation of methodology for petroleum resources evaluation, May 16-20, Denver, Colorado.

M. Raicar

Co-authored a paper on Simulation Study on Sensitivity of Fire-Flooding Heavy Oil

Membership on Committees

R.M. Procter

Chairman of Geological Potential Subcommittee

EMR Member of Board of Directors - Computer Modelling Group

Chairman of OERD Enhanced Oil Recovery subprogram (6.4) of Program 6 Conventional Oil and Gas

G.C. Taylor

Member of Geological Potential Subcommittee

P.J. Lee

Member of Geological Potential Subcommittee

M. Raicar

EMR Member of Technical Advisory Committee of Computer Modelling Group

Member of Technical Committee of Research Programs in Southwestern Ontario

K.N. Nairn

Member of ISPG Computer Advisory Committee

GEOLOGICAL INFORMATION SUBDIVISION

N.C. Ollerenshaw

This subdivision is responsible for communicating the results of the Institute's programs to the federal and provincial governments, their officials and agencies; and to industry, the universities and the general public. This is achieved mainly through the screening and processing of manuscripts for publication in the Geological Survey's own series of papers, bulletins and memoirs, and in established national and international scientific and technical journals. Items of immediate interest, requiring rapid publication, are made available through an Open File system. In support of this objective, the Subdivision maintains capabilities and facilities in scientific editing and information, cartography, technical photography and library services. In addition, the Subdivision maintains a large inventory of, and operates as a retail outlet for, all Geological Survey papers, bulletins, memoirs and geological maps, and departmental topographic maps for western Canada and the Canadian Arctic. The Subdivision also communicates with the scientific community and the public by responding to direct requests for information, by preparing semi-popular articles and displays, by sending news reports to technical and scientific journals and newsletters, by lectures, and by participating in the work of committees and associations.

During the past year, the two members of the editorial staff processed 25 reports in the Geological Survey series, 64 outside papers and abstracts, 5 open file reports, and 4 maps. Processing of manuscripts involves the selection of critical readers and the evaluation of their reports, scientific editing, copy editing, proofreading and, in many cases, the layout of the publication.

In 1983-84 the Subdivision printed Bulletin 313 by Norris, A.W. and Uyeno, T.T. in Calgary. I.S.P.G. involvement in the printing part of the process enabled the authors and technical staff to assert direct control over the quality of the paleontological plates with excellent results.

Most maps and illustrations produced by Institute scientists for publication are prepared in the Cartographic Section. To expedite publication, some are now prepared by the scientists themselves with the advice and guidance of our draftspersons. The work of the Section includes both black-and-white and multicoloured illustrations in addition to photo-mechanical and reproduction work. The Section also prepares slides for oral presentations and large graphic displays for workshops, meetings, and for information exchanges with universities. Good contacts are maintained with the local university and technical institute, lectures are given and students receive guided tours through our Cartographic complex as part of their course work.

The Photographic Section provides general and specialized photographic services for the Institute staff. Preparation of paleontological plates is possibly its most demanding and unique function. This entails photographing fossils from various key angles and, together with microphotography, involves about 40 per cent of the Section's effort. Copy work accounts for close to 50 per cent of staff time. Miscellaneous activities include I.D. and passport photography, specialized photographic work for some other Government departments, and an increasing amount of publicity work illustrating personnel and equipment in action. A considerable amount of photographic work was undertaken this year for foreign scientists visiting the I.S.P.G. under exchange programs.

Personnel Notes

The final months of 1983 were marked by a variety of personnel changes in the I.S.P.G. library. Marian Jones, Head Librarian for seventeen years (1966-1983 inclusive), retired in December. Flora Fritz has been Acting Head Librarian since Marian's retirement. Library clerk, Valery Chipper, left her position as Acquisitions Clerk in November to have a baby daughter, and then resigned to move to Vancouver Island. Shelley Webber replaced Valery in a term position in December, 1983, and Elizabeth Zuba began working as a term Library Assistant in January, 1984.

Don Stott, Jr. joined the library as a summer student again in 1983 during July and August.

Lynn Machan-Gorham returned to her duties as editorial assistant in August 1983, after being away on maternity leave.

Attendance at Meetings, Conferences and Courses

N.C. Ollerenshaw

Association of Earth Science Editors, annual meeting, Houston, Texas, October 9-12, 1983.

Visit to GID/GSC Ottawa, December 7-9, 1983.

L. MacLachlan

Sixth International Symposium on Automated Cartography, Calgary, Alberta, June 2-3, 1983.

Visit to GSC Ottawa, June 22-24, 1983.

Visit to DSS Edmonton, April 26, 1983.

J.W. Thomson

Visit to GSC Ottawa, December 13-16, 1983.

W.P. Vermette

Visit to GSC Ottawa, February 22-24, 1984.

B.H. Ortman

Ontario Institute of Chartered Cartographers annual general meeting in conjunction with OICC/CIS Cartotechniques III, Lindsay, Ontario, May 30-June 1, 1983.

F. Fritz

Visit to Ottawa: GSC library, Canadian Institute for Scientific and Technical Information (CISTI); NEB, CANMET and Surveys and Mapping libraries; April 1983.

EMR Job Description Writing course, I.S.P.G., Calgary, January, 1984.

Foothills Library Association workshop on "Calgary Libraries in Action", Calgary, January, 1984.

E. Zuba

Foothills Library Association workshop on "Calgary Libraries in Action", Calgary, January, 1984.

Membership on Committees

F. Fritz

I.S.P.G. Library Committee

L. MacLachlan

Chairman, I.S.P.G. Exhibits Committee

N.C. Ollerenshaw

Association of Earth Science Editors, Membership Committee, member.

I.S.P.G. Stratigraphic Nomenclature Committee, member.

I.S.P.G. Exhibits Committee, member.

B.C. Rutley

I.S.P.G. Exhibits Committee, member.

I.S.P.G. Support Staff Field Trip Committee, member.

STATISTICS ON SUBDIVISION ACTIVITIES
(April 1, 1983 – March 31, 1984)

Scientific Editor's Office

Format	Received	Edited	To Ottawa or Publisher	Printed
Memoirs	-	3	1	2
Bulletins	7	4	2	5
Papers	4	7	3	2
83-1B	14	14	14	14
84-1A	4	4	4	4
Maps	3	5	1	1
Open Files	8	N/A	5	5
Outside				
Papers	38	38	38	25
Abstracts	25	25	25	25

Geological Cartography Section

Maps and figures completed by the Cartography Section between April 1, 1983 and March 31, 1984.

	1982-1983	1983-1984
Multicolour maps and section sheets	5	1
Figure illustrations (page)	46	362
Figure illustrations (pocket)	41	15

Manuscript received	1982-1983	1983-1984
Multicolour geological maps	3	4
Figure illustrations (page)	173	407
Figure illustrations (pocket)	17	9

Maps and illustrations in progress at March 31, 1984

	1982-1983	1983-1984
Multicolour geological maps	2	5
Figure illustrations (page)	149	106
Figure illustrations (pocket)	15	9

Miscellaneous drafting which averaged approximately 28% of the total drafting time comprised 991 separate items.

Reproduction services	1982-1983	1983-1984
Diazo prints	5591	3991
Diazo prints (frame shots)	568	365
Di-chrome	477	604

Photomechanical services

Film (sheets, negatives & positives)	3903	4096
Drafting keys on scribecoat	129	49
Blueline on Cronaflex	60	48
Colour proofs	41	27
Peelcoats	54	103
C-1 prints	81	151
KC-5 prints	2071	2075
Autopositives (multiple exposure)	768	418
Sepia (dry erasable film)	184	392

Camera services

Film shots (line)	3279	7393
Film shots (halftone)	120	162
Paper	211	117

Photography Section

Production during the review years 1982-83 and 1983-84

	82-83	83-84
Total number of black and white continuous tone 4" x 5" negatives	1398	1351
Total number of black and white prints	10 525	11 884
Total number of contact proof sheets	886	773
Total number of 35 mm films (black and white and colour) submitted for processing by staff members	228	259
Total number of black and white 35 mm negative films	186	196
Total number of 35 mm colour slide films	157	259
Total number of colour negatives on file	253	945
Total number of colour prints	1949	2029

The I.S.P.G. Library

The year marks the end of an era for the Institute Library. Marian Jones, Head Librarian, retired in December, having set up an excellent earth sciences library collection and having instituted a high level of service to the Institute staff. The library is very fortunate to have gained her services and every attempt is being made to maintain the quality and to continue to improve performance. The library Acquisitions Clerk left in November on maternity leave and resigned in December to move to the milder climes of the west coast with her family.

The acquisitions work is presently being done by a term employee who joined us in December. A second term employee joined us in January to do cataloguing as well as other library duties, and services to the staff and public have been well maintained.

The Institute leased the MINISIS package, a Data Base Management System, for several applications, one of which is the automation of routine library procedures. The Assistant Librarian and Library Technician were trained in the use of MINISIS, but progress has been slower than was hoped for because of all the staff changes. The automation project has reached late planning stages and should be implemented by September, 1984.

The head librarians of the GSC libraries met for two days in February at I.S.P.G. to set out the objectives of a GSC Library Network and to discuss ways of exchanging bibliographic data created by using MINISIS. In February, the I.S.P.G. library was visited by the Systems Librarian from the Ottawa Library, to exchange information on implementing MINISIS in the two libraries, and to establish ways of merging data to create a Union List of GSC library holdings.

The Institute Library collection has now grown beyond the limit of available stack space. To alleviate the problem, a summer project was set up to move the less used sets of journals, reports and folded maps to a storage area in the basement. The project was managed with the aid of a summer student, who also helped with journal-binding preparation and the updating of the library series records, as well as helping with other library duties.

The library is in a transition stage, but without any adverse effects being suffered by its users, who continue to be considered "the raison d'être" of the library.

Library Statistics

1983-1984

ACQUISITIONS

Books, etc., acquired by purchase	730
Books, etc., acquired by gift or exchange	1017
Maps added	315

CIRCULATION

Books and periodicals (to staff only)	9288
Interlibrary loans	
Borrowed	211
Loans and photocopies provided	241

REFERENCE

Phone queries handled	1000
Online searches (for 50 topics)	100

Publications and Airphoto Section

CHARGE ACCOUNTS

A total of 20 accounts were closed during the year. Ten new accounts were opened, leaving a total of 184 accounts held in this office.

CORRESPONDENCE AND ORDERS

Approximately 2800 orders and enquiries were received by mail during the year.

TELEPHONE CALLS

Approximately 10 000 calls were received during the year.

VISITORS

A total of 10 194 persons visited the office during the year. Although sales were down during the year, a greater number of people seemed to become aware of the services offered by this office. Students from several colleges and technical schools toured the facilities during the year. The largest of these groups (30-40 students) came from Olds College.

BREAKDOWN OF SALES

	1982-83	1983-84
Surveys and Mapping	$ 96,316.80	$ 93,251.20
Nat. Air Photo Library	12,352.98	8,884.60
GSC Maps	21,441.23	11,973.65
Rock and Mineral Kits	2,556.00	1,805.00
Misc. GSC Material	1,098.13	1,192.10
GSC Publications	23,436.84	20,730.35
Mineral Development	269.00	261.10
Gravity Maps	150.00	61.50
	$157,620.98	$138,159.50

BREAKDOWN OF ACCOUNTS

	1982-83	1983-84
Credit Sales	$ 75,888.25	$ 65,754.50
Cash Sales	$ 83,229.65	$ 70,600.40
Received On Account	$ 74,391.35	$ 67,559.10

AIR PHOTOS

A total of 213 orders (162 prepaid) were forwarded to Ottawa during the year. These consisted of:

3861	Black and white contact prints
4	Colour contact prints
68	Flight line index maps
4	10" x 10" black and white enlargements
5	15" x 15" black and white enlargements
23	20" x 20" black and white enlargements
1	30" x 30" black and white enlargement
6	40" x 40" black and white enlargements
27	Enlargements to scale
1	30" x 30" colour enlargement
3	40" x 60" colour enlargements
1	15" x 15" transparency enlargement
93	Black and white diapositives
5	Colour diapositives
18	Landsat mosaics

PRECAMBRIAN GEOLOGY DIVISION

J.C. McGlynn, Director

INTRODUCTION

This Division is responsible for all aspects of the bedrock geological framework of the Precambrian Shield. In addition, units of the Division are charged with responsibility for isotope geochronological, petrological and paleomagnetic studies throughout Canada.

The objectives of the Division are: To provide systematic study of the geological framework of the Canadian Shield to standards consistent with the needs for mineral resources discovery and evaluation of future resource potential; to provide isotope geochronology and paleomagnetic studies contributing to consistent correlation and to uniform presentation of the geology of Canada; to provide petrogenetic and metamorphic studies on major rock groups and metamorphic assemblages in Canada, directed toward solution of important problems.

The Division is organized into six sections and a special project group. Three of the sections are responsible for the regional geology of the Canadian Shield and are named after the structural provinces in which they work; Bear-Slave, Northern Churchill and Superior Grenville. These sections report their bedrock studies on geological maps at various scales and in reports and scientific paprs. The Geochronology, Petrology and Paleomagnetic sections provide isotopic, petrologic and paleomagnetic studies by which age relations and processes of formation of rock assemblages are established. Special studies in the division undertake bedrock studies in volcanology, Precambrian stratigraphy and radioactive waste disposal.

The establishment consists of 62 continuing positions and 11 casual person years, largely used for employment of students for summer field work in the Canadian Shield.

Personnel Notes

F. Marier-Lalonde, formerly with Department of Fisheries and Oceans, joined the staff in November assuming the duties of Division administrative officer.

Approval of a NEED (New Employment, Expansion and Development) project proposal in May led to the selection, through Deparment of Employment and Immigration, of eight graduate geologists for a 6-month period. Patricia Hunt was selected to administer the project for its duration. Brian Goddard, Stephanie Woodend, Mark Firko, Jennifer Graves, Ross Knight, John Carmichael , Ingrid Pongratz and Alan Galley (for 1 month only) were the other members of the group. Their function was support geological work.

Dr. J. Jackson, from Bureau of Mineral Resources, Geology and Geophysics, Canberra, Australia, joined the Division April 25, for a 12 month scientific exchange working visit.

J. Patterson and D. Thompson continued as term support geologist until the end of the summer field season.

ADMINISTRATION

Attendance at Meetings, Conferences and Courses

J. MacManus

French Language Training, Branch Tutor, Ottawa.

Management by Objectives, PSC, Asticou, Quebec, January.

Management Theories and Concepts, Carleton University, Ottawa, January-March.

F. Marier-Lalonde

GSC Administrative Officers Meeting, Ottawa, March.

J.C. McGlynn

Geological Association of Canada Annual Meeting, Victoria, B.C., May.

D. Wereley

General Level - Material Management, PSC, Asticou, Quebec, July.

Supervisor Orientation, PSC, Asticou, Quebec, September.

French language course, Glebe Collegiate, Ottawa, September-December.

Membership on Committees

J. MacManus

Baillie Report Ad Hoc Committee, GSC.

J.C. McGlynn

Centre for Precambrian Studies, University of Manitoba, Board of Directors.

Northwest Territories Coordinating Committee on Work in the North.

International Union of Geological Sciences, corresponding member.

D. Wereley

GSC Christmas Party Committee.

BEAR-SLAVE SECTION

M.B. Lambert (Head)

Highlights

In the northwestern shield mapping of the northern part of the Wopmay orogen was completed as were field components of four Ph.D. thesis studies. Structural studies document the profound difference between 'Calderian' deformation, defined by the thin-skinned tectonics of the Asiak Foreland Thrusts-Fold Belt and the later 'Tree River' deformation characterized by thick-skinned tectonics in

which cover rocks were buckled into concentric folds with no associated thrusts and the basement/cover interface was shortened into lobate-cuspate folds resembling larger mullions. Unexplained patches of anomalously high "Tree River' strain and metamorphism were discovered far into the interior of the northern Slave craton. Unrelated to these events are later mega hexagonal block structures (ca. 30 - 100 km across) that developed from intersection strike-slip faults during a terminal pure shear event.

Final mapping in the western part of the Hepburn Metamorphic-plutonic Zone of the Wopmay Orogen established a ductile décollement within the Proterozoic units above the Archean basement, a regional set of inverted mineral isograds and the allochthonous nature of both the Hepburn Intrusive Suite and the associated thermal culmination. In the Hottah Terrane along the western side of the Bear Province U-Pb zircon ages from clasts in conglomerate suggests an age of about 2.27 Ga for sedimentation and volcanism and indicate that basement to the supracrustals is older than 2.27 Ga. Stratigraphic correlations between Wopmay Orogen and Kilohigok intracratonic basin were revised in a way that implies that Thelon Front and Coronation margin were active in part concurrently.

Mapping in the northeastern Slave Province and adjacent Thelon Tectonic Zone east of Bathurst Inlet showed that Archean lithologies, structural style and metamorphic grade are similar to those across the western boundary of the zone in the Healey Lake area, 100-150 km to the south. The southern area shows a general increase in metamorphic grade eastward and into the zone whereas in the northern part of the tectonic zone narrow belts of lower to middle amphibolite facies rocks separate extensive terranes of upper amphibolite migmatitic gneiss and granulites. The Goulburn Group which unconformably overlies Archean rocks east of Bathurst Inlet is metamorphosed to subgreenschist facies and folded with the basement. Farther east, greenschist facies outliers of the Group are tectonically interlayered with the Archean basement probably by northwest directed thrusts.

In the southern Slave Province, modelling of a 90 km east-west gravity profile, across the western margin of an Archean basin complex near Yellowknife suggests that the volcanics, which outcrop only at the margin of the basin, extend to a depth of 2 to 3 km and are continuous for a distance of about 15 km into the basin below the metasediments which occupy the main part of the basin.

Personnel Notes

F.H.A. Campbell continued his secondment to Headquarters.

P. Thomas joined the Section at the end of the year as a term support geologist.

P. Thompson, for 4 months of 1983, organized and ran the Precambrian High seminar series and was Division Rapporteur for Geogram.

Attendance at Meetings, Conferences and Courses

H.H. Bostock

Effective use and applications of microcomputer systems, Ottawa, October.

Geoscience Forum, Yellowknife, N.W.T., December

R.A. Frith

Geological Association of Canada Annual Meeting, Victoria, B.C., May.

NASA field trip to Kapuskasing area, September.

GSC Current Activities Forum, Ottawa, January.

J.B. Henderson

GSC Current Activities Forum, Ottawa, January.

R.S. Hildebrand

Geological Association of Canada, Victoria, B.C., May.

American Geophysical Union Meeting, San Francisco, U.S.A., December.

P.F. Hoffman

Cornell University Workshop on Cratons, Ithaca, N.Y., U.S.A., April 29-30.

Geological Association of Canada Annual Meeting, Victoria, B.C., May 11-13.

International Symposium on Evolution of Precambrian Crust, Beijing, China, September 2-8.

GSC Current Activities Forum, Ottawa, January.

Lithoprobe Workshop, Toronto, March 10-12.

Northeastern Section of Geological Society of America Annual Meeting, Providence, R.I., U.S.A., March 15-17.

M.B. Lambert

Management of R&D Personnel - pilot course, Ottawa, October 28 to December 2.

GSC Current Activities Forum, Ottawa, January.

M. St-Onge

Geological Association of Canada Annual Meeting, Victoria, B.C., May.

R. Tirrul

Geological Association of Canada Annual Meeting, Victoria, B.C., May.

GSC Current Activities Forum, Ottawa, January.

Geological Society of American Annual Meeting, N.E. Section, Providence, R.I., U.S.A., March.

Membership on Committees

A. Frith

GSC Field Equipment Committee, Chairman.

J.B. Henderson

External examiner, Ph.D. candidate.

P.F. Hoffman

Working Group 3, International Lithosphere Program, Member.

Precambrian Subcommission of International Union of Geological Sciences, Member.

Site-selection committee, Lithoprobe.

Nomination committee, Royal Society of Canada.

Associate editor, Geology.

Associate editor, Tectonics.

M.B. Lambert

Canadian National Committee, International Union of Geodesy and Geophysics.

Thesis Committees - 2 Ph.D., 1 M.Sc.

P. Thompson

Grant Committee for the "Fonds de Formation de Chercheurs et d'Action Concertéé - Québec", external member.

Screening Committee for "General Instructions for Field Parties", GSC.

Special Talks and Lectures

H.H. Bostock

"Geological Reconnaissance in the Hill Island Lake and Talston Lake areas, District of Mackenzie", Geoscience Forum, Yellowknife, December.

A. Frith

"Geochemistry and Origin of the Regan Intrusive Suite and other granitoids in the Northeastern Slave Province, Northwest Canadian Shield", Geological Association of Canada Annual Meeting, Victoria, B.C., May.

R.S. Hildebrand

"Ash-flows and their calderas", University of Connecticut, October and Ottawa University, February.

"Early Proterozoic folded cauldrons of the Labine Group", 100th Annual Krakatau Symposium, San Francisco, U.S.A., December.

Igneous petrology course, 4th year, Ottawa and Carleton Universities, Winter term.

P.F. Hoffman

"Assembly and growth of the North American craton in Proterozoic time", Cornell University Craton Workshop, Ithaca, N.Y., April 29.

"Extensive effects of three different collisions on the foreland of Wopmay orogen, northwest Canadian Shield", Geological Association of Canada Annual Meeting, Victoria, B.C., May 11.

"Three-stage subsidence of the 1.9 Ga Coronation margin", Canadian Geophysical Union, Victoria, B.C., May 13.

"Wopmay orogen: an example of early Proterozoic plate tectonics, northwest Canadian Precambrian Shield", International Symposium on Evolution of Precambrian Crust, Beijing, China, September 6.

"Wopmay orogen: an example of early Proterozoic plate tectonics, northwest Canadian Shield", University of Toronto, October 3.

"Foreland thrust and fold belt of Wopmay orogen", University of Ottawa, October 6.

"Is the Cape Smith belt a klippe", Earth Physics Branch, EMR, Ottawa, January 11 and McGill University, Montreal, February 13.

"Depositional and deformational histories of the externides of Wopmay orogen", GSC Current Activities Forum, Ottawa, January 19.

"Natural depth sections and thin-skinned tectonics in the Canadian Shield", Queen's University, Kingston, February 4.

"Subduction and accretion in Wopmay orogen", McGill University, Montreal, February 13.

"Construction and paleo-environmental dynamics of a 1.9 Ga continental margin carbonate terrace, Wopmay orogen, northwest Canada", University of Massachusetts, Amherst, Mass., U.S.A., March 13.

"Contrasting styles of crustal shortening of a 1.9 Ga continental margin, Wopmay orogen, northwest Canada", University of Massachusetts, Amherst, Mass., and Massachusetts Institute of Technology, Cambridge, Mass., U.S.A., March 14.

"Deformation and metamorphism of passive-margin prisms during continent-trench collision, as seen in the 1.9 Ga Wopmay orogen, NW Canada", NE section of Geological Society of America, Providence, R.I., U.S.A., March 16.

M.B. Lambert

"Origin of Volcanoes and the Eruption of Mount St. Helens, 1980", Dunlop School, Ottawa, April.

"Geological Excursion to Ecuador and the Galapogos Islands", United Church Men's Group, Ottawa, May.

"Evolution of the Cameron and Beaulieu River Volcanic Belts, Slave Province, N.W.T." (talk), "Cameron and Beaulieu River volcanic belts" (poster), GSC Current Activities Forum, Ottawa, January.

"Physical volcanology", graduate course, Carleton University, Ottawa, January 12-April 4.

M. St-Onge

"The Calderian Orogeny of Wopmay Orogen, N.W.T.: An evolution of an early Proterozoic collision-generated metamorphic-plutonic zone", and "Wopmay Fault zone - a major mylonite and brittle fault belt, internal zone, Wopmay orogen", Geological Association of Canada Annual Meeting, Victoria, B.C., May.

P. Thompson

"Polymetamorphism in the Healey Lake area - Implications for the Thelon Tectonic Zone", Memorial University, St. John's, Newfoundland, February 22 and Concordia University, Montreal, Quebec, March 1.

"Variations of temperature and pressure in the crust during regional metamorphism", Memorial University, St. John's, Newfoundland, February 23.

R. Tirrul

"'Calderian' structure of Asiak foreland thrust and fold belt", Geological Association of Canada Annual Meeting, Victoria, B.C., May.

Manuscripts Submitted

1 Memoir, 28 Abstracts, 12 Current Research Papers, 1 A-Series Map, 7 Outside Publications.

NORTHERN CHURCHILL SECTION

A.N. LeCheminant (Head)

Highlights

In the western Churchill Province south of Great Slave Lake, mapping in the Hill Island Lake area delineated three fault blocks involved in movements along a major north-south trending sinistral fault zone. The Tazin and Nonacho supracrustal sediments occupy different fault blocks. The Tazin Group however, has been deformed and intruded by granited whereas the Nonacho is only tilted. Two new scheelite occurrences were discovered in the Fort Smith (75D) and Hill Island Lake (75C) map-areas where tungsten mineralization was previously unknown. Scheelite occurs as veins in granite and amphibolite near contacts with megacrystic granite of Hudsonian Age.

In the central Keewatin District U-Pb zircon chronology established a 2.6 Ga age for acid volcanics of granites that are unconformably below the basal orthoquartizite of the Amer Group. Inferred depositional environments for the Amer Group are dominated by marginal marine facies and intensity of deformation and metamorphism of the Group increases from southwest to southeast.

Age determinations from the Angikumi-Yathkyed Lake region show a distinct area of at least 1000 km^2 where K-Ar ages on Archean rocks are about 2.4 Ga. A similar region was previously known near Kaminak Lake. These ages contrast with reset K-Ar dates of 1.7-1.8 Ga on Archean rocks elsewhere in southern Keewatin. U-Pb zircon chronology from southern Keewatin defines clusters of Archean ages at about 2.65-2.66 Ga and 273-276 Ga with strong evidence for isolated areas of pre 3.0 Ga crust.

A 1:500,000 geologic map of Melville Peninsula north of 68° was compiled. Geological and geophysical data shows an asymmetric distribution of rock units suggesting the region contains a tilted section through deep Archean(?) crust. High grade metamorphic rocks in the north are succeeded southward by progressively lower grade gneiss complexed and supracrustal strata.

Topical investigations of the Dubawnt Group include petrogenetic study of alkaline dykes linked to Christopher Island Formation volcanism and detailed mapping of an unusual cross-bedded sandstone facies of the Thelon Formation. Whole rock or REE and trace elements analyses show the alkaline dykes are shoshonitic lamprophyres with steep strongly LREE enriched patterns. High MgO, Ni and Cr contents suggest upper mantle origin with little fractionation. Thelon Formation sandstones north of Schultz Lake contain large-scale Festoon cross beds. The facies is interpreted as an aeolian dune field deposited by persistant westerly directed paleowinds.

Personnel Notes

S. Navratil joined the Section in the Fall as a term support geologist.

A. Galley contiued as term support geologist until the end of the field season.

Attendance at Meetings, Conferences and Courses

K.E. Eade

Prospectors and Developers Association General Meeting, Toronto, Ontario, March 4-7.

A. Fraser

Lunar and Planetary Institute Workshop, Ottawa, August 11-12.

GSC Current Activities Forum, Ottawa, January 17-19.

J.R. Henderson

CIM Geology Division field trip in eastern Nova Scotia, October 17-21.

Canadian Tectonics Group Annual Meeting, Edmonton and Jasper, Alberta, October 21-23.

Nova Scotia Department of Mines and Energy: Open House and Review of Activities, Halifax, N.S., November 30.

Northeastern Section Geological Society of America, Providence, Rhode Island, U.S.A., March 15-17.

G.D. Jackson

Geological Association of Canada Annual Meeting, Victoria, B.C., May.

Geological Society of America Annual Meeting, Indianapolis, U.S.A., October 31-November 4.

A. LeCheminant

Canadian Mineral Outlook Conference, Ottawa, May 17-18.

American Geophysical Union Fall Meeting, San Francisco, U.S.A., December 5-9.

GSC Current Activities Forum, Ottawa, January 18-19.

M. Schau

Geological Association of Canada/Mineralogical Association of Canada Annual Meeting, Victoria, B.C., May.

GSC Current Activities Forum, Ottawa, January.

S. Tella

Geological Association of Canada Annual Meeting, Victoria, B.C., May.

GSC Current Activities Forum, Ottawa, January.

Membership on Committees

T. Frisch

Served as abstractor of GSC publicaton for "Mineralogical Abstracts", published by the Mineralogical Society, London, England.

M. Schau

Geological Association of Canada, Volcanology Division, Secretary-Treasurer.

S. Tella

Branch Safety Committee, Precambrian Geology Division representative (field component).

TFSS Field Equipment Committee, Branch representative.

Special Talks and Lectures

T. Frisch

"Granulite facies metamorphism and anatexis in the northernmost Canadian Shield, Arctic Canada", University of Leicester, England, December 8.

"The Proterozoic Thule Group on Ellesmere Island and its bearing on the Nares Strait problem", University of Ottawa, January 8.

J.R. Henderson

"Geology of the region between Sheet Harbour and Sherbrooke", CIM Field trip introduction, Halifax, Nova Scotia, October 16.

"Structural history of the Meguma Terrane between Sheet Harbour and Sherbrooke", Nova Scotia Department of Mines and Energy Open House and Review of Activities, Halifax, Nova Scotia, November 30.

"Structural history of the Meguma Terrane in Nova Scotia from Sheet Harbour to Sherbrooke", Geological Society of America, Northeast Section Annual Meeting, Providence, Rhode Island, U.S.A., March 16.

G.D. Jackson

"Neohelikian subaerial basalts with ocean floor type chemistry, northwestern Baffin Island", Geological Association of Canada Annual Meeting, Victoria, B.C., May.

M. Schau

"Granulites of Northern Churchill Province - a progress report", Precambrian High, GSC, Ottawa, March 30.

Manuscripts Submitted

3 A-Series Maps, 1 Open File Map, 1 GSC Report, 3 Current Research Papers, 1 Outside Publication, 7 Abstracts, 1 Map.

SUPERIOR-GRENVILLE SECTION

A. Davidson (Head)

Highlights

In the Grenville Province of Ontario a structure reconnaissance of the northwest border zone of the Central Metasedimentary belt indicated that the structural style in the zone is one of ductile overthrusting to the north or northwest on southwest dipping planes. Successful modelling of structures formed during such ductile deformation was done on equipment at Queen's University. Preliminary versions of DNAG 1:500,000 geological maps of the Superior and Grenville Province have been completed.

Personnel Notes

A. Cacciotti joined the Section in the Fall as a term support geologist.

N. Culshaw continued as term support geologist.

I.F. Ermanovics continued secondment as Manager of the Radioactive Waste Disposal Program (A.E.C.L.).

J. Asadi-Zanjani joined the Section at end of the year as a term support geologist.

Attendance at Meeting, Conference and Courses

K.D. Card

Geological Association of Canada/Mineralogical Association of Canada Annual Meeting, Victoria, B.C., May.

Archean Geochemistry - Lunar Planetary Institute Field Workshop, Ottawa and Northern Ontario, August.

Ontario Geological Survey Annual Forum, Toronto, December.

GSC Current Activities Forum, Ottawa, January.

A. Ciesielski

Cornell Craton Workshop, Ithaca, New York, U.S.A., April 29.

Information Seminar, Ministry of Natural Resources and Energy, Quebec City, November.

A. Davidson

Friends of Grenville Meeting and Field Excursion, Adirondacks, New York, U.S.A., October.

International Symposium on Precambrian Crustal Evolution, Beijing, China, August 31 to September 9.

I.F. Ermanovics

Canadian Science Writers Association Seminar, Ottawa.

AECL 16th Information Meeting, Winnipeg, Manitoba.

AECL/EURATOM International Cooperation Meeting, Pinawa, Manitoba.

Organized and led field excursion to Massey, Atikokan and Pinawa.

S. Hanmer

Canadian Tectonics Group, Edmonton, Alberta, October 22-23.

J. Percival

Institute of Lake Superior Geology, Houghton, Michigan, U.S.A., May 11-14.

Quebec Department of Natural Resources, Quebec City, November 23-24.

Ontario Geological Survey Geoscience Forum, Toronto, December 6-7.

Personal Computers and Networking, Ottawa, March 5-7.

Lithoprobe Workshop, Toronto, March 10-12.

Membership on Committees

K.D. Card

Editorial Board Member of Geology.

IUGS subcommittee on Precambrian Time-scale, corresponding member.

North American Commission on Stratigraphic Nomenclature, member.

GAC special volume on the Archean, associate editor.

Ontario Geological Bicentennial volume on Sudbury, editorial committee member.

A. Davidson

Canadian Committee on Dynamics and Evolution of Lithosphere, member.

Organizer for GAC Symposium, May 1984.

Thesis committees for 2 students.

I.F. Ermanovics

Standing Committee on Geosphere Modelling (AECL), contributor.

Branch Program Managers Committee of the NFWM program, member.

Research Areas Operation Committee of the Geoscience Branch, AECL, member.

J. Percival

Quebec-Maine VIBROSEIS Planning Committee.

Vancouver Island Lithoprobe Planning Committee.

Special Talks and Lectures

K.D. Card

"Geology and geophysics of the Sudbury region", GAC Current Activities Forum, Ottawa, January.

A. Ciesielski

"Origine des granitoides en reference aux gneiss du domaine Bienville, Québec", Montréal, March 12, Quebec City, March 13, Chicoutimi, March 21.

A. Davidson

"Tectonic boundaries within the Grenville Province of the Canadian Shield", Beijing, China, September. Invited talks at Brock and Laurentian Universities, December.

I.F. Ermanovics

"Nuclear Fuel Waste Management, an earth scientist's perspective in designing a Canadian program with insights for future safety", Canadian Science Writers Association, CSWA-EMR seminar, Ottawa.

I.F. Ermanovics (cont'd.)

"Advances in the geoscience surveys of the East Bull Lake Research Area (RA7) near Massey, Ontario", AECL 16th Information Meeting of the NFWM Program, Winnipeg, Manitoba.

Talk given during AECL/EURATOM International Cooperation Meeting, Pinawa, Manitoba.

S. Hanmer

"Non-coaxial, often rotational, rarely ideal, never simple shear strain: shear joy, shear hell, shear zone", McMaster University, January 24, University of Toronto, January 25, Dalhousie University, February 24.

"Recognition of Fossil Shear zones", GSC Divisions in Calgary, Vancouver and Victoria, February 27 to March 1.

"What can granites do for structural geologists", University of Ottawa, March 27.

J. Percival

"Geological Overview of central Superior Province", GSC, Ottawa, August 10.

"Structure and evolution of Archean crust, central Superior Province, Ontario", University of Ottawa, October 20.

Manuscripts submitted

5 Open File Maps, 8 Abstracts, 13 Outside Publications, 7 Current Research Papers.

SPECIAL PROJECTS

Personnel Notes

F. Thompson continued with the Section, as term support geologist assisting B.V. Sanford. In September, he was reassigned to the DNAG project assisting P. Hoffman.

Attendance at Meetings, Conferences and Courses

W.R.A. Baragar

Geological Association of Canada Annual Meeting, Victoria, B.C., May.

International Crustal Research Drilling Group Management Meeting, Halifax, Nova Scotia, September 5-9, London, England, March 25-April 2, 1984.

Collaborative Special Projects Committee Meeting (Cyprus Project), Montreal, February 14-15.

B.V. Sanford

Ontario Petroleum Institute Annual Meeting, London, Ontario, October 16-18.

Ontario Hydro Geotechnical Seminar, Toronto, October 24.

Atomic Energy of Canada Ltd., Geoscience Seminar, Ottawa, February 21-23.

F.C. Taylor

Prospectors and Developers Association Annual Meeting, Toronto, March 5-7.

Membership on Committees

W.R.A. Baragar

Editorial Committee, Canadian Journal of Earth Sciences.

International Crustal Research Drilling Group, management panel.

Collaborative Special Projects Committee, Cyrpus Project.

Ph.D. Thesis Committee (I. Annesley), University of Ottawa.

B.V. Sanford

Member of Advisory Committee on Undersea Features to Canadian Permanent Committee on Geographic Names.

Special Talks and Lectures

W.R.A. Baragar

"Pillow formation and layered flows in the Circum-Ungava Belt of eastern Hudson Bay", Geological Association of Canada Annual Meeting, Victoria, B.C., May 12.

"The Cyprus Project", Deep River Science Association, Deep River, Ontario, November 18.

"Sheeted dykes of the Troodos Complex", ICRDG Meeting, London, England, March 29.

B.V. Sanford

"Paleozoic tectonics of the Canadian craton and their effects on the migration and entrapment of hydrocarbons along the eastern rim of the Michigan Basin in Ontario", Ontario Petroleum Institute Annual Meeting, Toronto, October 22.

"Phanerozoic tectonic history of Ontario", Ontario Hydro Seminar, Toronto, October 24.

"Phanerozoic and recent tectonics of the Canadian craton", AECL Geoscience Seminar, Ottawa, February 22.

Manuscripts Submitted

2 A-Series Maps, 1 Open File Map, 4 Outside Publications, 1 GSC Memoir, 1 Abstract.

GEOCHRONOLOGY SECTION

O. van Breemen (Head)

Highlights

In the Geochronology Section the U-Pb zircon age dating procedure was re-initiated with more precise and sensitive isotopic measurements on the MAT 261 solid source mass spectrometer and an improved Pb contamination blank. With improved procedures of zircon picking and abrasion accurate and unambiguous ages have been obtained for a number of rocks and events.

Archean and Aphebian U-Pb zircon ages have been obtained respectively on basement west and granulites east of the western boundary of the Thelon Front tectonic zone. Furthermore, Rb-Sr biotite ages together with a metamorphic isograd outline an abrupt western limit to an Aphebian thermal event affecting the older craton. In contrast, a low grade terrain in the centre of the western Churchill Province, in the Keewatin District, turns out to be of Archean age. Further south, some precise U-Pb zircon metamorphic ages have been slotted into the stratigraphy of the Lynn Lake and the Flin Flon belts.

Extensive 1500-1350 Ma igneous basement formation has been demonstrated in the southern Grenville Province, consistent with the pattern of temporal zones in the south-central part of the continent. U-Pb zircon data from the same suite of zircons indicates that Grenville metamorphic events were separated by as much as 130 Ma. Yet the data also demonstrate a remarkably small time interval between the growth of zircon in granulite facies rocks and tectonic transport of these to higher crustal levels.

A 600 Ma age from basement in a tectonic slice in western Newfoundland may be related to an early Appalachian phase of rifting or to the Avalonian event documented further east. A Silurian age for the large Topsails batholith precludes extensive Acadian effects in the area while strong Acadian effects have been demonstrated in the Cape Breton Highlands with Rb-Sr muscovite ages. Other useful ages have been obtained from the above regions and the Arctic. Extensive results from the Cordillera and Phanerozoic Arctic will soon be forthcoming from carefully processed and hand picked zircons.

The best news of the year was that approval has been given for the construction of a complex of clean chemistry laboratories. The details of the planning have been completed and the laminar flow clean air benches and fume hoods have already been built. The new facility should be streamlining our operation by the fall of 1984.

Personnel Notes

P. Hunt, NEED project manager, joined the Section in August as term support geologist.

D. Smith joined the Section as a term laboratory technician. He resigned in December to take another position.

Field Activities

Samples collected for U-Pb zircon geochronology and Rb-Sr/Sm-Nd isotope geochemistry from the Slave Province, near Yellowknife, with J.B. Henderson.

Preliminary evaluation of northwest edge of the Central Metasedimentary Belt for U-Pb zircon geochronology with S.K. Hanmer.

R.D. Stevens collected samples for U-Pb zircon geochronology from Lynn Lake area, Manitoba, with T.M. Gordon and Manitoba Department of Mines geologists.

Geologic mapping and collection for geochronologic studies were conducted in the northern Swannell Range and Cormier Range of northern British Columbia and in the Slocun Lake area of southeastern British Columbia. All areas are characterized by shear zones involving granitic and metamorphic rocks affected by Mesozoic and/or Cenozoic tectonic events in the Omineca Crystalline Belt.

Attendance at Meetings, Conference and Courses

W.D. Loveridge

Basic programming via computer assisted learning, Algonquin College, Ottawa.

R. Parrish

Geological Society of America, Cordilleran Section, Salt Lake City, Utah, U.S.A., May.

Geological Association of Canada Annual Meeting, Victoria, B.C., May.

Workshop on Cordilleran Tectonics, Carleton University, February.

F.B. Quigg

MAT 261 electronics/maintenance training and MAT 261 operator training, Finnigan MAT, Bremen, Germany, May 24 - June 10.

J.C. Roddick

American Geophysical Union Spring Meeting, Baltimore, U.S.A., May 30 - June 3.

J.C. Roddick, R. Sullivan, O. van Breemen

Visited AECL Chemical Laboratory, Chalk River, Ontario.

O. van Breemen

"Deep geology of the Midland Valley of Scotland and adjacent regions", Bicentenary Symposium, Royal Society of Edinburgh, Scotland, October.

Membership on Committees

J.C. Roddick

NSERC Grant Application Committee, Memorial University, St. John's, Newfoundland.

R.W. Sullivan

Branch Safety Committee.

O. van Breemen

EG-ESS Evaluation Committee, Branch Member.

NSERC Major Installation Committee (solid source mass spectrometer), University of Alberta, Edmonton.

Special Talks and Lectures

R.R. Parrish

"Short course on geochronology", Precambrian High, GSC, Ottawa, April; GSC, Vancouver, B.C., March.

"Short course on fission track dating", Queen's University, Kingston, Ontario, April.

J.C. Roddick

"Application of Nd isotopes to petrogenesis and geochronology", Precambrian High, GSC, Ottawa, April.

Series of 3 lectures on $^{40}Ar/^{39}Ar$ dating; Rb/Sr geochronology; Nd isotopic studies, GSC, Vancouver, B.C., March 28-30.

O. van Breemen

"U-Pb and Rb-Sr studies" and "Memory in Pb Isotopes", Precambrian High, GSC, Ottawa, April.

"Dating shear zones, granulite facies metamorphism and igneous precursors in the Grenville Province of Ontario, Canada", University of Glasgow, Scotland, October.

"Chronology of the Late Precambrian in Scotland" and "Linking episodic plutonism with subduction history in the Caledonides of Scotland, Memorial University, St. John's, Newfoundland.

Manuscripts Submitted

3 Outside Publications, 1 Current Research Paper, 3 Short Notes to Outside Journals.

Laboratory Statistics

K-Ar ages reported	20
Rb-Sr projects	21
Common Pb isotopic analyses	54
U-Pb zircon age projects	49

PALEOMAGNETIC SECTION

W.F. Fahrig (Head)

Personnel Notes

T. West joined the Section in October as a term support geologist.

Field Activities

K. Buchan carried out field sampling of Nipissing diabase, N.E. trending diabase dyke and Huronian red beds from Ontario and Quebec.

Attendance at Meetings, Conferences and Courses

K. Buchan and W.F. Fahrig

Ontario Geological Survey Geoscience Research Seminar, Toronto, December 6-7.

Special Talks and Lectures

K.L. Buchan

"Paleomagnetism and Precambrian plate tectonics", graduate course lecture, Queen's University, Kingston, Ontario, March 1.

Manuscripts submitted

4 Outside Publications, 3 Abstracts.

PETROLOGY SECTION

K.L. Currie (Head)

Highlights

Experimental work in the Petrology Section has established a univarient equilibrium curve between the rare sodium-zirconium silicates, elpidite and valssovite. At 0.1 K bar of pressure the equilibrium lies below 600°C. The common occurrence of these minerals in high level peralkaline granites is therefore a pressure-temperature indicator giving surprising low temperatures.

Personnel Notes

E. Zaleski and W. Neely joined the Section as term support geologists.

J. Whalen continued as term research geologist.

Attendance at Meeting, Conferences and Courses

F.W. Chandler

Field excursion to examine Sibley Group, Thunder Bay, Northern Ontario, May.

Organized informal field excursion to Huronian, Sioux and Elliot Lake area, Onario, May - June.

R.F. Emslie

Geological Association of Canada/Mineralogical Association of Canada Annual Meeting, Victoria, B.C., May 11-13.

E. Froese

Manitoba Resources Division Annual Meeting, Winnipeg, Manitoba, November.

T.M. Gordon

Geological Association of Canada/Mineralogical Association of Canada Annual Meeting, Victoria, B.C., May 11-13.

Manitoba Mineral Resources Division Annual Meeting, Winnipeg, Manitoba, May.

Saskatchewan Geological Survey Annual Meeting, November.

Personal Computer and Networking, Ottawa, March 5-7.

J.B. Whalen

Newfoundland Current Activities Forum, St. John's, Newfoundland, November 2-4.

Membership on Committees

F. Chandler

Member of Working Group for IGCP Projects 91, 157, 160.

Thesis Committees - 2 M.Sc. students.

Subproject of Sudbury-Timmins-Algoma-Mineral Project, Co-ordinator.

K.L. Currie

IGCP Plutonic Working Group.

T.M. Gordon

Branch Computer Working Committee.

Branch Management Standing Subcommittee on New Technology for Data and Information Acquisition and Processing.

Special Talks and Lectures

R.F. Emslie

"Igneous and tectonothermal evolution, Mealey Mountains, Labrador", Geological Association of Canada Annual Meeting, Victoria, B.C., May 11.

E. Froese

"In promise of cordierite-anthophyllite rocks", Precambrian High, GSC, Ottawa, February.

J.B. Whalen

"Topsails Igneous Terrane", Newfoundland Current Activities Forum, St. John's, Newfoundland, November 3.

Manuscripts Submitted

7 Current Research Papers, 1 GSC Report, 7 Outside Publications, 2 Abstracts, 2 Maps.

RESOURCE GEOPHYSICS AND GEOCHEMISTRY DIVISION

A.G. Darnley, Director

The Division provides geophysical and geochemical information on a nationally systematic basis to facilitate the discovery, evaluation and exploitation of Canada's mineral resources, and to increase knowledge of subsurface geology. This is done by conducting R&D relating to existing and new methods of mineral exploration technology, data interpretation and presentation; by undertaking R&D necessary to establish systematic measurement and reporting standards for exploration geophysics and geochemistry; by obtaining geophysical and geochemical data for compilation into national or regional surveys; by interpreting data and providing scientific and technical advice as required.

The Division serves as a national center for R&D into geophysical and geochemical methods relating to metalliferous exploration, regional, economic, environmental and engineering geology. The Division is in a position to design, manage, operate and interpret geophysical and geochemical data and surveys for a wide variety of applications ranging from local to national requirements.

The design, management and quality control of extensive regional surveys is one activity which a national geological survey must perform, and whereas it can be argued that pure research functions conflict with the university role, and detailed interpretations of data are best performed by end-users in industry, the middle-ground between the academic and the application is the most important of the division's functions because it would not be fulfilled by any other non-government organization. In the resource field the provision of reliable comprehensive regional geoscience data is what distinguishes developed from underdeveloped countries.

Highlights

Aeromagnetic surveys, commencing in 1947, were the first form of new technology to be applied by the G.S.C. to broad scale geological exploration. Early 1984 was a landmark in terms of the original aeromagnetic objectives which were to provide coverage for the whole of the Canadian Shield. By March 1984 the remaining maps for Northern Labrador had been released, thereby completing all the mainland shield. The only shield land areas remaining to be surveyed are Boothia Peninsula and about half of Baffin Island. The structural revelations provided by the magnetic patterns over the land areas of the shield make the large intervening underwater areas, such as Hudson Bay, Hudson Strait and Foxe Basin, increasingly tantalizing targets for future work of this type. Aeromagnetics in conjunction with the systematic geochemistry (including age and stable isotope studies) of the granitoid rocks may provide the best tool for reconstructing and understanding the evolution of the continental crust.

The rapid advance in the availability of digital aeromagnetic data over the past three years made possible in 1983/84 the preparation of new 1:1 M Coloured Magnetic Anomaly maps for most of the surveyed area of Canada, as well as Shaded Relief maps at the same scale. The latter accentuate near-surface short wavelength, high-relief magnetic features. These new products have created unprecedented interest in magnetics amongst regional geologists, and it is therefore somewhat ironic that 1983 was the first year since GSC commenced aeromagnetic surveys that no new "standard" (as distinct from gradiometer) aeromagnetic surveys were flown, due to financial constraints.

With respect to gradiometry new surveys were flown in Manitoba, Nova Scotia and Newfoundland, but the highlight of the year was the fact that the Kenting gradiometer, based on the GSC Queenair gradiometer design became operational in mid-year and immediately became commercially viable. During the year contracts were issued for the design and construction of two helicopter-borne gradiometer installations; at the end of the year satisfactory trials had been completed but final results were not available.

In geochemistry, 1983 marked a resurgence in regional geochemical surveying. New geochemical reconnaissance surveys were undertaken in three provinces, British Columbia, Manitoba and Labrador, and a large amount of data was released from the previous year's survey in Labrador. The forthcoming new series of Federal-Provincial Mineral Development Agreements were a welcome development during the year, making it possible to plan for a large scale resumption of geochemical work comparable to that which existed between 1975 and '78. Unfortunately in the interim the administrative arrangements have become more complex.

Detailed airborne radiometric surveys were flown under Federal-Provincial Agreements in northeastern Labrador and southern Nova Scotia in 1983, and reconnaissance coverage was extended with the addition of the Ottawa map sheet. A carbonatite discovered in Algonquin park as a result of earlier reconnaissance radiometric surveys, rich in thorium and rare earths, has been analysed in preparation for its use as the new International Atomic Energy Agency laboratory thorium standard.

A promising new development in borehole logging in 1983 was the GSC Induced Polarization probe designed to record digitally the full wave form. This will provide the interpreter with broad flexibility in processing the data. Work continued on the construction of calibration facilities, particularly for coal density logging, and additions were made to the Bells Corners Borehole Geophysics Test Area to permit hole-to-hole, three-dimensional experiments.

Throughout the year, evidence of the increasing value of shallow reflection seismic work was apparent from the numerous requests for transfer of the technology to North American industry, and culminating with an International Research and Development Corporation - sponsored trip to Malaysia and India, where the field techniques were demonstrated for the Univeristy of Malaysia, the Geological Survey of Malaysia, several mining groups and the National Geophysical Research Institute in Hyderabad.

Personnel Notes

Dr. A Larochelle, Assistant Director, died on June 8, 1983. He had been on sick leave since September 1981. He joined the Geophysics Division in 1953, and the major part of his scientific career had been devoted to the measurement of palaeomagnetism. A full obituary is contained in Geogram, No. 20, December 1983.

Mr. G. Artichuk, Division Administrative Officer from 1968 to 1983, finally relinquished his duties January 6, 1984.

Mrs. Norah Goodman, secretary to the Director's office retired June 30, 1983 and Mrs. Margaret Ford took over her duties.

Ms. Elaine Stevens was appointed to the Administrative Officer's position in November, 1983.

In January, 1984, it was announced that B.E. Manistre would henceforth report to the Director General's office as a member of the newly formed International Relations office.

Attendance at Meetings, Conferences and Courses

A.G. Darnley

Provisional National Mineral Exploration Technology Development Committee, Toronto, Ontario, May 4-5, 1983.

Independent Industrial Advisory Committee on Earth Science, Victoria, B.C., May 12-14, 1983.

IAEA/NEA Uranium Exploration R&D Group Meeting, Vienna, Austria, May 24-28, 1983.

Interdepartmental Working Group Meeting, LTA flight trials, Toronto, Ontario, June 8, 1983.

KEGS/GSC: Borehole Geophysics Symposium, Toronto, Ontario, August 29, 1983.

Manitoba Department of Energy and Mines Open House, Winnipeg, Manitoba, November 16, 1983.

Saskatchewan Geological Survey Open House, Regina, Saskatchewan, November 17-18, 1983.

Ontario Geoscience Forum, Toronto, Ontario, December 6, 1983.

Prospectors & Developers Convention, Toronto, Ontario, March 6-7, 1984.

Lithoprobe planning meeting, Toronto, Ontario, March 10-12, 1984.

B.E. Manistre

Coordinating Committee for Offshore Prospecting in Southeast Asia, Kuala Lumpur, Malaysia, November 5-14, 1983.

Special Talks and Lectures

A.G. Darnley

"Subsurface exploration" - opening address, KEGS/GSC Borehole Geophysics Symposium, University of Toronto, August 29, 1983.

"The Athabasca Axis" - proposal to Lithoprobe planning meeting, Toronto, Ontario, March 10, 1984.

Membership on Committees

A.G. Darnley

Chairman - NEA/IAEA Uranium Exploration R&D Group

Chairman - Exploration Technology and Geoscience Standards Subcommittees, National Geological Surveys Committee.

Member - Interdepartmental LTA Working Group.

Convener - Provisional National Steering Committee for Mineral Exploration Technology.

Member - Organizing Committee for Exploration '87.

Division Summary of New Information Released to the Public

26 Outside Publications
11 GSC Papers
10 Current Research Papers
10 Open Files
12 Poster Presentations
19 Oral Presentations
43 Special Lectures
36 Abstracts
187 Aeromagnetic Maps, Comprising:
- 82 Standard Series at 1:50,000
- 27 Standard Series at 1:250,000
- 5 Coloured Anomaly Maps at 1:1,000,000
- 1 Shaded Relief Map at 1:1,000,000

72 Gradiometer Series at various scales
70 Geophysical Series Gamma Ray Spectrometric Maps
100 National Geochemical Reconnaissance Maps

CIDA ADVISORY PROGRAM

B.E. Manistre

Zimbabwe

The CIDA program for Zimbabwe included an airborne magnetic survey of about 100,000 line km, and an INPUT plus magnetic survey of about 19,000 line km. The aeromagnetic survey was flown by Kenting Earth Sciences Ltd. from May to July, 1983, and compilation of the results progressed with a scheduled completion date in October, 1984. The INPUT Survey was flown by Geoterrex International Ltd. in August and September, 1983, and results were compiled by the end of March for delivery in April, 1984.

Thailand

Tender specifications for the systematic airborne geophysical survey of Thailand, prepared by GSC, were forwarded to the Department of Mineral Resources in Bangkok in April, 1983. During the year these specifications were reviewed and agreed upon by independent Finnish consultants; the tendering process proceeded; by the end of the year Kenting Earth Sciences Ltd. was advised that their bid was the lowest received from 5 countries, and negotiations were underway for the award of the largest single airborne geophysical survey contract ever tendered.

Brazil

In January, 1984, B.E. Manistre participated with CIDA in a mission to Brazil relative to the planning of a Cooperative Brazil/Canada program for technical assistance and training in mineral resources.

REGIONAL GEOPHYSICS SUBDIVISION

P.J. Hood (Head)

The primary objective of the Regional Geophysics Subdivision is to improve the understanding of the geological framework of Canada and to facilitate mineral exploration and development programs by providing a regional framework of basic geophysical data. Emphasis is placed upon magnetic methods. The Subdivision develops new survey instrumentation and techniques, conducts experimental surveys, devises new techniques for the computer treatment, presentation and interpretation of resultant data, prepares specifications for surveys execution, and supervises the publication of results. Geological interpretations of other results are provided to the extent possible with available staff.

The Regional Geophysics Subdivision consists of four sections: Contract Aeromagnetic Surveys, Experimental Airborne Operations, Geophysical Data Processing and Magnetic Geophysical Interpretation.

Highlights

In 1983, the process of transferring the GSC aeromagnetic gradiometer technology to Kenting Earth Sciences Ltd. of Ottawa was completed. Consequently Kenting was able to offer commercial aeromagnetic surveys by the Fall of 1983. The response for such airborne geophysical surveys far exceeded their expectations.

In addition to the development of fixed-wing aeromagnetic gradiometer systems, considerable progress was made in the development of two helicopter-borne gradiometer systems. This was accomplished through DSS R&D contracts with Geotech Ltd. of Markham, Ontario and Les Rélèves Geophysique of Ste. Foy, Quebec. The systems will be utilized for gradiometer surveys in the rugged terrain of the Gaspé area of Quebec.

It appears that the development of the aeromagnetic gradiometer technique in Canada for mining geophysical surveys has been a considerable scientific (and commercial) success and will enable the Canadian airborne geophysical survey industry to provide such unique services throughout the world.

Another very significant highlight has been the production of Applicon colour interval and shaded relief maps for most of the Canadian Precambrian Shield at the 1:1,000,000 scale. The resultant compilation has formed a display on the fifth floor of the GSC headquarters building and has been viewed by a constant stream of visitors. It is clear that this form of aeromagnetic compilation will influence greatly the geological ideas concerning the genesis of the Canadian Precambrian Shield.

The proceedings of the Exploration 77 symposium, which is GSC Economic Geology Report 31, has been translated into Chinese in three parts. Copies of two of the three parts covering the state-of-the-art papers in geophysics and the case history papers have been received in Ottawa.

Contract Aeromagnetic Surveys

The status of contract aeromagnetic surveys is summarized in Table 1.

The flying component of the aeromagnetic survey of northern Labrador was completed in the 1982 field season and in 1983/84 the remaining 82 1:50,000 and 11 1:250,000 total field maps were compiled by the contractor, Kenting Earth Sciences Ltd. of Ottawa. The monitoring of the project has been carried out by W.A. Knappers. All positive and negative materials, digital data tapes and other original data have now been received and will be stored in Public Archives. W.A. Knappers has continued monitoring the aeromagnetic survey of Zimbabwe on behalf of CIDA.

The first commercial aeromagnetic gradiometer survey amounting to 5392 line km. was awarded on August 15, 1983 to Kenting Earth Sciences Ltd. for a survey in the Mahone Bay area of Nova Scotia. E. Ready was the Project Leader for the contract and carried out a field inspection between November 22 and 26. In spite of the fact that the survey was carried out during the Fall when the weather conditions were less than ideal, resulting in considerable air turbulence, the resultant compiled maps have demonstrated the ability of Kenting to carry out high quality vertical gradient aeromagnetic surveys.

Table 1

Contract Aeromagnetic Surveys (1983-84)

Contract	GSC Project	Kilometres flown 1983	Maps Published in 1983/84	
			1:50,000	1:250,000
Labrador	810002	0	82	11
British Columbia and Alberta		0	-	16
Mahone Bay, Nova Scotia	830048	5392	0	0

Ocean Aeromagnetics Project

An aeromagnetic survey of a southern portion of the Greenland Ice Cap was carried out by the Convair 580 aircraft of the National Aeronautical Establishment at the request of the Greenland Geological Survey. The survey was completed in two phases namely April/May and September 1983 using Sondrestrom in west Greenland as the base of operations. Tie lines were also flown along the length of the Labrador Sea and Baffin Bay, and from Davis Strait to Iceland in support of the compilation of the Magnetic Anomaly Map of North America.

Magnetic Anomaly Map Project

Approximately 1.4 million square kilometres of aeromagnetic data were digitized during 1983/84. Five 1:1,000,000 coloured magnetic anomaly maps were issued in October 1983 and January 1984 bringing the total published to date to sixteen. A further seventeen magnetic anomaly maps have been compiled but there appears to be a negative warp in the data for the southern part of central Canada which may be due to an accumulated secular variation error in the early years of the aeromagnetic survey program. It will be necessary to fly east-west and north-south ties across the warp to enable the necessary datum correction to be made.

In addition, the first 1:1,000,000 shaded relief map was issued in July 1983 and this was for the Lockhart River sheet (NP-12/13).

A fourth edition of the Magnetic Anomaly Map of Canada is presently in press and will be issued before the end of 1984. A display of magnetic anomaly maps with emphasis on the very active Hemlo area was presented as an exhibit at the Prospectors and Developers Convention in Toronto during March 1984.

Queenair Aeromagnetic Gradiometer Project

In 1983, Kenting Earth Sciences Ltd. of Ottawa completed the fabrication of a vertical aeromagnetic gradiometer system and were assisted throughout the development by GSC personnel. The cesium magnetometer utilized was essentially a copy of the GSC single-cell self-orienting head. CAE active compensators were utilized in a similar fashion to those in the GSC system. The results of the first commercial gradiometer surveys have clearly demonstrated that Kenting's gradiometer system can meet the GSC specifications for such surveys.

The development of a triad gradiometer consisting of three magnetometers to measure both the vertical and transverse gradient continued during 1983. A transverse gradiometer boom has been built and test flown on the GSC Queenair aircraft; drag of the Y-shaped tail stinger was only slightly higher than for a single boom system and considerably less than the present vertical gradiometer system. It was clear from the test surveys that the horizontal separation of the Y-shaped tail stinger is sufficient to measure the transverse gradient in surveys of the Precambrian Shield.

The design of a new microprocessor-controlled data acquisition system has been completed by P. Sawatzky. All of the circuit cards have been designed and bench tested. The computer programs required to operate the system are being written by Software Kinetics of Ottawa and are about 80% complete.

In addition to the foregoing research and development work in gradiometry being carried out in-house, two development contracts were issued through DSS to develop two helicopter-borne gradiometer systems. The companies that received funding were Geotech Ltd. of Markham, Ontario who built an Overhauser gradiometer using sensors developed under a previous GSC-sponsored contract and manufactured by Gem Systems Ltd. of Toronto. A second helicopter-borne gradiometer system was developed by Les Rélèves Geophysique of Ste. Foy, Quebec using Scintrex cesium-vapour magnetometers. Both systems were successfully field tested in the Carleton Place area previously flown by the GSC Queenair system. A second survey of Mount Megantic, Quebec was carried out to ascertain whether the technique would produce useful results of areas of rugged terrain. It is clear from the compiled results that the technique can be successfully applied in the Gaspé area of Quebec.

High resolution aeromagnetic total field and vertical gradient/VLF EM surveys were carried out using the GSC Queenair aircraft in the following areas:

Guysborough, N.S.	11E/1,8;11D/16	5,364 km
Barrington Lake, Manitoba	64C/15,16	5,716 km
Buchans, Nfld.	12/A,H;2/D,E	8,071 km
Lake Ontario	30M/15,16; 30N/13,14,15	3,660 km

Thus a total of 22,811 line km of airborne geophysical data were acquired during 1983.

Statistics for the compilation of the Queenair data are given in Table 2 which shows that thirty 1:50,000 coloured total field and vertical gradient maps were open filed in the report period:

Table 2

Maps Published:	Scale	Gradiometer	Total Field
1. Flin Flon, Manitoba	1:50,000	9	9
2. McClarty Lake, Manitoba	1:50,000	4	4
3. Wollaston Lake, Saskatchewan	1:50,000	2	2
	TOTAL	15	15

Maps on Open File:	Scale	Gradiometer	Total Field
1. Lynn Lake, Manitoba	1:20,000	--	6
2. Lynn Lake, Manitoba	1:50,000	--	2
3. McClarty Lake, Manitoba	1:20,000	13	13
4. McClarty Lake, Manitoba	1:50,000	4	4
	TOTAL	17	25

Magnetic Interpretation

L.J. Kornik has developed an extensive library of Apple computer programs to produce magnetic model data, to display data graphically and also print out end products in colour. The prepared derived aeromagnetic maps of the East Bull Lake research area for the Radwaste Program and magnetic frequency spectrum maps were plotted to help delineate and classify fractures and faults. In addition a set of derived frequency maps of the McLarty Lake Area of Manitoba and a set of magnetic shadowgrams of various frequency spectrum were completed for the Manitoba Department of Mines.

Personnel Notes

J. Broome

Joined the subdivision on July 11, 1983.

Attendance at Meetings, Conferences and Courses

J. Broome

Computer Applications for Mineral Exploration, Toronto, January 1984.

Completed course "Applications in digital image processing", Ottawa University.

I. Butt

EDP project management, PSC Course, Asticou, Hull, May 16-25,1983.

Problem solving and decision-making workshop, EMR, Ottawa, June 23-24, 1983.

S.D. Dods

Design of on-line computer systems, PSC course, Asticou, Hull, May 30-June 3, 1983.

T.R. Flint

Transport Canada maintenance symposium, Toronto, October 1983.

P.J. Hood

18th General Assembly, IUGG, Hamburg, August 1983. Presented paper 'Canadian Magnetic Anomaly Map Program; a Review of Recent Advances' and reported on the activities of Working Group I-4 at the Reporter Review Session.

Attended the Society of Exploration Geophysicists meeting in Las Vegas, September 11-15, 1983 in order to convene a meeting of the Magnetic Anomaly Map of North America committee.

Attended the 7th Annual Open House of the Nova Scotia Department of Mines and Energy in Halifax on November 30, 1983. Presented a paper entitled 'Aeromagnetic gradiometer surveys in Meguma terrane'.

Attended the GSC Current Activities Forum in Ottawa. Presented a paper entitled 'Aeromagnetic reconnaissance of the Nares Strait, NWT' (with M.E. Bower, C.D. Hardwick and D.J. Teskey).

J. Janveau

Systems analysis and design, PSC course, Asticou, Hull, June 6-12, 1983.

Data base management system, PSC course, Asticou, Hull, November 7-9, 1983.

L.D. Lawley

Introduction to Fortran, Asticou, Hull, Quebec, May 9-13, 1983.

Computer System Fundamentals, CSC, Ottawa, March 19-23, 1984.

P. Sawatzky

Programming technology using Basic, EMR Computer Science Centre, Ottawa.

E.J. Schwarz

GAC - CGU meeting, Victoria, B.C., May 11-14,1983.

Association Canadienne Française pour l'Avancement des Sciences, Trois Rivieres, Quebec.

Introduction NOS/BE and graphics course, EMR Computer Science Centre.

D.J. Teskey

Attended CGU meeting, Victoria, B.C., May 1983, presented paper on enhancement and interpretation of one:one million magnetic anomaly maps (with S.D. Dods and P.J. Hood).

Attended SEG meeting, Las Vegas, September 11-15, 1983 and meeting of the Committee for the Compilation of the Magnetic Anomaly Maps of North America.

Attended 'Computer Applications in Mineral Exploration' meeting, Toronto, January 1984 and presented poster display.

Attended Prospectors and Developers Association meeting, Toronto, March 1984, and assisted in preparation of GSC display.

Special Talks and Lectures

P.J. Hood

Visited the Bundesanstalt fur Geowissenschaften und Rohstoffe in Hannover, W. Germany. Presented a talk on the GSC aeromagnetic survey program on August 29, 1983.

Attended the EMR Earth Science Sector briefing for petroleum industry representatives at the ISPG, Calgary on November 7, 1983. Presented a paper reviewing the progress in the compilation of the Magnetic Anomaly Map of North America and in particular the need to acquire additional coverage in western Canada.

E.J. Schwarz

Delivered two courses in geophysics until May 1983

at the Ecole Polytechnique in Montreal.

Membership on Committees

S.D. Dods

Member, Data Display Users Group, EMR Computer Science Centre.

P.J. Hood

Co-chairman, Magnetic Anomaly Map of North America Committee, DNAG Project, Geological Society of America.

Chairman, Working Group I-4, (Magnetic Anomalies -Land and Sea), Division 1, International Association of Geomagnetism and Aeronomy.

Member, Technical Subcommittee for Development of Commercial Aeromagnetic Gradiometer System, Eastern Ontario Subsidiary Agreement.

Member, Magnetic Field Survey Working Group, NASA.

E.J. Schwarz

Associate Editor, Geoscience Canada

Professeur Invité de Geophysique Appliquée, Ecole Polytechnique de Montreal.

D.J. Teskey

Associate Member, Magnetic Anomaly Map of North America Committee, GSA DNAG Project.

Subdivision Productivity

82 Standard Series 1:50,000 scale Aeromagnetic Maps
27 Standard Series 1:250,000 scale Aeromagnetic Maps
5 Coloured Aeromagnetic Maps 1:1,000,000
1 Shaded Relief Aeromagnetic Map 1:1,000,000
72 Gradiometer series Aeromagnetic Maps at various scales
1 Outside Publication
3 Current Research Papers
2 Open Files
8 Oral Presentations

RESOURCE GEOCHEMISTRY SUBDIVISION

E.H.W. Hornbrook (Head)

The objective of this Subdivision is to undertake research, develop, apply and evaluate methods of geochemical exploration for a variety of purposes; systematic data are gathered from a variety of sampling media and analytical techniques in order to assist the mineral exploration industry, government assessment of resources, and general geological mapping. Many of the data are also relevant to topical environmental and health problems. These data gathering activities are complemented by research on geochemical processes; by development of new methods of mineral exploration and resource appraisal; by study of new analytical techniques and geochemical instrumentation; and by software development to facilitate interpretation.

Highlights

National Geochemical Reconnaissance (NGR) Surveys in 1983-84 were carried out in Labrador, Manitoba and British Columbia.

The 1982 phase of the two-year NGR survey in Labrador under the Federal (cooperative) Mineral Program in Newfoundland was completed and the results were released in August, 1983 in four open files, a total of 80 maps and four texts. The 1983 phase was completed on schedule and the data will be released in four open files in June, 1984. This program provided another 110,000 km^2 coverage of Labrador to the 130,000 km^2 previously surveyed in 1977 and 1978. The remaining 60,000 km^2 of Labrador is expected to be completed under a new Mineral Agreement Program. Thus, Newfoundland will be the first Province to have complete NGR coverage of its total territory of the Island and Labrador.

The NGR stream sediment and water surveys cooperatively carried out under letters of understanding with the Province of British Columbia in NTS sheets 93M and N were completed and the results will be released in two open files (36 maps and 2 texts) in June, 1984.

The NGR lake sediment and water survey carried out in the Lynn Lake, Manitoba area, NTS 64C, under the Canada - Manitoba Interim Agreement was successfully completed and the results will be released in one open file (25 maps and text) in June, 1984.

The study of specialized granites by S.B. Ballantyne has revealed many significantly similar geochemical signatures and associated mineralizations between these granites in the Canadian Cordillera and the economically interesting granites in Alaska and those in the U.S.S.R. mined for Sn.

Dr. D.R. Boyle has completed the development and testing of down hole water sampling and measuring equipment that is operational to a depth of 300 m. This equipment will be used to develop methods for detecting concealed mineral deposits and hydrocarbon resources.

A number of ongoing gold studies were initiated in the Hemlo gold camp of Ontario in cooperation with industry and research institutes. Surficial geochemical investigations carried out by Dr. P.W.B. Friske under contract have discovered new pathfinder elements amongst those associated with this unusual gold deposit. Analytical speciation studies by Dr. D.C. Gregoire have indicated that most of the gold found in lake sediments is organically bound. An evaluation of commercial laboratory gold methodology by Ms. G.E.M. Hall has shown that hot aqua regia leaching followed by graphite furnace atomic absorption analysis provides the most acceptable precision. To comprehend the origin of the Hemlo deposits to enhance further exploration, Dr. E.M. Cameron with Dr. K. Hattori of Ottawa University conducted strontium and sulphur isotope studies that suggest synsedimentary origin in a restricted basin.

Mr. W. Dyck has perfected a quantitative method for determination of Po-210 that was used to confirm that there was no disequilibrium in the uranium series of the four Canadian Uranium Reference Standard Ores. Final interpretation of the well water survey in the Cypress Hills area of Saskatchewan by Mr. Dyck shows evidence of hidden mineralization, possible health hazards and revealed regional hydrogeochemical processes such as chemical weathering and evapotransport.

Dr. R.G. Garrett has acquired the equipment to proceed with the development of colour interactive geochemical analysis system. His work on composite sampling has provided a statistical and cost model of assistance in minimizing the cost of anomaly recognition with spin-off benefits for application outside of exploration geochemistry.

Dr. W.D. Goodfellow has used secular variations of $\delta^{34}S$ values in pyrite and barite to identify three periods in the Paleozoic during which the Selwyn Basin was stratified with anoxic bottom waters and cut-off from open oceans. These observations aid in revealing the nature of the continental margin and processes of ore-formation in the Selwyn Basin. Dr. Goodfellow took part in the discovery of a major iridium anomaly in late Devonian rocks at a mass extinction boundary which provides evidence for an extra-terrestrial impact at this time. This represents the first time an iridium anomaly has been found at a mass extinction boundary older than the Cretaceous-Tertiary extinction.

Dr. Goodfellow and Dr. G.F. Bonham-Carter have successfully devised a method of mathematically modelling digitized geological, surficial, geochemical and mineral occurrence data of the Nahanni map-area to differentiate between background and anomalous catchment basins with correction for background and dilution to identify new exploration target areas. Mr. D.J. Ellwood perfected a digital colour map production system to identify and display the catchment basins for assessment.

Research and development of analytical methods by Ms. G.E.M. Hall and her staff continued with the development of methodology for the determination of Mo and U in waters, gold in geological materials, and a scheme to separate and extract "soluble" and "insoluble" organic S from shales prior to $\delta^{34}S$ estimation. With Dr. D.C. Gregoire, procedures were established to determine gold in various phases in sediments and soils.

A Pixel 100/AP micro computer has been acquired by Mr. N.G. Lund and Mr. D.J. Ellwood to develop a second generation system for the management of geochemical data and to develop related computer software to direct the generation of computer graphics on Computer Science Center facilities.

Mr. J.J. Lynch, after preparation and testing, has four lake and four stream sediment international reference samples ready for distribution to participating laboratories world-wide for characterization prior to release to the public. A number of "in-house" reference standards were also prepared. Four new contracts were let by Mr. Lynch through Supply and Services Canada, to cover the NGR and Subdivision commercial analytical and sample preparation requirements.

The Gaspé - Lower St. Lawrence Geoscience Program coordinated by Dr. Y.T. Maurice was initiated and represents a major initiative by the GSC in the Province of Quebec over the next five years.

Personnel Notes

Dr. Y.T. Maurice has been seconded for most of his time to the Director General's office as Branch Co-ordinator of GSC participation in the special federal program on economic and regional development in the Gaspé region of Quebec.

Sample Preparation Laboratory - GSC

33,480 separate operations were carried out in the sample preparation laboratory on approximately 4,700 samples.

Samples Split	4,710
Crushing/Grinding	4,710
Ball Milling	10,325
Sieving	5,780
Super Panner	1,650
Frantz	3,435
Floatation	750
Heavy Liquid Separation	
Heavy Mineral Identification	
TOTAL	33,480

Trace Element Laboratory - GSC

Approximately 8,100 samples were analysed for a total of 24,000 determinations.

Water Samples Analysed
Total Determinations on Waters

Rocks, Ores, Sediment, Soil Samples analysed
Total Determinations on Solid Samples

In addition, 399 shales were extracted for their pyrite, barite and "soluble" sulphide contents in preparation for external ^{34}S estimation.

Contract Analytical Support Service

Samples Sent to Contractors
Total Determinations Carried Out

Contract Solid Sample Preparation Support Service

Total 1983 Solid Samples Prepared for Analyses
Total Pre-1983 Solid Samples Archived

Attendance at Meetings, Conferences and Courses

S.B. Ballantyne

GAC, MAC, CGU Joint Annual Meeting, Victoria, May 1983.

10th IGES, Helsinki, Finland, August 1983.

Prospectors and Developers Annual Meeting, Toronto, March 1984.

D.R. Boyle

Workshop on Groundwater Sampling and Interpretation of Groundwater Data, Whiteshell Nuclear Establishment, Pinawa, Manitoba, May 1983.

Water-Rock Interaction, Misasa, Japan, August 1983.

Canadian Nuclear Fuel Waste Management Geoscience Program, Ottawa, February 1984.

R.W. Boyle

10th IGES, Helsinki, Finland, August 1983.

SEG-AIME Annual Meeting, Los Angeles, February 1984.

Exploration for Ore Deposits of the North American Cordillera and the AEG Annual Meeting, Reno, Nevada, March 1984.

E.M. Cameron

10th IGES Helsinki, Finland, August 1983.

D.J. Ellwood

GSC Current Activities Forum, Ottawa, January 1984.

Personal Computers and Networking Seminar, Ottawa, March 1984.

R.G. Garrett

Joint ASA Statistical Society of Canada Meeting, Toronto, August 1983.

10th IGES, Helsinki, Finland, August, 1983.

2nd COGEODATA South American Symposium and COGEODATA Working Group Meeting, Buenos Aires, Argentina, November 1983.

Computer Applications in Mineral Exploration, Toronto, January 1984.

GSC Current Activities Forum, Ottawa, January 1984.

Exploration for Ore Deposits of the North American Cordillera and the AEG Annual Meeting, Reno, Nevada, March 1984.

W.D. Goodfellow

CIM-GAC Joing Meeting, Whitehorse, Y.T., December 1983.

GSC Current Activities Forum, Ottawa, January 1984.

Workshop on Deep-Sea Hydrothermal Project, Victoria, January 1984.

SEG-AIME Annual Meeting, Los Angeles, February 1984.

Workshop on Research Planning for Deep-Ocean Hydrothermal Systems, Victoria, March 1984.

D.C. Gregoire

GSC Current Activities Forum, Ottawa, January 1984.

Workshop on Reference Materials, Ottawa, February 1984.

G.E.M. Hall

GSC Current Activities Forum, Ottawa, January 1984.

Prospectors and Developers Annual Meeting, Toronto, March 1984.

E.H. Hornbrook

GSC Current Activities Forum, Ottawa, January 1984.

Prospectors and Developers Annual Meeting, Toronto, March 1984.

I.R. Jonasson

CIM-GAC Joint Meeting, Whitehorse, Y.T., December 1983.

GSC Current Activities Forum, Ottawa, January 1984.

Workshop on Research Planning for Deep-Ocean Hydrothermal Systems, Victoria, March 1984.

N.G. Lund

Personal Computers and Networking Seminar, Ottawa, March 1984.

Y.T. Maurice

GSC Current Activities Forum, Ottawa, January 1984.

Séminaire d'information 1983, Quebec Cité, Novembre 1983.

Geoscience Research Seminar, Toronto, December 1983.

Special Talks and Lectures

S.B. Ballantyne

"Sn-W associated with the Surprise Lake Batholith, B.C.". Special talk presented at the Lithophile Element Mineralization Workshop, Dept. of Geol. Science, Queen's University, Kingston, Ontario, April 1983.

"A tin-tungsten multi-media geochemical case history: Surprise Lake Batholith, British Columbia". Paper presented at the Joint GAC, MAC, CGU annual meeting, Victoria, May 1983.

"New tin-tungsten occurrences in the Surprise Lake granitic complex of the northern Canadian Cordillera: a geochemical case history". Paper presented at the 10th IGES, Helsinki, Finland, August 1983.

"Hydrogeochemical dispersion patterns of "specialized" granites in the Canadian Cordillera". Special talk presented at the 10th IGES Workshop Helsinki, Finland, August 1983.

D.R. Boyle

"Role of groundwaters in the formation of infiltration-type uranium deposits associated with granite and metamorphic basement complexes". Paper presented at the 4th International Symposium on water-rock interaction, Misasa, Japan, September 1983.

R.W. Boyle

Keynote Speech, given at the 10th IGES Helsinki, Finland, August 1983.

Keynote Speech, given at the Exploration of Ore Deposits of the North American Cordillera Symposium, Reno, Nevada, March 1984.

E.M. Cameron

"Role of geochemistry in the integrated search for deeply buried deposits: the Athabasca Basin". Poster presented at the 10th IGES Helsinki, Finland, August 1983.

"Strontium and sulphur isotopic geochemistry of the Hemlo deposit and other sulphate occurrences in the Superior Province". Poster presented at the GSC Current Activities Forum, Ottawa, January 1984.

D.J. Ellwood

"New drainage geochemical maps; Integration of digitized geology, topography and mineral occurrences, with implications for exploration in the Yukon". Poster presented at GSC Current Activities Forum, Ottawa, January 1984.

"Drainage basin analysis of surficial geochemical data: a mathematical method of evaluating anomalies with application to Pb-Zn deposits in the Selwyn Basin, Yukon". Poster presented at the Computer Applications in Mineral Exploration 1984 Workshop, Toronto, January 1984.

"Investigation of stream Zn and Pb as predictors of stratiform Zn-Pb deposits, Selwyn Basin, Yukon". Poster presented at Exploration for Ore Deposits of the North American Cordillera Symposium, Reno, Nevada, March 1984.

R.G. Garrett

"Optimal composite sample size selection, applications in geochemistry and remote sensing". Poster presented at the 10th IGES Helsinki, Finland, August 1983.

Lecture on "Sampling considerations in geology", presented at the Norwegian National Technical University, Trondheim, September 1983.

Lecture on "The analysis and display of exploration geochemical data", presented at Queen's University, Kingston, Ontario, October 1984.

"Computer aids in the interpretation of regional geochemical data". Paper presented at the 2nd COGEODATA South American Symposium, Buenos Aires, Argentina, November 1983.

"Computer graphics in aid of geochemical data interpretation". Paper presented at the Computer Applications in Mineral Exploration 1984, Toronto, January 1984.

W.D. Goodfellow

"The Paleozoic continental margin of northwestern Canada: rifting, volcanism, stratified basins and sulphide formation". Special lecture presented at the GAC Robinson Fund Special Lecture, St. John's Newfoundland, April 1983.

"Environment of formation of the Howards Pass (XY) Zn-Pb deposit, Selwyn Basin, Yukon and N.W.T.". Paper presented at the CIM-GAC joint meeting, Whitehorse, December 1983.

"Environment of formation of the Howards Pass (XY) Zn-Pb deposits, Selwyn Basin, Yukon and N.W.T." Poster presented at the CIM-GAC joint meeting, Whitehorse, December 1983.

"Sedimentary and diagenetic textures and deformation structures within the sulphide zone of the Howards Pass (XY) deposit, Yukon and N.W.T.". Poster presented at the CIM-GAC joint meeting Whitehorse, December 1983.

"New drainage geochemical maps: integration of digitized geology, topography and mineral occurrences, with implications for exploration in the Yukon". Poster presented at the GSC Current Activities Forum, Ottawa, January 1984.

"Drainage basin analysis of surficial geochemical data: a mathematical method of evaluating anomalies with application to Pb-Zn deposits in the Selwyn Basin, Yukon". Poster presented at the Computer Applications to Mineral Exploration 1984, Toronto, January 1984.

"Geology and stratiform sulphide deposits of the Canadian Appalachians". Special talk presented at the Victoria Workshop on Deep-Ocean Hydrothermal Systems, Victoria, February 1984.

"Primary halos associated with stratiform sulphide deposits; spatial and temporal distribution, origins and implications for exploration". Paper presented at the AIME-SEG meeting, Los Angeles, February 1984.

"Primary halos associated with stratiform sulphide deposits; spatial and temporal distribution, origins and implications for exploration." Poster presented at the AIME-SEG meeting, Los Angeles, February 1984.

"Investigation of stream Zn and Pb as predictors of stratiform Zn-Pb deposits, Selwyn Basin, Yukon". Poster presented at the Exploration for Ore Deposits of the North American Cordillera Symposium, Reno, Nevada, March 1984.

D.C. Gregoire

"Speciation of gold in sediments and soils". Poster presented at the Prospectors and Developers annual meeting, Toronto, March 1984.

G.E.M. Hall

"Assessment of analytical methods to determine gold". Poster presented at the GSC Current Activities Forum, Ottawa, January 1984.

"Surficial geochemistry of the Hemlo area, preliminary results". Poster presented at the Prospectors and Developers Annual Meeting, Toronto, March 1984.

E.H. Hornbrook

Lecture on "Geochemistry in mineral exploration". Presented at Queen's University, Kingston,

September 1983.

"Surficial geochemistry of the Hemlo area, preliminary results". Poster presented at the Prospectors and Developers annual meeting, Toronto, March 1984.

I.R. Jonasson

"Sedimentary and diagenetic textures and deformation structures within the sulphide zone of the Howards Pass (XY) Zn-Pb deposit, Yukon and N.W.T.". Paper presented at the joint CIM-GAC meeting Whitehorse, December 1983.

"Sedimentary and diagenetic textures and deformation structures within the sulphide zone of the Howards Pass (XY) Zn-Pb deposit, Yukon and N.W.T.". Poster presented at the GSC Current Activities Forum, Ottawa, January 1984.

Y.T. Maurice

Invited special talk on "Geochemistry" given at Environment Canada, Ottawa, April 1983.

Special talk to students of Sir Sanford Flemming College given at Ottawa, November 1983.

Special lectures (3) given at University of Montreal, Laval University and Université de Québec à Chicoutimi.

Memberships on Committees

D.R. Boyle

Member, IAEA Working Group II, Sandstone Type, Uranium Deposits.

Member, IAEA Working Group IV, Surficial Uranium Deposits.

R.W. Boyle

Councillor, Society Economic Geologists.

Series Editor, Benchmark Series on Economic Geology, SEG.

Editorial Board, Chemical Geology, Elsevier, Amsterdam.

Editorial and Research Board, Colorado School of Mines, Quarterly.

Canadian Chairman, SEG Symposium on Primary Dispersion Halos and Their Exploration Significance, Los Angeles, February 1984.

E.M. Cameron

Chairman, Plenary Session on Geochemical Workshop, 10th IGES, Helsinki, Finland.

Co-Chairman, NEA/IAEA Athabasca Basin Test Site Project.

Editor-in-Chief, Journal of Geochemical Exploration.

W. Dyck

Member, IAEA Working Group III, Gases in Uranium Exploration.

D.J. Ellwood

Member, Departmental Computer Users Committee.

R.G. Garrett

Branch Representative, Departmental MSAT (Satellite Communications) Committee.

Member, Branch Management Standing Subcommittee on New Technology for Data and Information Acquisition and Processing.

Member, COGEODATA Working Group on Exploration Data and Interpretation.

Vice President, Association of Exploration Geochemists.

Member, Organizing Committee for Exploration '87.

Member, Editorial Board of the Journal of Geochemical Exploration.

W.D. Goodfellow

Councillor, The Association of Exploration Geochemists.

Secretary, the Logan Club, Geological Survey of Canada.

D.C. Gregoire

Vice Chairman, Ottawa Valley Section of the Spectroscopy Society of Canada.

G.E.M. Hall

Session Chairwoman, organizing committee, 31st Canadian Spectroscopy Symposium, Grey Rocks, October 1984.

Session Chairwoman, organizing committee, 11th IGES, Toronto, April 1985.

GSC Representative on Management Committee for Ottawa-Carleton-GSC Shared Isotope Facility.

E.H. Hornbrook

Member, IAEA Working Group VIII, Biogeochemical Exploration for Uranium.

Session Chairman, organizing committee, 11th IGES, Toronto, April 1985.

I.R. Jonasson

RGG Division Representative, GSC Task Group on Submarine Hydrothermal Sulphides.

J.J. Lynch

Member, Baillie Report Committee on Collections.

Y.T. Maurice

Member, Steering Committee on Quebec Economic

and Regional Development Agreement.

Member, Steering Committee on Eastern Townships Geoscience Program.

Member, PhD Thesis Review Committee, Laval University.

Member, Executive Committee for the Gaspé-Lower St. Lawrence Development Program.

Subdivision Productivity

16	Outside Publications
8	GSC Papers
3	Current Research Papers
5	Open Files (100 Geochemical Maps)
11	Oral Presentations
12	Poster Sessions
11	Abstracts of Formal Talks
12	Special Talks or Lectures

RESOURCE GEOPHYSICS SUBDIVISION

K.A. Richardson (Head)

The objectives of this Subdivision are directed toward the development, application and evaluation of radiometric, electromagnetic, electrical and seismic methods of geophysics for mineral exploration, geological mapping and engineering geology. Research and development in geophysical instrumentation and exploration techniques are conducted in airborne, surface, borehole and marine environments.

The Subdivision develops new instrumentation both inhouse and in cooperation with industry, and devises new techniques for more efficient acquisition and interpretation of field data. Experimental surveys are conducted to demonstrate new developments and their application. Calibration facilities are designed, constructed and maintained for use by industry, academic and government agencies; advice is provided to users of the facilities in order to improve the standardization of geophysical measurements.

Highlights

Detailed airborne gamma-ray spectrometric surveys were flown with the GSC Skyvan (P.B. Holman) in the Yarmouth area of Nova Scotia (6,500 line km) and in the Nain area of Labrador (8,000 line km). Both these surveys were carried out under Federal-Provincial cooperative mineral agreements. The St. Georges Batholith, N.B. was surveyed (3,000 line km) to extend K.L. Ford's study of radioelements as indicators of mineralization in granitic rocks, and a survey was flown in the Muskoka area of Ontario (4,500 line km) to acquire a geophysical data set to be incorporated into an experiment using Radar data to be obtained from a space shuttle flight in August 1984 (V.R. Slaney, principal investigator). Other Skyvan experimental surveys included the investigation of several calibration sites across Canada and the effects of soil moisture and soil type on airborne gamma-ray measurements (R.L. Grasty), and the measurement of snow-water equivalent in the Souris River basin, Sask., the Lake Superior basin, and the Saint John River basin, N.B., in cooperation with the National Hydrology Research Institute. Gamma-ray spectrometric maps published during the year at 1:50,000 covered 3 map sheets in Nova Scotia, 5 sheets on the South Coast of Newfoundland and a small area at Strange Lake, Labrador-Quebec. Reconnaissance survey data were published for Sydney, N.S. and Deep River, Ont., 1:250,000 map sheets, and reconnaissance coverage was extended by flying the Ottawa map sheet (31 G).

All of the existing reconnaissance gamma-ray survey data, covering approximately 2.5×10^6 km^2 of Canada were cartographically compiled into 1:1,000,000 scale maps for Open File release (B.W. Charbonneau), and the first 1:1,000,000 scale colour compilation, combining thorium, uranium and potassium data from twelve 1:250,000 scale sheets as a single 3-component map (J.M. Carson). An interesting new mineral discovery resulting from a 1977 reconnaissance survey, was a carbonatite body, rich in thorium and rare earths, located near Allan Lake, in Algonquin Park.

The International Symposium on Borehole Geophysics organized jointly by the Division (P.G. Killeen) and the Canadian Exploration Geophysical Society and held in Toronto in August, was attended by over 200 delegates from 15 countries. Immediately before and after the Symposium, NEA/IAEA Borehole Logging Working Group meetings were held in Ottawa .

The borehole geophysics test area at Bells Corners near Ottawa was extended with an additional 730 metres of diamond drilling, providing a configuration of holes for 3-D experiments with hole-to-hole geophysical measurements (G.R. Bernius, P.G. Killeen).

Borehole Pulse E.M. measurements in the complex multiconductor environment of the Ruttan Mine in Manitoba led to improvements in interpretation techniques, and the identification of previously unknown conductors (A.V. Dyck).

During experimental surveys with E.M. systems in the Lynn Lake, Manitoba area, the strike length and dip of shallow conductors were successfully determined. Shallow E.M. work was able to map contaminated groundwater at a landfill site in Gloucester near Ottawa (A.K. Sinha, L.E. Stephens).

Mise-a-la-masse I.P. measurements in a hole-to-hole configuration at the Buchans Mine, Newfoundland indicated that the technique should be useful for mapping continuity of sphalerite-rich zones which were previously considered to be non-conductors (C.J. Mwenifumbo).

Preliminary results from field tests of the newly developed borehole I.P. (induced polarization) system are most encouraging. This system, using state-of-the-art technology to transmit signals in digital form from the down-hole probe, represents a significant advance over presently available equipment. Measurements show excellent repeatability with high resolution. Two Symposia demonstrations of the system using a "mini-probe" to detect polarizable rock samples in a water tank attracted considerable attention (Q. Bristow).

The computer-based data acquisition and recording system, originally developed as part of the Skyvan airborne gamma-ray spectrometer, has now been cloned four times to provide additional laboratory and field measurement capabilities within the division. The flexibility of this system was convincingly demonstrated in September 1983 when the truck-mounted version was used to conduct a full scale field evaluation of a Finnish made magnetic susceptibility borehole logging probe at two days notice. The probe was on exhibit at the KEGS/GSC Borehole Geo-

physics Symposium. The results of the test were published in "Current Research" (Q. Bristow, G. Bernius).

A single field test has been made of a multi-parameter borehole probe which is still in the course of development. High resolution logs were obtained of fluid conductivity, pressure and temperature in a single pass. The unit uses a digital multiplexing technique with down-hole analogue-to-digital conversion of the sensor signals (Q. Bristow).

A commercially developed X-ray Fluorescence analyser was substantially modified to improve the resolution and used to scan core samples. Preliminary data indicate that such a core scanner could provide qualitative information about the metal content of samples which would aid considerably in deciding which should be chemically assayed, and for which elements (Q. Bristow, J. Parker).

Shallow seismic reflection profiling was carried out at several locations in Canada to provide detailed overburden structure and to test the reflection method in varying terrain types. These locations were Shawville, P.Q., London, Ont., Niagara Falls, Ont., Coldstream Valley, B.C., Quesnel, B.C., Wandering River, Alta., and Medicine Hat, Alta. Over 30 km of reflection data was acquired at a subsurface density of coverage of 3 m. The data quality was generally good except in areas with high noise level and lack of near-surface water table (S.E. Pullan, R.M. Gagne).

Seismic reflection soundings were carried out along the drift paths of the CESAR main camp and a remote camp in April and May, 1983. Four hundred seismic records were digitally recorded at these two locations, which were separated by about 26 km. Analysis of the data is proceeding (A. Overton).

The seismic group has led in the development of international data format standards for engineering seismographs. Leading instrument manufacturers agreed on a standard format which was submitted for ratification to the Society of Exploration Geophysicists (J.A.M. Hunter).

A spring 1983 field season on the Beaufort Sea ice was conducted to obtain information on sub-seabottom permafrost. 18 holes were drilled into the seabottom to obtain insitu temperature and seismic velocity measurements of permafrost. In conjunction with Terrain Science Division personnel, samples of ice-bearing permafrost were recovered for laboratory analysis. Results suggest the development of seasonal frost on the seabottom, above the permafrost zone, in shallow water areas.

A marine seismic program was conducted in the Beaufort Sea from the Coast Guard vessel Nahidik to test a new deep-towed refraction system designed for the detection of sub-seabottom permafrost along future pipeline routes. The system consists of a 100 m 12-channel eel towed 5 m above the sea bottom. Seismic data is transmitted directly to a micro-computer system on board and data can be acquired at very high rates. The initial tests were successful, however data gathering was terminated early because of bad ice conditions.

In the Nuclear Fuel Waste Management Program, work on several samples indicated that tortuosity determined by diffusion experiments was 20% larger than that determined by electrical and porosity measurements, and also indicated that effective porosity rather than connecting porosity controls the diffusion flux contrary to existing theory (T.J. Katsube).

Personnel Notes

G.W. Cameron

Seconded to Director General's Office.

K.L. Ford

Successfully completed his M.Sc. Program at Carleton University in November 1983.

D.C. Gresham

Joined the Borehole Geophysics Section in May 1983 in a continuing PC position.

J.L. Morack

Returned to the University of Alaska in August 1983 after spending a sabbatical year with the Terrain Geophysics Section.

Attendance at Meetings,Conferences and Courses

G. Bernius

KEGS/GSC International Symposium and Workshop on Borehole Geophysics: Mining and Geotechnical Application, Toronto, Ontario, August 29-31, 1983.

Q. Bristow

KEGS/GSC International Symposium and Workshop on Borehole Geophysics: Mining and Geotechnical Applications, Toronto, Ontario, August 29-31, 1983.

NEA/IAEA Borehole Logging Working Group Meetings, Ottawa, Ontario, September 1-2 and 6-7, 1983.

J.M. Carson

Personal Computers & Networking, Ottawa, Ontario, March 5-7, 1984.

L.S. Collett

Society of Exploration Geophysicists Annual Meeting, Las Vegas, Nevada, September 12-15, 1983.

Computer Applications in Mineral Exploration, Toronto, Ontario, January 10-11, 1984.

Prospectors and Developers Association Annual Meeting, Toronto, Ontario, March 5-7, 1984.

A.V. Dyck

KEGS/GSC International Symposium and Workshop on Borehole Geophysics: Mining and Geotechnical Applications, Toronto, Ontario, August 29-31, 1983.

Society of Exploration Geophysicists Annual Meeting, Las Vegas, Nevada, September 12-15, 1983.

Computer Applications in Mineral Exploration, Toronto, Ontario, January 10-11, 1984.

K.L. Ford

Nova Scotia Department of Mines and Energy Open House, Halifax, Nova Scotia, November 30-December 1, 1983.

Geological Society of America, Northeastern Section, Annual Meeting, Providence, Rhode Island, March 15-17, 1984.

J.A. Grant

Tenth Annual North American Data General Users Group Conference, Toronto, Ontario, August 29-September 1, 1983.

Personal Computers & Networking, Ottawa, Ontario, March 5-7, 1984.

R.L. Grasty

NEA/IAEA Borehole Logging Working Group Meetings, Ottawa, Ontario, September 1-2 and 6-7, 1983.

J.A.M. Hunter

Fourth International Permafrost Conference, Fairbanks, Alaska, July 18, 1983.

Society of Exploration Geophysicists Annual Meeting, Las Vegas, Nevada, September 12-15, 1983.

W.G. Hyatt

KEGS/GSC International Symposium and Workshop on Borehole Geophysics: Mining and Geotechnical Applications, Toronto, Ontario, August 29-31, 1983.

T.J. Katsube

American Geophysical Union, Baltimore, Md., June, 1983.

Chalk River Geophysics Workshop, Ottawa, Ontario, December 13-14, 1983.

P.G. Killeen

SPWLA Conference, Calgary, Alberta, June 27-30, 1983.

KEGS/GSC International Symposium and Workshop on Borehole Geophysics: Mining and Geotechnical Applications, Toronto, Ontario, August 29-31, 1983.

NEA/IAEA Borehole Logging Working Group Meetings, Ottawa, Ontario, September 1-2 and 6-7, 1983.

Chalk River Geophysics Workshop, Ottawa, Ontario, December 13-14, 1983.

Prospectors and Developers Association Annual Meeting, Toronto, Ontario, March 5-7, 1984.

H.A. MacAulay

Fourth International Permafrost Conference, Fairbanks, Alaska, July 18, 1983.

C.J. Mwenifumbo

SPWLA Conference, Calgary, Alberta, June 27-30, 1983.

KEGS/GSC International Symposium and Workshop on Borehole Geophysics: Mining and Geotechnical Applications, Toronto, Ontario, August 29-31, 1983.

NEA/IAEA Borehole Logging Working Group Meetings, Ottawa, Ontario, September 1-2 and 6-7, 1983.

Chalk River Geophysics Workshop, Ottawa, Ontario, December 13-14, 1983.

S.E. Pullan

Society of Exploration Geophysicists, Annual Meeting, Las Vegas, Nevada, September 12-15, 1983.

K.A. Richardson

Provisional National Mineral Exploration Technology Development Program, Toronto, Ontario, May 4-5, 1983.

Prospectors and Developers Association, Annual Meeting, Toronto, Ontario, March 5-7, 1983.

A.K. Sinha

Fourth International Permafrost Conference, Fairbanks, Alaska, July 18, 1983.

Chalk River Geophysics Workshop, Ottawa, Ontario, December 13-14, 1983.

V.R. Slaney

Canadian Advisory Committee on Remote Sensing, Arnprior, Ontario, May 11, 1983.

Geosat Committee Meeting and Workshop, Flagstaff, Arizona, June 13-17, 1983.

Meeting of Team for SIR-B Project at NASA Jet Propulsion Laboratory, Palo Alto, California, September 5-9, 1983.

Geosat Committee Meeting, Dallas, Texas, April 20-21, 1983, AND, Houston, Texas, November 4, 1983.

Special Talks and Lectures

Q. Bristow

"A system for the digital transmission and continuous recording of full wave IP measurements in boreholes". Presented at the International Symposium and Workshop on Borehole Geophysics: Mining and Geotechnical Applications, Toronto, Ontario, August 29-31, 1983.

A.V. Dyck

"Drillhole EM measurements in mineral exploration". Presented at the International Symposium and Workshop on Borehole Geophysics: Mining and Geotechnical Applications, Toronto, Ontario, August 29-31, 1983.

"A review of drillhole time-domain EM methods in mineral exploration". Annual Meeting, Society of Exploration Geophysicists, Las Vegas, Nevada, September 11-15, 1983.

"Integrated borehole electrical surveys at Chalk River and implications for fracture-zone mapping". Chalk River Geophysics Workshop, Ottawa, Ontario, December 13-14, 1983.

K.L. Ford

"Application of airborne gamma-ray spectrometric surveys, Meguma Terrane, Nova Scotia". Annual Meeting, NE Section, Geological Society of America, Providence, Rhode Island, March 15-17, 1984.

R.L. Grasty

"Background radiation in Canada". Presented at the 1984 GSC Current Activities Forum, January 17-19, AND, at the Institute of Uranium Mining & Milling, Toronto, Ontario, May 19, 1983.

"Airborne gamma ray spectrometry". McGill University, Montreal, Quebec, May 3, 1983, AND, AECL, Chalk River, June 8, 1983.

J.A.M. Hunter

"Geophysical measurements of sub-bottom permafrost in the Canadian Beaufort Sea." Fourth International Permafrost Conference, Fairbanks, Alaska, July 18, 1983.

T.J. Katsube

"Fluid flow and storage potential of crystalline rocks". American Geophysical Union, Baltimore, Md., June, 1983.

"Pore structure and pathway rock samples from Chalk River". Chalk River Geophysics Workshop, Ottawa, Ontario, December 13-14, 1983.

"Electrical resistivity and acoustic velocity of rocks from Chalk River". Chalk River Geophysics Workshop, Ottawa, Ontario, December 13-14, 1983.

"Effect of stress on pore structure of rock samples from Chalk River". Chalk River Geophysics Workshop, Ottawa, Ontario, December 13-14, 1983.

"Characterization of rock mass pore structure". 17th Information Meeting of the Canadian Nuclear Fuel Waste Management Program - Geoscience, Ottawa, Ontario, February 21-23, 1984.

"Experimental work on diffusion". AECL Matrix Diffusion Workshop, Ottawa, Ontario, July 6, 1983.

P.G. Killeen

"Gamma-ray logging for uranium: status of international efforts to resolve discrepancies in calibration models". Presented at the SPWLA, Calgary, Alberta, June 27-30, 1983.

"A system of deep test holes and calibration facilities for developing and testing new borehole geophysical techniques". Presented at the International Symposium and Workshop on Borehole Geophysics: Mining and Geotechnical Applications, Toronto, Ontario, August 29-31, 1983.

"Gamma-ray spectral borehole logging at Chalk River". Chalk River Geophysics Workshop, Ottawa, Ontario, December 13-14, 1983.

H.A. MacAulay

"Evidence for seasonal variation of nearshore sub-bottom permafrost temperatures in the Canadian Beaufort Sea". Fourth International Permafrost Conference, Fairbanks, Alaska, July 18, 1983.

C.J. Mwenifumbo

"Applications of drillhole mise-a-la-masse techniques to the exploration for copper-lead-zinc deposits". Presented at the International Symposium and Workshop on Borehole Geophysics: Mining and Geotechnical Applications, Toronto, Ontario, August 29-31, 1983.

S.E. Pullan

"Seismic model studies of the overburden-bedrock reflection". Annual Meeting, Society of Exploration Geophysicists, Las Vegas, Nevada, September 11-15, 1983.

"Field experience with the shallow seismic reflection technique". 1984 GSC Current Activities Forum, Ottawa, Ontario, January 17-19, 1984.

A.K. Sinha

"Geophysical analysis of the new Intrablock grid at RA-4". 17th Information Meeting of the Canadian Nuclear Fuel Waste Management Program -Geoscience. Ottawa, Ontario, February 21-23, 1984.

"Fracture mapping by electrical and electromagnetic surveys at Chalk River Research Area, Ontario". GAC/MAC/CGU Meeting, Victoria, B.C., May 11-13, 1983.

"Deep electromagnetic sounding over the permafrost terrain in the Mackenzie Delta, N.W.T., Canada". 4th International Conference on Permafrost, Fairbanks, Alaska, July 18, 1983.

"Dipole-dipole resistivity survey at Chalk River, Ontario". Chalk River Geophysics Workshop, Ottawa, Ontario, December 13-14, 1983.

"Surface electromagnetic surveys at Chalk River, Ontario". Chalk River Geophysics Workshop, Ottawa, Ontario, December 13-14, 1983.

"Dighem II airborne electromagnetic-resistivity-magnetic-VLF survey of the Chalk River research area, Ontario". Chalk River Geophysics Workshop, Ottawa, Ontario, December 13-14, 1983.

V.R. Slaney

"SIR-A Voyage across Asia". Canadian Symposium on Remote Sensing, Montreal, Quebec, May 3, 1983, AND, Geosat Committee Meeting, Dallas, Texas, April 20-21, 1983.

"Canadian Space Activities". Geosat Committee Meeting, Flagstaff, Arizona, June 13-17, 1983, AND, Geosat Committee Meeting, Houston, Texas, November 4, 1983.

"Annual Report of the Geoscience Working Group".

Canadian Advisory Committee on Remote Sensing, Arnprior, Ontario, May 11, 1983.

T.I. Urbancic

"Multiparameter logging techniques applied to gold exploration". Presented at the International Symposium and Workshop on Borehole Geophysics: Mining and Geotechnical Applications, Toronto, Ontario, August 29-31, 1983, AND, the GSC Current Activities Forum, Ottawa, Ontario, January 17-19, 1984.

Memberships on Committees

J.M. Carson

Member, Departmental Computer Policy Committee's Subcommittee on Alternate Computing Facilities.

L.S. Collett

Member, Engineering and Groundwater Geophysics Committee, Society of Exploration Geophysicists.

Branch Representative, Program for Industry/Laboratory Projects, National Research Council.

Chairperson, Ontario Exploration Technology Development Fund, Ontario Geological Survey, BILD Program.

Director, Mineral Exploration Research Institute, Montreal, Quebec.

Member, Advisory Committee on Soil Resistivities, Canadian Electrical Association, Montreal, Quebec.

A.V. Dyck

Associate Editor, Borehole Geophysics, for "Geophysics".

R.L. Grasty

Member, IAEA Working Group on Improvements in the Measurement of Natural Gamma Radiation.

Departmental Representative, Working Group on "Radiation in Canada".

J.A.M. Hunter

Member, Permafrost Subcommittee of National Research Council.

Chairperson, Engineering and Groundwater Geophysics Committee, Society of Exploration Geophysicists.

Chairperson, Engineering Seismograph Digital Standards Subcommittee, Society of Exploration Geophysicists.

Editor for "Geoexploration".

Editor, Engineering Geophysics, for "Canadian Geophysical Bulletin".

T.J. Katsube

Chairperson, Nuclear Fuel Waste Management Program (NFWMP) Rock Sample Committee.

P.G. Killeen

Chairperson, Technical Program Committee, KEGS/GSC International Symposium and Workshop on Borehole Geophysics: Mining and Geotechnical Applications.

Chairperson, NEA/IAEA R&D Working Group on Borehole Logging in Uranium Exploration.

Secretary-Treasurer, Minerals and Geotechnical Logging Society.

Member, Calibration Volume Committee, SPWLA.

Member, Ad Hoc Committee on Geophysics for the Canadian Geoscience Council.

Member of ASTM Task Force on Borehole Sensors.

A.K. Sinha

Member, Reviews Committee of the Society of Exploration Geophysicists.

V.R. Slaney

Team Leader, Non-Renewable Resources with the Radarsat Project.

Member, Executive Committee, Canadian Advisory Council on Remote Sensing.

Chairperson, Geoscience Working Group, Canadian Advisory Council on Remote Sensing.

EMR representative, on Geosat Scientific and Technical Committees.

Subdivision Productivity

9 Outside Publications
3 GSC Papers
4 Current Research
3 Open Files
10 Geophysical Series (70 Gamma-ray Spectrometric Maps)
25 Abstracts of Formal Talks
31 Special Talks and Lectures

TERRAIN SCIENCES DIVISION

J.S. Scott, Director

Introduction

Responsibilities of the Division are provision of geoscientific data and interpretive information on the surficial geology and geomorphic processes of the Canadian landmass and for such geotechnical aspects of surficial and bedrock materials as may have a bearing on use of the terrain for various purposes. Management responsibility and provision of administrative services to the EMR co-operative program with Atomic Energy of Canada Limited for Nuclear Fuel Waste Management is also centered within the Division.

The objectives of the Division are: to provide a systematic coverage of surficial geology of the Canadian landmass consistent with the information requirements for effective use of the terrain and for the interpretation of Quaternary and Holocene geological events; to acquire an understanding of past and present geomorphic processes; to identify and assess the occurrence and magnitude of natural terrain hazards; to provide geoscience information to assist in the use, maintenance and restoration of the physical environment; and to provide standards, controls, and reference materials to ensure consistency of correlation between geological events of the Pleistocene and Holocene Epochs and to develop and maintain standards of mapping of surficial geology appropriate to national needs.

The Divisional organization comprises four sections. Regional Projects Section activities are directed largely toward geological investigations of the nature, origin and distribution of unconsolidated deposits and landforms, to provide geological maps of the areas investigated and to establish the stratigraphic and environmental history. Paleoecology and Geochronology Section is responsible for paleontological and paleoecological investigations of Quaternary fossil materials as an aid to stratigraphic correlation and determination of paleoenvironments and for the provision of ^{14}C dates on various organic materials. Sedimentology and Mineral Tracing Section is concerned with defining the mechanisms of glacial dispersal of bedrock components in glacial drift and with the determination of its geochemical characteristics. Geomorphic Processes and Engineering Geology Section is concerned with the study of active geomorphological processes with emphasis on the permafrost environment, but including studies of terrain hazards in various regions of southern Canada. This Section is also responsible for studies of the engineering characteristics of geological materials for engineering or terrain use purposes. Current activities include contributions to the Nuclear Fuel Waste Management Program.

During the year preliminary organization was completed for a Canadian Geoscience Council Committee to examine outputs of the Geological Survey in Quaternary and Engineering Geology. Professor M. Church, Department of Geography, University of British Columbia accepted the role of Chairman of the Committee.

At the end of the report-period the staff comprised 1 Research Manager, 24 Research Scientists, 13 Physical Scientists (6 terms), 8 technical support (2 term), and 7 administrative support. Staff of the Division are based primarily in Ottawa with small operational units in Calgary at the Institute of Sedimentary and Petroleum Geology and in the Vancouver Office of the Geological Survey.

During the year the Division approved the following for G.S.C. publication: 7 Papers; 2 Miscellaneous Reports; 2 Memoirs; 16 Maps; 7 Open Files; and 12 contributions to Current Research, Paper 84-1A. In addition 15 papers were approved for contribution to the Summary Volume of IGCP Project 24; and 29 papers and 7 abstracts were approved for Outside Publication.

REPORTS ON SECTIONS

DIVISION HEADQUARTERS

Division Headquarters, in addition to the Director's office, comprises the Scientific and Technical Services Unit, which provides editorial and cartographic services, the Administrative and Financial Services Unit, and the Secretarial and Clerical Services Unit. Also included in Division Headquarters is one Staff Scientist who carries out research and provides advice to the Branch and other Departments on marine geoscience programs.

Personnel Notes

Division Headquarters consists of a permanent staff of 1 Research Manager, 1 Research Scientist, 2 Physical Scientists, and 7 support staff. The Unit also supported 1 contract and 1 Research Agreement.

M. Price, a hydrogeologist with U.K. Institute of Geological Sciences, completed in September a one year assignment as part of the U.K.-Canada Public Servants Exchange Program. Mr. Price undertook an evaluation of some of the hydrogeological work done for the Nuclear Fuel Waste Management Program and reviewed potential applications of hydrogeology to various scientific projects of the Geological Survey.

Attendance at Meetings, Conferences and Courses

B.R. Pelletier

Centennial Conference of Canadian Hydrographic Association, Ottawa, April 1983.

Geological Association of Canada, Victoria, B.C., May 1983.

Workshop on Juan du Fuca Ridge, Sydney, B.C., May 1983.

J.S. Scott

Completed the "Orientation Course for EX's" at the Government training centre, Touraine, September 1983.

Membership on Committees

J.A. Lowdon

Geological Survey of Canada Radiocarbon Dating Committee, Member

Departmental Steering Committee for Review of the EG-ESS Standards, Branch Representative

B.R. Pelletier

Maritime Sediments, Associate Editor

Advisory Committee on Undersea Features Names, Member

Working Group Marine Atlases for Canada, Member

J.S. Scott

Department Committee for Research Manager Classification, Member

NRC Associate Committee on Geotechnical Research, Member

Departmental Advisory Committee on Access to Information and Privacy, Earth Sciences Sector Representative

Organizing Committee for 1984 Current Activities Forum, Chairman

Special Talks or Lectures

B.R. Pelletier

'Canadian marine geology' to Canadian Hydrographers, Ottawa, October 1983.

J.S. Scott

'Canada's natural resources' to Course XXXVII at the National Defence College, Kingston, Ontario, November 1983.

'Geoscience research - then and now' at the 17th Information Meeting, Nuclear Fuel Waste Management Program, Carleton University, Ottawa, February 1984.

Quaternary Discussion Group

Under the Chairmanship of W. Blake, Jr. the following papers were presented during March, April, and May 1983.

Dr. L. King, Geographisches Institut der Universität Heidelberg, Heidelberg, Federal Republic of Germany — Permafrost distribution in Scandinavia.

Dr. S.A. Edlund, Terrain Sciences Division, GSC, Ottawa — Bioclimatic zonation in the Arctic Is.

Professor H.M. French, University of Ottawa, Ottawa — The Panarctic, Dome et al. Hoodoo N-52 surface disposal experiment, Ellef Ringnes Is.

Professor D.J. Huntley, Simon Fraser University, Burnaby, B.C. — Thermoluminescence dating of sediments ("New Light from Old Dirt").

Dr. V.N. Rampton, Terrain Analysis & Mapping Services, Ltd., Carp — Quaternary geology of New Brunswick (the whole thing).

Dr. J.P. Smol, Queen's University, Kingston — The postglacial development of selected lakes in Eastern Canada, with examples from southern Ontario and Ellesmere Island.

Under the Chairmanship of P.A. Egginton the following papers were presented from October 1983 to March 1984.

Dr. S.G. Evans, Terrain Sciences Division, GSC, Ottawa — Landslides in the southern Canadian Cordillera.

Dr. J.J. Clague, Terrain Sciences Division, GSC, Vancouver — Quaternary stratigraphy and history of British Columbia.

Dr. D.G. Harry, Terrain Sciences Division, GSC, Ottawa — Ground ice origin and stratigraphy, western Canadian Arctic.

Dr. R.A. Klassen, Terrain Sciences Division, GSC, Ottawa — Labrador: A progress report.

Mr. P.H. Wyatt, Terrain Sciences Division, GSC, Ottawa — A technique for determining acid neutralizing capacity of till and other sediments.

Dr. R.N.W. DiLabio, Terrain Sciences Division, GSC, Ottawa — Till geochronology at Lac Brisson, Quebec and Newfoundland.

Ms. K. Langley and Dr. D. Fisher, Polar Continental Shelf Project, Ottawa — Late Laurentide modeling: basal inferences.

Dr. C.P. Gravenor, University of Windsor, Windsor — Magnetic and pebble fabrics of glaciomarine diamictons, Champlain Sea, Ontario.

Dr. C.J. Rodrigues, University of Windsor, Windsor — Ecostratigraphic study of late Quaternary sediment in Western Champlain Sea Basin.

Dr. J. Syvitski, Atlantic Geoscience Centre, Dartmouth — Arctic sandurs.

Dr. P.J. McLellan, M.J. O'Connor Associates, Calgary — Some aspects of massive rock avalanches in the Mackenzie Mountains.

Dr. H. Josenhans, Atlantic Geoscience Centre, Dartmouth — Surficial geology of the Labrador Shelf.

Dr. G. Prichonnet, Université du Québec à Montréal, Montréal — Stratigraphy and sedimentology of the Quaternary sequence in the Montréal area, Québec: paleogeographic remarks.

REGIONAL PROJECTS SECTION

R.J. Fulton and D.A. St-Onge (Heads)

The prime objectives of the Regional Projects Section are to provide a Canada-wide inventory of surficial materials and landforms and to establish the stratigraphy and environmental history of Quaternary deposits. Projects are designed to provide information on the nature and distribution of surficial materials and on terrain conditions, to determine the geologic history of the Quaternary period and to furnish an understanding of the genesis of deposits and landforms. Terrain and surficial geology information is required for all landuse activities in order to ensure that land resources are used economically, and that development will proceed without unacceptable deterioration of the environment. Important adjuncts of this work are preparation of regional syntheses, which explain the general nature and environmental history of Canada, and the development of expertise in terrain and environmental matters that can be tapped by other agencies.

Highlights

Detailed lichonometric studies in the Frances Lake area (105 H) in the Yukon involved the measurement of approximately 30 000 individual lichen in 61 sites. Preliminary results define two ages of rock glacier activity older than White River ash (1200 BP) and several younger periods of rock glacier activity and of morainic construction. Surveyed markers on 25 representative rock glaciers will allow long term monitoring of the activity of these landforms. These studies will eventually give us a much better understanding of the environmental record of southeastern Yukon.

Co-operation between the Geological Survey of Canada and l'Université de Montréal has made possible the detailed study of a type section in a postglacial debris flow exposed in the lower Coppermine River valley, Northwest Territories. The results are expected to lead to a better understanding of the modes of emplacement of olisthostromes in modern and in older sedimentary environments. The study may also help define the nature of glacier-related debris flows often referred to as "flow tills".

Detailed mapping of surficial deposits in the vicinity of Temiscaming (Québec and Ontario) suggests that the Lake McConnell Moraine marks the separation between an ice mass flowing to the SW (210°-240°) and another one flowing to the S-SE (180°-160°). These directions are believed to result mainly from deglaciation and a major glacial event with an ice flow direction to the SW probably preceded them. Interpretation of ice-flow indicators, mainly striations and lithology, undertaken in previous field seasons was followed up this summer. It has been of direct assistance to private organizations engaged in mineral exploration.

Preliminary results from landform investigations on Victoria Island show that primary (glacial) fabric is preserved on well drained sites less than one metre from the surface. This has important implications in the study and understanding of glacial landforms and the assumed intensity or pervasiveness of periglacial processes. This is an initial benefit of detailed study at representative sites to provide general concepts or models for large mapping areas.

Plant communities on the calcareous surficial materials of Banks and western and eastern Victoria Islands were compared with unexpected analogues along the western Hudson Bay coast. In the latter location, where Precambrian Shield derived-materials dominate, a narrow strip of calciphilous plant communities occur where shells are common in the beach sediments and soil development has not yet buffered the effect of the shell-designed calcareous material. This is a potentially important association when regional surficial geology mapping is in part land or plant communities.

The major Quaternary sections on the Mainland south of the Beaufort Sea between the Yukon-Alaska border and the Baillie Islands were remeasured and materials were collected for paleoecological and paleomagnetic analyses and for dating. The information gained will be used to establish the basic Quaternary stratigraphic framework of the area where extensive parts were never glaciated. Also, the results should provide a basis for correlating the Quaternary suites of sediments with those on adjacent Banks Island, the Yukon and Alaska.

A nonglacial-glacial-nonglacial sequence of sediments has been recognized in the Quaternary exposures of the middle reaches of the Fraser River. Boulders and coarse gravel at the base occur as a lag thought to represent erosion during the Olympia Nonglacial Interval; the thick aggradational sand and gravel above was deposited as Fraser Glaciation ice advanced into the area; a patchy till was deposited at the glacial maximum; and local fills of gravel and terraces cut in earlier deposits represent deglacial and Holocene erosion and deposition.

Work in the central Yukon showed that the general characteristics of the soil could be used as an indication of the age of the underlying till. It was also possible to use soils to establish correlation between Reid Glaciation of the Central Yukon and the second youngest glaciation of the Ogilvie Mountains. In addition, it was also confirmed that at least two glaciations occurred prior to Reid Glaciation.

A start was made on the mapping of the Cypress area of southwestern Saskatchewan. Preliminary results suggest that at least three tills are exposed at the surface and that loess at the surface in the area south of Shaunavon overlies a paleosol that pre-dates the last regional glaciation.

Personnel Notes

The Regional Projects Section consists of a permanent staff of 11 Research Scientists, 5 Physical Scientists, and 1 C.E.I.P. employee. The Section also supported 4 contracts and 4 EMR Research Agreements.

A.S. Dyke was stationed at the University of Alberta, Geography Department, from September 1983 to April 1984.

R.J. Fulton continued the major task of co-ordinating Divisional and national efforts in the revision of the Quaternary portion of Geology and Economic Minerals of Canada.

D.A. St-Onge was re-appointed to Terrain Sciences Division in September 1983 for a second year's assignment under provisions of the Canada Executive Interchange Program. He continued duties as Acting Section Head, Regional Projects Section, Ottawa personnel.

Attendance at Meetings, Conferences and Courses

J.J. Clague

Presented a paper at the Geological Association of Canada Annual Meeting, Victoria B.C., May 1983, and led a field excursion.

L.A. Dredge

INQUA Meeting and field trip on the Lithology and Genesis of Till, Barcelona, Spain, September 1983.

INQUA Subcommission on European Stratigraphy, Germany-Austria, September 1983.

S.A. Edlund

Presented a paper at the Annual Meeting of the Friends of Climatology, Ottawa, April 1983.

Presented a paper at the 13th Annual Arctic Workshop, Boulder, Colorado, March 1984.

R.J. Fulton

Presented a paper at the Joint Annual Meeting of the Geological Association of Canada and Mineralogical Association of Canada, Victoria, B.C., May 1983.

Presented a paper at the IGCP Editorial Board Meeting and Symposium, Paris, September 1983.

Annual Meeting of the North American Commission on Stratigraphic Nomenclature, held in conjunction with the Geological Society of America meeting, Indianapolis, October 1983.

D.R. Grant

Presented a paper at the NATO Symposium on "The Last Deglaciation", Virginia, May 1983.

Presented a paper at the Geological Association of Canada Annual Meeting, Victoria, B.C., May 1983.

Presented a paper at the Second Nordic Symposium on Climatic Changes and Related Problems, Stockholm, May 1983.

Presented a paper at the Correlation of Quaternary Chronologies Symposium, Toronto, May 1983.

Presented a paper at the Annual Meeting of Atlantic Geoscience Society, Amherst, Jan. 1984.

O.L. Hughes

Presented a paper at the Glaciation in Alaska Workshop, Chena Hotsprings, Alaska, March 1984.

F.M. Nixon

York Symposium, Toronto, May 1983.

S.H. Richard

Friends of the Pleistocene Annual Meeting, and participated in field trip, Augusta, Maine, May 1983.

D.A. St-Onge

Presented a paper at the Geological Association of Canada Annual Meeting, Victoria, May 1983.

Symposium on Correlation of Quaternary Chronologies, Toronto, May 1983.

Ontario Association of Geomorphologists, Hamilton, August 1983.

Presented a paper at the Geological Survey of Canada Current Activities Forum, Ottawa, January 1984.

D.R. Sharpe

Symposium on Correlation of Quaternary Chronologies, Toronto, May 1983; and co-leader for field trip.

A.M. Stalker

Symposium on Correlation of Quaternary Chronologies, Toronto, May 1983.

J.J. Veillette

York Symposium, Toronto, May 1983.

Presented a paper at the association québeçoise pour l'étude du Quaternaire, Sherbrooke, October 1983.

Open House, Ministre d'Energie et Ressources, Québec, November 1983.

J-S. Vincent

Presented a paper at association canadienne française pour l'avancement des sciences, Trois-Rivières, May 1983.

Presented a paper at the Symposium on Correlation of Quaternary Chronologies, Toronto, May 1983.

Membership on Committees

J.J. Clague

INQUA Subcommission on North American Quaternary Stratigraphy, Member

INQUA Commission on Quaternary Shorelines, Subcommission for the Americas, Member

J.J. Clague (cont'd.)

Canadian Journal of Earth Sciences, Associate Editor

A.S. Dyke

IGCP Project 24, Arctic Canada Working Group Member

S.A. Edlund

Arctic Institute of North America Canadian Committee of Ecological Land Classification, Member

Canadian Committee on Ecological Land Classification, Northlands Ecoregion Working Group, Member

R.J. Fulton

Geological Survey of Canada Radiocarbon Dating Committee, Member

Working Group, IGCP Project 73/1/24, Member

Expert Committee on Soil Survey, Agriculture Canada, EMR Representative

North American Commission on Stratigraphic Nomenclature, Commissioner

N.R. Gadd

Conseil Scientifique, Géographie physique et Quaternaire, Member

D.R. Grant

INQUA Commission on Quaternary Shorelines, President

Canadian Quaternary Association, Secretary-Treasurer

NRC Canadian National Committee for INQUA, Secretary

IGCP Project 24, Atlantic Provinces Subgroup, Leader

IGCP Project 200, Executive Board Member

North American Working Group of the IAG Commission on Recent Crustal Movements, Member

D.A. St-Onge

CNC-INQUA, President (until May 1983)

Geological Association of Canada, Vice President 1983-84

Royal Canadian Geographical Society, Secretary; Research Committee, Chairman; Editorial Committee and Massey Medal Committee, Member

Canadian Geoscience Committee on Quaternary Studies in Canada, Member

INQUA '87, Organizing Committee, Vice President

Comité d'Honneur de la Fondation ACFAS, membre

A.M. Stalker

Canadian Quaternary Association, Chairman

International Geological Correlation Program, IGCP Project 128, Member

INQUA Subcommittee on North American Quaternary Stratigraphy, Member

S.I.L. Working Group on "International projects on deep coring operations on relict lakes of the world", Member

Canadian National Committee for I.U.G.S., Member

J-S. Vincent

Association québécoise pour l'étude du Quaternaire, Président

Géographie physique et Quaternaire, Rédacteur adjoint

IGCP Project 24, Western Arctic Subgroup, Leader

Special Talks or Lectures

J.J. Clague

'Natural hazards in southwest Yukon Territory' at the School of Resources Management, Simon Fraser University, Burnaby, B.C., November 1983.

'Drainage changes in Yukon Territory during the Quaternary' to Department of Geological Sciences, University of B.C., Vancouver, December 1983.

'Quaternary geology of British Columbia' to Department of Archaeology, Simon Fraser University, Burnaby, B.C., March 1984.

A.S. Dyke

Seminars presented to graduate course on 'Circumpolar Quaternary Environments', Department of Geography, University of Alberta:

(a) Use of boulder and bedrock weathering: relative dating of moraines on Cumberland Peninsula, Baffin Island.
(b) Wisconsinan and Holocene sealevel history of Cumberland Sound, Baffin Island.
(c) Pre-Late Wisconsinan glacial and sealevel record of the central Canadian Arctic.
(d) Late Wisconsinan and Holocene glacial and sea-level record of the central Canadian Arctic.
(e) Laurentide Ice Sheet Problems - Part A: Configuration and flow patterns.
(f) Laurentide Ice Sheet Problems - Part B: Multiple Wisconsinan deglaciations of Hudson Bay - common fact or common fantasy?

Seminars presented to graduate 'Periglacial Geomorphology' course, University of Alberta:

(a) Radiocarbon dating of solifluction lobes in the central Arctic:
(b) Lichenometrical dating of Holocene rock glaciers and moraines in the southern Yukon.

Above talks given during Jan., Feb., and March 1984.

S.A. Edlund

'Bioclimatic zonation in the Canadian Arctic' to the following groups during 1983-84:

Combined Northern Affairs and Parks Canada group
Center for Northern Studies, Wolcott, Vt.
Woodstock Field Naturalists, Woodstock, Ont.
Polar Continental Shelf Project
Department of Geography, University of Windsor
Department of Geography, McMaster University
Northern Studies, McGill University
Department of Geography, Queen's University
Department of Geography, University of Waterloo
Department of Geography, Wilfred Laurier Univ.
Department of Land Resource Management, and
Department of Botany, University of Guelph
Atmospheric Environment Service, Downsview, Ont.
Department of Geography, York University
Department of Geography, Carleton University.

R.J. Fulton

'Quaternary Mapping' to Department of Earth Sciences, University of Quebec, Montreal, March 1984.

N.R. Gadd

'Ancient ice and early seas - Ottawa region' to Bell Northern Research Popular Lecture Series, Ottawa, December 1983.

D.A. St-Onge

'Le ravinement dans les Swan Hills, Alberta', at the Université du Québec à Montréal, Montréal, January 1984.

'Quaternary of the Coppermine River region' at the University of Alberta, Edmonton, March 1984.

J-S. Vincent

'Les glaciations quaternaires dans l'ouest de l'Arctique canadien, Centre d'études nordiques, Québec, October 1983.

PALEOECOLOGY AND GEOCHRONOLOGY SECTION

W. Blake, Jr. (Head)

A major portion of the work of the Paleoecology and Geochronology Section is of a laboratory nature, but specialized field studies, such as the coring of lake sediments, are carried out by staff members. In 1983 field work was undertaken in: Ontario, the Yukon, the coast of the District of Mackenzie, and Ellesmere Island. These field investigations, together with laboratory studies of previously collected samples, have provided additional information on past environments throughout Canada. Because the analyses of fossil diatoms, insects, marine invertebrates, pollen, seeds and wood are often coupled with radiocarbon age determinations, an appreciation is being gained of the rates at which the environment is changing and of the rates at which processes are occurring.

Highlights

Field work for the Yukon Refugium Project, a major interdisciplinary study in which the Section participates (especially with regard to fossil insects, plant macrofossils, and radiocarbon dating) was essentially completed in 1981, but some additional collections and stratigraphical studies were carried out in 1983. This research effort has involved GSC staff members as well as personnel from the National Museum of Man, the National Museum of Natural Sciences, the University of Alberta, the University of Minnesota, the University of Alaska, and the U.S. Geological Survey. A book entitled "Paleoecology of Beringia", summarizing many of the studies made, was published by Academic Press in 1982. Paleoecological analysis of the collections continues.

A second major interdisciplinary project is concerned with the glacial history of east-central Ellesmere Island and the adjacent coasts of northwest Greenland. Related studies include fluctuations of sea level, botany, rock weathering, water chemistry, marine invertebrate, climatic change (as deduced from the record of pollen, diatoms, other algae, and invertebrates preserved in lake sediments), and the development of boulder baricades and geomorphic processes occurring at the present coast. In addition to GSC personnel, participants have come from the University of Helsinki, the University of Copenhagen, Greenland Botanical Survey, Norsk Polarinstitutt, Scarborough College (University of Toronto), Sir Sanford Fleming College, Memorial University of Newfoundland, McMaster University, and Queen's University. The geological and botanical studies complement archeological investigations being carried out in the area by the Arctic Institute of North America.

Another area of emphasis involves palynological studies over a broad area extending from the Great Lakes to the Maritime Provinces. The palynological studies are often coupled with studies of plant macrofossil and fossil arthropods. Not only is a detailed knowledge of vegetation history emerging from these investigations, but cross-checking of radiocarbon dates on marine and terrestrial materials may be possible. One of the chief aims of the project is to resolve chronological problems between the Champlain Sea, which formerly occupied the Ottawa-St. Lawrence Lowland, and the Great Lakes area.

With regard to diatoms, emphasis is being placed on studying near-surface lake sediments from selected sites in Ontario and Quebec to determine the effects of acid rain on the aquatic environment. A second major study involved the collecting of surface snow samples from several Arctic ice caps; all samples contained diatoms, including marine species indicative of long distance transport. These samples are now being compared with precipitation collected nearer to sea level along the east coast of Ellesmere Island.

The Radiocarbon Dating Laboratory, now in its 24th year of operation, has completed more than 3900 age determinations on a variety of organic materials — wood, peat, gyttja, shells, bone, antler, horn, ivory, charcoal, and hair. These age determinations bear on problems such as the time of deglaciation or

the time that a given area emerged from the sea. In some localities it has been possible to bracket the time of glacial advances. In other localities an appreciation has been gained of the rates at which changes in the environment are occurring or the rates at which a variety of processes are taking place. Results of the dating program are published annually in the GSC Paper Series; List XXIII has now appeared. Laboratory research is being conducted into the problems of: (1) dating sediments from hard water lakes, and (2) obtaining reliable ages on bones.

Personnel Notes

The Paleoecology and Geochronology Section consists of a permanent staff of 5 Research Scientists, 1 Physical Scientist, and 2 Technicians. In addition, 3 Physical Scientists work in support positions. The Section also supported 1 contract and 2 EMR Research Agreements.

J.P. Smol of the Department of Biology, Queen's University, joined the Section as a Visiting Fellow to work on lake sediment cores from the Arctic.

Attendance at Meetings, Conferences and Courses

T.W. Anderson

National Museum of Natural Sciences Conference on Critical Periods in Climate History, May 1983.

W. Blake, Jr.

Presented a paper at the NATO Advanced Study Workshop on "The Last Deglaciation: Timing and Mechanism", Airlie, Virginia, May 1983.

Geological Society of America Annual Meeting, Indiananpolis, Indiana, October-November 1983.

16th Nordic Geological Winter Meeting, Stockholm, Sweden, January 1984.

J.V. Matthews, Jr.

Presented a paper at the National Museum of Natural Sciences Conference on Critical Periods in Climate History, Ottawa, May 1983.

R.J. Mott

Presented a paper at the National Museum of Natural Sciences Conference on Critical Periods in Climate History, Ottawa, May 1983.

Membership on Committees

T.W. Anderson

Canadian National Committee for INQUA, Member (until May 1983)

National Research Council Peat Forum, Member

Geological Survey of Canada Radiocarbon Dating Committee, Member

T.W. Anderson (cont'd.)

Divisional Committee for EMR Research Agreements, Member

W. Blake, Jr.

American Quaternary Association, Councillor 1982-1986

Fellows Committee, Arctic Institute of North America, Calgary, Chairman

Canadian Committee on Climatic Fluctuations and Man, Member (until Autumn 1983)

Geological Survey of Canada Radiocarbon Dating Committee, Chairman

Ph.D. Thesis Committee for M. Krawetz, Department of Geography, McMaster University, Hamilton, Ontario, Member

J.V. Matthews, Jr.

Scientific Committee for a Biological Survey of Canada (Terrestrial Arthropods Components), Member

Climate Planning Board, Alternate Member

Canadian Committee on Climatic Fluctuations and Man, Member

R.J. Mott

Branch Safety Committee, Member

Special Talks or Lectures

T.W. Anderson

'Palynology studies in Lake Erie' to the Supreme Court of Ontario, Toronto, November 1983; this was in connection with litigation against the Department of Public Works as a result of DPW activities at Port Burwell, Ontario.

W. Blake, Jr.

'The glacial history of the northern Baffin Bay area, Canadian Arctic Archipelago and Greenland' to graduate students and faculty at the Naturgeografiska Institutionen, Stockholms Universitet, Stockholm, Sweden, and at the Geographisches Institut, ETH, Zürich, Switzerland, both in January 1984.

'Quaternary geology and glacial history of Arctic Canada' to graduate students and faculty at the Department of Geology, University of Ottawa, Ottawa, March 1984.

J.V. Matthews, Jr.

'Future climate: past as key to the future' to a general audience (Sigma Xi) largely scientific, at the National Research Council Auditorium, January 1984.

Laboratory Statistics

Paleoecology

1. Samples processed

Diatom samples	
samples processed	38
filters prepared	52
slides prepared	210
slides investigated	175
Palynological	176
Wood treatments	118

2. Reports completed

Diatom	3
Fossil Arthropod	38
Palynological	1
Plant Macrofossils	38
Wood	53

Geochronology

3. Determinations completed

Radiocarbon ages (GSC)	
Geological samples	211
Archeological samples	1
Geochemical samples	6
$^{13}C/^{12}C$ ratios (University of Waterloo - contract)	214

SEDIMENTOLOGY AND MINERAL TRACING SECTION

W.W. Shilts (Head)

The primary task of the Section is to provide information on the physical and mineralogical-chemical properties of glacial and associated surficial sediments of Canada. Research is aimed at providing basic data on regional variations in drift properties and at developing techniques of using drift composition to aid in prospecting or evaluation of environmental or geotechnical problems. In addition, members of the Section do basic research on glacial and lacustrine sedimentation and map surficial sediments where necessary to support sedimentological, geochemical, or remote sensing activities.

The Sedimentology-Engineering Geology Laboratories are administered within this Section. These Laboratories provide research facilities and analyses as well as preparation of samples for Terrain Sciences Division staff and for other scientists within and outside of the Geological Survey.

Highlights

Maps of the surficial geology of Coats and Mansel Islands have been compiled at a scale of 1:125 000 using airphoto interpretation and field work carried out from Canadian Coast Guard icebreaker Pierre Radisson in 1979.

Sonar profiling was continued with special emphasis on documenting effects of seismic events and neotectonic movements on lacustrine sedimentation. Subaqueous landslides and modern faulting were found in high quality records from Lake Temiskaming. Lac Deschênes (Ottawa River at Ottawa) was found to be underlain by a deep channel, cut into postglacial marine sediments. The channel is now a site of deposition suggesting that the submerged erosional features are related to major neotectonic movement postdating 9000 years B.P. Papers were presented on Sonar results at the annual G.S.A. meeting and Current Research Forum.

Two deep holes were drilled on contract and cores recovered of the sedimentary sequence underlying Lac Deschênes.

Two weeks were spent studying esker sedimentation and glacial dispersal from Paleozoic outlier(s) near Deep Rose Lake in north-central Keewatin. The esker systems were found to be partially submerged in outwash emitted from the retreating ice-front mouth of the tunnel in which they were deposited. Understanding this sedimentation model is critical for interpreting the source of mineralized erratics found on one or another element of the system.

Surficial geology mapping and till geochemical sampling were carried out near Churchill Falls, Labrador in preparation for a major ERDA project to be carried out in the region. A previously unrecognized northeastern glacial movement was detected through striation and dispersal studies.

Lithological studies were carried out on till and other samples collected from the Labrador Shelf on CSS Hudson cruise. Patterns of dispersal of distinctive Paleozoic erratics are likely to yield crucial information of glacier flow paths and iceberg drift patterns.

Major stratigraphic studies were continued in the Severn River and adjacent systems by boat and helicopter traverses along the Severn and adjacent rivers. Three post Sangamon (interglacial) glacial events and several new sites of organic beds were located and amino acid analysis was carried out on marine shells. Amino Acid analysis just completed of shells collected from marine beds below till on Abitibi River two years ago suggests that those beds represent a Late Wisconsin interstadial event (in the 30 000-50 000 year B.P. range) and not interglacial beds — confirming earlier evidence that Hudson Bay was opened and closed by glaciers at least twice after the last interglacial.

Sampling of drift was carried out in western New Brunswick both to map areas sensitive to acid rain and to serve as background to drift sampling programs anticipated in upcoming ERDA programs in the area.

A very fine, well documented collection of over 40 heavy mineral species separated from till was assembled and a preliminary reference guide completed. It is intended to publish a manual for heavy mineral identification and to sell sets of 35 mm slides of the reference collection separately.

Mapping of the surficial geology of the Haliburton area was completed and is being incorporated into a Ph.D. thesis at University of Illinois. Papers describing till sedimentology of the area were presented at north-central GSA and at a till symposium organized by New York State Geological Survey in Albany.

Mapping was completed of a spectacular dispersal train from the Strange Lake, Labrador Zr-Y-Nb-Be deposit. This represents one of the first or possibly the first documentation of rare-earth dispersal trains in till.

Sampling of till was begun in the Lynn Lake, Manitoba area to provide geochemical background for planning the extensive ERDA program beginning in that area in 1984.

Scanning Electron Microscope (SEM) with EDS (Energy Dispersive Spectrometry) capability was increasingly used to scan sand-sized heavy mineral separates for economically important minerals. Working with industry scientists, substantial progress has been made in describing the genesis of gold spheres as secondary, young chemical precipitates in glacial till and gravel sampled by overburden drilling in the Abitibi Clay Belt.

One scientist was invited by the Geological Survey of Finland to spend two weeks visiting all major Drift Prospecting projects in Finland. Much useful technological information was exchanged.

Work was begun on the clay mineralogy and chemistry of sediments and deposits around submarine volcanic vents in rift areas.

Remote sensing research in arctic areas was continued, particularly using satellite imagery of King William Island. Two major tectonic features (faults or dykes) were found to bisect the island but were only visible using special image enhancement techniques developed by one of the Section's scientists.

The Section designed the drift-prospecting (esker sampling) component of the successful STAMP program. Geochemical data from that program have been compiled and pinpoint areas of gold enrichment and geochemical dispersal anomalies in eskers crossing greenstone belts.

Personnel Notes

The Sedimentology and Mineral Tracing Section consists of a permanent staff of 3 Research Scientists, 3 Physical Scientists, and 5 Technicians. In addition, 2 Physical Scientists and 2 Technicians work in support positions. The Section also supported 2 contracts.

Attendance at Meetings, Conferences and Courses

J.R. Bélanger

Presented a paper at the Conference on Remote Sensing, Montreal, May 1983.

J.R. Bélanger (cont'd.)

Presented a paper at the Conference on Automated Cartography, Ottawa, October 1983.

R.N.W. DiLabio

Presented poster display at Manitoba Department of Energy and Mines Current Activities Forum, Winnipeg, November 1983.

Presented poster display at Newfoundland Department of Mines and Energy Current Activities Forum, St. John's, November 1983.

Presented two poster displays at Geological Survey of Canada Current Activities Forum, Ottawa, January 1984.

I.M. Kettles

Geological Society of America Regional Meeting, Madison, Wisconsin, April 1983.

Presented a paper at the Geological Society of America Annual Meeting, Indianapolis, Indiana, October-November 1983.

R.A. Klassen

Newfoundland Department of Mines and Energy Current Activities Forum, St. John's, November 1983.

W.W. Shilts

Presented a keynote paper at the IGES/SMGP, 10th International Geochemical Symposium, Helsinki, August 1983.

Presented a keynote paper at the Binghampton Geomorphology Symposium, Buffalo, September 1983.

Presented a paper at the Geological Society of America Annual Meeting, Indianapolis, Indiana, October-November 1983.

Presented a paper at the Geological Survey of Canada Current Activities Forum, Ottawa, January 1984.

Presented a paper at the LRTAP Peer Review, Toronto, February 1984.

Membership on Committees

J.R. Bélanger

Branch Computer Facilities Committee, Member

Terrain Sciences Divisional Computer Committee, Member

R.N.W. DiLabio

Divisional Display Committee, Member

W.W. Shilts

INQUA Commission on Genesis and Lithology of Quaternary Deposits, Corresponding Member

INQUA, Working Group 9, Glacigene Deposits as Indicators of Glacial Movements, Member

International Geological Correlation Program (Quaternary Glaciations in the Northern Hemisphere), Member

Research and Monitoring Co-ordinating Committee on Acid Rain, Member

Acid Rain Research, Geological Survey, Co-ordinator

U.S.-Canada terrestrial effects work group - Acid Rain (LRTAP) negotiating committee, Member

Special Talks or Lectures

I.M. Kettles

'Acid rain - Frontenac Arch and surrounding areas, Ontario' to the Illinois State Geological Survey Quaternary Group, Urbana, Illinois, April 1983.

W.W. Shilts

'Sonar studies and acid rain' to CCIW staff, Burlington, Ontario, October 1983.

'History and dynamics of Laurentide Ice Sheet' to graduate students, University of Wisconsin, Madison, March 1984.

'Symbiotic relationship of pure and applied science' to a general audience, Lewis B. Weeks Lecture Series, University of Wisconsin, Madison, March 1984.

Laboratories

Physical Sedimentation Laboratory, Tunney's Pasture

This Laboratory is operating at 3/4 strength because of a shift of one person to the Drift Chemistry and Mineralogy Laboratory on Booth Street.

Yearly Report

	No. of Samples
Freeze Drying	1490
Complete Sieve & Pipette	287
Gravel-Sand-Silt-Clay	1027
Hygroscopic Moisture Content	1314
Atterberg Limits	61
Calcite/Dolomite Ratio	87
Total Carbonate (acid dissolution)	32
Specific Gravity	25

Drift Chemistry and Mineralogy Laboratory

This Laboratory operated at 2/3 strength for much of the year. Much effort is expended by both laboratories in maintaining a drift sample reference collection and computer file for rapid location of samples for further analyses.

Production Summary

	No. of Samples
Clay Separations (for chemical analysis)	2670
Dry sieving to <64μm (for carbonate determination)	1470
Carbonate/non-carbonate carbon determinations (Leco carbon analyzer)	680
Heavy mineral separations	280
Grinding of coarse fractions (for chemical analysis)	50

Geomorphic Processes and Engineering Geology Section

J.A. Heginbottom (Head)

The task of the Geomorphic Processes and Engineering Geology Section is to provide information on the nature and occurrence of geomorphic processes and on the engineering characteristics of geological materials in Canada, including the continental shelves. Particular emphasis is placed on processes of the permafrost environment of northern Canada, and on studies related to landslide hazards. The work of the Section also includes studies related to resource development in the mountains of western Canada and studies of fluvial processes. Facilities available in the Section include a cold room and an 18 m recirculating flume.

Highlights

Identification of localities in southern British Columbia at which the potential for rockfall and landslide pose a potential problem for loss of property and possibly also loss of life.

Establishment of a project to examine the impact of construction of the Norman Wells to Zama Lake pipeline on the geological environment of the upper Mackenzie Valley.

Completion of field work for a terrain map of the Finlayson Lake map area (105 G) and completion of a MS terrain map of the Sheldon Lake map area (105 J), Yukon.

Successful completion of a drilling program from the sea ice to investigate geotechnical and geophysical properties of seabottom sediments in the southern Beaufort Sea.

Personnel Notes

The Geomorphic Processes and Engineering Geology Section consists of a permanent staff of 4 Research Scientists, 2 Physical Scientists and 1 Technician. The Section also supported 3 contracts and 2 EMR Research Agreements.

D.G. Harry joined the Division and the Federal Government in August 1983. He received his Ph.D. in 1982 from the University of Ottawa.

L.E. Jackson moved from Calgary to Vancouver.

Attendance at Meetings, Conferences and Courses

P.A. Egginton

Short course on 'River Engineering' at Water Survey of Canada, Ottawa, March 1984.

S.G. Evans

Presented a paper at the Joint Annual Meeting of the Geological Association of Canada and the Mineralogical Association of Canada, Victoria, B.C., May 1983.

J.A. Heginbottom

Presented a poster display at the 4th International Conference on Permafrost, Fairbanks, Alaska; and participated in field excursion; July 1983.

L.E. Jackson

Presented a poster display at the Geological Survey of Canada Current Activities Forum, Ottawa, January 1984.

Presented a poster display at the British Columbia Chamber of Mines Cordilleran Roundup, Vancouver, January 1984.

P.J. Kurfurst

Presented a paper at the Symposium on Engineering Geology Underground Construction, Lisbon, Portugal, September 1983.

Membership on Committees

D.G. Harry

Commission on the Significance of Periglacial Phenomena, International Geographical Union, Corresponding Member

J.A. Heginbottom

Permafrost Subcommittee, NRC Associate Committee on Geotechnical Research, Member

Working Group on Ground Ice, International Commission on Snow & Ice, Member

Commission on the Significance of Periglacial Phenomena, International Geographical Union, Corresponding Member

Terrain Sciences Division Display Committee, Chairman

Interdepartmental Working Group on Proposed IBP Ecological Sites, Member

L.E. Jackson

I.S.P.G. Library Committee, Member

I.S.P.G. Safety Committee, Member

International Conference on Palynology 1984, Member; Organizing Committee, Member; Field Trips Subcommittee, Chairman

P.J. Kurfurst

Underground Research Laboratory Project Management Committee, Member

Underground Research Laboratory Site Evaluation Subcommittee, Chairman

Committee on Needed Research for Northern Pipelines, Member

NEP Subcommittee on Canadian Facility for Controlled Environmental Research and Testing, Member

Executive Committee, Engineering Geology Division, Canadian Geotechnical Society, Member

Special Talks or Lectures

L.E. Jackson

'Debris flow hazard, Canadian Rocky Mountains' to faculty and students - (a) Department of Geology, University of Alberta, Edmonton, September 1983; (b) Department of Geology, University of British Columbia, Vancouver, February 1984; (c) Quaternary Discussion Group, Simon Fraser University, Brunaby, February 1984.

STAFF LIST

(to March 31, 1984, as supplied by reporting units)

DIRECTOR GENERAL'S OFFICE

Price, R.A., Director General
Smalldridge, J., Secretary
Fyles, J.G., Chief Geologist
Birtch, E.J., Secretary
Hall, E., Scientific Executive Officer
Picklyk, D.
Patenaude, C.

Special Projects

Bolton, T.E.
Okulitch, A.

Program Office

Benson, D.G.
Petre, M.A.

International Relations Unit and Episodes

Berger, A.R.
Collis, B., Secretary

Administrative Services

Claude, Y.P.
Blake, C.
Caron-Blais, J.
Chenier, D.
Clarke, J.
Colterman, M.
Davidson, D.O.
Gagnon, S.M.
Gareau, K.L.
Gariepy, R.A.
Gilliland, J.
Kochan, P.
Kostiew, S.
Lagroix, W.J.
Legere, J.
Monteforte, G.
Parnham, S.J.
Pelletier, M.
Robinson, R.
Roodman, M.
Rozon, R.A.
St. Dennis, D.J.
Salter, I.C.
Thompson, L.
Winsor, D.

Personnel

Fracke, K.
Lemon, P.
Benson, P.
Janney, D.K.
Smallman, D.
Devlin, F.
Saucier, D.
DeMarch, L.
Jamieson, L.
Scharfe, G.
Morrison, S.

Financial Services

Stapledon, J.D.
Taylor, R.P.
Forbes, H.
Deslauriers, I.M.
Eastham, A.
Potter, J.
Powers, M.

ATLANTIC GEOSCIENCE CENTRE

Keen, M.J., Director
Dennis, P.E., Secretary

Administration

Denman, S.
Henderson, T.
Racine, C.E.
Tolliver, D.P.
Vetese, B.T.

Environmental Marine Geology

Amos, C.L.
Asprey, K.W.
Blasco, S.M.
Buckley, D.E.
Clattenburg, D.A.
Cole, F.E.
Cranston, R.E.
Deonarine, B.
Fitzgerald, R.A.
Forbes, D.L.
Frobel, D.H.
Harmes, R.A.
LeBlanc, K.W.G.
Lewis, C.F.M.
Mudie, P.J.
Piper, D.
Rashid, M.A.
Robertson, K.R.
Schafer, C.T.
Syvitski, J.P.M.
Taylor, R.
Vilks, G.
Winters, G.V.

Regional Reconnaissance

Blakeney, C.P.
Cronk, S.P.
Fader, G.B.
Jackson, H.R.
Josenhans, W.H.
Keen, C.E.
Loncarevic, B.D.
MacLean, B.
Macnab, R.F.
Miller, R.O.
Nichols, B.C.
Reid, I.
Shih, K.G.
Srivastava, S.P.

Eastern Petroleum Geology

Ascoli, P.
Avery, M.P.
Barss, M.S.
Bell, J.S.
Cook, G.L.
Crilley, B.J.
Davies, E.H.
Gradstein, F.M.
Grant, A.C.
Grant, G.M.
Hacquebard, P.
Howie, R.D.
Jackson, A.E.
Jansa, L.F.
Lake, P.B.
MacMillan, W.C.
McApline, K.D.
Maclean, B.C.
Mitchell, C.J.
Thomas, F.C.
Wade, J.A.
Williams, G.L.

Program Support

Atkinson, A.S.
Beaver, D.E.
Boyce, W.A.
Chapman, C.B.
Coady, V.F.
Fenn, G.W.
Fricker, A.
Gorveatt, M.E.
Hardy, I.A.
Heffler, D.E.
Hubley, S.
Hughes, M.D.
Jodrey, F.D.
Johnston, B.L.
Locke, D.R.
Manchester, K.S.
Murphy, R.J.
Nielson, J.A.
Sherin, A.G.
Sparkes, R.

Secondments to the Atlantic Oceanographic Library

Hale, K.G.
Jollimore, S.F.
Mazerall, A.M.

CORDILLERAN GEOLOGY DIVISION

Campbell, R.B., Director
Chiu, W., Secretary
Jamieson, A., Administrative Officer
Shurben, P.K., Office Manager

Dong, M.
Force, M.
Gillis, E.
Oliveric, T.A.
Vanlier, B.E.

Sales Office

Langenhaun, O.L.
Hajek, L.

Cordilleran Mainland Geology Subdivision

Anderson, R.G.
Dodds, C.J.
Eisbacher, G.H.
Gabrielse, H.
Gordey, S.
Krause, P.T.
Monger, J.W.H.
Orchard, M.J.
Reesor, J.E.
Roddick, J.A.
Souther, J.G.
Struik, L.C.
Tempelman-Kluit, D.J.
Thompson, R.I.
Tipper, H.W.
Wheeler, J.O.
Woodsworth, G.J.

Library

Akehurst, M.K.
Horwath, M.W.

Pacific Marine Geology Subdivision

Yorath, C.J., Head
Bornhold, B.D.
Cameron, B.E.B.
Currie, R.
Forbes, T.C.
Frydecky, I.I.
Hamilton, T.
Hill, W.A.M.
Jewsbury, G.S.
Johns, M.
Luternauer, J.
McLaren, P.
Studsrud, W.

CENTRAL LABORATORIES AND TECHNICAL SERVICES

Maxwell, J.A., Director
Clemmer, J.E., Senior Admin. Clerk
Goulet, M.-J.

Analytical Chemistry Section

Lachance, G.R., Head

Chemical and X-Ray Laboratories

Bertrand, N.
Bouvier, J.L.
Courville, S.
Faulkner, R.D.
Grushman, V.E.
McManus, P.A.
Rioux, D.P.
Rousseau, R.M.
Sen Gupta, J.G.
Veys, C.
Watson, F.J.

Spectrographic Laboratories

Belanger, P.G.
Bender, G.P.
Champ, W.H.
Church, K.A.
Meeds, R.A.
Wiles, C.T.

Mineralogy Section

Plant, A.G., Head

Mineralogical Studies

Bonardi, M.
Delabio, R.N.
Harris, D.C.
LeCheminant, G.M.
Pringle, G.J.
Roberts, A.C.
Stenson, A.P.
Walker, D.A.

Mineral Separation and Sample Preparation

Christie, R.W.
Gordon, R.G.
Huot, J.M.R.
Machin, D.B.

National Collections

Ansell, H.G.
Darnley, E.A.
Frewen, S.
Herd, R.K.
ter Haar Romeny, W.U.

Mineral and Rock Set Preparation

Demers, Y.
Laperriere, S.
Larose, J.M.
Racine, T.H.

Technical Services Section

Thibedeau, R.J., Head

Mechanical Services and Instrument Development Shop

Banszky, S.
Forconi, R.
Going, S.
Lalonde, J.K.

Electronic Services

Cote, O.L.

ECONOMIC GEOLOGY DIVISION

Findlay, D.C., Director
McLeod, C.R., Assistant to the Director
Braham, M.M., Secretary
Gaudreau, R.A., Admin. Officer
Picard-Charron, L., Admin. Clerk

Special Projects

Cumming, L.M.
Gross, G.A.
Poole, W.H.

Mineral Deposits Geology

Duke, J.M.
Dunsmore, H.E.
Eckstrand, O.R.
Kerswill, J.A.
Kirkham, R.V.
Lydon, J.W.
Sangster, D.F.
Sinclair, W.D.
Thorpe, R.I.

Laboratory and Technical Services

Lancaster, R.D.
Burke, R.D.
Carrier, J.J.
Darcy, G.
Williamson, B

Regional Metallogenic Studies

Roscoe, S.M.
Dawson, K.M.
Franklin, J.M.
Green, S.B.
Miller, A.R.
Poulsen, K.H.

Regional Mineral Resource Assessment

Ruzicka, V.
Bell, R.T.
Gandhi, S.S.
Henderson, M.N.
Jefferson, C.W.
McGuire, L.L.
Prasad, N.
Scoates, R.F.J.

Mathematical Applications in Geology

Agterberg, F.P.
Bonham-Carter, G.F.
Chung, C.F.
Rencz, A.

Mineral Resource Information Services

Garson, D.F.
Douma, A.G.
Laramee, P.M.
Shaw, J.
Scully, S.A.

GEOLOGICAL INFORMATION DIVISION

Blackadar, R.G., Director
Tremblay, D.M., Secretary
Poirier, D., Admin. Officer
Griffin, P.J., Asst. to Director

Scientific Editing and Publication Production

Morgan, W.C.
Dufour, M.F.
Vincent, L.E.
Busby, D.
Kiel, M.J.

Publications and Distribution

Touchette, J.L.L.
Letang, G.E.
Clarke, C.R.
Murphy, B.
Plouffe, G.
Lacroix, C.
Villemaire, L.

Data Systems Group

Charlesworth, P.B.
Gunn, K.L.
Scaga, T.

Photographic Services

Kempt, J.W.
Beckstead, D.C.
White, J.
Lemieux, G.
Kelly, R.

Library Services

Bourgeois, A.E.
Alexander, S.O.
Frebold, E.
Naraynsingh, T.
Kumar, I.
Wilks, J.
Swan, R.
Tedford, D.E.
Foster, M.
Roadhouse, D.
Frieday, L.A.
Pleasant, R.
Smith, E.
Carey, L.
Stark, W.P.
Mason, M.

National GEOSCAN Centre

Reade, D.
Kopf-Johnson, A.
Bouchard, D.

Cartography

Bill, J.
Knudson, K.
DiMillo, M.
Currie, G.P.

Checking Unit

Lavigne, G.H.
Mainville, B.
Sauvageau, J.A.R.

Drafting Unit A

Williams, J.B.F.

Sub-unit A-1

Maahs, E.
Ferguson, J.
Papps, L.
Pratt, J.A.Y.
St. Pierre, M.
Thomson, H.A.

Sub-unit A-2

Yelle, J.S.
Brown, D.G.
Grenier, N.
O'Regan, P.
St. Amour, P.
St. Pierre-Savard, Y.

Drafting Unit B

Foster, V.

Sub-unit B-1

Allard, R.L.
Frohberg, S.
Hudon, M.
Kurfurst, D.
Renaud, L.
Sigouin, M.

Sub-unit B-2

Daugherty, R.F.
Belec, E.G.
Corrigan, P.
Daley, L.A.
Hill, R.S.
Narraway, J.

Drafting Unit C

Dumbrell, E.A.

Sub-unit C-1

Corriveau, J.P.
Coulthart, I.A.
Enright, M.L.
Fairfield, R.D.J.
Heney, F.J.
Saffin, R.S.

Sub-unit C-2

Barbary, G.J.
Hermann, P.
King, J.A.
Perron, R.R.
Potvin, R.Y.
Young, W.G.

Photomechanical Unit

Wylie, W.G.
de la Fontaine, M.E.
MacKenzie, R.J.G.
McNeill, D.G.
Wilkinson, R.W.

INSTITUTE OF SEDIMENTARY AND PETROLEUM GEOLOGY

Nassichuk, W.W., Director
Brindle, J.E., A/Assistant Director
Andrechuk, J., Secretary

Administration Subdivision

Cameron, K.M., Admin. Officer
Brown, M., Secretary

Office Services Section

Broad, P.C.

Pay and Benefits

Stadnyk, M.

Central Registry

Hennessey, M.A.T.
Alert, S.B.

Library

Fritz, F.
Hwang, F.

Accounts and Finance

Albert, D.K.
Li, D.Y.H.

Stationery and Supplies

Williams, W.J.
Davies, B.F.

Building and Engineering Services

Jermy, C.R.
Brydges, G.E.
Clayton, E.M.
Elahee, R.B.
Walker, B.A.
Stadnyk, A.

Regional Geology Subdivision

Cook, D.G.

Arctic Islands

Thorsteinsson, R.
Christie, R.L.
Embry, A.F.
Mayr, U.
Trettin, H.P.

Mainland

Cecile, M.P.
Aitken, J.D.
Dixon, J.
Geldsetzer, H.H.J.
Meijer-Drees, N.C.
Morrow, D.W.
Price, L.L.
Pugh, D.C.
Banerjee, I.
Stott, D.F.
McMechan, M.E.
Williams, G.K.
Richards, B.C.

Core and Sample Repository

Banning, W.W.
Copithorne, D.

Sedimentological Labs

McEwan, W.O.

Geological Technician

Snow, E.

Paleontology Subdivision

Bamber, E.W., Acting Head
Boyce, D.D., Secretary

Micropaleontology

Wall, J.W.
McNeil, D.H.
Uyeno, T.T.
Utting, J.
Sweet, A.R.
McIntyre, D.J.
Kalgutkar, R.M.
Then, D.R.
Hriskevich, B.J.A.
Dougherty, B.J.

Macropaleontology

Norris, A.W.
Norford, B.S.
Pedder, A.E.H.
Poulton, T.P.
Michie, R.D.

Ottawa Paleontology Section

Tozer, E.T.
Lee, L., Secretary
Copeland, M.J.
McGregor, D.C.
Fritz, W.H.
Nowlan, G.S.
Erdmer, E.
Whitehead, A.
Martin, G.P.

Curation

Halkett, M.A.
Smith, G.G.E.

Petroleum Geology Subdivision

McMillan, N.J.
Thompson, C., Secretary

Petroleum Resources Section

Osadetz, K.G.
Dietrich, J.R.
Densmore, A.A.
Fuglem, M.O.
Wallace-Dudley, K.E.
McNeill, N.J.

Geochemistry Section

Snowdon, L.R.
Foscolos, A.E.
Heinrich, A.
Wong, J.N.Y.
Davidson, R.A.
Gorham, B.L.
Northcott, E.M.
Fanjoy, R.G.
Ferguson, M.W.
Brook, P.W.

Data Management

Nairn, K.
Labonte, M.
Lepard, D.W.

Coal Geology Subdivision

Norris, D.K.
Smith, D.J., Secretary

Coal Technology Section

Cameron, A.R.
Kalkreuth, W.D.
Goodarzi, F.
Pratt, K.C.

Resource Evaluation Section

Hughes, J.D.
Dawson, F.M.
Smith, G.G.
Mottershead, K.E.
Boonstra, C.A.

Coal Geology Section

Gibson, D.W.
Ricketts, B.D.
Jerzykiewicz, T.

Geological Information Subdivision

Ollerenshaw, N.C.
Machan-Gorman, L.C.

Word Processing Centre

Greener, P.L.
King, H.
Seif, A.Y.
Beauregard, D.A.
Varalta, M.L.
Oliver, A.E.

Publication and Airphoto Distribution

Cormier, D.A.
Spirritts, J.
McCloskey, J.S.

Photography

Rutley, B.C.
Sharman, W.B.

Cartography

MacLachlan, L.
Walter, D.J.
Ortman, B.H.
Thompson, J.W.
Waddell, J.H.
Fischer, B.E.
Vermette, W.P.
Whitman, G.S.
Wallace, M.D.
Orzeck, S.D.

Reproduction

Wardle, L.
Edwards, G.N.

Petroleum Resource Assessment Secretariat

Procter, R.M.
Foo, A., Secretary
Taylor, G.C.
Lee, P.J.
Raicar, M.
Skibo, D.N.

PRECAMBRIAN GEOLOGY DIVISION

Administration

McGlynn, J.C., Director
Gougeon, C.L., Secretary
Manning, J.E.
Marier-Lalonde, F.
Wereley, D.

Secretarial Services

Cox, B.F.

Technical Services

Bencik, K.C.
Greer, J.M.

Support Geologists

Carmichael, J.
Firko, M.
Galley, A.
Goodard, B.
Graves, J.
Knight, R.
MacManus, J.
Maley, J.
Patterson, J.
Pongratz, I.
Thompson, D.
Woodend, S.

Bear-Slave Section

Lambert, M.B. (Head)
Bostock, H.H.
Campbell, F.H.A.
Frith, R.A.
Henderson, J.B.
Hildebrand, R.S.
Hoffman, P.H.
St-Onge, M.
Tirrul, R.
Thomas, P.
Thompson, P.H.

Northern Churchill Section

LeCheminant, A.N. (Head)
Eade, K.E.
Fraser, J.A.
Frisch, T.
Henderson, J.R.
Jackson, G.D.
Navratil, S.
Schau, M.P.
Tella, S.

Superior-Grenville Section

Davidson, A. (Head)
Asadi-Zanjani, J.
Cacciotti, A.
Card, K.D.
Ciesielski,A.
Culshaw, N.
Ermanovics, I.F.
Hanmer, S.
Percival, J.

Special Projects

Baragar, W.R.A.
Sanford, B.V.
Taylor, F.C.
Thompson, F.C.

Geochronology Section

van Breemen, O. (Head)
Bellerive, D.C.
Bisson, J.C.
Hunt, P.
Loveridge, D.
MacRae, J.L.
Parrish, R.
Quigg, F.B.
Roddick, J.C.
Santowski, K.
Seguin, R.J.
Smith, D.
Stevens, R.D.
Sullivan, R.W.

Paleomagnetic Section

Fahrig, W.F. (Head)
Buchan, K.L.
Christie, K.W.
Freda, G.N.
West, T.

Petrology Section

Currie, K.L. (Head)
Chandler, F.W.
Emslie, R.F.
Froese, E.
Gordon, T.M.
Neely, W.
Whelan, J.B.
Zaleski, E.

RESOURCE GEOPHYSICS AND GEOCHEMISTRY DIVISION

Administration

Darnley, A.G., Director
Durham, C.C., Tech. Ops.
Stevens, E., Admin. Officer
Ford, M.I., Secretary
Good, B.M.
Grierson, M.

Special Projects

Boyle, R.W. (Geochemistry)
Cameron, E.M. (Geochemistry)
Collett, L.S. (Geophysics)
Katsube, T.J. (Nuclear Fuel Waste Management)
Manistre, B.E. (Foreign Aid)
Washkurak, S.

Resource Geophysics Subdivision

Richardson, K.A.
Mooney, K.M.

Terrain Geophysics Section

Hunter, J.A.M. (Head)
Burns, R.A.
Elsmore, S.
Gagne, R.M.
Good, R.
MacAulay, H.A.
Overton, A.
Pullan, S.
Wilson, M.L.

Radiation Geophysics Section

Grasty, R.L. (Head)
Cameron, G.W.
Carson, J.M.
Charbonneau, B.W.
Cannon, C.
Ford, K.L.
Grant, J.
Holman, P.B.
Slaney, V.R.
Schock, L.

Borehole Geophysics Section

Killeen, P.G. (Head)
Bernius, G.R.
Birk, S.
Dyck, A.V.
Hyatt, W.G.
Mwenifumbo, J.
Sinha, A.K.
Stephens, L.

Instrumentation R & D Section

Bristow, Q. (Head)
Blanchard, Y.
Frechette, J.
Gauvreau, C.
Parker, J.J.
Sloka, R.J.

Regional Geophysics Subdivision

Hood, P.J. (Head)

Magnetic Interpretation Section

Kornik, L.J. (Head)
Abbinett, D.
Bower, M.E.
Broome, J.
McGrath, P.H.
Schwarz, E.

Contract Aeromagnetic Surveys Section

Ready, E.E. (Head)
Knapper, W.M.
Reveler, D.

Data Processing Section

Teskey, D. (Head)
Anderson, K.
Butt, I.
Dods, S.D.
Janveau, J.
Lawley, L.

Experimental Airborne Operations Section

Sawatzky, P. (Head)
Dicaire, A.
Flint, T.R.
Knapp, H.W.
Olson, D.G.

Resource Geochemistry Subdivision

Hornbrook, E.H.W. (Head)
Blondin, M.A.C.
Daniel, J.C.

Exploration Research Section

Garrett, R.G. (Head)
Dyck, W.
Jonasson, I.R.

Regional Research Section

Goodfellow, W.D.
Ballantyne, S.B.
Boyle, D.R.
Maurice, Y.T.

Analytical Laboratories

Hall, G.E.M. (Head)
Geogoire, D.C.
Alexander, W.
Gauthier, G.
Lavergne, P.G.
MacLaurin, A.I.
Nelson, W.
Pelchat, J.C.
Vaive, J.

Standards and Data Services

Lynch, J.J. (Head)
Ellwood, D.J.
Galletta, A.
Lund, N.G.

TERRAIN SCIENCES DIVISION

Scott, J.S., Director
Lowdon, J.A., Assistant to the Director

Secretarial and Clerical Services

Morency, L.S., Supervisor
Grainger, B.J.
Slegr, M.

Administrative and Financial Services

Casey, A.J., Supervisor
McLeish, P.A.
Lisle, A.E.

Scientific and Technical Services

Dumych, H., Supervisor
Gerrard, T.

Staff Scientist

Pelletier, B.R.

Regional Projects Section

St-Onge, D.A., A/Head
Dredge, L.A.
Dyke, A.S.
Edlund, S.A.
Gadd, N.R.
Grant, D.R.
Hodgson, D.A.
Nixon, F.M.
Richard, S.H.
Sharpe, D.R.
Veillette, J.J.
Vincent, J-S.

Fulton, R.J., Head
Clague, J.J.
Hughes, O.L.
Klassen, R.W.
Stalker, A.M.

Paleoecology and Geochronology Section

Blake, W., Jr., Head
Anderson, T.W.
Federovich, S.
Matthews, J.V., Jr.

Paleoecology Laboratory

Mott, R.J., Supervisor

Radiocarbon Laboratory

McNeely, R.N., Supervisor
Robertson, I.M.
Telka, A.M.

Sedimentology and Mineral Tracing Section

Shilts, W.W., Head
Adshead, J.D.
Bélanger, J.R.
DiLabio, R.N.W.
Kettles, I.
Klassen, R.A.

Sedimentology-Engineering Geology Laboratories

Henderson, P.
Luscombe, J.R.
Kelly, R.G.
McFarlane, C.M.
Rivoire, B.A.

Geomorphic Processes and Engineering Geology Section

Heginbottom, J.A., Head
Bisson, J.G.
Egginton, P.A.
Evans, S.G.
Harry, D.G.
Jackson, L.E.
Kurfurst, P.J.