CANADA

DEPARTMENT OF ENERGY,

MINES AND RESOURCES

GEOLOGICAL SURVEY OF CANADA

ANNUAL REPORT

APRIL 1, 1984 TO MARCH 31, 1985

FOR DEPARTMENTAL USE ONLY

OTTAWA

1985

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GEOLOGICAL SURVEY OF CANADA
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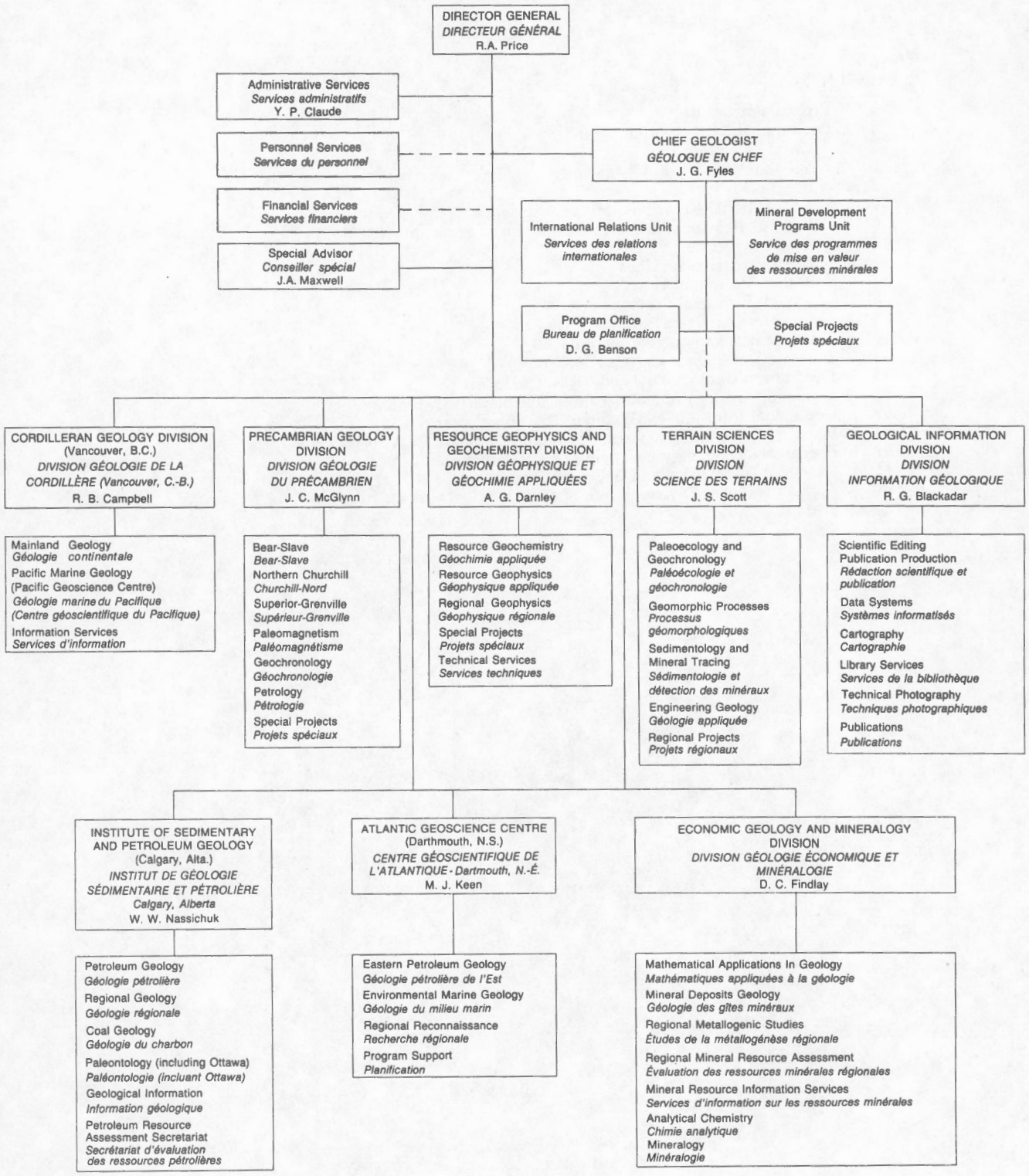

GEOLOGICAL SURVEY OF CANADA
PROGRAM STRUCTURE 1984-85 RESOURCES BY SUB-ACTIVITY

	SALARY	OPERATING	CAPITAL	CONT.	TOTAL	P-Y'S
Activity Management	1,623	1,527	469	63	3,682	42.4
Precambrian Geology	3,779	1,907	82		5,769	79.0
Geological Information	3,307	1,257	92		4,656	98.5
Economic Geology and Mineralogy	4,231	1,203	355		5,788	97.0
Resource Geophysics and Geochem.	4,705	6,190	517		11,412	102.4
Institute of Sed. and Petrol. Geol.	6,802	5,248	1,056		13,106	148.6
Terrain Sciences	3,225	1,240	82		4,547	72.0
Cordilleran Geology	2,342	1,243	263		3,848	49.3
Atlantic Geoscience Centre	5,386	9,869	2,306		17,562	116.2
Activity Total	35,400	29,684	5,222	63	70,369	805.4

The following major items are included in the expenditures above:

	($000's)
Energy Research and Development	5,770
Mineral Development Agreements	2,530
Frontier Geoscience Program	5,673
Northern Oil and Gas Action Program	541
Gaspé-Lower St. Lawrence Program	952
Asbestos Strategy	350
Bilateral Maritime Boundary Disputes	3,973
Total	19,789

The summer program of the Geological Survey was enhanced by 134 students provided with person-years by the Summer Canada Program.

OFFICE OF THE DIRECTOR GENERAL

R.A. Price

In 1984-85 the Office of the Director General maintained the organizational arrangement established in the previous year. The responsibilities of the Mineral Development Program Office, initiated late last year, expanded rapidly following formal signing of Mineral Development Agreements with five provinces. Each agreement includes investigations by several Divisions of GSC, commencing in 1984.

The Frontier Geoscience Program, Initiated in June 1984, involved work during the year by four GSC Divisions, the Polar Continental Shelf Project and the Earth Physics Branch. This program is managed by Dr. R.A. Price, reporting to a steering committee chaired by Dr. W.W. Hutchison. Dr. D. Picklyk serves as program officer. Managers of the various tasks comprising the program are as follows:

East Coast	-	Dr. M.J. Keen
West Coast	-	Dr. R.B. Campbell
Western Arctic	-	Dr. W.W. Nassichuk
Arctic Islands	-	Dr. W.W. Nassichuk
Support R&D	-	Dr. J.G. Fyles
Logistics	-	Mr. G. Hobson

R.A. Price

Attendance at Meetings, Conferences and Courses

GSA-DNAG Steering Committee Meeting, Boulder, Colorado, April 30 - May 2, 1984.

CNC-IUGS Meeting, Toronto, Ontario, May 12, 1984.

Lithoprobe Steering Committee Meeting, London, Ontario, May 13, 1984.

Symposium on Deformation and Thrusting, Université Paul Sabotier; followed by field trip to the Pyrénées, Toulouse, France, May 14-18, 1984. Speaker - "The Southeastern Canadian Cordillera: Thrust Faulting, Tectonic Wedging and Delamination of the Lithosphere".

Visit to Elf Aquitaine, Pau and Boussens, France, May 19-23, 1984. Lectures on "Tectonic Evolution of the North American Cordillera".

Meeting with University of Quebec officials to discuss possible projects, Quebec City, P.Q., May 29, 1984.

BIO Open House, Halifax, Nova Scotia, May 30, 1984.

Meeting with Quebec officials to discuss Precambrian geology, Quebec City, P.Q., June 4, 1984.

International Symposium on Deep Structure of Continental Crust. Speaker - "The Foreland Thrust and Fold Belt of the Canadian Rockies and its Geotectonic Significance". Followed by meeting of North American-European Coordinating Group on Earth Sciences (representing ADM, ESS), Cornell University, Ithaca, New York, June 24 - July 4, 1984.

Planning meeting on Frontier Geoscience Program, Calgary, Alberta, July 11-13, 1984.

Head of Canadian Delegation to 27th International Geological Congress; Plenary Session Speaker - "The Dynamics and Evolution of the Lithosphere - Framework for the Earth Resources and the Reduction of Hazards". Symposium on Tectonics of the Circum Pacific: Speaker - "Eocene Horizontal Stretching and Ductile Necking of Continental Lithosphere Associated with Transform Faulting within the Canadian Cordillera". Section on Tectonics: Speaker -"Thrust Faulting, Tectonic Wedging and Delamination of the Lithosphere: Examples from the Canadian Cordillera". Moscow, USSR, July 23-August 15, 1984.

Meeting of CGC and visit to ISPG, Calgary, Alberta, September 7-11, 1984.

20th General Assembly of ICSU, Symposium on Global Change, Speaker - "Global Change - The Lithosphere: Laboratory and Library", Ottawa, Ont., September 24-28, 1984.

GSA Annual Meeting; Symposium on Transects: Speaker - "Cordilleran Tectonic Accretion - The North American Connection as Illustrated in Continental Margin Transect B-2"; Symposium on Extensional Tectonics: Paper (co-authored with R.D. McMechan - Speaker) - "Crustal Extension and Thinning in a Foreland Thrust and Fold Belt, Southern Canadian Rockies"; and DNAG Steering Committee Meeting; Reno, Nevada, November 4-8, 1984.

Independent Industrial Advisory Committee Meeting, Halifax, Nova Scotia, November 9, 1984.

Provincial Open House, Regina, Saskatchewan, November 14, 1984.

Provincial Open House, Winnipeg, Manitoba, November 15, 1984.

Meeting of Advisory Committee to the Department of Geological and Geophysical Sciences, Princeton University, Princeton, New Jersey, November 16-17, 1984.

Visit to Department of Geological Sciences, Queen's University. Lecture on "Tectonic Evolution of the Canadian Cordillera", Kingston, Ontario, November 23, 1984.

Branch Management Committee Meeting, Ottawa, Ontario, November 27-28, 1984.

CNC-IUGS Meeting, Ottawa, November 28, 1984.

Canadian Geoscience Council's Annual Meeting, Ottawa, Ontario, November 29-30, 1984.

Planning meeting of Frontier Geoscience Program, Calgary, Alberta, December 16-18, 1984.

Lithoprobe Steering Committe Meeting, Calgary, Alberta, January 17-19, 1985.

IUGS Executive Committee Meeting and Seminar. Speaker - "A Review of the Status of ICL - Reorganization and Future Objectives". Rabat, Morocco, February 7-14, 1985.

Branch Management Committee Meeting, Vancouver, B.C., March 5-6, 1985.

Prospectors and Developers Annual Meeting; IGCP-CNC Meeting; CNC-ILP Meeting; and Workshop on Mineral Inventory Data Files, Panel Member. Toronto, Ontario, March 10-14, 1985.

Membership on Committees

Member, Centennial Program Steering Committee, Geological Society of America, 1980-

Member, Canadian Geological Foundation, 1982 -

Co-Chairman, National Geological Surveys Committee, 1983 -

Member, Advisory Committee, Department of Geological and Geophysical Sciences, Princeton University, 1984 -

Member, Board of Electors, Chair in Geology, Cambridge University, Cambridge, U.K., 1983-85.

Chairman, Advisory Committee, Department of Earth Sciences, Memorial University of Newfoundland, 1985 -

North American Editor, Tectonics, American Geophysical Union, 1985 - 1988.

Member, Editorial Board, Journal of Structural Geology, 1985 -

Director, International Union of Geological Sciences Advisory Board on Research Development, 1985 -

CHIEF GEOLOGIST

J.G. Fyles

Attendance at Meetings, Conferences and Courses

Correlation of Quaternary Deposits and Events in the area around Beaufort Sea Workshop, Calgary, Alberta, April 3-4, 1984; meeting at ISPG, April 5, 1984.

CIM-sponsored "Till Tomorrow" Symposium, Kirkland Lake, Ont., May 8-9, 1984.

Canadian Geoscience Council Meeting, London, Ont., May 16-17, 1984.

Saskatchewan Mineral Development Agreement Management Committee Meeting, Regina, Sask., May 27-28, 1984.

Manitoba Mineral Development Agreement Management Committee Meeting, Winnipeg, Man.; Frontier Geoscience Program Meeting, Calgary, Alberta; visit field parties in the North, July 10-17, 1984.

Provincial Mines Ministers Conference, Yellowknife, NWT, August 7-8, 1984.

Program Review, AGC, Dartmouth, September 23-25, 1984.

Policy Advisory Committee on Northern Land Use Planning for NWT, Yellowknife, NWT, September 19-21, 1984.

Bill Mathews Symposium, Vancouver, B.C.; Program Review at PGC and CGD, October 9-12, 1984.

OERD Meeting and Program Review, Calgary, Alberta, October 23-25, 1984.

Saskatchewan Mineral Development Agreement Management Committee Meeting and Saskatchewan Open House; Manitoba Mineral Development Management Committee Meeting and Manitoba Open House, November 12-16, 1984.

Frontier Geoscience Program Meeting, Calgary, December 17-18, 1984.

Program Review at PGC and CGD; meeting with officials of the Dept. of Energy, Mines and Petroleum Resources, Victoria, December 9-14, 1984.

Program Review, AGC, Dartmouth, N.S., January 16-17, 1985.

Branch Management Committee Meeting, Vancouver, B.C., March 5-7, 1985.

Prospectors and Developers Meeting, Toronto, Ont., March 13-14, 1985.

Membership on Committees

Member, Management Committee, Canada/Manitoba Mineral Development Agreement 1984-89.

Member, Geoscience Subcommittee, Canada-Manitoba Mineral Development Agreement.

Member, Management Committee, Canada/Saskatchewan Mineral Development Agreement 1984-89.

Member, Geoscience Subcommittee, Canada/Saskatchewan Mineral Development Agreement.

Chairman, Energy Research Advisory Committee on Permafrost Research (Task 6.1.4).

Chairman, Energy Research Advisory Committee on Reservoir Characterization (Tasks 6.1.1 and 6.1.3).

Special Advisor

J.A. Maxwell

Attendance at Meetings, Conferences and Courses

Seminar on Emergency Planning Management, May 1984.

Departmental Retirement Course, October 1984.

Membership on Committees

Branch Management Committee.

Canadian Geoscience Coordinator, Canada/Federal Republic of Germany Scientific & Technical Cooperative Agreement.

Group Executive, EMR Executive Committee for 1984 United Way Public Service Campaign.

Departmental Merit Award Committee.

Classification Committees.

Special Assistant

G.W. Cameron

Attendance at Meetings, Conferences and Courses

OERD Meeting, Calgary, Alberta, October 23, 1984.

Membership on Committees

Secretary, Energy Research Advisory Committee on Permafrost Research (Task 6.1.4).

Secretary, Energy Research Advisory Committee on Reservoir Characterization (Tasks 6.1.1 and 6.1.3).

SPECIAL PROJECTS

T.E. Bolton

Attendance at Meetings, Conferences and Courses

Geological Association of Canada, Annual Meting, London, Ont., May 1984.

Canadian Paleontology and Biostratigraphy Seminar, Ottawa, Ont., September 1984.

Ontario Geological Survey Open House, Toronto, Ont., December 1984.

Northeastern Section, Paleontological Society, Annual Meeting, Lancaster, Pennsylvania, March 1985.

Membership on Committees

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

Vice President, 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.

Corresponding Member, IUGS Subcommission on Silurian Stratigraphy.

Corresponding Member, IUGS Ordovician-Silurian Boundary Working Group.

A.V. Okulitch

Andrew V. Okulitch's primary assignment is editing and coordinating the Geological Atlas of Canada Program. During his third year as coordinator, refinements were made to the standards and format of the atlas, particularly those of Phanerozoic and Precambrian time scales, geotectonic correlation charts and legends. Compilation has been completed for three maps from Ontario and new compilations made of correlation charts. Work continues on adjoining maps and several from the Cordillera. Six maps and charts have been compiled from the Arctic Islands and four others have been started. 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 resulted in initiation of compilation of two maps. About twenty-five maps are in various stages of production. Because of other responsibilities (see below) completion of the first maps will likely be delayed until 1985.

He has also continued analysis of structures of the Arctic Platform in southern Ellesmere Island resulting in a new tectonic synthesis for the region. Contributions to the final report (project leader, U. Mayr, ISPG) will be done in 1985.

He also made contributions to the Decade of North American Geology project in the form of drafts of 1:5,000,000 and 1:2,000,000 scale maps of the onland and offshore bedrock geology of the Arctic Islands (with H.P. Trettin) and text describing structure and tectonics of the Arctic.

Attendance at Meetings, Conferences and Courses

Canadian Tectonics Group, Maniwaki, October 1984.

Coordination of Atlas map production, Ottawa, October 1984.

Geological Society of America, Annual Meeting, Reno, Nevada, November 1984.

Cordilleran Tectonics Workshop, University of Calgary, Calgary, February 1985.

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.

Member, Geological Association of Canada, Past President's Medal Selection Committee.

Associate Editor (Structure), Canadian Journal of Earth Sciences.

GSC representative for joint compilation of regional maps and a 1:10,000,000 scale circumpolar bedrock geology map, Program of Scientific and Technical Cooperation between the USSR and Canada on Problems of Arctic and Northern Study Development.

Talks

"Compressional and extensional tectonics near dextral continental transform faults within the Arctic Platform, southeastern Ellesmere Island, Canada", given at ISPG, Calgary, University of Toronto and Reno, Nevada, October and November 1984.

INTERNATIONAL RELATIONS UNIT AND EPISODES SECRETARIAT

Inter-governmental Activities

The general policy of establishing Memoranda of Understanding with other Geological Institutions, to cover the exchange of scientific information and establish a basis for cooperation where appropriate, was pursued during the year.

In September 1984 a MOU was signed between the British Geological Survey, the Earth Physics Branch of EMR, and the GSC. Similar MOU's are under preparation and discussion with the Directorate of Geology and Mineral Resources, Indonesia, and the Ministry of Geology and Mineral Resources, People's Republic of China.

Following the initiatives taken at the International Geological Congress in Moscow, GSC participation in the Canada/USSR cooperation plan has been initiated. Five research projects are now defined. Detailed proposals for projects 3 and 4 were submitted to Dr. Hutchison's office in January 1985. The first visit of a Russian delegation to Canada is expected in April 1985 as part of Project 5.

Technical support for the Commonwealth Science Council, Mineral Program.

Inter-departmental Activities

1. In support of the Department of External Affairs:
   a) Asia and Pacific Branch.
      Mr. B.E. Manistre and Dr. P.J. Hood visited the Directorate of Geology and Mineral Resources, Bandung, on separate occasions, to promote Canadian interests in the Indonesian national mineral development program, to be financed through the Asian Development Bank.

   b) Caribbean and Central America Bureau.
      B.E. Manistre joined an External Affairs mission to Honduras to assess a request for proposals, from the Honduran government, to participate in a mineral development program, financed through the International American Development Bank.

2. Activities in support of the Canadian International Development Agency (CIDA), under the EMR/CIDA MOU.
   a) Provision of inspection and monitoring services for airborne geophysical surveys, by members of RGG Division in: Rwanda, Zimbabwe and Thailand. Assistance to the Department of Mineral Resources, Thailand, in the design and implementation of airborne surveys, and the construction of calibration pads for radiometric instrumentation.

   b) Participation in planning mission to Jamaica for geochemical survey project (Dr. R.G. Garrett).

   c) Consulting services re purchase and implementation of a computer system in Malaysia (Dr. R.G. Garrett).

d) Provision of draft Plan of Operations for projects in Brasil involving provision of Canadian consultants and training of Brasilians in Canada. (B.E. Manistre).

3. Activities in support of the International Development Research Centre (IDRC).
   Participation in IDRC project for shallow reflection seismic work in Malaysia and Thailand. (Dr. J.A.M. Hunter, and the Terrain Geophysics Section of RGG).

4. Activities in support of the United Nations.
   Provision of Special Adviser to the Committee for Co-ordination of Joint Prospecting for Mineral Resources in Asian Offshore Areas (CCOP).

Episodes Secretariat

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 1983-84 the Geological Survey of Canada continued to support approximately half 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. Displays were mounted at several national and international conferences. The Episodes Secretariat also continues as the main distribution point for the New Publication Series of IUGS.

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. Scientific reviewers and advisers on publication policy provided useful assistance. In October 1984 A.R. Berger was assigned to a part-time position with the Geological Association of Canada, based temporarily in St. John's, Nfld.

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 (to July 1984).

Member, Mineral Industries Panel of Intermediate Technology Development Group.

Executive Director, Geological Association of Canada (from October 1984).

Attendance at Meetings, Conferences and Courses

B.E. Manistre

EMR International Support Activities Workshop, August 1984.

13th Meeting of the Commonwealth Science Council, September 1984.

Annual meeting of the Committee for Coordination of Offshore Prospecting, Bandung, November 1984.

A.R. Berger

CGC Meetings: London, May 1984; Calgary, September 1984; Ottawa, November 1984.

GAC Meetings: Calgary, September 1984 (Executive); Fredericton, October 1984 (Executive and Council); St. John's, December 1984 (Executive); Ottawa, February 1985 (Executive and Council).

CC/Unesco Annual Meeting, St. John's, June 1984.

AGID Council Meeting, Bangkok, July 1984.

International Geological Congress, Moscow, August 1984 (alternate delegate for structural geology).

Geological Society of America Annual Meeting, Reno, November 1984.

IUGS Executive Meeting, Rabat, February 1985.

MINERAL DEVELOPMENT PROGRAM OFFICE

The Mineral Development Program Office was established in 1983-84 to co-ordinate the GSC activities under the federal-provincial mineral development agreements (1984-89) and within the two federal programs in Quebec (the Asbestos Initiatives program and le Plan de Développement Economique, Canada/Gaspésie et Bas St-Laurent). Co-ordinators work with GSC comptroller and divisions implementing the projects on the one hand, and with staff of the provinces and EMR Mineral Policy Sector on the other hand.

Federal-Provincial Mineral Development Programs (1984-89)

Five federal-provincial mineral development agreements (MDA), subsidiary to the umbrella Economic and Regional Development Agreements (ERDA), were signed by EMR and provincial ministers early in the year. (see Table, opposite page).

Total cost to EMR and the provinces over 5 years is $102 million, of which 62% is to be spent on geoscience programs. Geoscience programs consist of a mix of several activities agreed upon as appropriate to the needs of each province in order to strengthen and diversify the mineral industry sector of the provincial economy. Common to most programs are geological mapping of areas with mineral potential, metallogenic studies, surficial geology and till geochemistry, aeromagnetic gradiometer and airborne radiometric surveys, and geochemical surveys of lake sediments or stream sediments. Identified projects within these broad activities were distributed between the GSC and the provincial sides of the Programs as appropriate to the experience, capability and capacity of each agency. Most work is carried in a "parallel" fashion, i.e. each agency conducts projects with its own funds. Inter-agency co-ordination and cooperation is ensured through management committees and geoscience subcommittees, some with lower level working groups.

	Mineral Development Agreement - 5 Years				Geoscience Component - 5 Years			GSC
	Date of Signing	Total Funding Program	Federal Funding Share	Prov. Funding Share	Total	Federal	Prov.	Allot 84-85 O&M + Salary
	1984	$M	$M	$M	$M	$M	$M	$000
Manitoba	April 18	24.7	14.8	9.9	13.0	8.0	5.0	1212
Newfoundland	May 4	22.0	15.4	6.6	16.4	7.95 (Para) 3.3 (Joint)	1.95 (Para) 3.2 (Joint)	1409
Saskatchewan	May 16	6.38	3.19	3.19	5.34	2.2	3.14	400
Nova Scotia	June 11	26.945	16.125	10.820	16.86	8.955	7.905	1357
New Brunswick	June 25	22.307	15.0	7.307	12.373	8.5	3.873	947
Total		102.332	64.515	37.817	63.973	38.905	25.068	5325

Activity levels within the fiscal year of the GSC projects were low because of the late signing of the agreements and the heavy loads imposed upon the regular staff of the implementing divisions.

	O&M Allotted to GSC Divisions 1984-85 $000	Percentage Usage %
Manitoba	862	72
Newfoundland	1269	45
Saskatchewan	340	59
Nova Scotia	1130	55
New Brunswick	749	38

Seven short reports were published in GSC Current Research Part 85-1A and five have been accepted for publication in Part 85-1B. Scientific highlights are recorded in reports prepared by divisions.

Asbestos Initiatives, Geoscience Program - F.D. Anderson, Co-ordinator

On November 17, 1983, Treasury Board authorized EMR to enter into a six year agreement with the asbestos industry to establish an Asbestos Institute with the Government of Quebec and to undertake other federal initiatives for a total of $9.6M. The federal geoscience program received an allotment of $1.5M to be spent equally during fiscal years 1984-85, 1985-86 and 1986-87.

Objective of the geoscience program is to aid diversification of the mineral industry in the Eastern Townships of Quebec from an almost total dependency on asbestos. The program is divided into three subprograms: Overburden Geochemistry, Exploration Geophysics and Metallogenic Studies.

A request has been made to reprofile $134k of the 1984-85 allotment of $500k into 1985-86. The underspending of about 27% can be generally attributed to the delays in establishing contracts involving new methods in this start-up year.

Nine projects were started in 1984-85. Four projects in overburden geochemistry that included investigations of placer gold along the Chaudière-Eaton river watersheds, a heavy mineral stream sediment survey and the application of remote sensing to drift prospecting.

A reconnaissance IP survey was carried out on Hadrynian schist in an attempt to assess the potential of contained disseminated polymetallic sulphides. An airborne gradiometer-VLF survey was completed and three profiles made over the Stanstead granite. Results of the airborne surveys will be available in 1985-86.

A geochemical study was started on the St. Roberts Au-Ag-W deposit by McGill University staff. Investigations on several small base metal deposits by geologists from Concordia University were started and should provide information on their temperature of formation and conditions of deposition. A study of illite crystallinity near the Stanstead granite was completed by McGill University staff.

Scientific highlights are reported by individual divisions elsewhere in this volume.

Plan de Développement Economique, Canada/Gaspésie et Bas St-Laurent, Volet Mines - Y.T. Maurice, co-ordinateur

Plusieurs projets ont débuté en 1984-85. On a cartographié en détail et échantillonné les roches du complexe granitique des monts McGerrigle dans le but d'en étudier l'origine et d'en évaluer le potentiel économique. Au mont Albert, on a étudié la structure et la pétrographie des roches de l'auréole métamorphique autour des massifs ultrabasiques. Dans les comtés de Témiscouata et Rimouski, des chercheurs de l'Université de Montréal ont entrepris l'étude des roches d'age silurien inférieur dans le but d'en arriver à connaître la source des composants détritiques, le milieu de sédimentation et les mécanismes de transports.

Dans le domaine de la métallogénie, nous avons participé à une étude géochimique du nouveau gisement à la mine Gaspé - la zone E - et avons effectué un examen et un échantillonnage détaillé d'environ vingt-cinq indices de plomb-zinc-barytine qui ne sont pas reliés aux intrusions granitiques. Ces indices se retrouvent dans la partie septentrionale de la péninsule et on cherche à connaître l'origine et le mode de mise en place de ces minéralisations dans le contexte tectonique des Appalaches. On a aussi effectué des études géochimiques et isotopiques de plusieurs indices de cuivre au voisinage des granites dont les gisements Sullipek et Madeleine.

Deux projets de géochimie ont été entrepris dans le cadre du programme en 1984-85: une étude lithogéochimique régionale et un levé de minéraux lourds dans le secteur de Matapédia. Ce dernier cherche principalement à expliquer l'origine de l'or détritique dans cette région.

Une étude des dépots quaternaires a été effectuée dans la partie supérieure de la vallée de la Matapédia dans le but d'approfondir nos connaissances sur les directions de l'écoulement glaciaire dans ce secteur.

En géophysique, on a effectué un levé de gradiométrie héliportée et VLF-EM sur un total d'environ 2250 km^2 comprenant les régions situées au sud du parc de la Gaspésie et entre les monts McGerrigle et Murdochville. Les résultats, sous forme de cartes couleur sont attendus au début de l'été 1985.

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

Canada-Nova Scotia Cooperative Mineral Program 1981-84 and Federal Mineral Program in Newfoundland (Canada-Newfoundland cooperative mineral program 1982-84) ended March 31, 1984. The GSC's geoscience components of the two programs were organized and managed by W.H. Poole. Carried over into 1984-85 was $200,000 for each program for wind-down expenditures and publication of reports and maps.

Nova Scotia. No new projects were implemented. The carried-over O&M of $200k was underspent by $75k which has been requested for carry-over into 1985-86. Expenditures of $125k were on contracts and purchases. Fourteen geochemical stream sediment maps for 12 elements, 1:50,000 scale, were released on open file. Aeromagnetic vertical gradient and total field maps were released by publication or open file for two areas. Two maps were published in colour for the Nova Scotia side of the Program. Three final reports are in press as GSC Papers. Five reports have been contributed to a proposed Meguma volume and await editing by W.H. Poole and thence publication as a GSC Paper. Six projects have been continued by GSC under the Canada-Nova Scotia Mineral Development Agreement 1984-89, and their final reports and maps will be published under that program.

Newfoundland. No new projects were implemented. The carried-over O&M of $200k was underspent by $93k which has been requested for carry-over in 1985-86. Expenditures of $107k were on contracts and purchases. One final geological report on an area in Labrador was published as GSC Paper 84-18. Aeromagnetic vertical gradient and total field maps on the Buchans-Badger area were released on open file (the first government gradiometer survey in Newfoundland). Lake sediment and water geochemical surveys of four 1:250,000 scale map areas in Labrador were released on open file. Geological maps covering the North Bay granite were also placed on open file. Several maps and reports from the Newfoundland side of the Program were published. Ten reports have been contributed to a proposed Buchans volume and await editing by R.V. Kirkham, EGM. About seven final reports and/or maps are expected to be submitted during 1985-86. Several projects have continued under the jointly funded projects of the Canada-Newfoundland Mineral Development Agreement 1984-89.

Deep Seismic Reflection Profile

Quebec and Maine - W.H. Poole, Co-ordinator

The VIBROSEIS seismic survey across the Appalachian orogen from southern Quebec to coastal Maine is a cooperative project of USGS, GSC, Earth Physics Branch, Maine Geological Survey and several universities in Canada and United States. Dr. D.B. Stewart of USGS is project leader. Field data was acquired in 1983 on the northern half of the profile (including Lac Mégantic to the US border), and in 1984 on the southern half to the Maine coast. USGS awarded contracts to Geophysical Systems Corporation, California (GeoSystem) in both years for a total line-mileage of 196 miles at an average cost of $5181 US per mile. Post-field processing of field data is complete for the northern part and in process for the southern part. All knowledgable participants are pleased with the quality of field data acquired.

A USGS-Earth Physics Branch refraction experiment was carried out in 1984 to cover the entire zone from St. Lawrence Platform to the Maine coast. Quality of data is reportedly exceptionally good. Several subsidiary seismic experiments were conducted by American university groups.

A USGS-contracted marine survey bridged the gap between the onshore VIBROSEIS line and an existing USGS line across Georges Bank.

Results of 1983 work were discussed at a conference in Cornell, New York and a multi-authored paper has been submitted to American Geophysical Union for publication. Data and interpretations were displayed at the meeting of Northeastern Section of Geological Society of America.

In summary, deep seismic data has now been collected across the entire Appalachian orogen and the submerged Coastal Plain to the shelf edge. Interpretations of the 1983 data are being reported while 1984 data is being processed and interpreted. The one major scientific breakthrough is the identification of shallow dipping northwest-directed thrusts within the central and northwest part of the orogen.

Personnel Notes

Dr. F.D. Anderson was appointed part-time to a position of co-ordinator on March 31, 1984. He was assigned to co-ordinate GSC components of two programs - Asbestos Initiatives Geoscience Program and the Canada-New Brunswick Mineral Development Agreement, 1984-89.

Sandra J. Gallant joined the Office on February 18, 1985.

At year-end, the Office consisted of two full time co-ordinators (W.H. Poole in charge of Office and co-ordinator for the Newfoundland and Nova Scotia mineral development agreements; and Y.T. Maurice, co-ordinator for Plan de Développement Economique, Canada/Gaspésie et Bas St-Laurent, Volet Mines), one part-time co-ordinator (F.D. Anderson), a part-time administrative officer (J.G. Arnold) and a full time clerk (S.J. Gallant). Dr. Maurice also carries out scientific studies under Resource Geophysics and Geochemistry Division.

Attendance at Meetings, Conferences and Courses

F.D. Anderson

Management Committee meetings, Canada-New Brunswick Mineral Development Agreement, Ottawa, July 6, 1984; Fredericton, November 28, 1984; and Ottawa, February 28, 1985.

Open House, Fredericton, November 27, 1984.

Seminaire d'information sur les activities du Ministère de l'Energie et des Ressources, Quebec City, November 28-29, 1984.

GSC Current Activities Forum, Ottawa, January 22-24, 1985.

Y.T. Maurice

"Till Tomorrow", Kirkland Lake, Ont., May 8-11, 1984.

Séminaire d'information sur les activitées du Ministère de l'Energie et des Ressources, Quebec City, November 28-29, 1984.

GSC Current Activities Forum, Ottawa, January 22-24, 1985.

W.H Poole

Management Committee meetings, Canada-Newfoundland Mineral Development Agreement, St. John's, May 23, 1984; Ottawa, July 5, 1984; St. John's, October 31, 1984; and Ottawa, March 8, 1985.

Management Committee meetings, Canada-Nova Scotia Mineral Development Agreement, Halifax, June 26, 1984; Halifax, November 30, 1984; and Ottawa, February 26, 1985.

Management Committee meetings, Canada-New Brunswick Mineral Development Agreement, Ottawa, July 6, 1984; Fredericton, November 28, 1984; and Ottawa, February 28, 1985.

Open House, Newfoundland, St. John's, November 1, 1984; New Brunswick, Fredericton, November 27, 1984; and Nova Scotia, Halifax, November 29, 1984.

Field excursion, Caledonide orogen, United Kingdom, August 19-September 2, 1984.

IGCP Caledonide Orogen Project 27 workshop and annual international working committee meeting, Glasgow, U.K., September 3-8, 1984. Represented Canadian project leader.

CUSMAP workshop, Franconia, N.H., September 25-27, 1984.

CIM field excursion, mineral deposits of Newfoundland, October 25-30, 1984.

GSC Current Activities Forum, Ottawa, January 22-24, 1985.

Ad hoc committee, Newfoundland and Labrador Association of Explorationists, review of GSC 1985-86 projects under Canada-Newfoundland Mineral Development Agreement, St. John's, February 14, 1985.

Special Talks or Lectures

W.H. Poole

"The new federal-provincial mineral development agreement". Presented at Newfoundland Open House, St. John's, November 1, 1984.

Membership on Committees

F.D. Anderson

Member, Geoscience Subcommittee, Canada-New Brunswick Mineral Development Agreement

Y.T. Maurice

Member, PhD thesis review committee, Laval University.

Member, Executive Committee, le Plan de Développement Economique, Canada/Gaspésie et Bas St-Laurent, Volet Mines.

Member, FCAC Research Grant Committee, Québec.

Member, Board of Directors, Mineral Exploration Research Institute, Montreal.

W.H. Poole

Secretary, Canadian Working Committee, International Geological Correlation Programme, Project 27 - Caledonide Orogen.

Member, Management Committee, Canada-Newfoundland Mineral Development Agreement.

Member, Geoscience Subcommittees for Canada-Newfoundland Mineral Development Agreement and for Canada-Nova Scotia Mineral Development Agreement.

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 Sector.

D.G. Benson

Attendance at Meetings, Conferences and Courses

AGC Program Review, Dartmouth, September 24-26, 1984.

CGD Program Review, Vancouver, December 10, 1984.

ISPG Program Review, Calgary, December 12-13, 1984.

IGCP-CNC Tenth Annual Meeting, Toronto, March 12, 1985.

ADMINISTRATIVE SERVICES

This year's highlights include the launching of the new Branch Computerized Inventory. This project is being carried out in conjunction with the Branch CARP Plan. Another major project is conversion of all Branch operational and administrative records to the new system. A conversion list and a cross-reference system have been created to ease the transition. The records office staff have been trained and are now providing full service to this Branch.

Personnel Notes

Randy Robinson left on Language Training in April 1984 and successfully completed it and returned to work in March 1985. Gino Monteforte replaced Randy Robinson as Supervisor of the Branch Records office for the duration.

Arrivals:

Krista Jenson - WPC - December 1984
Claude Lacroix - B&VS - August 1984
Michel Haines - B&VS - December 1984
Diana Watters - S&R - November 1984

Departures:

Susan Gagnon - WPC - May 1984

PERSONNEL UNIT

The Sector Personnel Unit is responsible for assisting the Branch in 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.

During 1984-85 Branch Personnel Units were reorganized to form the present sectoral service which is headed by John Hussar. Karl Fracke who for some years had headed the GSC unit retired from the Public Service in January 1985.

Following is a breakdown of actions completed during 1984-85.

Staffing

Appointments from outside the Public Service

Scientific & Professional	76
Administrative & Foreign Service	19
Technical	39
Administrative Support	18
Operational	9
Total:	161

Appointments from within the Public Service

Scientific & Professional	55
Administrative & Foreign Service	17
Technical	33
Administrative Support	25
Operational	3
Total:	133

Staffing - Students

COSEP	119
Summer Canada	134
COOP	8
Total	261

Classification actions

Term - Completed	286
Indeterminate - Completed	148
Dry-Runs - Completed	8
Total	442

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:

Boileau, Joanne:
September 83-February 84 – term accounts payable clerk.

REPORT ON THE 1985 CURRENT ACTIVITIES FORUM January 22-24, 1985

Chairman - D.C. Findlay
General Co-ordinate - S.B. Green
Poster Session Co-ordinators: - F.M. Nixon, S.B. Green
Technical Services Co-ordinator: - B.L. Williamson
Program Publicity, Publications: - M.F. Dufour

Publicity for the Forum consisted of:

1. Notices in the Monthly Information Circular beginning in August of 1984.
2. Two advertisements which appeared in consecutive weeks in the Northern Miner.
3. A special mailing of the circular to 500 local members of the Royal Canadian Geographical Society.
4. An advertisement in the Ottawa Citizen which appeared on the Monday before the Forum.

The Forum was again held at the Capital Congress Centre and included a public lecture on the evening of 22 January and poster and formal presentations on the two following days.

1985 Forum Attendance

Public Lecture, Tuesday January 22

A lecture by D.A. St-Onge of the Terrain Sciences Division entitled "Canada's Landscape: Beauty Through Understanding" was attended by more than 600 persons. The exceptionally good attendance for this lecutre was due largely to the popularity of Dr. St-Onge as a public speaker and because of a special mailing to the Geographical Society of which Dr. St-Onge is a member.

Poster Session, Tuesday to Thursday January 22-24

A total of 34 posters were presented in Salon E of the Congress Centre. These were open for informal inspection on Tuesday evening, all day on Wednesday and until 1:00 pm on Thursday. A special evening session was held on Wednesday from seven to ten pm.

Attendance at the poster session was excellent particularly after the conclusion of the afternoon plenary sessions on Wednesday. The evening arrangement with a cash bar was not that well attended.

Technical Sessions, Wednesday and Thursday
January 23-24

The technical sessions were opened on Wednesday morning by the Honorable R.E.J. Layton, Minister of State for Mines whose remarks were well received by about 350 persons. A total of 20 papers were presented including three devoted to seafloor studies as part of the special theme session presented on Thursday afternoon.

1985 Forum Attendance

Attendance at the 1984/85 Forums has been summarized in the following table.

	1985	1984
GSC Employees	216	189
Industry Representatives	124	90
Other Government	98	34
University	107	132
Other	22	22
	567	511*

*Includes 44 from other federal agencies

This represents an overall attendance increase of 11% but particularly noteworthy is the increased attendance by industry representatives which was up by 37% when compared to last year's attendance.

1985 Forum Costs

The following table is a summary of expenses incurred for the 1985 GSC Current Activities Forum:

Space Rental	4 305.00
Hospitality	860.00
Audio/Visual	1 255.00*
Moving	398.50
Display Boards	800.00* *
Total	7 618.50

* An additional 600.00 in video costs were borne by the divisions that incurred them.

** Ten new cork-covered display boards were purchased both in support of the GSC Forum and for those displays that were sent to the Prospectors and Developers Association Annual Convention in Toronto during March, 1985.

GSC Participation at Prospectors and Developers Association Annual Convention, Toronto Canada; March 10-14, 1985

At the request of the Prospectors and Developers Association (PDA) the Geological Survey of Canada sent a selection of posters from the GSC Forum to the PDA Annual Convention held at the Royal York Hotel in Toronto during the second week in March. Twenty posters that were oriented towards exploration and economic geology in general were set up in a room that was provided to the GSC under the auspices of the PDA and the Canadian Geoscience Council.

The display was very well received particularly those posters that represented the Mineral Resource Information Services group of the Economic Geology and Mineralogy Division (D. Garson, R. Laramee) and the National GEOSCAN service (D. Reade.).

It seems likely that this will become an annual event for us and while most equipment necessary for the displays is either already available in house or from companies in Toronto specializing in display services it should be noted that abundant auxilliary lighting should be shipped with the poster as ambient room light was marginal.

A total cost of 457.00 was incurred for the rental of display related material for this occasion.

PUBLICATIONS IN OUTSIDE JOURNALS

The reports that follow for each division document the formal and informal output of the Branch in 1984-85. This list gives the titles, authors and journal or publisher of many of the items published in the scientific literature. It was prepared from the GEOREF database and comprises all listings in that database with a 1984 date which were written by GSC staff members. This list, the annual index to GSC reports and maps, and the lists of oral presentations etc. contained in the following papers, provide a measure of the output of the Branch during the past 12 to 15 months.

ADSHEAD, J.D.
FERROMANGANESE-TRACE METAL RELATIONSHIPS IN ARCTIC LAKES; THE GEOLOGICAL SOCIETY OF AMERICA, 1984 ANNUAL MEETING; ABSTRACTS WITH PROGRAMS; SEP 1984, VOL. 16, NO. 6, P. 426.

AGTERBERG, F.P.
THEORY, APPLICATION AND COMPARISON OF STRATIGRAPHIC CORRELATION METHODS; PROCEEDINGS OF IGCP PROJECT 148 MEETING; COMPUTERS & GEOSCIENCES (III); 1984, VOL. 10, NO. 1, 188 P.

AGTERBERG, F.P.
USE OF SPATIAL ANALYSIS IN MINERAL RESOURCE EVALUATION; JOURNAL OF THE INTERNATIONAL ASSOCIATION FOR MATHEMATICAL GEOLOGY (III); AUG 1984, VOL. 16, NO. 6, P. 565-589.

AGTERBERG, F.P.
PROBABILISTIC MINERAL AND ENERGY RESOURCE EVALUATION; SCIENTIFIC PROGRAM AND ABSTRACTS; NINTH INTERNATIONAL CODATA CONFERENCE; CODATA BULLETIN; MAR 1984, VOL. 54, P. 80.

AGTERBERG, F.P.
REPLY TO COMMENTS ON "USE OF SPATIAL ANALYSIS IN MINERAL RESOURCE EVALUATION"; JOURNAL OF THE INTERNATIONAL ASSOCIATION FOR MATHEMATICAL GEOLOGY (III); AUG 1984, VOL. 16, NO. 6, P. 595-600.

AGTERBERG, F.P.
SPATIAL ANALYSIS IN THE EARTH SCIENCES; SCIENTIFIC PROGRAM AND ABSTRACTS; NINTH INTERNATIONAL CODATA CONFERENCE; CODATA BULLETIN; MAR 1984, VOL. 54, P. 10.

AGTERBERG, F.P.; GRADSTEIN, F.M.; WILLIAMSON, M.
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AMOS, C.L.; KING, E.L.; **BORNHOLD, B.D.** (EDITOR); GUILCHER, A. (EDITOR)
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ANDERSON, T.W.; LEWIS, C.F.M.;
FYFE, W.S. (CHAIRPERSON)
POSTGLACIAL WATER-LEVEL HISTORY OF THE LAKE ONTARIO BASIN; GAC.MAC, 1984; PROGRAM WITH ABSTRACTS; JOINT ANNUAL MEETING GEOLOGICAL ASSOCIATION OF CANADA; 1984, VOL. 9, P. 41.

BAMBER, E.W.; MACQUEEN, R.W.; **RICHARDS, B.C.; GELDSETZER, H.H.J.** (EDITOR); **NASSICHUK, W.W.** (EDITOR); BELT, E.S. (EDITOR); MACQUEEN, R.W. (EDITOR);
FACIES RELATIONSHIPS AT THE MISSISSIPPIAN CARBONATE PLATFORM MARGIN, WESTERN CANADA; INTERNATIONAL CONGRESS ON CARBONIFEROUS STRATIGRAPHY AND GEOLOGY (III); 1984, VOL. 9, NO. 3, P. 461-478.

SANDO, W.J.; **BAMBER E.W.;** SUTHERLAND, P.K. (EDITOR); MANGER, W.L. (EDITOR)
CORAL ZONATION OF THE MISSISSIPPIAN SYSTEM OF WESTERN NORTH AMERICA; BIOSTRATIGRAPHY; INTERNATIONAL CONGRESS ON CARBONIFEROUS STRATIGRAPHY AND GEOLOGY (III); 1984, VOL. (VOL. 2), P. 289-300.

BARAGAR, W.R.A.; LAMBERT, M.B.; BAGLOW, N.; GIBSON, I.L.; FYFE, W.S. (CHAIRPERSON)
SHEETED DYKE COMPLEX, TROODOS OPHIOLITE; GAC.MAC, 1984; PROGRAM WITH ABSTRACTS: JOINT ANNUAL MEETING GEOLOGICAL ASSOCIATION OF CANADA; 1984, VOL. 9, P. 44.

BARAGAR, W.R.A.
PILLOW FORMATION AND LAYERED FLOWS IN THE CIRCUM-SUPERIOR BELT OF EASTERN HUDSON BAY; CANADIAN JOURNAL OF EARTH SCIENCES; JUL 1984, VOL. 21, NO. 7, P. 781-792.

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SURFICIAL GEOLOGY OF THE CONTINENTAL SHELF, NORTHWESTERN VANCOUVER ISLAND; MARINE GEOLOGY; MAY 1984, VOL. 57, No. 1-4, P. 89-112.

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GRAVITY AND MAGNETIC STUDIES OF THE SUDBURY STRUCTURE; GAC.MAC, 1984; PROGRAM WITH ABSTRACTS; JOINT ANNUAL MEETING – GEOLOGICAL ASSOCIATION OF CANADA; 1984, VOL. 9, P. 69,

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CURRENT STATISTICAL DEVELOPMENTS IN THE GEOSCIENCES; INTRODUCTION TO THE SPECIAL ISSUE ON STATISTICS AND THE EARTH SCIENCES; CURRENT STATISTICAL DEVELOPMENTS IN THE GEOSCIENCES: JOURNAL OF THE INTERNATIONAL ASSOCIATION FOR MATHEMATICAL GEOLOGY (III); AUG 1984, VOL. 16, NO. 6, P. 529-530.

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ECKSTRAND, O.R. (PREFACER);
WATKINSON, D.H. (PREFACER)
THE DISTRIBUTION OF NICKEL AND IRON BETWEEN OLIVINE AND MAGMATIC SULFIDES IN SOME NATURAL ASSEMBLAGES; THE CANADIAN MINERALOGIST; FEB 1984, VOL. 22, (PART 1), P. 55-66.

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ATLANTIC GEOSCIENCE CENTRE

M. J. KEEN

The Division's objectives are briefly to ensure that geological information and expertise are available for the offshore regions of Atlantic and Arctic Canada, the sedimentary basins of the Appalachian region, and for the ocean basins in general when necessary. The knowledge and information is directed to national needs of the following sorts: identification of the base of resources available; the formulation of mineral and energy policy; making exploration for Canadian resources easier; and enhancement of 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 occurrences 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 determination 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, 50 Research Scientists, Physical Scientists, Engineers and Computer Scientists, 41 Scientific and Technical Support staff, 13 Administrative, Secretarial and Clerical staff.

ADMINISTRATION SUBDIVISION

The objectives of the Administration Subdivision are to provide efficient and effective financial, personnel and general administrative guidance and support to the Atlantic Geoscience 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, Assistant Director and a Secretary; an Administrative Officer, two Financial Clerks, a Personnel Clerk and a Secretary. Dr. David I. Ross, who left AGC in 1978 to join NORDCO Ltd., St. John's, Newfoundland, returned to AGC as Assistant Director in July 1984.

Attendance at Meetings, Conferences and Courses

M. J. Keen

Ocean Drilling Program Canadian Executive Committee meeting, Ottawa, April 30, 1984

Canadian Geoscience Council Annual Meeting, London, Ontario, May 14-15, 1984

Bedford Institute of Oceanography Open House, April 30 - May 4, 1984

Canadian Geophysical Union Annual Meeting, Dalhousie University, Halifax, June 1, 1984

GSC Branch Management Committee meeting, Ottawa, June 5-6, 1984

Ocean Drilling Program International Executive Committee meeting, France, June 18-22, 1984

OERD Meeting, Calgary, July 11, 1984

NSERC Site Proposal meeting, Memorial University of Newfoundland, St. John's, Newfoundland, July 17, 1984

GSC Branch Management Committee meeting, Ottawa, September 18-19, 1984

AGC Project Review, September 24-26, 1984

Ocean Drilling Program meeting, University of Rhode Island, October 15-16, 1984

OSS Ship Requirements Meeting, Ottawa, November 14, 1984

Ocean Drilling Program Workshop, Dalhousie University, Halifax, November 26, 1984

GSC Branch Management Committee meeting, Ottawa, November 27-28, 1984

EMR Coordinating Committee on Marine Geoscience Research, Ottawa, November 29, 1984

Canadian Geoscience Council meeting, Ottawa, November 30, 1984

DFO/EMR Guiding Committee on Offshore Surveys, Dartmouth, December 6, 1984

OERD Meeting, ISPG, Calgary, December 13-14, 1984

GSC Current Activities Forum, Ottawa, January 22-24, 1985

GSC Branch Management Committee meeting, Vancouver, March 5-6, 1985

Canadian Geoscience Council Annual Meeting, Toronto, March 12, 1985

Ocean Drilling Program International Executive Committee meeting, Miami, March 18-20, 1985

EMR Coordinating Committee on Marine Geoscience Research, Ottawa, March 26, 1985

D. I. Ross

AGC Project Review, Dartmouth, September 24-26, 1984

Workshop on "Introduction to Offshore Operations of the Petroleum Industry", St. John's, Newfoundland, October 10-12, 1984

DFO/EMR Guiding Committee on Offshore Surveys, Dartmouth, December 6, 1984

OERD Meeting, ISPG, Calgary, December 13-14, 1984

Seabed II Steering Committee meeting, NRC, Ottawa, March 21, 1984

Membership on Committees

M. J. Keen

DFO/EMR Guiding Committee on Offshore Surveys

BIO Directors' Committee

Dalhousie University, Adjunct Professor

Atlantic Regional Interdepartmental Committee on Environmental Issues

Canadian Geophysical Union, Past-President

OSS (Atlantic) Management Committee (observer)

Canadian Geoscience Council: Chairman, Marine Geosciences Committee

Canadian Executive Committee for Ocean Drilling Program (Secretary)

Alternate Canadian Member, International Executive Committee, Ocean Drilling Program

EMR Coordinating Committee on Marine Geoscience Research (Secretary)

Advisory Board, Newfoundland Institute of Cold Ocean Sciences (NICOS)

D. I. Ross

Marine Technical Society, Canadian Maritime Section

Ocean Drilling Program Canadian Executive Committee

CSA Task Force on Foundations

CGC Marine Geosciences Committee

AGU Committee on International Participation

REGIONAL RECONNAISSANCE SUBDIVISION

Charlotte E. Keen
(Head)

The primary objective of the Regional Reconnaissance Subdivision is to study the deep geology and geophysical properties of the continental margins and adjacent offshore regions in order to understand the processes controlling their development and evolution. While effort is focussed on the comtemporary margins, this has inevitably led to studies of the adjacent continental and oceanic regions, and to interests in analogous features globally. To accomplish this, Subdivision scientists carry out detailed studies in key areas, using seismic and potential field data collected from ships, aircraft, satellites, and Arctic ice camps. Findings are integrated with the results of work done elsewhere or derived from complementary data types. Geodynamic modelling to test conceptual models is a key element of our program. Cooperative effort is an important aspect of the work, involving ongoing contact and collaboration with other federal government agencies, universities, industry, and foreign institutions.

In 1984, an internal re-organization rationalized to some extent the grouping of AGC staff according to discipline. Accordingly, four members of the Subdivision who specialized in surficial and bedrock geology studies were re-assigned to another AGC unit with a clearer mandate for that kind of activity.

The Subdivision presently comprises nine geophysicists, four technicians, one post-doctoral fellow, and one secretary. (Action is planned or underway to increase that complement by hiring new staff.) It is divided into two groups organized broadly according to methodology: Seismic and Potential Field studies. While common problems are approached in a coordinated fashion, each group concentrates largely on the development and application of techniques for the collection, analysis, and interpretation of the different classes of data that fall within its respective purview.

Highlights

Crustal Seismic Studies

Crustal seismic studies have been carried out largely under the scientific leaderships of Ian Reid and Charlotte Keen, with instrumentation development handled by Brian Nichols.

A major experiment on the southern margin of the Grand Banks saw the continuation and completion of work begun in 1983 to study the ocean-continent transition across the transform margin in that area. This is an important experiment because little is known about transform margins, and the Grand Banks margin is one of the best examples in the world of this margin type. The principal technique for this was seismic refraction using ocean-bottom seismometers (OBS), applied in two ways: by a set of closely spaced refraction profiles using an airgun source in order to obtain complete coverage of the transition in upper crustal structure across the margin; and with explosive sources of up to 300 kg., detonated in deep water and recorded by an OBS array across the margin in order to provide

information on the deep crustal structure of the continental crust adjacent to the margin. Seismic reflection was also carried out, including the first (and successful) test of a new digital seismic acquisition system. The seismic reflection data provide an existing first look at the transform margin and clearly show a linear volcanic ridge, several kilometers high now buried beneath sediment. This ridge, similar to those observed on oceanic transform faults appear to mark the seaward side of the ocean-continent boundary. The 13 days of almost continuous data gathering included 17 OBS deployments, with 1 loss.

A new minicomputer-based processing system is now in production, after several months of software development and implementation. This is designed principally to handle OBS refraction data, and it is possible to process this much more efficiently than in the past. In addition, the improved processing and display capabilities make it possible to extract the maximum amount of information from the data. The first data set being analyzed is a refraction experiment which was conducted over the Laurentian Channel in 1983, incidental to a microseismicity study. Strong lateral variation in structure, probably associated with salt diapirism, is apparent, together with a complete set of crustal arrivals and some evidence for higher velocity, probably mantle, arrivals. Full analysis of the results is in progress. Following this, complete processing of the data from the 2-year transform margin study is expected to occupy much of the Summer months of 1985.

Lithoprobe East

Under the guidance of Charlotte Keen, the Frontier Geoscience Program provided the opportunity to undertake, through contract, a deep multichannel reflection survey across the Appalachian structures northeast of Newfoundland and out across Orphan Basin and the adjacent continental margin. This is a major contribution to the Lithoprobe project. Excellent results were obtained, providing information on structure within and below the entire crustal column.

The data show the extent of the ancient passive margin below the over-thrust belt of the Appalachian orogen and indicate that the Dunnage ("oceanic") terrane is entirely allocthonous. The Dover fault between the Avalon and Gander terranes is a deep vertical fault, which truncates Moho. Thrust faults within the crust, extending down into the upper mantle have been delineated below the miogeocline.

Across the passive margin several very deep sedimentary basins have been observed. This part of the data set is still being processed, but preliminary results also suggest that oceanic and continental crustal thicknesses may be determined near the ocean-continent transition.

Plate Kinematics of the North Atlantic

Shiri Srivastava has examined in detail the interaction of Iberia with Eurasia and Africa during the seafloor spreading history of the North Atlantic. By re-examining the geophysical data in the Northeast and Northwest Atlantic, he has established that Iberia never moved as an independent microplate, but moved alternately with the Eurasian or the African plate. During the Jurassic episode of Atlantic seafloor spreading, Iberia was part of Eurasia. During the Cretaceous and most the the Paleogene, when Iberia moved independently from Eurasia, it was part of the African plate with the Eurasia-Africa plate boundary extending from the Pyrenees to King's Trough. In late Paleogene, the Eurasia-Africa plate boundary shifted to its present Azores-Gibraltar location, thereby re-attaching Iberia to the Eurasian plate. Such a model fits well with the formation of the Pyrenees, Azores-Biscay Rise and King's Trough in early- to mid-Paleogene. Further exploration of such a model for the kinematics of the NAM-EUR-IBE-AFR plate system will also provide better constraints on the early rifting and drifting evolution of the Newfoundland, Iberian and European continental margins.

Arctic Investigations

Ruth Jackson has been coordinating AGC involvement in CESAR (Canadian Expedition to Study the Alpha Ridge). Geological and geophysical results suggest a Late Cretaceous age for the ridge. A highly weathered suite of alkaline volcanic rocks were dredged from a basement outcrop. The seismic reflection record displays a graben, a typical tensional tectonic feature, while the refraction profiles reveal an unusually thick crust near 40 km with a high velocity basal layer in the range of 7.3 km/s. The velocity structure is typical of a large plateau formed of oceanic crust, and is consistent with other data.

The CESAR cores have been analyzed and written up in a major GSC Paper to appear in 1985. A significant Late Cretaceous silicious core was documented; the remaining cores described the present to Miocene history of the Arctic Ocean.

Gravity data collected across Ellesmere Island and Nares Strait show a significant anomaly with values as low as -120 mGals. The anomaly cannot be attributed to the water or sedimentary layers in the Strait, but is attributed to variations in crustal densities or to the shape of the M discontinuity. The anomaly is similar to those measured across ancient suture zones, and is similar in shape but with less amplitude than those observed on modern collisional boundaries.

Recent efforts have been directed toward establishing with EPB, a seismic refraction program from the Ice Island, on the Canadian Arctic Margin.

Potential Fields Data Base Operations

With John Woodside as the primary AGC participant, a major development project was undertaken to develop a single data base containing all EMR gravity observations and most EMR marine magnetic measurements. This data base should be a reality by mid-1985. Following extensive consultation of users of potential field data in EMR at PGC, AGC and in Ottawa during the past year, an effective structure was designed at EPB for this System 2000 Data Base. The

development of software for loading and access of the data base proceeded in parallel with a complete review of all AGC gravity and magnetic data to remove bad data and flag all remaining data with a subjective indication of quality. The data base will be ready for loading in April 1985, as the network adjustment of all marine gravity data and the editing of AGC marine magnetic data are completed.

Efficient access to the data will be provided by high speed data communications. Implementation of this link required additional hardware and software at AGC.

Potential Fields Operations

Ron Macnab coordinated AGC involvement in a combined hydrographic-geophysical survey of the Laurentian Channel, St. Pierre Bank, and the western Grand Banks. Bathymetric, gravimetric, and magnetic data were collected over 12,000 km of track at an average spacing of 18.5 km, to map an area covering some 117,000 km.

This operation marked a milestone of sorts in the offshore regional geophysical mapping program that was instituted in 1964: the entire East Coast Offshore from the Gulf of Maine to Davis Strait has now been mapped. Surveying of Baffin Bay must await the advent of full-time GPS coverage, now scheduled for 1988 or later. This allows a pause in field operations, during which time the existing data base can be rationalized or enhanced from other sources, and prepared for major interpretive treatment.

Industry has been collecting potential field data in the east coast offshore since the late 60's, and by statute, has had to file reports describing these activities with the Canada Oil and Gas Lands Administration (COGLA) or its predecessors. These reports become public after five years. It has been recognized for some time that the data sets resulting from this commerical activity could serve a useful purpose in complementing or enhancing data acquired during Government programs in the same region. Under the project leadership of Ron Macnab, a local consulting firm was engaged to perform a search through COGLA files in order to identify likely data sets. This was followed up by discussions with various industry representatives, with a view to negotiating a possible transfer of private sector data for assimilation into the new EMR data base.

As a preliminary to joint study with USGS workers, a contract was issued to Kenting Earth Sciences to undertake interpretive processing of aeromagnetic data collected in 1982 over Georges Bank and the southwest Scotian Shelf. The primary product of the contract was a depth to basement map; this was immediately useful in refining earlier estimates of basin size and shape, as derived from an analysis of seismic reflection data.

The development of potential field instrumentation has been handled by Bosko Loncarevic, and has consisted largely of the final evaluation process for the Bodenseewerk KSS-30 sea gravimeter, plus the implementation of a prototype data logging system.

A detailed survey had been undertaken in Mahone Bay, N.S., to demonstrate that useful gravity measurements could be made in protected inshore waters from a small ship if good navigation were available. In this case, navigational accuracy was better than 5 m (using SYLEDIS) and the RMS accuracy of the survey was about 1.5 mGal (using the BSW KSS-30 sea gravity meter system).

A geological interpretation of the data was undertaken, and the high precision of the gravity measurements permitted delimitation of the westward projection of the Goldenville quartzites across the southern part of the Central Basin (causing an anomaly of only two or three mGals). The contact between Halifax slates and Devonian granites to the north creates the largest anomaly measured (over 10 mGal).

The KSS-30 sea gravimeter was also employed on the regional survey of Laurentian Channel and St. Pierre Bank. It was operated alongside a LaCoste and Romberg Straight-Line meter (SL1) provided by the Earth Physics Branch, so that a comparison could be made between the two meters. The agreement between the two instruments under a variety of operational conditions was remarkable, though mean crossover discrepancy was significantly smaller for SL1.

Progress was made with a new on-line analysis and logging equipment (CIGAL). This system will replace the principal geophysical logger BIODAL which has been in continuous operation since 1965.

Satellite Altimetry Applications for Marine Gravity

Under the project leadership of John Woodside, a contract was issued in late October 1984 to Prof. Petr Vanicek and colleagues at the Department of Surveying and Engineering at the University of New Brunswick. The contract is for a feasibility study, one product of which would be SEASAT altimetry data and the software to manipulate and handle such data along with marine gravity data. Quantitative comparison of gravity anomaly and geoid information derived from satellite and marine measurements will lead to determination of the characteristics of the different types of data and their mutual complementarity.

In the first four months of the contract, the necessary data have been compiled, graphical display and data handling software set up, and the analytical problems addressed. Satellite altimetry data were obtained from three different American sources (NASA, Ohio State University, and National Geodetic Survey) and compared for quality and applicability for the project. Marine and land surface gravity data were acquired from Earth Physics Branch and Atlantic Geoscience Centre. Because of the density of marine data, a method for decimating the data was set up following some experimentation. The first theoretical problem was finding a suitable method of converting geoidal heights into gravity anomalies, because standard techniques such as collocation or spherical harmonic analysis were not considered useful. Instead, the Molodenskij approach (inverse Stoke's method) was adapted for use with a higher order reference spheroid defined by a satellite-determined geopotential field (model GEM-L2, which is defined to degree and order 20)

rather than a reference ellipsoid. Correction of altimetry data for sea surface topography is just getting underway as attempts are made to obtain the oceanographic data used by Levitus in the 'Climatological Atlas of the World Ocean' in a digital form.

Ocean Drilling Program in Labrador Sea and Baffin Bay

Sea-floor drilling will be carried out at selected sites in the Labrador Sea and in Baffin Bay in order to decipher the paleoceanographic and paleoclimatic conditions which prevailed during the Paleogene and Neogene, and to date the opening history of these regions.

Under the project leadership of Shiri Srivastava, a cruise was undertaken by AGC to carry out detailed geological/geophyscial surveys of the proposed drilling sites in the Labrador Sea. Data from this cruise have been compiled as maps showing detailed geological structures.

Present plans are to drill one hole in the Labrador Sea and one hole in Baffin Bay during Leg 105 of ODP. The leg is due to start on August 24 from Stavanger in Norway and to end on November 2., at St. John's. Shiri Srivastava will be one of the two Co-Chief scientists on board the drill ship SEDCO 471 (JOIDES RESOLUTION).

Geodynamic Modelling

Charlotte Keen has continued her studies of the dynamics of rifting. This is a continuation of a joint project with C. Beaumont at Dalhousie to model the processes involved in the rifting and development of continental margins. The results show that simple extension of the lithosphere during rifting can produce some rather surprising and important side effects. These include thinning the lithosphere from below, due to initiation of small-scale convection below stretched lithosphere and both syn-rift and post rift uplift of the shoulders of rift zones. The latter could explain why syn-rift marine sediments are now found some 600 m above sea level on north-eastern Baffin Island and Bylot Island.

Geology of Canada - Decade of North American Geology

Almost everyone in the subdivision is contributing to this mammoth project. Not only are many contributing to the volume on the Eastern Canadian Offshore, but to other volumes in the series as well. These include the Transects, Arctic and North Atlantic Ocean Volumes. The efforts will continue over the next year.

Personnel Notes

Charlotte Keen assumed the position of permanent Subdivision Head. She replaced the Acting Head Ron Macnab, who resumed his duties in the Potential Fields Group.

Samuel Ojo, of Ahmadu Bello University in Zaria, Nigeria joined the Subdivision for a one-year term as an NSERC fellow.

Brian MacLean, Gordon Fader, Heiner Josenhans, and Bob Miller were re-assigned to the Environmental Marine Geology Subdivision.

Suzanne Cronk, the Subdivision Secretary, has been on leave for several months and Robert Bendokas has been, in her absence, Acting Secretary.

Attendance at Meetings, Conferences and Courses

P. Girouard

-DEL VAX/VMS Operators Course
-DEL VAX/VMS Utilities and Commands Course

R. Jackson

-Canadian Geophysical Union Meeting, Halifax, May 1984.
-27th International Geological Congress

C.E. Keen

-GAC & Lithoprobe Steering Committee Meeting, London, Ontario, May 1984.
-NSERC - September 1984.
-GAC Forum - January 1985.
-CNC Lithosphere - March 1985.
-WHOI Meeting - Invited Speaker - LASE October 1984.
-CSEG/Lithoprobe Advisory Committee Meeting - February 28, 1985.

B.D. Loncarevic

-Canadian Geophysical Union Meeting, Halifax, May, 1984.

R.F. Macnab

-CMOS/CGU - 1984 Congress - Halifax

I. Reid

-Lithoprobe Seismic Group Meeting - Calgary, January 2-3, 1985.
-DFO/COGLA Workshop on "Effects of Explosives in the Marine Environment, Halifax - January 12-14, 1985.

S.P. Srivastava

-AGU Conference (Cincinnati, San Francisco)
-CGU Meeting - Halifax
-Several meetings with Ocean Drilling Program Group.

J.M. Woodside

-CGU/CMOS Meeting - Halifax
-AGU Meeting - San Francisco
-AGS Meeting - Wolfville, N.S.
-Data Tech/Institute Course on Networking
-Personal Computers.

Special Talks and Lectures

R. Jackson

-CESAR talk to Canadian Institute of National Affairs and the Dalhousie Ocean Studies Program.

C.E. Keen

-CGS Current Activities Forum - "Evolution of Rifted Continental Margins".
-Invited Speaker at Woods Hole Oceanographic Institution Meeting on Deep Seismic Reflectors on Continental Shelves. "LASE".

B.D. Loncarevic

-Inshore Geophysics, CGU Meeting in Halifax May 30, 1984 (with John Woodside).
-Operational Experience with the KSS-30 Marine Gravity Meter, CSPG Meeting in Calgary. June 18, 1984 (with John Peirce and C.C. Chong).

S.P. Srivastava

-Series of seminars at Woods Hole Oceanographic Institution, Woods Hole, Mass., and at University of Rhode Island.

J.M. Woodside

-Paper at CGU Meeting in Halifax, May 1984 (with B.D. Loncarevic)
-Paper at AGS Meeting.
-Lectures in Geophysics to Cartography II students at CHS Headquarters.
-Seminar on East Coast Geophysics to the Canadian Hydrographic Association.
-Talk on Geophysics to combined elementary classes at Crichton Park School.

Membership on Committees

R. Jackson

-(Member) International Lithosphere Sub-committee on the Arctic.

C.E. Keen

-(Member) CNC Lithosphere
-(Member) WG2 Arctic of CC7 ILP
-(Member) CMG (IUGS)
-(Member) Lithoprobe Steering Committee
-(Member) NSERC Commission on Strategic Grants
-(Member) Wilson (CGU) and Miller (Royal Society) Medal Committees

R.F. Macnab

-(Member) Executive Committee on Replacement of Shipboard Computers
-(Member) Data Management Advisory Committee

B. Nichols

-(Member) Remote Sensing Committee

S.P. Srivastava

-(Member) Tectonophysics Panel of the Ocean Drilling Program
-(Member) International Association of Geomagnetism and Aeronomy

J.M. Woodside

-(Member) Directing Board of Bureau Gravimetrique International

Subdivision Manuscripts

During the fiscal year April 1, 1984 to March 31, 1985, the Subdivision staff were involved in the production of twelve manuscripts for outside publications, thirteen for inside publications, three open file reports, and twenty abstracts of oral papers.

ENVIRONMENTAL MARINE GEOLOGY SUBDIVISION

David J.W. Piper

The subdivision is responsible for surficial marine geology of marine areas off the eastern and northern coasts of Canada.

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 map the distribution of surficial sediments, to provide improved knowledge of recent and Quaternary 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.

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), the Northern Oil and Gas Action Program (NOGAP) 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 advise and assessment to regulatory agencies and other levels of government.

HIGHLIGHTS

Beaufort Sea

A seismic profiling and coring program was successfully carried out on the Yukon shelf. This area is dominated by over consolidated pre-Wisconsinan sediments and is thus quite different from the Beaufort shelf to the east.

A physical modelling facility and computer controlled scaled seismic acquisition system was established under contract at the University of Calgary to synthetically model the structure and stratigraphy of the upper 1km of shelf sediment. This work has shown that there is excellent correlation between physical models and field data relating to the distribution of permafrost.

A major cooperative ice scour mapping program involving ESRF, PERD and GSC funding, has been completed on the Beaufort shelf. A significant number of new and deep scours were identified.

The nearshore drilling program in the North Point area obtained more than 20 boreholes that showed an unusually thick (9m) Holocene sediment sequence. A recently completed program of nearshore drilling in the King Point and Phillips Bay region provided about 12 boreholes for assessing nearshore geotechnical and permafrost properties of sediments.

A summer field program on the Beaufort Coast obtained aerial video coverage of almost the whole coast west of the Tuk peninsula, and resurveyed coastal retreat monitoring stations first established in 1973.

Deep Ocean Nuclear Waste Disposal Assessment

Work coordinated through the international Seabed Working Group has continued through this year. A cruise in November acquired the longest cores yet obtained from the Nares Abyssal Plain study area, permitting prediction of geochemical controls on migration of radionuclides at greater depths. Geophysical data demonstrated shallow faults that are believed related to dewatering processes.

Previously obtained pore-water data from the Sohm Abyssal Plain contained levels of dissolved iron two to four orders of magnitude greater than predicted using conventional phase equilibria. It is suggested that this iron is in a metastable $FeSi_2O_3(OH)_8$ form.

Coastal Studies

A cooperative program funded by NATO allowed AGC scientists to examine the morphodynamics of gravel beaches in Ireland, and to gain expertise from Irish scientists on the evolution and management of these beaches and their associated dunes. Some of the experience of this work appears in a review prepared for a volume on glaciated coasts on beaches of Atlantic Canada.

Open file reports were released on coastal geology maps of Northwestern Bathurst Island Group, and annotated video tapes of the coastline of Jones Sound.

Advice was provided to Parks Canada on the stability of beaches in the Cape Breton Highland National Park, and in particular the effects of the severe storm in 1983.

Wave transformation and associated sediment transport across the shore face were studies as part of the Canadian Coastal Sediment Study at Stanhope, P.E.I.

The effects of major winter storms on coastal barriers in southern Newfoundland were investigated, and a summary review of the coastline of Newfoundland was prepared.

Fjord Studies

A high resolution seismic survey of Saguenay Fjord showed evidence of widespread subaqueous failures of various ages on the floor of the fjord.

Predictive algorithms were developed for time averaged settling velocity of suspended particulate matter which allow the prediction of rates of sediment accumulation with distance from river mouths.

Massive Holocene sediment slides were identified in five Baffin fjords, suggesting a major earthquake centred on Scott Trough.

A major data report and eight scientific manuscripts have been published on the Sedimentology of Arctic Fjords Experiment.

Scotian Shelf

An ESRF-funded study, coordinated with on-going PERD work, has mapped the migration of radioactively tagged sand tracer at two sites on Sable Island Bank. Fine sand near the Venture site moved about 10m per month during the winter. The data will be used to calibrate predictive sediment transport models developed during the year for the eastern Scotian Shelf.

A major report on the Wisconsinian glacial history of the Scotian Shelf and the evolution of marginal systems beneath ice shelves has been completed and released to open file.

A compilation was completed of evidence for Holocene faulting on the eastern part of the Scotian Shelf.

Hibernia Area

Staff from AGC have been involved in the initial states of the Hibernia EIS.

Joint work with C-Core and DND at Hibernia allowed better characterization of features previously only identified by sidescan. Depth of disturbance rods and tracer sand were deployed to assess winter sediment transport.

Work in Avalon Channel showed sandy bedforms in 70 to 130m water depth and iceberg scours in greater than 110m are relict features related to times of lowered sea level.

A study has been completed of the Holocene sediment evolution of the Hibernia area, including an assessment of the rates of sediment transport.

Clay mineral analysis in the Hibernia area suggests that the unconformity at the top of the Tertiary was subaerially exposed for a long time, accounting for some of its geotechnical properties.

Continential Slope

SeaMARC I was used to investigate the near-surface instability of the continental slope along much of the Labrador and continental margins, including the areas of well sites in Davis Strait, Labrador Slope, Flemish Pass and the Scotian Slope. Iceberg scours were detected to water depths of 650m.

Seismically induced slumping and sediment diapirism were detected in Flemish Pass and on the Scotian Slope.

A successful test cruise of the Seabed II system on the Scotia Slope obtained high resolution seismic profiles with 150m penetration in 2000m water depth, revealing debris flows, pockmarks and relict iceberg scours.

Labrador Shelf and Eastern Arctic

A field program aimed at providing correlation between the terrestrian and marine stratigraphies on the Labrador coast was carried out in Nachvak Fjord. It suggests a minimal ice advance in the Late Wisconsinian.

A review of the glacial and post-glacial history of the Labrador Shelf has been completed.

A major synthesis of the Quaternary marine geology of the south east Baffin Shelf has been completed.

A contract review was completed of all existing surficial geological and geotechnical data relevant to the Arctic Island Channels marine areas.

PERSONNEL NOTES

Ms. Carmelita Fisher joined the Subdivision from the Department of National Defense as secretary, in place of Mrs. Cecilia Middleton who resigned to bring up her young family. Ms. Florence Spencer, who had been acting in the position, left for Program Support Subdivision.

Ms. Jean Dabros joined the Subdivision as a palynology technician. She previously worked with the G.S.C. in Ottawa.

Dr. Bernie Boudreau joined the Subdivision as a visiting fellow. Bernie is a geochemical modeller, and has just completed a Ph.D. at Yale.

Dr. M. Rashid continues to be on leave of absence from the Subdivision for medical reasons.

Dr. Marc Stoffyn has left the Subdivision after completing three years as a contract scientist supported by AECL to carry out analyses of sediment pore water for trace element composition. He will begin a new career as a land speculator and contractor.

In March 1985 the Subdivision had reached a temporary complement of 57 employees.

Attendance at Meetings, Conferences and Courses

C.L. Amos

C^2S^2 Steering Committee Meeting, Ottawa, Ontario, May 3-4, 1984

DCOM Meeting, Vancouver, B.C., May 8-13, 1984.

Presented Chignecto Bay Stratigraphic model to SEPM to Fine Grained Sediment and to present findings of cohesion exp., Calgary, Alberta, June 14-18, 1984.

Presented Fundy Lecture and CESAR Lecture at the University of New Brunswick, Fredericton, New Brunswick, December 5, 1984.

S.M. Blasco

ESRF Contract review, Ice Scour; PERD Contract Reviews, Ice Scour Geology; and Boundary Dispute discussions with CHS/DSS, Victoria, British Columbia June 24-28, 1984.

Coordinate GSC/INA Beaufort Sea field program, Montreal, Quebec, July 6, 1984.

Meeting of the Beaufort Sea Field Program Planning Committee for MV Banksland, Ottawa, Ontario, July 12-13, 1984.

OERD contract reviews, joint field programs with ESSO/Gulf/Dome, future research projects with APOA, Calgary, Alberta, August 14-18, 1984.

OERD contract reviews NORDCO/Memorial sidescan mosaicing technology report Bercha, St. John's, Newfoundland, August 30-September 1, 1984.

Meetings with OERD on multi-year planning and meeting DIAND on Beaufort geology, Ottawa, Ontario, September 5-6, 1984.

ESRF ice scour meeting, deep geology contract, ESSO/Gulf/Dome Permafrost Contract Review/workshop preparation, Calgary, Alberta, September 8-12, 1984.

Arctic Waters Meeting (AWAC), Whitehorse, Yukon, September 23-26, 1984.

OERD status review of offshore geotechnics; ice scour contract review, Shearer; ESRF review with Loken, ice scour contract Geoterrex/ESRF seismicity, Ottawa, Ontario, September 26-28, 1984.

Denver, Colorado, International Permafrost Workshop sponsored by National Academy of Sciences, Denver, Colorado, October 21-24, 1984.

OERD Permafrost Committee Meeting, J.G. Fyles; ESRF project review; OERD contract review - Geoterrex, Ottawa, Ontario, October 30-1, 1984.

EPB Seismicity Workshop; meeting with industry/government on Beaufort seismicity; OERD contract review - Geoterrex/Shearer, Ottawa, Ontario, November 14-16, 1984.

OERD Budget/Planning Review, ESRF ice scour review meeting, Ottawa, Ontario, November 20-21, 1984.

Industry-Government Permafrost/Hydrote Committee Meeting, OERD contract reviews, Calgary, Alberta, November 26-30, 1984. Also travelled to Yellowknife.

Permafrost Research Committee - J.G. Fyles and ESRF/OERD ice scour research review, Ottawa, Ontario, December 18-20, 1984.

OERD review; ice scour contract review, (ESRF/OERD); and Beaufort Sea field programs 1985 (meeting with DIAND), Ottawa, Ontario, January 14-17, 1985.

OERD review with industry, St. John's, Newfoundland, January 28-29, 1985.

1985 Field Program SGSC/Industry discussions; OERD contract reviews - University of Calgary/M.J. O'Connor; and ESRF contract reviews/Ice Scour Workshop presentations, Calgary, Alberta, February 3-9, 1985.

Meetings to complete OTC ice scour paper; complete ESRF Data Base Study; correlation of Beaufort Seismicity with Shelf structure with EPB and discussions with MOT/CNS on shiptime on Beaufort Sea for Science, Victoria, British Columbia, February 17-24, 1985.

OERD contract review - Deep Geology and ESRF contract review - Ice Scour, Ottawa, Ontario, March 14, 1985.

D.E. Buckley

Attend Site Selection Task Group meeting of NEA, Seabed Working Group; to plan cruise to Nares Abyssal Plain based on Dutch information, Amsterdam, Netherlands, September 14-21, 1984.

NSERC site visit to Laval University to review Dr. Peter Campbell and Dr. Andre Tessier, St. Foy, Quebec, February 3-4, 1985.

Attend annual geophysics workshop - EPB Ottawa and present paper on Seabed Disposal of HLRW. Visit EMR office of Environmentqal Affairs and AECB, Ottawa, Ontario, February 12-15, 1985.

R.E. Cranston

Meeting of the coordinating bureau and executive group meeting of the Seabed Working Group, Berlin, June 3-8, 1984.

Site selection meeting of Seabed Working Group to plan activities for French cruise to abyssal plain for log coring and geochemistry, Amsterdam, Netherlands, September 14-21, 1984.

Cruise planning meeting to organize international cruise to both subseabed disposal sites in the North Atlantic in June 1985, Paris, France, January 10-18, 1985.

S. d'Apollonia

Ice Scour Workshop, Calgary, Alberta, February 4-19, 1985.

BRUTIV Users' Meeting, St. Andrew's Biological Station, St. Andrew's, New Brunswick, November 16, 1984.

G. Fader

Attended Hibernia EIS Workshop '85 as GSC representative, St. John's, Newfoundland, January 22-24, 1985.

R.A. Fitzgerald

New Orleans to attend course in chromatography.

D.L. Forbes

Attend Canadian Coastal Conference Planning Meeting with Newfoundland Government liaison & Site Surveys, St. John's, Newfoundland, April 17-19, 1984.

Coordinate Beaufort Sea NOGAP Program with DIAND, Ottawa, Ontario, June 26-27, 1984.

Canadian Coastal Sediment Study field work and ACROSES meetings, Charlottetown, P.E.I., October 2-12, 1984.

NOGAP contract consultation and meeting with DIAND/NAP, Whitehorse, Yukon, and Victoria/Sidney, British Columbia, November 19-24, 1984.

D.H. Frobel

Canadian Coastal Sediment Study Open Workshop - NRC ACROSES, Ottawa, Ontario, May 2-4, 1984.

P. Hill

Review palynology contract, present seminar at Memorial University of Newfoundland, March 6-8, 1985.

H. Josenhans

Present talk at Memorial University, advise graduate student, discuss paper with C. Lynas and plan cruise with V. Barrie, St. John's, Newfoundland, October 30-November 2, 1984.

To discuss joint paper with R. Klassen, Ottawa, Ontario and to present talk at University of Illinois and discuss onshore/offshore correlation with P. Clark, Chicago, Illinois, Illinois, February 4-10, 1985.

C.F.M. Lewis

Attend Glacial Stratigraphy Field trip and Great Lakes Symposium, London, Ontario, May 11-16, 1984.

Attend COGLA, Ottawa presentation - Hibernia Sable Seabed Stability, Ottawa, Ontario, May 17-18, 1984.

Meeting with Mobil, C-Core, NORDCO, St. John's, Newfoundland, June 16-27, 1984.

Attend review meeting at Mobil, St. John's for discussion of Hibernia area research; also review C-CORE's Cormorant cruise plan, St. John's, Newfoundland, September 27-30, 1984.

Attend workshop for associates of C-CORE, Memorial University of Newfoundland, St. John's, Newfoundland, October 23-26, 1984.

Attend ESRF Ice Scour Committee Meeting, Ottawa, Ontario, December 9-12, 1984.

Project progress meeting with C-CORE and geotechnics program review with Mobil, St. John's, Newfoundland, January 27-29, 1985.

Discuss constraints to development with Petro Canada and discuss ice scour research with industry at Gulf Canada, Calgary, Alberta, February 3-11, 1985.

Attend contract review meeting at NORDCO/ Geonautics and attend DIGS field planning meeting at C-CORE, Memorial University of Newfoundland, St. John's, Newfoundland, March 4-8, 1985.

B. MacLean

Confer with Panarctic and Arctic Petro Op Assoc. re NOGAP, Calgary, Alberta, August 7-10, 1984.

Discuss with NORDCO re acoustic drill possible NOGAP application, St. John's, Newfoundland, August 30, 1984.

Meetings and discussions with Polar Shelf and J. Hunter re 1985 Arctic I. Channels field program plans and with D. Hodgson re onshore Quaternary in the region, Ottawa, Ontario, November 28-30, 1984.

R. Miller

Current Activities Forum, to set up and maintain AGC poster session, Ottawa, Ontario, January 21-25, 1985.

K. Moran

Visit NRC re spring field program data & Beaufort Sea OERD PGM; and Seminar talk for Terrain Sciences on slope, Ottawa, Ontario, April 18-20, 1984.

Visit with Fenco on ESRF Iceberg Grounding Contract NORDCO: PILP - final meeting, St. John's, Newfoundland, April 26-28, 1984.

Canadian Standards Association Subcommittee meeting on foundations in the offshore, Toronto, Ontario, June 6, 1984.

Lab travel to MIT to discuss geotechnical research in Alaskan Beaufort Sea and cooperation and

TUFFS University lectures - Geotech Engineering Practice, Boston, Massachusetts, July 10-13, 1984.

CSA/CPA Task Force on Foundations for Offshore Structures, Toronto, Ontario, July 25-27, 1984.

Short technical course on the presssuremeter, core penetrometer and foundation design, Texas, August 13-17, 1984.

Invited to speak on Beaufort Sea seabed stability at workshop on Seismic Hazards to Canadian Offshore Structures, Ottawa, Ontario, November 15-16, 1984.

CSA Task Force on Foundations for Offshore Structures, Inuvik, N.W.T., November 27-29, 1984.

Associate Committee Meeting on Geotechnical Research, sub-committee on Marine Geotechnical ENGR meeting, Ottawa, Ontario, January 27-28, 1985.

Review and finalize geotechnical zonation of Beaufort Sea with M.J. O'Connor and review DINA Spring Drilling Program, Calgary, Alberta, February 4-10, 1985.

P.J. Mudie

Attend CGC Quaternary Geoscience Committee meeting and GSC Committee on Pleistocene Onshore-Offshore Stratigraphy, London, Ontario, May 12-15, 1984.

Attend Sixth International Palynological Conference. Chairperson and presentation of two papers, Calgary, Alberta, August 27-September 2, 1984.

Attend meeting of Quaternary Geoscience Committee of Canadian Geoscience Council, Ottawa, Ontario, November 16, 1984.

D.J.W. Piper

Attend C^2S^2 Steering Committee Meeting, Ottawa, Ontario, May 3-4, 1984.

GAC Council, CJES Editors, CNC-INQUA, CANQUA Meeting; TS-AGC Pleistocence; and COGLA and C^2S^2 Steering Committee Meeting, London, Ontario and Ottawa, Ontario, May 13-17, 1984.

ESRF Committee Meeting, Calgary, Alberta, September 16-19, 1984.

Earth Physics Branch workshop on Paleoseismicity: discussions and present paper, Ottawa, Ontario, November 15-16, 1984.

Present paper at GSC Current Activities and C^2S^2, Ottawa, Ontario, January 24-25, 1984.

C.T. Schafer

Attend meeting of Interdepartmental Task Force on Proxy Climate Data Workshop, Ottawa, Ontario, January 20-23, 1985.

J.P.M. Syvitski

Participate with lecture and to give address on SAFE advances SEPM Fine-grained Sediment Conference, San Jose, California, August 5-14, 1984.

Sit as a panel expert on U.S. ONR proposal for research option on the marine geology/geophysics of shallow marginal seas (polar), Arlington, Virginia, January 31-February 2, 1985.

G. Vilks

Meet with tech staff and Panarctic and APOA to discuss NOGAP field project, Calgary, Alberta, August 7-10, 1984.

Participate with PCSP Annual Field Planning meeting and to meet Terrain Sciences personnel, Ottawa, Ontario, November 28-30, 1984.

G.V. Winters

Present SPM results for 1983 field observations in three Arctic fjords at 2nd Arctic Fjord workshop at BIO, Dartmouth, Nova Scotia, October 3-6, 1984.

Attend 1982-1984 Workshop, Ocean Dumping Research and Development Fund, March 11-12, 1985.

SPECIAL TALKS AND LECTURES

C.L. Amos

Presentation of APICS Distinguished Lecturer in Geology, St. Francis Xavier University, November 14, 1984.

Presentation of APICS Distinguished Lecturer in Geology, Dalhousie University, November 21, 1984.

Presentation of APICS Distinguished Lecturer in Geology, Mount Allison University, November 28, 1984.

S.M. Blasco

"Quaternary Geology and Sedimentary Processes active on the Canadian Beaufort Continental Shelf and their impact on offshore development", N.W.T. Geoscience Forum, Yellowknife, December 4, 1984.

"Application of ROV submersible technology to Arctic geoscience studies", BIO Presentation, December 2, 1984, Halifax.

D. Buckley

"Research on Deep Sea Sediments", Bedford Institute of Oceanography Open House, May 31, June 2, 1984

"Deep Sea Research", Association of Science Teachers of Nova Scotia, Annual Meeting, October 26, 1984.

"HUDSON 84-046: "How we survived the loss of SeaMARC I." Science Hour, Atlantic Geoscience Centre, Bedford Institute of Oceanography, February 1, 1985.

"The seabed disposal option for high level nuclear waste." Environmental Affairs, Department of Energy, Mines and Resources, Ottawa, February 13, 1985.

"The occurrence and significance of compaction faults in deep sea sediments." Annual Geophysics Workshop on Nuclear Fuels Waste Management. Earth Physics Branch, Department of Energy, Mines and Resources, Ottawa, February 15, 1985.

G.B. Fader

"Seismostratigraphic Interpretation of High Resolution Seismic Reflection Profiles" Acoustic Workshop, Calgary, Alberta, April 15-16, 1984.

"Seabed I and Seabed II Projects of the Geological Survey of Canada", Alberta Venture Corp., Edmonton, Alberta, June 1984.

"Quaternary Geology and Engineering on the Scotian Shelf and Grand Banks of Newfoundland", Technical University of Nova Scotia, November, 1984.

"Marine Geology at the Atlantic Geoscience Centre, Geological Survey of Canada", St. Mary's University, Halifax, November 10, 1984.

"Geology of the Scotian Shelf and Grand Banks of Newfoundland", COGLA, Ottawa, December 4, 1984.

"Acoustic Studies in Marine Geology", Defense Research Establishment Atlantic (DREA), Dartmouth, Nova Scotia, January 4, 1985.

"Surficial Geology and Subsurface Quaternary Stratigraphy - Scotian Shelf." Canada Oils and Gas Lands Administration (COGLA) Workshop on Jackup Drilling Rigs in the Canadian Offshore, Chateau Halifax, January 8, 1985.

"Sidescan Sonogram Interpretation", Huntec '70 Limited, Toronto, Ontario, January 1985.

M. Stoffyn

"Geochemistry of pore waters and the research program on sub-seabed disposal of high level nuclear waste.", Department of Oceanography, Dalhousie University, March 11, 1985.

Membership on Committees

S.M. Blasco

Chairman, Joint Industry/Government Beaufort Sea Seabed Synthesis ad hoc Working Group.

Chairman, PERD Offshore Geotechnics Committee.

Member, Joint Industry/Government ad hoc Working Group on Permafrost and Hydrates Research.

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

Member, PERD Marine Engineering Committee.

Member, PERD Permafrost Committee.

Member, DIAND Arctic Waters Advisor Committee (AWAC).

D.E. Buckley

Member, Canadian Ocean Dumping Advisory Committee - Environmental Assessment of Impact of Dredging in Miramichi Estuary.

Member, Nuclear Energy Agency, Seabed Working Group - Site Assessment Task.

Member, National Science and Engineering Research Council, Site Visit Committee, Laval University.

Member, Graduate Research Advisory Committee, Oceanography, Dalhousie University.

Member, Long Range Transport of Air Pollutants, Atlantic Region.

Member, Bedford Institute of Oceanography, Hazardous Chemicals Committee.

R.E. Cranston

Canadian Delegate Seabed Working Group (SWG); NEA/OECD.

Chairperson, Sediment Barrier Task Group, SWG.

Member, Coordinating Bureau, SWG.

Scientific Program Coordinator, ESOPE Expedition (French long coring cruise).

Local Meeting Planner, SWG-10 Annual Meeting.

Regional Editor, Water Pollution Control Journal of Canada.

Member, BIO Mini-Lecture Series for Open House.

Judge, Canada Wide Science Fair.

G. Fader

Scientific Advisor, Seabed II, Huntec '70 Limited, Technical Management Committee.

Atlantic Geoscience Centre Representative, Departmental Committee On Ocean Mining.

Member, Underwater Mining Institute Symposium 1985, local organizing committee.

Member, Steering Committee of Study of Residual Toxicity and Debris from Offshore Well Sites.

Scientific Advisor, Marine Data Processor Project of Eastland Ocean Research.

Co-Chairman, Mobil Oil, Hibernia Environmental Impact Statement Assessment Committee.

Secretary, Nova Scotia Quaternary Associates, "NSQUA".

D.L. Forbes

Member, Canadian Coastal Conference Organizing Committee.

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

Editor, ACROSES Bulletin.

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.

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.

Member, Canadian Standard Association Sub-committee on offshore Foundations.

P.J. Mudie

Member, Canadian Geoscience Council Committee on Quaternary Research.

Member, ad hoc Committee for Canadian Participation in the Ocean Drilling Program.

Member, ad hoc Ice Island Sampling Committee.

D.J.W. Piper

Member, Canadian Coastal Sediment Study Steering Committee.

Member, ESRF Bottom Sediment Transport Committee.

Chairman, Membership Committee Geological Association of Canada Council.

Member, Organizing Committee INQUA 87.

Editorial 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 on the Canadian Committee on Climate Fluctuations and Man.

AGC/BIO representative Canadian Task Force on Proxy Climate Data.

Member, Working Group for Point Lepreau Environmental Monitoring.

AGC representative, Nova Scotia Climate Advisory Committe (AES).

J.P.M. Syvitski

Member, BIO Fish Lab Committee.

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

Chairman, IUGS Committee on Grain Size Analysis of Sediments.

R.B. Taylor

Chairman, Terrain Sub-Committee of the Sable Island Environmental Advisory Committee (an interdepartmental, Federal and Provincial Agency).

Member, Steering Committee of the 14th Arctic Workshop of ALSI (Arctic Land-Sea Interaction), November 1985.

G. Vilks

Chairman, 14th Arctic Workshop Steering Committee.

LABORATORY STATISTICS

SEDIMENTOLOGY LABORATORY	1983-84	1984-85
Manual Sieve Analysis	76	26
Sieve and Pipette Analysis	101	0
Settling Tube Analysis	859	894
Sedigraphy Analysis	489	633
Coulter Counter Analyses	104	1652
Organic Carbon Analysis	2200	980
GEOCHEMISTRY LABORATORY		
Elemental Analysis, Organic	400	55
Elemental Analysis, Inorganic	29000	15700
RADIOGRAPHIC LABORATORY		
X-Radiographs of Sedimentary Core	1998	1180
X-Ray Diffraction Analyses	950	825
OCEAN DUMPING PERMIT EVALUATIONS	82	158

EASTERN PETROLEUM GEOLOGY SUBDIVISION

J.S. Bell

Introduction

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, to interpret the hydrocarbon potential of these basins, and to undertake periodic appraisals of such resources. These studies provide the basic information required for numerically modelling continental margin evolution. Studies of the Upper Paleozoic basins of the Atlantic provinces and their coal and hydrocarbon resources are also undertaken.

The Subdivision's studies of the Atlantic continental margin are based primarily on industry generated, multichannel seismic and the approximately 260 wells drilled to date. About 700,000km of multichannel seismic are now available for examination. Well data studied include logs and samples. Hydrocarbon exploration has been active in the last year on the Grand Banks and the Scotian Shelf. The data base for the information for the Upper Paleozoic investigations includes surface sections, coal, salt and potash mines, and some core holes, as well as a limited number of offshore wells.

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-three 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 involves 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 LITHFILE. 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.

The oil industry's exploratory activity offshore influences the Subdivision's workload. The Venture and Hibernia discoveries have focussed attention on the Scotian Shelf and East Newfoundland Shelf. As a result there has been a marked increase in the number of wells drilled and seismic surveys conducted in these areas 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 inter-

departmental assessment. It 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. All the well samples are presently stored at Bedford Institute, where they are available for study to any interested party after lapsing of the confidential period. The recently signed Atlantic Accord will lead to transferring the offshore Newfoundland and Labrador well samples from Bedford Institute to the COGLA office in St. John's.

Highlights

BASIN ANALYSIS AND PETROLEUM GEOLOGY

Scotian Shelf

A major thrust is now underway to delineate in detail the structure of the Scotian Shelf and to define the form and extent of the major paleotectonic features of this classic passive margin province. Some 108 wells have now been drilled on the Scotian Shelf. Eight mid-shelf holes penetrate Paleozoic basement and all of them document facies variations within the Mesozoic and Cenozoic prograding wedges which have built up the continental margin. In this fiscal year, we acquired around 70,000km of high quality recent oil industry multichannel reflection seismic lines. Much of this data is still confidential and interpretations based on it cannot be published before 1988-89. It promises to yield a detailed understanding of such features as the Abenaki carbonate bank and the down-to-basin growth fault configuration. Simplified structure and isopach maps supported by released seismic profiles are being prepared for the Decade of North American Geology/Geology of Canada volume, "The Continental Margin: Eastern Canada".

The recently shot seismic data provide a "deeper look" than has been available previously, and it now appears that the depth to basement in the Scotian Basin may have to be revised downwards. It is planned to integrate the seismic sequence mapping with lithologic and paleofacies data derived from sample examination, Lithfile and biostratigraphic studies. Lithfile has already generated lithofacies maps of the Logan Canyon Formation which hint at three or more source areas for the sands.

Following completion of a theoretical hydrocarbon generation model for the Scotian Shelf built around burial histories and present day thermal gradient information from drilled wells, more vitrinite reflectance measurements have been made on kerogen residues from ditch cutting samples collected from wells in the Venture area. Several wells studied recently exhibit a regular log normal increase in vitrinite reflectance to depths of approximately 4500m. Below this, reflectance increases more rapidly with depth, approximately paralleling an apparent increase in thermal gradient, which may be related to the onset of geopressures. Information from other maturation indicators is being obtained. If real, this change in maturation gradient may be documenting recent (and, possibly, current) temperature increases in the deeper parts of the Sable Basin which could be related to gas generation. Reflectance levels of 1.0 Ro to 1.2 Ro, which are assured to represent peak gas generation, occur around 5000m in the gas-prone Verrill Canyon Formation source rock.

Initial studies of geopressures and in-situ rock stresses on the Scotian Shelf give the following picture. Formation fluid pressures greater than hydrostatic pressures are encountered in wells in the Sable subbasin, at depths below approximately 3750m and 4750m in normally compacted sediments. Overpressures build up rapidly and at 5500m in the Venture B-43 well, for example, the formation fluid pressure amounts to 84% of the calculated pressure exerted by the overburden. If geopressures continue to increase with depth below the base of the drilled section in this manner, formation pressures would completely support the overlying rocks at depths of 6-7000m, implying that active listric normal faults might sole out at these depths.

Over depths of 500m to 5500m in the Venture area, pressures recorded while drilling suggest that the largest and smallest principal stresses are horizontal, with the intermediate principal stress being vertical. Breakout orientations show that the greater horizontal stress is oriented NNE-SSW. This stress regime is thought to reflect mantle tractions on the base of the North American lithosphere.

Study of the Montagnais I-94 well has shown that the stratigraphic succession is more complex than previously believed. It now appears probable that the so-called "igneous" rocks in the Early Tertiary section may have originated through meteoritic impact. If this interpretation is supported by upcoming geochemical and petrographic studies, this will document an offshore meteoritic impact onto marine sediments and provide a significant opportunity, using data from nearby wells, to investigate how such an impact affected contemporaneous marine biotic communities.

Grand Banks

During the past year the East Newfoundland Shelf area was studied intensively in response to the active and successful hydrocarbon exploration program currently underway in the Jeanne d'Arc Basin. The aggressive exploration programs of several operating companies have provided a detailed suite of logs and well samples for investigating basin evolution. During the fiscal year, work continued on defining the stratigraphic framework of the East Newfoundland Shelf area. Log data, seismic profiles and biostratigraphy have provided the background for revised correlations within the Jeanne d'Arc Basin and a much more complex configuration of unconformities than was previously recognised. In particular, a Late Jurassic unconformity has been documented which exhibits a dissected and deeply channelled surface. Overlying conglomerates and neritic channel sands imply that this surface formed through processes involving subaerial erosion. These stratigraphic and biostratigraphic studies have provided a correlation framework adequate for formalising the stratigraphic nomenclature of the area. This will be done once detailed petrographic, sedimentological and diagenetic information from available cores cut in Jurassic and Cretaceous sequences has been gathered and synthesised in an ongoing contractual study.

Regional seismic interpretation is ongoing on the Grand Banks and the 'Base Event' (partially equivalent to the Avalon Unconformity) has been widely mapped at a scale of 1:250,000. Maps of deeper horizons are in progress, as well as an updated regional Basement/Tectonic map. A major feature of this map is the great thickness of sediments along the axis of the Jeanne d'Arc Basin; the top of Basement is at a depth of 15km or deeper.

Over the past year, vitrinite reflectance values were measured on samples from 12 wells on the East Newfoundland Shelf. These organic maturation profiles augmented our data to the level where regional variation could be mapped, and it became clear that maturation/depth relationships varied significantly over the Jeanne d'Arc Basin. For example, along the axis, sediments become marginally mature for oil generation at depths of approximately 2000m, whereas around the margins this level of maturation is only reached at depths of 3000m or greater. This configuration may be due to the relatively greater thermal conductivity of Jurassic salt which is concentrated in the centre of the basin and/or greater heat flow due to a thinner continental crust beneath the basin axis.

Time Temperature Index (TTI) modelling suggests that peak oil generation from the recognised Jurassic oil source rocks occurred in the Eocene time. Maturation profiles were also determined for 2 wells in the South Whale Basin and indicate that peak gas generation would occur at approximately 5000m burial depth, similar to the Scotian Shelf.

A preliminary review of geopressures has been made. Unlike the Scotian Shelf, geopressures in the Jeanne d'Arc Basin appear to be more stratigraphically controlled and the rocks involved are undercompacted.

Labrador Shelf

Because of the cessation of industry exploration activity and, also due to lack of staff, little work has been done on material from the Labrador Shelf during the past fiscal year.

Vitrinite reflectance measurements were made on coals and dispersed organics from the Hare Bay E-21 well. An anomalously steep profile was obtained with an offset apparent around the Cretaceous-Carboniferous contact at 3401m. Pre-Cretaceous erosion of several thousand metres of section is indicated. Maturation levels suggested that oil is unlikely to have been preserved below the sub-Cretaceous unconformity.

Available maturation data on the Labrador Shelf has been compiled and a hydrocarbon generation model developed by means of Time Temperature Index analysis.

Gulf of St. Lawrence and surrounding areas

Studies continued on the hydrocarbon inventory of the Upper Paleozoic rocks in the Atlantic Provinces and the Gulf of St. Lawrence. As part of this effort a major compilation of data bearing on all Upper Paleozoic evaporites in southeastern Canada is in progress and nearing completion. Two reports were completed on the Windsor Salt in the Minas and Cumberland subbasins. During the fiscal year, surface sections of the Horton, Windsor, Canso-Riversdale and Cumberland-Pictou groups were examined in the field in northern Nova Scotia. Field examination concentrated on logging reservoir properties and potential seal units and collecting coal and organic-rich shale samples for organic maturation measurements. Paleocurrent data was also recorded to aid paleogeographic reconstructions.

Ash and sulphur determinations were made from samples from the Seven Foot seam in the Mabou-Inverness area. When combined with vitrinite reflectance measurements and maceral data, these showed that the coal is not suitable for metallurgical purposes. Work on the Phalen Seam in the Lingan reserve area of the Sydney coalfield showed that it contains acceptable metallurgical coal. Coal rank measurements were made on two onshore wells drilled in the Sydney coalfield. In neither well (depths 890m and 340m) was there any appreciable increase in rank with depth. This unexpected finding may be related to the abundance of sandstone in the sequence, which could have conducted similar quantities of heat to all the coals in the section.

Studies of igneous rocks in the Northumberland Strait F-25 well were finalised and a manuscript prepared for publication. The upper dolerite unit of Triassic age in this well has crystallised from undepleted tholeiitic magma, and it represents the earliest known example of rift-related volcanism on the eastern Canadian continental margin.

Resource Appraisal

The report "Petroleum Resources of the Scotian Shelf" by J.A. Wade, G.A. Campbell, R.M. Procter and G.C. Taylor has been completed, reviewed and approved for publication as a GSC Paper. The study was a cooperative enterprise involving staff from Eastern Petroleum Geology, COGLA, and the Institute of Sedimentary and Petroleum Geology. Seven plays were identified, six of which were previously recognised. The new play involves the multiply-faulted, geopressured gas-bearing sandstone reservoirs of the Missisauga and MicMac formations in the Sable subbasin. At the present time, this play contains the bulk of proven and anticipated probable gas reserves on the Scotian Shelf.

A major overview of offshore Eastern Canada's hydrocarbon discoveries and resource potential was presented as an invited paper at the American Association of Petroleum Geologists' Wallace Pratt Memorial Conference in Phoenix, Arizona. This paper entitled: "The continental margin of eastern Canada - geological framework and petroleum potential" by A.C. Grant, K.D. McAlpine and J.A. Wade has also been presented locally at several forums and a manuscript has been submitted for publication in the Pratt Conference Proceedings. The study presents a regional tectonic overview of all the offshore basins, outlines the trapping regimes of all the significant hydrocarbon accumulations, discusses the types and origins of the trapped hydrocarbons and their local setting, and includes estimates of future potential.

The subdivision has also undertaken studies in the Jeanne d'Arc Basin during this fiscal year, which will be utilised and built upon for a resource evaluation exercise planned for 1985-86. Much of this work has been referred to in the preceeding section on Basin Analysis and Petroleum Geology, but it also includes obtaining geochemical analyses for oil typing and source rock evaluation in the Jeanne d'Arc Basin, and TTI modelling to assess when hydrocarbons may have been generated at various well sites. Seismic interpretation is ongoing and is proving to be an essential component of resource evaluation, since it provides the regional structural configuration to counterbalance the information from wells, which are usually drilled on "anomalous" structural prospects.

Multichannel reflection seismic data (289km) has been acquired on St. Pierre Bank. This data has been interpreted, mapped and tied into the regional basin framework and tied to reinterpreted seismic lines which cross the Hermine E-94 and Emerillon C-56 well sites.

Because of contractual difficulties, detailed studies aimed at documenting the nature and origin of geopressures on the Scotian Shelf and Grand Banks were not initiated during the fiscal year. However, useful information has been gathered from Mobil Oil and a literature review has been completed. Studies of the stratigraphy and sedimentology of geopressured reservoir sands in the Venture and Hibernia areas were commenced.

A report has been compiled on the regional hydrocarbon potential of the Labrador Shelf. Conclusions are partly based on data from confidential wells and the report will be open-filed once this information is released.

Vitrinite reflectance measurements have provided information on organic maturation in 18 wells and 2 coal mining areas. During the year significant software improvements have been made to the Zonax microcomputer-photometric microscope system with a resultant improvement in report format. Open File reports now contain information on all the reflectance measurements made as well as the interpreted sample means and maturation profiles. These changes allow users to make their own interpretations of thermal maturation levels and assess the versions offered. One fall-out of this expanded documentation has been the recognition, in several wells, of significant populations of reworked vitrinite. In the southern Grand Banks, the maturation levels of reworked vitrinite in the Tern A-68 and Puffin B-90 wells, together with their structural setting, suggested that eroded Carboniferous coals were the source. This led to the recognition that a synclinorium filled with coal-bearing Upper Carboniferous rocks might subcrop beneath Mesozoic strata east of the Hermine E-94 well on the southern Grand Banks. Such a sequence could be a source for gas trapped in overlying reservoirs.

In addition to these ongoing studies, the subdivision has been represented at meetings of the Petroleum Resources Appraisal Secretariat and staff have been involved in working meetings with Secretariat and COGLA colleagues.

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 our longterm objective 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 palynology and micropaleontology.

During the report year, emphasis has been placed on developing and refining biozonations of Jurassic and Cretaceous sequences on the Scotian Shelf and Grand Banks. The many recently drilled wells clustered within and around the Venture and Hibernia fields have provided both the need and the opportunity to undertake refined biostratigraphic studies. As has been true in the past, most of the material studied has been derived from ditch cuttings, which inevitably contain caved material. Extensive core material is sometimes available, especially over intervals containing reservoir sands (for example, 638.2m of continuous core from Hibernia I-46) and this provides uncontaminated in-situ samples. However, Eastern Petroleum Geology biostratigraphers frequently cannot examine material from sidewall cores, which is routinely available to their oil industry counterparts and often to consultants. It is hoped to alleviate this situation in the coming year.

Palynology

A palynological zonation has been erected for the hiatus-ridden Kimmeridgian to Turonian interval in the Hibernia field. It is based on a study of samples from the Hibernia J-34, I-46, P-15 and K-18 wells and consists of 14 zones and 35 subzones. At a subzone level, this gives a resolution of approximately two million years. With improved processing techniques for the fine fraction slides, the Aptian-Turonian zonation was refined and can now be used to give highly focussed age control above and below the Avalon and assocated mid-Cretaceous unconformities on the Grand Banks. Palynological analysis of the interval around the Avalon Unconformity at the Rankin M-36 well has been completed as part of a basinwide study of the mid-Cretaceous units in the Jeanne d'Arc Basin. The palynostratigraphy of the Late Jurassic section in Flying Foam I-13 has also been revised.

A detailed palynological analysis has been made of the Jurassic sections of the Acadia K-62, Mohican I-100, Moheida P-15 and Glooscap C-63 wells on the Scotian Shelf and an informal zonation has been constructed. This work will be incorporated into an ongoing comprehensive study aimed at refining the palynomorph zonation of Jurassic to Lower Cretaceous strata on the Scotian Shelf, with emphasis on the Sable Island/Venture area. Relevant sections of the following wells have been analysed: Cree E-35, Demascota G-32, Cohasset D-42, Olympia A-12 and Venture B-43. Diverse assemblages of heretofore

unpublished taxa are present, which have good potential as biostratigraphic markers. Some sections from gas-prone levels in the wells, however, have yielded specimens which are too "cooked" to be of use for detailed biozonation.

Portions of the Montagnais I-94 (Scotian Shelf) and the Brant P-87 (Grand Banks) have been analysed to provide age control for volcanic rocks encountered in the wells.

Samples from a pilot study on five surface sections in the Subbetic region of Spain, which straddled the Jurassic-Cretaceous boundary, were examined during the year. It was hoped that the sections would yield palynomorphs and allow calibration between dinoflagellate assemblages comparable to those from offshore Eastern Canada and European ammonite zones. Unfortunately, no palynomorphs were found.

One of the major achievements of the largely U.S.-funded Deep Sea Drilling Project has been the refined biostratigraphic zonations tied to the absolute time scale which have emerged from studying large amounts of cored material recovered from the World's ocean basins. At present, work is underway to develop a Late Cretaceous-Tertiary dinoflagellate zonation for the Atlantic Ocean and to compare this to the existing zonation for Eastern Canada and thereby achieve more precise dating. Analyses of Paleogene samples are underway.

Although taxonomy is the basis for all paleontological studies, its documentation is very time consuming and operational constraints have limited the involvement of E.P.G. biostratigraphers in earlier years. G.S.C. palynologists have a unique opportunity to publish on the taxonomy of palynomorphs from offshore and onshore sections because of their accumulated knowledge, experience, and access to the BIOSTRAT data base. Cataloguing and description are now underway aided by two video systems linked to microscopes. An index of fossil and extant schizaealean species has been prepared for publication and an update of the dinoflagellate index is almost completed.

Because of the resignation of Dr. Davies, no further work has been undertaken on attempting to identify pockets of non-marine Cretaceous sediments in mainland Nova Scotia and Cape Breton. It is hoped that this investigation can be reactivated, since information on Cretaceous deposits will be valuable for paleogeographical reconstructions and shelf subsidence modelling.

Micropaleontology

In the Grand Banks area, ostracod zonations have been established in the Hibernia M-36, Hibernia I-46 and Rankin M-36 wells, and an ostracod/foraminiferal zonation has been set up for Gabriel C-60. Information from these wells has been incorporated into a Mesozoic biozonation for the East Newfoundland Basin which consists of 9 assemblage zones that are recognised for the Kimmeridgian to Early Cenomanian interval. This zonation has been established on the basis of ostracod range data from 10 wells. A high resolution quantitative foraminiferal biozonation of Jurassoc and Lower Cretaceous strata has been established in the East Newfoundland Basin, using CASC programming to provide an optimum sort of the vertical range data.

For the Scotian Shelf, foraminiferal/ostracod zonations have been established for the South Venture O-59 well and revisions made to the lower part of the Cree E-35 well, which is now recognised to include Berriasian-Valanginian strata.

A report on the Berriasian and Valanginian foraminiferal/ostracod biozonation of the Atlantic Margin of North America has been completed. It contains an updated and improved zonation which allow separation of the Berriasian and Valanginian stage. It has been calibrated with the calpionellid biozonation both in the Georges Bank and in the East Newfoundland Basin, and is fully applicable from the Baltimore Canyon Trough to the Flemish Pass, allowing dating and correlation of Berriasian-Valanginian sediments in 32 wells. After the completion of this report, the interval previously comprehensively dated Berriasian-Valanginian in the Oneida O-25 and Onondaga E-84 wells (Scotian Shelf) has been re-examined. The finding of some newly established foraminiferal Berriasian indicators has allowed the separation of the Berriasian from the Valanginian in both wells.

During the year, steady progress was made in entering micropaleontological data into digitised data bases to facilitate range chart production and establish optimum zonal sequences. In addition, a deep water foraminiferal zonation for the North Sea has been developed, which will be of assistance in zoning Eastern Canadian wells which penetrate outer shelf and bathyal facies.

Attempts are being made to correlate the Eastern Canadian foraminiferal/ostracod zones to European ammonite zones. A pilot study on outcropping Spanish ammonite-bearing sections which straddle the Jurassic-Cretaceous boundary is in progress. Initial results suggest that only parts of some of the sampled sections (those of Middle Berriasian to Valanginian age) contain foraminiferal assemblages sufficiently similar to those of the Canadian Atlantic shelf to allow a meaningful comparison. It appears that the Spanish sequences are generally much deeper water deposits than the Canadian equivalents.

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, LEXFILE, and LITHFILE. Together these data bases constitute OCTOPUS, the data management programme of the Subdivision.

WELLSYS, the well data base, contains geographic, geologic, and engineering data on all offshore, east coast wells. It now lists geographic and engineering data on 237 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.

During the fiscal year, basic geographic and engineering data on all offshore East Coast wells were incorporated into WELLSYS. This data base was also updated so that all Eastern Petroleum Geology's internal reports on statigraphy, lithology and organic maturation are now included in the file. Entry of the subdivision's paleontological reports is underway. A simplified output format for quick concise summaries of subsurface test results has been developed and data from all the Hibernia and Venture wells entered to meet immediate operational needs. During the year, WELLSYS provided information to A.G.C. subdivisions, federal and provincial agencies and oil companies.

BIOSTRAT contains detailed palynological analyses of more than 100 wells, plus formation picks, ages, visual kerogen, and vitrinite reflectance data. Foraminiferal data are now being loaded. BIOSTRAT will produce sophisticated range plots using a relative time scale. Using this capability, it has been possible to produce range charts of more than 400 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, with author and date of publication.

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.

KREMPFILE is a palynological data base which includes only published information. It is a jointly funded endeavour supported by an industrial consortium with operations supervised within the Eastern Petroleum Geology Subdivision. Using contractual assistance supplied by the consortium, 10,800 documents in the data base were updated this year. 9000 of these have been passed through check programs and are ready for reloading. Palynodata Inc. has been set up as a non-profit organisation to carry on the project and provide public access to the data.

LEXFILE contains information on formal, informal, and abandoned, lithostratigraphic 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.

LITHFILE contains lithological data on all released offshore Eastern Canadian wells. Sample descriptions are purchased from Canadian Stratigraphic Services and reformatted for A.G.C.'s System 2000 data base. Outputs include lithofacies information for selected intervals for incorporation into maps and sections and vertical histograms of specified lithologic data for chosen wells. Software development is underway for generating vertical profiles and posting maps. LITHFILE maps will be generated for contributions to the D.N.A.G. volume "The Continental Margin: eastern Canada".

Personnel Notes

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

Sebastian Bell assumed the position of Subdivision Head on April 15th, 1985. He replaced the former Head, Graham Williams, who is undertaking a special assignment in palynology.

Rob Fensome (palynologist) joined the Subdivision in September 1984.

Ed Davies (palynologist) resigned during the year and Carol Mitchell (secretary) retired. Nelly Koziel has been Acting Secretary for the Subdivision.

Paul Davidson (technician) resigned during the fiscal year.

Carol Mitchell's enormous contribution over the years was recognised by her receiving a Public Service Merit Award.

Mark Williamson (Visiting Fellow) continued working on secondment to the Subdivision. He is studying Late Jurassic-Early Cretaceous foraminifera of the East Newfoundland Basin.

Gilles Dromart from the University of Lyon, France, spent five months with the Subdivision studying DSDP Late Jurassic-Early Cretaceous carbonates with Dr. L.F. Jansa.

Attendance at Meetings, Conferences and Courses

P. Ascoli

I.U.G.S. Jurassic-Cretaceous Boundary Working Group, Sümeg, Hungary, September 17-22, 1984.

M.P. Avery

Atlantic Geoscience Society Symposium, Wolfville, January 18-19, 1985.

M.S. Barss

International Palynology Commission Conference, Calgary, August 25-30, 1984.

Annual Meeting, American Association of Stratigraphic Palynologists, Arlington, Virginia, October 17-20, 1984.

Annual Meeting of the Geological Survey of Canada's Palynologists, Ottawa, October, 1984.

J.S. Bell

Canadian Geophysical Union Annual Meeting, Halifax, May 29-June 2, 1984.

Advanced Ocean Drilling Program, Downhole Measurements Panel Meeting, Lamont-Doherty Geological Observatory, New York, September 19-21, 1984.

National Conference on Earth Science - Geopressure and Hydrocarbon Occurrences, Banff, November 5-9, 1984.

Atlantic Geoscience Society Symposium, Wolfville, January 18-19, 1985.

E.H. Davies

International Palynological Commission Conference, Calgary, August 25-30, 1984.

R.A. Fensome

Annual Meeting of the Geological Survey of Canada's palynologists, Ottawa, October 1984.

Meetings of Dinoflagellate research workers, Toronto, November 1984; Ottawa, March 1985.

F.M. Gradstein

27th International Geological Conference, Moscow, August 1984.

Paleoceanography Conference, Geological Society of London, U.K., 1984.

Ocean Drilling Program Workshop, Halifax, 1985.

A.C. Grant

American Geophysical Union Spring Meeting, Cincinnati, May 1984.

A.A.P.G. Pratt Memorial Conference, Phoenix, Arizona, December 1984.

Atlantic Geoscience Society Symposium, Wolfville, January 18-19, 1985.

P.A. Hacquebard

Mineralogical Society of Nova Scotia, Ingonish, June 28-30, 1984.

International Commission on Coal Petrology, Calgary, August 19-23, 1984.

Society of Organic Petrologists Annual Meeting, Washington, October 16-17, 1984.

Atlantic Geoscience Society Symposium, Wolfville, January 18-19, 1985.

R.D. Howie

Atlantic Geoscience Society Symposium, Wolfville, January 18-19, 1985.

L.F. Jansa

Various Ocean Drilling Program planning meetings, 1984.

Atlantic Geoscience Society Symposium, Wolfville, January 18-19, 1985

Invited lecture, McMaster University, Hamilton, March 9, 1985.

P.B. Lake

Intel Technical Fundamentals course, Dartmouth, July 30-August 3, 1984.

Atlantic Geoscience Society Symposium, Wolfville, January 18-19, 1985.

G.C. Milligan Symposium, Halifax, March 23, 1985.

W.C. MacMillan

Atlantic Geoscience Society Symposium, Wolfville, January 18-19, 1985.

K.D. McAlpine

Working meetings on Hydrocarbon Assessment for the Geogological Survey of Canada, Halifax and Ottawa, April-November, 1984.

Petroleum Resources Appraisal Panel Meeting "World Oil Reserves", Ottawa, June 7, 1984.

J.A. Wade

National Conference on Earth Science - Geopressures and hydrocarbon occurrences, Banff, November 5-9, 1984.

G.L. Williams

International Palynology Commission Conference, Calgary, August 25-30, 1984.

Biostratigraphy of Dinoflagellates, Louisiana State University, Baton Rouge, Louisiana, September 13-17, 1984.

Membership on Committees

P. Ascoli

Member, I.U.G.S. Jurassic-Cretaceous Boundary Working Group.

Member, Organising Committee of "Benthos '86".

M.S. Barss

President, Canadian Association of Palynologists.

Member, A.G.C. Data Management Advisory Committee.

G.S.C. Representative on Palynodata Steering Committee.

J.S. Bell

Member, Canadian National Committee on the Lithosphere.

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

Member, Geological Association of Canada Past Presidents Medal Committee.

G.S.C. Representative, Canadian Committee of World Petroleum Congress.

Vice Chairman, Organising Committee A.G.S.-C.S.P.G.-I.U.L. Basins of Eastern Canada Symposium.

E.H. Davies

Member, I.U.G.S. Jurassic-Cretaceous Boundary Working Group.

R.A. Fensome

Secretary-Treasurer, Canadian Association of Palynologists.

Assistant Secretary, International Federation of Palynological Societies.

F.M. Gradstein

Chairman, Presidential Nominating Committee, Micropaleontological Society.

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

Associate Editor, Micropaleontology.

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

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

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

A.C. Grant

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

P.A. Hacquebard

Member, Council of Mining Society of Nova Scotia.

R.D. Howie

Member, Federal-Provincial workshop on oil shale.

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, I.G.C.P. Committee 171 (Circum - Pacific Jurassic).

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

W.C. MacMillan

Secretary, Atlantic Geoscience Society.

Member, Organising Committee, A.G.S.-C.S.P.G.-I.U.L. Basins of Eastern Canada Symposium.

G.L. Williams

Chairman, National Liaison Committee, Canadian Society of Petroleum Geologists.

Chairman, Special Projects Committee, Geological Association of Canada.

Chairman, Awards Committee, American Association of Stratigraphic Palynologists.

Chairman, Geology Committee, Atlantic Provinces Council on the Sciences.

Chairman, Social Programme and Transportation, A.G.S.-C.S.P.G. IUL Symposium, Basins of Eastern Canada and Worldwide Analogues.

Special Talks, Lectures and Poster Sessions

P. Ascoli

"Foraminiferal, ostracod and calpionellid biozonation across the Jurassic-Cretaceous Boundary on the Atlantic Margin of North America." I.U.G.S. Jurassic-Cretaceous Boundary Working Group Committee Meeting, Hungary, September 1984.

M.P. Avery

Poster Session: "Organic maturation on the Grand Banks". A.G.S. Symposium, Wolfville, January 1985.

M.S. Barss

"Paleontological Data Management at the Atlantic Geoscience Centre". International Palynology Commission Conference, Calgary, August 1984; Annual Meeting, American Association of Stratigraphic Palynologists, Arlington, Virginia, October 1984.

J.S. Bell

"Stress orientations in the North American Plate". Canadian Geophysical Union Annual Meeting, Halifax, June 1984.

"Stress relief bed-slip in the Canadian Rocky Mountains". Canadian Geophysical Union Annual Meeting, Halifax, June 1984.

"Stress orientations from breakouts and their application in the Western Canadian Basin and Rocky Mountain Foothills". Canadian Geophysical Union Annual Meeting, Halifax, June 1984.

"Computer-generated lithofacies maps of the Logan Canyon Formation, Scotian Shelf". McConnell Club, I.S.P.G., Calgary, November 1984.

Poster Session: "Logan Canyon Formation Lithofacies, Scotian Shelf". Atlantic Geoscience Society Symposium, Wolfville, January 1985.

"Scotian Shelf in-situ stress regime interpreted from oil well data". Atlantic Geoscience Society Symposium, Wolfville, January 1985.

"The Scotian Shelf Stress Regime and its implications for hydrocarbon production and plate tectonics". Atlantic Geoscience Society Invited Lecture, Halifax, February 1985.

E.H. Davies

Seminars on Palynostratigraphy of Hibernia area given to Petro-Canada (Calgary) and Mobil (Toronto).

"Anemiacean, Schizaeanean and related spores". International Palynological Commission Conference, Calgary, August 1984.

"Provincialism in Cretaceous Dinoflagellates - fact or fiction?". International Palynological Commission Conference, Calgary, August 1984.

F.M. Gradstein

Talk at 27th International Geological Congress, Moscow.

Talk at Paleoceanography Conference, Geological Society of London, London U.K.

Various lectures at North American and European Universities, Surveys and oil company laboratories.

A.C. Grant

"Everted structures in the Solander Basin, New Zealand". American Geophysical Union Spring Meeting, Cincinnati, May 1984.

"A seismic base-event map for the continental margin around Newfoundland". Canadian Geophysical Union Annual Meeting, Halifax, June 1984.

"Petroleum Geophysics", 3 lectures and discussion workshop. St. Mary's University, Halifax, November 1984.

"The continental margin of eastern Canada - geological framework and petroleum potential". A.A.P.G. Pratt Memorial Conference, Phoenix, Arizona, December 1984; Atlantic Geoscience Society Symposium, Wolfville, January 1985.

"Hydrocarbon potential of the frontier margins of Canada". A.G.C. Science Hour, January 1985; St. Mary's University, Halifax, March 1985.

"Petroleum Geophysics". Department of Geology, Dalhousie University, Halifax, January 1985.

P.A. Hacquebard

Course of 12 lectures on Coal Petrology and Coal Geology. Dalhousie University, Halifax, January-April 1985.

"The Coal fields of Eastern Canada". International Commission for Coal Petrology, Calgary, August 1984.

"Paleoenvironmental and tectonic control on coal deposition in Eastern Canada". Atlantic Geoscience Society Symposium, Wolfville, January 1985.

G.L. Williams

"Provincialism in Cretaceous dinoflagellates - fact or fiction?" International Palynological Commission Conference, Calgary, August 1984.

Series of lectures, Biostratigraphy of Dinoflagellates, Louisiana State University, Baton Rouge, Louisiana, September 1984.

The Subdivision staff produced 3 G.S.C. papers, 3 Contributions to G.S.C. Current Research, 14 outside papers, 17 published abstracts and 1 G.S.C. Open File Report during 1983-1984. In Addition, 26 biostratigraphic reports on wells, 23 organic geochemistry reports on vitrinited reflectance and 6 stratigraphic reports were completed as internal reports during this period.

Laboratory Statistics

Drafting

Original figures	541
Revisions in person hours	434
Exhibition displays in person hours	50

Micropaleontology

Samples picked	2441
Slides prepared	2462
S.E.M. photographs	525
Microscope photographs	315

Coal Petrology

Reflectance analyses	168
Maceral analyses	28

Palynology

Palynology samples processed	1547
Palynology slides	5244
Kerogen samples processed	765
Kerogen slides	700

Sedimentary Petrology

Thin sections	272
Cuttings sampled	485
Compilations (figures)	3

PROGRAM SUPPORT SUBDIVISION

K.S. Manchester

The mandate of the Program Support Subdivision is to provide effective central support in electronic and mechanical engineering, data management, information system planning, coordination, development and maintenance, field logistics and field equipment maintenance.

To meet this mandate the Subdivision is divided into three sections:

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

In recent years staff in this section have taken on responsibility for the management of significant contracts for maintenance and enhancement of systems, have cooperated with engineers and scientific staff in the improvement of systems and equipment and have adjusted to the increasing use of computers as integral components in many systems.

The Instrument Development Section designs, develops and tests electronic and mechanical equipment to enhance existing systems or to meet the requirements for new instrumentation made necessary by new scientific objectives of the Division.

This group works in close cooperation with scientific investigators during planning, design, development and implementation of new systems.

The Data Management Section is responsible for the safe archiving and cataloging of data and samples and provision of reasonable accessibility; the administration of data release and provision of better methods of data release; the development and maintenance of AGC institutional software and provision of assistance in software development; the management of institutional information systems and advising and implementing policy on AGC computer usage.

HIGHLIGHTS

AGC managed the acquisition of a new Hepburn Limited deep tow winch similar to the previously acquired AGC winch and the installation of it on the CFAV Endeavour for PGC to enable PGC to carry out deep tow surveys using SeaMARC I off the Juan de Fuca Ridge in June 1984. As part of this project AGC also managed the acquisition of 9000m of a new design electro-mechanical deep tow cable and an instrumented deep tow sheave for the winch. The winch acquisition, testing and installation design was carried out largely by contract to Whitman Benn & Associates Limited of Halifax, N.S.

SeaMARC I Logistics

The SeaMARC I deep towed sidescan sonar system owned by the Lamont Doherty Geological Observatory of Columbia University was contracted by AGC for the third year in a row on a joint project to survey the Nova Scotian and Labrador slopes. This year the contract was more complex as it also called for carrying out surveys for PGC with the CFAV Endeavour on the Juan de Fuca Ridge and with CSS Hudson in the Nares Abyssal Plain.

The AGC arranged for the removal of the SeaMARC I system from the R.V. Conrad in Pireus, Greece on May 20. It was transported via container ship to Halifax and then across Canada by dedicated truck to Esquimalt, B.C., and installed on the Endeavour which sailed on June 15. The SeaMARC system along with the new PGC deep tow cable was then removed from Endeavour and trucked back to AGC where it was installed on CSS Hudson in late July to carry out successful surveys of the Laurentian Fan and the Labrador Slope in September and October. The system was then briefly used with CSS Hudson on a joint project with U.S. agencies to investigate the sediments of the Nares Abyssal Plain in November before being lost in 5800m of water, probably due to buoyancy failure of the towed fish.

Cable Handling

GSC Project 830003 for Development and Implementation of Cable Handling and Maintenance Procedures has made significant progress in its goal to investigate, design, acquire and implement equipment and procedures to improve the life and use of the many varied and expensive oceanographic cables used by AGC. A new large Timberland Equipment Limited cable reeler and tensioner was acquired which now allows proper handling and tensioning on winches of all BIO cables. Contracts have been issued to and completed by Brooke Ocean Technology Limited with reports produced on:

Pt. 1 - Lubricant Selection

Pt. 2 - Testing of Lubrication Equipment.

Pt. 3 - Lubricant Analysis.

Pt. 4 - Design of prototype cable washing and lubricating equipment.

The results of the reports have already been largely implemented by AGC and the reports will be released later in the year via the GSC Open File.

Acoustic Positioning

AGC & PGC have taken a major step into the areas of long and short baseline acoustic navigation during the last year. AGC combined the future requirements of PGC for long baseline acoustic positioning on the Juan de Fuca Ridge area; the present requirements of DFO's ARCS project for under ice long baseline acoustic positioning; AGC's requirements for short baseline acoustic positioning as part of the Huntec Seabed II contract, the positioning of the SeaMARC I towed body relative to CSS Hudson during 1985 and the requirement for long baseline acoustic positioning in the Nares Abyssal Plains in November of 1985 for detailed sampling work. It also managed

the acquisition of both long and short line Oceano acoustic positioning instrumentation by AGC, Huntec and DFO. This included the installation on CSS Hudson which was carried out by an AGC managed contract issued by Huntec to Oceano who sub-contracted a local engineering firm to design and carry out the installation.

This somewhat complex series of arrangements has enabled PGC, AGC and the DFO ARCS projects to meet their present and near future acoustic positioning requirements in a satisfactory and economical way by agreeing to jointly cooperate on the acquisition and use of almost $500,000 worth of equipment.

Curation

Field (land) samples and offshore marine sediment samples collected either from the seabed or to a depth of up to 40 meters below the seabed in the Eastern Canadian Offshore and ocean basins are curated on behalf of GSC at the Atlantic Geoscience Center, BIO, Dartmouth, N.S. These samples are curated within the confines of a 1028 square meter core sample repository in both ambient and cold storage (4°C) conditions. In an attempt to continue to provide adequate curation of these major collections a (16 foot) lateral extension was recently completed to the existing large walk in Bally refrigeration box. A mobile storage system equipped with galvanized "D" tube racking, a 110v., AC single phase motor and movement control panels was installed within the Bally unit to easily accommodate and access the more than 9000 pieces of core within the collection. A mechanically assisted high density storage system with a security locking device was also recently installed to facilitate curation of AGC's geologic data including GSC Open File reports, cruise reports, maps, acoustic tapes.

In 1984/85 256 samples were recovered and placed in curation including 39 grabs and dredges and 217 cores. Total length of core recovered in 1984/85 was 393.23m. Maximum penetration was 13.33 meters at site 84046-022 in the Nares Abyssal Plain. The maximum water depth from which a core was recovered was 5848m.

A new industrial x-radiograph facility has also been constructed according to Radiation Protection Bureau of Health and Welfare specifications to accommodate the Philips Image Intensifier video with Precise optics and the Hewlett-Packard 43805N radiograph unit. The recent completion of a modern 270 square foot wet lab for geotechnical analyses and extrusion of whole cores by AGC staff will also be a tremendous asset to our many ongoing scientific marine sampling programs.

Sample Inventory Database

The new Sample Inventory Database (SID) is a sample management system that has been initiated on the BIO Cyber 173 mainframe using System 2000. This system will give staff direct access to storage location, procurement and sampling history, sample processing etc. for all samples in AGC's collections. The inventory is in active use for recently collected samples (1984 and 1985), and records of earlier samples are presently being updated and checked. Inquiries based on normal criteria such as geographic location, amount of penetration, cruise, dates etc., can be better addressed than in the past.

Technical Services

AGC conducted a major wire change on CSS Hudson in a foreign port using the new tensioning and reeling machines purchased by AGC. Five thousand meters of 0.86 diameter duplex wire was removed from the Pengo winch on the foredeck of CSS Hudson and 6000 meters of 3/4" diameter coring wire replaced it during a two day turnaround time in Bermuda.

AGC for the first time has started to ship our compressor containers via commercial container ships. This was done twice this year (from Bermuda to Halifax, Barbados to Halifax). This need arose due to the increased use of containers by scientists and the many phases of each cruise between home port calls.

Program Support logistically prepared for and maintained eight cruises and field parties for universities and other government departments, in addition to our normal AGC requirements.

1. Earth Physics Branch (Quest)
2. Dalhousie University (Hudson)
3. Dalhousie University (Dawson)
4. Chemical Oceanography, DFO, OSS, AOL (Baffin)
5. Chemical Oceanography, DFO, OSS, AOL (Dawson)
6. Memorial University (Dawson)
7. Dalhousie University (Eastern shore)
8. INRS (Rimouski)

Program Support technologists spent approximately 728 person days at sea or in the field supporting approximately 35 scientific projects.

A major effort was made by Program Support personnel in the planning for and logistical support of the Ice Island program for Regional Reconnaissance.

Program Support staff were deeply involved in the logistical aspects of the NOGAP project for Ice Islands.

Support was given to a major Ocean Bottom Seismometer cruise with 24 successful lowerings of the AGC designed and built recorders.

A joint Canadian Armed Forces, Maritime Command, NORDCO, AGC cruise was successfully completed using the HMCS Cormorant utilizing AGC's sidescan and the Armed Forces' submersible SDL-1.

Program Support carried out continued design and manufacture of components for a single channel digital seismic reflection system.

Microfilming For The Future

By the end of fiscal 1984/85 over 1400 documents from cruises dating back to 1963 had been copied on to microfiche to protect AGC from loss and catastrophe.

During fiscal year 1984/85, Program Support in cooperation with the Public Archives of Canada reported on the feasibility of using flow microfilm systems to reproduce geophysical records for security and distribution.

Underway Geophysical Database

The database which keeps track of the location of underway geophysical data was upgraded in 1984/85 and now contains information on 143 cruises. The information is summarized at the end of this report.

Lithostratigraphic File

From a tape of lithologic descriptions purchased from Canstrat of Calgary in April 1984, a database was prototyped and functioning in two months. It has been used for several preliminary reports. Most initial effort has gone towards examining totals of each rock type by formation. This is being expanded into ways of examining composition, interval by interval, for a large section. The next goal is to improve the capability for mapping this data. After three additions to the original file, the database now contains the descriptions of 162 offshore wells.

Software Inventory

To improve the maintenance of our significant software investment, an inventory has been created for the use of any programmers. The initial step has been to use it to plan and manage all programming work within the support group, thereby doubling or tripling our supervisory capability. Design and reviewing techniques are being improved, so that we can do more by contracts and with short-term staff. Vendor software and in-house written applications are being recorded for personal computers, so that the system will fulfill its inventory function which is to catalog any available software.

Personnel Notes

The Subdivision consists of a permanent staff of one senior manager, two engineers, two physical scientists, two computer scientists, twelve technicans and one clerk.

William MacKinnon, a mechanical engineer joined the Subdivision in January 1985.

Deborah Langdon, a programmer analyst, joined the Subdivision in September 1984. Deborah was previously associated with the Department of Environment, Forestry Service, in St. John's, Newfoundland.

Florence Spencer joined the Subdivision in September 1984 as a term secretary.

David Hackett joined the Subdivision in January 1985 as a term computer programmer.

Attendance at Meetings, Conferences and Courses

A. Fricker

ASTUTE meeting, Austin, Texas, April 29-May 3, 1984.

ASTUTE meeting, Hilton Head, South Carolina, November 11-15, 1984.

University of New Brunswick Cooperative Program Advisory Board meeting, Fredericton, New Brunswick, November 20, 1984.

AGS Symposium, Wolfville, Nova Scotia, January 18-20, 1985.

Meeting between ASTUTE and SAS Institute re System 2000, Washington, D.C., January 29, 1985.

I.A. Hardy

GSA meeting in Reno, Nevada, November 4-7, 1984.

AGS Symposium, Wolfville, Nova Scotia, January 18-20, 1985.

D.E. Heffler

Meeting with Davis Engineering on ASSP Contract, Ottawa, Ontario, April 6, 1984

Meeting with NRC and Davis Engineering on ASSP Contract, Ottawa, Ontario, August 28-29, 1984.

D. Langdon

System 2000 course, Toronto, Ontario, October 22-26, 1984.

ASTUTE meeting, Hilton Head, South Carolina, November 12-15, 1985.

D.R. Locke

CORE Show, Halifax, Nova Scotia, October 18, 1984.

W. MacKinnon

MTS Workshop, Washington, D.C., February 24-27, 1985.

K.S. Manchester

ROV Conference, San Diego, California, May 15-17, 1984.

SeaMARC I planning meeting at Pacific Geoscience Centre, Sidney, B.C., May 29-30, 1984.

Seabed II committee meeting, Toronto, Ontario, May 31, 1984.

Seabed II committee meeting, Ottawa, Ontario, June 19, 1984.

Ocean Drilling Program Technology & Engineering Development Committee meeting, Houston, Texas, October 3-4, 1984.
CORE Show, Halifax, Nova Scoita, October 17, 1984.

Seabed II meeting, Toronto, Ontario, January 29, 1985.

DFO Class II Vessel Committee meeting, Ottawa, Ontario, March 27, 1985.

S. Merchant

System 2000 Technical Fundamentals course, Dartmouth, Nova Scotia, August 2, 1984.

A.G. Sherin

CORE Show, Halifax, Nova Scotia, October 18, 1984.

National Computer Graphics Association Annual Meeting, Anaheim, California, May 13-17, 1984.

Toronto Computer Show, November 19-20, 1984.

Membership on Committees

A.S. Atkinson

Electronics Stores Committee

C.B. Chapman

Industry Advisory Committee to the Electronic Engineering Technician Program for the Department of Education for the Province of Nova Scotia.

A. Fricker

University of New Brunswick Computer Science Cooperative Education Advisory Committee

President, International Association of System 2000 Users for Technical Exchange (ASTUTE)

Executive, Atlantic Geoscience Society

AGS Educational Video Project

Organising Committee for the 1986 AGS Basins Symposium.

M.E. Gorveatt

BIO Safety Committee

BIO Container Committee

I.A. Hardy

Management Committee for BIO Storage Areas

Arctic Land Sea Interaction Workshop '85 Steering Committee

Long Core Drilling Program Sable Island Advisory Committee (1985)

Quaternary Paleoceanography of Eastern Canada Committee

D.E. Heffler

BIO Instrumentation Development Review Committee

M.D. Hughes

BIO Safety Subcommittee

K.S. Manchester

Canadian member on the Technical and Engineering Development Committee of the Ocean Drilling Program

AGC representative on the BIO Ship Users Committee

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

Energy, Mines & Resources representative on the DFO Class II Ship Design Committee

A.G. Sherin

BIO Computer Advisory Committee

Data Management Advisory Committee

Subdivision Manuscripts

The Subdivision staff produced two published papers, five abstracts and three Open File Reports.

Data Management Requests For Services

	Internal	External
Data (computer & analogue:	82	25
General Info:	4	2
Reproduction:	341	1
Computer:	2	0
GSC/EPB Open Files:	3	5
Purchasing Services:	10	0
Stationery:	2	0
Samples:	261	48

Subsampling:	
x-radiographs	1140
Foraminifer	1593
Palynology	535
Diatoms	60
Coccoliths/smear slides	41/82
Lithologic analyses (carbonate)	218
Geotechnical:	
Atterberg's Limits	238
Water Content	190
Sediment Slabbing	101
Swedish cone test	2
Shear vane	64
Porewater Chemistry	14
Consolidation	24
Specific gravity	5
Dating:	
C^{14}	14
O^{18}	321
Tandem accelerator	16
Total organic matter	3
Paleomagnetic	2525
Thermoluminescence (TL)	3
Lead 210	200
Sediment Size Analyses:	1422
Epoxy peels	61
Trace element	19

Underway Data

Type of Data	Kilometers
Bathymetry	735359.980
BRUTIV	379.920
Gravity	598895.36
Magnetics	924030.14
Reflection	240232.91
Refraction	16119.47
SeaMARC	1860.34
Sidescan	33708.23
Sonobuoy	377.24
3.5 kHz	871.89

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 existing major hydrocarbon production. 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 1984-85 were approximately $99,000.

Highlights

Studies in the western Anahim Volcanic Belt were concentrated between Bella Coola and the outer coast. This zone across the central Coast Mountains is a westward extension of the volcanic belt defined by three late Cenozoic peralkaline shield and caldera complexes in the adjacent Interior Plateau. Within the strongly uplifted and dissected Coast Plutonic Complex the volcanic belt is represented of salic volcanic piles. King Island pluton comprises a massive core of hypersolvus syenite and a marginal phase of microlitic soda granite. The composition of these rocks is unique in the Coast Plutonic Complex and confirms that the Anahim Belt is a deep-rooted, trans-Cordilleran belt of peralkaline magmatism.

Geological, geophysical and geochemical investigations of potential geothermal sources have now been augmented by bio-assays of certain thermal springs to test the effect of the water on living organisms to determine its suitability for use in fish and shell fish culture.

Fossil crinoid columnals, now replaced by a variety of silicate minerals in an amphibolitic boudin were found in the Central Gneiss Complex of the Coast Plutonic Complex near Terrace - these clearly identifiable fossils are in upper amphibolite facies rocks which may be higher grade than other known fossil bearing rocks. This find clearly demonstrates that the Central Gneiss includes rocks no older than Ordovician and that are probably upper Paleozoic. Present data suggests that strata ranging from Permian to lower Cretaceous may extend from the Intermontane Belt into the Coast Plutonic Complex and form the protolith of the Central Gneiss. Structures near the western margin of the Intermontane Belt are dominated by northeastward directed imbricate thrust faults and related ductile shears probably representing very significant shortening. Differing structural styles between the Intermontane and Coast Plutonic Complex may represent different structural levels of the same late Cretaceous tectonic event - superstructure and infrastructure and attendant crustal thickening - now juxtaposed by Eocene(?) offsets on steep northerly trending faults.

Continuing work on the Sylvester Allochthon and underlying autochthonous rocks north and east of Dease Lake has revealed that the autochthonous rocks are intensely imbricated in westerly directed duplex structures in contrast to the easterly directed structures at the base of the allochthon. The allochthon itself consists of at least four major thrust sheets that include progressively younger rocks to the west. In the autochthon pebble and local cobble conglomerate of the Devonian-early Mississippian "black clastic" unit in Jennings River area displays abundant evidence of turbiditic deposition. Clasts are entirely of local derivation; chert clasts are of secondary origin and hence are not radiolarian oceanic chert.

In the western part of Lardeau area new work has provided the first evidence for early Permian thrust faulting in the Canadian Cordillera. Lower Permian basalt (Kaslo Group) is repeated by an easterly directed thrust fault and the fault plane is cut by an early Permian dioritic intrusion that in turn is overlain by early Permian

conglomerate.

Four Lithoprobe I deep reflection seismic profiles were shot during May and June. The first was across southern Vancouver Island and the others were across the Cowichan Uplift, San Juan and Leech River faults. Coherent reflectors were obtained at several horizons, the deepest to six seconds (one way time: 30 Km?).

Supporting geological studies to Lithoprobe permitted:

1. The identification of probable thrust faults on Vancouver Island.
2. The identification of a sheeted dike complex within the Mechosin Volcanics of southern Vancouver Island.
3. A start to the unravelling of the complex stratigraphy of the Sicker Group in the Cowichan Uplift, Nanoose Uplift and elsewhere.
4. The identification of very deep water depositional environments in the Nanaimo Group which are presently at elevations of 1250 m.

Substantial progress has been made on compilation and publication of multibeam high-resolution bathymetric (Seabeam) and long-range side-scan sonar (Seamarc II) data over the northern Juan de Fuca Ridge system. These data sets made a significant contribution to the discovery of the "Magic Mountain" hydrothermal vents at 49°45'N, 130°16'W.

Studies of the surficial geology in Hecate Strait and Queen Charlotte Sound have outlined areas of boulder fields, shallow gas, sand waves and slope instability and have made possible the delineation of areas that require additional detailed study to further determine the extent of hazards to sea floor development. Research in collaboration with Louisiana State and Texas A & M universities in Bute Inlet revealed that a deltaic area at the head disintegrated within the past few 1000 years at which time lobes of sandy material moved up to 35 km down the channel. Incised channels, then formed, now carry sand delivered to the Delta into the deep basin of the fiord.

Other marine surficial geology studies have been concerned with tidal-flat erosion induced by major coal port development at Roberts Bank. This work has provided a basis for monitoring efforts to control erosion of ecologically important eelgrass beds which are now achieving some success.

Biostratigraphic investigations of Cretaceous strata on Queen Charlotte Islands, using foraminiferal assemblages, indicate that some formations previously believed to be separate and of different ages are in fact facies equivalents (shallow and deep water) of the same age. Implications of these discoveries suggests the possibility that a great thickness of Cretaceous sediments may be buried beneath the Massett volcanics on Graham Island. These clastics are potential reservoir rocks above the petroliferous Triassic Kunga and Jurassic Maude Formations.

In January a "show-and-tell" sponsored by the British Columbia and Yukon Chamber of Mines was shared by the Cordilleran and other Divisions of the Geological Survey with the Geological Branch of the British Columbia Ministry of Energy, Mines and Petroleum Resources, the DIAND geology group from Yukon, the University of British Columbia Department of Geological Sciences and several exploration companies. The event attracted a registered audience of more than 900, mainly from the exploration industry. The Geological Survey participation occupied a full day involving a program review and technical lectures in the morning and a poster session in the afternoon. The event was judged to be a great success, as was the initial meeting in 1984, and plans are already underway for a repeat in January, 1986.

A new enterprise for the staff of the Division was the delivery of a lecture series on the Geology of the Canadian Cordillera at U.B.C. The two-hour lectures were presented each week for 10 weeks in the winter and spring term and constituted a credit course for graduate students. The lectures consistently attracted many auditors as well as enrolled students. Present plans are to repeat the series in the winter-spring of 1987.

Personnel Notes

The Cordilleran Division has 44 full-time employees, 28 at Vancouver, 1 at Ottawa and 15 at Pacific Geoscience Centre. At Vancouver there are 14 scientists 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 7 support and administrative staff. R.G. Currie is the subdivision head.

Vancouver Office

R.G. Anderson, following a period as a post-doctorate fellow, jointed the staff as a research scientist in May, 1984.

K. Wellar assumed the post of administrative officer in May, 1984.

G.H. Eisbacher resigned in August, 1984 and took a position at Karlsruhe University, F.R.G.

Pacific Geoscience Centre

R.D. MacDonald jointed the staff to provide scientific and technical a support for marine geoscience research in June, 1984.

G.C. Horel was appointed to assist in computer programming and data processing in July, 1984.

P. McLaren took leave-of-absence in July, 1984 for 1 year to pursue his research interests at Cambridge University.

Attendance at Meetings, Conferences, Courses

R.G. Anderson

"Writing About Scientific and Academic Work for a Popular Audience", November 3-4, 1984, Vancouver, B.C.

"Geochronology and Isotope Geology for the Geologist and Explorationist", February 25, 1985, Vancouver, B.C.

Cordilleran Geology Round Up, January 3, 1985, Vancouver, B.C.

B.D. Bornhold

International Association of Sedimentologists European Meeting, Marseille, April, 1984.

American Geophysical Union, Fall Meeting, San Francisco, December, 1984.

Workshop on Ocean Drilling in the Northeast Pacific, University of Washington, February, 1985.

Introduction to Microcomputers, Camosun College, February, 1985.

R.B. Campbell

Annual Meeting, Cordilleran Section, Geological Society of America, Anchorage, Alaska, 30 May - 1 June, 1984.

Geology and Exploration Roundup, British Columbia and Yukon Chamber of Mines, Vancouver, B.C., 23-25 January, 1985.

Lithoprobe Workshop, University of Calgary, 22 February, 1985.

Cordilleran Workshop, University of Calgary, 23-24 February, 1985.

R.G. Currie

American Geophysical Union, Annual Fall Meeting; San Francisco, December 9-13, 1984.

Geology and Exploration Roundup, British Columbia and Yukon Chamber of Mines, Vancouver, B.C., 23-25 January, 1985.

H. Gabrielse

Geological Society of America, Cordilleran Section Meeting, Anchorage, Alaska, May, 1984.

Geological Society of America, Annual Meeting, Reno, Nevada, Nov. 1984.

Geology and Exploration Roundup, British Columbia and Yukon Chamber of Mines, Vancouver, B.C., 23-25 January, 1985.

S.P. Gordey

Geological Association of Canada, Cordilleran Section, Short Course No. 4, Vancouver, B.C., February 25, 1985.

Geology and Exploration Roundup, British Columbia and Yukon Chamber of Mines, Vancouver, B.C. 23-25 January, 1985.

T.S. Hamilton

Spring Annual American Geophysical Union Meeting, Cincinnati.

J.L. Luternauer

Symposium on the Sedimentology of Shelf Sands and Sandstones, University of Calgary, 15-17 June, 1984.

J.W.H. Monger

27th International Geological Congress, Moscow, U.S.S.R., August 4-14, 1984.

Geological Society of America, Reno, Nevada, 31 October - 3 November, 1984.

B.C. and Yukon Chamber of Mines, "Cordilleran Round-up", 23-25 January, 1985.

Lithoprobe Workshop, Univ. of Calgary, 22 February, 1985.

Cordilleran Workshop, Univ. of Calgary, 23-24 February, 1985.

M.J. Orchard

Canadian Paleontology and Biostratigraphy Seminar, Ottawa, 28-30 Sept., 1984.

B.C. and Yukon Chamber of Mines Meeting, Vancouver, 23-25 January, 1985.

J.A. Roddick

Cordilleran Geology and Exploration Roundup, Vancouver, January, 1985.

J.G. Souther

CPEMR Workshop on Forecasting Volcanic Eruptions; Hilo, Hawaii, June 9-11.

Geology and Exploration Roundup, British Columbia and Yukon Chamber of Mines, Vancouver, B.C., 23-25 January, 1985.

L.C. Struik

CIMM District 6 Meeting, Kamloops, October 24-27, 1984.

B.C. and Yukon Chamber of Mines, Annual Geology and Exploration Roundup, Vancouver, January 23-25, 1985.

Cordilleran Workshop, Calgary, February 23-24, 1985.

D.J. Tempelman-Kluit

Annual Meeting, Geological Society of America, Reno, Nov. 5-8, 1984.

B.C. and Yukon Chamber of Mines Roundup, 23-25 January, 1985.

R.I. Thompson

Geological Society of America, Anchorage, Alaska, May, 1984.

Canadian Society of Petroleum Geologists Annual Meeting, Calgary, June, 1984.

Geological Association of Canada, Cord. Section Symposium, Vancouver, February, 1985.

B.C. & Yukon Chamber of Mines, Geology on Exploration Roundup, January, 1985.

H.W. Tipper

Paleontology Section, Geological Association of Canada in Ottawa in September.

Geology and Exploration Roundup, British Columbia and Yukon Chamber of Mines, Vancouver, B.C., 23-25 January, 1985.

J.O. Wheeler

Geological Association of Canada, annual meeting, London, Ontario, May 14-16, 1984.

Geological Society of America, annual meeting, Reno, Nevada, November 5-8, 1984.

Geology and Exploraton Roundup, British Columbia and Yukon Chamber of Mines, Vancouver, B.C., 23-25 January, 1985.

G.J. Woodsworth

Canadian Permanent Committee on Geographic Names, Annual Meeting, Charlottetown, September 1984.

Advisory Committee on Glaciological and Alpine Nomenclature, Victoria, March 1985.

Conference on Small-Scale Mining Development Opportunities, Terrace, November 1984.

Geology and Exploration Roundup, British Columbia and Yukon Chamber of Mines, Vancouver, B.C., 23-25 January, 1985.

C.J. Yorath

Canadian Society of Petroleum Geologists and Canadian Society of Exploration Geophysicists, Calgary, June, 1984.

International Symposium on the Queen Charlotte Islands, Vancouver, August, 1984.

Current Research Forum, Ottawa, January, 1985.

Special Talks or Lectures

R.G. Anderson

"The several faces of granitic rocks: classification, associated mineralization, tectonic setting and Cordilleran examples", Geological Association of Canada, Cordilleran Section, Lecture Program, November 8, 1984, Vancouver, B.C.

B.D. Bornhold

"Sedimentation on the Vancouver Island Continental Shelf", University of British Columber, Oceanography Dept., December, 1984.

"Sedimentary processes in British Columbia fiords", Oregon State University, School of Oceanography, February, 1985.

"Sedimentary processes in British Columbia fiords", Vancouver Island Geotechnical Group, March, 1985.

R.B. Campbell

"Terrains of the Saint Elias Mountains", Cordilleran Section, Geological Society of America, Anchorage Alaska, 30 May - 1 June, 1984.

R.G. Currie

"Review of geological and geophysical activities at the Pacific Geoscience Centre", B.C. and Yukon Chamber of Mines "Cordilleran Roundup", Vancouver, B.C., January, 1984.

H. Gabrielse

"Transcurrent faulting in the north-central Cordillera"; Dept. of Geosciences, Tucson, Arizona, April, 1984.

"Structural styles and plate collision in north-central British Columbia"; Canadian Society of Petroleum Geologists, Structural Geology Division, Calgary, December 1984.

S.P. Gordey

"Structural evolution of the northern Cordilleran miogeocline" (60 mins.); presented April 12, 1984, through Geological Association of Canada, Cordilleran Division, Lecture Programme, Vancouver, B.C.

(by M.J. Orchard) "Conodonts and stratigraphy of Mackenzie Platform margin and overlying rocks, Yukon and N.W.T." (post session - 50% by S.P. Gordey); presented September 30, 1984 at Canadian Paleontology and Biostratigraphy Seminar, Ottawa, Ontario.

"Igneous, sedimentary and metamorphic rocks" (3-2 hr. sessions); presented Oct. 18, 23, and 25, 1984, Vancouver, as part of the British Columbia and Yukon Chamber of Mines Prospecting and Mining School, Vancouver, B.C.

T.S. Hamilton

"Large Scale Mantle Convection - Implications for Volcanism and Magma Segregation" at Spring Amercian Geophysical Union meeting 1984, EOS, v. 65, No. 16, p. 273.

J.L. Luternauer

"Natural vs Development-Induced Patterns of Sedimentation on Southern Roberts Bank, Fraser River Delta"; Institute for Quaternary Research at Simon Fraser University.

J.W.H. Monger

"Evidence for large-scale horizontal displacement within the North America Cordillera"; 27th International Geological Congress, 4-14 August, 1984.

"Transect B2: crustal evolution in the Intermontane Belt and Coast Plutonic Complex, southern Canada, Cordillera"; Geological Society of America.

"Evolution of southwestern Intermontane Belt"; Cordilleran Round-Up + 4 lectures at U.B.C. (2 in Graduate, 2 in undergraduate course).

M.J. Orchard

"A preliminary account of the conodont record at the western edge of the Mackenzie Platform (Nahanni Map Area), Northwestern Canada"; Geological Society of America, Lexington, 5-6 April.

"A tale of three terranes: contrasts in Late Paleozoic stratigraphy across the Western Cordillera; Canadian Paleontology and Biostratigraphy Seminar"; Ottawa, 28-30 Sept. 1984.

"Conodonts: application in the Western Cordillera"; University of British Columbia, 13 March.

J.A. Roddick

"The Coast Plutonic Complex"; lecture U.B.C., February 1985.

J.G. Souther

"The roots of alkaline volcanoes in the central Coast Range"; H.W. Mathews Symposium, Vancouver, October, 1984.

"Cenozoic Volcanism in the Canadian Cordillera, Graduate Seminar, U.B.C., Vancouver, April, 1984.

"Rappourteur"; CPEMR Workshop on forecasting volcanic eruptions, Hawaii, May, 1984.

"The Western Anahim Belt, Geological Assication of Canada Lecture Series, Victoria, February, 1985.

"Peralkaline Volcanism in B.C."; Dawson Club Lecture, U.B.C., February 14, 1985.

"Cenozoic Volcanism in the Cordillera"; U.B.C., Graduate Seminar, March, 1985.

L.C. Struik

University of British Columbia, Afternoon lecture series, January 18, 1985.

D.J. Tempelman-Kluit

"Crustal extension in Okanagan", Geological Society of America, Annual Meeting, 5-8 Nov., 1984.

Graduate Student Course at U.B.C. lecture in Omineca Belt Program over view of G.S.C. Cordilleran Section at Roundup, Jan. 23-25, 1985.

Geological Association of Canada, short course in Geology of Cordillera at Vancouver, March 25,1985 and at Edmonton, March 21-22, 1985.

R.I. Thompson

"Late Proterozoic Extension"; G.S.A., Anchorage, Canadian Society of Petroleum Geologists, Calgary and B.C./Yukon Chamber of Mines, Vancouver.

H.W. Tipper

U.B.C.-special course presented by G.S.C.

J.O. Wheeler

Omineca Belt to U.B.C. regional geology course, March 18, 1985.

G.J. Woodsworth

"Geological Overview of Northwest B.C.", Conference on Small-Scale Mining Development Opportunities, Terrace, November 1984.

"Mesozoic Evolution of the Coast Plutonic Complex", Geology and Exploration Roundup, B.C. and Yukon Chamber of Mines, January 1985.

"Technics of the Prince Rupert - Terrace area", U.B.C., February 1985.

"Mesozoic Evolution of the Coast Plutonic Complex", Princeton University, January 1985, and Bryn Mawr College, January 1985.

C.J. Yorath

"The Queen Charlotte Islands and Queen Charlotte Basin: Tectonic history and petroleum possibilities". Present to:

1. Exploration Update. Joint Meeting of the Canadian Society of Petroleum Geologists, Calgary, June, 1984.
2. Lecture to post graduate students, University of Alberta, Edmonton, March, 1975.
3. International Symposium on the Queen Charlotte Islands, Vancouver, August, 1984.

"Structural style of the Insular Belt". Presented as one of a series of lectures comprising a course on the Geology of the Canadian Cordillera to student at the University of British.

LITHOPROBE - PHASE 1: Southern Vancouver Island. Integration of reflection seismic profiles with surface geological studies. Presented to:

1. Current Research Forum, Ottawa, February, 1985.
2. British Columbia Association of Professional Engineers - Victoria Section, February, 1985.
3. Edmonton Geological Society of Edmonton, March, 1985.
4. EMR staff at ISPG, Cordilleran Division, Vancouver and Pacific Geoscience Centre.

Membership on Committees

R.G. Anderson

First year as Councillor on Geological Association of Canada, Cordilleran Section Executive.

B.D. Bornhold

EMR Departmental Coordinating Committee on Ocean Mining.

Environmental Studies Revolving Fund - Bottom Sediment Transport.

Advisory Committee on Undersea Feature Names.

Southern Ocean Panel, Ocean Drilling Project.

National Correspondent, International Association of Sedimentologists.

R.B. Campbell

B.C. and Yukon Chamber of Mines, Member of Broad.

R.G. Currie

Member - DNAG Magnetic Anomaly Map Compilation.

Committee - Northeast Pacific Quadrant.

H. Gabrielse

Member, Committee Douglas Medal, Canadian Society of Petroleum Geology.

Member, Committee on Education and Research, Geological Society of America, Structural Geology Division.

Member, Organizing Committee, Geological Society of America, Cordilleran Section Meeting, Vancouver, May, 1985.

S.P. Gordey

Representative on British Columbia and Yukon Chamber of Mines Safety Committee.

J.L. Luternauer

Scientific advisor to: a. the Fraser River Delta Roberts Bank (Coal Port) Environmental Review Committee which is assessing the physical and biological impact of the development and recommending measures to control and mitigate effects.
b. Provincial Order in Council 908 Environmental Committee assessing B.C. Gas Pipeline proposal, Greater Vancouver Fraser River Delta sewage pipeline proposal, breakwater construction at the Tsawwassen marsh.

Invited to join thesis committee for PhD study of the stratigraphy/paleo-environments of the Fraser River Delta (At Simon Fraser University).

Invited to guide and supervise with Mr. Church post-doctoral study program on the sediment budget at the Fraser Delta front (at UBC).

Review manuscript for GSA Bulletin and Journal of Sed. Petrology.

J.W.H. Monger

Councillor, Geological Society of America.

Vice-chairman, Working Group 2, International Committee on Lithosphere.

J.A. Roddick

Editor, IGCP Project 220: Correlation and resource evaluation of thin/tungsten granites in southeast Asia and the western Pacific region.

J.G. Souther

Sub-program Co-ordinator (Cordillera) of the EMR geothermal program.

Member, Geological Society of America, Bulletin Board of Associate Editors.

Member of Canadian Earthquake Prediction Evaluation Committee.

Rapporteur for CPEMR workshop on Forecasting Volcanic Eruptions.

Member C. Hickson Ph.D. Thesis Committee, U.B.C.

Vice-President Canadian Geothermal Resources Association.

D.J. Tempelman-Kluit

Education Committee B.C. Yukon Chamber of Mines.

Councillor, Geological Association of Canada.

R.I. Thompson

President, Geological Association of Canada, Cordilleran Section.

Member, Canadian Society of Petroleum Geologists ,Liasion Committee.

Associate Editor, Canadian Society of Petroleum Geologists Bulletin.

J.O. Wheeler

Member of Steering Committee for Geological Society of America, Centennial project - The Decade of North Geology (DNAG).

Honorary member, Lithoprobe Steering Committee.

G.J. Woodworth

Canadian Permanent Committee on Geographic Names.

Advisory Committee on Glacialogical and Alpine Nomenclature.

C.J. Yorath

Member, Canadian Society of Petroleum Geologists.

Awarded Canadian Society of Petroleum Geologists Medal of Merit for 1923. Presented February, 1985.

ECONOMIC GEOLOGY AND MINERALOGY DIVISION

D.C. Findlay, Director

General

On April 1, 1984, the present Economic Geology and Mineralogy Division (EGM) was formed through a merger of the former Economic Geology Division and the Mineralogy and Analytical Chemistry sections of Central Laboratories and Technical Services Division (CLTS). The Technical Services units of CLTS were transferred to the Resource Geophysics and Geochemistry Division(RGG) at the same time. The new Division (EGM) has a continuing staff strength of 88 person years plus (currently) 9.5 person years in term positions that are mainly assigned to activities in federal-provincial Mineral Development Agreements (MDAs) in Manitoba, Saskatchewan, New Brunswick, Nova Scotia and Newfoundland.

The expanded Division has six 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.
5. To provide analytical services and mineralogical expertise in support of research activities of EGM and other GSC Divisions, and to develop new or refined analytical techniques for use by GSC and for transfer to commercial laboratories.
6. To develop and curate National and Branch rock, mineral and meteorite collections and to provide mineralogical information to the Canadian public.

To carry out these responsibilities, the Division is organized into an Administrative Unit, an Economic Geology Subdivision (five sections, a Special Projects Unit and a Mineral Deposits Laboratory) and a Mineralogy and Chemistry Subdivision (Analytical Chemistry and Mineralogy Sections). The objectives and roles of the separate units and highlights of their activities are presented under the relevant headings on the following pages.

During 1984/85 the Division supported 13 EMR Research Agreements and 20 outside research contracts (6 A-Base, 14 externally funded).

Highlights
(Divison Summary)

Staff continued to contribute to a variety of internal and external (to GSC) activities in addition to normal EGM project work. Some 33 externally funded projects were either operational during the report period or designed or modified for implementation in 1985-86 under 5 federal-provincial agreements, 2 federal initiatives in Quebec and the Boundary Disputes Program.

Division scientists participated in international projects such as ISMI (International Strategic Minerals Inventory), a UNESCO-IUGS (International Union of Geological Sciences) project on global models for mineral deposits and Third World technology transfer, preparations for a joint USGS (United States Geological Survey)/GSC workshop on resource assessment methodologies to be held in 1985, the USGS CUSMAP (Conterminous U.S. Mineral Assessment Program), investigations of seafloor hydrothermal sulphide deposits on and adjacent to active spreading ridges, various IGCP (International Geological Correlation Programme) projects, the International Crustal Research Drilling Group Cyprus Project, and the International Atomic Energy Agency. One scientist visited the Peoples' Republic of China where field examinations were made of major iron and manganese deposits.

The publication of Economic Geology Series Report 36, "A Synopsis of Canadian Mineral Deposits", represented a major collective Division effort that has been adopted as a textbook by at least one Canadian university. An expanded and revised eddition of this report will form one of the main components of the DNAG (Decade of North American Geology) volume on Mineral Deposits of Canada, being prepared by the Division.

The (new) Division as a whole has benefitted from major additions to the facilities of the Analytical Chemistry and Mineralogy sections and improved lines of communication between these sections and the Economic Geology Subdivision, one of the main users of their services.

The Canadian Geoscience Council Advisory Committee chaired by Prof. A.J. Naldrett, University of Toronto, completed its investigation of mineral deposits research at the GSC and submitted its report to the Director General in October. The report and a response by the GSC will be published in 1985 as a GSC Paper.

The Division was responsible for organizing the 1985 GSC Current Activities Forum, coordinating the display of 20 GSC posters (mostly from the Forum) at the annual meeting of the Prospectors and Developers Association in Toronto, and in cooperation with the Association, co-organizing with Mineral Policy Sector a workshop on "Mineral Inventory Data Files".

ADMINISTRATION

This unit, comprising the Director, Assistant, Secretary, Administrative Officer and two Financial Clerks, provides general administrative support and manages the financial and personnel resources for the Division.

Personnel Notes

M.M. Braham successfully completed French Language Training; **S. Faeder** provided secretarial support in the interim.

1

Attendance at Conferences, Meetings, and Courses

D.C. Findlay

Prospectors and Developers Association, Toronto, March 1985.

Steering Committee, UNESCO-IUGS Mineral Deposits Model Programme, Paris.

U.S. Geological Survey V.E. McKelvey Mineral Resources Forum, Denver, February 1985.

Manitoba Mineral Resources Division Open House, Winnipeg, November 1984; TALK: "GSC Program in Manitoba".

Saskatchewan Geological Survey Open House, Regina, November 1984; TALK: "GSC Program in Saskatchewan".

Workshop on Mineral Inventory Data Files, Toronto, March 1985; TALK: "Introduction to the Issues".

C.R. McLeod

Marine Minerals Data Workshop, National Oceanic and Atmospheric Administration, Boulder, Colorado, February 1985.

Membership on Committees

D.C. Findlay

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.

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.

Organizing Committee for 1985 Current Activities Forum, Chairman.

International Union of Geological Sciences UNESCO Mineral Deposit Modelling Program; Member Steering Committee.

USGS/GSC Resource Assessment Methodology Workshop Organizing Committee, Member.

C.R. McLeod

Energy, Mines and Resources Committee for Ocean Mining, Working Group for Deep Ocean Mining, Member.

ECONOMIC GEOLOGY SUBDIVISION

Subdivision 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 the geology of those containing major metal commodities such as copper, nickel, lead-zinc, gold, silver, iron, molybdenum and uranium, coupled with special investigations of tin, tungsten, chromium, platinum-group metals, rare-earth metals and such other deposits 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;

4. The development and application of methods, including mathematical methods, to evaluate the potential of various geological regions to contain undiscovered mineral resources;

5. The design and implementation of mineral deposit related projects (incorporating elements of items 1-4 above) for federal-provincial Mineral Development Agreements and other externally funded programs, either by supervision of contracted studies or by direct participation.

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

At the end of the report period the Subdivision staff comprised 28 research scientists, 12 physical scientists and 4 technical and clerical support persons.

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, 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

Deposits of Sedimentary Affinity

A general genetic model for stratiform baritic deposits in the Selwyn Basin (Yukon and Northwest Territories) was developed. According to this model, ore solutions for the base metal-rich baritic deposits were generated from higher-temperature, deeper

aquifers than the solutions that gave rise to barren barite deposits. The model also predicts that the hydrothermal solutions responsible for the barren stratiform barite deposits had the optimum composition for the mobilization of gold. Analysis of samples from the TEA deposit indicate that the baritite is indeed enriched in gold by comparison to other basinal lithologies.

A model developed previously for sediment-hosted stratiform Pb-Zn deposits was applied to Irish base metal deposits. This predicted the existence of a deep Carboniferous basin in central Ireland which has been substantiated by deep drilling and gravity data released subsequently by the private sector.

A successful predictive model was developed for base metal occurrences in Upper Windsor Group limestones in Nova Scotia and New Brunswick and in equivalent units in Newfoundland. This led to the demonstration of the lateral continuity of low-grade mineralization at a particular stratigraphic horizon over 6 km in north-central Nova Scotia.

Examination of the Redstone copper deposit in the Northwest Territories has demonstrated the existence of a low-grade Pb-Zn zone overlying the copper zone. Examination of drill core at the Hayhook occurrence north of Redstone revealed the existence of low grade disseminated copper mineralization.

Metallogeny of Mafic and Ultramafic Rocks

Investigation of nickel-copper sulphide deposits at Lynn Lake, Manitoba revealed a possible relationship between mineralization in the gabbroic intrusions and stratiform sulphides in the supracrustal country rocks. This suggests a local source of sulphur and offers an important exploration guide.

Studies of the relative concentrations of selenium and sulphur in magmatic sulphide ores are yielding important results. The majority of deposits of komatiitic affinity are depleted in selenium, suggesting a crustal source for their sulphur. By contrast, many deposits hosted by gabbroic intrusions of tholeiitic affinity have selenium/sulphur ratios close to the chondritic value indicating that sulphur is of mantle derivation. These conclusions are contrary to those widely accepted a few years ago.

An investigation of chromite in the Bird River Sill in Manitoba, undertaken in collaboration with the Manitoba Department of Energy and Mines and university scientists, has revealed that while there are large compositional variations within individual samples, there is little variation among the 150 samples studied. There are two compositional trends apparent within the chromites. A magmatic trend towards lower Mg/Mg+Fe ratios indicates super or subsolidus equilibration with a relatively large proportion of ferromagnesian minerals. The secondary trend towards ferrit-chromite reflects the reaction of magmatic chromite with secondary magnetite overgrowths during metamorphism.

Volcanogenic Massive Sulphide Deposits

Studies of volcanogenic massive sulphide deposits in Cyprus in conjunction with the International Crustal Research Drilling Group are continuing. These studies are contributing significantly to the understanding of Canadian massive sulphide deposits. Of particular importance is the observation that the Cyprus deposits are the best "dry land" analogues of the seafloor hydrothermal sulphide deposits on the Juan de Fuca and Explorer ridges, currently the subject of a major departmental research effort.

Examination of structural features in the vicinity of the Buchans copper deposits in Newfoundland has shown that the locations and offsets of some postulated faults are incorrect, demonstrating the need for further structural studies to guide exploration in the area in the future.

An investigation carried out in Kenya at the request of the United Nations Revolving Fund contributed significantly to UNRF exploration plans in the area. Useful scientific results were also realized, including the recognition that metamorphism of a pyrrhotite-bearing alteration pipe leads to an assemblage dominated by ferrohornblende rather than chlorite.

Gold Deposits

Mineralogical studies of the Agassiz gold deposit, Manitoba, indicates that, in addition to the enrichment in lead and zinc which was known previously, the ore is also unusually rich in silver, antimony and nickel. Argentopentlandite was identified in the deposit making it only the third known Canadian locality of this mineral.

Investigation of gold associated with iron formation at Contwoyto Lake, Northwest Territories indicates that gold, silver and sulphur were concentrated by processes associated with chemical sedimentation and early diagenesis. Volcanism, pelagic sedimentation, biologic activity and later metamorphism have also played an important role. These mechanisms seem similar to those responsible for the famous Homestake deposit in South Dakota.

Isotopic Studies

Lead isotope studies continue to yield important information on the genesis and timing of mineralization in Precambrian and Phanerozoic terranes. Lead isotope model ages of 2990-3000 Ma for massive sulphide and vein deposits of Wabigoon subprovince, northwestern Ontario have been confirmed by zircon U-Pb ages done by laboratories of the Precambrian Division (GSC), ROM (Royal Ontario Museum) and OGS (Ontario Geological Survey), substantiating the utility of this approach in geochronology. Comparable 2900 Ma ages are similarly indicated for the Wawa area, Ontario where the lead isotope data also suggest that the lead was derived from much older crustal rocks that were enriched in uranium relative to lead.

Deposits Related to Felsic Intrusions

Study of "comb quartz" growth layers in the aplitic, apical portions of felsic intrusions closely associated with porphyry deposits suggests a genetic connection between crystallization of the intrusion and formation of associated hydrothermal ore deposits.

Investigation and chemical documentation of mineralized felsic intrusions in the northern Cordillera in British Columbia and the Yukon Territory has revealed a relationship between mineralization type, host rock type and tectonic setting. In particular, molybdenum-tungsten-tin deposits are associated with collision-related granitic bodies (accreted terranes) whereas copper-rich deposits are associated with subduction-related granodioritic rocks.

Personnel Notes

Dr. L.J. Hulbert joined the Section in July 1984 as Research Scientist. He will undertake studies of the metallogeny of mafic and ultramafic rocks with a particular emphasis on platinum group elements. Dr. Hulbert has extensive research experience in the Bushveld complex of southern Africa, the world's most important repository of platinum and chromium resources.

Dr. B.E. Taylor joined the Section on October 1, 1984 as Research Scientist and Manager of the joint GSC-OCCGS (Ottawa-Carleton Centre for Geological Sciences) Stable Isotope Facility. Dr. Taylor has experience in the application of stable isotope geochemistry to a broad range of geologic problems, and his research at GSC will focus initially on the stable isotope systematics of hydrothermal mineral deposits.

A. Pasitchniak, S. Thompson, P. Schwann and **S. Adcock** provided term support for parts of the year.

H. Jamieson completed her Visiting Fellowship term with the Section in July 1984.

Attendance at Conferences, Meetings, and Courses

J.J. Carriere

Current Activities Forum, Geological Survey of Canada, Ottawa, January 1985.

J.M. Duke

Fifth Arab Mineral Resources Conference, Khartoum, Sudan February 1985. TALK: "Descriptive, Genetic and Process Models for Nickel Sulphide Deposits of Komatiitic Affinity".

Geological Association of Canada/Mineralogical Association of Canada Joint Annual Meeting London, Ontario May 1984.

O.R. Eckstrand

Fifth Arab Mineral Resources Conference, Khartoum, Sudan February 1985.

IUGS-UNESCO Meeting, Deposit Modelling, Washington, D.C. September 1984.

Geological Association of Canada/Mineralogical Association of Canada Joint Annual Meeting, London, Ontario, May.

J.A. Kerswill

Geological Association of Canada/Mineralogical Association of Canada Annual Meeting in London, May 1984; TALK: "The Lupin Gold Deposit, Contwoyto Lake area, N.W.T.; Styles of gold distribution and possible genetic models".

Current Activities Forum, Geological Survey of Canada, Ottawa, January 1985.

R.V. Kirkham

Conference on "Recent Advances in the Geochemistry of Ore Deposits", Montreal, May 1984.

Prospectors and Developers Annual Meeting, Toronto, March 1985.

W.D. Sinclair

Canadian Institute of Mining and Metallurgy, Annual General Meeting, Ottawa, April 1984.

Recent Advances in the Geochemistry of Ore Deposits, Mineral Exploration Research Institute, Montreal, May 1984.

International Strategic Minerals Inventory Working Group, 5th Annual Meeting, Perth Australia, September 1984.

Geological Society of America Annual Meeting, Reno, November 1984. TALK: "The porphyry W-Mo deposit and associated Sn and polymetallic zones in the Fire Tower Zone, Mount Pleasant, New Brunswick".

Current Activities Forum, Geological Survey of Canada, January 1985. TALK: "Tin deposits in western Tasmania: some observations and comparisons with Canadian tin deposits".

B.E. Taylor

Geological Society of America Meeting Reno, Nevada November 1984. TALKS: "The Mount Emmons porphyry molybdenum deposit, Colorado: Magmatic degassing and meteoric water overprinting"; "Hydrogen isotope study of large-scale meteoric water transport in northern California and Nevada"; "Sources and temperatures of ore fluids in the northern Motherhode, California (Alleghany district): Oxygen and carbon isotope evidence".

American Geophysical Union Meeting, San Francisco, December 1984 TALKS: "Mantle CO_2 degassing at Long Valley, Steamboat Springs, and the Coso Range"; "Quantitative determination of the relative vertical fluxes of meteoric water using deuterium and oxygen -18"; "Oxygen isotope fractionation between Co_2 and H_20 in dynamic soil systems."

R.I. Thorpe

Canadian Institute of Mining and Metallurgy, Annual Meeting, Ottawa, April 1984.

Canadian Institute of Mining and Metallurgy, Field Symposium, Geology and Ore Deposits of the Chibougamau Region, Chibougamau, September 1984.

B. Williamson

Ontario Geological Survey Geoscience Research Seminar, Toronto, December 1984.

Current Activities Forum, Geological Survey of Canada, Ottawa, January 1985.

St. John's Ambulance First Aid Course, EMR, Ottawa, March 1985.

Special Talks and Lectures

J.M. Duke

"The Finnish Chromite Province"; The Friends of Forsterite, 10th Anniversary Meeting, Toronto, Ontario, April 1984.

L. Hulbert

"The Bushveld Complex and its mineral resources"; Canadian Institute of Mining, Saskatoon Branch, and University of Saskatchewan, Department of Geology.

W.D. Sinclair

"The porphyry W-Mo deposit and associated Sn and polymetallic zones in the Fire Tower zone, Mount Pleasant, New Brunswick"; University of Tasmania, Hobart, September 1984, and McGill University, March 1985.

"Mo, W and Sn and associated granitoid rocks in the northern Canadian Cordillera and adjacent parts of Alaska"; Australasian Institute of Mining and Metallurgy, Zeehan, Tasmania, September 1984; Bureau of Mineral Resources, Canberra, September 1984; and McGill University, March 1985.

"Tin and tungsten deposits of southeast China", Billiton Canada Limited, Mount Pleasant, New Brunswick, August 1984.

B.E. Taylor

"Hydrogen isotope evidence for degassing of rhyolite magmas and implications for the origin of Climax-type molybdenum deposits"; United States Geological Survey, December 1984.

"Mother Lode Gold Deposits: Geologic and geochemical overview and comparisons to Archean analogues"; United States Geological Survey, December 1984.

"Hydrogen isotope evidence for degassing of rhyolitic magmas and implications for certain hydrothermal ore deposits"; O.C.C.G.S. Seminar Series, Ottawa University, 1985.

R.I. Thorpe

"Lead isotope evidence regarding mineralization stages in the Chibougamau District"; CIM Field Symposium, Chibougamau, September 1984.

Membership on Committees

J.J. Carriere

Canada Savings Bond Campaign, 1984 - Branch Organizer.

J.M. Duke

International Geological Correlation Programme, Project 161, "Sulphide deposits in mafic and ultramafic rocks", participant.

Mineralogical Association of Canada, Acting secretary.

Editorial Board, Economic Geology.

Mineralogical Association of Canada, Member of Finance Committee.

O.R. Eckstrand

Ottawa-Carleton-GSC Stable Isotope Facility Mangement Committee (interim member).

R.V. Kirkham

Canada-Newfoundland Geoscience Co-operative Mineral Program, Coordinator of Buchans Projects.

Publications Committee, Society of Economic Geologists.

Planning Committee for Special MDD-GAC-MAC Symposium on "Sediment-hosted stratiform copper deposits".

Nova Scotia Mineral Development Agreement (ERDA) Co-ordinator for Economic Geology and Mineralogy Division's projects.

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.

International Strategic Minerals Inventory Working Group, member.

Canada - New Brunswick Mineral Development Agreement (ERDA), coordinator for Economic Geology & Mineralogy.

B.E. Taylor

Management Committee, Joint OCCGS/GSC Stable Isotope Laboratoty.

R.I. Thorpe

Mineralogical Association of Canada, Associate Editor.

Interdepartmental Working Committee on Northern Mineral and Energy Resource Assessment, Member.

B. Williamson

Geological Survey of Canada, Current Activities Forum, Ottawa, January 1984, Technical Services Co-ordinator.

GSC Christmas Party Committee, member.

Regional Mineral Resource Assessment Section
V.Ruzicka

The Section conducts non-renewable resource assessment studies of specific areas. These studies include: (a) resource appraisals of uranium-bearing areas; (b) estimates of resources additional to reserves in identified uranium deposits and; (c) general assessments of mineral resource potential in northern Canada for land use planning activities including national parks and other conservation areas. The assessments are based on regional metallogenic studies and on 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 and Northern Affairs, Canada Centre for Mineral and Energy Technology and Uranium and Nuclear Energy Branch of Energy Mines and Resources. Interim assessments of inferred resources in identified deposits and of results of exploration activities in Canada are

conducted during alternate years. The 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.

Mineral resource assessments of northern areas yield qualitative ratings of mineral resource potential based on probabilities of occurrence of individual deposit types. The reports are published as GSC Open Files and are used in northern land use policy and planning.

In addition the Section participates in integrated metallogenic studies of specific geological environments, and supervising and monitoring of projects in various federal-provincial Mineral Development Agreements (MDAs).

Highlights

Interim assessments of Canada's Estimated Additional Resources of uranium (i.e. resources in the inferred category) as of December 31, 1983, analysis of exploration activities for uranium in Canada in 1983, and geological evaluation of recently discovered uranium deposits in Saskatchewan (Cigar Lake, Sand Lake, Dominique-Peter), Quebec (Cogema 'L' Zone) and occurrences in the District of Mackenzie (Boomerang Lake), in Ontario (Black Sturgeon Lake) and Quebec-Labrador (Schefferville area) were completed.

Evaluation of the Cigar Lake deposit, which is at present the world's largest high grade uranium deposit (containing in excess of 100,000 tonnes U in ores grading 12% U) contributed to refinement of a genetic model for unconformity-related uranium-polymetallic deposits. Evaluation of the Dominique-Peter deposit in the Carswell Structure showed that deposition of the monometallic uranium mineralization was structurally controlled by a flat-lying ductile mylonite zone along an unconformity between two lower Aphebian units. At the Boomerang Lake uranium-gold occurrence at the sub-Thelon unconformity, N.W.T., mineralization is consistent with the current model for sub-Athabasca unconformity-related deposits.

During investigation of new uranium occurrences in the Labrador Trough, lean phosphorite associated with uranium mineralization was identified at the contact between the Sokoman Formation and the Menihek Formation.

Investigations of uranium vein-type occurrences in the Otish Basin and uranium-molybdenum and uranium-copper occurrences in the Romanet Lake area in Labrador Trough, Quebec, revealed similarities in elemental assemblages (including the presence of significant selenium) and other metallogenic features which are considered characteristic of the Circum-Ungava uranium metallogenic domain.

Investigation of uranium occurrences in the Black Sturgeon Lake area, Ontario, showed that uranium vein-type mineralization is associated with Keweenawan hydrothermal activity and is restricted to ferruginous metavolcanics adjacent to uraniferous igneous rocks. The latter probably provided the source of uranium.

Regional mineral resource appraisal work in northern Canada was continued in the Banks Island - western Victoria Island areas. New descriptions of copper occurrences and associated alteration in the uppermost Shaler Group and Natkusiak basalts, Victoria Island were published. The work led to definition of a new formation (Kuujjua Formation - quartzarenite), to documentation of an angular unconformity between the Shaler Group rocks and the basalts, and to subdivision of the Natkusiak basalts into seven members. In the Artillery Lake area, N.W.T., a number of new small Pb-Zn-Cu occurrences were documented in Aphebian dolomite of Artillery Lake Basin.

In Redstone Copper Belt, District of Mackenzie, geological mapping and basin analysis in the Coates Lake area yielded evidence of late remobilization of copper and to postulation of tectonic events 1.7 and 1.1 Ga ago in the crust beneath Selwyn Basin.

Office studies were begun for resource assessments of Wager Bay and Southampton Island preparatory to 1985 field investigations.

Uranium file records were increased by 121 occurrences. As of March 1985 the total number of occurrences in the file was 2160. Information on these occurrences, along with descriptions of individual uranium deposit type and a metallogenic map of uranium are being prepared for the new edition of Economic Geology series No. 16 'Geology of Uranium and Thorium Deposits in Canada'.

Personnel Notes

M. St-Martin completed his service as term support geologist for the Section during the year.

Attendance at Conferences, Meetings, and Courses

R.T. Bell

International Atomic Energy Agency Workshop on Uranium in Volcanic Rocks El Paso, Texas, April 1984. TALK: "Overview of Uranium in volcanic rocks of the Canadian Cordillera".

Current Activities Forum, Geological Survey of Canada, Ottawa, January 1985. POSTER: "Uranium in Circum-Ungava Geosyncline" with V.Ruzicka & G. LeCheminant.

Prospectors & Developers Association; Annual Meeting, Toronto, March, 1985.

S.S. Gandhi

Geological Association of Canada/ Mineralogical Association of Canada London, Ontario; May 1984. TALK: "Galena - sphalerite - chalcopyrite veins in Aphebian dolomite at Artillery Lake, N.W.T.".

12th Annual Geoscience Forum, Yellowknife, N.W.T., December 1984.

M. Henderson

Geological Association of Canada/Mineralogical Association of Canada Annual Meeting, London, Ontario, May 1984.

Friends of Grenville, Field Trip, September 1984.

Symposium honoring John Rodgers entitled: "Processes in continental lithospheric Deformation", Yale University, February 1985.

Geological Society of America, Northeastern Section Meeting; March 1985.

Canadian Tectonic Studies Group, Manivalin, Quebec, October 1984.

C.W. Jefferson

Interdivisional meeting on non-renewable resource assessment, ISPG/Calgary, April 1984.

Geological Association of Canada/Mineralogical Association of Canada, Joint Annual Meeting, London, Ontario, May 1984. TALK: "Reconnaissance geochemistry and copper sources in the Redstone Copper Belt, Mackenzie Mountains, N.W.T.";

12th Annual Geoscience Forum, Yellowknife, December, 1984. TALKS: "Redstone Copper Belt: Tectonics, sedimentation and relevance to Late Proterozoic metallogeny of northwestern Canada; Geology and copper occurrences of Natkusiak basalts, Victoria Island, N.W.T."; POSTER SESSION: "Resource Evaluation, MERA process and regional metallogenic studies in northern Canada".

Current Activities Forum, Geological Survey of Canada, Ottawa, January 1985. TALK: "Redstone Copper Belt; Tectonics, sedimentation and relevance to Late Proterozoic Metallogeny of northwestern Canada".

Prospectors and Developers Association Annual Convention, Toronto, March 1985. TALK: "Redstone Copper Belts; Tectonics, sedimentation and relevance to Late Proterozoic Metallogeny of northwestern Canada".

N. Prasad

Current Activities Forum, Geological Survey of Canada, Ottawa, January 1985.

V. Ruzicka

International Atomic Energy Agency Technical Committee Meeting on Uranium Resources and Supply in Africa; Niamey, October, 1984. TALK: "Possibilities of additional uranium deposits in Africa".

Current Activities Forum, Geological Survey of Canada, Ottawa, January 1985. POSTER: "Uranium in Circum-Ungava Geosyncline", co-author with R.T. Bell and G. M. LeCheminant.

R.F.J. Scoates

Geological Association of Canada/Mineralogical Association of Canada Annual Meeting, London, Ontario, May 1984. TALK: "The Fox River Sill, northeastern Manitoba; a subvolcanic intrusion", Special Session on Dykes, Sills and other Subvolcanic Phenomena.

12th Annual Geoscience Forum, Yellowknife, N.W.T., December 1984. POSTER: "MERA: Resources evaluation and regional metallogenic studies in northern Canada" (with C.W. Jefferson, D.C. Findlay and S.M. Roscoe).

Manitoba Mineral Resources Division Annual Meeting with Industry, Winnipeg, November 1984.

Current Activities Forum, Geological Survey of Canada, Ottawa, January 1985. POSTER SESSION: "Chromite mineralogy of the Bird River Sill", (with J.M. Duke, S.V. Thompson, D. Watkinson, P. Jones, R. Talkington and D. Watson).

Prospectors and Developers Association, Annual Meeting, Toronto March, 1985. POSTER: "Chromite mineralogy of the Bird River Sill" (with J.M. Duke, S.V. Thompson, D. Watkinson, P. Jones, R. Talkington and D. Watson).

Special Talks and Lectures

C.W. Jefferson

"Redstone Copper Belt: Stratigraphy, sedimentation and relevance to the Late Proterozoic tectonic evolution of northwestern Canada"; Institute of Sedimentary and Petroleum Geology, Calgary, April 1984.

"Sabkhas"; Carleton University, October 1984.

"Redstone Copper Belt; Tectonics, sedimentation and relevance to Late Proterozoic Metallogeny of northwestern Canada"; Precambrian High, Geological Survey of Canada, Ottawa, November 1984.

R.F.J. Scoates

"The Fox River Sill and Bird River Sill, significant stratiform intrusions of Manitoba", special lecture to economic geology graduate students, University of Toronto, Toronto, Ontario.

Membership on Committees

R.T. Bell

Working Group on "Exploration for Uranium in Volcanic Rocks"; International Atomic Energy Agency; Member.

C.W. Jefferson

Chairman of Committee for Field Trips; GAC/MAC/CGU Annual Meeting to be held in Ottawa, 1986.

V. Ruzicka

Energy, Mines and Resources Uranium Resource Appraisal Subcommittee on Estimated Additional Resources, Chairman.

Elsevier Scientific Publishing Company, Editorial Board of 'Uranium', Member.

Working Group of Project V, International Atomic Energy Agency (Lower Proterzoic Vein Type Deposits), Member.

International Atomic Energy Agency. Working Group of Project III: (Uranium deposits, Proterozoic Quartz-Pebble Conglomerates), Member; Technical Committee on "Recognition of Uranium Provinces", Member; Technical Committee on Uranium Resources, Member.

R.F.J. Scoates

Geological Association of Canada, Winnipeg Section, Past President.

Advisory Board of the Centre for Precambrian Studies, University of Manitoba, Member.

GSC Steering committee for proposed USGS/GSC Workshop on Resource Assessment Methods, Member.

Thompson Nickel Belt Working Group (Friends of the Nickel Belt); Founding Member.

GSC - Working Committee on Northern Mineral Resource Assessment, Member.

Regional Metallogenic Studies Section
S.M. Roscoe

The Section objective is to carry out 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 an alternate genetic hypothesis 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

Studies in the Geraldton-Beardmore gold district, Ontario have interpreted the roles of iron formations and porphyritic intrusions as structural and chemical traps for gold which, according to lead isotope and U/Pb determinations, was emplaced at a very late stage in the Archean evolution of the area. In the Flin Flon-Snow Lake belt (Manitoba MDA), it was found that: the porphyritic rocks in the Herb Lake gold camp are of volcanic origin; gold and tungsten concentrations at Phantom Lake are controlled by major structural elements; specific stuctural/stratigraphic gold-bearing domains can be distinguished at Elbow Lake; controls for gold mineralization at Amisk Lake were structural rather than stratigraphic; and an extensive silicified zone south of Chisel Lake indicates a major high temperature water/rock reaction zone which may have been the source of metals for the volcanogenic massive sulphide deposits in the Snow Lake camp. Studies of the San Antonio Mine (Manitoba MDA) were focused on structural relationships of auriferous veins. Auriferous veins at Star Lake, Saskatchewan (Saskatchewan MDA), were found to be in a previously unrecognized mylonite zone, the extensions of which represent new exploration targets.

In the Northwest Territories and Yukon Territory, documentation of regional metallogenic features and investigations of specific mineral deposits continued. It was noted that auriferous seams in Proterozoic quartzite of the Hurwitz Group, currently mined by Cullaton Lake gold mines, are rooted in altered Archean turbiditic metasedimentary rocks which themselves contain auriferous pyritic zones and probably represent paleosol. Further investigations may provide evidence that the unconformity is an attractive exploration target through areas where basal Hurwitz strata are deformed and metamorphosed. Field comparisons were made of Blachford, Aylmer, and Booth River anorogenic intrusions in the Slave structural province and layering of possible economic significance was discovered in the basal ultramafic zone of the Booth River Complex. In Yukon, Pb and S isotope studies are being used to interpret modes of origin and times of mineralization of silver and base metal occurrences in the Midway and adjacent districts southwest of Watson Lake.

A map depicting inferred metallogenic domains in northern Canada was compiled as an aid to planning of resource investigations and as a prototype for a metallogenic map. Field investigations of currently unproductive domains were begun in areas east and south of the more extensively explored Slave structural province. Some evidence was found to strengthen indications that strata in these areas, generally but probably incorrectly considered to represent highly deformed equivalents of Archean strata in the Slave province, together with younger intrusive rocks can be expected to contain mineral deposit suites differentfrom those in Slave Province.

The Section was heavily involved in Canada-provincial Mineral Development Agreements in 1984. Projects included metallogenic studies in the LaRonge and Amisk Lake areas, Saskatchewan, the Flin Flon-Snow Lake and Bissett Areas, Manitoba, the eastern part of the Meguma Terrane, Nova Scotia, western Labrador (Newfoundland), carbonate rocks of western Newfoundland, and the Buchans mining camp in Newfoundland.

Personnel Notes

Dr. A.R. Miller returned in February from a one-year scientific exchange visit with the Bureau of Mineral Resources, Canberra, Australia, where he investigated deposits in the Pine Creek uranium district and elsewhere in Australia for purposes of comparing regional metallogenic parameters there with those in Keewatin District.

Dr. Francois Robert joined the section in January 1985 following post-doctoral work focused on fluid inclusion studies at University of Michigan. His PhD thesis work at Ecole Polytechnique was based on a detailed study of structural control of gold mineralization and associated hydrothermal alteration at the Sigma Gold Mine, Val d'Or, Quebec. He will be engaged in metallogenic studies in eastern Canada and is beginning this work with investigations in the Val d'Or-Malartic section of the Abitibi greenstone belt, as well as preliminary studies in parts of the Grenville structural province.

Dr. Tyson Birkett joined the section June 1984 under a two year term contract to work on eastern Canada ERDA projects and metallogenic overviews. He

brings experience in mineral exploration, particularly in Quebec, and expertise on beneficiation of iron ores, mineralogy and mineral processing of rare metal-bearing alkalic granites.

A.Galley, D. Ames, M. St. Martin, M. Firko (Ottawa and field), C. Saunders (St. John's) A. Langille (Halifax) and D.V. Venugopal (Fredericton), participated in Section ERDA projects using ERDA term positions. **C.D. Anglin** provided term support for Boundary Dispute Program activities.

Attendance at Conferences, Meetings, and Courses

J.M. Franklin

Geological Association of Canada/Mineralogical Association of Canada London, May 1984. TALK: "Silver veins, Thunder Bay District" and "Volcanology of the Mattabi Mine sequence";

Canadian Institute Mining Annual General Meeting, Ottawa, April 1984.

Irish Association for Economic Geology, Dublin September 1984. TALK: "Massive sulphide deposits in modern and ancient environments".

American Geophysical Union, San Francisco, December 1984. TALK: "Hydrothermal activity and tectonics of the northern Juan de Fuca ridge".

Current Activities Forum, Geological Survey of Canada, Ottawa, January 1985. TALK & POSTER: "Sulphides on the Juan de Fuca ridge".

U.S. Geological Survey, McKelvey Symposium, Denver, February 1985.

S.B. Green

Prospectors and Developers Association Annual Meeting, Toronto, March 1985, as General Co-ordinator, GSC Display.

"Sedimentary Ore Deposits", course by D.F. Sangster, attended for credit, Ottawa University.

K.H.Poulsen

Institute of Lake Superior Geology, Wausau, Wisconsin.

Canadian Institute Mining and Metallurgy, Chibougamau Symposiums, September 1984. TALK: "Mineralization associated with Archean gabbro-anorthosite intrusions, Rainy Lake area, Northwestern Ontario".

Saskatchewan Open House, Regina, November 1984.

Manitoba Open House, Winnipeg, November 1984.

Ontario Open House, Toronto, December 1984.

S.M. Roscoe

Geological Association of Canada/Mineralogical Association of Canada Annual Meeting London, Ontario, May 1984.

Special Talks and lectures

J.M. Franklin

"Gold deposits of the Canadian Shield"; delivered at United States Geological Survey, April 1984; University of Minnesota at Duluth, May & October 1984; Mt. Allison University, University of New Brunswick Acadia University, and St. Francis Xavier University, January 1985.

"Application of lead isotopes to the genesis of mineral deposits in the Canadian Shield", United States Geological Survey, April 1984.

"Alteration associated with massive sulphide deposits"; delivered at University of Minnesota, May & October 1984; Mt. Allison University, University of New Brunswick, Acadia University, and St. Francis Xavier University, January 1985.

"Copper deposits of the Canadian Shield" International Geological Congress, Moscow, August 1984; delivered by G.A. Gross.

"Massive sulphide deposits;" short course at University of Toronto.

"Gold in Central Canada"; key note address, Canadian Institute Mining and Metalllurgy District 4, Thunder Bay, October 1984.

"Massive sulphide deposits in fast-spreading ridges"; Mt. Allison University, January 1985.

"Lead isotopic aspects of the Chibougamau base metal and gold deposits"; CIM-Chibougamau Symposium, September 1984.

CBC - Quirks and Quarks; "Hydrothermal activity on oceanic ridges", January 1985.

"Volcanology of the Onaman River Massive Sulphide district", Institute of Lake Superior Geology, Wausau, Wisconsin, May 1984.

"Chloritoid Alteration at Wawa" (poster session), Ontario Geological Survey Open House, December 1984.

S.B. Green

Firearms instructor for Field Officer Training, Departmental Safety Course.

K.H. Poulsen

"Metallogeny of an Archean Wrench Zone, Rainy Lake, Ontario", Precambrian High; Winnipeg Branch, Geological Association of Canada; & University of Toronto seminar, invited speaker.

"Structural geology of mineral deposits", University of Minnesota at Duluth.

S.M. Roscoe

"Lead isotope dating of galena-bearing veins in dolomite at Artillery Lake, Northwest Territories and Mistassini Lake, Quebec"; Yellowknife Geoscience Forum, December 1984.

Membership on Committees

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.

S.B. Green

Study of Research and Development in the Exploration for Mineral Deposits; CGC Task Group Assistant.

Current Activities Forum, Geological Survey of Canada, Ottawa, January 1985, General Co-ordinator.

Technical Committee Chairman for GAC/MAC/CGU Annual Meeting to be held in Ottawa, 1986.

IUGS/GSC, Current Activities Forum 1986, General Co-ordinator.

Canadian Geoscience Council Annual Survey of New Discoveries, co-ordinator.

Screening Committee on General Instructions for Field Parties, GSC representative.

CIMM Survey of Canadian Thesis Topics, coordinator.

K.H. Poulsen

Eastern Ontario Subsidiary Agreement, Minerals Sub-committee, Branch Representative.

EMR research agreement committee, EGM

Mathematical Application in Geology

F.P. Agterberg

The objectives of the Section are: **(i)** to develop and apply probabilistic methods of mineral resource estimation for land-use planning purposes; **(ii)** to provide statistical expertise and services to projects throughout the Geological Survey; **(iii)** to develop statistical exploration methods for use by the mineral industry; **(iv)** to develop and apply new methods for the integration and interpretation of various geoscience data sets, including LANDSAT and other remotely sensed data.

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

Specific topics on which consultation is provided include: (1) fitting of frequency distribution models; (2) trend-surface analysis and geostatistical contouring techniques including "Kriging"; (3) multivariate statistics applied to geological data; (4) image analysis of remote sensing data, map patterns and photomicrographs; (5) artificial intelligence and expert systems in geology; (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 new technique developed in collaboration with RGG Staff for "filtering" stream-silt geochemical data by using digitizing methods to remove geochemical contributions due to bedrock lithology and stream catchment basin effects continues to show promise. Field testing in the Nahanni district, Selwyn Basin, Yukon yielded positive results (new secondary zinc mineralization discovered).

As input to the Radwaste program, investigations were carried out on the use of multiple regression for petrophysical characterization of granites as a function of alteration.

Work continued on modifications and refinements to the RASC (Ranking and Scaling) and CASC (Correlation And Scaling in time) computer programs developed in collaboration with AGC for treating foraminiferal data sets in quantitative biostratigraphy. Applications of these programs using well data sets from the Labrador Shelf and Hibernia oilfield continued. A new project on mathematical and biostratigraphical characterization of multiple Labrador Shelf/Grand Banks zonation was initiated using data on dinoflagellates, spores and pollen in addition to foraminifera.

A variety of investigations on image analysis and (LANDSAT) image enhancement techniques continued. Methods for statistical correlations of mapped geological data (faults, contacts, mineral deposit distributions) with LANDSAT lineament data (lineament enhancement) are now fairly advanced and sets of computer programs in this area have been developed. A new system for treating digital images of remotely-sensed data, called "BIAS" (Basic Image Analysis Software) is under development.

Work on computer programs for processing images digitized on the new Optronics laser scanner of Lands Directorate, Environment Canada, is nearing completion. This includes reading the magnetic tapes on which the images are initially recorded and making use of the 'playback' facility on the Optronics for display of processed images. A new software package "MORPHOLOG" which does image analysis on grey-tone images was obtained from Centre de Morphologie Mathematique in Fontainebleau, France.

Work continued on the investigation of "confidence bands" of quantiles (percentiles), a classic problem in the application of statistics to various kinds of geoscience data. This is being approached through the development of a computer program called WIENER which computes probabilities associated with Wiener and Brownian bridge processes. The method has been applied to construct confidence bands on frequency distributions of detection limit truncated geochemical data.

Field tests on the correlation of digital airborne data from MEIS (multi-detector electro-optical imaging scanner) with biogeochemical (vegetation) data commenced in eastern Ontario, with the objective of developing correlation techniques for airborne RS anomalies with metal anomalies in ground materials. Results over a carbonatite showing in Algonquin Park parallel geochemical and geophysical results.

Work on a computer program for statistical analysis of directional features was continued. This allows the construction of vector fields by smoothing of observed data and interpolating between them.

Personnel Notes

S.N. Lew continued as scientific programmer during the year. Part-time assistance was provided by **J. Oliver, I. Thomas, and C. Vander Grient.**

Two graduate students at the University of Ottawa joined the Section as guestworkers: **E. Grunsky** on multivariate statistical analysis of chemical data from volcanic suites in northern Ontario, and **M. D'Iorio** on integration of various types of microfossil data from Labrador Shelf/Grand Banks wells.

Zou Haiqing returned to Wuhan College of Geology, People's Republic of China in May after completing 26 months with the Section as Visiting Research Scholar.

Attendance at Conferences, Meetings, and Courses

F.P. Agterberg

Ninth International Conference of Committee on Data for Science and Technology, Jerusalem, Israel, June 1984; TALKS: "Spatial Analysis in the Earth Sciences", Plenary Lecture, and "Probabilistic Mineral and Energy Resource Evaluation".

27th International Geological Congress, Moscow, U.S.S.R., August, 1984; TALKS: "Quality of time scales - a statistical appraisal;" "Discrete probability distributions for mineral deposits in cells"; and "Probabilistic method for automated stratigraphic correlation".

13th Annual Geochautauqua on Computers in the Earth Sciences, Morgantown, W.V., October, 1984, Quantitative Stratigraphy Project, TALK: "Computer algorithms and data bases resulting from the IGCP".

Ocean Drilling Program Workshop, Halifax, N.S., November 1984.

Geological Survey of Canada, Current Activities Forum, Ottawa, January 1985.

G.F. Bonham-Carter

Association of Exploration Geochemists Annual Meeting, Reno, Nevada, March 1984. POSTER & PAPER: "Investigation of Stream Zn and Pb as predictors of stratiform Zn-Pb deposits, Selwyn Basin, Yukon", with W.D. Goodfellow.

Pre-conference workshop on "Integration of geo-coded data bases", sponsored by Canada Centre for Remote Sensing and Canadian Remote Sensing Society, Ottawa July 1984; TALK: "Spatial correlation of features on geological maps".

18th International Conference on Remote Sensing, Paris, October 1984, POSTER: "Quantitative relationship between Landsat-derived linears and occurrence of gold in the Timmins - Kirkland Lake area, Ontario".

Current Activities Forum, Geological Survey of Canada, Ottawa, January 1985, TALK: "Detection of Landsat linears and methods of correlating mineral occurrences with lineaments", with A.N. Rencz. POSTER: "Quantitative relationships between gold occurrences and lineaments, Timmins -Kirkland Lake area".

A.N. Rencz

Ninth Canadian Symposium on Remote Sensing. St. Johns, Newfoundland, August, 1984

Current Activities Forum, Geological Survey of Canada, Ottawa, January 1985; TALK: "Detection of Landsat linears and methods of correlating mineral occurrences with linears".

Geoscience working committee on geobotany and remote sensing, Toronto, December 1984 & March 1985.

Field course in remote sensing for exploration geology, San Francisco, March, 1985.

Special Talks and Lectures

F.P. Agterberg

"Quantitative stratigraphic correlation", University of Milano, June 1985.

"Spatial pattern analysis in geoscience", University of Bologna, June 1985.

"Geomathematics", Module of course GEO 52g2, Ottawa-Carleton Centre for Geoscience Studies, October, November, 1984.
"Statistics in Geology, course GEO3100, Geology Department, University of Ottawa, January-March, 1985.

G.F. Bonham-Carter

"Some remote sensing applications to geology", Ontario Geological Survey, February 1985.

C.F. Chung

"Geomathematics in mining applications: - Statistical prediction of sulphur content in coal" Politechnical Institute of Turin, Italy.

"Multivariate statistical analysis for resource evaluation - SIMSAG - C.I.N.E.C.A.", Bologna, Italy.

"Estimation of the variance for the map generated by SURFACE II," Institute of Topography, University of Bologna, Italy.

"Estimation of probabilities associated with Wiener and Brownian bridge processes and their applications", Department of Statistics, Carleton University, Ottawa.

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.

International Geological Correlation Programme Project 148, Quantitative Stratigraphic Correlation Techniques, Leader, International Working Group and Co-leader, Canadian Working Group.

Carleton University, Department of Mathematics and Statistics, Adjunct Professor;

Laboratory Research in Statistics and Probability, member.

University of Ottawa, Department of Geology, Adjunct Professor and Graduate School member.

Canadian Mining and Metallurgical Bulletin, Geology Division, Editorial Board.

A.N. Rencz

Canadian Advisory Committee on Remote Sensing, member.

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 Divisional computerized mineral deposits database (CANMINDEX) as well as providing assistance relating to computer-based geoscience data management and display. The section also provides divisional library and reference services relevant to mineral deposits research.

Highlights

Significant progress was achieved in 1984-85 in the area of information management through the use of micro-computers, particularly in two projects in which MRIS participated in this fiscal year. Data for the Yava deposit project, Salmon River Basin, Nova Scotia were collected in the field using a lap-top portable micro-computer and then transferred to the EMR main-frame computers using the DATAPAC telephone network. A desktop micro-computer was used to further transform this raw data in order to produce printed output and also, again on the mainframe computer, three dimensional graphic representations of the Yava mineral deposit.

Approximately 1110 deposits were added to CANMINDEX bringing the total to 20,500. This comprised mineral deposit information compiled under the Sudbury-Timmins-Algoma Minerals Program (STAMP) Project 1. As part of the same project, 1136 CANMINDEX records were updated. APPLE computers were used on-site to increase the efficiency of the data entry and querying process. These data are being prepared for release in hardcopy and digital form.

MRIS participated in a mineral inventory data files workshop in Toronto which drew speakers and audience from federal and provincial governments and industry. Central to the discussions was the need to make mineral resources data more readily available to all parties concerned and to avoid unnecessary duplication of effort in compiling the information.

"User-friendly" computer procedures were implemented which allow mineral deposit overlays to be plotted using CANMINDEX data at standard NTS scales. Methods for cluster plotting ("mining camp" deposits) were developed in support of the Mineral Deposits Map of Canada project.

Forty retrievals of mineral deposit information were made from the Economic Geology mineral deposits database for officers in this and three other divisions of the Branch. Staff assisted in building or downloading from the CYBER, several small databases on microcomputers where geologists have taken advantage of the micro's flexibility, ease of use and full-screen editing to prepare and analyze their data.

Attendance at Conferences, Meetings, and Courses

D.F. Garson

Infofetch Training Seminar, December 1984, Computer Science Centre, Ottawa.

Current Activities Forum, Geological Survey of Canada, Ottawa, January 1985.

Prospectors & Developers Association Annual Meeting, Toronto, March 1985, POSTER: "CANMINDEX".

J.M. Shaw

Carleton University 67.324 "Mineral Deposits"

Orientation to EMR, January 1985.

Introduction to Data Communications, EMR.

Current Activities Forum, Geological Survey of Canada, Ottawa, January 1985.

R.M. Laramee

Completed all required courses and obtained "Certificat en Informatique de gestion" from Universite du Quebec a Hull, May 1984.

Training seminar on Infofetch system by Magna Systems November 1984.

Current Activities Forum, Geological Survey of Canada, Ottawa, January 1985.

Prospectors and Developers Association Annual Meeting, March 1985. POSTER: "CANMINDEX".

S.A. Scully

In-house French Tutoring April '84-March '85, 3 hours per week.

Orientation to EMR, January 1985.

A.G. Douma

Current Activities Forum, Geological Survey of Canada, Ottawa, January 1985.

First Aid Certificate Renewal March 1985, Ottawa.

Special Talks and Lectures

D.F. Garson

"CANMINDEX", paper co-authored with R.M. Laramee, Workshop on Mineral Inventory Data Files, March 1985, Toronto.

R.M. Laramee

"CANMINDEX", Co-authored with & presented by D.F. Garson, at Workshop on Mineral Inventory Data Files, March 1985, Toronto.

Membership on Committees

J.M. Shaw

Geological Survey of Canada Children's Christmas Party 1984

R.M. Laramee

Infofetch Evaluation Group Member, December 1984 to April 1985

Special Projects

Three senior staff geologists have responsibilities that include: the geology of iron, manganese, lead and zinc deposits in Canada; the geology of ocean mineral resources; and the curation and management of collections of ores and host rocks.

Highlights

Confirmation of the syngenetic origin of the rare earth element content (up to 6%) in Algoma type oxide facies ironformation in China adds to the metallogenic significance of ironformation and related facies of chemically precipitated rocks.

Field study of metamorphic features of ironformation and mica and phosphate deposits in carbonatite rocks of the Aldan Shield, USSR, provided a basis for comparison of similar deposits in the Grenville Province.

Geochemical studies of ironformation and recent metalliferous sediments are providing data for identifying comparable sedimentary processes and environments for the deposition of recent and ancient mineral deposits.

An Economic Geology Series Report "Classification, distribution and grade-tonnage summaries of Canadian lead-zinc deposits," submitted for publication summarizes quantifiable characteristics of Canadian deposits and occurrences; volcanic-associated exhalative and vein/replacement deposits constitute 47 and 37 percent, respectively, of the total deposit population, the median size of all Canadian lead-zinc deposits is 0.5 million tonnes of ore.

A detailed study of the Yava lead deposit, Cape Breton Island revealed that: the lead was almost certainly derived locally from a Lower Devonian quartz feldspar porphyry; high coal vitrinite values are likely caused by oxidation of the coaly material rather than by thermal maturation; modern drainage patterns in the Salmon River Basin represent the exhumed Pennsylvanian-age drainage which controlled original ore deposition, and modern patterns could be used as a guide to other, similar deposits in the area.

Discovery of several stratabound sandstone-lead occurrences in Gaspe may indicate potential for large-tonnage, low-grade lead deposits in the region.

Personnel Notes

D.F. Sangster was transferred to the Special Projects unit in April, 1984. He was the 1984 recipient of the Society of Economic Geologists Silver Medal.

D. Ames, P. Valliancourt and **Z. Richardson** provided term support for parts of the year.

Attendance at Conferences, Meetings, and Courses

L.M. Cumming

86th Annual General Meeting of CIM, Ottawa, April 1984. TALK: "A Canadian Research Collection for Economic Geology".

Canadian Biostratigraphic Seminar, University of Ottawa, September 1984.

Physical Sciences in the Eighties, Hertzberg Lectures, NRC Ottawa, November 1984.

Current Activities Forum, Geological Survey of Canada, Ottawa, January 1985.

Prospectors and Developers Association, Toronto, March 1985.

Mineral Inventory Data Files Workshop, Toronto, March 1985.

G.A. Gross

27th International Geological Congress, Moscow, USSR, August 1984. Delivered TALK authored by J.M. Franklin entitled "Copper deposits of the Canadian Shield".

D.F. Sangster

"Symposium on mineral deposits of Ireland" - sponsored by Irish Association for Economic Geology, Dublin, Ireland, September 1984.

Special Talks and Lectures

G.A. Gross

"Metallogeny of ironformation rocks, and metalliferous sediments", series of 10 lectures for ministries of Metallurgy and Geology in China.

D.F. Sangster

"Sediment-hosted Pb-Zn deposits" University of Witwatersrand, Pretoria, South Africa (three-day course), April 1984.

"Sediment-hosted Pb-Zn deposits" Geological Society of Southwest Africa - one day course - Windhoek, SWA. April, 1984.

"Sediment-hosted Pb-Zn deposit" Geological Society of Zimbabwe - one day course, Harare, Zimbabwe, April 1984.

"Age of mineralization in Mississippi Valley-type (MVT) deposits; A critical requirement for genetic modelling", Irish Association for Economic Geology, Dublin Ireland, September 1984.

Presented Fall Term course at Ottawa University on "Sedimentary Mineral Deposits", September - December 1984.

Membership on Committees

L.M. Cumming

Ottawa Branch CIM, Executive Committee, member.

Youth Science Foundation, Executive Committee, member, representing Geological Association of Canada.

Ottawa Regional Science Fair, judging committee, member.

G.A. Gross

Precambrian Research Editorial Board, member.

Canada - USSR Mixed Commission on Economic Industrial, Scientific and Technical Cooperation, Applied Geology Working Group, Canadian Co-chairman.

Geological Survey of Canada Task Group on Submarine Metalliferous Hydrothermal Systems, member.

EMR Departmental Committee on Ocean Mining, member.

International Geological Correlation Program Project 91, Metallogeny of the Precambrian, Canadian Co-ordinator; Project 111, Manganese Ore deposits, member; Project 187, Siliceous Sediments, member.

D.F. Sangster

Carleton University, Ottawa, Honorary Adjunct Professor.

Society of Economic Geologists, member of: Thayer Lindsey Speakers Committee; Committee on Committees

Mineral Deposits Laboratory
R.D. Lancaster

The Mineral Deposits Laboratory is responsible for the processing of rock specimens through sorting, slabbing and polishing samples and through the preparation of polished sections and mineral separations. Specimens are slabbed to provide a flat, fresh surface for examination and to divide the sample for various other uses, e.g. chemical analyses, mineral separation, polishing.

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

Mineral separations are obtained by selective grinding of rock samples to a specific grain size and subsequent processing by various combinations of magnetic, heavy liquid and superpanner methods of concentration to produce monominerallic fractions primarily for isotopic and trace elements analyses.

Production Statistics for the Year

Specimens Slabbed for:	
Economic Geology and Mineralogy	3939
Resources Geophysics & Geochemistry	722
Precambrian Geology	14
Other	18
TOTAL	4693
Specimens Slabbed & Polished for:	
Economic Geology & Mineralogy	651
Resource Geophysics & Geochemistry	412
Precambrian Geology	2
TOTAL	1065
Polished Sections Prepared for:	
Economic Geology & Mineralogy	738
Resource Geophysics & Geochemistry	10
Precambrian Geology	12
TOTAL	750
Mineral Separations Prepared for:	
Economic Geology & Mineralogy	498
Resource Geophysics & Geochemistry	53
Precambrian Geology	8
TOTAL	559

The unit is responsible for the maintenance of a research microscopy laboratory, cathodoluminescence equipment, and a heating-freezing stage and ancillary equipment for fluid inclusion studies (new). Divisional drafting services are also the responsibility of this unit.

Attendance at Conferences, Meetings, and Courses

R.D. Lancaster

Current Activities Forum, Geological Survey of Canada Ottawa, January 1985.

Membership on Committees

R.D. Lancaster

Branch Safety Committee, Member.

MINERALOGY AND CHEMISTRY SUBDIVISION
A.G. Plant

The main responsibilities of the Subdivision are as follows:

1. To provide chemical and mineralogical support (data, advice, assistance) as required for Branch scientific projects, and occasionally for other projects and organizations, through the development and operation of chemical and mineralogical laboratories;

2. To develop and maintain, by means of ongoing research and development on methods and instrumentation, an up-to-date capability to provide the expertise required;

3. To carry out mineralogical research studies on minerals and selected mineral deposits, independently or in collaboration with other geoscientists;

4. To develop and curate National and Branch rock, mineral and meteorite collections;

5. To provide mineralogical information to the Canadian public.

At the end of the report period the Subdivision comprised 2 research scientists, 11 physical scientists, 2 chemists and 23 scientific and technical support staff.

Mineralogy Section

The Section provides the facilities and expertise for mineralogical studies by maintaining and developing laboratories for X-ray diffraction and crystallography, electron microprobe analysis and scanning electron microscopy. These are complemented by the sample preparation and mineral separating laboratories, the latter being almost exclusively devoted to the needs of geochronological research. The Section has responsibility for the Reference Collection Facility at Tunney's Pasture where it maintains the GSC rock collection, while the Reference Series of the National Mineral Collection (approximately 14 000 specimens) and the National Meteorite Collection are housed at 601 Booth Street. Information to the public is provided through the preparation and sale of sets of rocks and minerals, the free examination of specimens submitted by the public, and the preparation and publication of guidebooks to Canadian mineral areas as an aid to collectors and tourism.

X-ray Diffraction, Electron Microbeam Analysis and General Mineralogy

Four hundred and fifty-five (455) requisitions for X-ray diffraction, electron microprobe analysis, scanning electron microscopy, petrographic studies and general mineralogy were completed during the year in support of 81 projects. X-ray powder pattern determinations involved 1232 mineral identifications by Debye-Scherrer powder camera and 138 new standard reference patterns were added to the collection. The X-ray diffractometer transferred from the Precambrian Division in 1983 has been automated with the addition of a microprocessor control unit. The unit has greatly reduced the length of time required per analysis and has eliminated manual settings of the diffractometer, thus preventing misalignment of the equipment. With the improved service provided, the number of XRD analyses has increased from 378 in 1983-84 to 1032 in 1984-85.

Petrography and mineral identification, through polished and polished-thin sections, X-ray diffraction and microprobe analysis, were carried out on research projects for various divisions. The results of these studies were reported in 40 internal reports. For uranium-related studies, 121 autoradiographs were prepared, and the method of preparation improved to avoid handling of powdered uraninite during sample layout. Analytical studies were provided by the electron microprobe and scanning electron microscope laboratories in support of 38 Branch projects and 4 external projects requiring a total of 3679 hours of instrument time. The 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.

The installation of the new electron microprobe was completed at the beginning of the report period and the instrument integrated into the laboratory operation. Image and particle analysis systems were evaluated during the year and the selected instrumentation was received at the end of the fiscal year. It will be used to provide quantitative data to support a broad range of research projects in sedimentology, petrology, mineral deposits, paleontology and mineralogy.

Mineralogical studies of Hemlo gold deposits continued in cooperation with company personnel. To date, more than 700 polished sections and 110 polished thin sections, representing 23 drill holes from the properties of Teck Corona, Noranda and Lac Minerals have been examined. The new microprobe has proved to be invaluable for this study as multiple-element analyses of all minerals are now readily available. These investigations are contributing significantly to the understanding of the nature, distribution and statigraphic relationships of the unusual mineral assemblages associated with gold in the Hemlo camp and have received complimentary comments and support from companies involved.

Sample Preparation and Mineral Separation

Numbers of samples prepared for chemical analysis is shown in the following table, together with subtotals for each Division. This work resulted from 80 requisitions in support of 40 projects.

	PC	EGM	RGG	CGTS		Other	Total
Forwarded 83-84	188	188	0	13	0	20	409
Received 84-85	467	1113	62	62	283	52	2039
Completed 84-85	540	1301	62	75	283	72	2333
Carried 85-86	115	0	0	0	0	0	115

Sample preparation and mineral separation for geochronology included the following: 4 potassium-argon and 19 rubidium-strontium whole rock samples; 62 zircon, 62 monazite, 70 biotite, 41 amphibole, 6 muscovite and 27 other mineral concentrates. In addition, separations were completed for 56 miscellaneous mineral concentrates for other projects.

Curation of Collections

Curation of the National Mineral Collection, Systematic Reference Series, resulted in the addition of 208 mineral specimens, including 22 species new to the collection, and 67 bulk accessions. Curation of the Historic Ore Collection saw it moved to the Reference Collection Facility at Tunney's Pasture, where space was also provided for suites of mineralogical research specimens. Curation of the rock collections resulted in the addition of 1984 field collections and of several field collections from previous seasons, along with at least 3 reference suites from world localities. Suites for analysis from archived collections were provided in 3 instances. Curation of the National Meteorite Collection resulted in repatriation of a cut portion of the THURLOW iron, and additional RED DEER HILL accession. A specimen of INNISFREE was loaned overseas for low level counting of long-lived isotopes. Continuous care was provided for the collections at the Reference Collection Facility, Tunney's Pasture, including receipt and retrieval of numerous specimens, assistance to many researchers, and reconstruction of certain facilities to provide different storage areas for current/field versus archival collections, a petrography

laboratory, and facilities for temporary office areas to examine collections. Massive moves of collections between 601 Booth Street, and within the Reference Collection Facility, were accomplished.

Project personnel carried out field work in the Yukon, Northwest Territories and Quebec, and many specimens of the rare mineral armenite were obtained in cooperation with personnel from the National Museum of Natural Sciences. In response to over 80 requests from Branch personnel, other geoscience institutions, universities, and industry, over 350 specimens were selected and provided for research. Ten exchanges were carried out with other institutions, collectors and mineral dealers.

Assistance to the Public

Information provided to the public by the Curatorial Services Unit required the identification of more than 250 rock and mineral samples, with results being communicated in 37 written and 49 oral reports. Miscellaneous information related to minerals and rocks was given in person or by telephone on numerous occasions.

Enquiries on minerals and mineral occurrences were received by Mrs. Stenson as follows: 40 office visits, 65 telephone enquiries and 20 letters. Identifications were provided for 80 specimens.

Preparation of Rock and Mineral Sets

Seven thousand, six hundred and twenty-four (7, 624) sets of rocks and minerals were prepared and shipped during the year, compared to 6,622 in 83-84. The distribution of these across Canada was as follows:

	1983-84	1984-85
Alberta	1,353	1,075
British Columbia	250	147
Manitoba	107	144
New Brunswick	80	180
Newfoundland	44	64
Nova Scotia	332	340
N.W.T.	136	27
Ontario	1,089	1,307
P.E.I.	25	27
Quebec	548	1,782
Saskatchewan	392	74
Yukon	190	180
G.S.C. Offices	1,496	1,306
E.M.R. Offices	460	890
Other	120	81

At the request of the National Film Board, 25 collections were prepared and supplied to accompany Earth Science Filmstrip Kits. Revenue from the sale of all sets and collections payable to the Receiver General, was $30,621.00 ($26,488.00 in 83-84). The large increase in the distribution of rock and mineral sets to the Province of Quebec is mainly due to the introduction of a new school manual (Initiation aux sciences) at the Secondary School level. Production of a revised economic collection to replace the 120 specimen collection which was discontinued in February 1982 is under consideration.

Special requests for specimens were filled for: National Museum Mobile Exhibit; Information Division EMR for display at the Canadian National Exhibition in Toronto; Minister's Office, EMR; Science North Sudbury; Children's Museum in Hamilton; Ottawa Public Library; Canadian Embassy in Brussels, Belgium; and for different officers and labs of the GSC. A display on rock and mineral collections was also loaned out to the Ottawa Public Library.

Field work was undertaken at 53 localities in British Columbia, Alberta, Saskatchewan, Manitoba, Ontario and Quebec. The work involved more than 36,000 km of travel by plane, boat and truck and the collection of 24 tons of minerals, rocks, ores and fossils.

Attendance at Conferences, Meetings, and Courses

H.G. Ansell

Eleventh Annual Rochester Academy of Sciences Mineralogical Symposium, Rochester, New York, April 1984.

Tucson Gem & Mineral Show, Tucson, Arizona, February 1985.

Current Activities Forum, Geological Survey of Canada, Ottawa, January 1985. TALK: "The National Mineral Collection Database: On-line Collection Management".

M. Bonardi

Cameca Microprobe User School - San Diego, June 1984.

Microbeam Analysis Society Annual Meeting. Lehigh University, July 1984.

Workshop/Tutorial on Analytical Electron Microscopy and Microbeam Analysis, EMR CANMET, Ottawa, July 1984.

R.N. Delabio

Short Course on the PW1710 X-Ray Diffractometer at Philips Laboratories, Toronto, May 1984.

EMR Performance Review and Employee Appraisal Workshop, December 1984.

R.W. Christie

EMR First Aid Course, March 1985

D.C. Harris

Geological Association of Canada/Mineralogical Association of Canada Annual Meeting, London Ontario, May 1984. TALK: "Mineralogy of the International Corona and Golden Giant gold deposits, Hemlo Area, Ontario".

Hemlo 1985, The Golden Year, gold deposits forum, University of Western Ontario, February 1985.

R.K. Herd

Eleventh Annual Rochester Academy of Sciences Mineralogy Symposium, Rochester, New York, April 1984.

Geological Association of Canada/Mineralogical Association of Canada Meetings, London, Ontario, May 1984. TALKS: "Sapphirine-garnet granulites and associated rocks from the St. Maurice River area, Grenville province (Mineral textures and reactions)"; "Sapphirine-bearing granulites and associated rocks from the St.

Maurice area, Grenville province (Mineral chemistry and PT conditions)".

National Research Council of Canada Open House, Ottawa, June 1984.

PARIS (Pictorial and Artifact Retrieval and Information System) User Representatives Seminar, Ottawa, 1984.

National Research Council of Canada Associate Committee on Meteorites Annual Meeting, October 1984.

Polar Continental Shelf Project, General Planning Meeting, November 1984.

Current Activities Forum, Geological Survey of Canada, Ottawa, January 1985. TALK: "The National Mineral Collection Database: On-line collection management".

J.M. Huot

EMR Retirement Course, March 1985.

G.M. Lecheminant

Current Activities Forum, Geological Survey of Canada, Ottawa, January 1985.

A.G. Plant

Workshop/Tutorial on Analytical Electron Microscopy and Microbeam Analysis, EMR CANMET, Ottawa, July 1984.

Executive Committee Meeting of Spectroscopy Society of Canada, Ste. Jovite, October 1984.

National Research Council of Canada Associate Committee on Meteorites, Ottawa, October 1984.

Meetings at University of Toronto to monitor progress in the establishments of the Isotrace Laboratory, September, December 1984 and January 1985.
Current Activities Forum, Geological Survey of Canada, Ottawa, January 1985.

G.J. Pringle

Workshop/Tutorial on Analytical Electron Microscopy and Microbeam Analysis, EMR CANMET, Ottawa, July 1984.

A.C. Roberts

Rochester Mineralogy Symposium, April 1984.

Joint Committee for Powder Diffraction Standards biannual meeting, Essington, Pennsylvania, October 1984 and March 1985,

A.P. Stenson

Mineralogical Association of Canada, Annual and Executive meetings, London, Ontario, May 1984.

Joint Geological Association of Canada/Mineralogical Association of Canada Meeting, London, Ontario, May 1984.

Mineralogical Association of Canada Executive meeting, Ottawa, Ontario, October 1984.

Joint Committee for Powder Diffraction Standards Fall meeting, Essington, PA, October 1984.

Geological Association of Canada/Mineralogical Association of Canada Council meeting, Ottawa, Ontario, February 1985.

Joint Committee for Powder Diffraction Standards Annual meeting, Essington, PA, March 1985.

D.A. Walker

Scanning Electron Microscopy 1984 Symposium, Philadelphia, April 1984.

Workshop/Tutorial on Analytical Electron Microscopy and Microbeam Analysis, EMR CANMET, Ottawa, July 1984.

Special Talks and Lectures

H.G. Ansell

"Minerals of the Rapid Creek - Big Fish River area, Yukon Territory: a review plus new information", Mineralogical Society of America - Friends of Mineralogy Symposium, Tucson, Arizona, February 1985.

R.K. Herd

"Identification of rocks and minerals for children", Ottawa Public Library, August 1984.

A.P. Stenson

School of Continuing Education series of 8 sessions on Gemology, Carleton University, April/May 1984.

Membership on Committees

H.G. Ansell

Ad Hoc Committee on Baillie Report on GSC Collections

National Capital Region PARIS User Group (Natural Sciences Database, Canadian Heritage Information Network).

R.W. Christie

Branch Christmas Party Committee, member.

R.G. Gordon

Branch Christmas Party Committee, Chairman.

D.C. Harris

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

Mineralogical Association of Canada, Membership Committee, Chairman.

R.K. Herd

Ad Hoc Committee on Baillie Report on GSC Collections, Chairman.

National Research Council of Canada Associate Committee on Meteorites (also Education and Research Subcommittees), member.

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

National Capital Region PARIS User Group (Natural Sciences Database, Canadian Heritage Information Network), member.

Cultural Property Export and Import Act, for Minerals and Meteorites, Expert Examiner.

Field Trip to St-Hilaire, Quebec: Mineralogical Association of Canada Ottawa Meeting, 1986, Co-ordinator (with R. Gault).

A.G. Plant

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

Spectroscopy Society of Canada, Past-President.

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

National Research Council of Canada Associate Committee on Meteorites, member.

Natural Science and Engineering Research Council of Canada Committee for Infrastructure Grant Application, by Surface Science Laboratory, University of Western Ontario, member.

A.C. Roberts

Joint Committee for Powder Diffraction Standards, member; work on (a) Metals and Alloys Subcommittee (b) Metals and Alloys Common Names Task Group and (c) Minerals Subcommittee.

A.P. Stenson

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

Joint Committee for Powder Diffraction Standards, International Centre for Diffraction Data, Member and Mineralogical Association of Canada, representative.

Joint Committee for Powder Diffraction Standards, International Centre for Diffraction Data, Secretary, Minerals Subcommittee.

W.U. ter Haar Romeny

Branch Safety Committee, member.

Analytical Chemistry Section
G.R. Lachance

The ongoing objective of the Analytical Chemistry Section is to provide compositional data on a wide variety of geological materials submitted by GSC scientists. Currently, the short term objectives are to upgrade instrumentation and methods to bring them to "state of the art" levels in order to provide on the one hand, the higher level of accuracy necessary for some research studies, and on the other to provide data on broad suites of elemental concentrations on much larger numbers of samples required for some projects. While some progress is being made in extending the range of analytical services offered, it is increasingly evident that many non-routine analytical requests (e.g. speciation, highly mineralized samples, constituents at ultra-trace levels) cannot be met adequately in-house at present.

The various analytical techniques used to provide compositional data for rock, ore and mineral samples range from classical chemical methods for unusual samples to instrumental techniques that include atomic absorption (flame and graphite furnace), infra-red analysis, ICP-emission spectroscopy, and X-ray fluorescence spectrometry with both wavelength and energy dispersive systems. Method development is a necessary prerequisite for the laboratories and is undertaken, often concurrently, with requests for analyses of materials for which the Section does not have established methods. The Section also takes a leading role in the study and certification of international standard reference materials for chemical analyses.

A major step in upgrading optical spectrometry instrumentation to "state of the art" level was taken with the phasing out of both DC arc spectrometers (Jarrell Ash Direct Reader and Ebert 3.4 m photographic) and the acquisition of a simultaneous 48 channel Inductively Coupled Plasma (ICP) emission spectrometer. The instrument was delivered in late September and became operational in early December. As of March 1985 methods have been adapted for the determination of: (i) the major constituents Si, Ti, Al, Fe, Mn, Mg, Ca, Na, K and P while monitoring the concentration levels of Ba, Co, Cr, Cu, Ni, Sr, V, Y, Zn and Zr; (ii) the "trace" constituents P, Ba, Be, Co, Cr, Cu, La, Ni, Sr, V, Y, Yb, Zn and Zr while monitoring Mo, Nb and Pb for "above normal" occurrences.

The change from a DC arc excitation source which requires specimens in solid form to ICP excitation which requires specimens in aqueous form required a re-allocation of some staff within the Section. Methods were adapted for the dissolution of samples by fusion for the "majors" program and by fusion following multi-acid treatment for the "trace" program. The ground work has been laid for using a portion of the "trace" solutions for a pre-concentration step that would enable eight rare earth elements to be determined by ICP while another portion would be used for elements that will continue to be determined by the atomic absorption technique.

The productivity of the Chemical, ICP and XRF laboratories is shown in the following table, together with the overall status of samples processed by the Section. During the report period, 5205 samples were analyzed for major, minor and trace elements involving about 150 000 individual determinations. This compares with 6664 samples analyzed in 83-84, but which included 1408 samples for single element determinations. As of March 31, the backlog of samples on hand for analysis had been reduced to 1157, of which 887 were received in February and March, compared to a backlog of 2121 for the previous year. This marked improvement in sample throughput was due to the successful introduction of the ICP spectrometer noted earlier.

Analytical Chemistry Section productivity for Fiscal Year 1984-85 by number of samples:

SECTION	Carried over	Requested	Reported	Carried Forward
CG	80	60	140	0
EGM	793	1719	2009	503
PC	466	529	785	210
RGG	19	1361	1040	340
TS	702	493	1131	64
OTHER	61	79	100	40
TOTAL	**2121**	**4241**	**5205**	**1157**
CHMLAB				
CG	80	60	140	0
EGM	577	1659	1754	482
PC	283	529	602	210
RGG	19	990	673	336
TS	702	492	1130	64
OTHER	61	72	106	27
TOTAL	**1722**	**3802**	**4405**	**1119**
ICP LAB				
CG	80	7	87	0
EGM	216	563	372	380
PC	188	31	188	31
RGG	0	250	112	138
TS	0	45	40	5
OTHER	0	61	21	40
TOTAL	**484**	**930**	**820**	**594**
XRF LAB				
CG	80	60	140	0
EGM	472	1270	1414	328
PC	466	341	743	64
RGG	19	1002	819	202
TS	0	369	364	5
OTHER	61	77	125	13
TOTAL	**1098**	**3119**	**3605**	**612**

Personnel Notes

Mr. W.H. (Hal) Champ retired in June after a career spanning more than 35 years as a public servant, most of those years as Head of the Optical Emission Laboratory. Hal can certainly be considered as being "the father" of optical spectrometry at the GSC having set up the facility in the early 1950s and tackled the arduous task of applying this technique for the analysis of geological materials. Hal's career spanned the "instrumental revolution" i.e. from earlier days when spectrographers were expected to redesign commercially available instruments and develop methods with few (if any at all) reference materials to the age of highly sophisticated, computer controlled automatons which are expected to deliver a flood of "true" results.

Attendance at Conferences, Meetings, and Courses

R.M. Rousseau

33rd Annual Denver X-Ray Conference, August 1984.

C. Veys

Timesharing course, EMR Computer Science Centre, May 1984.

X-Ray Clinic, Albany, N.Y., June 1984.

EMR Safety Oriented First Aid Course, February 1985.

Special Talks and Lectures

G.R. Lachance

Guest instructor, X-Ray Clinic, State University of New York at Albany, Albany, N.Y., June 1984.

"X-Ray fluorescence, an accommodating technique", Annual Meeting Spectrocopy Society of Canada, Ste. Jovite, Quebec, October 1984.

Membership on Committees

J.G. Sen Gupta

Branch Safety Committee.

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 government, academia and industry in a timely and cost effective manner; to maintain the Library of the Geological Survey as the principal earth science library in Canada forming as it does the geoscience component of the National Library and thus a major Canadian information source; to manage the National GEOSCAN Centre which co-ordinates the activities of the federal-provincial bibliographic database; to provide Branch management with advice on the application of data systems and to co-ordinate Branch initiatives in data systems and Branch input into Departmental systems and reporting procedures; to provide comprehensive drafting, photomechanical, photographic and cartographic services including the curation of a large collection of photographic negatives dating back to the 1870s; and to provide a Branch information service.

The division operated through seven sections in 1984-85: Scientific Editing and Publication Production, Library, Data Systems, Cartography and Reproduction Services, Technical Photography, Publications Distribution and Divisional Administration. Effective 1 April 1985 the Technical Photography Section was transferred to Cartography and Reproduction Services.

The report year saw about a 50 per cent increase in the resources available to the Branch through the introduction of new programs such as Mineral Development Agreements, Frontier Geoscience Program etc. The effect of these programs was felt to a minor degree during the report period, mainly in an increase in submissions for "Current Research" but also in the production of several papers. Some production costs were met by funding from the "add-on" programs and discussions were held with program co-ordinators concerning the implications to the publication program when major outputs come on stream, probably in 1985-86. These will affect editorial services, layout, and cartography. An increasing use of contract services is the obvious way to meet these demands but such an approach will require an adequate monitoring system which could require the use of in-house staff. However until the outputs from these programs increase it is not worthwhile to set up such systems.

In April 1984 the Department implemented a new policy concerning the publication of scientific, professional and technical reports in both official languages. As part of this policy the Director, Geological Information Division each month recommends to the Director General the language(s) of publication for reports approved for publication and these recommendations are forwarded to the ADM Earth Sciences for final approval. The application of the new policy in 1984-85 resulted in an increase in the number of reports published in both Official Languages as well as an increasing use of extended summaries in both French and English. Good service was received from EMR Translation Service for short texts but the requirement of 2 days per 1000 words results in major reports taking several months for translation and a gap of up to 6 months or more between the release of an English report and its French edition.

As part of the GSC's continuing program of public awareness the Division produced a major display for the Precambrian Geology Division for use at the Geological Association of Canada Annual Meeting. A second display was prepared for use at Minister Layton's PC caucus Open House in December. Both displays were used subsequently as well as being set-up in Logan Hall when not being used elsewhere. These displays, prepared by the Cartographic and Reproduction Services Section, required several thousand hours of work. Fortunately no backlog existed in the production of maps otherwise a choice between displays and maps would have had to have been made.

In 1984-85 about 5000 pages of text was forwarded for printing – a slight decrease from the previous year which was mainly due to timing as 1985-86 started off with some major jobs. "Current Research" Part A comprised 802 pages and Part B (for July 1985 release) will likely also be a large volume. It is possible that it and subsequent issues will be published in two or more volumes.

During 1984-85 we published:

3	memoirs
3	bulletins
14	papers
4	miscellaneous series reports
1	economic geology report
24	multicoloured maps
4	monochrome maps
49	geophysical maps
136	open files

In addition 2 memoirs, 6 papers, 3 maps and 51 geophysical maps were reprinted.

Personnel Notes

Dr. P.B. Charlesworth, Chief, Data Systems Section returned to fulltime work from maternity leave in September although she had continued to give direction to the work of the section for much of the period of her absence.

Diane Tremblay, divisional secretary proceeded on maternity leave in October. J. Caron was seconded from the Word Processing Centre to fill this vacancy and provided excellent support through the remainder of the report period and into 1985-86.

M.J. Kiel was confirmed as Head, Publication Production Unit in June and proceeded on French Language Training in January 1985. D.A. Busby, appointed Acting Head as from January 1985, was assisted by Susan Fowler.

John Kempt, Head, Photographic Section was absent for extensive periods during the year and late in the report period was obliged to request retirement on the grounds of physical disability effective July 1985.

Attendance at Meetings, Conferences and Courses

R.G. Blackadar

Decade of North American Geology Steering Committee, Reno, NV, Nov. 4-8, 1984 (and GSA)
GSC Branch Management Committee meetings, June, September, November, March.
R.S. Appraisal meeting.

W.C. Morgan
Association of Earth Science Editors, Portland, Oregon
French Language Training (part-time, Maple Leaf School).

P.J. Griffin
Mineral Outlook '84; May 1984.

Membership on Committees

R.G. Blackadar
- Branch Management Committee
- Secretary, EMR Committee on Scientific Publications in Both Official Languages
- EMR Computer Policy Committee (sector rep.)
- Earth Sciences Sector Communications Committee
- Steering Committee, Decade of North American Geology
- Chairman, GEOSCAN Management Subcommittee.

P.J. Griffin
- National Earth Science Series 1:1 million maps
- Ad hoc Baillie Report subcommittee
- GAC 86 Hospitality subcommittee
- Geology of Canada series publication guidelines.

M.J. Kiel
- GAC 86 Publications Committee.

DATA SYSTEMS SECTION

P.B. Charlesworth

The role of the Data Systems Section is to provide advice and assistance to branch scientists and management in the broad area of Electronic Information Systems (EIS) policy and application. The section continued to provide this kind of assistance throughout the branch. The annual Information Technology and Systems Plan (ITSP) was compiled and submitted to the EIS Secretariat for inclusion in the overall departmental plan in February. Information was collected at the same time to provide input for the GSC response to the initial version of the 1986/91 (scientific) computer needs study, which is to be completed during the coming fiscal year.

This year's projects included the implementation of the fixed asset inventory system and its utilization in the preparation of the background data and reports required for a CARP submission and the development of a large number of micro-micro and micro-mainframe communications procedures.

Personnel Notes

Mr. John Glynn accepted the position of senior systems consultant in March/1985.

Attendance at Meetings, Conferences and Courses

P.B. Charlesworth
Data Processing Institute – Management of Change
Introduction to the VAX at CSC course
Artificial Intelligence and Expert Systems Seminar
HP3000 System Manager Course.

K. Gunn
Introduction to the VAX at CSC course.
Business Information Planning, TIP Corp.
Distributed Processing, CIPS - Business Graphics, IP Sharp

T. Scaga
Data Processing Institute – Management of Change
Data Communications and Networks Course.

Membership on Committees

P.B. Charlesworth
- Chairperson, EMR Computer Users Committee
- EMR Computer Policy Committee
- Branch Computer Management Committee
- VAX Facilities Management Committee
- EMR Ad Hoc Telecommunications Committee
- EMR Data Management (software) Committee
- HP3000 Facilities Management Committee.

LIBRARY SERVICES

A.E. Bourgeois

CURRENT YEAR ACTIVITIES

1. Library Administration

The GSC 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, analyses and description, processing, retrieval and circulation of literature which are required to meet demands for high quality and immediate information.

In order to continue to meet ever increasing demands the Library took advantage of the Cooperative Student Programme to increase human resources by 8 person-months in Technical Services and 8 person-months in Information Services.

The Mineral Development Agreement Programme made funding available to the GSC Library and the National GEOSCAN Centre to work on retrospective clean-up of GEOSCAN, a federal-provincial database in support of the mineral industry of Canada. The equivalent of 1.5 person years was funded through this programme.

These extra 3.16 person year's together with increased use of automated systems has contributed greatly to the maintenance of the high level of service provided to our clientele.

2. Information Services

In addition to its on-going activities the following projects were undertaken:

A. Reference and Circulation
- Implementation of the systematic weeding of the library's older material;
- reorganization of the physical collection including the move of the GSC reserve collection and the LC collection;
- preparation for the introduction of an Online/ Catalogue which included a study on user training and an analysis of terminal requirements.

B. Map Library
- Initiation of a distribution service of the library's map catalogue to 10 university libraries at the request of the Ontario Council of University Libraries Map Group;
- drafting of a background paper on the mandate of the GSC Map Library.

3. Technical Services

This was a year of major activities centering around the implementation of an in-house automatic system.

A. Acquisitions
"HERMES" the library acquisition system became operational. All book orders are now generated by the system and financial details are controlled on it.

B. Cataloguing/Indexing
"GEOCAT" the library's on-line cataloguing database was defined, tested and implemented during the year. As of March 24/85 all cataloguing records are being input into the system.

The library continued to increase bilingual access to the collection by reviewing and revising French language records to ensure validity and consistency.

C. Systems and Projects Librarian
Together with the Systems Librarian SHL Systemhouse Ltd. developed an on-line library catalogue. The GSC Library's catalogue will provide more access points for the user and quicker retrieval of information.

Appoximately 10 000 GSC records were edited in the GEOSCAN Database.

GSC's library automated acquisition system has been adapted by EMR Headquarter's library and the Earth Physics Library with the assistance of our systems staff.

4. National GEOSCAN Centre

A. Indexing and Data Maintenance
NGC continued to provide support for all aspects of agency participation in GEOSCAN including the development of a method for downloading records from GEOSCAN which will be used by Alberta and CSPG to transfer their data into GEODIAL.

Significant progress was made on a major project to review and correct records converted from RAID. Four agencies have completed clean-up and the others are actively working on it (except Saskatchewan).

An ongoing project to manually review and correct newly entered GEOSCAN records was initiated in 1984/85.

B. System Documentation
The following documents were completely revised and reissued:
GEOSCAN Indexing Tools
GEOSCAN database definition table
Batch and online entry coding sheets.

C. Training
Library personnel at the Institute of Sedimentary and Petroleum Geology (GSC) and the Cordilleran Geology Division (GSC) received online retrieval documentation and training.

Representatives from the Canadian Society of Petroleum Geologists and a new staff member at the Alberta Geological Survey received training on indexing methodology and the MINISIS system.

D. Promotion of GEOSCAN
GEOSCAN was demonstrated in April 1984 at the Annual Meeting of the Canadian Institute for Mining and Metallurgy. GEOSCAN was also demonstrated in March 1985 at the Annual Meeting of the Prospectors and Developers Association.

An article on the GEOSCAN database and the National GEOSCAN Centre appeared in Entre Nous, EMR's departmental newsletter.

E. System Hardware and Software Developments
In April 1984, GSC entered into a Facilities Management contract that provided a HP3000 computer and operator support. NGC files were transferred to this new computer in May 1984. D. Reade acted as HP3000 System Manager throughout the year and was responsible for administration of the Facilities Management contract.

Datapac 3101 service was replaced with 3000 service and this resulted in a net reduction of 20% in the hourly usage costs.

NGC acquired software and hardware for the MICOM 2001E word processor and a MICOM/HP3000 link was successfully used throughout the year to transfer products, text files and scientific manuscripts.

PERSONNEL CHANGES

National GEOSCAN Centre

Diane Bouchard was appointed to the position of the National GEOSCAN Centre Secretary in April 1984.

COMMITTEE MEMBERSHIP

S.O. Alexander
- EMR Cataloguers' Working Committee
- Ottawa-Hull UTLAS Users Committee.

A.E. Bourgeois
- Association of Chief Librarians/National Geological Surveys
- Council of Federal Libraries
- Collection Rationalization Committee (Convener)
- Planning and Priorities Committee
- Steering Committee
- EMR Standing Committee of Head Librarians (Chairperson)
- Geoscience Information Society (Vice-president)

L.A. Frieday
- EMR Cataloguers' Working Committee
- Ottawa-Hull UTLAS Users Committee.

E. Klobouk
- National GEOSCAN Data Base Committee.

A. Kopf-Johnson
- National GEOSCAN Data Base Committee.

T. Naraynsingh
- Association of Canada Map Libraries
- Utlas Users Group for Cartographic Materials
- Ontario Editor, ACML Bulletin.

D.S. Reade
- GEOSCAN Management Subcommittee (Ex-officio)
- MINISIS User's Group (EMR representative)
- National GEOSCAN Data Base Committee (Chairperson).

W.P. Stark
- National GEOSCAN Data Base Committee.

R. Swan
- Council of Federal Libraries' Committee on Conservation/Preservation of Library Materials.

D. Tedford
- Envoy 100 Users Group.

J. Wilks
- CAN/SDI Centres Committee
- Canadian Association for Information Science, Ottawa Chapter (Secretary).

CONFERENCES ATTENDED

Tara Naraynsingh
Association of Canadian Map Libraries Annual Conference, June 1984, Fredericton

Rosemary Swan
Canadian Association for Information Science Annual Conference, May 1984, Toronto

Judy Wilks
Canadian Institute of Mining and Metallurgy Annual Conference, April 1984, Ottawa (demonstrated GEOSCAN* GeoRef)

W.P. Stark, D. Tedford
Canadian Library Association Annual Conference, June 1984, Toronto

A.E. Bourgeois, D.S. Reade
Geoscience Information Society Annual Conference, November 1984, Reno, Nevada

D.S. Reade
HP3000 Canadian Users Group Meeting, September 1984, Ottawa

J. Wilks
National Online Meeting, April 1984, New York, N.Y.

L.A. Frieday
Ontario Library Association Annual Conference, October 1984, Ottawa

S.O. Alexander, A.E. Bourgeois, D.S. Reade, W.P. Stark
SHL/MINISIS Users' Group Meeting, 1984

S.O. Alexander
Special Libraries Association Annual Conference, June 1984, New York, N.Y.

LIBRARY SERVICES STATISTICS: 84/85

1. GSC LIBRARY

A. Information Delivery		
Supplied by Library	14 336	(98.8%)
Referred to other sources	178	(1.2%)
B. Document Delivery		
Items requested	54 556	
Items supplied:		
from GSC collection	52 220	(95.7%)
from other libraries	984	(1.8%)
total	53 204	(97.5%)
C. Document Analysis		
Monographs, serials, reports, etc.	3 081	
Maps	450	
GSC publications	696	
Total	4 227	
D. Collection Growth		
Monograph volumes	991	
Map sheets	2 501	
Microform reels/sets	3 920	
Serial volumes	2 133	
(issues 14 244)		
(new titles 36)		
Total	9 554	

2. NATIONAL GEOSCAN CENTRE

A. Database Growth	
Records added	6 085
Total records in db	92 528
B. Information Delivery	
Custom indexes	33
On-line retrievals (by GSC Library)	93
C. Participating Agencies	
Total Number	12

GEOLOGICAL CARTOGRAPHY SECTION

J. Bill

The Cartography Section met its major objectives during the year, in providing a comprehensive cartographic, graphic and photomechanical service to the Branch. There was a continuing improvement in the Section's overall production through-put-time.

The photomechanical unit met all priority requests despite a lengthy series of mechanical breakdowns and equipment failures.

Miscellaneous Report 38, The Sediments volume of the Marine Science Atlas of the Beaufort Sea, was printed and bound by year end.

The "Standards and Specifications for the Preparation of Geological Maps" manual was printed and released as Miscellaneous Report 34.

A Compugraphics type-composition workstation was acquired late in the year. This improves considerably our response capability for priority typesetting requests. The keyboard input will be done in-house on an off-line workstation, with the actual typesetting being done on a typesetter at the Surveys and Mapping Branch.

Tests were conducted during the year on the production of multicolour maps directly from author or cartography prepared hand-coloured originals, using camera colour-separation techniques. A test sheet, Map 1618A, King William Island and Adelaide Peninsula, was successfully produced and printed using this method. This provides a method for quick release of multicolour maps and figures. Although the aesthetic quality will not match that of completely redrafted maps, there is no degradation of technical accuracy since the author's line work and symbols are directly reproduced. With recently acquired large format colour-separation screens we can now reproduce, in one piece and at the same scale, manuscripts up to 90 cm x 115 cm.

Start up problems of the new 4-colour press at Surveys and Mapping Branch resulted in some delays in the printing of our maps, and some paper and ink problems also encountered should be cleared up during 1985.

Two in-house committees, formed over one year ago, completed their tasks. The Display Committee designed and started production of a formal Cartography display. A second committee prepared the first of a series of notes and reports for eventual inclusion in a technical manual dealing with cartographic production procedures and guidelines not covered in our Standards and Specifications manual.

Attendance at Meetings, Seminars and Courses

Cartographic Workshops – Cartotechniques IV – OICC – Lindsay, Ontario, May 1984

General Graphic Arts – Graphic Arts International Union – Ottawa, Winter 1984-85 (evenings)

P. Corrigan, R. Daugherty, E. Maahs, J. Narraway

Preparing for Competitions – EMR – Ottawa

10 employees

Orientation to EMR – Ottawa

5 employees

Pre-Retirement Workshop – Ottawa

3 employees

Staffing for Managers – EMR – Ottawa – June and November 1984

J-P. Corriveau, R. Daugherty, V. Foster, J. Yelle

Introduction to Computers – PSC – Ottawa – Fall 1984-85

G. Currie

Performance Review and Employee Appraisal – EMR – Ottawa – Winter 1984-85

G. Barbary, R. Daugherty, E. Dumbrell, F. Williams

Classification for Managers – EMR – Ottawa – September 1984

V. Foster

Time Management Workshop – EMR – Ottawa – Winter 1984-85

R. Daugherty, E. Dumbrell

Computers from a Manager's Viewpoint – Algonquin College – Ottawa – Winter 1984-85

V. Foster

Auto-Carto 7 – American Congress on Surveying and Mapping – Washington, D.C. – March 1985

J. Bill, V. Foster

Membership on Committees

J. Bill
- Advisory Committee for the Surveying and Mapping Technology Program, Algonquin College
- Treasury Board – Classification Standard Review Committee – Drafting and Illustrations Group.

V. Foster
- Board of Directors, Ontario Institute of Chartered Cartographers
- EMR Interdepartmental Topographic Map Design Committee.

S. Junginger-Frohberg
- Board of Directors, and Secretary, Ontario Institute of Chartered Cartographers.

F. Heney
- Branch Safety Committee.

F. Williams
– EMR – Reproduction and Quality Assurance Advisory Committee.

Cartography Display Committee
J-P. Corriveau, V. Foster, E. Maahs

Cartography Guidelines Committee
G. Barbary, R. Daugherty, B. Mainville, J. Yelle

Personnel Notes

Section strength remained at 53 with 3 vacant positions in the process of being staffed at year end.

Graham Wylie was promoted by competition to supervisor of the Photomechanical Unit in April 1984.

G. Lavigne retired in September from the Quality Control Unit, after 35 years of service with the GSC.

PRODUCTION DATA

Maps and illustrations received during the fiscal year:

	1983-84	1984-85
Multicoloured geological maps	18	17
"B" Series maps	7	9
Figure illustrations (pocket)	58	23
Figure illustrations (page)	335	341
Geophysical Maps and Indexes	153	44
Special Projects – Panels for Displays	26	14

Maps, illustrations and photomechanical work completed by the Cartography Section:

	1983-84	1984-85
Multicoloured geological maps	21	16
"B" Series maps	4	4
Figure illustrations (pocket)	8	21
Figure illustrations (page)	123	232
Geophysical Maps reprinted	20	0
Multicoloured maps reprinted	4	0
Preliminary geological maps reprinted	1	2
Figure illustrations (pocket) reprinted	1	0
Indexes to Publications revised	30	0
Open File Maps and Profiles	242	121
Special Projects – Panels for Display	16	12
Atlas Pages – Beaufort Sea	0	32
Photomechanical:		
Camera	9 556	8 130
Contacts		
Film and papers	24 042	27 903
Colour Keys	711	617
Peelcoats	237	318
Transfers	59	19
Scribetches	5	0
Final Pre-Screen	478	210
Colour Proofs	137	152
Whiteprints	6 500	7 500
Direct colour prints (PMT)	0	25

Carry-over of maps and illustrations in progress at the end of fiscal year:

	1983-84	1984-85
Multicoloured geological maps	27	20
"B" Series maps	7	10
Figure illustrations (pocket)	61	16
Figure illustrations (page)	363	341
Open File Maps and Profiles	150	193
Geophysical Maps and Indexes	99	40
Special Projects – Beaufort Sea	77	40
– Panels for Displays	18	20

There were 473 miscellaneous (Z numbered) drafting jobs completed during the year, which took 10 637 person hours. In addition to the normal map production operations, the photomechanical unit processed 1386 (X numbered) miscellaneous jobs for various authors and Divisions.

A total of 285 requisitions for Compugraphics typesetting for Ottawa, Calgary and Dartmouth cartographers were processed through S & M Branch. There were 736 master topographic negatives requisitioned from S & M Branch for reproduction in Photomech for authors and cartographers in Calgary, Ottawa and Vancouver.

Automated Digitizing

	1983-84	1984-85
Point Mode – R.G.G.	48	72
– E.G.M.	0	2
– T.S.	0	3
Line Mode – R.G.G.	2	32
– E.G.M.	0	14
– T.S.	7	3
– Prec.	6	0

Fifteen projections at various scales were prepared with the co-operative assistance of Surveys and Mapping Branch.

Checking Unit

	1983-84	1984-85
"A" Series maps checked at proof stage	18	14
"B" Series maps checked at proof stage	1	2
Pocket, page figures, miscellaneous	270	52
	289	68

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 materials and from Ciba colour materials.

Fossil Studio

The fossil studio supplies photographs of fossils. Rock specimens are photographed to show their mineral content, thin sections for 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 accessories 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 sandsgrains, 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 manually or by means of an Ilford 2000 automated processor.

ACQUISITIONS

An Agfa-Gevaert RPS 2024 vertical camera was obtained for the copy studio.

PUBLICATIONS DISTRIBUTION OFFICE

J.L.L. Touchette

The following publications were received during the year:

Economic Geology	1
Memoirs	3
Memoirs (reprinted)	2
Bulletins	3
Preliminary Papers	14
Preliminary Papers (reprinted)	6
Misc. Report Series	4
Misc. Geology	21
Open Files	5
Open Files (reprinted)	2
Microfiche	17
Maps "A" Series	24
Maps "A" Series (reprinted)	1
Preliminary Maps	4
Preliminary Maps (reprinted)	2
Geophysical Maps	49
Geophysical Maps (reprinted)	51

DISTRIBUTION DATA

Maps	39 598
Reports	25 368
Indices, listings, posters, etc.	92 372
Total distribution (free and paid)	157 338

OTHER DATA

Requests for information, publications, rock and mineral sets, etc.	12 135
Visitors (cash sales 1136) (others 1946)	3 082
Notification Lists sent out	15

REVENUE

Derived from sales of reports, maps, rock and mineral sets, photographs, etc. *	$ 115 755.42

* Unadjusted

($ value) Products supplied to regional offices	41 812.00
TOTAL SALES VALUE	**$ 157 567.42**

PRODUCTION DATA

PHOTOGRAPHS TAKEN

Equipment-Labs-Portraits-Passports	221			221	
Continuous tone maps-charts	725			725	
Line copies	525			525	
Rock & Mineral Specimens	116		433	549	
Thin Sections	237		278	515	
Polished Specimens					
Auto-Radiographs					
Requisition Processing COL. ROLLS (34)		24	952	976	
Duplicate Slides			1496	1496	
B/W Negs from Colour Slides	932			932	
Fossil Negatives	297			297	
Overhead Transparencies			33	33	
Reverse Text Slides			44	44	
TOTAL PROCESSED	3053	24	3236	6313	6313

Prints and Enlargements

Black and White				8228	
Colour				1437	
TOTAL				9665	9665

OTHER OPERATIONS

Prints & Enlargements Numbered & Stamped				5782	
Prints & Enlargements to Outside Agencies				647	
Colour Slides				4175	
B & W Slides				922	
Slides mounted				5915	
Negatives Opaqued				968	
Negatives Retouched				113	
Prints spotted				80	
Prints from photo centre				3124	
Slides remounted				25	22051

GRAND TOTAL 38029

INSTITUTE OF SEDIMENTARY AND PETROLEUM GEOLOGY

W.W. Nassichuk

ISPG 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 multidisciplinary basin studies. 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 is responsible for preparing geological maps and lithostratigraphic and sedimentological reports for 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 ISPG, that is the Regional Geology, Paleontology, Petroleum Geology, and Coal Geology Subdivisions, in concert with the Petroleum Resources Assessment Secretariat reflect the four Strategic Objectives of ISPG 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. A world class geological library, available to the public is under the jurisdiction of the Administration Subdivision. ISPG 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 154.5 person years including 80 scientific and professional positions, 8 operational, 35 technical, 3 administrative and 37 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 ISPG in research activities.

Attendance at Meetings Conferences and Courses

W.W. Nassichuk

Meeting to negotiate USSR-Canada Arctic Earth Science Agreement, Moscow, April 8-15, 1984.

Participation in work on Tertiary sedimentation in shelf environment and presentation of story about Tertiary/Beaufort and oil and potential, Scripts Institute of Oceanography at LaJolla, California, April 17-27, 1984.

Presentation of address to the AMD's Industrial Advisory Committee, Ottawa, May 22-24, 1984.

Branch Management Committee Meeting, Ottawa, June 4-6, 1984.

Meeting of 27 International Geological Congress, Moscow, July 24-August 12, 1984.

Branch Management Committee Meeting, Ottawa, September 18, 19, 1984.

Meeting with United States Geological Survey, Denver, October 9-12, 1984.

Meeting C.F. Minerals, Kelowna, October 29, 1984.

Meeting of Geological Survey Advisory Committee to the Alberta Research Council, Edmonton, November 1, 1984.

Meeting with B.C. Ministry of Energy, Mines and Petroleum Resources, Victoria, December 10-12, 1984.

Branch Management Committee Meeting, Ottawa, January 20-25, 1985.

Branch Management Committee Meeting, Vancouver, March 4-7, 1985.

Lecture to Geological Society of America Petroleum Society, Boise, Idaho, March 13-15, 1985.

Meeting Petroleum Resources Appraisal Panel, Ottawa, March 27-28, 1985

J. Andrechuk

Business English Refresher, Southern Alberta Institute of Technology, January 22-April 23, 1985.

Special Talks and Lectures

W.W. Nassichuk

October 1984 **"Canada's oil and gas supply"** presented to 80 officers of Nato Military College visiting Calgary from Rome; at Currie Barracks, Calgary.

October 1984 **"Oil and gas in Arctic Canada and Alaska,"** presented to Kelowna Chamber of Commerce, prospectors and developers.

November 1984 **"Circum-polar oil and gas,"** presented to Canadian Energy Institute monthly meeting, Calgary.

January 1984 **"Arctic Canada, Alaska and Siberia; Geology and Energy,"** presented to CIM Petroleum Society monthly meeting, Calgary.

March 1985 **"Oil and gas potential in Arctic regions of the world"** presented to Energy Colloquium held at Boise State University, Boise, Idaho.

August 1984 **"What are the big Permian problems in the world?"**; presented to the IUGS Subcommission on Permian Stratigraphy, 26th International Geological Congress, Moscow.

March 1985 **"The geology of Arctic North America"**; presented to the Department of Geology, Boise State University, Boise, Idaho.

Membership on Committees

W.W. Nassichuk

Past Vice-Chairman and Newsletter Editor, Subcommission on Permian Stratigraphy, International Union of Geological Sciences.

Corresponding Member, Subcommission on Carboniferous Stratigraphy, International Union of Geological Scientists.

Member, North American Working Group on Middle Pennsylvanian of North America.

Co-Chairman, Working Group on Permian Stratigraphy and Boreal Relations.

J.E. Brindle

Chairman, ISPG Ad Hoc Committee on Open House.

Chairman, ISPG Ad Hoc Committee on Space Allocation.

Member, Computer Service Committee.

Member, University Research Park Committee.

ADMINISTRATIVE SUBDIVISION

K.M. Cameron

The objective of the Administrative Subdivision are directed toward providing efficient and timely administrative, financial and logistical services to the Division.

The Subdivision is manned by a staff of 20. During the fiscal year 1984-85, the following staff changes occurred:

Promotions

Mrs. F. Fritz was promoted from an LS-02 to an LS-03 (Head Librarian) effective September 26, 1984.

Transfers

Mr. R.P. Morgan, an LS-02 transferred from the Department of Argiculture to join the ISPG Library Staff on December 3, 1984.

Resignations

Mr. B.F. Davies an STS-03 resigned on March 31, 1985 to accept a position in the private sector.

Retirements

Mr. E.M. Clayton a GL-MAM-9 retired on November 23, 1984 after 10 years with ISPG.

Death

Mrs. Irene Rose passed away on April 1, 1984 after 25 years in the Public Service.

Appointments

Ms. S. Webber was appointed to the Library as a CR-04 on May 31, 1984.

Mr. K. VanZeeventer was appointed to the Building Services section as a GL-MAM-8 on February 11, 1984.

Attendance at Meetings Conference and Courses

K.M. Cameron

Branch Administrative Officer's Meeting, Vancouver/Patricia Bay, August, 1984.

Branch Administrative Officer's Meeting, Ottawa, March, 1985.

S.B. Alert

Benekit Course (Employee Benefits), Edmonton, February, 1984.

W.J. Williams

Material Management Course, Edmonton, August, 1984.

D.Y.H. Li

General Drafting Course, Calgary, September, 1984 to March, 1985.

S. Webber

Library Reading Services Course I and II, Calgary, September, 1984 to March, 1985.

Records Management Seminar, Calgary, December, 1984.

M. Brown

Effective Secretary Seminar, Calgary, July, 1984.

Records Management Seminar, Calgary, December, 1984.

F. Fritz

Dynamics of Supervision Course, Calgary, October, 1984.

Calgary Librarians in Action Course, Calgary, January, 1985.

GeoScan Searching Course, Calgary, February, 1985.

INet and Envoy 100 Course, Calgary, February, 1985.

R.P. Morgan

Library Map Searching Course, Calgary, February, 1985.

ISPG Library

During the year several staffing actions took place which meant that the automation project was not completed, nevertheless, steady progress was made. The demand for library services remained high and library staff rose to the occasion. Two summer students enabled several special projects to be completed: binding of journals; creation of publishers' file online; creation of a subject headings list online; updating the library's university calendar collection; identifying duplicate holdings for exchange; as well as helping in general library routines. In February a library technician student came to the library for her three-week work placement and participated in a spectrum of library routines. The exercise was of mutual benefit as the library gained by her assistance and the student gained practice and experience.

The librarian attended a meeting of the GSC Libraries Network in Ottawa in May when progress was made on the policy manual. During the same visit, contact was made with the Federal Libraries Liaison Office and library documentation was collected. A tour of the library was sponsored and promoted by the Foothills Library Association on October 18th, 1984. Despite the inclement weather (a blizzard), there was considerable interest and staff visited from Shell, PetroCan, BP, Nova-Husky, Dome, Alberta Petroleum Marketing Commission, the University of Calgary and Marigold Library System. Marianne Scott, National Librarian of Canada, visited the library on October 25th, 1984 and made several suggestions for coping during times of cutback and restraint. The librarian visited the B.I.O. Library in December, 1984 to glean information on building a collection for scientists involved in a boundary dispute project. Since then, progress has been made with the project at ISPG and a database has been created, which provides multi-access points to the information therein.

Innovations in the library include the use of electronic mail, the installation of a photocopier and direct searching of GOESCAN database, all perceived as enhancements in the provision of high quality, timely information.

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 date 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. Frontier Geoscience funding, and the establishment of an ice island research station, have permitted major new initiatives particularly the commencement and future planning of reflection and refraction seismic programs on the continental shelf. There, programs are being carried out in cooperation with RGG, AGC, and Earth Physics Branch. 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 12 million samples and 26 thousand boxes of core are stored at the Institute; the number of samples increases by about 300 thousand 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 thousand wells drilled in Western and Arctic Canada. The repository is being expanded by the addition of about 3 thousand square metres of floor area.

Highlights

A suspect terrane now is recognized in northernmost Ellesmere Island. It is divisible into four major successions that are Neohelikian, Hadrynian to earliest Ordovician, Early to medial Ordovician, and late Middle Ordovician to Late Silurian in age respectively. The Helikian to medial Ordovician record has more in common with the Caledonian than with the Franklinian mobile belt, but affinites with the latter become apparent from latest Ordovician time onward and accretion probably occurred in the Late Silurian.

The Ella Bay area of northeast Ellesmere Island is the only locality known in the Franklinian belt where the Ordovician shelf-basin transition is exposed. Recent stratigraphic-structural studies confirm that the shelf margin here was steep and eventually attained a relief of roughly 1.5 km owing to a low rate of sedimentation in the basin. This bypass-margin is marked by a submarine unconformity, along which Silurian flysch abuts against considerably older Ordovician shelf carbonates. A carbonate buildup existed at the shelf margin in late Early to early Middle Ordovician time. It rimmed a shelf basin, in which subtidal carbonates and evaporties were deposited.

The early Late Cambrian to Early Silurian basinal deposits are included in the Hazen Formation, which now is divided into slope, proximal basin and distal basin facies. The latter is extremely condensed, containing only 250m of strata west of upper Tanquary Fiord. The Canrobert and Ibbet Bay formations of northwestern Melville Island are comparable in overall lithology and mode of origin to the Hazen Formation.

Recent U/Pb age determination on zircon, combined with an earlier K/Ar determination, indicate bimodal, Predominantly gabbroic but also granitic plutonism in northern Ellesmere Island in the early Late Cretaceous (92 Ma). The isochron plot, in agreement with limited field observations, shows that the granitic material was derived from the Helikian basement.

The first of two years of regional mapping on Melville Island has revealed the en echelon character of the Upper Devonian folds in Canrobert Hills. These observations are consistent with a northeast - striking wrench fault system in tectonic basement active during the Ellesmerian Orogeny. These zones of crustal weakness were reactivated as northeast-striking dextral wrench faults and cast-striking listric normal growth faults during mid-Carboniferous to Permian downwarp of Sverdrup Basin.

A restudy of the Ordovician to Upper Devonian beds of Melville Island was begun in 1984. The sequence is interpreted to begin (Ordovician) with gravity-emplaced carbonate slope deposits with interlayered finely laminated beds. This is succeeded (Early Ordovician to late Early Devonian) by a deep-basinal succession of graptolitic shales with minor re-sedimented carbonates. Turbidites (Middle Devonian) represent the beginning of the dominantly clastic, deltaic-marine and non-marine sedimentation (the clastic wedge) that formed the youngest (Middle and Late Devonian) phase of sedimentation of the Franklinian Geosyncline.

Mapping in southwestern Mount Eduni map-area (106A) revealed isolated, NW-aligned areas of strata of the Little Dal Group (Proterozoic, pre-Windermere), overlain by Windermere-aged strata of the Twitya and, locally, Shezal Formations. At these localities, the entire 'Copper cycle', the Sayunei and, locally, the Shezal Formation are missing. The Little Dal outcrops are taken to be the SW shoulder of one of the rift-depressions that several authors have concluded to be the site of accumulation of the 'Copper cycle' and the Sayunei (Lower Rapitan) Formation. In the vicinity, therefore, the Redstone Copper Belt, exposed and subsurface, cannot exceed the width of the rift-depression, about 16 km.

A new model has been proposed for the development of Upper Devonian reefs in the Alberta Basin. Outcrop evidence from the Ancient Wall Reef suggests that narrow stromatoporoidal ridges on the early Frasnian carbonate platform (Flume Formation) were bypassed by the first arrival of terrigenous siliciclastics, thus escaped "suffocation" and continued to grow into reef complexes. The ridges appear to be unrelated to pre-Devonian basement faults in topography.

The extinction horizon at the Frasnian-Famennian (Upper Devonian) boundary was identified in the Front Ranges east of Jasper using faunal, sedimentological and geochemical data. The extinction event is documented by an abrupt change from well-oxygenated, cross-bedded, dolomitic quartz-siltstone to an anoxic, very pyritiferous, laminated, argillaceous lime mud-stone.

Detailed stratigraphic analysis based on regional cross-sections in the subsurface of central Alberta indicates that the shale facies of the Woodbend Group includes two large scale wedge-like deposits. These wedges are presumed to be the result of a progradational process of basin fill. The presence of wedge-like deposits makes it difficult to correlate units across the basin or correlate subsurface units with formations in the Rocky Mountains. It is anticipated that further work and the additional information from micropaleontological age determinations will establish some firm regional relationshps in the Woodbend Group.

Personnel Notes

1. Dr. D.F. Stott received two awards from the CSPG: a Tracks Award for work as co-editor of CSPG Memoir 9 "The Mesozoic of Middle North America", and a Special Service Award (large framed print of "Gyrfalcon" by obert Bateman). The Special Service Award was for various contributions, particularly as president of the society and as general chairman for the conference on "The Mesozoic of Middle North America".

2. Dr. J.D. Aitken received a promotion to RES-4, effective April 1, 1985.

3. Mr. Leon Price took early retirement in January of 1985 after thirty-five years with the GSC.

4. Dr. D.C. Pugh took early retirement in September of 1984 after thirty years with the GSC. He is currently attending Maharishi 'nternational University, Fairfield, Iowa.

5. Mr. Dan Copithorne left the ISPG in October of 1984 after two years working in Core and Sample Repository. His position was filled by Mr. Phil ' ewis in January, 1985.

6. Mrs. Elspeth Snow was seconded to Geological Publications Subdivision in February to serve as Editorial Assistant during maternity leave of the incumbent, Mrs. Lynn Machan-Gorham.

Attendance at Meetings Conferences and Courses

J.D. Aitken

Carbonates in Subsurface and Outcrops, CSPG Core Conference, Calgary, October 1984.

I. Banerjee

Montana Geological Society 1984 Field Conference and Symposium, Kalispell, Montana, September 1984.

M.P. Cecile

Carbonates in Subsurface and Outcrops, CSPG Core Conference, Calgary, October 1984.

R.L. Christie

Arctic Institute of North America Lectures, Calgary, October 1984, February, March 1985.

D.G. Cook

GSA Annual Meeting, Reno, Nevada, November 1984.

In house course, "Geophysics for Geologists", March 1985.

J. Dixon

CSPG Annual Convention, Calgary, June 1984.

AAPG Annual Convention, New Orleans, Louisiana, March 1985.

Alaska Geological Society Meeting, Anchorage, Alaska, November 1984.

A.F. Embry

CSPG Annual Convention, Calgary, June 1984

GSA Annual Meeting, Reno, Nevada, November 1984.

Norwegian Petroleum Society Seminar, Stavanger, Norway, February 1985.

AAPG Annual Meeting, New Orleans, Louisiana, March 1985.

H. Geldsetzer

CSPG Sedimentology Division Meeting, Calgary, November 1984

SEPM Annual Meeting, San José, California, August 1984.

CSPG Annual Convention, Calgary, June 1984.

Carbonates in Subsurface and Outcrop, CSPG Core Conference, Calgary, October 1984.

In house course, "Geophysics for Geologists", March 1985.

C. Harrison

In house course, "Geophysics for Geologists", March 1985.

U. Mayr

Canadian Paleontology and Biostratigraphy Seminar, Ottawa, October 1984.

Norwegian Petroleum Society Seminar, Stavanger, Norway, February 1985.

Geologische Vereinigung, 75th Annual Meeting, Keil, West Germany, March 1985.

In house course, "Geophysics for Geologists", March 1985.

M. McMechan

In house course, "Geophysics for Geologists", March 1985.

CSPG Annual Convention, Calgary, June 1984.

N. Meijer-Dress

SEPM Annual Meeting, San José, California, August 1984.

In house course, "Geophysics for Geologists", March 1985.

Carbonates in Subsurface and Outcrops, CSPG Core Conference, Calgary, October, 1984.

D. Morrow

Carbonates in Subsurface and Outcrop, CSPG Core Conference, Calgary, October, 1984.

B.C. and Yukon Chamber of Mines, Annual Meeting, Vancouver, January 1984.

CSPG Annual Convention, Calgary, June 1984.

B. Richards

CSPG Paleontology Division Meeting, Calgary, January 1984.

D.F. Stott

British Columbia Coal Symposium, Fernie, B.C. September 1984.

Structural Geology and Sedimentology, Pyrenees Mountains, Field trip, Spain, October 1984.

In house course, "Geophysics for Geologists", March 1985.

H. Trettin

In house course, "Geophysics for Geologists", March 1985.

Special Talks and Lectures

J.D. Aitken

CSPG Field trip Leader, "Sub-Devonian unconformity at Ghost River", Calgary, June 1984.

"Recurrent lithofacies and regional facies change in Middle Cambrian, Strata, Alberta". CSPG Core Conference display, Calgary, October 1984.

I. Banerjee

"Depositional episodes during Mannville sedimentation in Southern Alberta", Montana Geological Society, Kalispell, Montana, September 1984.

R.L. Christie

"Geographic and geological exploration in the Canadian Arctic", Arctic Institute of North America Lectures, Calgary, October 1984, February, March 1985.

J. Dixon

"Upper Cretaceous to Holocene stratigraphy of the Beaufort-Mackenzie Basin", (co-author J. Dietrich), CSPG Luncheon Meeting, Calgary, September 1984.

"Mesozoic and Cenozoic geology of Mackenzie Delta and Beaufort Sea", (co-author J. Dietrich), Alaska Geological Society, Anchorage, Alaska, November 1984.

A.F. Embry

"Upper Jurassic to lowermost Cretaceous stratigraphy, sedimentology and petroleum geology, Sverdrup Basin", CSPG Annual Convention, Calgary, June 1984.

"Triassic eustatic sea level changes: Evidence from the Canadian Arctic Archipelago", GSA Annual Meeting, Reno, Nevada, November 1984.

"Mesozoic geology, Canadian Arctic Islands", Norwegian Petroleum Society Seminar, Stavanger, Norway, February 1985.

"Mesozoic geology, Arctic Islands: Implications for the origin of the Amerasian Basin", AAPG Annual Meeting, New Orleans, Louisiana, March 1985.

H. Geldsetzer

"The role of fine-grained siliclastics in the development of organic buildups", SEPM Annual Meeting, San José, California, June 1984.

"Black shale - the controlling factor in the Upper Devonian reef complexes in the Alberta Basin", CSPG Sedimentology Division Meeting, Calgary, November 1984.

"Upper Devonian reef complexes, with emphasis on the Ancient Wall Reef", Parks Canada lecture, Jasper, December 1984.

"Reef-Off-Reef facies relations on the northwest margin of Ancient Wall Reef", Core and sample display, CSPG Core Conference, Calgary, October 1984.

Field trip leader, "Devonian platforms, reef edges and shale basins of the south-central Rocky Mountains", (co-leader E. Mountjoy), CSPG Annual Convention, Calgary, June 1984.

C. Harrison

"Devonian to Permian tectonics of Melville Island", Rice University, Houston, Texas, February 1985.

U. Mayr

"Upper Paleozoic (Carboniferous-Permian) stratigraphy of the eastern Sverdrup Basin, Special Seminar, Norwegian Petroleum Society, Stavanger, Norway, February 1985.

"Baffin Bay, the Wegener fault and newly discovered wrench faults on southern Ellesmere Island, Canadian Arctic Archipelago", Geologische Vereinigung, 75th Annual Meeting, Keil, West Germany, March 1985.

N. Meijer-Drees

"Middle Devonian carbonates and anhydrites, District of Mackenzie, Canada", SEPM Annual Meeting, San José, California, August 1984.

"Upper Devonian surface and subsurface lithostratigraphic units, west central Alberta and east central British Columbia", Core and sample display, CSPG Core Conference, Calgary, October 1984.

D. Morrow

"The Devonian Manetoe Facies - a gas-bearing white sparry dolomite", Poster display, CSPG Annual Convention, Calgary, June 1984.

"Shallow water sequences in the Early Devonian Corridor Member of the Northwest Territories, Canada", CSPG Annual Convention, Calgary, June 1984.

B. Richards

"Sedimentology of the Lower Carboniferous of the Monkman Pass area", CSPG Paleontology Division Meeting, Calgary, January 1984.

Field Trip Leader, "Geology of the Southern Rocky Mountains", Calgary, August 1984.

Field Trip Leader, "Mississippian stratigraphy and sedimentology, Canyon Creek (Moose Mountain), Alberta", [co-leaders E. Bamber. B. Styon (Shell Res.)], Calgary, June 1984.

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 National Conference on Earth Science, Advisory Committee.

Member, CSPG International Division.

Member, ISPG Exhibits Committee.

Member, Second International Symposium on the Devonian System.

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

Vice-President, CSPG Executive.

ISPG Liaison Officer to Alberta Geological Survey.

Member, ISPG Computer Service Committee.

Member, CSPG 1986 Convention Committee.

Member, CSPG International Liaison Committee.

J.D. Dixon

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.

Technical Progrm Chairman, Second International Symposium on the Devonian System.

Member, International Subcommittee on Stratigraphic Classification.

H. Geldsetzer

Member, Organizing Committee of Canadian Reef Inventory Project (Symposium and GSC Memoir 1987).

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

Chairman, CSPG Sedimentology Division.

D.W. Morrow

Member, Continuing Education Committee, CSPG.

D.F. Stott

Co-editor, Sedimentary Cover of the North American Craton - Canada (DNAG; GSC Sp. Publ. No. 2).

H.P. Trettin

Leader, Innuitian Volume (DNAG; GSC Sp. Publ. No. 2).

Member, Ph.D. Thesis Committee, University of Ottawa.

Lapidary

Thin sections, standard	350
Special Grain Inventory	66
Polished Slabs	24

Core and Sample Repository

Well Samples received:

Alberta	70,000
British Columbia	14,500
Saskatchewan	16,200
Manitoba	-
Offshore	9,800
Northwest Territories	28,650
	139,150

Mechanical logs received:

Alberta	26,500
British Columbia	920
Saskatchewan	3,450
Manitoba	810
Northwest Territories	360
	32,040

Territories Core Received: 1,100 boxes.

Visitors requiring core, samples, or related information: 2,100

8,500 boxes of core were 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.

Cuttings or core from about 70 wells were sampled for various scientific purposes by 10 to 15 oil companies (estimate only) and our own scientific staff.

PALEONTOLOGY SUBDIVISION

A.C. Higgins

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.

Paleotemperature studies, both as an aid to hydrocarbon and mineral exploration and as a contribution to the burial and uplift history of sedimentary basins, are increasingly being pursued in the Subdivision. The principal fossil geothermometers include graptolites, conodonts and palynomorphs. Fossil interpretations and colour

assessments, are carried out by paleontologists in both Calgary and Ottawa, but quantification of maturity assessments is being developed in cooperation with scientists of the Coal Subdivision.

Paleontology Subdivision Highlights - 1984-85

Subdivision scientists and associated outside specialists completed 135 paleontological reports on 1420 collections of fossils from outcrop and subsurface. These reports were prepared for direct quotation in publications and provided dating, correlation and hydrocarbon maturity data of rock units throughout Canada for use by the GSC, other EMR agencies, industry, the Department of Indian and Northern Affairs and Provincial Government agencies, such as the Alberta Geological Survey.

Two scientists of the subdivision are providing biostratigraphic and paleoecologic data for integration with sedimentologic models being developed by a research officer of the Alberta Geological Survey in a joint study of the Upper Cretaceous of the Dinosaur Provincial Park area, a UNESCO World Heritage Site. Palynological data, giving biostratigraphical and maturity indices, is being supplied to the Nova Scotia Department of Mines as a contribution to a study of the Uranium/Lead/Zinc prospects at the Horton-Windsor Group (Carboniferous) Boundary.

In the Arctic Islands, palynologic and conodont analyses of the Upper Paleozoic of recently drilled wells contributed significantly to the understanding of the biostratigraphy and maturity history of parts of the Sverdrup Basin. Work on the Beaufort Sea Natsek E56 well has led to significant revisions of age based on a study of the Tertiary foraminifera. A cooperative effort by scientists of the Petroleum, Regional and Paleontology Subdivisions resulted in the publication of the paper "Sequence analysis and Nomenclature of Upper Cretaceous to Holocene strata in the Beaufort-Mackenzie Basin", an attempt to recognise a basin-wide stratigraphy.

The introduction of the Frontier Geoscience Progam has had, and will continue to have, a major impact on the Subdivision. Projects commenced include a multidisciplinary study of the maturity history of the Sverdrup Basin and Paleozoic Platform by the use of conodonts, palynomorphs, scolecodonts and graptolites integrated with vitrinite reflectance studies being carried out by Coal Subdivision. Biostratigraphic studies of the Arctic Islands include the integration of palynologic, conodont and coral zonal schemes in the Paleozoic and foraminiferal, palynologic and ammonite schemes in the Mesozoic. Joint studies of the foraminiferal and palynologic sequence in the Beaufort Sea/Mackenzie Delta have commenced.

Scientists of the Subdivision made significant contributions to International events during the year. Fourteen scientists are now either members of Subcommissions of the IUGS Stratigraphic Commission or of working groups associated with the Subcommissions. Major decisions of the Devonian Subcommission on boundaries within the system have been made and their impact on Canadian stratigraphy was assessed in a paper written by Subdivision scientists titled "Intra Devonian Series Boundaries in Canada".

The working group on the proposed new Mid-Carboniferous Boundary examined two sections in the USA as potential stratotypes for the new boundary. The Canadian division of the Precambrian-Cambrian Boundary Project (IGCP Project 29) is currently studying strata in Newfoundland and the NW Territories. Joint studies have been started between a scientist of the Paleontology Subdivision and one from Queen's University, on sections from the Wernecke, Selwyne and Mackenzie Mountains. The 6th International Palynological Conference was held in Calgary in September, 1984 and contributions to both the organisation of the meeting and field excursions were made by subdivision scientists.

A joint study by members of the Coal and Paleontology subdivisions and of the University of Alberta on the Cretaceous-Tertiary Boundary in Alberta led to the discovery of a significant iridium anomaly at a horizon chosen by study of the palynological sequence. This discovery adds credence to the view that a significant event occurred at this boundary.

Several members of the Subdivision have contributed to volumes of the Decade of North American Geology (DNAG). These include the "Geology of the Hudson Platform", "Carboniferous/Permian Stratigraphy and Depositional History, Eastern Cordillera" (Cordilleran volume) Carboniferous and Permian chapters for Sedimentary Cover of the Craton: Canada (ISPG volume).

A major survey of thermal maturity levels in the Lower Paleozoic of eastern Canada has been completed as a joint project between the Paleontology Subdivision (Ottawa Section) and Memorial University of Newfoundland. Significant 'hot spots' have been identified, using conodonts as thermal indicators, which have implications for both mineral and hydrocarbon exploration. A manuscript "Thermal maturation of Paleozoic strata in eastern Canada from Conodont Colour Alteration Index (CAI) data with implications for burial history, tectonic evolution, hot spot tracks and mineral and hydrocarbon potential", has been completed.

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, B. Acker was appointed secretary to the Subdivision. B.J. Dougherty and D.R. Then were replaced, during their maternity leave, by term employees Riaj Velji and G. Tsang. On September 31, 1984, E.W. Bamber, who had been Acting Head of Paleontology for three years, returned to his former research scientist position. A.C. Higgins, who had been Head of the Micropaleontology Section, was appointed Head of the Subdivision from October 1, 1984. D.H. McNeil was appointed Head of the Micropaleontology Section on November 29, 1984. Dr. P. Sartenaer, Royal Institute of Natural Sciences, Belgium, worked at the Institute from September to December, 1984, on Devonian brachiopods from Canada.

Attendance at Meetings Conferences and Courses

Meeting of the International Working Group on the Cambrian-Ordovician Boundary, Kazakhstan, USSR, July-August, 1984

B.S. Norford

Meeting of the Canadian Geoscience Council, Toronto, March 1985

B.S. Norford

"Geophysics for Geologists" course, ISPG March 25-29, 1985

D.H. McNeil
T.T. Uyeno
J. Utting

CSPG-CSEG National Convention, "Exploration Update", Calgary, June 18, 1984

D.H. McNeil
A.C. Higgins
B.J. Dougherty
T.T. Uyeno

6th International Palynological Conference, Calgary, August 26 - September 1, 1984

J. Utting
A.R. Sweet
D.J. McIntyre
R.M. Kalgutkar
D.C. McGregor

GSC Palynologists Annual Meeting, Ottawa, October, 1985

J. Utting
D.C. McGregor
D.J. McIntyre
A.R. Sweet

GSC Conodont Annual Meeting, Ottawa, October 1984

A.C. Higgins
T.T. Uyeno
G.S. Nowlan

27th International Geological Congress, Moscow, USSR, August 4, 1984

E.T. Tozer

Permian-Triassic Boundary Working Group, Moscow, USSR, August 8, 1984

E.T. Tozer

Meeting of the Subcommission on Triassic Stratigraphy, Moscow USSR, August 10, 1984

E.T. Tozer

Annual Meeting of American Association of Palynologists, Washington D.C., October 1984

D.J. McIntyre
D.C. McGregor

Annual Meeting of the Geological Society of America, Reno, Nevada, November 5-8, 1984

A.C. Higgins

Joint Meeting of the Southeastern and North-Central sections, Geological Society of America, Lexington, Kentucky, April 4-6, 1984

G.S. Nowlan

Annual Meeting, Geological Association of Canada, London, Ontario, May 14-16, 1984

G.S. Nowlan

Canadian Paleontology and Biostratigraphy Seminar, Ottawa, Ontario, September 28-30, 1984

G.S. Nowlan

International Symposium on Jurassic Stratigraphy (Joint Meeting of International Subcommission on Jurassic Stratigraphy and IGCP Project 171 (Circum-Pacific Jurassic) Erlangen, W. Germany, September 1-8, 1984)

T.P. Poulton

6th International Palynological Conference, Calgary, September, 1984 (Excusion Guides)

J.H. Wall
E.W. Bamber
J. Utting
A.R. Sweet
D.J. McIntyre

ISPG Support Staff Excursion to Dinosaur Provincial Park and Bassano, September 29-30, 1984 (Excursion Guide)

J.H. Wall

Special Talks and Lectures

D.H. McNeil

The biostratigraphic potential of alveolar-walled agglutinated Foraminifera in the Paleogene of the Beaufort Sea, Arctic Canada, CSPG-CSEG National Convention "Exploration Update", Calgary, June 18, 1984.

A.C. Higgins

Correlation of conodont colour alteration indices (CAI) and vitrinite reflectance in the Upper Devonian and Lower Carboniferous rocks of NE British Columbia and NW Alberta - Indicators of maturity. CSPG-CSEG "Exploration Update" June 1984 (Joint with W.D. Kalkreuth and B.J. Dougherty).

G.S. Nowlan

Biostratigraphic significance of protoconodonts, associated phosphatic microfossils and trace fossils near the Precambrian-Cambrian boundary, Yukon Territory, Canada. Joint meeting of Southeastern and North-Central sections, Geological Society of America, Lexington, Kentucky, April 5, 1984.

Late Ordovician - Early Silurian conodont biostratigraphy and provincialism in the northern Canadian Cordillera. Annual Meeting, Geological Association of Canada, London, Ontario, May 14, 1984.

Conodonts as indicators of time, tectonic history and hotspot tracks, and their application to mineral hydrocarbon exploration. Invited lecture, Geocolloquim Series, Queen's University, Kingston, March 28, 1985.

J. Utting

Carboniferous palynology in Canada, 6th International Palynological Conference, Calgary, September, 1984.

Membership on Committees

E.W. Bamber

Dinantian Working Group within International Subcommission on Carboniferous Stratigraphy.

North American Study Group, International Subcommission on Permian 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, voting member.

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.

Canadian Paleontological Monograph Series (GAC-CSPG), Business Manager of Committee for Palaeontographic Canadiana.

Mississippian and Middle Pennsylvanian Working Groups, IUGS Subcommission of Carboniferous Stratigraphy.

Secretary, Paleontological Division of the Canadian Society of Petroleum Geologists.

Geological Potential Committee, Member

D.C. McGregor

International Federation of Palynological Societies, President.

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 Commission on Stratigraphy, Working Group on the Devonian-Carboniferous Boundary, member.

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.

Foreign Secretary of the Canadian Geoscience Council and a member of its Board of Directors.

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, Titular 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

Special Series Editor, Geoscience Canada.

Adjunct Professor, University of Ottawa School of Graduate Studies, University of Ottawa, member.

A.E.H. Pedder

International Association for the Study of Fossil Cnidaria, Council member.

Subcommission on Devonian Stratigraphy, corresponding member

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.

D.J. McIntyre

American Association of Stratigraphic Palynologists, Director.

Laboratory Statistics - Calgary

Foraminifer Laboratory

895 outcrop and well samples were processed for scientific projects led by D.H. McNeil and J.H. Wall.

Conodont Laboratory

425 well and outcrop samples were processed in the laboratory. In addition the laboratory technician organized data and shipping and monitored results for the processing of 696 samples on separate outside contracts. Faunas from 62 samples were picked under outside contract. All samples are for study for A.C. Higgins and T.T. Uyeno.

Palynology Laboratory

1587 surface and subsurface samples were processed for palynomorph preparation. 39 samples were prepared for contractual service projects outside of ISPG. A further 500 samples were processed for J. Utting under outside contract. All preparations are for scientific projects led by A.R. Sweet, D.J. McIntyre and J. Utting.

Macropaleontology Laboratory

The major output consisted of 1635 coral and foraminiferal thin sections for study by A.E.H. Pedder, E.W. Bamber and B.S. Norford and paleontologists outside ISPG. Casts and moulds of the fossils numbered 8, fossils were picked from 9 acid residues.

Curation Statistics - Calgary

"C" Numbers Issued	10,070
Transferred from Ottawa	1,000

Open File 490 listing subsurface samples from the District of Mackenzie, District of Franklin and Yukon Territory was completed. Fossils, rocks and thin sections were loaned to, donated to or processed for: universitites, exploration companies and government agencies. Palynological type material from 6 authors were curated for temporary storage.

Laboratory Statistics - Ottawa

Lapidary Laboratory

Rock thin sections	
Standard, produced by laboratory	4,050
Oriented	120
Large	175
Polished, purchased by contract	1,514
Polished, produced by laboratory	40
Polished rock surfaces	160
Rock trim cuts	5,290
Levelled rock surfaces and saw cuts	3,850

Paleontology Laboratory

Preparation:	
Thin sections	106
Plaster casts	64
Rubber moulds	5
Silicone Rubber moulds	43
Epoxy casts	86
Curation:	
Parcels received	40
Parcels shipped	179
Trays of fossils, U. of Ottawa	45
Plastic bins of fossils, U of Ottawa	92
Fossil localities catalogued (GSC Localities 99869 to 101217)	1349
Collections received with Calgary numbers	496

Palynology Laboratory

In the Ottawa palynology laboratory, supervised by D.C. McGregor, 234 surface and subsurface samples were processed, and 949 slides were prepared containing marine and non-marine palynomorphs of Ordovician to Devonian age.

Conodont Laboratory

In the Ottawa conodont laboratory, supervised by G.S. Nowlan, 330 samples were acidized and 358 samples were organized for picking on outside contract.

PETROLEUM GEOLOGY SUBDIVISION

N.J. McMillan

The Petroleum Geology Subdivision is responsible for conducting research, mapping and compilation of geological information pertaining to the sedimentary basins of Arctic and Western Canada. Research is also conducted into the mode of origin and occurrence of petroleum to provide necessary background for the evaluation studies and reserve estimates. The Subdivision activities are interrelated with activities 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 document petroleum plays and parametric data required for resource assessment. It generates computer data files related to well information, oil and gas pool data and other information. New concepts guiding directions for research can arise from this Section's activity. Some 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 dominant activity and task is to do and participate in scientific research which is directed to understanding petroleum occurrence and location in Canada.

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 Petroleum Geology Subdivision

An unedited map of the crystalline rocks of the Western Canada sedimentary basin is being used as it is being revised. The data for it and other data are being presented on the new topographic base map of Western Canada. Comprehensive formation temperature maps have been prepared for southern Alberta as well as vitrinite reflectance profiles. Plans for the multidisciplinary Peace River Arch project were finalised for the summer of 1985. The geology and engineering properties of the Crystal Field (Viking Fm., Alberta) is virtually complete. The first phase of the Bakken Formation study of Williston Basin (Saskatchewan) resulted in an open file report widely sought by the Petroleum Industry. In addition an Upper Shaunavon (Jurassic, Saskatchewan) study is completed and essentially prepared for release.

The maps for Mackenize Corridor study are completed and being readied for open file release. An open file has been released on the Petroleum Geology of the Norman Wells Oilfield. Additional Proterozoic rocks from the Mackenzie Corridor were analyzed for source potential and data acquisition on Paleocene source rocks from the Beaufort Mackenzie was completed. Stratigraphy of the Beaufort Sea/Mackenzie Delta has been published. The first seismic stratigraphy study in the Beaufort Sea (the Kopanor Field) has been completed. The Alberta Research Council, under contract to ISPG is making progress on a geopressure study of the Mackenzie Beaufort. Extensive biomarker analyses were carried out at ISPG on oils and source rock extracts for Beaufort-Mackenzie samples.

A project concerned with the mass transfer of elements in clastic sequences is initiated by drilling two 18 metre 3 1/2" diameter cores on East Drake well east of Sabine Peninsula, Melville Island. Also in the Arctic, biomarker analyses have been done on several Schei Point samples.

Pyrolysis logs have been run for several frontier wells and routine analyses of recovered liquid hydrocarbon phases were carried out.

The oil shale program was completed with the publication of GSC paper 85-11 summarising the results obtained over the past several years. Several open file reports including detailed analytical results from the Nova Scotia deposits are now available.

The inorganic geochemistry personnel have produced papers on diagenesis as well as mineral matter and trace elements of coal.

Personnel Notes

The Petroleum Geology Subdivision employs a permanent staff of 16 scientists, 10 technicians, and 1 secretary.

A. Hamblin, J. Barclay and J. Podruski were transferred to the subdivision from the Secretariat.

P.W. Brooks joined the organic geochemistry section as an organic geochemist.

L.R. Snowdon was appointed as an adjunct professor to the University of Waterloo, Geology Department for a three year term.

Randell Stephenson continues as a Post Doctoral Fellow in the subdivision. He will assume the dominant role in acquisition and interpretation of results of Peace River Arch refraction profiles.

Attendance at Meetings Conferences and Courses

P.W. Brooks

Presented poster at ASMS, San Antonio, Texas, May, 1984.

Gordon Research Conference, Plymouth, N.H., August, 1984.

Kratos Users Meeting, Vancouver, British Columbia, January, 1985.

PetroCanada Special Presentation on Scotian Shelf, AGC, March, 1985.

A.A. Densmore

CSEG-CGU Annual Meeting, Calgary, Alberta, May, 1984.

M. Fuglem

CSEG-CGU Annual Meeting, Calgary, Alberta, May, 1984.

N.J. McMillan

A.A.P.G. Annual Meeting, New Orleans, March, 1985.

Sask. Geol. Soc. - Williston Basin Symposium, October, 1984.

M. Northcott

Kratos Users Meeting, Vancouver, British Columbia, January, 1985.

K.G. Osadetz

Sask. Geol. Soc. - Williston Basin Symposium, October, 1984.

Resources, of N.W.T. Conferences, Yelowknife, N.W.T., December, 1984.

L.R. Snowdon

Gordon Research Conference, Plymouth, N.H., August, 1984.

PetroCanada Special Presentation on Scotian Shelf, AGC, March, 1985.

Special Talks and Lectures

P.W. Brooks

"Application of mass spectrometry to biochemistry and geochemistry", Calgary Mass Spectrometry Group and Atlantic Geoscience Centre.

"Special ionization techniques in mass spectrometry", Calgary Mass Spectrometry Group.

N.J. McMillan

"Petroleum Resources of North American Arctic Basins", New Orleans, A.A.P.G. Annual Meeting.

K.G. Osadetz

"Petroleum Geology of the Heiberg Group, Sverdrup Basin": Dalhousie University, and Resources Conference, Yellowknife, N.W.T.

L.R. Snowdon

"Comparison of Rock Eval pyrolysis and extract results for Ontario Oil shales", Kernforschungsaulage, Julich, Federal Republic of Germany.

Committee Memberships

M. O. Fuglem

CSPG, Cross Section Committee

N. J. McMillan

CSPG "Geolog" Committee, Member.
CSPG International Devonian Symposium, Editor.
CSPG Publications and Sales Committee, Member.
CSPG Reprint Series Committee
CSPG Conference Theme Search Committee

K.G. Osadetz

President, ISPG McConnell Club
ISPG Computer Committee

L. R. Snowdon

ISPG Computer Committee
Medal of Merit, 1983, Chairman
CSPG Geochemistry Division, Chairman

Organic Geochemistry Laboratories

Analysis of light hydrocarbons and organic carbon:

	83/84	84/85
Organic Carbon Analysis	3,720	1,800
Total Carbon	214	200

Extraction and Separation of hydrocarbon fractions:

	83/84	84/85
Extractions	36	134
Distillations	43	28
Separations	231	70
Gas Chromatographic Analysis	250	150

Kerogen Studies:

	83/84	84/85
Isolation	6	
CHN Elemental Analysis	163	

Source Oil Correlation Studies:

	83/84	84/85
Gasoline Range	441	335
Mass Spectrometry (Faman)	35	20
Capillary GC/MS Analysis	30	350
Pyrolysis Gas Chromatography	20	150

Rock-Eval Analysis:

	83/84	84/85
Whole Rock Analysis	4,650	5,775

SEM Lab Statistics

	83/84	84/85
Exposures:		
Paleontology Subdivision	100	499
Petroleum	1,040	107
Regional	-	-
Coal	100	50
Others (Machine Shop, NEB, etc.)	1,176	50

Inorganic Geochemistry

	83/84	84/85
XRD Mineral Determinations	5,634	5,714
XRF Analysis	4,564	3,075
Infra-red Analysis	40	6
TGA/DTA	2,401	390
Atomic Absorption Analysis	1,959	36(296)
Low Temperature Ash	53	98(360)
High Temperature Ash	53	9(9)
CHN		2160
Proximate Analysis		218
Miscellaneous (C, P, S, Moisture, pH)	763	1480

COAL GEOLOGY SUBDIVISION

D.W. Gibson

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 and with industry. These activities are designed to meet policy, regulatory and information requirements of the Department of Energy, Mines and Resources.

To fulfill this role, the Subdivision is organized into three sections. The Geology of Coal Section conducts stratigraphic, sedimentologic 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, northern mainland and Arctic Canada. 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 including graptolites and chitinozoa. 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, quality and mineability of these coal deposits.

Highlights

The Coal Geology Subdivision continues to amass geoscientific data on the coal measures of Canada for the National Coal Inventory. Significant progress is being made in the development and modification of new computer applications for coal resource evaluation. Subdivision highlights are as follows:

1. The discovery of a major marine tongue containing a fauna of Late Early Albian age in the coal-bearing Gething Formation indicates (a) that the marine facies correlates with part of the Moosebar Formation at Peace River; and (b) that the economically thick coals at the top of the Gething Formation in the Sukunka area are much younger than seams at the top of the Gething Formation in the Peace Canyon area.

2. A new stratigraphic subdivision of the Saunders group based on cyclicity has been devised. The Cretaceous-Tertiary boundary has been palynologically determined and confirmed by an iridium anomaly, within the coal-bearing Saunders succession at the base of the Mynheer coal zone.

3. Geological investigations including coal resource estimates were completed on Tertiary coal measures in the Fort Norman-Tertiary Hills area and western Axel Heiberg Island (NWT).

4. Coal resource index prepared for Yukon and mainland Northwest Territories.

5. Trace element analyses of Canadian coals reveal that those with a high concentration of boron and sodium are typical of a more brackish environment.

6. Hat Creek coals from Deposits No. 1 and No. 2 are petrologically similar and are interpreted to have formed under similar paleoenvironments.

7. The dispersion of optical properties of graptolites follows a similar trend as those for coal or bitumen of similar levels of metamorphism.

8. Coal rank studies in the Rocky Mountain Foothills and Front Ranges north of Grande Cache Alberta, show that the degree of thermal maturation decreases westward from the core of the Alberta Syncline. Time temperature models suggest that the maturation decrease is due to a decrease in length of time and depth of burial westward as a consequence of Laramide deformation.

9. Comparison of petrographic analyses and chemical data. Pairs of samples (hand-picked vitrain plus whole coal) ranging in rank from lignite to semianthracite show that high inertinite coals tend to have lower volatile contents than pure vitrains of the same rank. Variable liptinite contents tend to offset this relationship.

10. A comprehensive computer-assisted evaluation of the commercially significant subbituminous coal deposits near Sheerness, Alberta was completed. A computer-processable coal quality data base and associated computer programs were completed and applied to assessing distributions of analysed quality attributes of Sheerness coals. A method for reliably estimating in situ bulk densities of coals was developed and used to compile analyses of sampled plies within the coal zones.

11. Coal resource assessment completed for the Legal-Morinville coal project of central Alberta.

12. Methods have been developed to allow integration of computer-based coal deposit models with Environment Canada's land use data. Coal resources can now be classified according to the surface land use with a resolution of one hectare.

13. Procedures have been implemented for the collection, digitizing and integration of coal ownership information with coal resource and environmental data, so that resources held by various owners may be identified.

14. Geostatistical procedures have been implemented so that the estimation variance associated with coal resource estimates can be quantified and used as a criterion for assurance of existence.

Personnel Notes

The Coal Geology Subdivision consists of 11 scientists, 2 technicians and one secretary.

D.K. Norris retired March 1, 1985 as Head, Coal Geology Subdivision in order that he may devote more time to the completion of geological maps and reports on the southern and northern Cordillera. D.W. Gibson has been designated Acting Head of the subdivision.

G.G. Smith was appointed Head, Resource Evaluation Section, replacing J.D. Hughes who returned to full time research on resource evaluation methodologies.

D. Lepard has temporarily been assigned to the subdivision as a computer programmer, replacing K. Mottershead who is on maternity leave.

D.K. Norris was awarded the Douglas Medal of the Canadian Society of Petroleum Geologists for his outstanding work in structural geology research in western Canada and the far north.

D.K. Norris with T. Dixon and D.F. Stott participated in a field trip to the Pyrenean chain of northern Spain and southern France. The tectonic evolution of the chain was compared with that of the northern Cordillera of Yukon Territory and Alaska.

A. Sherwood, New Zealand's senior coal resource geologist, spent six months with the Resource Evaluation Section learning G.S.C. techniques and procedures for evaluating coal deposits.

W.D Kalkreuth was on leave of absence from October 1, 1984 to June 30, 1985 undertaking studies on geochemical and petrographic properties of organic materials at the Institute for Petroleum and Organic Geochemistry, Jülich, West Germany.

F.M. Dawson D.W Gibson, J.D. Hughes and B.D. Ricketts participated in a field trip to the Book Cliffs area of Utah to examine Cretaceous coal-bearing rocks and depositional environments.

Attendance at Meetings
Conferences and Courses

A.R. Cameron

C.S.P.G.-C.S.E.G. Annual Meeting, Calgary, June 1984.

International Committee for Coal Petrology Conference, Calgary, August 1984.

British Columbia Coal Geology Symposium, Fernie B.C. September 1984.

Rocky Mountain Coal Symposium, Bismark, N.D., October 1984.

Liquid Fuels Workshop, Ottawa, December 1984.

F.M. Dawson

Practical Geostatistics Course, Calgary, July 1984.

British Columbia Coal Geology Symposium, Fernie, B.C., September 1984.

National Perspectives on Coal Seminar, C.S.P.G., Calgary, October 1984.

D.W. Gibson

International Committee for Coal Petrology Conference, Calgary, August 1984.

Montana Geological Society Symposium, Kalispell, Montana, September 1984.

F. Goodarzi

International Committee for Coal Petrology Conference, Calgary, August 1984.

J.D. Hughes

C.I.M.M. Annual Meeting, Ottawa, April 1984.

Practical Geostatistics Course, Calgary, August 1984.

British Columbia Coal Geology Symposium, Fernie, B.C., September 1984.

National Perspectives on Coal Seminar, C.S.P.G., Calgary, October 1984.

Coal Workshop - British Columbia Ministry of Mines and Petroleum Resources, Victoria, B.C., January, 1985.

T. Jerzykiewicz

C.S.P.G. Research Symposium on Sedimentology of Shelf Sands and Sandstones, Calgary, June 1984.

Canadian Paleontology and Biostratigraphy Seminar, Ottawa, September 1984.

G.S.C. Current Activities Forum, Ottawa, January 1985.

W.D. Kalkreuth

A.A.P.G. Annual Convention, San Antonio, Texas, May 1984.

International Committee for Coal Petrology, Annual Meeting, Calgary, August 1984.

German Society of Petroleum Research and Coal

Chemistry, Innsbruck, Austria, November 1984.

D.K. Norris

Annual Meeting of the Cordilleran Section, Geological Society of America, Anchorage, Alaska, May 1984.

B.D. Ricketts

C.S.P.G. Research Symposium on Sedimentology of Shelf Sands and Sandstones, Calgary, June 1984.

A.A.P.G. Field Symposium on Carboniferous Coal and Delta Sequences, Kentucky, October 1984.

G.G. Smith

C.I.M.M. Annual General Meeting, Ottawa, April 1984.

Sedimentology of Shelf Sands and Sandstones, C.S.P.G. Research Symposium, Calgary, June 1984.

British Columbia Coal Geology Symposium, Fernie, B.C., September, 1984.

National Perspectives on Coal Seminar, C.S.P.G., Calgary, October 1984.

Coal Workshop - British Columbia Ministry of Mines and Petroleum Resources, Victoria, B.C., January, 1985.

Special Talks or Lectures

A.R. Cameron

"Comparison of reflectance data for various macerals from coals of the Kootenay Group, southeastern British Columbia", to Rocky Mountain Coal Symposium, Bismark, N.D., October 1984, C.S.PG. Coal Division Meeting, Calgary and British Columbia Coal Geology Symposium, Fernie, B.C.

"Reflectance and fluorescence measurements as indicators of organic metamorphism". Lecture for geology students, St. Francis Xavier University, Nova Scotia, October 1984.

F.M. Dawson

"Coal exploration and development potential of the southern Rocky Mountains". C.S.P.G. Coal Group, Calgary, February 1985.

D.W. Gibson

"Stratigraphy and sedimentary environments of the Jura-Cretaceous Kootenay Group, Crowsnest Pass area, Alberta and British Columbia". Montana Geological Society Symposium, Kalispell, Montana, September 1984.

Led field trip with A.R. Cameron to examine stratigraphy, sedimentary environments and coal occurrences, Crowsnest Pass area, Alberta and British Columbia, for International Committee of Coal Petrology, August 1984.

F. Goodarzi

"Organic petrology of the Hat Creek coal deposit No. 1". International Committee for Coal Petrology Conference, Calgary, August 1984.

J.D. Hughes

"Coal resources and reserves of.Canada - an update". C.I.M.M. Annual Meeting, Ottawa, April 1984.

"Computer based methods for coal basin analysis and resource assessment utilized in Canada's National Coal Inventory". C.I.M.M. Annual Meeting, Ottawa, April 1984.

"Geology of Mount Allan". C.S.P.G. Luncheon Meeting, Calgary, June 1984.

"Coal in Canada - methods and products of Canada's Coal Inventory". International Committee for Coal Petrology Conference, Calgary, August 1984.

"The Geological Survey of Canada's National Coal Inventory". C.S.P.G. Seminar, Role of Government in the Coal Industry, Calgary, October 1984.

T. Jerzykiewicz

"Gigantic foresets infilling tectonically controlled scours in the shelf floor, an example from the Bohemian Cretaceous Basin". Poster session, C.S.PG. Research Symposium on Sedimentology of Shelf Sands and Sandstones, Calgary, June 1984.

"New data about the stratigraphy of the Saunders Group, central Alberta Foothills". I.S.P.G. McConnell Club, Calgary, January 1985.

"Stratigraphy and sedimentology of coal-bearing Upper Cretaceous-Paleocene Saunders Group, central Alberta Foothills between Athabasca and Blackstone Rivers". G.S.C. Current Activities Forum, Ottawa, January 1985.

"Determination of the Cretaceous-Tertiary boundary in central Alberta: the Saunders Group and its regional correlatives". C.S.P.G. Paleontology Division, Calgary, February 1985. (co-speaker with A.R. Sweet).

W.D. Kalkreuth

"Organic petrology of selected oil shale samples from the Lower Carboniferous Albert Formation, New Brunswick, Canada". (with G. Macauley). A.A.P.G. Annual Meeting, San Antonio, Texas, May 1984.

"Application of spectral fluorescence in organic geochemistry" (with H. v.d. Dick). C.S.P.G. Exploration Update 84, Calgary, June 1984.

"Rank variation and composition of coals from Peace River Coalfield, N.E. British Columbia and adjacent parts of west-central Alberta". International Committee for Coal Petrology, Annual Meeting, Calgary, August 1984.

"Stepwise pyrolysis of high-volatile bituminous coal from Nova Scotia". German Society of Petroleum Research and Coal Chemistry, November 1984.

D.K. Norris

"The tectonic evolution of the northern Cordillera of Canada and Alaska". Annual Meeting of the Cordilleran Section, G.S.A., Anchorage, Alaska, May 1984.

"Structural style of the Kootenay Group". International Committee for Coal Petrology Annual Meeting, Calgary, August 1984.

"Geology and tectonic evolution of southern Canada Basin". Research staff of Shell Development Company, Houston, Texas, March 1985.

G.G. Smith

"Coal - its origin, composition, geological occurrence, mining and utilization". Lecture at Southern Alberta Institute of Technology, Calgary, January 1985.

"A comprehensive evaluation of coal resources near Sheerness, Alberta". A formal slide-supported presentation to Luscar Limited and Manalta Coal Limited, who provided most of the proprietary data used for the study, January and February, 1985.

"Coal - its origin, occurrence, mining and utilization". Lecture at St. Boniface Elementary School, Calgary, February 1984.

Membership on Committees

A.R. Cameron

International Committee for Coal Petrology, member.

Editorial Board, International Journal of Coal Geology

Chairman, Canadian Coal Petrographers Group.

F.M. Dawson

Chairman, Coal Group, Canadian Society of Petroleum Geologists.

D.W. Gibson

I.G.C.P. Correlation of Coal-Bearing Formations Project 166, national representative.

E.M.R. Departmental Coal Committee, member.

F. Goodarzi

International Committee for Coal Petrology, member.

Editorial Board of Fuel, member.

I.S.P.G. Library Committee, member

J.D. Hughes

Technical Committee - Joint Federal-Provincial B.C. Coal Data Collection Project, member.

I.S.P.G. Computer Committee, member..

W.D. Kalkreuth

Interntional Committee for Coal Petrology, member.

B.D. Ricketts

Associate editor, Bulletin Canadian Society of Petroleum Geologists.

I.S.P.G. Library Committee, member.

I.S.P.G. Exhibits Committee, member.

G.G. Smith

Coal Division, Technical Programs Committee, Canadian Institute of Mining and Metallurgy, member.

Technical Committee - Joint Federal-Provincial B.C. Coal Data Collection Project, member.

Coal Technology Laboratory

1118 pellets of coal, kerogen and other organic materials were prepared. Some of these organic materials included graptolite remains which required special treatment for the production of suitable reflected light specimens.

COAL GEOLOGY SUBDIVISION STAFF LIST

Coal Geology Subdivision

Gibson, D.W., Acting Head
Boonstra, C.A.
Smith, D.J., Secretary

Coal Technology Section

Cameron, A.R.
Goodarzi, F.
Kalkreuth, W.D.
Pratt, K.C.

Resource Evaluation Section

Smith, G.G.
Dawson, F.M.
Hughes, JD.
Mottershead, K.E.

Geology of Coal Section

Jerzykiewicz, T.
Norris, D.K.
Ricketts, B.D.

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

The Petroleum Resource Appraisal Secretariat role has continued to modify in response to the Department's need for information. Primarily this involved the assumption of a catalytic role in Basin Analysis studies throughout the Survey and the focusing of the results from the Basin Study Teams toward resource assessment. Considerable effort was expended to acquire four additional petroleum geoscientists to provide the appropriate linkages to the Basin Study Teams. Specific highlights follow:

1. May 1984 - **Oil and Gas Opportunities in the Third World,** a report prepared for the International Energy Relations Branch of EMR.

2. July 1984 - Presented a five day workshop in Petroleum Resource Appraisal Methodology to the West German Geological Survey in Hannover.

3. September 1984 - Hosted the Denver based petroleum resource appraisal group of the USGS in Calgary to assist them in methodology for their appraisal of Federal Lands.

4. December 1984 - Co-ordinated presentation and prepared report to PANEL entitled **Supply Price Estimates for Existing and Potential Discoveries in Overpressured and Deep-Seated Structure Plays of the Scotian Shelf Region** (Panel Report 84.03).

5. March 1985 - Presented Part I of a major new assessment on the remaining oil potential of Western Canada to PANEL - **Oil Resources of Western Canada: Part 1. Devonian and Pre-Devonian** (Panel Report 85.01).

6. March 1985 - Completion and licensing for public purchase of PRIMES - a linked multiprogram computer software system for petroleum resource assessment usage.

Personnel Notes

The Secretariat currently consists of an Executive Director, seven scientists, an engineer 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

J.R. Dietrich - Geophysicist

D.N. Skibo - Operations Geologist in evaluation activity

J.E. Barclay - Petroleum Geologist

A.P. Hamblin - Petroleum Geologist

J.A. Podruski - Petroleum Geologist

A.G. Foo - Secretary

Attendance at Meetings, Conferences and Courses

J.R. Dietrich

Participated in CSEG National Convention, May, 1984, Calgary

Attended one week course on Basin Analysis, October, 1984, Calgary

D.N. Skibo

Attended 5th Generation Computing and Expert Systems Conference, Sept. 20-21, 1984, Calgary

Attended an in-house course on Geophysics for Geologists, March 25-29, 1985, ISPG, Calgary

Attended Canadian Society Petroleum Geologists Annual Meeting, June 18-20, 1984, Calgary

A.P. Hamblin

Attended a course on Petroleum Generation & Occurrence, November 19-23, 1984, Calgary

Special Talks or Lectures

R.M. Procter

Paper published in 1984

Evaluation of Oil and Gas Potential of an Offshore Westcoast Canada Play - an Example of Geological Survey of Canada Methodology.
International Union of Geological Sciences Publication No. 17, p.39-62

G.C. Taylor

Paper published in 1984

Evaluation of Oil and Gas Potential of an Offshore Westcoast Canada Play - an Example of Geological Survey of Canada Methodology.
International Union of Geological Sciences Publication No. 17, p.39-62

P.J. Lee

Paper published in 1984

1. Prediction of Oil or Gas Pool Sizes when Discovery Record is Available.
   Mathematical Geology, v.17,no.2,p.95-113

2. PRIMES: a Petroleum Resources Information Management and Evaluation System.
   Oil & Gas Journal, Oct. 1, 1984, p.204-206

Paper accepted for publication

1. Evaluation of Petroleum Resources from Pool Size Distributions.
   AAPG

J.R. Dietrich

Presented paper "Upper Cretaceous to Holocene Geology of the Beaufort Sea - Mackenzie Delta Area" at CSPG Luncheon Meeting, September, 1984, Calgary

Presented Paper "Regional Stratigraphy and Structure of the Beaufort Sea Continental Margin" to ISPG McConnell Club, September, 1984, Calgary

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 sub-program (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

A.P. Hamblin

Member of CSPG Student/Industry Field Trip Committee

Member of CSPG Graduate Thesis Awards Committee

Member of CSPG '86 Conference Technical Program Committee

J.E. Barclay

Contributor to CSPG Oil & Gas Fields Project

Geological Advisor to Peace River Arch Crustal Refraction Seismic Project

GEOLOGICAL PUBLICATIONS 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, cartography, technical photography and word processing. 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 28 reports in the Geological Survey series, 76 outside papers and abstracts, 13 open file reports, and 1 map. 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.

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.

The Word Processing Centre (consisting of five operators, under the supervision of P.L. Greener) was transferred from Administration into the Geological Publications Subdivision in June, 1984. At the same time, the ISPG Library unit was transferred from G.P.S. to Administration.

The Word Processing Centre produces all the Institute's manuscript copy for scientific papers, ranging from initial drafts to the final, camera-ready copy for the printer. Each year, some 30,000 pages are processed. In addition, some 700 letters and memoranda are typed as a special service. ISPG uses a network of ten Xerox workstations and one microcomputer to process and transfer both copy and data.

The Publications and Air Photo Section is the largest, best organized and undoubtedly the most efficient retail outlet of its kind in Western Canada. If sale trends for geological papers and maps are a valid indication, the 7 per cent increase in sales recorded by PAPS in 1984-85, over sales in 1983-84, reflects an upward trend in the western Canadian Oil Industry.

Personnel Notes

Cathy Brennan joined the Word Processing Centre on 20th July, 1984, as Switchboard Operator/Receptionist, and Dannielle Beauregard rejoined the Centre on 17th December, 1984 after eighteen months absence on maternity leave and transfer status.

Lynn Machan-Gorham handed over her duties (as Editorial Assistant) to Elspeth Snow in March, 1985, and departed on five months maternity leave. Elspeth is "on loan" from the Regional Geology Subdivision.

Attendance at Meetings Conferences and Courses

N.C. Ollerenshaw

Visit to GID/GSC Ottawa, July 24-28, 1984.

L. MacLachlan

Visit to GSC Vancouver, April 19, 1984.

Visit to IOS/PGS Sidney, July 11 and 12, and November 1 and 2, 1984.

Visit to GSC/S&M Ottawa, December 19, 1984.

Visit to ENR/C of E Edmonton, February 18, 1985.

Seventh International Symposium on Computer Assisted Cartography, Washington, D.C., March 11-15, 1985.

W.P. Vermette

Visit to ENR/C of E Edmonton, February 18, 1985.

First aid course, February 27 and 28, 1985.

J.W. Thomson

Visit to ENR/C of E Edmonton, February 18, 1985.

J.H. Waddell

First aid course, February 27 and 28, 1985.

Dannielle Beauregard

Star 8010, December 17-21, 1984.

Cathy Brennan

Siemens Switchboard Course, July 20-25, 1984.

Pat Greener

Star 8010 and File Server, April 25-27, 1984.

Xerox 860 Training Course, July 23-26, 1984.

Savin Photocopier, December 6, 1984.

St. John's First Aid Course, February 27-28, 1985.

Hilde King

Savin Photocopier, December 6, 1984.

Ann Seif

Xerox 860 Training Course, October 22-25, 1984.

Savin Photocopier Training, June 11, 1984.

Maria Varalta

Xerox 860 Training Course, October 22-25, 1984.

Membership on Committees

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, 1984 — March 31, 1985)

Scientific Editor's Office

Format	Received	Edited & Approved	To Ottawa or Publisher	Printed
Memoirs	-	-	-	-
Bulletins	3	-	1	2
Papers	7	4	3	3
84-1B	13	13	13	13
85-1A	6	6	6	6
85-1B	11	5	N/A	N/A
Maps	2	1	-	1
Open Files	15	N/A	13	16
Outside				
Papers	52	52	52	38
Abstracts	24	24	24	24

Geological Cartography Section

Maps and figures completed by the Cartography Section between April 1, 1984 and March 31, 1985.

	1983-1984	1984-1985
Multicolour maps and section sheets	1	5
Figure illustrations (page)	362	164
Figure illustrations (pocket)	15	9

Manuscripts received	1983-1984	1984-1985
Multicolour geological maps	4	7
Figure illustrations (page)	407	349
Figure illustrations (pocket)	9	9

Maps and illustrations in progress at March 31, 1985

	1983-1984	1984-1985
Multicolour geological maps	5	7
Figure illustrations (page)	106	277
Figure illustrations (pocket)	9	10

Miscellaneous drafting which averaged approximately 25% of the total drafting time, comprised 1437 separate items, 304 of which were slides.

Reproduction services	1983-1984	1984-1985
Diazo prints	3991	8121
Diazo prints (frame shots)	365	525
Di-chrome	604	303
Photomechanical services		
Film (sheets, negatives and positives)	4096	3120
Drafting keys on scribecoat	49	100
Blueline on Cronaflex	48	14
Colour proofs	27	11
Peelcoats	103	72
C-1 prints	151	17
KC-5 prints	2075	1403
Autopositives (multiple exposure)	418	963
Sepia (dry erasable film)	392	199
Camera services		
Film shots (line)	7393	3002
Film shots (halftone)	162	264
Paper	117	30

Word Processing Centre

Statistics 1984—1985

Letters	538
Memos	216
Tables	124
Blueline pages	10 096
8 1/2 x 11 pages	4910
8 1/2 x 14 pages	15 140
Miscellaneous items	1128

Photography Section

Production during the review years 1983-84 and 1984-85

	83-84	84-85
Total number of black and white, continuous tone 4" x 5" negatives	1351	1514
Total number of black and white prints	11 884	11 566
Total number of contact proof sheets	773	895
Total number of 35 mm films (black and white and colour) submitted for processing by staff members	259	177
Total number of black and white 35 mm negative films	196	170
Total number of 35 mm colour slide films	259	178
Total number of colour negatives on file	945	1141
Total number of colour prints	2029	2728

Publications and Airphoto Section

This year has proved to be a busy one for the Publications Office. While the sale of GSC publications decreased slightly, the demand for topographic maps increased. This was mainly due to the fact that this office now stocks maps covering the entire country at three of the four scales available.

The Sixth International Palynological Conference was held at the University of Calgary in August, 1984. Display space was made available to the Institute and many of the Survey's reports dealing with palynology and the geology of the Calgary region were made available for viewing. Publications' staff manned the display, answering any questions and directing those attending the conference to the Institute when they wished to purchase any publications. The display received a great many compliments and was considered one of the finest at the conference.

A number of charge accounts were closed during the year as they were not being used. Thirty-one new accounts were opened, leaving a total of 179 accounts held in this office.

The number of individuals who visited the office during the year increased from 10,194 in the previous fiscal year to 11,083. Many of the visitors were from foreign countries and, in the case of some from the United States, had flown to Calgary specifically to purchase materials on the geology of Alberta from the Institute and other agencies.

Breakdown of Sales

	1983-84	1984-85
Surveys and Mapping	$ 93,251.20	$107,450.35
Nat. Air Photo Library	8,884.60	9,328.47
GSC Maps	11,973.65	9,890.00
Rock and Mineral Kits	1,805.00	2,941.00
Misc. GSC Material	1,192.10	820.48
GSC Publications	20,730.35	16,727.54
Mineral Development	261.10	223.35
Gravity Maps	61.50	28.50
Total Sales	$138,159.50	$147,409.69

Breakdown of Accounts

	1983-84	1984-85
Credit Sales	$ 65,754.50	$ 77,174.95
Cash Sales	$ 70,600.40	$ 70,508.39
Received On Account	$ 67,559.10	$ 76,901.30

Air Photos

A total of 194 orders (146 prepaid) were forwarded to Ottawa during the year. These consisted of:

4542	Black and white contact prints
35	Colour contact prints
133	Flight line index maps
6	10" x 10" black and white enlargements
2	15" x 15" black and white enlargements
10	20" x 20" black and white enlargements
11	30" x 30" black and white enlargement
2	40" x 40" black and white enlargements
2	Black and white enlargements to scale
11	Itek prints
56	Black and white diapositives
4	Landsat mosaics

A graph showing the trend of sales follows:

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. Within these objectives, priorities include application and testing of plate tectonic theory to Precambrian studies and deep crustal studies.

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 papers. 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, used for employment of students for summer field work.

Personnel Notes

D. Woods, visiting scientist from Queen's University, commenced studies with the Division in June.

N. Culshaw commenced a post-doctoral fellowship in September.

R. Bell joined the Division, in January, as a trainee draughtperson for a three month term.

C. Bristol, visiting scientist from Brandon University, Manitoba, commenced studies with the Division in September.

R.D. Stevens, isotope analyst with the Geochronology Section, retired in May.

ADMINISTRATION

Attendance at Meetings, Conferences and Courses

C. Gougeon

Pre-retirement Workshop, Ottawa, June.

Information Processing System, Xerox Advanced Seminar, Ottawa, August.

First Aid Course, Ottawa, October.

J. MacManus

Management Skills for Assistants-to, Financial Post Seminar, Ottawa, December.

GSC Current Activities Forum, Ottawa, January.

F. Marier-Lalonde

Administrative Officers Committee Meeting, Vancouver, British Columbia, August and Ottawa, March.

Management Orientation Program for Supervisors, Ottawa, October.

J.C. McGlynn

Geological Association of Canada, Annual Meeting, London, Ontario, May.

Membership on Committees

J.C. McGlynn

Northwest Territories Coordinating Committee on Work in the North.

International Union of Geological Sciences, corresponding member

BEAR-SLAVE SECTION

M.B. Lambert (Head)

Highlights

The on-going program to understand the nature and significance of the boundary between the Slave and Churchill provinces (Thelon Tectonic Zone) continued with mapping of a northern part in the Tinney Hills and Overby Lake map areas and a transect across the southern part in the Artillery Lake area.

In the northern segment the western limit of the Thelon Tectonic Zone coincides with a fundamental lithologic change, a high concentration of basic intrusions, a major shear zone, and immediately to the west, the occurrence of anomalously high pressure metamorphic rocks. The zone comprises numerous parallel tectonic segments separated by low grade, ductile shear zones in which dextral transcurrent movement dominated.

Preliminary geochronology supports field evidence that the main tectonometamorphic event, including syn-metamorphic nappe-style tectonics, occurred about 2600 Ga ago. This high strain event culminated with plutonic activity and high grade regional metamorphism. Following intrusion of a major swarm of basic dykes and deposition of Goulburn Group sedimentary cover sequence, a second high strain but lower grade event caused the cover to be folded into and overthrust by the Archean basement. This event caused widespread retrogression and shearing of the basement and anchizone to greenschist facies metamorphism in the Goulburn Group. Structural studies tentatively suggest main-phase southeastward directed thrusting and second-phase northwestward thrusting in the basement.

Field work in the Bear Creek Hills region of Bathurst Inlet revealed a previously unrecognized thrust-fold belt, involving Goulburn Group rocks, demonstrated to be related to the Thelon Tectonic Zone. Local stratigraphy and structure in this area indicate that the Bathurst Fault must have a minimum left-slip displacement of 100 km.

The southern transect contains three structural domains: (1) a western domain typical of the Slave Province (curvilinear structural trends, abundant Yellowknife supracrustal rocks, low to intermediate grade of metamorphism and plutonic units similar to bodies in the Yellowknife area some 400 km to the west); (2) an eastern domain characteristic of the western Churchill Province (linear structural trends, abundant mylonitic shear zones and high metamorphic grades, including granulite grade rocks); and (3) a central domain characterized by prominent shear foliation that is transitional between the other two but separated from them by shear zones.

The Thelon Front, recognized in the Healey Lake area to the north as a wide shear zone, narrows in the Artillery Lake area where it marks the boundary between the central and eastern domains and possibly dies out southwards. The "Front" may continue southward along the shear zone at the boundary between the central and western domains. Three phases of deformation include (1) an early phase of ductile deformation that resulted in prominent north-northeasterly linear trends throughout the central and eastern domains, (2) narrow, sharply defined mylonite zones superimposed on early structures; and (3) northeasterly trending faults parallel to the trend of the McDonald Fault system.

A reconnaissance ground VLF (very low frequency) electromagnetic and ground magnetic geophysical survey across part of the transition shows that prominent conductivity anomalies relate to vertical shear zones. Irregular magnetic "topography" that typifies the transition relates more to primary differences in lithology than to subsequent shearing, which has a recognizable but lower order effect.

Structural studies in the Laloche River-MacDonald Lake area, southeast of Great Slave Lake, established a major dextral transcurrent shear zone up to 25 km wide. Initial results suggest a decrease in metamorphic grade and spatial migration of the locus of high strain rate with time.

In the Hottah Terrane in the western part of the Great Bear Magmatic Zone of the Bear Province, two igneous suites of different ages were recognized: a pre-tectonic (pre-1.8 Ga) assemblage comprising intermediate plutons and volcanic rocks, and a post-magmatic arc related to eastward subduction, which suggests that the Coronation Margin developed in a back-arc setting. The post-tectonic granites may have been generated during closure of the back-arc basin and consequent collision of the Hottah Terrane with the Coronation Margin.

In the Asiak foreland thrust-fold belt of the Wopmay orogen, initial results from construction of second-generation structural cross-sections indicate that the position of ramps from basement décollement was localized beneath previously initiated buckle folds of the Rocknest Formation. Continued evolution of these folds follows the model of fault-propagation folds.

Microprobe analyses of chemically zoned, inclusion-rich garnets from the metamorphic internal zone of the orogen has led to the derivation of a new technique for obtaining precise multipoint P-T-X paths for metapelitic rocks.

Preliminary work in the Labrador Trough and the internides to the east suggest that subsidence of the Labrador margin of the craton produced two successive continental terrane wedges both of which are overlain by basinal foredeep deposits. The older foredeep shoaled to a carbonate platform that prograded towards the craton and the younger foredeep shoaled to a fluvial molasse. An evolving flexural arch in the foreland is suggested by cratonward truncation of the two shelf-foredeep sequences. Deformation of the margin includes early thin-skinned thrusting directed toward the craton that was developed above a décollement in the older foredeep. This deformation was followed by more ductile basement-involved thrusting verging to and away from the craton. Near Ungava Bay the frontal thin-skinned thrust had a displacement of at least 25 km - in other words the Labrador "trough" is unlikely to have developed in situ.

The importance of thrusting is also evident in the Cape Smith belt or Ungava Trough where preliminary work confirms Hoffman's recent speculation that the volcanic belt is a giant tectonic klippe by developing abundant evidence of early, south-directed, ductile, simple shear affecting the whole lower metasedimentary sequence with minimal involvement of the Archean basements. Superimposed on this structure are well-developed cascading folds that occur on the flanks of large basement antiforms, indicating diapiric amplication of the basement folds. In the upper volcanic sequences, south-directed thrusts and subsequent normal faults may be brittle manifestations of the same deformations at higher structural levels. This style of deformation may well serve as a model for the structural evolution of older Archean "greenstone belts". The unravelling of the complex structure of this belt will have an important influence on future mineral exploration.

Personnel Notes

F.H.A. Campbell continued his secondment to Headquarters.

R.S. Hildebrand was co-organizer for the Precambrian High seminar series.

Attendance at Meetings, Conferences and Courses

J.B. Henderson

GSC Current Activities Forum, Ottawa, January.

P.F. Hoffman

Geological Association of Canada and Mineralogical Association of Canada, Annual Meeting, London, Ontario, May.

27th International Geological Congress, Moscow, USSR., August.

U.S. Precambrian Final Decade of North American Geology Meeting, Denver, Colorado, U.S.A., February.

Conference of Processes in Continental Lithosphere Deformation, New Haven, Connecticut, U.S.A., February.

M. St-Onge

Geological Association of Canada and Mineralogical Association of Canada, Annual Meeting, London, Ontario, May.

Québec Current Activities Forum, Quebec City, November.

GSC Current Activities Forum, Ottawa, January.

Princeton Symposium on "Vertical Motion in Orogenic Belts", Princeton University, New Jersey, U.S.A., February.

Membership on Committees

A. Frith

TFSS Field Equipment Committee, Chairman.

P.F. Hoffman

Working Group on Proterozoic Lithospheric Evolution, International Lithosphere Program, member.

Site Selection Committee for Canadian Lithoprobe Program.

N.S.E.R.C. Review Committee for Cyprus Drilling Project.

International Geological Correlation project on Proterozoic Folded Belts, member.

Nomination Committee, Royal Society of Canada.

Subcommission on Precambrian stratigraphy (IUGS), member.

P. Thompson

Grant Committee for the "Fonds de Formation de Chercheurs et d'Action Concertée - Québec", external member.

Special Talks and Lectures

P.F. Hoffman

"Adventures in the Precambrian"; Johns Hopkins University, Baltimore, U.S.A., April.

"Is the Cape Smith belt a klippe?", Geological Association of Canada, London, Ontario, May; St. Mary's University, Halifax, Nova Scotia and University of New Brunswick, Fredericton, March.

"Subsidence and sedimentation on the Coronation margin" and "Wopmay Fault Zone", Geological Association of Canada, London, Ontario, May.

"Contrasting styles of crustal shortening in Wopmay Orogen", IGC, Moscow, USSR, August and University of Utah, Salt Lake City, U.S.A. February.

"Carbonate continental shelf in Wopmay Orogen", "Assembly and growth to the North American craton in Proterozoic time" and "Stratigraphy of a Proterozoic Continental Margin", IGC, Moscow, USSR, August.

"Supercontinents, world-wide orogeny, anorogenic magmatism and the North American Precambrian", State University of New York, Albany and Lamont-Doherty, New York, U.S.A., September; GSC, Ottawa, November; Washington University, St. Louis, U.S.A., December; Dalhousie University, Halifax, Nova Scotia and University of New Brunswick, Fredericton, March.

"Labrador Trough and Cape Smith belt", GSC, Ottawa, October and Washington University, St. Louis, U.S.A., December.

"Thin-and thick-skinned tectonics in Wopmay Orogen and the Cape Smith greenstone belt", Yale University, New Haven, Connecticut, U.S.A., February.

"Rocknest carbonate shelf", University of Utah, Salt Lake City, U.S.A., March.

M.R. St-Onge

"Zoned poikiloblastic garnets: documentation of syn-metamorphic uplift P-T paths in Wopmay Orogen, NWT", GSC, Ottawa, February.

"Zoned poikiloblastic garnets: ups and downs of metamorphic rocks in overthrust belts", Queen's University, Kingston, Ontario, March.

P. Thompson

"Geology across the western boundary of the Thelon Tectonic Zone in the Tinney Hills - Overby Lake map area, east of Bathurst Inlet", Geoscience Forum, Yellowknife, NWT, December.

Manuscripts Submitted

6 GSC Papers, 5 Outside Publications, 1 A-Series Map, 3 Abstracts.

NORTHERN CHURCHILL SECTION

A.N. LeCheminant (Head)

Highlights

Major field projects near Chantrey Inlet and in northern Baffin Island were completed in 1984. A new project to map granulite facies rocks in northwestern Melville Peninsula was initiated. Other areas of emphasis included compilation of regional geological maps for parts of the Districts of Keewatin and Franklin and petrologic and metamorphic studies related to previously completed mapping.

Lower amphibolite grade metasedimentry rocks of the Aphebian(?) Chantrey Group form a narrow northeast-trending synclinal belt 220 km long extending across Chantrey Inlet. The belt consists largely of shallow-marine sediments, strongly deformed by two periods of folding. Contacts with Archean basement are intensely sheared. Metasedimentary rocks are locally overturned to the north and overthrust by basement gneisses. Units of dark pyritic schist are tentatively interpreted as similar to rocks of the ore-rich Kupferschier and Zambian Copperbelt.

Mapping and stratigraphic studies in Eclipse and North Bylot Troughs, northwestern Baffin Island, revealed new details of the 1.20-1.25 Ga Mackenzie rifting episode. About 6100 m of Bylot Supergroup rocks, deposited during rifting, were divided into three groups: a lower and upper sequence, each of which grades upwards from alluvial to basinal and/or subtidal strata, and a middle shelf carbonate sequence. Thick coastal sabkha evaporites occur in the middle carbonates, and tholeiitic subaerial basalts occur near the base of the lower group. Facies distribution and syndepositional faults suggest some separation of Greenland from North America occurred during Bylot Supergroup sedimentation. There was major post-depositional faulting during emplacement of Hadrynian Franklin diabase dykes and during formation of the Cretaceous Lancaster Aulacogen.

A 1:500 000 geological map of Melville Peninsula north of 68°N was placed on open file. This is the first geological map for most of the region. Gravity and reconnaissance geological data suggest that the area contains a tilted section through deep Archean crust with high grade metamorphic rocks in the north and progressively lower grade gneisses and supracrustal belts to the south. This year's field work initiated study of the high grade metamorphic rocks exposed in the northwestern part of the region. Mapping indicates a tonalitic-granodioritic complex cut by granite and mafic dykes is unconformably(?) overlain by sediments correlated with the 2.9 Ga Prince Albert Group. These units were metamorphosed to granulite grade (in the west) and upper amphibolite grade (in the east), probably in the late Archean. Only the western half of a positive gravity anomaly in the map area is at granulite grade, suggesting that the simple model of a tilted crustal section is complicated by thermal doming. Proterozoic high-angle east-west faults cut the region prior to mid-Devonian uplift of the Melville Peninsula horst.

A preliminary geological compilation map of NTS 46, 56 and parts of 47, 57 and 66 was placed on open file. This 1:1 000 000 map will be updated as mapping progresses in this poorly known area. Integration of geophysical data with early geological reconnaissance mapping has resulted in better delineation of several major lithostructural domains in the northwestern Churchill Province. The first draft of the 1:1 000 000 geological atlas sheet for NTS 55 has been submitted to the editor. This atlas sheet includes a legend-correlation chart, index of source maps, dyke map and geotectonic index map.

Small granulite complexes and granulite lenses occur within or adjacent to major shear zones in the northwest Churchill Province. The Tulemalu Fault Zone contains garnet-clinopyroxene granulite lenses which record P-T conditions in the order of 10-11.5 kb and 750-800°C. These lenses are interpreted as fragments of deep crust that have tectonically transported to higher levels along the fault zone. The Kramanituar Complex (layered gabbro-anorthosite-granulite) may have been produced in a ductile fault associated with the Chesterfield Fault Zone. Granulite developed within the fault zone as a consequence of the emplacement of the igneous complex. With continued movement along the fault zone the complex was deformed and faulted as it rose to the surface.

Microprobe analyses of phenocrysts from 1.8 Ga lamprophyres and alkaline volcanic rocks in the Baker Lake region confirm the upper mantle source for these rocks suggested by whole rock analyses. Ti-rich mica xenocrysts imply that a metasomatic K, Ti, Fe and Ba enrichment process preceded the alkaline magmatic activity. Complex zoning and diffusion profiles provide a sensitive record of magmatic processes and suggest rapid magma ascent from the mantle.

Attendance at Meetings, Conferences and Courses

K.E. Eade

Canadian Institute of Mining and Metallurgy, Annual General Meeting, Ottawa, April.

T. Frisch

Geological Society of America, Annual Meeting, Reno, Nevada, U.S.A., November.

J.R. Henderson

Friends of the Grenville, Field Conference, Minder, Ontario, October.

Canadian Tectonics Group, Maniwaki, Quebec, October.

Geological Society of America, Northeastern Section, Lancaster, PA., U.S.A., March.

A. LeCheminant

Geological Association of Canada and Mineralogical Association of Canada, Annual Meeting, London, Ontario, May.

Geological Society of America, Annual Meeting, Reno, Nevada, U.S.A., November.

GSC Current Activities Forum, Ottawa, January.

S. Tella

Geological Association of Canada and Mineralogical Association of Canada, Annual Meeting, London, Ontario, May.

GSC Current Activities Forum, Ottawa, January.

Membership on Committees

J.R. Henderson

Geological Association of Canada, Structural and Tectonics Division, Secretary-Treasurer (with M.N. Henderson).

Member of Gold Working Group in the Economic Geology and Mineralogy Division of the GSC.

S. Tella

TFSS Field Equipment Committee, Precambrian Division representative.

GSC Branch Safety Committee, member (field component).

Thesis Committee - 1 Ph.D. and 1 B.Sc.

Special Talks and Lectures

J.R. Henderson

"Folding and Cleavage Formation in the Goldenville Formation, Nova Scotia", Maniwaki, Quebec, October and Lancaster, PA, U.S.A., March.

"Auriferous quartz veins in the Meguma Group, eastern Nova Scotia: Their geometry and origin due to hydraulic fracturing", GSC Current Activities Forum, Ottawa, January.

A.N. LeCheminant

"Proterozoic shoshonitic lamprophyres from central District of Keewatin: distribution and petrogenesis", poster session for Geological Association of Canada and Mineralogical Association of Canada, Annual Meeting, London, Ontario, May.

Manuscripts Submitted

3 GSC Publications, 1 Outside Publication, 6 Abstracts, 1 Open File Map, 1 A-series Map.

SUPERIOR-GRENVILLE SECTION

A. Davidson (Head)

Highlights

Detailed studies in the Grenville Province on problems outlined by earlier reconnaissance have 1) confirmed the presence of a wedge of 1.75 Ga volcanic and high-level plutonic rocks between Huronian strata and the Grenville Front near Killarney, Ontario, and shown that the Grenville Front Tectonic Zone in this area is the locus of several southeast-dipping mylonite zones in which kinematic indicators clearly infer northwestward thrust displacement; 2) outlined in detail the lithologic and structural parameters that characterize three adjacent domains near Huntsville, Ontario, that are bounded by major ductile shear zones; 3) shown that small coronitic gabbro bodies occur in discrete clusters and trains within shear gneisses, whereas anorthosite tends to deform into thin, continuous sheets; preliminary mineral phase geochemistry indicates that metamorphic temperatures in the sheared rocks were about 100°C lower than those recorded in the adjacent blocks. In the Haliburton area, Ontario, major, discrete thrusts slices have been identified at the northwest edge of the Central Metasedimentary Belt, in part within highly mobile marble mélange. Study of aluminous syenite plutons in the Gatineau valley, Quebec, shows that they clearly cut strongly deformed and metamorphosed Grenville Supergroup rocks, but are themselves in part recrystallized and locally cut by shear zones and pegmatites.

In the vicinity of Chibougamau, Quebec, part of the Grenville Front Tectonic Zone has been recognized as parautochthonous with respect to the adjacent Superior Province; Archean lithologies at higher metamorphic grade, in part transposed, cross the Grenville Front. In the northern part of the Kapuskasing Structure, Ontario, geobarometric studies confirm vertical fault zone displacement of as much as 10 km; pressure estimates of 8 kb characterize the Kapuskasing zone, whereas pressures of 5 kb were extant in the adjacent Quetico Belt to the west. In contrast, pressure estimates across the transition from greenschist to amphibolite/migmatite grade in the Quetico Belt south of Atikokan suggest that a constant crustal level is now exposed.

An accelerated rate of diamond drilling at the Atikokan Research Area is testing linear geological and geophysical targets in granite. The targets are thought to be fractured fault zones, and detected from aerial photographs and ground fracture analysis, and airborne and ground magnetic and VLF-EM surveys. This data set is proving to be a successful method for locating fracture zones at depths that may be potential hydrogeological pathways.

Brines with total dissolved solids of up to 200-300 g/L continue to be detected in deeper sections (ca. 600-1200 m) of plutonic rocks. Although the origin of the brines remains uncertain, the determination of the rate of equilibration of these waters with their fracture wall-rocks is deemed critical in demonstrating the antiquity of this deep hydrological system.

The shaft for the Underground Research Laboratory is completed at 256 m. Geological and geophysical 'mapping' down-shaft continues to test and validate surface to subsurface assessments of plutonic characteristics that were postulated prior to shaft construction. The assessments appear to have been reasonable and accurate.

A field program of regional structural discrimination of plutonic rocks of Superior Province in Ontario has been initiated with the purpose to document the general applicability of plutonic rock characteristics established in detail in three research areas.

Personnel Notes

I.F. Ermanovics has completed his term as manager of geoscience studies in support of the Nuclear Fuel Waste Management Program, and will be returning to field studies in northern Labrador.

K.D. Card and A. Davidson have been occupied with geological compilation at 1:5 000 000 scale for Decade of North American Geology, and presented a provisional version of the new geological map of the Superior and Grenville Provinces at the GSC Current Research Forum, Ottawa, in January.

K.D. Card, A. Davidson and J.A. Percival led separate field excursions in May, associated with the Annual Meeting of the Geological Association of Canada in London, Ontario.

Attendance at Meetings, Conferences and Courses

K.D. Card

Geological Association of Canada, London, Ontario, May.

Continental Crust Symposium, Cornell University, Ithaca, New York, U.S.A., June.

Archean Geochemistry Field Workshop, Minnesota, U.S.A., October.

A. Davidson

Geological Association of Canada, Annual Meeting, London, Ontario, May.

NATO Advanced Science Institute, Norway, July.

Friends of Grenville Meeting, Haliburton, Ontario, September.

John Rodgers Symposium, Yale University, New Haven, Connecticut, February.

Decade of North American Geology, Precambrian Meeting, Denver, U.S.A., March.

CANDEL Annual Meeting, Toronto, Ontario, March.

I. Ermanovics

Information Meeting of the Nuclear Fuel Waste Management Program, General Meeting, Winnipeg, Manitoba, September.

The Civilian Radioactive Waste Management Information Meeting, Washington DC., U.S.A., December.

S. Hanmer

Geological Association of Canada and Mineralogical Association of Canada, Annual Meeting, London, Ontario, May.

Canadian Tectonics Group, Maniwaki, Quebec, October.

John Rodgers Symposium, Yale University, New Haven, Connecticut, U.S.A., March.

J. Percival

Geological Association of Canada and Mineralogical Association of Canada, Annual Meeting, London, Ontario, May.

Deep structure of the Continental Crust, Cornell University, Ithaca, New York, U.S.A., June.

Archean Geochemistry Field Conference, Granite Falls, Minnesota, U.S.A., August.

Geological Society of America, Annual Meeting, Reno, Nevada, U.S.A., November.

Processes of Continental Deformation, Yale University, New Haven, Connecticut, U.S.A., February.

Membership on Committees

K.D. Card

International Union of Geological Sciences, Precambrian Stratigraphic Committee.

NSERC Review Committee, University of Manitoba-INCO application.

McMaster University, Department of Geology, Examining Committee.

A. Davidson

Canadian National Committee on Dynamics and Evolution of the Lithosphere.

North American Commission for Stratigraphic Nomenclature.

International Geological Correlation Program, Working Group 3 - Proterozoic Lithospheric Evolution.

Geological Association of Canada Special Paper, editorial committee.

Thesis Committee - 2 Ph.D's.

I.F. Ermanovics

Applied Geoscience Branch of the Nuclear Fuel Waste Management Program, WNRE/AECL, Pinawa, Geosphere Modelling Committee and Research Areas Operations Committee.

S. Hanmer

Canadian Tectonics Group, Organizing Committee.

J. Percival

Vancouver Island Seismic Profile Planning Committee.

Kapuskasing Lithoprobe Planning Committee, Co-ordinator.

Special Talks and Lectures

K.D. Card

"The Sudbury Structure: its regional geological-geophysical setting", Geological Association of Canadian and Mineralogical Association of Canada Annual Meeting, London, Ontario, May.

"Decade of North American Geology" - poster display, GSC Current Activities Forum, Ottawa, January.

A. Davidson

"The southwestern Grenville Province", Geological Association of Canada, Annual Meeting, London, Ontario, May.

"Tectonic boundaries with the Grenville Province of the Canadian Shield", NATO Institute, Norway, July.

"Ductile deformation and the development of the Grenville Orogen", State University of New York, Albany, New York, March.

I.F. Ermanovics

"The Geological Program in the Nuclear Fuel Waste Management Program", Canada-Europe (Euratom) Meeting, Pinawa, Manitoba, April.

"Advances in geological studies of granitic and gabbroic rocks in the Nuclear Fuel Waste Management Program", Winnipeg, Manitoba, September.

S. Hanmer

Kinematic Indicators" and "Precambrian High", Carleton University, Ottawa, March.

"Great Slave Lake Shear Zone", GSC, Ottawa, March.

J. Percival

"Mafic migmatites of the Kapuskasing Uplift, Ontario", ETH Zurich, Switzerland, April.

"A possible exposed Conrad discontinuity in the Kapuskasing Uplift, Ontario", International Symposium, Cornell University, Ithaca, New York, June.

"Archean tectonic styles with examples from the southern Canadian Shield", Reno, Nevada, U.S.A., November.

Manuscripts submitted

10 GSC Papers, 9 Abstracts, 5 Outside Publications, 1 Open File Map, 2 Maps.

SPECIAL PROJECTS SECTION

Highlights

In a continuing investigation of Phanerozoic and recent tectonics of the St. Lawrence Platform and adjacent regions of the Canadian Shield research to date indicates that contemporary seismic events occur in greater numbers in fault-bounded blocks along the axes of the major arch systems that have a long history of tectonic rejuvenation during the Phanerozoic. This finding has useful application in the definition of those regions of the craton that are the most likely to remain tectonically stable in future periods of geological time. This work provides a framework for ongoing research by AECL and Ontario Hydro for underground disposal of nuclear wastes, and sites for nuclear and hydro-electric generating systems.

Attendance at Meetings, Conferences and Courses

W.R.A. Baragar

Meeting and field trip, London and Cornwall, England, Management Panel International Crustal Research Drilling Group, March/April.

Geological Association of Canada, Annual Meeting, London, Ontario, May.

Collaborative Studies Project Meeting, (Canadian participation, Cyprus Project), St. John's, Newfoundland, January.

B.V. Sanford

Advisory Committee Meeting on Names for Undersea and Maritime Features, Dartmouth, Nova Scotia, November.

F.C. Taylor

Prospectors and Developers Association Annual Meeting, Toronto, March.

Membership on Committees

W.R.A. Baragar

International Crustal Research Drilling Group, management panel.

Canadian Journal of Earth Sciences, editorial committee.

Ph.D. Committee, Ottawa, University.

B.V. Sanford

Advisory Committee on Names for Undersea and Maritime Features (to Canadian Permanent Committee on Geographic Names).

Special Talks and Lectures

W.R.A. Baragar

"Some thoughts on the Sheeted Dyke zone, Troodos Ophiolite", Memorial University, St. John's, Newfoundland, January.

Manuscripts Submitted

2 Abstracts, 4 Outside Publications, 1 GSC Paper.

GEOCHRONOLOGY SECTION

O. van Breemen (Head)

Highlights

Three new chemistry laboratories have been built and will provide the Geochronology Section with some of the best positive clean air (class 100) facilities in existence. In addition, a project has been successfully completed manufacturing a purified ^{205}Pb isotopic spike via cyclotion bombardment and hot cell chemical separation of radioactive Bi^{205} from Pb^{205} (done in collaboration with Atomic Energy of Canada Ltd.). This spike and the benefits acrrued from its use will help put our laboratory at the forefront of precise and diagnostic U-Pb geochronology. Other laboratory related advances include the development of integrated computer software for reduction, regression and handling of large amounts of mass spectrometric data, virtually eliminating the need for manual numeric transcription; the establishment and acquisition of zircon polishing, etching and photomicrographic techniques essential to proper acquisition and interpretation of U-Pb systematics. In spite of major construction upheavals this year, a high level of productivity has been maintained.

Work in the Valhalla Complex (southeastern B.C.) has demonstrated the existence of multiple east-directed, probably Paleocene-Eocene shear zones throughout the complex. Pb-U zircon geochronology shows that granitic units are 90 to 58 Ma old with an age of about 52 Ma for the end of ductile strain. Such dating strongly indicates that some if not most of the shearing is probably related to extensional tectonics. A 770 Ma old syn-rift volcanic complex (Mt. Harper) marks the age of initial rifting of the Cordilleran Miogeosycnline. From northwestern Ellesmere Island (Arctic) U-Pb zircon ages have been obtained ranging from the middle Proterozoic to the Cretaceous which demonstrate a remarkable coincidence of events with the Appalachian-Caledonian belt of the North Atlantic region.

Along the Thelon Front (N.W.T.) a major Aphebian orogenic belt has been identified, involving precursors younger than Archean basement, with granulite facies metamorphism and tectonism between 1990 and 1950 Ma and plutonism extending to 1920 Ma. U-Pb monazite ages suggest that this belt extends south of the McDonald Fault at least up to the Alberta border. A concurrent study of zircon core morphology established an unambiguous technique of identifying sedimentary components in S type granite. In Manitoba, the Rusty Lake volcanic belt previously thought to be part of the more northerly Lynn Lake volcanic belt appears to be 30 Ma younger at 1880 Ma, th ough plutonism of this age extends through both belts.

In the Grenville Orogenic Belt (Ontario) 1160-990 Ma zircons from syntectonic granitoids along the NW edge of the Central Metasedimentary Belt have thrown light on the order of structural events within the thrusted boundary zone. In western Newfoundland, Ordovician granulite facies metamorphism has been identified as well as Ordovician and Silurian episodic plutonism culminating in a peralkaline character. U-Pb zircon dates from coeval felsic volcanics integrated with fauna from associated sediments have demonstrated Llandoverian overlap sequences which link the Humber, Dunnage, Avalon and Meguma teranes (the latter two in New Brunswick and Nova Scotia).

Numerous ages are helping to piece together the geology in other areas while Sr isotopes from sulphates and carbonates (Selwyn Basin, Hemlo) are continuing to prove useful in characterizing mineralized and barren horizons.

Field Activities

Samples collected for U-Pb zircon geochronology and Rb-Sr/Sm-Nd isotope geochemistry from the Artillery Lake and Healey Lake Map sheets (District of Mackenzie) with J.B. Henderson.

Samples collected for U-Pb zircon dating from the Indin Map Sheet (District of Mackenzie) with R.A. Frith.

Two field trips to the Central Metasedimentary Belt, Grenville Province, eastern Ontario (Geological Association of Canada and Friends of the Grenville).

Attendance at Meetings, Conference and Courses

P. Hunt

Computer Course, EMR, January.

R. Parrish

International Conference on Fission Track Dating, Troy, New York, U.S.A., August.

J.C. Roddick

Geological Association of Canada, Annual Meeting, London, Ontario, May.

Royal Ontario Museum, Toronto, Ontario, September.

Finnigan MAT Users Group Meeting, San José, California, U.S.A., October.

O. van Breemen

Geological Association of Canada and Mineralogical Association of Canada, Annual Meeting, London, Ontario, May.

Participated in Symposium: "New Perspectives on the Grenville Problem".

Membership on Committees

P. Hunt

GSC Christmas Party Committee.

GSC Current Activities Forum, Technical Arrangements Committee.

R.W. Sullivan

GSC Safety Committee

O. van Breemen

EG-ESS Evaluation Committee, Branch Member.

Special Talks and Lectures

R. Parrish

Presented workshop on Fission Track Dating at Massachusetts Institute of Technology, April, and Dalhousie University, Halifax, Nova Scotia, November.

"Fission track dating and uplift studies", Princeton University, New Jersey, U.S.A., February.

"Short Course on Geochronology", Geological Association Short Course, No. 4, Vancouver, British Columbia, February.

J.C. Roddick

Introduction of data processing system for mass spectrometer, Memorial University, St. John's, Newfoundland, August.

Short course on Geochronology and Isotope Geology, Geological Association of Canada, Vancouver, British Columbia, February.

O. van Breemen

"Evolution of the Caledonides" and "Geochronology of tectonites, granulites and their igneous precursors in the Grenville Province, Ontario, Canada", Department of Geology, Lawrence, Kansas, U.S.A., March.

Manuscripts Submitted

4 Outside Publications, 3 Abstracts, 5 GSC Reports, 1 Short Note to Outside Journal.

Laboratory Statistics

K-Ar ages reported 132.
Rb-Sr projects 16; whole and minerals analyzed 152
U-Pb zircon (monazite) projects 74; mineral fractions analyzed 262.

PALEOMAGNETIC SECTION

W.F. Fahrig (Head)

Highlights

Paleomagnetic and petrographic characteristics of the Nipissing Diabase have been compared over a broad region between Lake Huron and Lake Timiskaming in northeastern Ontario. It has been shown that both common Nipissing paleomagnetic directions are carried by petrographically fresh samples. This suggests that two ages of intrusion may be present. However, the possibility that there has been thermal overprinting without accompanying chemical alteration has not been ruled out.

A third magnetization has been isolate in the western portion of the study area. It is the dominant magnetization at many Nipissing sites. Current studies are designed to test the primary or secondary nature of this component.

Attendance at Meetings, Conferences and Courses

K. Buchan

Canadian Geophysical Union Meeting, Halifax, Nova Scotia, May/June.

W.F. Fahrig

Geological Association of Canada, Annual Meeting, London, Ontario, May.

Special Talks and Lectures

K.L. Buchan

"Paleomagnetism of the Ottawa Islands of the Circum-Ungava Belt" and "Uplift studies and the nature of remanent magnetization in the contact zone of some Precambrian dykes", Halifax, Nova Scotia, June.

W.F. Fahrig

"Tectonic significance of some major Aphebian diabase dyke swarms", Geological Association of Canada, Annual Meeting, London, Ontario, May.

Manuscripts submitted

3 Outside Publications, 1 GSC Report, 3 Abstracts.

PETROLOGY SECTION

K.L. Currie (Head)

The Petrology Section analyses rock and mineral assemblages with the goal of understanding and quantifying processes of rock formation and transformation. Detailed field studies supply material for analysis and provide an opportunity for the application of models worked out in the laboratory. The section includes laboratories for the study of rock-forming processes at high temperatures and pressures. The section has also taken responsibility for the bedrock mapping component of the federal-provincial mineral development agreements.

Highlights

A combination of radiometric dating, stratigraphic analysis and careful field mapping demonstrated an early Silurian overlap assemblage across the eastern tectonic zones of the Appalachian orogen. Contrary to popular current models, these zones must have been assembled by this time, including the Meguma zone of southern Nova Scotia. This overlap assemblage implies, among other things, that the eastern margin of the continent may have been broken up and reassembled, rather than composed of far-travelled fragments.

Large scale compilation of plutonic rocks of the Canadian Appalachians demonstrates that much of the magmatism is late Ordovician to Silurian, rather than Devonian. The pattern of ages suggests a fairly continuous magmatic history from late Precambrian to Devonian rather than the two stage history previously envisaged. The petrography and chemistry of the plutons suggest persistent accretion of material by subduction, either continuous or episodic. Detailed chemical studies show that even recycled magmatic material was mainly derived from relatively recent older plutons. Mixing processes, including spectacular examples involving three or more components, appear ubiquitous.

Mineral chemistry of the Mistastin batholith of Labrador permits tracing the cooling history from high temperature (+900°) monzodiorites through pyroxene monzonite, biotite hornblende granite to fayalite syenite.

Fluid inclusions suggest that the accompanying fluids changed form CO_2-rich to water and fluorine-rich. The batholith appears to have crystallized at about 10-12 km depth. The evolution of this type of body is of particular interest since they may be the parents of mineralized peralkaline granites of the Lac Brisson (Strange Lake) type.

Studies of greenstone belts and their metamorphic equivalents in Manitoba and Saskatchewan have demonstrated that some amphibolites within the Kisseynew gneiss belt represent metamorphosed volcanics, lending support to the view that portions of the gneiss belt represent metamorphosed Flin Flon volcanic belt. However, careful examination of the metamorphic transition to the migmatite zone shows that the transition cannot be ascribed to simple closed system reaction, but involves metasomatism and vein injection, probably the result of magmatic hydrothermal activity. In some cases, detailed petrographic work has identified the reactions leading to the observed mineralogical changes. Cordierite-anthophyllite rocks within the gneiss belt represent metamorphosed hydrothermal alteration zones. Since these rocks are more widespread than sulphide mineralization, they constitute a potential exploration target.

Personnel Notes

C. van Staal, G.M. Yeo, and J.T. van Berkel accepted term positions to carry on geological work in Atlantic Canada under federal-provincial agreements.

Attendance at Meetings, Conferences and Courses

K.L. Currie

International Geological Correlation Program, Project 27 (Appalachian-Caledonide Orogen), final meeting, Glasgow, Scotland, August/September.

E. Froese

Manitoba Mineral Resources Division, Annual Meeting, Winnipeg, Manitoba, November.

T.M. Gordon

Manitoba Mineral Resources Division, Annual Meeting, Winnipeg, Manitoba, November.

GSC Current Activities Forum, Ottawa, January.

Introduction to the VAX, Ottawa, March.

J.B. Whalen

Geological Association of Canada, Annual Meeting, London, Ontario, May.

G. Yeo

Nova Scotia Department of Mines and Energy, Open House, Halifax, Nova Scotia, November.

Atlantic Geoscience Society, Appalachian Tectonics Symposium, Halifax Nova Scotia, January.

Membership on Committees

F. Chandler

Thesis Committees - 3 M.Sc. students.

Committee for Sudbury-Timmins-Algoma-Mineral Project (S.T.A.M.P.), co-ordinator.
Thesis examiner - 2 M.Sc. students.

Scientific authority for Nova Scotia Mineral Development Agreement.

K.L. Currie

International Geological Correlation Program, Project 27, Plutonics Working Group.

T.M. Gordon

Branch Computer Users Committee.

Co-organizer for Precambrian High Series.

G. Yeo

Geological Association of Canada 1986 Field Trip Committee.

Special Talks and Lectures

K.L. Currie

"An overview of Appalachian plutonism", Glasgow, Scotland, August.

"Identification of displaced terranes by analysis of plutonism", University of Lowell, Lowell, Massachusetts, U.S.A., October.

E. Froese

"Metamorphism of sulphide deposits", École Polytechnique, Montreal, Quebec, March.

T.M. Gordon

"Mass balance calculations in metamorphism", Ottawa, February.

J.B. Whalen

"The Uasilau - Yau Yau intrusive complex, New Britain, Papau, New Guinea: an island arc plutonic suite", Geological Association of Canada, Annual Meeting, London, Ontario, May.

"Interpretation of aeromagnetic gradiometer results from the Buchans area" (presented by L.J. Kornik), GSC Current Activities Forum, Ottawa, January.

G. Yeo

"Precambrian geology of the Cordillera", Carleton University, Ottawa, November.

"Late Proterozoic Iron Formation", St. Francis Xavier University, Antigonish, Nova Scotia, January.

Presented 3rd year sedimentology and stratigraphy course (22 lectures), Department of Geology, Carleton University, Ottawa, January to April.

Manuscripts Submitted

8 Outside Publications, 3 Maps, 14 GSC Papers, 2 Abstracts.

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 thus 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 purposes ranging from local to national requirements. The methods have international applications covering not only resource assessment and exploration, but also environmental questions and hazards.

The organization structure of the Division remained essentially unchanged during 1984-85. The CIDA liaison function, performed by B.E. Manistre as a Special Project since November 1973, which had been transferred to the Director-Generals Office under the name of International Liaison in January '84, is no longer in the Division, but as a consequence of the dismantling of the Central Laboratories and Technical Services Division at the end of March '84 the Resource Geophysics Subdivision became responsible for the Instrument Development Workshop (R.J. Thibedeau, Section Head). This facility had originally been set up in the Geophysics Division in 1962. The Resource Geophysics Subdivision now consists of five sections, Radiation Geophysics, Terrain Geophysics, Instrumentation R&D, Borehole Geophysics, plus the Workshop. The other two subdivisions in RGG Division each consist of four sections, as follows: Regional Geophysics Subdivision; Experimental Airborne Operations, Data Processing, Contract Aeromagnetic Surveys, and Magnetic Interpretation. Resource Geochemistry Subdivision; Exploration Research, Regional Research, Standards and Data Services, and Analytical Laboratories. One Special Projects Officer (L.S. Collett) is largely occupied in a technology transfer advisory role linking the geophysical service industry to various government funding programs and agencies.

Commentary

This fiscal year has seen the expansion of a variety of activities anticipated last year. There was a substantial increase in regional geochemical surveys, both standard and gradient aeromagnetic surveys, and in support for a CIDA-sponsored activity, namely supervision of the Thailand Airborne Survey. Details are given under the appropriate subdivision highlights. Despite the extra workload created by these assignments, the normal full range of Division activities was maintained, albeit at a somewhat slower pace. The additional activities were all made possible through funding from a variety of add-on programs, Mineral Development Agreements, Frontier Geoscience, Boundary Dispute etc. which collectively provided 63% of the Division's operating budget totalling $8.8 M. Whilst the major part of the add-on funding was spent through contractors, the overall design of projects, preparation of specifications, supervision and checking of products has to be done by experienced staff who are thereby deflected from new research. Undoubtedly the future of the country is well served by the provision of a comprehensive national geoscience data base, based on reproducible quantitative standards, but one of the costs of this acquisition is the further deferral of desirable innovations. The present burst of data gathering is a consequence of the recognition of the value of the method development and demonstrations performed by the Division over the past 20 years. Activities which seemed a dream in the mid-60's and which were brought to fruition within the last decade are now routine, albeit provided there is careful monitoring of details to ensure adherence to standards. Unfortunately the resources to ensure that a new generation of methods will be available for routine use around the turn-of-the-century are not at hand. Laboratory, office and storage space, capital equipment additions and replacements, and young scientists and technicians are all needed now to ensure the continuation of our present reputation into the next century. The horizons of science and technology are continually expanding, and it is inherently impossible to be at the leading edge, or even maintain present capabilities if R&D expenditures cannot grow.

In the context of the future, one lesson of past innovations in applied geophysics and geochemistry is that innovations are rarely conceived or stimulated by a committee approach; at best committees provide encouragement after ideas have been proved successful. The innovations of the past have been the brainchild of very small groups, who have had sufficient freedom of action to pursue their ideas despite challenges from their peers. False starts are an inherent aspect of innovation; if the selection process plays for safety, then it is virtually certain that all but the most pedestrian innovations will be discouraged before they can be proven. Innovations cannot happen without an entrepreneurial spirit, and if research organizations are to be successful, this spirit must be encouraged.

One event during the year reflecting the end of an era was the termination of support by the NEA and IAEA for the international Joint Group on Uranium Exploration R&D. Since its formation in 1976 this had spawned 9 subgroups on topics embracing many aspects of exploration, several of them with significant implications beyond uranium. On different occasions 12 GSC scientists directly participated in the activities as Chairmen or members of working groups. The participation facilitated and strengthened collaboration in exploration technology between 14 countries. Steps are being taken to seek out another international umbrella organization to allow these linkages to be maintained.

Attendance at Meetings, Conferences and Courses

A.G. Darnley

C.I.M. Annual Meeting, Ottawa, April 16 to 18, 1984. (Session Co-Chairman)

NEA/IAEA Uranium Exploration R&D Group Meeting, Paris, France, May 21, 1984. (Chairman)

NEA/IAEA Workshop on Recognition of Uranium Provinces, Keyworth, U.K., May 23, 1984.

NEA/IAEA Workshops on Gases, Gamma-Radiation Measurements and Subsurface Geophysics, Lulea and Mala, Sweden, September 10-12, 1984.

Exploration '87 Planning Meetings, Toronto, May 28, 1984, September 4, 1984 and January 4, 1985.

International Geological Congress, Moscow, USSR, August 4 to 24, 1984, including visit to the Zheltoreschenskoye uranium deposit in the Ukraine.

Discussion on Swedish Deep Exploration Program, Stockholm, Sweden, September 13, 1984.

Farnborough Aerospace Exhibition, U.K., September 6-7, 1984.

Ontario Geological Survey Geoscience Research Seminar, Toronto, December 3-5, 1984.

Joint Meeting with British Columbia Department of Energy, Mines and Petroleum, Victoria, December 10-12, 1984.

Annual Project Review for Mineral Resources Development Project, Bangkok, Thailand, February 3 to February 14, 1985.

GSC Branch Management Meeting, Vancouver, March 5 and 6, 1985.

Prospectors and Developers Annual Convention, Toronto, March 10-13, 1985.

Special Talks and Lectures

A.G. Darnley

"The background to the Athabasca Project". Presented to CIM Geology Division, Mineral Exploration Research Session, Ottawa, April 17, 1984.

"Multi-disciplinary, multi-agency research - the way ahead for exploration". Presented to CIM Geology Division, Exploration Technology Session, Ottawa, April 17, 1984.

"A review of recent work concerning the origin of the Athabasca uranium deposits". Presented to 27th International Geological Congress, Moscow, USSR, August 1984. (Co-authors R.H. Wallis and V. Ruzicka)

Membership on Committees

A.G. Darnley

Chairman - NEA/IAEA Uranium Exploration R&D Group

Member - Organizing Committee for Exploration '87.

Chairman - Exploration Technology and Geoscience Standards Subcommittees, National Geological Surveys Committee.

Member - Interdepartmental LTA (Airship) Working Group.

Division Summary of New Information Released to the Public

28 Outside Publications
14 GSC Papers
14 Open Files
13 Poster Presentations
51 Abstracts of Formal Talks
121 Aeromagnetic Maps (60 in 3 Open Files; 61 as published maps) including the Fourth Edition of the Magnetic Anomaly Map of Canada.
146 Geochemical Maps
287 Radiometric Maps

ADMINISTRATION

E.C. Stevens

The Administration section of RGG is responsible for providing administrative, financial and personnel support to the scientific community within the Division. During fiscal year 84-85, a major change occurred in the Administration Section - an internal computerized budget reporting system was designed and implemented. This will assist the project managers in their financial management.

REGIONAL GEOPHYSICS SUBDIVISION

P.J. Hood

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

The year saw a significant increase in the contracting out of aeromagnetic surveys and 8 new contracts were issued. The largest of these was for a survey in the Beaufort Sea and northern Yukon which was funded through the Boundary Dispute and Frontier Geoscience programs. A survey was also mounted in northern Baffin Island to assist Pb-Zn exploration to maintain the life of the Nanisivik mine. The remaining 6 contracts were for aeromagnetic gradiometer surveys funded under the Mineral Development Agreements with the Provinces. The first helicopter-borne aeromagnetic gradiometer survey was carried out by Les Releves Géophysique of Quebec City in the Gaspé Peninsula of Quebec. This 10,386 line kilometre survey has demonstrated that areas of rugged terrain can be effectively surveyed using the technique. It is also clear that when flown at low level such gradiometer surveys produce a much more coherent and therefore useful end product than ground magnetic surveys. The fact that the magnetic sensors are a little removed from the Precambrian rock surface greatly helps the coherency of

the data from line to line. Aeromagnetic surveying is substantially the only kind of airborne geophysical survey work available to Canadian contractors because of the depressed state of base metal exploration.

A new edition, the fourth, of the 1:5M Magnetic Anomaly Map of Canada was issued in 1984. In addition a record nineteen 1:1M magnetic anomaly maps were published so there is now substantial coverage of this type of map for the Precambrian Shield.

Contract Aeromagnetic Surveys

The status of contract aeromagnetic surveys is summarized in Table 1.

During the year 8 aeromagnetic survey contracts were issued. The largest of these was for an 82,000 line km (single sensor) survey in the Beaufort Sea and northern Yukon which was funded through the Boundary Dispute and Frontier Geoscience programs. A 64,048 line km conventional aeromagnetic survey to assist Pb-Zn exploration in NW Baffin Island was also mounted, 90% of the flying was completed by September 1984 when bad weather and serious damage to one of the survey aircraft terminated the operation for the year. In addition six MDA-funded aeromagnetic gradiometer contracts were issued as follows: Newfoundland (14,000 line km), Nova Scotia (14,342 line km), New Brunswick (14,300 line km), Quebec-Gaspé (10,386 line km) and Eastern Townships (5,662 line km), and a combined contract in Manitoba (10,506 line km) and Saskatchewan (4,778 line km). The Gaspé survey was the first contracted helicopter-borne gradiometer survey to be mounted and demonstrated that areas of rugged terrain could be effectively surveyed utilizing the technique.

Due to lateness of signing the Mineral Development Agreements and the formalities of mounting contracts through DSS, a number of aeromagnetic gradiometer contracts could not be completed by the end of FY 84/85.

Table 1

Contract Aeromagnetic Surveys (1984-85)

Contract	GSC Project	Type of Survey FW=Fixed Wing H=Helicopter	Kilometres Flown in 1984	Maps Published 1984/85
N Baffin Island	840040	FW - Single Sensor	59,489	0
Beaufort Sea	840074	FW - Single Sensor	25,745	0
Newfoundland	840073	FW - Gradiometer	4,828	0
Nova Scotia	830048& 840072	H - Gradiometer	14,342	16
New Brunswick	840071	FW & H - Gradiometer	14,300	0
Gaspé	840070	H - Gradiometer	10,386	0
Eastern Townships	840069	FW - Gradiometer	5,662	0
Manitoba	840068	FW - Gradiometer	10,506	0
Saskatchewan	840068	FW - Gradiometer	4,778	0
Georges Bank	820040	FW - Single Sensor	0	13
		TOTAL	150,036	29

Ocean Aeromagnetic Project

Additional lines were flown across the Judge Daly Promontory in northern Ellesmere Island adjacent to the Nares Strait in April 1984. The results showed that the dyke anomaly which runs along northern Nares Strait does in fact extend across the Promontory at least as far as Carl Ritter Bay so that the dyke system extends a distance of at least 200 km from the Arctic Ocean. It is inferred that the dyke has been injected into an existing fault system. This appears to be the first direct geophysical evidence that there has been movement along the Nares Strait as Wegener postulated in 1912. A paper summarizing the results of the work to-date was published in Current Research Paper 85-1A.

In addition a tie line was flown from the Denmark Strait between Iceland and eastern Greenland to the southern tip of Greenland to join earlier work. Additional lines were also flown across southern Greenland at the request of and with financial support from the Greenland Geological Survey.

Magnetic Anomaly Map Project

A new edition of the 1:5M Magnetic Anomaly Map of Canada was issued in 1984. The fourth edition of this colour map is actually the first bilingual edition and is the last such map to be issued in the classical style. The next edition will be a digitally compiled map using a raster colour plotter which gives superior detail. The digital data

is available as a result of the compilation of the 1:1M magnetic anomaly map of which a record 19 were produced during the report year. Substantial coverage for the Canadian Precambrian Shield is now available for the 1:1M magnetic anomaly maps. Displays of these and the derived shaded relief maps were shown at the GSC Current Activities Forum and the Prospectors and Developers Convention in Toronto.

Queenair Aeromagnetic Gradiometer Project

The complete overhaul and maintenance of the Queenair aeromagnetic system has resulted in improved data acquisition quality for this field season. The aircraft has flown 25,743 line kilometres over Lake Ontario and Lake of the Woods as part of the work necessary to fill in gaps in the forthcoming Magnetic Anomaly Map of North America; 5,740 line kilometres over Vancouver Island as a contribution to the Lithoprobe project; 3,380 line kilometres across Ontario and Quebec to obtain tie-lines to confirm base levels of aeromagnetic surveys flown during the 1950's and 60's.

Because the Queenair aircraft was engaged on field operations through most of the summer no progress was possible with the testing of the horizontal gradient tail stinger.

An aeromagnetic/gradiometer compilation system has been designed and written to take advantage of the virtual memory and graphical capability of the new Vax 11/780 computer. This should result in a considerable reduction in computer costs while significantly increasing processing capabilities.

The statistics for map products resulting from the Queenair project are given in the following table:-

Table 2

Maps Published:

		Scale	Gradiometer	Total Field
1.	Wollaston Lake, Saskatchewan	1:50,000	2	2
2.	McClarty Lake, Manitoba	1:50,000	4	4
			--	--
	TOTAL		6	6

Maps on Open File:

		Scale	Gradiometer	Total Field
1.	Barrington, Manitoba	1:20,000	6	6
2.	Barrington, Manitoba	1:50,000	2	2
3.	Buchans/Badger, Newfoundland	1:25,000	8	8
4.	Buchans/Badger, Newfoundland	1:50,000	2	2
			--	--
	TOTAL		18	18

Magnetic Interpretation

L.J. Kornik carried out an interpretation of the aeromagnetic gradiometer for the Buchans area which was incorporated into a paper with J.B. Whalen and J. Thurlow which will be published in the Buchans volume. Considerable time was spent helping I. Hosain of the Manitoba Department of Energy and Mines prepare a regional synthesis using the McLarty Lake aeromagnetic gradiometer survey data.

J. Broome continued the development of software for the display and enhancement of aeromagnetic data on an IBM-PC microcomputer.

E.J. Schwarz continued carrying out an interpretation of geophysical data from the Abitibi Greenstone Belt and one internal paper was published during the report year.

Personnel Notes

Bernard Daudier joined the Division with the official French title of "Coopérant" from January, 1983, to February, 1984. He took a Master's Degree in Geophysical Engineering at the Ecole National de Géologie in Nancy, France. While in Canada, Bernard looked after the computer programming aspects of a new potential field interpretation method which is being developed and evaluated by the Division.

Barbara Ellis, Donald Sarazin, Peter Stone joined the subdivision as term employees under the Mineral Development Agreement project on February 18, April 22 and March 18, 1985 respectively.

Attendance at Meetings, Conferences and Courses

K. Anderson

Attended Introduction to Vax Computer and Cyber/Vax Computer Graphics Courses presented by the EMR Computer Science Centre, Ottawa, March 12-13, 1985.

J. Broome

Attended the symposium "Geophysics for Gold" organized by the CIMM in Val D'Or, Quebec in November 1984. Presented paper entitled "Qualtitative interpretation of aeromagnetic data with examples from the Val D'Or area".

Presented a poster session at the GSC Current Activities Forum in Ottawa, January 22-24, 1985 on display techniques for magnetic anomaly maps.

Attended the Prospectors and Developers Convention in Toronto, from March 10-14, 1985. Presented a poster session in the GSC exhibit room dealing with the various display techniques for regional magnetic anomaly maps.

Completed two graduate courses at the University of Ottawa in image processing techniques.

I. Butt

Attended a course presented by the Computer Science Centre entitled "Introduction to Cyber/Vax Graphics" on March 13, 1985.

B. Ellis

Attended Introduction to Cyber/Vax Computer Graphics Courses given by the EMR Computer Science Centre on March 13, 1984.

P.J. Hood

Attended the American Geophysical Union Meeting in Cincinnati, from May 14-18, 1984. Presented a paper entitled "Aeromagnetic reconnaissance of the Nares Strait, NWT. Co-authored with D.W. Strangway and J. Arkani-Hamed a paper entitled "Detection of global magnetic anomalies using low altitude satellites".

Attended the 11th Annual Meeting of the Canadian Geophysical Union in Halifax, from May 29-June 1, 1984. Presented a paper entitled "Direct geophysical evidence for displacement along Nares Strait from low-level aeromagnetic data which was co-authored with M. Bower, C.D. Hardwick and D.J. Teskey.

Attended the Society of Exploration Geophysicists Meeting in Atlanta, from December 2-6, 1984. Convened a meeting of the Committee for the preparation of the Magnetic Anomaly Map of North America.

Attended the Prospectors and Developers Convention in Toronto, from March 10-14, 1985.

L.J. Kornik

Presented a poster display and paper with J.G. Thurlow and J. Whalen entitled "An interpretation of aeromagnetic gradiometer results from the Buchans area of Newfoundland" at the GSC Current Activities Forum in Ottawa, January 22-24, 1985.

L. Lawley

Attended three one-day courses presented by the EMR Computer Science Centre as follows:- March 12 - Introduction to the Vax system; March 13 - Introduction to Cyber/Vax Graphics; March 14 - Dataplotting Virtual Graphics Language.

E.J. Schwarz

Co-authored paper with L. Laverdure, L. Losier, and E. Poterlot entitled "Interpretation preliminaire des données gravimetriques, magnetiques et seismiques de la ceinture de l'Abitibi" at the Association Canadienne Française pour l'Avancement des Sciences at the University of Laval in May 1984.

Attended the Canadian Geophysical Union Meeting in Halifax, from May 29-June 1, 1984. Presented a paper with K.L. Buchan entitled "Uplift studies and the nature of remanent magnetization in the contact zone of some Precambrian dykes". Also presented a paper entitled "Preliminary gravity, magnetic and seismic refraction results from the Abitibi Greenstone Belt, Quebec" with L. Laverdure, L. Losier, E. Poterlot, M. Pilkington and D.J. Crossley as co-authors. Was co-author of a paper entitled "Interpretation from seismic refraction data from the Abitibi region" with D.J. Crossley, C. Parker and E. Poterlot.

D.J. Teskey

Attended the Canadian Geophysical Union Meeting in Halifax, from May 29-June 1, 1984. Presented a paper which was co-authored by S.D. Dods and P.J. Hood entitled "Advances in the magnetic anomaly mapping program at the Geological Survey of Canada".

Attended the Society of Exploration Geophysicists Meeting in Atlanta, from December 2-6, 1984.

Special Talks and Lectures

P.J. Hood

Presented a talk in Peking, China on August 6, 1984 entitled "Exploration for sulphide mineral deposits" during the International Geological Instruments Exhibition.

Presented the following talks to members of the Chinese Ministry of Geology and Mineral Resources as follows:-

(1) State of the art of exploration geophysics - August 11 in Peking, August 18 in Xian, August 22 in Shanghai and August 24 in Kweilin.

(2) Aeromagnetic gradiometry - August 13 in Peking.

(3) Regional geophysical maps - August 14 in Peking.

Presented a talk entitled "Applications of geophysics to mineral exploration" to about 30 students from

Ecole des Mines, Paris in Alice Wilson Hall on September 24, 1984.

Presented a talk entitled "China revisited: a debriefing" to KEGS at the Engineers Club, Toronto, on October 9, 1984.

Membership on Committees

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, Organizing Committee, Exploration '87 Symposium.

E.J. Schwarz

Associate Editor, Geoscience Canada.

Professeur Invité de Géophysique Appliquée, Ecole Polytechnique de Montreal.

D.J. Teskey

Associate Member, Magnetic Anomaly Map of North America Committee, DNAG Project, Geological Society of America and Co-Chairman of its Magnetic Data Exchange Format Subcommittee.

Subdivision Productivity

121 Aeromagnetic Maps (60 in 3 Open Files; 61 as published maps) including the Fourth Edition of the Magnetic Map of Canada.
5 Outside Publications
2 GSC Papers
18 Abstracts of Formal Talks
3 Open Files
4 Poster Sessions

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

The Subdivision was involved in Federal-Provincial Mineral Development Agreements with Newfoundland, Nova Scotia, New Brunswick, Manitoba and Saskatchewan. This year's activities included: regional geochemical surveys in Newfoundland, Manitoba and Saskatchewan; follow-up geochemical studies in Nova Scotia and project planning in New Brunswick. The Subdivision was also involved in a joint geochemical survey with British Columbia.

The 1983 phase of the two-year geochemical reconnaissance survey under the Federal (cooperative) Mineral Program in Newfoundland was completed and four open files were released in 1984. The lake sediment and water survey carried out in 1983 under the Canada-Manitoba Interim Agreement in NTS 64C (Lynn Lake area) was completed and open filed. The joint 1983 survey with British Columbia, carried out under letters of understanding, was completed in two map sheets and released in open files. The results of the Subdivision funded environmentally oriented regional lake sediment and water survey carried out in Ontario in 1982 was released in two open files.

Regional geochemical reconnaissance surveys are carried out by E.H. Hornbrook, P.W.B. Friske, J.J. Lynch, N.G. Lund, A. Galletta, B. Elliott and M. McCurdy.

An evaluation of regional reconnaissance stream geochemical data and follow-up survey results by S.B. Ballantyne has shown that a multi-media, multi-element approach to exploration can facilitate discovery of tin mineralization in the Canadian Cordillera. This work was received with much interest in Canada and at a scientific meeting in China where it was presented.

As part of the continuing development of the down hole groundwater pump system, Dr. D.R. Boyle has successfully tested a dual valve pumping device that approximately doubles the flow rate decreasing significantly sampling time and increasing the volume collected.

The work of Dr. E.M. Cameron on sulphur isotopes in the Hemlo gold camp area has revealed that these deposits contain strongly ^{34}S depleted pyrites which is unusual for Archean mineralization. Studies of these and some other large Archean gold deposits indicates that they were formed from relatively oxidizing solutions, permitting isotopic fractionation between oxidized and reduced species, which favoured the dissolution, transport and precipitation of gold.

The strong He anomalies, found by W. Dyck, in a lake in the Baker Lake region of the NWT provide evidence of a deep major fracture system. Coincident U anomalies suggest the fracture system is a conduit for uranium mineralized solutions.

D.J. Ellwood has developed a system to plot Applicon plots on a laser plotter permitting the computer production of press-ready colour separations of geochemical maps. These are a much improved high contrast crisp coloured version of the standard Applicon coloured maps. To facilitate multi-element interpretation, he has also developed a format for displaying the distribution of 4 elements on one map: one as a contoured base and the other three as symbols.

Dr. R.G. Garrett has begun development of the interactive graphics computer system IDEAS on the Departmental VAX facility. The system has already been used to interpret regional geochemical data from MDA surveys and by Subdivision geochemists.

Dr. D.C. Gregoire has completed a method for the selective extraction of organically bound gold from surficial materials producing accurate determination down to 1 ppb in the parent material.

G.E.M. Hall and her staff have completed the establishment of a fully integrated micro-computer system to receive data from A.A. or IC (ion chromatography) stations for management, evaluation and report transfer to the Cyber computer. A method to determine boron in rocks was established because it was not otherwise available at the GSC and it is of increasing use in geochemical studies.

J.J. Lynch has released four lake and four stream sediment international reference samples to participating laboratories for characterization prior to release to the public.

Dr. Y.T. Maurice has developed a new model for the origin of placer gold in the eastern townships of Quebec based on data from a recent heavy mineral stream sediment survey that used new dredging and concentration procedures for collection and preparation of samples.

Personnel Notes

Dr. Y.T. Maurice remains seconded for most of his time to the Director General's office as Branch Coordinator of GSC participation in the special federal program on economic and regional development in the Gaspe region of Quebec.

Dr. P.W.B. Friske joined the Resource Geochemistry Subdivision as Mineral Agreement Survey Geochemist for the duration of the Federal-Provincial Mineral Development Agreements. Dr. Friske, who obtained his doctorate in applied geochemistry from the University of New Brunswick, brings to the Subdivision several years of experience in geochemical research and exploration activity with government and industry.

Martin McCurdy, a recent geology graduate from Carleton University, has joined the Subdivision to assist John Lynch and Peter Friske in activities related to the Federal-Provincial Mineral Development Agreements. Martin is no stranger to geochemistry, having worked in Ottawa several summers as a student assistant.

Barbara Elliott has returned to the GSC on staff with the Resource Geochemistry Subdivision to carry out data management for the Federal-Provincial Mineral Development Agreement surveys. Barbara, who has a B.A. in geography from the University of Ottawa, previously worked in the Division with the radiometrics surveys group from 1971 to 1977.

Best wishes of the Subdivision to Alice I. MacLaurin who left our Analytical Laboratories Section in September. During fifteen years of service, Alice made significant contributions to the activities and operations of the laboratories. Her skills in almost every facet of analytical chemistry were well appreciated by the staff. We shall all miss her congenial and friendly personality.

Attendance at Meetings, Conferences and Courses

S.B. Ballantyne

Workshop on Recent Advances in the Geochemistry of Ore Deposits, at the Mineral Exploration Research Institute, Montreal, May 1984.

4th International Symposium on Geology of Tin Deposits, Nanning, China, October 1984.

Cordilleran Geology and Exploration Round-Up, Vancouver, January 1985.

53rd Annual Prospectors and Developers Association Annual Meeting, Toronto, March 1985.

D.R. Boyle

27th International Geological Congress, Moscow, U.S.S.R., August 1984.

National Symposium and Exposition on Groundwater Instrumentation, Los Vegas, April 1984.

Workshop on Applications of Groundwater Geochemistry, Banff, June 1984.

E.M. Cameron

Geological Association of Canada Annual Meeting, London, Ontario, May 1984.

53rd Annual Prospectors and Developers Association Annual Meeting, Toronto, March 1985.

W. Dyck

I.A.E.A. Consultants Meeting for the Radon Prospecting Manual, Vienna, Austria, December 1984.

D.J. Ellwood

Cordilleran Geology and Exploration Round-Up, Vancouver, January 1985.

53rd Annual Prospectors and Developers Association Annual Meeting, Toronto, March 1985.

P.W.B. Friske

Cordilleran Geology and Exploration Round-Up, Vancouver, January 1985.

53rd Annual Prospectors and Developers Association Meeting, Toronto, March 1985.

G. Gauthier

31st Canadian Spectroscopy Symposium, St. Jovite, Quebec, October 1984.

R.G. Garrett

9th International CODATA Meeting, Jerusalem, Israel, June 1984.

COGEODATA-Joanneum Research Society Seminar and Joint Meeting on Multivariate Techniques on Geochemical and Other Data in Mineral Resource Assessment and Environmental Applications, Leoben, Austria, December 1984.

COGEODATA Workshop on Le role de L'ordinateur dans l'interpretation simultance des donnees deprospection miniere (teledection, geologie, geophysique, geochemie), Sophia Antipolis, France, March 1985.

W.D. Goodfellow

CIMM Annual Meeting, Ottawa, April 1984.

Workshop on Black Smokers and Sulphide Deposits, Juan de Fuca Ridge, Victoria, May 1984.

Geological Association of Canada Annual Meeting, London, May 1984.

GSC Current Activities Forum, Ottawa, January 1985.

Workshop on Offshore Studies of Hydrothermal Vents, Juan de Fuca Ridge, Seattle, March 1985.

D.C. Gregoire

Federation of Analytical Chemistry and Spectroscopy Societies, 11th Annual Meeting, Philadelphia, Pa., September 1984.

31st Canadian Spectroscopy Symposium, St. Jovite, Quebec, October 1984.

G.E.M. Hall

31st Canadian Spectroscopy Symposium, St. Jovite, Quebec, October 1984.

ICP/ES JY-38 Instrument Training Course, Metuchen, New Jersey, January 1985.

E.H.W. Hornbrook

Cordilleran Geology and Exploration Round-Up, Vancouver, January 1985.

I.R. Jonasson

Workshop on Offshore Studies of Hydrothermal Vents, Juan de Fuca Ridge, Seattle, March 1985.

J.C. Pelchat

ICP-ES JY-38 Instrument Training Course, Metuchen, New Jersey, January 1985.

J.E. Vaive

31st Canadian Spectroscopy Symposium, St. Jovite, Quebec, October 1984.

Special Talks and Lectures

S.B. Ballantyne

"An Evaluation of Reconnaissance and Follow-Up Geochemical Surveys to Delineate Favourable Areas for Tin Mineralization in the Northern Canadian Cordillera". Paper presented at the 4th International Symposium on the Geology of Tin Deposits, Nanning, China, October 1984.

D.R. Boyle

"Geological Environments for Basal-Type Uranium Deposits in Sedimentary Host Rocks" and "Surficial Uranium Deposits in North America". Papers presented at the 27th International Geological Congress, Moscow, U.S.S.R., August 1984.

E.M. Cameron

"Sulphur-Cycle in the Precambrian". Special talk given to the Kalgoorlie Geological Society, Kalgoorlie, Australia, April 1984.

"The Hemlo Gold Deposit". Special talk given to the Association of Exploration Geochemists, Perth, Australia, April 1984.

"Sulphate in the Late Precambrian Seawater: Evidence from the Hemlo Gold Deposit, Ontario". Paper presented at the G.A.C. Annual Meeting, London, Ontario, May 1984.

R.G. Garrett

"Computer Graphics Procedures to Aid in the Interpretation of Resource Geochemistry Data in Use at the Geological Survey of Canada". Special talk given to the Geological Survey of Malaysia, Ipoh, Malaysia, January 1985.

"Examples of Application of Geochemical Data in Resource Assessment Studies". Special talk given to the COGEODATA-Joanneum Research society joint meeting in Leoben, Austria, December 1984.

"Preparation des donnees. Creations des donnees soumises aux traitments. Traitments Preliminaires". Special talk given at the COGEODATA workshop in Sophia Antipolis, France, March 1985.

"Geochemical Data - Retrospect and Prospect". Paper presented at 9th International CODATA Meeting, Jerusalem, Israel, June 1984.

W.D. Goodfellow

"Environment of Formation of the Howards Pass Deposit, Selwyn Basin". Special talk given at the Special Lectures Series, University of Waterloo, February 1985.

"Geochemical Studies Planned for 1985, Explorer and Endeavour Ridges". Special talk given at the Workshop on Hydrothermal Vents, Seattle, March 1985.

"Influence of Seafloor Hydrothermal Processes on Paleoenvironments in the Selwyn Basin, Yukon". Paper presented at the G.A.C. Meeting, London, Ontario, May 1984.

"Assessment of the Physical and Chemical Processes Affecting the Transportation and Deposition of Metals Derived from Lead-Zinc Deposits, Selwyn Basin, Yukon Territory". Paper presented at the CIMM meeting, Ottawa, April 1984.

I.R. Jonasson

"Geology and Geochemistry of the XY Zn-Pb Deposit, Yukon". Special talk given to the CSIRO Division of Mineralogy and Geochemistry, Sydney, N.S.W., Australia, November 1984.

"Stratigraphic Geochemistry of the XY Zn-Pb Deposit and its Host Rocks, Yukon". Special talk given to the CSIRO Division of Mineralogy and Geochemistry, Perth, Australia, November 1984.

Memberships on Committees

S.B. Ballantyne

Chairman, Technical Session, 11th International Geochemical Exploration Symposium.

D.R. Boyle

Member, Working Group II (Sandstone Type Uranium Deposits), I.A.E.A.

Member, Working Group IV (Surficial Uranium Deposits), I.A.E.A.

E.M. Cameron

Editor-in-Chief, Journal of Geochemical Exploration.

D.J. Ellwood

Member, Departmental Computer Users Committee.

R.G. Garrett

President, Association of Exploration Geochemists.

Member, Editorial Board of the Journal of Geochemical Exploration.

Co-Chairman (program) of the 11th International Geochemical Exploration Symposium.

Member, Organizing Committee for Exploration '87, Toronto.

Secretary-Treasurer, COGEODATA.

W.D. Goodfellow

Councillor, Association of Exploration Geochemistry.

Chairman, Technical Session, 11th International Geochemical Exploration Symposium.

D.C. Gregoire

Treasurer, Ottawa Valley Section, Spectroscopy Society of Canada.

Panel Member, Workshop on Graphite Furnace, Atomic Absorption Spectrometry, St. Jovite, Quebec, October, 1984.

G.E.M. Hall

Chairperson, Technical Session, 31st Canadian Spectroscopy Symposium, St. Jovite, Quebec, October, 1984.

Member, Exploration Technology Development Fund Committee for Ontario.

Chairperson, Technical Session, 11th International Geochemical Exploration Symposium.

E.H.W. Hornbrook

Chairman, Technical Session, 11th International Geochemical Exploration Symposium.

I.R. Jonasson

Member, Joint Working Group USGS-GSC on Ocean Floor Sulphides.

Research Scientist Executive Committee, PIPS.

Subdivision Productivity

13 Outside Publications
4 GSC Papers
4 Abstracts for Formal Talks
9 Open Files (146 Geochemical Maps)
6 Poster Sessions
8 Oral Presentations

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

Reconnaissance airborne gamma-ray spectrometer surveys were flown over five 1:250,000 sheets in Saskatchewan, Manitoba and Quebec, in order to complete the coverage of 1:1,000,000 map sheets for small scale compilation purposes. (P.B. Holman) Small scale (1:1,000,000) radioelement distribution maps compiled from Uranium Reconnaissance Program data, and all other existing reconnaissance radiometric coverage were released on Open File in July, 1984. (B.W. Charbonneau)

Under Mineral Development Agreements, detailed gamma-ray spectrometer surveys were flown in Southwestern Newfoundland (eleven 1:50,000 sheets) and in North-Central New Brunswick (seven 1:50,000 sheets); and in support of a multidisciplinary investigation of a carbonatite intrusion in Eastern Ontario a survey was flown over two 1:50,000 sheets.

This carbonatite intrusion, about 1 km in diameter, was recently recognized as a result of its high thorium concentration shown on airborne radiometric results. The intrusion has no obvious magnetic signature and essentially no outcrop. Ground follow-up investigations (K.L. Ford) indicated high concentrations of thorium, rare earths, zinc, barium and phosphorus in this body. Two 300 m test holes were drilled in the carbonatite, presenting a unique opportunity to study the radioelement distribution within the carbonatite and the relationship to rare earth

elements. The variation in density (barite content) as well as magnetic susceptibility make these two test holes ideal for developing these two borehole logging methods.

Ground follow-up of airborne radiometric surveys in the Northwest Territories produced new occurrences of uranium and thorium, rare earths, molybdenum, tungsten and gold, associated with radioactive granites in the Nueltin Lake area. (B.W. Charbonneau)

Deep sounding EM surveys to measure permafrost near Tuktoyaktuk were made in April, 1984, and a brief survey at Illisarvik drained lake qualitatively showed an increase in ice thickness over the last two years. Deep EM soundings were carried out at various sites in Southern Ontario to map gently dipping sedimentary strata to depths of 500 m or more, and the results compared favourably with geology known from drill holes. (A.K. Sinha)

A survey was carried out in Atikokan in Northern Ontario to field test a new EM technique for mapping and discriminating fracture zones. The magnetic wave-tilt measurements produced data superior to ground VLF and has potential for mapping weak conductors; this would be useful in the Nuclear Fuel Waste Management Program.

Analysis and compilation of seismic data from Operation CESAR continued; however, work on the CESAR and LOREX data was curtailed with the development of the new ICE ISLAND Project. Seismic reflection profiling tests were carried out on the ICE ISLAND in September, 1984, demonstrating the feasibility of this work. As a result of this test, seismic profiling will form a part of the ICE ISLAND project in 1985/86. (A. Overton)

Beaufort Sea permafrost studies included the completion of a revised interpretation of refraction records, compiled at 1:250,000 scale, to be produced as a GSC paper in 1985. A multidisciplinary geotechnical survey (with Terrain Science Division) included subseabottom drilling, uphole seismic velocity measurements, thermal conductivity measurements, and seabottom refraction measurements. (J.A.M. Hunter) Development of a prototype seismic filter/preamplifier unit was completed with provision for software control of filter cutoff frequencies and preamplifier gains, (Q. Bristow) and the unit was successfully tested during sea trials of a deep-towed eel designed by GSC for sea-bed profiling. The ability to control the filter cutoff frequencies to within a few cycles/second was critical in this application.

High resolution reflection seismic tests were carried out at locations across Canada for various applications (bedrock mapping, overburden stratigraphy, hydrology, land slide studies) in cooperation with Ontario and Alberta governments, and GSC Terrain Sciences Division. In January and February, 1985, IDRC sponsored a visit by GSC seismic personnel to Malaysia to train University and Government scientists in the application of GSC-developed reflection seismic techniques to mineral exploration in karst topography, and to Thailand to test the application of these techniques to stratigraphic mapping in the Bangkok delta, for planning remedial action relative to subsidence of the area. (J.A.M. Hunter, S.E. Pullan)

In borehole logging several new applications to mineral exploration were investigated. At Larder Lake, magnetic susceptibility logging was able to delineate pyritized and carbonatized zones by characteristic changes in susceptibility caused by alteration. Also Mise-a-la-Masse (MALM) measurements were effective for mapping conductive gold-sulphide mineralization between boreholes. At Cormorant Lake, Manitoba, susceptibility logging was carried out in plastic cased boreholes (in conjunction with the Manitoba Dept. of Mines) to aid the interpretation of magnetic surveys over the sedimentary veneer at the edge of the shield. At Hemlo a full suite of logs (gamma spectral, IP, resistivity, SP, temperature, susceptibility, and density) were completed in several boreholes. It was found that mineralized zones could be characterized by high density values (the barite-gold association), high susceptibility values (possibly due to pyrrhotite) and high K values (potassic alteration). Interpretation of Timmins data from the Kidd Creek mine (Hoyle Pond) shows that the MALM method can be successfully applied in correlating low-resistivity, gold-bearing carbonate alteration zones from hole to hole. MALM was also used successfully to map fracture continuity between boreholes at East Bull Lake. The in-situ susceptibility measurements in boreholes obtained in a few hours of logging were shown to compare favourably with susceptibility logs obtained over a period of weeks from drill core samples. (P.G. Killeen, C.J. Mwenifumbo)

In addition to the above field studies, progress was made on establishment of calibration facilities for coal logging with the installation of two in-ground tanks in Nova Scotia to hold the future calibration zones of a model borehole.

In support of Nuclear Fuel Waste Management Program, a method was developed to determine hydraulic permeability of fractures and rock matrix in crystalline rocks, using focussed beam electrical log, fluid resistivity log and density logs. The method has been applied to borehole data from the URL area. Statistical techniques to determine pocket porosity in crystalline rocks and used for characterization of the rocks. (T.J. Katsube)

During the year, moves were made to establish a geophysical rock properties laboratory. In spite of lack of space in which to locate such a new laboratory, equipment in various locations at Booth, Aberdeen and Lebreton Sts. was used to determine density, acoustic, electrical and magnetic properties of a suite of core samples from Hemlo, and samples from borehole logging test facilities. (L.E. Stephens)

Members of the Subdivision staff spent a total of 174 person days in Thailand in support of CIDA on the Thai Geophysical Project. (R.L. Grasty, P.B. Holman, P.G. Killeen, K.A. Richardson) In July calibration pads for airborne gamma ray spectrometer systems were constructed south of Bangkok under GSC supervision, and by the end of the year 5 contractor aircraft were approved for production operations. In March, 1985, a full time geophysicist was hired by CIDA consultants (SNC Ltd.) to ease the requirement for GSC advisors to Thailand.

In remote sensing applications, digital image analysis techniques were applied to multiple data sets for the Rossignol area of Nova Scotia; magnetic and radiometric data were used in conjunction with satellite imagery, to produce a pseudo lithologic map. (V.R. Slaney)

The Instrument Development Shop, headed by R.J. Thibedeau, responded to a variety of design, fabrication, modification and maintenance work requests for the Branch. Some of the items which have been completed, tested and put into operation, are an argon extraction system, core sample cutting head, shot gun seismic source, portable winch for borehole logging, video camera support

for scanning electron microscope, and design of faxitron x-ray system.

Instrument Development Shop Statistics

Work orders received during 84/85	176
Work orders carried from 83/84	59
Total on hand during 84/85	235
Cancellations	30
Net Amount	205
Work orders completed during 84/85	170
Work orders to be carried into 85/86	35

Distribution of Shop Work by Division

	Percent
Prec	28.4
EGM	20.6
TS	19.9
RGG	15.7
GID	1.8
ISPG	1.5
Admin	1.3
DGO	0.1
Emergency repairs and maintenance	10.7

Personnel Notes

H.A. MacAulay

Retired in February, 1985, after 31 years of service to the government of Canada.

G.J. Palacky

Joined the Subdivision in March, 1985, to establish test sites for electromagnetic methods, and to initiate airborne resistivity mapping of Canada.

R.B.K. Shives

Joined the Subdivision in January, 1985, to work on gamma-ray spectrometer survey data related to the New Brunswick Mineral Development Agreement.

A.V. Dyck

Under an exchange agreement with Queen's University, moved to Kingston in August, 1984, to spend a year teaching geophysics there.

J.F. Bourillet

A French-Coopérant, began his 14-month term at the GSC in November, 1984, working on compilation of airborne radiometric data.

Attendance at Meetings, Conferences and Courses

G.R. Bernius

CIM Annual Meeting, Ottawa, April 16-18, 1984.

GSC Current Activities Forum, Ottawa, January 22-24, 1985.

Q. Bristow

NEA/IAEA Working Group Meeting, Lulea, Sweden, September 10-14, 1984.

GSC Current Activities Forum, Ottawa, January 22-24, 1985.

B.W. Charbonneau

CIM Annual Meeting, Ottawa, April 16-18, 1984.

GSC Current Activities Forum, Ottawa, January 22-24, 1985.

L.S. Collett

54th International SEG Meeting, Atlanta, December 3-7, 1984.

CIM Annual Meeting, Ottawa, April 16-18, 1984.

GSC Current Activities Forum, Ottawa, January 22-24, 1985.

K.L. Ford

CIM Annual Meeting, Ottawa, April 16-18, 1984.

GSC Current Activities Forum, Ottawa, January 22-24, 1985.

Prospectors and Developers Convention, Toronto, March 11-13, 1985.

R.L. Good

54th International SEG Meeting, Atlanta, December 3-7, 1984.

R.L. Grasty

NEA/IAEA Working Group Meeting, Lulea, Sweden, September 10-14, 1984.

J.A. Hunter

54th International SEG Meeting, Atlanta, December 3-7, 1984.

T.J. Katsube

Geophysics Workshop (NFWMP), Ottawa, February 14-15, 1985.

P.G. Killeen

CIM Annual Meeting, Ottawa, April 16-18, 1984.

Society of Well Log Analysts Symposium, New Orleans, June 10-13, 1984.

NEA/IAEA Working Group Meeting, Lulea, Sweden, September 10-14, 1984.

IAEA Advisory Group Meeting: Gamma, X-Ray and Neutron Techniques for the Coal Industry, Vienna, Austria, December 4-7, 1984.

GSC Current Activities Forum, Ottawa, January 22-24, 1985.

C.J. Mwenifumbo

CIM "Geophysics for Gold" Symposium, Val d'Or, November 12-13, 1984.

GSC Current Activities Forum, Ottawa, January 22-24, 1985.

A. Overton

CMOS/CGU Congress, Halifax, May 29-June 1, 1984.

S. Pullan

54th International SEG Meeting, Atlanta, December 3-7, 1984.

GSC Current Activities Forum, Ottawa, January 22-24, 1985.

A.K. Sinha

17th Annual Information Meeting, Canadian Nuclear Fuel Waste Management Program, Ottawa, February 21, 1984.

Permafrost Workshop, Golden, October 23-24, 1984.

54th International SEG Meeting, Atlanta, December 2-6, 1984.

46th Annual EAEG Meeting, London, England, June 19-22, 1984.

GSC Current Activities Forum, Ottawa, January 22-24, 1985.

V.R. Slaney

GEOSAT Committee Meeting, San Antonio, May 23-25, 1984.

9th Canadian Symposium on Remote Sensing, St. John's, August 13-17, 1984.

GEOSAT Committee Meeting, Reno, November 8, 1984.

GSC Current Activities Forum, Ottawa, January 22-24, 1985.

GEOSAT Committee Meeting, Washington, January 24, 1985.

K.A. Richardson

Newfoundland Dept. of Mines and Energy "Review of Activities", St. John's, October 31-November 3, 1984.

GSC Current Activities Forum, Ottawa, January 22-24, 1985.

McKelvey Forum on Mineral Energy Resources, Denver, February 6-8, 1985.

Special Talks and Lectures

R.L. Good

"A 12-channel marine eel for engineering refraction-reflection seismic surveying". Presented at the 54th International SEG Meeting, Atlanta, December 3-7, 1984.

J.A. Hunter

"Iso-offset time display of seismic refraction data". Presented at the 54th International SEG Meeting, Atlanta, December 3-7, 1984.

T.J. Katsube

"Methods to determine porosity and permeability in crystalline rocks from standard geophysical logs". Presented at the Nuclear Fuel Waste Management Program Geophysics Workshop, Ottawa, February 14-15, 1985.

P.G. Killeen

"Nuclear-based borehole assay techniques - the state-of-the-art". Presented at the CIM Annual General Meeting, Ottawa, April 16-18, 1984.

"A review of nuclear-based borehole assay techniques in mineral exploration". Presented at Helsinki University of Technology, Helskinki, September 14, 1984.

"Training Seminar on Radiometric Methods of Prospecting and Geologic Mapping". Presented at the University of Malaya, Kuala Lumpur, October 29-31, 1984.

"Airborne, surface and borehole radiometric methods: a short course" - a series of eight lectures plus labs. Presented at the Department of Mineral Resources, Bangkok, Thailand, October 22-November 6, 1984.

"An overview of research activities in applied geophysics at the Geological Survey of Canada: airborne, surface, and borehole techniques". Presented at the University of Waterloo, Waterloo, November 15, 1984.

"Current developments in nuclear techniques for coal logging in Canada". Presented at the IAEA Advisory Group Meeting: Gamma, X-Ray and Neutron Techniques for the Coal Industry, Vienna, Austria, December 4-7, 1984.

Exploration Geophysics Course, GEO 3190. Presented at the University of Ottawa Geology Department; 26 lectures, Ottawa, January to April, 1984.

C.J. Mwenifumbo

"An application of the mise-a-la-masse method to the mapping of gold bearing alteration zones". Presented at the CIM "Geophysics for Gold" Symposium, Val d'Or, November 12-13, 1984.

"Mapping of auriferous sulphide horizons by hole-to-hole mise-à-la-masse borehole logging." Presented at the GSC Current Activities Forum, Ottawa, January 21, 1985.

A. Overton

"A comparison of seismic signatures, Lomonosov and Alpha Ridges, Arctic Ocean Basin". Presented at the CMOS/CGU Congress, Halifax, May 29-June 1, 1984.

S. Pullan

"A new source for engineering seismic surveys". Presented at the 54th International SEG Meeting, Atlanta, December 3-7, 1984.

A.K. Sinha

"Geophysical analysis of the new intrablock grid at RA-4". Presented at the 17th Information Meeting of the Canadian Nuclear Fuel Waste Management Program, Ottawa, February 21, 1984.

"Deep transient EM sounding in the Mackenzie Delta, N.W.T., Canada." Presented at the Permafrost Workshop, Golden, October 23-24, 1984.

"Interpretation of ground VLF-EM data is terms of simple models". Presented at the 54th International SEG Meeting, Atlanta, December 3-7, 1984.

"Detection and mapping of a complex conductor near Timmins by transient and multifrequency electromagnetic systems". Presented at the 46th Annual EAEG Meeting, London, England, June 19-22, 1984.

V.R. Slaney

"Applications of an image analysis system to geophysical-geochemical data sets to produce computer-plotted pseudo lithologic maps." Presented at the GSC Current Activities Forum, Ottawa, January 23, 1985.

Memberships on Committees

L.S. Collett

Member, Engineering and Groundwater Geophysics Committee, Society of Exploration Geophysicists.

Member, Program for Industry/Laboratory Projects, National Research Council, Branch representative.

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.

Editor for First Break, EAEG.

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.

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.

G.J. Palacky

Associate editor, International Scientific Advances, for "Geophysics".

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

287 radiometric maps (25 Open Files, 16 G-Series)
10 Outside Publications
8 GSC Papers
29 Abstracts of Formal Talks
3 Poster Sessions
2 Open Files (video film of airborne operations, seismic software)

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 the Canadian Geoscience Council provided an ad hoc Committee on Quaternary Engineering Geology, chaired by Professor M. Church, U.B.C., to examine Divisional products and user requirements in Quaternary and engineering geology. The Committee produced, circulated and evaluated two questionnaires. The first questionnaire was circulated nationally to a broad range of Terrain Sciences information user groups and the second questionnaire to a more restricted group of specialized users. Committee members interviewed individual members of the scientific staff at offices in Ottawa, Calgary and Vancouver. In December the Committee Chairman interviewed the Director General and Director, Terrain Sciences Division to obtain clarification on issues of Branch publication policy. A draft copy of the Committee's report containing findings, conclusions and recommendations is anticipated in May 1985.

At the end of the report-period the staff comprised 1 Research Manager, 25 Research Scientists, 15 Physical Scientists (9 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 publication: 15 GSC Reports; 16 Maps; 7 Open Files; and 18 contributions to Current Research. In addition 24 papers and 8 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.

Attendance at Meetings, Conferences and Courses

B.R. Pelletier

Geological Association of Canada Annual Meeting, London, Ontario, May 1984.

A.G.C. Program Review Meeting, Dartmouth, Nova Scotia, November 1984.

Presented a paper at the Atlantic University Geological Conference, Halifax, Nova Scotia, November 1984.

1985 Current Activities Forum, Ottawa, January 1985.

J.S. Scott

Geological Society of America Annual Meeting, Reno, Nevada, November 1984.

J.S. Scott (cont'd.)

Presented a paper at the Geoscience Forum, Yellowknife, December 1984.

Chaired session on Atikokan Research Area at the Geophysics Workshop, Nuclear Fuel Waste Management Program, February 1985.

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 and Atlantic Geology, 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

Geological Society of America, Committee on Geology and Public Policy, Member

Special Talks or Lectures

B.R. Pelletier

'Marine geology' to Canadian Hydrographic Service, Ottawa, October 1984.

J.S. Scott

'Canada's mineral, forest and fisheries resources' to Course XXXVIII at the National Defence College, Kingston, Ontario, October 1984.

Quaternary Discussion Group

Under the Chairmanship of A.MacS. Stalker the following papers were presented during October 1984 to March 1985.

Professor Cui Zhijiu, Beijing University, China -- A review of certain periglacial phenomenon in China.

Mr. R.J. Mott, Terrain Sciences Division, GSC, Ottawa -- The Allerød/Younger dryas climatic oscillation: was it a European climatic anomaly or did it also occur in northeastern North America?

Dr. S.G. Evans, Terrain Sciences Division, GSC, Ottawa -- Catastrophic processes associated with glacier forelands.

Mr. H. Josenhans, Atlantic Geoscience Centre, Dartmouth -- On the physical properties and Quaternary evolution of the Labrador shelf sediments.

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

Field work in the Gaspésie area, within the framework of the federal-provincial mineral agreement was for 1984 limited to one project in the Lac Matapédia area conducted by G. Prichonnet from UQUAM. Distribution of erratics and ice-flow indicators on bedrock suggest complex ice-flow conditions with components to the SE-SSE, to the SW and W and to the NE(?). Till samples (200) were collected from natural exposures and back-hoe trenches, and were analyzed for 10 trace elements. Further investigation is planned for 1985.

An evaluation of existing Quaternary maps for the Gaspé Peninsula as to coverage and quality led to the planning of a small scale compilation map for the whole peninsula. A detailed mineral tracing project with P. David of Université de Montréal was also planned.

Preparation continued on the Quaternary Volume for the new Geology of Canada series. This volume is a contribution for the decade of North American Geology series and in addition to covering Canada will contain a section prepared by Danish geologists on the Quaternary of Greenland. This volume, being compiled by about 50 scientists both inside and outside the Geological Survey of Canada, presents a description of the Quaternary geology of Canada and Greenland, and includes several chapters that discuss the interplay between Quaternary deposits and processes and man. The first draft of much of the volume has been completed and hopefully the volume will be ready for critical review in June. A

surficial materials map of Canada, scale of 1:5 000 000, is being prepared as a companion piece for the Quaternary Volume. It will be the first map to show the nature of surface materials of all Canada. The map is about one-half completed.

In April 1984 the Division sponsored a joint Canadian-American workshop on "Correlation of Quaternary Deposits and Events in the area around the Beaufort Sea". Participants from the GSC, the USGS, as well as from the academic and consulting community pooled their knowledge and strived to present a coherent picture of the Quaternary geology of the area which is presently undergoing much exploration and development activity. One of the main results of the meeting was the preparation of a chart correlating Quaternary deposits and events in northwestern North America.

Surficial geology mapping in the northwest Arctic Islands has demonstrated that a short-lived glacial ice shelf at least 60 000 km^2 filled Viscount Melville Sound between Victoria and Melville Islands ca. 10 000 years ago[1]. This is the first large ice shelf identified in the Arctic, and only the second large paleo shelf identified by geological methods, rather than being hypothesized on the basis of glaciological theory. Growth and decay of the shelf is one of few events so far age-bracketed for the perimeter of the last main North American ice sheet. It provides significant information about climate and ice dynamics for the northwest sector of the ice sheet. Recognition of this event will also aid mapping of surficial deposits (terrestrial and marine) over the western Northwest Passage and adjacent channels.

A major record of glacial and non-glacial deposits is preserved in the Manitoba portion of the Hudson Bay Lowlands, and adjacent Shield areas. Three major glaciations are represented. The earliest interglacial is represented by a paleosol. The last interglaciation (Sangamon?) is represented by proglacial gravels, glaciolacustrine varves, sandy alluvium and marl, wood-bearing peat beds, lacustrine silts, and clays which may have a marine origin. Evidence from Manitoba suggests that a large ice mass persisted over Hudson Bay during the entire Wisconsin Glaciation, but that multiple till sheets were emplaced during the Wisconsinan by ice flowing from different centres. These conclusions differ substantially from other recent interpretations. The regional distribution and diverse character of the glacial and interglacial record warrant further work in this area.

Mapping on Prince of Wales Island led to the collection of more than 100 samples of shells, driftwood, Whale bone, marine algae, and plant detritus related to former sea level stands between 0.5 m and 188 m above present. These will allow reconstruction of the pattern and rates of postglacial crustal movements in an area where preliminary data point to the possibility of substantial postglacial or lateglacial faulting.

Extensive lichen-free zones were mapped on the high plateaus of western Melville Island. These may indicate extensive ice or firn cover during the Little Ice Age. At the other extreme, several black shale formations, particularly a member of the Ibbett Bay Formation, support a surprisingly dense and diverse flora for a High Arctic region and in some areas may represent interfingering of mid-arctic floristic associations into the western Queen Elizabeth Islands. These two apparently contradictory results from mapping during the summer of 1984 point to the need to better understand the interrelationships between flora, parent material, macro climate and paleoclimate in Canada's Arctic Islands.

Mapping of Quaternary deposits in the Lac Rouvière area of the N.W.T. has made it possible to delineate the northeastern limit of Glacial Lake McConnel, the ancestral Great Bear Lake. Deltas, beaches and trim lines define the level of a glacial lake at about 285 m a.s.l. The lake occupied the basin of the upper reaches of the Dease River and Sandy Creek. Collapse structures around the apex of deltas and DeGeer type moraines indicate that the lake was in contact with glacier ice. Sediments in the Sandy Creek basin were deposited there by water flowing from the Dismal Lakes basin into a bay at the northeast limit of Glacial Lake McConnel. These results modify our previous understanding of the mode and time of deglaciation in the area between Great Bear Lake and the Coppermine River.

As a result of Quaternary field work in southern Victoria Island the significance of thaw-failure erosional events as it affects the Quaternary landscape, is being increasingly recognized -- in some cases in dramatic fashion. A presently active thaw-lake is producing, within prodelta sediments, a circular lake with concentric ridges adjacent to the lake. Melting of exposed ice is triggering a complete remobilization of the sediment to liquid slurries that eventually move out of the local drainage basin. The remaining ridges are residual blocks from the above process that are probably moving downslope under tension due to solifluction/ground ice activity or simple gravity movement to the free surface. Recognition of these features assists the understanding of the inactive surrounding terrain that is dramatically marked with a parallel ridge pattern occurring over several hundred km^2. Description of exposed sediment sections has revealed common massive remobilized sediment.

A second major finding on Victoria Island relates to the mounting evidence that major glacial landforms may be produced by subglacial meltwater-sediment accumulation. A very broad upland landscape marked by a level fluted surface was found to comprise (almost totally) sandy sediment. Traditionally, glacial fluting is associated with the deposition of till. Thin till-like sediments are found on top of many of these sequences but these are equally likely to be solifluction deposits and not true tills. The fluted landscape is spatially gradational to large esker features that are acknowledged meltwater drainage features. In addition, the fluted and esker landscapes are transitional to drumlin features. These drumlin features consist of stratified deposits including interbedded sand and diamicts. These sections seem to further support the concept of major subglacial sedimentation by meltwater and sediment gravity flow.

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[1]D.A. Hodgson and J-S. Vincent. "A 10 000 yr BP extensive ice shelf over Viscount Melville Sound, Arctic Canada". Quaternary Research 22, p. 18-30.

Personnel Notes

The Regional Projects Section consists of a permanent staff of 12 Research Scientists, and 5 Physical Scientists. The Section also supported 3 EMR Research Agreements.

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.N. Proudfoot of the Department of Geology, University of Alberta, joined the Section as a Visiting Fellow to work on problems related to characterization of tills in southwestern Saskatchewan.

D.A. St-Onge commenced permanent employment with the Geological Survey on August 27, 1984. He had been previously working in the Division through the Interchange Canada Assignment Program.

Attendance at Meetings, Conferences and Courses

J.J. Clague

Geological Association of Canada, London, Ontario, May 1984.

Presented a paper at the Queen Charlotte Islands International Symposium, Vancouver, B.C., August 1984.

Presented a paper at the W.H. Mathews Symposium, Vancouver, B.C., October 1984.

L.A. Dredge

Presented a paper at the AQQUA Conference, Sherbrook, October 1984.

S.A. Edlund

Presented a paper at the 13th Arctic Workshop, Boulder, Colorado, March 1984.

Presented a paper and poster at the 1984 Arctic Science Conference, Anchorage, Alaska, October 1984.

R.J. Fulton

Presented a poster, and took part in a field trip, at the Geological Association of Canada, London, May 1984.

North American Commission on Stratigraphic Nomenclature Meeting, Reno, Nevada, November 1984.

N.R. Gadd

Presented a paper at the Geological Association of Canada, and attended the pre-conference field trip, London, Ontario, May 1984.

D.R. Grant

ICSU Syumposium on Global Change, Ottawa, September 1984.

D.R. Grant (cont'd.)

IGCP-200 International Symposium on Late Quaternary Sea-Level Changes, Mar del Plata, Argentina, September-October 1984.

INQUA Shorelines Commission Field Conference on Patagonian Shorelevels, Argentina, October 1984.

INQUA Field Conference on Glacial Geology of the Southern Andes, Bariloche to Mendoza, Argentina, October 1984.

Dalhousie University Symposium on Undergraduate Geological Education, Halifax, N.S., March 1985.

O.L. Hughes

Presented a paper at the Joint Canadian-American Workshop on correlation of Quaternary deposits and events in the area around the Beaufort Sea, Calgary, Alberta, April 1984.

R.W. Klassen

INQUA Commission, Genesis of Quaternary Deposits Meeting, Medicine Hat, Alberta, August 1984.

F.M. Nixon

Till Tomorrow Workshop, CIM-OGS, Kirkland Lake, May 1984.

S.H. Richard

Friends of the Pleistocene Annual Meeting, and field trip, Massena, New York, May 1984.

D.A. St-Onge

Presided Council and Executive Committee meetings of the Geological Association of Canada Annual Meeting, London, Ontario, May 1984.

V^{e} congrēs de l'AQQUA, Sherbrooke, October 1984.

Presided meeting of Geological Association of Canada Executive Committee Meeting, St. John's, Newfoundland, December 1984; and Ottawa, February 1985.

Canadian Geoscience Council meeting, Ottawa, December 1984.

Presented a paper at the 1985 Current Activities Forum, Ottawa, January 1985.

Canadian Geoscience Council meeting, Toronto, March 1985.

D.R. Sharpe

Presented a paper at the Geological Association of Canada, and took part in field trip, London, Ontario, May 1984.

Presented a paper at the AQQUA Congress, and took part in field trip, Sherbrooke, October 1984.

Canadian Geoscience Council Meeting, as CANQUA representative, December 1984.

D.R. Sharpe (cont'd.)

Presented a poster at the 1985 Current Activities Forum, Ottawa, January 1985.

A.M. Stalker

Geological Association of Canada, London, Ontario, May 1984.

INQUA Meetings; CANQUA, CNC-IUGS; Toronto,

J.J. Veillette

Presented a poster session at the AQQUA Conference, Sherbrooke, Quebec, October 1984.

J-S. Vincent

Ve Congrès de l'AQQUA, Sherbrooke, Quebec, October 1984.

INQUA Symposium, Sherbrooke, Quebec, October 1984.

Presented a paper at the Joint Canadian-American Workshop on correlation of Quaternary deposits and events in the area around the Beaufort Sea, Calgary, Alberta, April 1984.

Membership on Committees

J.J. Clague

INQUA Subcommission on North American Quaternary Stratigraphy, Member

INQUA Commission on Quaternary Shorelines, Subcommission for the Americas, Member

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

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.R. Sharpe

Canadian Quaternary Association, Council Member

D.A. St-Onge

Geological Association of Canada, President 84/85

Royal Canadian Geographical Society, Vice President; Research Committee, Editorial Committee and Massey Medal Committee, Member

INQUA '87, Organizing Committee, Vice President

Comité d'Honneur de la Fondation ACFAS, membre

A.M. Stalker

Canadian Quaternary Association, Past 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-sortent

Géographie physique et Quaternaire, Rédacteur adjoint

IGCP Project 24, Western Arctic Subgroup, Leader

Special Talks or Lectures

J.J. Clague

'Pleistocene glaciation in British Columbia' at Hanford Site Characterization Plan Meeting, Seattle, Washington, January 1985.

J.J. Clague (cont'd.)

'Quaternary stratigraphic record in British Columbia: evidence for episodic sedimentation and erosion controlled by glaciation' to the Department of Geological Sciences, University of British Columbia, Vancouver, B.C., March 1985.

J.J. Veillette

'Terrain Sciences Division Activities' to geology students from France, Ottawa, September 1984.

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 1984 field work was undertaken in: Nova Scotia, Ontario, Ellesmere Island, and Greenland. 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. However, the discovery of a new and important tephra layer necessitated additional field work and collecting in 1984. 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 and dating of the collections continues.

A second major interdisciplinary study, the Cape Herschel 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 invertebrates, climatic changes (as deduced from the record of pollen, diatoms, other algae, and invertebrates preserved in lake sediments), and the development of boulder barricades 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 which have been 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 coupled with studies of plant macrofossil and fossil arthropods, and significant horizons are dated by the radiocarbon method. Not only is a detailed knowledge of vegetation and climatic 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, a major study has 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 (rime frost and snow) collected nearer to sea level along the east coast of Ellesmere Island.

The Radiocarbon Dating Laboratory, now in its 25th year of operation, has completed more than 4000 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, the rate of sedimentation in lakes, the rate at which peat deposits are building up, the time that landslides occurred, or the time that selected areas emerged from the sea. In some localities it has been possible to bracket the time of glacial advances. Results of the dating program are published annually in the GSC Paper Series; List XXIV has now appeared and List XXV is in preparation. Laboratory research is being conducted into the problems of: (1) dating sediments from hard-water lakes, and (2) obtaining reliable ages on bones.

The advent of radiocarbon dating by accelerator mass spectrometry has permitted a start to be made on more precise chronological studies in several parts of the country. Age determinations on milligram-sized samples have been obtained on a variety of materials from the IsoTrace Laboratory, University of Toronto. Materials analyzed include wood, shell, bone, spruce needles, the chitinous covering on pelecypod shells, and microtine fecal pellets.

Personnel Notes

The Paleoecology and Geochronology Section consists of a permanent staff of 5 Research Scientists, 2 Physical Scientists, and 2 Technicians. In addition, 3 Physical Scientists work in support positions. The Section also supported 4 contracts and 4 EMR Research Agreements.

H. Jetté commenced employment with the Division in April 1984.

J.P. Smol of the Department of Biology, Queen's University, terminated his Visiting Fellowship on 1 September 1984 in order to take up a tenure-track position at Queen's.

Attendance at Meetings, Conferences and Courses

T.W. Anderson

Presented a paper at the Joint Annual Meeting of GAC/MAC, London, Ontario, May 1984.

Presented a poster at the VIth International Palynological Conference, Calgary, August 1984.

W. Blake, Jr.

User Workshop on Accelerator Mass Spectrometry, Burnaby, B.C., September 1984.

S. Federovich

Presented a poster at the 1985 Current Activities Forum, Ottawa, January 1985.

J.V. Matthews, Jr.

Presented a paper at the Beaufort Sea Correlation Workshop, Calgary, April 1984.

R.J. Mott

Presented a paper and a poster at the VIth International Palynological Conference, Calgary, August 1984.

Presented a paper at the INQUA/AQQA Meetings, Sherbrooke, P.Q., October 1984.

Presented a poster at the 1985 Current Activities Forum, Ottawa, January 1985.

Membership on Committees

T.W. Anderson

National Research Council Peat Forum, Member

Geological Survey of Canada Radiocarbon Dating Committee, Member

W. Blake, Jr.

American Quaternary Association, Councillor 1982-1986

Fellows Committee, Arctic Institute of North America, Calgary, Chairman

Ad Hoc Committee for Curator, IsoTrace Labortory, University of Toronto

Geological Survey of Canada Radiocarbon Dating Committee, Chairman

Divisional Committee for EMR Research Agreements, Member

Ph.D. Thesis Committee for M. Krawetz, Department of Geography, McMaster University, Hamilton, Member

J.V. Matthews

Biological Survey of Canada, Scientific Advisory Board, Member

Climate Planning Board, Member

Canadian Committee on Climatic Fluctuations and Man, Member

Task Force on Proxy Climate Data (of CCCF), Chairman

External Examiner for M. Bombin's Ph.D. Thesis, Department of Anthropology, University of Alberta, Edmonton

R.J. Mott

Branch Safety Committee, Member

External Examiner for F. Guay's M.Sc. Thesis, University of Ottawa, Ottawa

Special Talks or Lectures

T.W. Anderson

'Quaternary palynology and its relationship to archeology' to the Ottawa Archeological Society at the National Museum, Ottawa, February 1985.

Laboratory Statistics

Paleoecology

1. Samples processed

Diatom samples	
samples processed	109
filters prepared	62
slides prepared	30
slides investigated	137
Palynological	132
Wood treatments	100

2. Reports completed

Diatom	5
Fossil Arthropod	19
Palynological	13
Plant Macrofossils	18
Wood	53

Geochronology

3. Determinations completed

Radiocarbon ages (GSC)	
Geological samples	205
Geochemical samples	8
$^{13}C/^{12}C$ ratios (University of Waterloo - contract)	199

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

Over the past fiscal year, the Section has become heavily involved in carrying out projects as part of Federal/Provincial Mineral Development Agreements (ERDA) and a special Federal program to stimulate earth sciences research in the asbestos-producing region of the eastern townships of Quebec. Under these externally funded programs, we are presently carrying out drift prospecting and glacial geological research in northern Manitoba, central Labrador, Eastern Townships of Quebec, central New Brunswick, and Nova Scotia. In addition, officers of the Section carried out projects aimed at providing a geological base for acid rain research.

An airphoto mapping project designed to depict major glacial features of the northwestern Canadian Shield, covering some 66 x 1:250 000 NTS sheets, was designed and carried out by contract. The resulting map, combined with about 40 other published and unpublished maps, will serve as a base for contributions to EG-1 revision and DNAG publications. The regional patterns of glacial features provide important input into models of glacial dynamics and history; the patterns have been revealed for the first time through this project.

Under the Manitoba MDA project, similar airphoto compilation is being carried out in an effort to provide an updated summary map of the surficial geology of northeastern Manitoba. The airphoto interpretation in combination with published work serves as a base with which an extensive reconnaissance drift geochemical sampling program can be evaluated. Both mapping and sampling are used to complement standard geochemical and geophysical surveys carried out by RGG Division in the region.

Widespread interest in the origin of gold spheres has led to further research and more reports of spheres from the Abitibi clay belt, Nigeria, and Papua, New Guinea. The research so far indicates that these spheres represent gold chemically precipitated from low temperature solutions.

Clay separation methods employed by Drift Chemistry and Mineralogy Laboratory for providing material for routine chemical analyses, have been transferred to two universities, one provincial government, and two commercial laboratories.

In a co-operative project with University of Windsor, detailed micropaleontological studies of marine sediment cores collected from Lac Deschênes (Ottawa River) clearly delineate the changing salinity of the Champlain Sea with time and provides a type reference core against which sedimentary environments elsewhere in the Champlain basin may be compared. Detailed logging of the core reveals sedimentological discontinuities that reflect major sonar reflectors as well as the microfaunal shifts with salinity.

Amino acid and C^{14} accelerator dating of major new marine shell collections from stratigraphic sections in the Hudson Bay Lowlands continue to strengthen the argument for multiple openings of Hudson Bay during the Wisconsin. In situ marine shells from sub-till beds on Abitibi River yield a Classicial Wisconsin ($\sim$33 000 yr. B.P.) preliminary accelerator date, in close agreement with age inferred from Amino Acid Data.

Remote sensing of trace metal influence on vegetation of the area around Thetford Mines yielded promising correlations between nickel-rich soils and vegetation signature on satellite imagery.

Side-scan sonar equipment, borrowed from Atlantic Geoscience Centre, was deployed from a small (Zodiac) boat in areas of known sublacustrine landslides. The survey provided graphic images of the morphology of the slides as well as some unsuspected basin margin morphology related to groundwater input from permeable lakeshore deposits. The wreck of a ship of substantial size was inadvertantly found in 40 m of water in Lake Temiskaming.

Three deep stratigraphic boreholes and approximately 50 km of dynamite seismic refraction profiles were completed as part of the start-up phase of the Chaudière Valley buried gold placer project, funded through the federal Eastern Townships Earth Sciences Program. The boreholes provided excellent cores but proved that conventional rotary drilling techniques are not cost effective in this environment. The seismic surveys revealed deep, previously unknown, buried valleys and provide an excellent guide for selection of boreholes to be drilled in 1985 with improved methods.

A contract with Waterloo University researchers was carried out to test the hypothesis that methane gas, generated at the base of postglacial organic lake sediments, can transport some cations through the sediment column, concentrating them at the sediment-water interface. The environmental and mineral exploration implications of this process, the possibility of which was first revealed by S. & M.T. Sonar and SCUBA Diver work, are very important. If the hypothesis can be proven, it provides an explanation for metal enrichment in near-surface

sediments from natural rather than anthropogenic causes.

A unique body of lake and drift geochemical data have been assembled by Geochemistry Subdivision and S. & M.T. Section in a co-operative project carried out over the Canadian Shield from Thousand Islands to Georgian Bay. From these data one can judge to what extent original drift composition influences modern lake environments and to what extent secondary chemical proesses (both natural and anthropogenic) are important.

A contract to further develop a technique for measuring acid neutralizing capacity (ANC) of glacial soils was carried out based on research initiated in S. & M.T. laboratories. The originally developed technique is presently being employed in modified form in several university and government laboratories in Canada, the U.S., and Finland, where it is known informally as the "Wyatt technique" after its GSC developer.

Personnel Notes

The Sedimentology and Mineral Tracing Section consists of a permanent staff of 3 Research Scientists, 4 Physical Scientists, and 5 Technicians. In addition, 5 Physical Scientists and 3 Technicians work in support positions. The Section also supervised 6 contracts, 1 EMR Research Agreement, and supported 5 Ph.D. and 2 M.Sc. theses.

J.M. Aylsworth commenced indeterminate status in September 1984.

Attendance at Meetings, Conferences and Courses

J.R. Bélanger

Presented a paper at the 9th Canadian Symposium on Remote Sensing, St. John's, Newfoundland, August 1984.

Presented a paper at the International Seminar on Geobotany and Biogeochemistry in Exploration for Ground Water and Mineral Resources, Tirupati, India, November 1984.

Presented a paper at the 1985 Current Activities Forum, Ottawa, January 1985.

R.N.W. DiLabio

Presented a paper at the Till Tomorrow Workshop, Kirkland Lake, May 1984.

Presented a paper at the Manitoba Geological Services Branch Annual Meeting, Winnipeg, November 1984.

Presented a poster display at the Newfoundland Department of Mines and Energy Current Activities Forum, St. John's, Newfoundland, November 1984.

Presented 2 posters at the 1985 Current Activities Forum, Ottawa, January 1985.

Presented a poster display at the Prospectors and Developers Association Annual Meeting, Toronto, March 1985.

I. Kettles

Presented a poster display at the Till Tomorrow Conference, Kirkland Lake, May 1984.

R.A. Klassen

Presented a paper at the 5th Congress, Association Quebecoise pour l'étude du Quaternaire, Sherbrooke, October 1984.

Presented a poster display and short talk at the Newfoundland Department of Mines and Energy Current Activities Forum, St. John's, Newfoundland, November 1984.

W.W. Shilts

RMCC Meeting, Toronto, April 1984.

Presented a paper at the Till Tomorrow Conference, Kirkland Lake, May 1984.

NSERC Committee, Toronto, September 1984.

RMCC Meeting, Ottawa, December 1984.

RMCC Meeting (Aquatic Subgroup), Toronto, March 1985.

Membership on Committees

J.M. Aylsworth

Terrain Sciences Map Legend Committee, Member

J.R. Bélanger

Branch Computer Facilities Committee, Member

Terrain Sciences Divisional Computer Committee, Member

Canadian Remote Sensing Society, Member

Association quebecoise pour l'étude du Quaternaire, membre

R.N.W. DiLabio

Terrain Sciences Division Display Committee, Member

11th International Geochemical Exploration Symposium, 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

W.W. Shilts (cont'd.)

Acid Rain Research, Geological Survey, Co-ordinator

Special Talks or Lectures

J.R. Bélanger

'Mineral prospecting based on remote sensing and botany' at Concordia University, Montreal, March 1985.

W.W. Shilts

'Drift propsecting (keynote)' to exploration geologists, Kirkland Lake, May 1984.

'SONAR studies' to AECL staff, Chalk River, November 1984.

'Geology of Laurentide ice sheet' to students and staff of University of Colorado, Boulder, December 1984.

'Geology of Laurentide ice sheet' to students and staff of Waterloo University, Waterloo, January 1985.

'Geology of Laurentide ice sheet' at the Ottawa Glaciological Society, University of Ottawa, Ottawa, February 1985.

'Geology of Laurentide ice sheet' to students and staff of University of Sherbrooke, Sherbrooke, February 1985.

'Periglacial Phenomena' to students and staff of University of Sherbrooke, Sherbrooke, February 1985.

'Glacial dispersal' to Department of Geology and Botany, Laurentian Univeristy, Sudbury, February 1985.

Laboratories

Physical Sedimentation Laboratory, Tunney's Pasture

Yearly Report

	No. of Samples
Freeze Drying	1485
Complete Sieve & Pipette	290
Gravel-Sand-Silt-Clay	1150
Hygroscopic Moisture Content	1185
Atterberg Limits	103
Calcite/Dolomite Ratio	13
Natural Water Content	60
Soil Colour Determination	600

Drift Chemistry and Mineralogy Laboratory

This Laboratory operated at 2/3 strength for part 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)	2470
Dry sieving to <64μm (for carbonate and trace element determination)	2160
Carbonate/non-carbonate carbon determinations (Leco carbon analyzer)	1320
Heavy mineral separations	6
Grinding of coarse fractions (for chemical analysis)	130
Clay slide mounts for XRD	100
Samples & splits coded and archived	7800

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. Advice is provided on the implications of development proposals on the physical environment. 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 research cold room.

Highlights

Continuation 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 a terrain map of the Sheldon Lake map area (105 J), Yukon.

Successful completion of a small drilling program in the Beaufort Sea coastal zone, to test specialized equipment for the investigation of geophysical and geotechnical properties of seabottom sediments.

Establishment of a project, in co-operation with AGC, to compile a review of the engineering geological conditions of the coastal zone of the Beaufort Sea.

Examination of the stability of moraine dammed lakes and study of recent moraine dam failures in the southern Cordillera.

Personnel Notes

The Geomorphic Processes and Engineering Geology Section consists of a permanent staff of 4 Research Scientists, 2 Physical Scientists and 1 Technician. In addition, 2 Physical Scientists work in support positions. The Section also supervised 5 contracts and 3 EMR Research Agreements.

Attendance at Meetings, Conferences and Courses

S.G. Evans

IVth International Symposium on Landslides, Toronto, September 1984.

D.G. Harry

Presented a paper at the Commission on the Significance of Periglacial Phenomena, International Geographical Union, Paris, France, August 1984.

Attended course on Project Assessment: Project Audit, Banff Centre, School of Management, Banff, October 1984.

J.A. Heginbottom

GSC-USGS Workshop on Quaternary Correlation, Calgary, April 1984.

Presented a paper at the U.S. Committee on Permafrost, Denver, October 1984.

National Research Council Permafrost Subcommittee, Calgary, October 1984.

Presented a paper at the National Research Council Permafrost Subcommittee, Ottawa, March 1985.

L.E. Jackson

Presented a paper at the Debris Flow Symposium, Meeting of Geological Society of America, Reno, Nevada, November 1984.

P.J. Kurfurst

Canadian Geotechnical Conference, Toronto, September 1984.

Membership on Committees

D.G. Harry

Commission on the Significance of Periglacial Phenomena, International Geographical Union, Corresponding Member

Norman Wells Project Research and Monitoring Working Group, DOE, 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

EMR Permafrost Committee, Member

L.E. Jackson

International Conference on Palynology 1984, Member; Organizing Committee, Member; Field Trips Subcommittee, Chairman

P.J. Kurfurst

Underground Research Laboratory Project Management Committee, Member

Subcommittee on Marine Geotechnical Engineering, NRC Associate Committee on Geotechnical Research, 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

S.G. Evans

Five lectures on 'Landslides in the Cordillera' to graduate students in geotechnical engineering at the University of Alberta, Edmonton, November-December 1984.

L.E. Jackson

'Paraglacial sedimentation in the Cordillera during the Holocene' to Department of Geology, University of B.C., Vancouver, March 1985.

P.J. Kurfurst

'Geotechnical evaluation of the seabottom sediments, SE Beaufort Sea' to Acoustic Geotechnial Workshop, Calgary, April 1984.

'Underground Research Laboratory' to delegation of Academia Sinica, Ottawa, August 1984.

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(to March 31, 1985, as supplied by reporting units)

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