CANADA

DEPARTMENT OF ENERGY,

MINES AND RESOURCES

GEOLOGICAL SURVEY OF CANADA

ANNUAL REPORT

APRIL 1, 1980 TO MARCH 31, 1981

FOR DEPARTMENTAL USE ONLY

OTTAWA

1981

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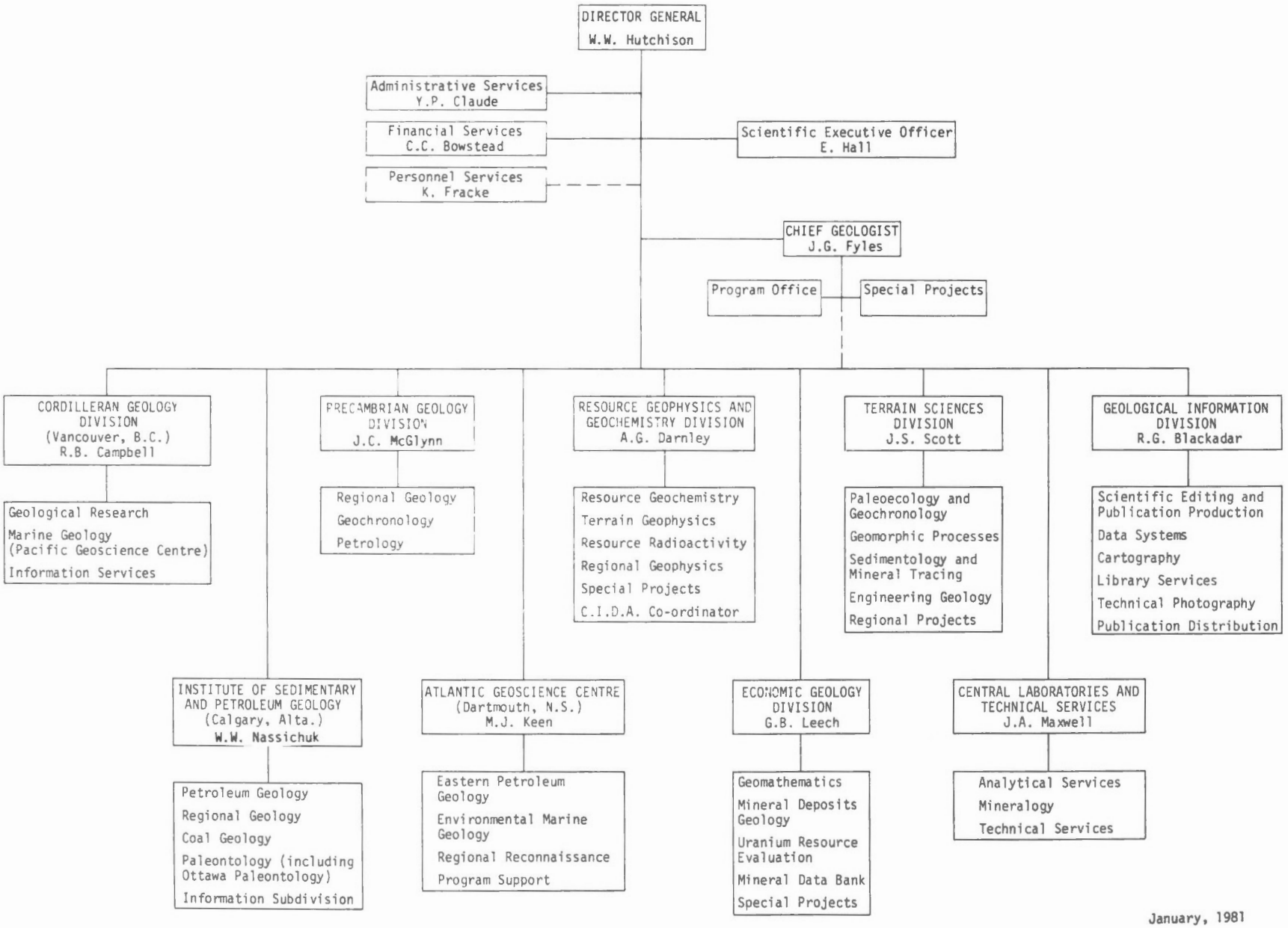

January, 1981

PROGRAM STRUCTURE

The overall objective of the Geological Survey of Canada is to ensure the availability of comprehensive knowledge, technology, and expertise concerning the geology of Canada (on and offshore), including geological aspects of mineral resources and non-renewable energy resources and geological conditions affecting land and seabed use. In working towards the attainment of this objective, the Survey determines the resource base of Canada, facilitates formulation of mineral and energy policy, assists in resource exploration and exploitation and promotes effective management of land and resources.

Within 1980-81, as in previous years, the functions of the Survey to attain this objective were divided among three separate programs of the Department: the "Earth Sciences Program", "Energy Program" and "Minerals Program". During the latter part of the year a new program structure was established which placed the Geological Survey in its entirety in the "Minerals and Earth Science Program" under the "Geological Surveys" activity. At the commencement of the new fiscal year (April 1, 1981) all the pre-existing resources of the Survey, both financial and personnel, were consolidated in this single Activity and Program.

The 1980-81 resources of the Geological Survey (as of March 31, 1981) are as follows:

Division (Sub-Activity)	P/Y	$000's Resources
Cordilleran Geology	44	2,053
Sedimentary & Petroleum Geology	148 3/4	6,908
Precambrian Geology	75	3,519
Atlantic Geoscience	96 1/2	5,772
Terrain Sciences	65 1/4	2,400*
Economic Geology	50	2,033
Resource Geophys. & Geochem.	97	6,013
Geological Information	92	2,893
Central Laboratories	46	1,323
Br. Mgmt. & Support Service	42 1/2	2,372
	757	35,286*

*Does not include $978,000 managed by Terrain Sciences for the Radwaste Program

OFFICE OF THE DIRECTOR GENERAL

Senior-level changes in the Department during 1980-81 have substantially affected the Geological Survey and have had a salubrious influence on working relationships. Appointment of Dr. A.E. Collin as Associate Deputy Minister has been followed by adjustments in head office organization that affect the Branch. Both Dr. Collin and the Honourable Judy Erola, Minister of States (Mines) have shown considerable interest in the activities of the Geological Survey. Within the year, Mrs. Erola visited all of the regional offices of the Geological Survey as well as Branch Headquarters.

At the end of December 1980, Dr. D.J. McLaren stepped down as Director General of the Geological Survey and concurrently was appointed as Assistant Deputy Minister (Science and Technology) in place of Dr. J.D. Keys who likewise stepped down from his position at that time. During Dr. McLaren's seven years as Director and Director General, the Survey actively pursued an increasing involvement in the provision of policy advice to EMR and other departments of government. Among major GSC thrusts started or expanded under his leadership may be mentioned the provision of resources to provide a secretariat for IUGS; founding, with the provinces, of the National Geological Surveys Committee; development of methodologies for, and providing estimates on, Canada's oil, gas, coal and uranium resources; detailed studies on environmental concerns such as northern pipeline routes, radioactive waste disposal, acid rain and coastal sensitivity; and fostering a strengthening of Canadian geoscience associations.

Dr. W.W. Hutchison became the fifteenth Director of the Geological Survey on January 1, 1981. Prior to his appointment Dr. Hutchison served as Secretary General of the International Union for Geological Sciences.

Dr. J.E. Brindle left his position as Head of the Program Office in May 1980 to assume new duties as Head, Petroleum Geology Subdivision at ISPG.

On December 1, 1980, Dr. D.C. Findlay transferred from the Economic Geology Division to the Director General's Office to become Senior Advisor, Resource Appraisal.

Canadian Geoscience Council Visiting Committee

The second phase of the CGC's study started at a meeting in October 1979 with responsibility for "examination of published and unpublished output of the Branch and its value in regard to the Departmental mission, usefulness to users, timeliness, format and efficiency of production". Members are J.A. Coope, Chairman, B. d'Anglejan, A. Sutherland Brown, P.L. Gordey, D.W. Strangway, M.G. Tanguay. B.S. Norford is GSC liaison officer to the Committee. During the year members of the Committee have visited a number of units of the Survey and some of the users of Survey information. A questionnaire was sent to several hundred users in the summer of 1980 and the results are now being tabulated with the assistance of Statistics Canada.

National Geological Surveys Committee Meetings

Two meetings of the NGSC were held during fiscal 1980-81 -- the first of these on May 20, 1980 in Halifax and the second on December 10, 1980 in Ottawa.

Staffing Problems at ISPG

A major, and continuing, problem during the year was the difficulty faced in recruiting and retaining staff in Calgary in face of the high financial incentives offered by industry. One government initiative to the problem was to pay "oil and gas specialists", in the Physical Scientist classification, lump sum payments ranging from $2,500 per year for PC 3's to $4,000 per year for PC 5's. However, no comparable scheme was initiated for other energy specialists or for Research Scientists or Research Managers.

Realizing that the problems include more than PC oil and gas specialists and that it is a Canada-wide problem and includes agencies apart from GSC, an EMR Project Team on Energy Specialists was formed under the chairmanship of W.W. Nassichuk to advise on steps that can be taken to ameliorate the situation for government scientists. It is hoped that by the summer of 1981 the Committee will be in a position to propose some short and long term solutions.

Decade of North American Geology

The year saw an acceleration in the Branch involvement with the GSA Centennial Project - Decade of North American Geology (DNAG). The nine volumes planned for Canada will be prepared and published by GSC as the replacement for Geology and Economic Minerals of Canada - 5th edition (1970). John Wheeler is Project Coordinator for this new edition of EG1 and is also Coordinator for the Canadian input to DNAG.

D.J. McLaren

Attendance at Meetings and Conferences

Annual Meeting of National Academy of Sciences and Solvay Conference, Washington, April 20-24, 1980.

26th International Geological Congress, Paris, July 7-17, 1980.

UNESCO General Conference to present report on International Geological Correlation Programme, Yugoslavia, September 19-October 5, 1980.

W.W. Hutchison

Awards

The Bancroft Medal by the Royal Society of Canada.

Attendance at Meetings, Conferences and Courses

Meetings of Canadian Geoscience Council Visiting Committee, Ottawa, January 19, 1981.

Resource Assessment, Calgary, Alberta, January 20-21, 1981.

IUGS Executive Committee Meeting, Accra, Ghana, January 22-27, 1981.

Annual Symposium of Cordilleran Section, GAC, Vancouver, B.C., February 12-15,1981.

38th Meeting of Canadian Geoscience Council, Toronto, March 8-9, 1981.

Member of Canadian Delegation with Minister Judy Erola, Washington, D.C. March 31 - April 2, 1981.

Membership on Committees

Ex-officio Member of Board, IGCP, (until July 1980).

Co-Chairman, VII International CODATA Conference, Kyoto, Japan.

Chairman, IUGS Research Development Program.

Ex-officio Member, Canadian Geoscience Council.

Past Secretary General, International Union of Geological Sciences.

Scientific Reviewer, EPISODES.

Talks

"Rocks and your Future" - talk to Royal Society of Canada, Montreal, June 1980.

CHIEF GEOLOGIST

J.G. Fyles

Attendance at Meetings, Conferences and Courses

National Geological Surveys Committee Meeting, Halifax, N.S., May 18, 1980.

Geological Association of Canada - Halifax '80 Conference, Halifax, N.S., May 19 and 20, 1980.

Canadian Geoscience Council Meeting, Calgary, September 28 and 29, 1980.

Dreimanis Day Symposium, University of Western Ontario, October 10, 1981.

Provincial Mines Ministers Conference, Halifax, October 27, 1980.

Program Office

D.G. Benson

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 system used in the Branch for the management of the scientific and technical program is highly documented. Proposed projects require the approval of all levels of management up to and including the Chief Geologist as being appropriate and timely contributions to the work of the Branch. The same levels of management monitor annual progress and assess the final results of projects.

The Branch Program for 1981-82 was reviewed on a Division by Division basis in October and November by the Chief Geologist and the Program Office Head. Strategic Objectives and Long Term Plans for the Branch were written and compiled, and Operational Plans and Activity Approval Documents for the Branch for 1981-82 compiled and submitted for review by the Executive Committee. The 1979-80 year-end and the 1980-81 mid-year Performance reports were prepared for submission to the ADM (Science and Technology). Assistance was given in the preparation of the Strategic Overview and Operational Plans for 1982-83.

The information accumulated by Program Office also forms the source of replies to complex questionnaires from other departments and agencies as well as to Parliamentary questions and to questions from other Sectors. A complete catalogue of scientific and technical projects is prepared and published each year as well as lists of proposed field work in Provinces and the North. These are sent to Provinces and to other interested federal agencies. An annual report on forthcoming program is prepared for the Government Activities in the North report. Topographic map requirements for the Branch are also compiled annually by Program Office for Surveys and Mapping Branch. A map showing the status of bedrock geological mapping in Canada is revised and published biennially, together with status maps detailing surficial geology, airborne gamma-ray spectrometry coverage, regional geochemical surveys to national geochemical reconnaissance standards and aeromagnetic shipborne magnetometer coverage.

All unsolicited proposals coming to the Branch from the S&T Sector Office are channelled through Program Office for referral to appropriate Divisions. These proposals continued to reach us in large numbers during the year.

Personnel Notes

D.G. Benson began acting as Chief Program Officer in June 1980, replacing J.E. Brindle.

M.A. Petre began acting as Assistant Program Officer following the departure of D.W. Stalker who left GSC for a position with the Department of Fisheries and Oceans.

SPECIAL PROJECTS

T.E. Bolton

Attendance at Meetings, Conferences and Courses

Canadian Paleontology and Biostratigraphy Seminar and Field Trip, Fredericton, N.B., September 1980.

Short Course on Echinoderms, Geological Society of America, Atlanta, Georgia, November 1980.

INTERNATIONAL UNION OF GEOLOGICAL SCIENCES (IUGS)

The IUGS Secretariat, housed in the GSC since 1978, is responsible for the day-to-day administration of the Union - the largest (91 member countries) international non-governmental, non-profit scientific association in the world, dedicated to fostering and coordinating geoscientific projects, interdisciplinary programs and meetings, and improving communications in earth sciences. Much of the scientific work of the Union is conducted through its 9 Commissions, 5 Committees, 21 Affiliated Associations, and two major Joint Programs - the International Geological Correlation Programme (IGCP) co-sponsored by Unesco, and the Lithosphere Program, co-sponsored by the International Union of Geodesy and Geophysics (IUGG) and the International Council of Scientific Unions (ICSU). The Secretariat acts as the central clearing-house for all communications and contracts involving these constituent bodies.

During the first six months of 1980, much of the Secretariat's efforts was devoted to preparing for the quadrennial meeting of the IUGS Council, planning two meetings of the IUGS Executive Committee and other IUGS bodies, and advising on plans for the 26th International Geological Congress held in Paris in July. In April, a Special Issue of EPISODES was produced commemorating the Congress and summarizing the latest concepts of European geology; it was distributed to over 9,000 readers around the world.

Following the election of a new IUGS Secretary General (Dr. C.C. Weber) in Paris during July, 1980, part of the Ottawa Secretariat's operations were gradually transferred to the Paris Secretariat in the latter part of 1980. The Ottawa Secretariat, however, prepared, printed and distributed the minutes of the Council and Executive Committee Meetings in Paris, the new IUGS constitution (as approved by Council) in the fall, produced four issues of EPISODES on schedule, and administered all the contracts under IGCP and COGEODATA through to January 1, 1981.

Dr. W.W. Hutchison left the Secretariat and the position of Acting Secretary General in December; Dr. V. Lafferty continued in her position as Manager of the Ottawa Secretariat and Editor of EPISODES. The Ottawa Secretariat now maintains responsibility for production and marketing of EPISODES and other IUGS publications, administration of the IUGS Research Development Program, public relations and promotion work for IUGS, particularly in North America. The Ottawa Secretariat was heavily involved in preparations for the XXIInd Executive Committee Meeting held in Accra in January, in the production of the minutes of this meeting in February, and in preparations for the IUGS/Unesco/IGCP/GSA Symposium on the Precambrian of Africa, held in Ghana early in 1981.

Attendance at Meetings, Conferences and Courses

W.W. Hutchison

- American Association of Petroleum Geologists, Denver, June, 1980
- 26th International Geological Congress, Paris, July, 1980
- VII International Codata Conference, Kyoto, Japan, October, 1980
- Geological Society of America, Atlanta, November, 1980

Membership on Committees

To July, 1980

- Secretary General, IUGS
  - Member, IUGS Constitution Committee
  - Member, IUGS Nominating Committee
  - Member, IUGS Advisory Board for Publications
  - Member, IUGS Finance Committee

- Member, Steering Committee, 26th International Geological Congress
- Scientific Editor, EPISODES
- Ex-officio Member, Board of International Geological Correlation Programme

Attendance at Meetings, Conferences and Courses

V. Lafferty

- American Association of Petroleum Geologists, Denver, June, 1980
- 26th International Geological Congress, Paris, July, 1980
- Association of Earth Science Editors, Halifax, October, 1980
- Geological Society of America, Atlanta, November, 1980
- Government Policy and Decision-Making (PDI course), November, 1980
- IUGS/Unesco/GSA/IGCP Conference "Precambrian in Africa", Accra, January, 1981
- IUGS Executive Committee Meeting, Accra and Koforidua, January, 1981
- IUGS Advisory Board for Publications Meeting, Paris, February, 1981

Membership on Committees

- Editor, EPISODES
- Member, Commission des Relations Extérieures du 26 ème CGI
- Member, IUGS Advisory Board for Publications
- Member, GEOTIMES Advisory Committee (AGI)

Talks

- "EPISODES - Newsletter at a Crossroads" - delivered at the 14th Annual AESE Meeting, Halifax, October, 1980

IUGS Secretariat Staff as of March 31, 1981.
GSC Staff: V. Lafferty
IUGS Staff: B. Collis, P. Gray, and J. Jenness (part-time consultant)

ATLANTIC GEOSCIENCE CENTRE

M. J. KEEN

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

We meet these objectives by: undertaking geological, geophysical and geochemical research and surveys to national standards; regional interpretation and synthesis of the processes and history of geological evolution; establishment of appropriate national and international standards for geological chronology, correlation, reference materials and surveys; identification of the characteristics and probable locations of occurrence of coal, oil and gas resource 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 three Research Managers, 42 Research Scientists, Physical Scientists and Engineers, 36 Scientific and Technical Support staff, ten 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 administration support necessary to ensure a smooth operation.

Highlights

The expanded complex at B.I.O. was officially opened in May 1980 by The Honourable Judy Erola, Minister of State for Mines and the Honourable Romeo LeBlanc, Minister of Fisheries and Oceans.

B.I.O. Open House was held May 20-23, 1980. In excess of 100 displays were situated in various locations throughout the Institute. An estimated 30,000 people visited the Institute.

The French Language Program is continuing at B.I.O. Approximately 15 A.G.C. employees participate in the program on a regular basis.

The Canadian Society for Non-Destructive Testing conducted a Radiographic Training course at A.G.C. Fourteen employees at B.I.O. successfully completed the course.

A.G.C. received a half million dollars from the Office of Energy Research and Development in January. This money was used to purchase capital equipment. This equipment will be used in A.G.C.'s work in petroleum exploration and development activities.

Jacques Cousteau and the Calypso visited B.I.O. in July 1980. He visited various laboratories in the Institute and conducted a press conference to discuss his planned cruise up the St. Lawrence and into the Great Lakes.

Personnel Notes

The Subdivision consists of a permanent staff of 1 Director and Secretary; 1 Administrative Officer, 2 Financial Clerks, 1 Personnel Clerk and 1 Secretary.

Margaret MacDonald resigned as the Director's Secretary in July 1980. Pat Dennis replaced her in September 1980.

Doreen Campbell accepted a position with Ministry of Transport in October 1980. A.G.C. grieved. In December 1980, Terry Henderson replaced her as Division Accountant.

Shirley Denman replaced Sharon McLeod as Admin. and Program Support Secretary in March 1981.

Attendance at Meetings, Conferences, Courses

M. J. Keen

Attended meeting with GSC and Petrocanada in Calgary, June 19-25, 1980.

Attended GSC Branch Management Committee meeting in Vancouver and Victoria, October 15-17, 1980.

Attended meeting with Joides Directors and Canadian representatives re Deep Sea Drilling Project in Toronto, October 23, 1980.

Attended meeting in Ottawa on the National Energy Policy, October 29, 1980.

Attended NSERC Advisory Panel on Oceans meeting in Ottawa, September 2-5, 1980.

Attended meetings at A.G.C. with Petrocanada staff to discuss cooperative projects, September 15, 1980.

Took part in a cruise aboard CSS DAWSON, September 22 - October 3, 1980.

Attended Joint EMR/DFO Guiding Committee on Offshore Surveys meeting in Ottawa, November 26, 1980.

Attended Canadian Geoscience Council meetings in Ottawa, December 8-9, 1980.

M. J. Keen (contd.)

Attended GSC Research Agreements meeting in Ottawa, January 15-16, 1981.

Attended OERD Proposals meeting in Ottawa, January 19, 1981.

Attended Huntec Seabed meeting at A.G.C., January 26, 1981.

Attended RES Appraisals meeting in Ottawa, January 28-29, 1981.

Attended NSERC Grant Selection Committee meeting in Ottawa, February 9-11, 1981.

Attended Canadian Geoscience Council meetings in Toronto, March 8-9, 1981.

Attended Seabed Project Steering Committee meeting in Ottawa, March 13, 1981.

Attended Seabed meeting in Ottawa, March 19, 1981.

Membership on Committees

M. J. Keen

Atlantic Subcommittee on Oceanography

EMR/DFO Joint Guiding Committee on Offshore Surveys

BIO Directors Committee

Associate Editor, C.J.E.S.

Associate Editor, Marine Geology

Dalhousie University, Adjunct Professor

NSERC, Interdisciplinary Advisory Panel on Strategic Grants on Oceans

Canadian Geological Foundation

Atlantic Region Interdepartmental Committee on Environmental Issues

Canadian Geophysical Union

O.S.S. (Atlantic) Management Committee

P. G. Stewart

AGC/BIO Safety Committee

BIO Space Committee

AGC Staff List for August 1, 1980 - Breakdown by Categories

Fulltime:	EN-ENG	2
	Physical Science	17
	Research Science	19
	Research Manager	3
	Computer Systems	1
	Technical Support	35
	Admin. Support	9
		86
Casuals:		5

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Regional Reconnaissance Subdivision

R.T. Haworth (Head)

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

The Subdivision, comprising fourteen scientists and four scientific support technicians, is divided into sections organized according to both geography and discipline. The Baffin Bay-Labrador Sea Studies section is a geographically defined section because of the logistical problems in mounting operations in the North. All scientific operations both of AGC and the scientific units of other departments at Bedford Institute of Oceanography have to be coordinated in order to effectively use the only research vessel capable of operating in ice infested waters. The Ocean Basins and Margins section is concerned with determining the structure of the present continental margin, and those processes within the ocean basins that control its development. Systematic geological mapping of the continental margin of Atlantic Canada is carried out by the Scotian Shelf-Grand Banks Studies section, while the Geophysical Surveys section primarily carries out its mapping in conjunction with surveys of the Canadian Hydrographic Service.

The Subdivision is administered by a Secretary.

Highlights

Ocean Basins and Margins

The thermal and subsidence history of the Labrador and Nova Scotian margins, as predicted by extension and mantle upwelling during continental rifting compare well with observations.

Similar models describe the evolution of Baffin Bay, a controversial area which some believe to be underlain by oceanic crust which others think is a continental sedimentary basin formed by extension. The models show that Baffin Bay cannot be formed by continental extension and graben formation, without also accepting about 200 km of lateral separation between Greenland and North America. The latter is unacceptable to many geologists and means that all data must be critically reexamined.

Regional Reconnaissance Annual Report

These studies did not include the mechanical behaviour of the lithosphere (rigidity) in controlling its response to sediment loading. The effects of a lithosphere of finite rigidity which is temperature dependent have now been included and the combined thermo-mechanical model allows prediction of crustal structure, gravity anomalies, thermal history, subsidence history, stratigraphy and basin configuration. These provide powerful constraints, because observational data must satisfy all predicted properties. Results show that flexure of the lithosphere is important landward of the hinge line, that gravity and crustal structure cannot both be satisfied using a simple model of extension during rifting, and that the long wavelength components of gravity are affected by the lateral temperature changes in the lithosphere.

Measurements of heat flow across the continental margin and the radioactive heat production in sediments sampled in deep exploratory wells on the continental shelf are underway as an additional check on the validity of this model and its success in predicting the maturity of hydrocarbons in the marginal sedimentary basins.

The Lesser Antilles Deep Lithospheric Experiment carried out jointly with U.K., French and West Indian scientists in early 1980 showed that the 100 Ma old oceanic lithosphere of the western Atlantic appears to consist of a single layer, below the crust, in which the velocity increases slowly with depth. High velocities of about 8.5 km s^{-1} are measured at depths of about 40 km. These data provide the first convincing results of such high velocities, which cannot be explained by the present simple petrological models of the lithosphere. No low velocity zones appear to be present to depths of about 70 km.

Refraction results on the continental margins of Nova Scotia have provided important data on the seismic stratigraphy of the deeply buried sediment layers, not sampled in wells or defined by conventional multi-channel seismic data. They show that off Nova Scotia the crust of pre-rift age has thinned by factors of 1.8 - 2.5, in good agreement with subsidence data.

Results obtained during a seismic refraction experiment to determine the crustal section between the Pacific ocean crust and the Cordillera turned out to be of poor quality because inferior tape was used for magnetic recording. This has led to an examination of the method of data recording in the ocean bottom seismometers, optimum Bias setting, and an evaluation of different magnetic tapes.

The Fram III field operation at the edge of the Arctic Ocean Basin (86N, 22W), to investigate the variation in crustal structure of the Arctic Basin with age and distance from the Arctic mid-ocean Ridge, began in late March 1980 and continued to early May 1980. The primary conclusions from its predecessor, Fram I, were the existence of crust only 3 km thick except in the vicinity of the hot spot where crust is 8 km thick. Where crust is thin the amplitude of the magnetic anomalies is reduced and where crust is thick the amplitude is about four times as great, having important implication for the magnetic source layer.

Regional Reconnaissance Annual Report

A crustal cross-section of the Eurasian Basin was prepared so that the variation of crust with distance and time from a slow spreading ridge could be examined. A thermodynamic model for oceanic crust according to which crustal thickness is dependent on spreading rate is apparently in agreement with observations, the most critical of these being in slow spreading areas such as the Arctic. Heat flow measurements will be made during the 1981 field program (Fram III) to test this model.

Baffin Bay-Labrador Sea Studies

Compilation of magnetic data in the Labrador Sea shows that the oceanic anomalies in the northern Labrador Sea off Nain and Saglek Banks decrease in their amplitude to the north and are unrecognizable off Hudson Strait. A similar compilation of seismic reflection data in the Labrador Sea shows considerable variations in the character of the acoustic basement and a lack of symmetry in the type of basement across its axial zone. The resulting pattern in the type of basement gets progressively complicated to the north. Using the high density magnetic data collected in this region and the multichannel reflection data the basement structure is interpreted to have resulted from jumps in the ridge axis and the increase in the obliqueness in the direction of spreading relative to the ridge axis. The situation gets more complicated across Davis Strait where excessive outpouring of basalt during Late Paleocene has obliterated the magnetic lineations. Prominent structural highs as seen in seismic reflection data and supported by gravity measurements lie in the middle of Davis Strait.

Short lengths of drilled core samples consisting of basalts were recovered from this structural high during 1980 cruise, basalt has been encountered in some of the deep exploratory wells drilled on the Labrador and west Greenland Shelves, and basalt was recovered in dredge hauls off the west Greenland margin. Preliminary petrological and geochronological analyses of these samples show that older basalt is encountered on the Labrador Shelf (Berriasian Hauterivian) and younger (Turonian) farther to the north on the Greenland and south Baffin Island Shelves. Such a decrease in the ages of the basalt to the north agrees with progressive opening of the Labrador Sea from south to north. A later change in the mode of spreading in the Labrador Sea/Baffin Bay regions is recognized from the widespread occurrence of Paleocene volcanic on land and in offshore regions of Davis Strait.

Further direct evidence of continuing natural hydrocarbon seepage from the seabed at Scott Inlet was obtained in the fall of 1980. Oil droplets were observed erupting at the surface of the sea and forming iridescent patches that almost instantaneously spread into slicks. The seep is associated with a structural high near the seaward end of the submarine trough that extends across the Baffin Island continental shelf at Scott Inlet. Upturned strata that flank this structural high beneath the outer south wall of Scott Trough are the likely source of the persistent seepage. Seepage also appears to be occurring at other localities in this region, but on a more spasmodic basis,

both in the Scott Inlet area and at Buchan Gulf to the north, where truncation of underlying strata by erosion permits escape of formation fluids as gasses into the water column.

A petroliferous core of considerable interest was collected from a diapir-like (piercing fold) structure east of Cumberland Sound on the Baffin Island continental shelf. The mudstone core gave off a strong petroliferous odour and bubbles upon recovery. It provided the first tangible evidence of the age and composition of the strata present at this structure, and is encouraging news for northern oil exploration.

Seismic reflection data collected on the Labrador Shelf provided the necessary regional coverage to permit definition of the extent of glaciation in the Cartwright Saddle area, and showed evidence for extensive pre-late Wisconsinan glaciation. An ice-lift off margin was defined in the Hudson Strait area. In dating such glacial events, problems have arisen because there are large discrepancies between shell and total organic matter ^{14}C dates of pro-glacial marine sediments on the Labrador Shelf. The shell dates generally appear to be younger by up to 16,000 years. It is postulated that the total organic matter dates are locally unreliable due to contamination by reworked terrestrial carbon.

High resolution and airgun seismic reflection data cores and ^{14}C dates have permitted delineation of ten mappable acoustic/morphologic units between 57°N and 61°N on the northern Labrador Shelf. From these data the following sequence of glaciation and deposition is suggested: (1) ice grounds on the shelf and upper slope during the glacial maximum; (2) shelf-basinal and bank portions of the ice sheet begin basal melting before 9,750 B.P. and ca. 10,260 B.P., respectively; (3) degrounding of the ice in shelf-basins and admisstion of sea water by 9,750 B.P. perhaps at first beneath ice shelves; (4) deposition of fine-grained glacial muds in basins as runoff from actively ablating valley glaciers on Labrador finds it way into fiord-like embayments in the ice sheet (ca. 9,750 B.P. to 8,380 B.P.); and (5) deformation of sediments on shallower portions of the shelf and upper slope possibly by surge ice exiting outer Hudson Strait - ca. 8,380 B.P. to 7,500 B.P.

Oxygen isotopic analyses of cores in the Northwest Labrador Sea indicate prominent meltwater anomalies at the stage 1 - 2 boundary and in late stage 6. Similar events were noted in Baffin Bay and in the Gulf of Mexico leading to a comparative discussion of the Late Quaternary glacial meltwater records in these areas and the implications of inferred meltwater gradients.

Schematic circulation diagrams of the North Atlantic for ~80,000 B.P. to ~57,000 B.P.; ~25,000 B.P. to ~13,000 B.P. and ~13,000 B.P. to 9,800 B.P. have been prepared in an examination of Terrigenous sand in Labrador Sea hemipelagic sediments and paleoglacial events on Baffin Island over the last 100,000 years.

An hypothesis of ice-sheet development in the Arctic Ocean during glacials by the process of freezing river runoff into sea ice has been developed. An Arctic Ocean ice sheet built in this way would explain a wide range of apparently conflicting terrestrial and marine evidence. It would for example effect a 0.4% ^{18}O depletion of the oceans without any lowering of sea level.

The driving mechanism is probably changes in arctic insolation caused by obliquity variations.

Geophysical Surveys

Gravity and magnetic data have been acquired for the NE Atlantic margin from the British and Irish Geological Surveys to form part of the Appalachian-Caledonide compilation of geophysical data, an activity of IGCP Project 27. For the Appalachians, both the Magnetic Anomaly and Bouguer Gravity Anomaly maps were printed and are now on sale. These compilations are being used as the basis for extrapolating structures between the Newfoundland Appalachians and the British Caledonides. The most obvious correlation is that between the Gander zone of Newfoundland and the area of southern Ireland that includes the Leinster massif. Southeast of each of these zones are ultramafic and continental margin sequences and northwest of each of them are geological units that are interpreted as part of a suture zone. All of these units have characteristic geophysical signatures which may be traced across the 900 km of continental shelf that separated the areas on pre-drift reconstructions of the North Atlantic.

It is not possible to reconcile the present geological interpretations of the tectonic history of Newfoundland with the cratonic movements deduced paleomagnetically. Whereas the Ordovician events have been interpreted geologically to have been caused by continental collision, the two "colliding" continents are interpreted by paleomagnetic data to be well separated at that time. Other conflicts concern the absence of the geological evidence for Silivian ocean closure, and the geological debate over paleomagnetic evidence for major transcurrent motion during the Devonian and Carboniferous.

Anisotropic P wave velocities were found in the allochthonous ultramafic sequences of the Bay of Islands and Hare Bay, Newfoundland. Those in the Hare Bay allochthon were comparable with measurements made in Cyprus.

Gravity and magnetic data from a survey of the Scotian Margin were contoured and released on Open File. During this exercise staff developed a familiarity with GPCP and can now produce contour maps on a routine production basis. Work is now underway to evaluate use of the Applicon system in direct production of National Resource Map colour masks.

Reprocessing of the Labrador Sea data backlog has therefore been started: the magnetic data is being checked, corrected, and contoured for publication in the NRM series; the gravity data has been found to contain serious datum errors, and has to be thoroughly and carefully checked prior to submission to the adjustment procedure.

A two-ship survey of the Davis Strait area was only 60% completed due to navigational problems. Although informal compilations of Labrador Sea have been completed and released on Open File, the digital data file is not well adjusted and internally consistent in its datum.

Regional Reconnaissance Annual Report

Scotian Shelf-Grand Banks Studies

Seabed is a research project of HUNTEC (70) Ltd. of Toronto that is being financed by the federal government to develop a remote method of determining quantitative parameters to characterize the surficial sedimentary units of the sea floor. The deep-towed "Boomer" developed specifically for Seabed has been steadily improve and refined over the review period. The input energy levels have been substantially increased, which significantly improved the acoustic output. The acoustic energy has actually been increased by 6 dB while, through improve noise reduction and stability, the boomer "ringing" has been decreased by 30 dB. Such refinements as moisture detectors, alerting the operator of a po sible leak, have improved the reliability on-task. Graphic recordings have been improved by an adaptable time variable gain feature to obtain real time graphic recordings of optimum quality. A further refinement is an improved Adaptive Body Motion Compensator that ensures high quality graphics in the heaviest towing weather without operator intervention.

Work has beer completed on an Acoustic Reflectivity Module (ARM), which calculates and displays in real time the reflectivity metrics, and yields information about the acoustic hardness and variability of the seabed; this adds measurably to lithologic interpretation. This equipment will soon be tested at sea.

A digital data link has been developed which, by time division multiplexing, permits transmission of up tc 16 channels of information from the two fish to ship via a single coaxial cable or twisted pair. Additional features include the capability to merge the two fish stream with streams from the ship for positioning and other data as required.

Finally a tow fish positioning system using an ultra-short baseline digital sonar could be fitted to provide precise positioning useful for selecting drilling sites. Such equipment has been designed and a prototype built.

Future development of the equipment has been proposed to produce a multidisciplinary platform, which could include sidescan sonar, reflectivity profilers, and digital sounders as well as the seismic equipment.

High resolution seismic reflection information on the sediments and bedrock in the vicinity of the Hibernia oil discovery site on the Grand Banks was obtained during 1980 with the Huntec Deep Towed High Resolution Seismic Reflection System. A BIO-designed sidescan sonar profiler with a range of 750 m on each side of the ship provided sonograms of the seabed. Magnetic data were collected with a proton precession magnetometer, surficial sediment samples were collected with a van Veen grab, and the bottom of the seabed was photographed at various sites. The survey revealed that the proposed underwater pipeline route from the Hibernia area to Newfoundland was interrupted by an area of exposed, well indurated bedrock that was well scoured by grounded icebergs in the past. The threat from icebergs requires that the pipeline be buried for protection but this is not possible because the bedrock cannot be trenched by conventional means. Further, the very cold temperatures of the

water in the area demand that any pipeline have at least a 36-inch diameter pipe in order to lessen the restart pressures should the crude oil flow have to be halted. Thus problems associated with pipeline transport are considerable and either an alternate route or means such as shipping by tankers must be found to transport the oil ashore. Such discoveries underscore the importance of the surficial mapping program to evaluation of production engineering proposals.

Personnel Notes

The Subdivision presently consists of a permanent staff of 14 scientists, 3 technicians, 2 term employees, and a secretary.

Dr. John Woodside, marine geophysicist with the Regional Geophysics group, returned in January 1981 from a year's secondment to the position of Senior Marine Geophysicist with the U. N. Committee for Coordiantion of Joint Prospecting for Mineral Mesources in Asian Offshore areas in Bangkok, Thailand. Since his return he has been working with Charlotte Keen to coordinate preparation for AGC's participation in the Large Aperture Seismic Experiment with three U.S. institutions.

Dr. Allin Folinsbee, marine geophysicist with the Regional Geophysics group, resigned his position in April 1980 and moved to Calgary where is he working with Petro-Canada on east coast exploration. He was replaced at AGC by a returning Ron Macnab who, as Minicomputer coordinator at Bedford Institute of Oceanography for five years, had been closely associated with AGC sea going programs and prior to that had been a leading participant in them.

Dr. Robin Falconer, who had been Acting Head of the Subdivision for much of the previous year, spent a hectic six months preparing publications arising from his Arctic work and then returned to his native New Zealand where he has subsequently been acting as the local representative for Geonautics.

Dr. Dick Fillon, who had been investigating the surficial geology and paleoceanography of the Labrador Sea and Shelf for the past six years, left AGC in April 1981 to join the Belle W. Baruch Institute of Marine Science at University of South Carolina.

David Livingstone, geological technician with the Baffin Bay and Labrador Sea Studies section and BIO expert on the use of skywave LORAN-C for navigation in the Arctic, joined the Geoscience Mapping Section of the Canadian Hydrographic Service in Ottawa. He was replaced by Paul Girouard previously with Eastern Petroleum Geology Subdivision.

Janet Fougere (nee Myers) secretary to the subdivision for the past eight years became a mother during the year and left to take up a position with the RCMP in Halifax. Jane Dawe, previously with Transport Canada, took over as secretary in February 1981.

Regional Reconnaissance Annual Report

Attendance at Meetings, Conferences and Courses

G. B. Fader

Society of Exploration Geophysicists Annual Meeting, Houston, Texas, November 16 - 21, 1980.

R. H. Fillon

Institute of Quaternary Studies, University of Maine at Orono for AMQUA meeting, August 18 - 21, 1980.

Canadian National Committee for the International Quaternary Association (for NRC) at Quebec City, September 26, 1980.

I. A. Hardy

American Quaternary Association Meeting, Orono, Maine, August 15 - 21, 1980.

R. T. Haworth

Penrose Conference to discuss Tectonics and Geophysics of the Appalachians, Atlanta, Georgia, April 27 - May 2, 1980.

Management Development for Research Managers course, Tourraine, Quebec, February 15 - 27, 1981.

H. R. Jackson

AGU conference to present paper on "Crustal refraction and seismic reflection results from FRAM I". Spring meeting of the American Geophysical Union, Toronto, May 23 - 27, 1980.

CESAR Planning Meeting and to see A. Judge about heat flow equipment for FRAM III, and see A. Moire about details of refraction program on CESAR, Ottawa, October 26 - 27, 1980.

AGU conference to present "The relationship of spreading rates to crustal thickness" by I. Reid and R. Jackson, San Francisco, December 6 - 13, 1980.

H. W. Josenhans

University of Guelph Continuing Education Department symposium on "Glacial, Glaciofluvial and Glaciolacustrine systems", Guelph, May 8 - 11, 1980.

Regional Reconnaissance Annual Report

H. W. Josenhans (cont'd)

Terrain Sciences, Geological Survey of Canada, to discuss glacial geology on Labrador, Ottawa, December 3 - 5, 1980.

Institute of Arctic and Alpine Research, to discuss Labrador geology with INSTAAR group and to present poster session and present talk on Labrador offshore geology, Boulder, Colorado, March 11 - 17, 1981.

C. E. Keen

Canadian National Committee of IUGG, Ottawa, April 18, 1980.

Canadian Lithosphere Committee and joint US/CAN Geodynamics meeting, Toronto, May 21 - 25, 1980.

Royal Society of Canada meeting at the University of Quebec, Montreal, June 1 - 2, 1980.

26th. International Geological Congress meeting, Paris, France, July 10 - 18.

Hedberg Conference for discussion on development of continental margins, Galveston, Texas, January 11 - 16, 1981.

Canadian Geoscience Council meeting, Toronto, March 9, 1981.

L. H. King

AMQUA meeting and field trip on glaciomarine geology of eastern Maine, Bangor, Maine, August 14 - 16, 1980.

GSA meeting and to serve on the North American Commission on Stratigraphic Nomenclature, Atlanta, Georgia, November 14 - 21, 1980.

B. D. Loncarevic

IGCP Science Advisory Council meeting, Paris, France, February 19 - 25, 1981.

B. MacLean

Institute of Arctic and Alpine Research, to discuss eastern Arctic geology and participate in Arctic workshop, Boulder, Colorado, March 10 - 15, 1981.

S. P. Srivastava

American Geophysical Union meeting, Toronto, May 22 - 23, 1980.

Stratigraphic Interpretation of Seismic Data course, AAPG-SEG, London, England, March 21 - April 2, 1981.

Regional Reconnaissance Annual Report

Membership on Committees

G. B. Fader

Mosaics "Technical" Committee.

Energy, Mines and Resources Committee on Offshore Minerals.

R. H. Fillon

Atlantic Provinces Subgroup of the Canadian Working Group on Quaternary Glaciations in the Northern Hemisphere (IUGS-UNESCO-USGP).

International Geological Correlation Program Project 73124 - Quaternary Glaciations in the Northern Hemisphere, Canadian Working Group.

Canadian National Committee for INQUA.

R. T. Haworth

Associate Editor of Maritimes Sediments and Atlantic Geology.

Physical Interpretation of Gravity Anomalies Special Study Group 5.45 of the International Gravity Commission.

International Geological Correlation Program, Project 27 (Caledonide Orogen). Canadian Working Group and International Special Study Group on Geophysics and Geologic Correlation.

Continental Margin Transect Working Group of the Canadian and U.S. Geodynamics Committee.

Tectonic Map of North America Working Group for the American Association of Petrcleum Geologists.

H. Josenhans

Member of Committee between AGC and Terrain Sciences to organize workshop on Surficial Geology and Map of Canada.

C. E. Keen

Councillor, Geological Association of Canada.

Canadian Geodynamics Committee and NE Appalachian Working Group on Plate Margins Transect.

Chairman, Canadian Lithosphere Project.

Regional Reconnaissance Annual Report

C. E. Keen (cont'd)

Ex-officio Member of Canadian National Committee of the International Union of Geodesy and Geophysics.

Member, Commission on Marine Geology.

L. H. King

Research Associate, Department of Geology, Dalhousie University.

North American Commission on Stratigraphic Nomenclature.

Seabed Steering Committee.

Mosaics Committee.

B. D. Loncarevic

Scientific Advisory Committee of the International Geological Correlation Project (IGCP).

Canadian National Committee for SCOR.

Editor-in-Chief, Marine Geophysical Researches.

BIO Ship Users Committee.

S. P. Srivastava

Working Group I-4. "Magnetic Anomalies". Division 1 of the International Association of Geomagnetism and Aeronomy.

Working Group I-1. "International Geomagnetic Reference Field". Division 1 of the International Association of Geomagnetism and Aeronomy.

J. M. Woodside

Member of Board of Directors of the International Gravity Bureau, International Gravity Commission.

Regional Reconnaissance Annual Report

Special Talks and Lectures

R. H. Fillon

"Labrador Sea in the Quaternary". Series of lectures presented at the University of Colorado, INSTAAR, January 30 - February 6, 1981.

"Deglacial Events on the Labrador Shelf". Presented at the University of South Carolina. Also discussed short term isotopic anomalies in Labrador Sea and Gulf of Mexico with D. Williams at the Baruch Institute. September 14 - 18, 1980.

R. T. Haworth

"Geophysical-Geological correlations in the Appalachains and Caledonides". Presented at SUNY (Buffalo), November 23 - 26, 1980.

H. R. Jackson

"Crustal refraction and Seismic reflection results from FRAM I". Presented at the spring meeting of the American Geophysical Union, Toronto, May 23 - 27, 1980.

"The relationship of spreading rates to crustal thickness" by I. Reid and R. Jackson. Presented at AGU conference, San Francisco, December 6 - 13, 1980.

H. W. Josenhans

"Labrador Offshore Geology". Presented at the University of Colorado, INSTAAR group, Boulder, Colorado, Marcy 11 - 17, 1981.

C. E. Keen

Discussion on development of continental margins presented at Hedberg Conference on Continental Margins in Galveston, Texas, January 11 - 16, 1980.

Presented lecture at 26th. International Geological Congress meeting, Paris, France, July 10 - 18, 1980.

Presented series of lectures at Memorial University of Newfoundland, University of New Brunswick, University of Montreal, Carleton, Toronto, Manitoba, Saskatchewan, Alberta, University of British Columbia. October 14 - 29, 1980.

R. F. Macnab

"Marine Geophysics" lecture to Hydrographic Step II cruise, Ottawa, November 18 - 20, 1980.

Regional Reconnaissance Annual Report

S. P. Srivastava

"Variation in Basement Topography and Formation of Magnetic Quiet Zone in the Central Region of the Labrador Sea". Presented at American Geophysical Union meeting, Toronto, May 22 - 23, 1980.

Subdivision Manuscripts

During the fiscal year April 1, 1980, to March 31, 1981, the Subdivision produced twelve manuscripts for outside journals, five for inside journals, three for Open File, and seven "Abstract Only".

ENVIRONMENTAL MARINE GEOLOGY SUBDIVISION

K.R. Robertson and D.J.W. Piper

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

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

Scientists within the subdivision are organized in three major discipline groups, but some staff from each of these groups also contribute to multidisciplinary tasks or studies. These discipline groups are Coastal Geodynamics, covering a wide range of geological and process studies on the coast and shelf; Paleoecology, concerned principally with late Quaternary environmental changes and their geological significance; and Geochemistry, involving work on the distribution of both organic and inorganic chemical species in sediments and the water column.

Highlights

Coastal Geodynamics

- A joint Industry/Government Beaufort Sea Seabed Synthesis Program was initiated. Manned submersible trials were carried out with Woods Hole and the U.S. Office of Naval Research in St. Croix.

- A joint government/industry study of the Hibernia well site established that bottom sediment movement occurs only in severe extreme storms, and that postglacial iceberg scours >2-3 m deep occur once every 200 m of survey line. A numerical model for simulation of shelf sediment transport was developed.

- Baseline coastal information for eastern Lancaster Sound and northeastern Baffin Island, N.W.T., was compiled in a report.

- Seasonal variation in beach and seabed morphology in northeast Cape Breton Island, N.S., shows dynamic offshore sand bodies.

Marine Inorganic Geochemistry

- Continuing work on an evaluation of the feasibility of disposing of high-level nuclear waste in deep sea sediments involved two cruises to the Sohm Abyssal Plain and a joint U.S. cruise to the Mendocino Basin in the northwest Pacific. 3,200 chemical analyses for 12 different elements in pore waters and sediments show that there are a wide variety

of geochemical environments and diagenetic conditions. The wide variety of geochemical conditions and partition coefficients for several elements indicates that simplified models for calculation of diffusion rates of ions through marine sediments will not adequately predict release rates of radionuclides from marine sediments.

- New techniques of electrochemical measurements of sulfides and sulfate under cold nitrogen atmospheres in sediments and pore waters have been developed to aid in identifying reducing zones.

Paleoecology

- Benthic environments lying below the axis of the Western Boundary Undercurrent (WBU) off Northeast Newfoundland contain anomalously dense living foraminiferal populations associated with sediment reworking. Sedimentation rates on the upslope side of the WBU may be as high as 9.1 cm - 1000 yrs^{-1} and offer good potential for resolving Holocene paleoceanographic and sedimentologic events.

Personnel Notes

The subdivision presently consists of 13 scientists, 2 Visiting Fellows, 9 technicians and 1 support staff. The subdivision was not staffed to its full authorized allotment.

K.R. Robertson was Acting Head, Environmental Marine Geology, for the year. D.J.W. Piper was appointed Head effective June 1, 1981.

Dr. J.P.M. Syvitski joined the subdivision January 2, 1981. He was formerly with the University of Calgary and specializes in marine sedimentology, particularly in studies of fjords and suspended sediment.

Dr. J.-P. Guilbault, a Visiting Fellow, originally from Montreal and having completed studies at the University of Aarhus, Denmark, joined the subdivision on December 10, 1981.

Attendance at Meetings, Conferences, Courses

C.L. Amos

Workshop on Offshore Environment in the 80's, St. John's, Newfoundland, December 1-5, 1980.

D.C.O.M. Meeting, Ottawa, Ontario, December 17-18, 1980.

S.M. Blasco

CESAR Meetings, Ottawa, Ontario, May 14, 1980.

APOA Meeting, Calgary, Alberta, May 15-17, 1980.

LOREX Workshop, Toronto, Ontario, May 24-27, 1980.

CESAR Planning Meeting, Ottawa, Ontario, May 28, 1980.

Beaufort Sea Working Group Meeting, Ottawa, Ontario, May 29-30, 1980.

Quaternary Coastal Field Trip, France, June 26 to July 7, 1980.

International Geological Congress, Paris, France, July 7-17, 1980.

Beaufort Sea Advisory Committee Meeting, Ottawa, Ontario, October 26-28, 1980.

CESAR Planning Meeting, Ottawa, Ontario, October 26-28, 1980.

DINA Advisory Committee Meeting, CESAR Meeting and OERD Funding Meeting, Ottawa, Ontario, December 7-11, 1980.

Beaufort Sea Surficial Geology Industry/Government Committee Meeting, Calgary, Alberta, February 5-6, 1981.

D.E. Buckley

Information Meeting on Geotechnical Properties and Geological Disposal of Radioactive Waste, Ottawa, Ontario, May 4-6, 1980.

GAC/MAC Field Trip #23 Leader to Upper Bay of Fundy, May 22-24, 1980.

International Meeting on Impacts of Radionuclide Releases into the Marine Environment, IAEA Headquarters, Vienna, Austria, October 4-18, 1980.

NRC Associate Committee on Shoreline Erosion and Sedimentation, Quebec City, Quebec, October 23-24, 1980.

Official Delegate to Site Selection Task - Nuclear Waste Program, NEA/Seabed Working Group Meeting, Paris, France, February 2-5, 1981.

R.E. Cranston

Energy Dispersive X-Ray Analyses Workshop, Central Laboratory and Administrative Services, Ottawa, Ontario, October 7-10, 1980.

Oral Presentation Skills Course, Public Service Commission, Halifax, Nova Scotia, November 12-14, 1980.

AGU Fall Meeting, San Francisco, California, December 7-11, 1980.

Canadian Representative on the Rock and Sediment Working Group, Seabed Working Group Meeting, Paris, France, February 2-5, 1981.

B. Deonarine

Laboratory Course in Scanning Electron Microscopy, Woods Hole Oceanographic Institute, Woods Hole, Massachusetts, October 24-31, 1980.

C.F.M. Lewis

AGU Conference, Toronto, Ontario, May 22-27, 1980.

Industry/Government Working Group on Ice Scour Research Meeting, Ottawa, Ontario, May 29-30, 1980.

Workshop on Energy Resources of Atlantic Provinces, Atlantic Geoscience Society, Fredericton, New Brunswick, January 23-25, 1981.

Symposium on Transportation and Production Systems for Hibernia Oil Discovery, St. John's, Newfoundland, February 16-18, 1981.

NRC Subcommittee on Marine Geotechnical Engineering, Toronto, Ontario March 12-13, 1981.

C.T. Schafer

Changed work station to Institute of Marine Sciences, University of Miami, Florida, to carry out comparative studies of benthonic foraminifera species, May 1 to July 31, 1980.

Workshop on Research in the Labrador Coastal and Offshore Region, Memorial University, Labrador Institute of Northern Studies, Goose Bay, September 4-6, 1980.

Geological Society of America, Cushman Foundation Symposium, Atlanta, Georgia, November 16-21, 1980.

R.B. Taylor

ISPG Sedimentological Field Trip to P.E.I. and N. New Brunswick, September 19-25, 1980.

Non-Renewable Resource Study Team Meeting, Ottawa, Ontario, February 26-27, 1981.

B.J. Topliss

Ocean Science Workshop, Madison, Wisconsin, October 13-15, 1980.

Land Survey Institute Meeting, Lawrencetown, Nova Scotia, March 13, 1981.

G. Vilks

Canadian Representative to the Executive Committee, NEA/Seabed Working Group Meeting, Paris, France, February 2-5, 1981.

Membership on Committees

C.L. Amos

Departmental Committee on Ocean Mining

Interdepartmental Environmental Advisory Committee

S.M. Blasco

Chairman, Arctic Petroleum Operators Association, Beaufort Sea Seabed Synthesis Committee

Member, Seabed Engineering Aspects, DINA, Beaufort Sea Artificial Island Technical Advisory Committee

Member, Arctic Petroleum Operators Association, Permafrost and Hydrates Working Group

Member, Arctic Petroleum Operators Association, Ice Scour Working Group

Coordinator, NEP-OERD Beaufort Sea Geotechnical Program

BIO Liaison Coordinator, CESAR Planning Committee

D.E. Buckley

Member, National Research Council Associate Committee on Shoreline Erosion and Sedimentation

Member, Organizing Committee for International Association of Sedimentologists Congress for 1982

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

Canadian Delegate, International Atomic Energy Agency - Impacts of Radionuclide Releases into the Marine Environment

Member, Nuclear Energy Agency - Seabed Working Group

R.E. Cranston

Canadian Delegate, Nuclear Energy Agency - Seabed Working Group

BIO Library Committee

Interdepartmental Laboratory Coordinating Committee for Atlantic Region

C.F.M. Lewis

NRC Subcommittee on Marine Geotechnical Engineering

NRC (United States) Marine Board Committee on Arctic Seafloor Engineering

Joint Industry/Government Working Group on Ice Scour Research

M.A. Rashid

Associate Editor, Geochemical Journal, Geochemical Society of Japan

K.R. Robertson

Atlantic Geoscience Centre Safety Committee

C.T. Schafer

Expanded Regional Ocean Dumping Advisory Committee

Working Group for Pt. Lepreau Environmental Monitoring

Facilities Committee, Joint Oceanographic Assembly (Halifax, August 1982)

J.P.M. Syvitski

International Association of Sedimentologists Symposium Chairman, Canada '82

R.B. Taylor

Sable Island Environmental Advisory Committee

Non-Renewable Resources Team, RADARSAT Project

Coastal/Marine Environmental Information System, Steering Committee

B.J. Topliss

BIO Remote Sensing Committee

G. Vilks

Seabed Working Group, Radioactive Waste Management Committee

Special Talks and Lectures

S.M. Blasco

"Seabed Geology and Geomorphology of the Lomonosov Ridge" presented at International Geological Congress, Paris, France, July 10, 1980.

D.E. Buckley

"Ocean Disposal of Nuclear Waste" presented at Information Meeting on Geotechnical Properties and Geological Disposal of Radioactive Waste, Ottawa, Ontario, May 4-6, 1980.

R.E. Cranston

"Modelling the Distribution of Dissolved Chromium in Cascadia Basin" presented at the Annual Meeting of the American Geophysical Union in San Francisco, December 7-17, 1980.

"Summary of Geochemical Pore Water Data from the NW Atlantic" presented at Seabed Working Group Meeting, Paris, France, February 2, 1981.

"Marine Geochemical Implication of High Level Nuclear Waste Disposal" presented to Advanced Chemical Oceanography Class, Dalhousie University, Halifax, Nova Scotia, February 20, 1981.

J.-P. Guilbault

Presented talk on the relation between micropaleontology and geotechnique in the Champlain Sea sediments at the 10th Annual Workshop of INSTAAR (Institute of Arctic and Alpine Research) in Boulder, Colorado, March 12-14, 1981.

C.F.M. Lewis

"Ice Scour Studies on the Labrador Shelf" presented at Workshop on Research in the Labrador Coastal and Offshore Region, Goose Bay, Labrador, September 4-5, 1980.

"Geological Evidence of Iceberg Groundings" invited presentation to Symposium on Transportation and Production Systems for Hibernia Oil Discovery, St. John's, Newfoundland, February 17, 1981.

M.A. Rashid

"Binding of Nutrients and Pollutants with Sediments", an invited lecture presented at Marine Science Centre, McGill University, Montreal, P.Q., October 19-22, 1980.

C.T. Schafer

"Holocene Record of the Western Boundary Undercurrent on the Continental Slope and Rise off Northeast Newfoundland" presented at Workshop on Research in the Labrador Coastal and Offshore Region, Goose Bay, Labrador, September 4-5, 1980.

"Spatial Distribution and Abundance of Living Foraminifera in Bathyal Environments off Newfoundland" presented at GSA-Cushman Foundation Symposium on Quaternary Benthic Foraminifera of North American Continental Margins, Atlanta, November 16-21, 1980.

"Paleoceanographic Significance of Holocene Sediment Bioturbation" invited lecture presented at Department of Geology, Louisiana State University, Baton Rouge, March 3, 1981.

J.P.M. Syvitski

"Recent Observations in West Coast Fjords vis PISCES IV Submersible" presented at Department of Oceanography, University of Quebec at Rimouski, Quebec, January 29, 1981.

G. Vilks

"Late Glacial and Postglacial Boundary in Sediments of Eastern Canada, Denmark and Norway" presented at GAC Annual Meeting, Halifax, Nova Scotia, May 1980.

"Arctic Deep Water Foraminifera and Their Relationship to Labrador Current Faunas" and "Late Glacial and Postglacial Boundary in Sediments of Eastern Canada, Denmark and Norway" presented at Symposium on the Young Cenozoicum of the Arctic and the North Sea, Aarhus, Denmark, September 9-12, 1980.

"Foraminifera in Surface Sediments of Southeastern Labrador Shelf and Lake Melville, Canada, presented at Symposium on Quaternary Benthic Foraminifera of North American Continental Margins (GSA Annual Meeting), Atlanta, November 17-20, 1980.

Subdivision Manuscripts

During the year 1980-81, the staff of the subdivision produced 21 outside and internal publications and 5 abstracts.

EASTERN PETROLEUM GEOLOGY SUBDIVISION

G.L. Williams

The past year has witnessed dramatic developments in the exploration for oil and gas in offshore eastern Canada. The initial promise of the first well on the Hibernia structure has been confirmed in two subsequent wells, so that recoverable reserves of oil are now variously estimated at one to two billion barrels for this field. Drilling around Sable Island has also shown considerable promise with a stepout well on the Venture structure suggesting that commercial gas production will soon become a reality for the Scotian Shelf. These developments have focussed increasing attention on the importance of this frontier region to Canada's future welfare, and the role of the Eastern Petroleum Geology Subdivision at Bedford Institute.

The Subdivision, originally set up in 1972, is taxed (and not be the Federal Government) with unravelling the geology of the sedimentary basins of eastern Canada, onshore and offshore, and with providing accurate appraisals of the hydrocarbon reserves. Both the Hibernia and Venture structures are therefore included within our sphere of interest which from North to South includes Baffin Bay, Davis Strait, the Labrador Shelf, Northeast Newfoundland, the Grand Banks, the Gulf of St. Lawrence and the Scotian Shelf. The subsurface geology of this huge area, stretching from about 44°N to 76°N (the equivalent of going from southern France to Spitsbergen), is the responsibility of twelve geologists within the Subdivision. These scientists, in addition to undertaking regional geological and geophysical studies, also provide expertise in various disciplines such as biostratigraphy (palynology and micropaleontology), lithostratigraphy, geochemistry, visual kerogen, vitrinite reflectance and log analysis. The data base for these studies includes multichannel seismic, samples and logs from offshore wells, and surface sections from geologically related areas such as the North Atlantic (D.S.D.P. sites), western Europe, northwest Africa and the eastern United States.

One of the most critical roles of the Eastern Petroleum Geology Subdivision is its input into the interdepartmental resource appraisal. Our geologists, in conjunction with the Resource Management Branch, are responsible for producing estimates of the hydrocarbon reserves in the offshore basins, and for periodic updates. During the past year we have commenced a preliminary reappraisal of the East Newfoundland Basin which includes the Hibernia structure. The Subdivision is also concerned with appraisal of coal resources in the Maritimes in cooperation with the Provincial surveys and, in Nova Scotia, DEVCO.

All offshore east coast well samples are catalogued and curated at Bedford Institute by the Resource Management Branch. This Branch is also responsible for micropaleontological processing on behalf of the Subdivision and for a public collection. Palynological processing is undertaken by E.P.G. Samples and processed material from all wells are available for examination by the general public at the end of the two year confidential period. This system provides opportunity for scientists outside the Federal Government to work on the samples and ensures a permanent record of an invaluable offshore data base.

Highlights

Recent theories regarding the high source rock potential of evaporites are being applied to studies of the Windsor Group in the Gulf of St. Lawrence; in this basin the Upper Paleozoic rocks attain a thickness of over 30,000 ft.

Analyses of pyrite distribution in the Harbour seam of the Donkin Reserve area, the Sydney Coalfield, confirm that 60-80% of the total sulphur is pyritic sulphur. This has considerable economic significance with regard to coal cleaning and sulphur reduction.

Coals from the Carboniferous Basin of New Brunswick show a remarkable increase in rank towards the southwest corner of the basin. This may indicate a zone of mineralization, as seems to be confirmed by recent discoveries.

Vitrinite reflectance values of coaly fragments from the Yava Base Metal Mine, Cape Breton Island, can be related to mineralization, with the highest values being in samples from such zones. The vitrinite reflectance readings and assumed burial time of 60 m.y., indicate a temperature of 130-150°C for the hydrothermal solutions that carried in the lead-zinc precipitates.

D.S.D.P. Leg 76 shed new light on the early spreading history of the North Atlantic Ocean and resulted in recovery of the oldest sediments to date from the deep ocean. These marine sediments of Callovian age (143 m.y.) thus indicate that initial spreading was three times greater than at present. The contained foraminifera and nannofossils also confirm that open oceanic conditions existed soon after the origin of the Atlantic Ocean. In the same hole, the presence of gas hydrates was confirmed and quantitative studies carried out for the first time on these potentially economic deposits.

The interdisciplinary study of the East Newfoundland Basin is continuing with input from biostratigraphy, lithostratigraphy, organic geochemistry, visual kerogen, vitrinite reflectance and multichannel seismic data. The probable source rocks for the Hibernia oil have been identified; these may be related to potential source rocks in the Porcupine Basin.

A GLORIA generated, mosaic reconstruction of the seafloor in the vicinity of the Laurentian Fan shows some significant differences to existing hydrographic charts. GLORIA, a deep water (slope and beyond) sidescan system, will be used to conduct further reconnaissance surveys next year.

Available samples of volcanics from Scotian Shelf wells are currently being dated using the potassium-argon dating technique. This should help to elucidate the thermal history of the margin.

Hydrozoans recorded from two Scotian Shelf wells represent the first known occurrences of Jurassic-Cretaceous sponges and stromatoporoids from the eastern North American margin. They will be invaluable in furthering our knowledge of reefal environments in the Abenaki Formation.

A detailed taxonomic and paleoecologic reappraisal of agglutinated foraminifera in Labrador Shelf and North Sea wells has been related to a proposed

zonation based on stratotypes. This has resulted in a predictive paleoecological model for petroleum basins which enables regional geologists to more accurately construct geohistory curves, and hence decipher the geological history in a more meaningful manner.

The modified micropaleontological zonations for the Late Jurassic have been successfully applied to the East Newfoundland Basin and calibrated to the standard worldwide calpionellid zonation.

A proposed miospore-dinoflagellate zonation for the Lias of Portugal has been used to date coeval sediments on the Grand Banks and to correlate with the type section of the Lias in southern England.

The newly developed spore-pollen zonation in the Early Cretaceous of the Scotian Shelf shows excellent agreement with the existing zonation for the U.S. Atlantic Coastal Plain.

The latest alphabetical listing of all fossil dinoflagellate taxa includes 413 genera and 2210 species.

The Rangefile program, a sophisticated computer program for manipulating paleontological data, became operational with several successful range plots being produced. Coding of the absolute time scale now allows production of charts showing known worldwide ranges of more than 400 dinocyst species. This will be the basis of a centralized system receiving data from palynologists in seven countries.

Halifax '80, the joint annual meeting of the Geological Association of Canada and the Mineralogical Association of Canada, was hosted by the Atlantic Geoscience Society. Members of the Subdivision played a prominent part in the success of this meeting attended by about 1000 people.

Personnel Notes

There are twelve scientists, five technicians and three support staff in the Subdivision. The lone visiting fellow, Mr. Piet Doeven, accepted a position with Petro-Canada last November after completing a study of Late Cretaceous nannofossils of offshore eastern Canada.

Ed Davies, formerly with Phillips Petroleum, joined the Subdivision in April as a palynologist. Ed's Ph.D. study, completed at the University of Toronto, was on Jurassic-Lower Cretaceous dinoflagellates from the Sverdrup Basin.

Paul Girouard, a lithostratigraphic technician, transferred from the Subdivision to the Regional Reconnaissance Subdivision where he is now a marine geoscience technologist.

Paul Lake joined E.P.G.S. in February as a lithostratigraphic technician. He is a graduate of Dalhousie University and has had some oil industry experience in Calgary.

Peter Hacquebard continues to receive recognition for his outstanding research in coal petrology. In May he was awarded an honorary degree in laws by Dalhousie University.

Felix Gradstein played a crucial role in the success of D.S.D.P. Leg 76. He served as co-chief scientist on a leg which witnessed the recovery of the oldest sedimentary rocks found to date in the deep ocean.

During the year several members of the Subdivision, including Alan Grant, Lubomir Jansa and John Wade, have acted as advisers to Bill Okoth, a Master's student at Dalhousie. When Bill returns to Kenya he will be in charge of that country's geological studies of their offshore.

Attendance at Meetings, Conferences and Courses

P. Ascoli

Joint Annual Meeting, Geological Association of Canada and Mineralogical Association of Canada, Halifax, Nova Scotia, May 19-21, 1980.

M.S. Barss

Joint Annual Meeting, Geological Association of Canada and Mineralogical Association of Canada, Halifax, Nova Scotia, May 19-21, 1980.

Meeting of the Kremp Steering Committee, Keystone, Colorado, October 14, 1980.

Annual Meeting of the Geological Survey of Canada's Palynologists, Dartmouth, Nova Scotia, November 19-20, 1980.

J.P. Bujak

Joint Annual Meeting, Geological Association of Canada and Mineralogical Association of Canada, Halifax, Nova Scotia, May 19-21, 1980.

Fifth International Palynological Conference, Cambridge, England, June 29-July 6, 1980.

Annual Meeting of the Geological Survey of Canada's Palynologists, Dartmouth, Nova Scotia, November 19-20, 1980.

E.H. Davies

Annual Meeting, American Association of Stratigraphic Palynologists, Keystone, Colorado, October 15-18, 1980.

Annual Meeting of the Geological Survey of Canada's Palynologists, Dartmouth, Nova Scotia, November 19-20, 1980.

F.M. Gradstein

A.A.P.G. Sponsored Symposium, "Interregional Unconformities on the Atlantic Margin of North America, Woods Hole, Massachusetts, April 28-30, 1980.

Joint Annual Meeting, Geological Association of Canada and Mineralogical Association of Canada, Halifax, Nova Scotia, May 19-21, 1980.

Twenty-sixth International Geological Congress, Paris, France, July 7-17, 1980.

Workshop on Benthonic Foraminifera of Mesozoic-Cenozoic Basins, Dallas, Texas, June 2-7, 1980.

A.C. Grant

Annual Meeting, Canadian Society of Exploration Geophysicists, Calgary, Alberta, May 7-9, 1980.

Departmental Meeting for Resource Appraisal, Ottawa, Ontario, May 13-14, 1980.

Joint Annual Meeting, Geological Association of Canada and Mineralogical Association of Canada, Halifax, Nova Scotia, May 19-21, 1980.

Annual Meeting, Association of Earth Science Editors, Halifax, Nova Scotia, October 20-22, 1981.

"Hollis Hedberg Symposium on continental margins", Galveston, Texas, January 14-16, 1981.

Meeting JOIDES Advisory Panel on Passive Ocean Margins, Galveston, Texas, January 17-19, 1981.

G.M. Grant

Annual Meeting, Ontario Institute of Chartered Cartographers, Ottawa, Ontario, May 7-8, 1980.

Course, "Dynamics of Supervision", Halifax, Nova Scotia, November 17-21, 1980.

P.A. Hacquebard

Joint Annual Meeting, Geological Association of Canada and Mineralogical Association of Canada, Halifax, Nova Scotia, May 19-21, 1981.

Annual Meeting, Mining Society of Nova Scotia, Ingonish, Nova Scotia, June 26-28, 1980.

Visit Geol. Landesamt in Krefeld, West Germany, October 1980.

Meeting of the Canadian Coal Petrologists' Group, Ottawa, Ontario, November 6-7, 1980.

Annual Meeting, Geological Society of America, Atlanta, Georgia, November 17-20, 1980.

R.D. Howie

Joint Annual Meeting, Geological Association of Canada and Mineralogical Association of Canada, Halifax, Nova Scotia, May 19-21, 1980.

Symposium "Energy Audit of the Eighties", Canadian Society of Petroleum Geologists, Calgary, Alberta, September 28-October 1, 1980.

Colloquium, "Mineral and Energy Resources of the Atlantic Provinces, Atlantic Geoscience Society, Fredericton, New Brunswick, January 23-24, 1981.

L.F. Jansa

Joint Annual Meeting, Geological Association of Canada and Mineralogical Association of Canada, Halifax, Nova Scotia, May 19-21, 1980.

Twenty-sixth International Geological Congress, Paris, France, July 7-17, 1980.

Meeting JOIDES Advisory Panel on Ocean Paleoenvironments, Bermuda, February 4-6, 1981.

D.C. Umpleby

Departmental Meeting for Resource Appraisal, Ottawa, Ontario, May 13-14, 1980.

Interdepartmental Meeting for Resource Appraisal, Ottawa, Ontario, June 9-10, 1980.

Symposium "The Evaluation of Petroleum Resources", Calgary, Alberta, January 20-21, 1981.

Interdepartmental Meeting for Resource Appraisal, Calgary, Alberta, January 22-23, 1981.

Interdepartmental Meeting for Resource Appraisal, Ottawa, Ontario, February 25-27, 1981.

Course, "Stratigraphic Interpretation of Seismic Data", London, England, March 23-27, 1981.

J.A. Wade

A.A.P.G. Sponsored Symposium, "Interregional Unconformities on the Atlantic Margin of North America", Woods Hole, Massachusetts, April 28-30, 1980.

Departmental Meeting for Resource Appraisal, Ottawa, Ontario May 13-14, 1980.

Interdepartmental Meeting for Resource Appraisal, Ottawa, Ontario, June 9-10, 1980.

Petroleum Geology and Geochemistry Delegation to People's Republic of China, October 5-25, 1980.

Symposium, "The Evaluation of Petroleum Resources", Calgary, Alberta, January 20-21, 1981.

Interdepartmental Meeting for Resource Appraisal, Calgary, Alberta, January 22-23, 1981.

Interdepartmental Meeting for Resource Appraisal, Ottawa, Ontario, February 25-27, 1981.

Course, "Stratigraphic Interpretation of Seismic Data", London, England, March 23-27, 1981.

G.L. Williams

Meeting, Canadian Paleontology Task Force, Ottawa, Ontario, April 28-29, 1980.

Joint Annual Meeting, Geological Association of Canada and Mineralogical Association of Canada, Halifax, Nova Scotia, May 19-21, 1980.

Canadian Paleontology and Biostratigraphy Seminar, Fredericton, New Brunswick, September 27, 1980.

Annual Meeting of the Geological Survey of Canada's Palynologists, Dartmouth, Nova Scotia, November 19-20, 1980.

Colloquium, "Mineral and Energy Resources of the Atlantic Provinces", Atlantic Geoscience Society, Fredericton, New Brunswick, January 23-24, 1981.

Membership on Committees

P. Ascoli

Member of Subgroup on Smaller Benthonic Foraminifera, Working Group 9, International Geological Correlation Program.

Member of Mid-Cretaceous Events Project, Working Group 58, International Geological Correlation Program.

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

M.S. Barss

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

Member of Transportation Committee, 1980 Annual Meeting, Halifax, Geological Association of Canada.

J.P. Bujak

Co-chairman of the A.G.S. Nova Scotia Geological Highway Map Committee.

Councillor, American Association of Stratigraphic Palynologists.

Newsletter Editor, Canadian Association of Palynologists.

F.M. Gradstein

Member, Seminar Committee, Bedford Institute of Oceanography.

Member of Mid-Cretaceous Events Project, Working Group 58, International Geological Correlation Program.

Member of Quantitative Stratigraphic Correlation Techniques Project, Working Group 148, International Geological Correlation Program.

Co-Chief Scientist, D.S.D.P. Leg 76.

A.C. Grant

Member of Field Trip Committee and Associate Editor of Field Guides, 1980 Annual Meeting, Halifax, Geological Association of Canada.

Member of Seismic Committee, Atlantic Geoscience Centre.

Associate Editor, Bulletin of Canadian Petroleum Geology.

P.A. Hacquebard

Member, Management Subcommittee of Joint D.R.E.E.-E.M.R.-N.S. Dept. of Mines and Energy, Coal Drilling Project in Nova Scotia.

Vice-President, Mining Society of Nova Scotia.

Chairman, Halifax Branch, Mining Society of Nova Scotia.

Member, International Commission on Coal Petrology.

R.D. Howie

Chairman, Committee for G.A.C. '80 Display, Atlantic Geoscience Centre.

Member Canadian-New Brunswick Minerals and Fuels Committee.

L.F. Jansa

East Coast Representative, Canadian Society of Petroleum Geologists.

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

Member of Mid Cretaceous Events Project, Working Group 58, International Geological Correlation Program.

Member, Organization Committee of II International Sedimentological Congress.

D.C. Umpleby

Councillor, Atlantic Geoscience Society.

G.L. Williams

Editor of Geolog, Geological Association of Canada Newsletter.

Member, Editorial Committee, Geological Association of Canada.

Chairman, Paleontology Division, Geological Association of Canada.

Member of Steering Committee, 1980 Annual Meeting, Halifax, Geological Association of Canada (Entertainments Chairman).

Associate Editor, Marine Micropaleontology.

Member, Canadian National Committee, International Geological Correlation program.

Member, Canadian Paleontology Task Force.

Special Talks, Lectures and Poster Sessions

P. Ascoli

"Calpionellid and Foraminiferal-Ostracod Biostratigraphy at the Jurassic-Cretaceous Boundary, Offshore Eastern Canada", Joint Annual Meeting, G.A.C./M.A.C., Halifax, Nova Scotia, May 1980.

"Multiple Microfossil Zonations for the Mesozoic-Cenozoic, Offshore Eastern Canada", Poster Session, Joint Annual Meeting, G.A.C./M.A.C., Halifax, Nova Scotia, May 1980 (with Bujak, Doeven, Gradstein and Williams).

"Biostratigraphy of Ostracods and Calpionellids", Dalhousie University, Halifax, Nova Scotia, January 1981.

J.P. Bujak

"Visual kerogen studies of offshore wells, eastern Canada", Dalhousie University, Halifax, Nova Scotia, February 1981, Poster Session, Joint Annual Meeting, G.A.C./M.A.C., Halifax, Nova Scotia, May 1980.

"D.S.D.P. Dinoflagellate and Kerogen Studies", Bedford Institute, Dartmouth, Nova Scotia, February 1980.

E.H. Davies

"Archeopyle Patterns in Late Cretaceous Peridiniaceans", Annual Meeting, American Association of Stratigraphic Palynologists, Keystone, Colorado, October 1980.

"The Evolution of Dinoflagellates", Annual Meeting, American Association of Stratigraphic Palynologists, Keystone, Colorado, October 1980.

P.H. Doeven

"Late Cretaceous Nannofossil Stratigaphy and Aspects of Carbonate Sedimentation on the Canadian Atlantic Margin", Joint Annual Meeting, G.A.C./M.A.C., Halifax, Nova Scotia, May 1980.

F.M. Gradstein

"Gap Stratigraphy", Woods Hole, April 1980.

Lecture, "Agglutinated Foraminifera", Workshop on Benthonic Foraminifera, Dallas, Texas, June 1980.

"Models of Cenozoic Foraminiferal Stratigraphy, Northwestern Atlantic Margin", International Geological Congress, Paris, July 1980.

"Agglutinated Foraminiferal History of the Labrador and North Sea", International Geological Congress, Paris, July 1980.

Lecture, "Deep Sea Drilling Project Leg 76", Dalhousie University, Halifax, Bedford Institute, Dartmouth, Nova Scotia and Woods Hole, Massachusetts, February 1981.

A.C. Grant

"Problems with Plate Tectonics: The Labrador Sea", Annual Meeting, C.S.E.G., Calgary, Alberta, May 1980.

"Problems with Plate Tectonic Models for Baffin Bay", Joint Annual Meeting, G.A.C./M.A.C., Halifax, Nova Scotia, May 1980.

"Problems with Plate Tectonics: The Labrador Sea", Poster Session, C.S.P.G. Convention, Calgary, Alberta, September 1980.

Lecture, "Petroleum geology of offshore Eastern Canada", Nova Scotia Institute of Science, Halifax and Wolfville, Nova Scotia, January 1980.

Lecture, "Petroleum geology of offshore Eastern Canada", M.B.A. Students, Dalhousie University, Halifax, Nova Scotia, February 1981.

Lecture, "Petroleum geology of offshore Eastern Canada", Mount Allison University, Sackville; University of New Brunswick, Fredericton, March 1981.

P.A. Hacquebard

"Geologic Development of the Sydney Coal Basin", Joint Annual Meeting, G.A.C./M.A.C., Halifax, Nova Scotia, May 1980.

Lecture, "Coal Geology and Coal Petrology", University of Oklahoma at Norman, Oklahoma, November 1980.

Lecture, "Coal Geology and Coal Petrology", University of New Brunswick, Fredericton, New Brunswick; Acadia University, Wolfville, Nova Scotia, January 1981.

"Value of Occurrence of Detrital Particles of Coal in Tracing the Provenance of Sedimentary Rocks", Atlantic Geoscience Society Colloquium, Fredericton, New Brunswick, January 1981.

R.D. Howie

"Carboniferous Salt in Atlantic Canada", Joint Annual Meeting, G.A.C./M.A.C., Halifax, Nova Scotia, May 1980.

"The Albert Formation, New Brunswick, Deltas and Oil Shale", Poster Session, C.S.P.G. Convention, Calgary, Alberta, September 1980.

Lecture, "Carboniferous Salt in Atlantic Canada", Queen's University, Kingston; Laval University, Quebec, November 1980.

Lecture, "The Albert Formation, New Brunswick, Deltas and Oil Shale", Queen's University, Kingston; Laval University, Quebec, November 1980.

Lecture, "The Albert Formation, New Brunswick, Deltas and Oil Shale", Atlantic Geoscience Society Colloquium, Fredericton, New Brunswick, January 1981.

Lecture, "The Albert Formation, New Brunswick, Deltas and Oil Shale", Charles P. Allen High School, Bedford, February 1981.

Lecture, "Athabasca Tar Sands", Charles P. Allen High School, Bedford, February 1981.

L.F. Jansa

Invited Lecture, "Anatomy and Hydrocarbon Potential of Conjugated Margins of the Central North Atlantic, Texas A & M University, College Station, Texas, April 1980.

"Sedimentary Processes in the North Atlantic and their Significance in Plate Tectonic Reconstructions", Joint Annual Meeting, G.A.C./M.A.C., Halifax, Nova Scotia, May 1980.

Invited Lecture, "Carbonate Platforms of the Eastern North American Margin", International Geological Congress, Paris, July 1980.

Invited Lecture, "The Paleoenvironment and Development of Conjugated Margins of the North Atlantic", International Geological Congress, Paris, July 1980. (Co-authored by J. Schlee, U.S.G.S.)

Invited Lecture, "Development of the Carbonate Platforms along the Eastern North American Margin and their Hydrocarbon Prospectivity", Houston Geological Society, Houston, Texas, March 1981.

Lecture, "Hydrocarbon potential of the East Coast Carbonate Belt", Gulf Oil Research Group, Houston, Texas, March 1981.

Lecture, "Stratigraphy in Geologic Exploration", Dalhousie University, Halifax, Nova Scotia, March 1981.

J.A. Wade

"Geology and Resource Assessment of the Scotian Shelf", Daqing, People's Republic of China, October 1980.

"Geology and Hydrocarbon Occurrence, the Scotian Shelf", Chengdu, People's Republic of China, October, 1980.

"Geology, Hydrocarbon Occurrences and Resource Assessment, the Scotian Shelf", Research Centre, Wuxi, The People's Republic of China, October 1980.

"Probability Methods in Hydrocarbon Resource Assessment Using East Coast Data", Dalhousie University, Halifax, February 1981.

G.L. Williams

"Evolution of Dinoflagellates", Canadian Paleontology and Biostratigraphy Seminar, Fredericton, New Brunswick, September 1980.

"Dinoflagellates: Morphology, Taxonomy, Stratigraphy and Paleoecology", Dalhousie University, Halifax, Nova Scotia, October 1980.

"Oil and Gas in Canada: Past, Present and Future", Atlantic Geoscience Society Colloquium, Fredericton, New Brunswick, January 1981.

"Some of the Small Problems in Biostratigraphy, with Emphasis on Palynomorphs", Dalhousie University, Halifax, Nova Scotia, February 1981.

"Geology and Hydrocarbon Potential of Offshore Eastern Canada", Bedford Institute, Dartmouth, Nova Scotia, March 1981.

Subdivision Manuscripts

The Subdivision staff produced 1 G.S.C. Paper, 2 G.S.C. Open File Reports, 14 outside papers and 12 "abstract only" manuscripts during 1980-81. In addition, 32 biostratigraphic reports on wells, D.S.D.P. cores and outcrop samples, 4 reports on vitrinite reflectance and 20 lithostratigraphic reports on offshore wells were completed during the same period.

Laboratory Statistics

Drafting

Original Figures	241
Revisions in man hours	317

Micropaleontology

Samples picked	2245
Slides prepared	2998
S.E.M. photographs	900

Coal Petrology

Reflectance analyses	157
Maceral analyses	65

Palynology

Samples processed	1404
Organic matter samples	1176
Slides prepared	4592
S.E.M. photographs	60

Sedimentary Petrology

Thin sections	694
Photographs	0

PROGRAM SUPPORT SUBDIVISION

K. S. MANCHESTER

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

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

This section also in co-operation with Research Management and Conservation Branch, provides curation services for the Division for core, dredge, grab and other marine geological samples. It also manages a contract for routine soft sediment analysis for the Division and provides a regional sample repository for marine geological samples collected by University and industrial concerns that are donated to the Division.

The Marine Geoscience equipment, operational and Development Section is responsible for providing operating and maintaining all the marine geoscience field equipment of the Division. This includes a large range of marine geophysical seismic refraction and reflection instruments, Side Scan Sonar Survey systems, and magnetic and gravity instruments as well as marine geological sampling equipment such as piston, gravity, rock and vibrocorers; Shipek, Van Veen and Eckman grab samples and rock dredges. This section also provides the divisions primary logistic and storage support for all field projects and equipment by providing field vehicles, ATV's, trailers, launches, boats and freight and laboratory containers.

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

HIGHLIGHTS

Data Management Section

Information System Development:

- GEOFFREY (Geophysical data management system - GSC project 790039) The detailed design for the data management software was completed and reviewed. A preliminary study of the user requirements for the display of geophysical data was conducted by Regional Reconnaisance. Preparation of data for eventual inclusion in the GEOFFREY data base continued with a major effort in consolidation of calibration information and validation of raw data. The contract for the implimentation of GEOFFREY software was awarded in February 1981 and the first phase was completed by year end.

- Well Data Systems: Year end saw the production of the first Range-charts for the palynology of offshore wells. Although the system was still awkward to use, the benefits of the system and increased effectiveness of the biostratigraphers was evident. A new project was initiated in this fiscal year to extend the development of systems for use by the biostratigraphers beyond the Rangefile application. Top-level specification of the system and some preparatory work for the conversion to data base was completed.

- Geochemistry Data Base: Data base design and data loading programs were completed for a system for Environmental Marine Geology's geo-chemistry section to support the deep ocean radioactive nuclear waste disposal project.

- Kremp: Responsibility for the management of the GSC Kremp data base was transferred to AGC in 1980/81. Data Section maintained and modified data checking programs for the data base and assisted the Palynologists with their retrievals. Specifications for a new data base design were prepared for implimentation in 1981/82.

- Sedimentology: Data Section designed and implimented two data bases for the sedimentologists in Environmental Marine Geology in 1980/81. The iceberg scour data base stores information on the extent and type of sediment disturbance by icebergs obtained from the analysis of seismic and bathymetry, and sidescan sonar analog records. The sediment transport model data base provides the sedimentologists with a tool to store information on an area of the continental shelf and allows the modelling of transport of sediment in that area with the capability of changing the modeling algorithm and parameters.

Curation:

- Cataloguing and consolidation of the sample collections showed significant progress in 1980/81.

- Agreement was reached within BIO for the establishment of BIO Map Library.

Marine Geoscience Equipment, operational and development Section

- 846 man days were spent by the Section's technical staff in support of AGC field projects for an average of 82 days in the field per man with a high of 121 days by one person.

- 12 cruises and two field projects were supported in the Arctic Ocean, Pacific Ocean, Atlantic Ocean, Baffin Bay, Labrador Sea, Grand Banks, Newfoundland Bays, Sohm Abyssal Plain, Ungava Bay and Davis Atrait areas.

- The joint AGC, Dalhousie University, and Metrology Division of A.O.L. project to develop a single umbilical system for the BIO Rock-core drill was successfully tested on the Mid-Atlantic Ridge and Baffin Bay areas to water depths of 800 meters. A planned test to its full design depth of 3500 meters will be carried out in 1981.

- AGC provided support to P.G.C. on a seismic refraction program off Vancouver Island on a joint project.

- The C.S.S. Hudson was equiped and mobilized for future 1981 AGC projects in Feburary 1981 before it left on its second cruise to the West Coast of Canada and the Beaufort Sea areas during 1981.

- A new Second Huntec Deep Tow Survey System was purchased and the original D.T.S. system was upgraded to the current standards upon the completion of the SEABED I development program. These two systems will be maintained as production systems.

- AGC's contribution to FRAM II was successfully mobilized and supported by Section staff in a U.S.N.O sponsored project to investigate the Arctic Ocean Basin from sea-ice based camps.

- A new generation Bodensweewerek Sea gravimeter system was ordered for delivery in July 1981 that will replace our 18 year old units on multidiscipline surveys where it will give superior quality data under poorer sea conditions on smaller ships on ships courses that vary considerably under good navigational control in partial ice covered areas of Eastern Canada Arctic.

- The Ocean Bottom Seismometer Development continued with the design of an improved sampler electrolysis activated release. Four Benlton acoustic releases were acquired giving the OBS's a command release capability.

- Heffler and Loncarvic participated in a successful International O.B.S. calibration project in France in May 1980.

- Our proto-type sediment dynamics monitor (RALPH) project built a second improved version with the unit being successfully tested in Bedford Basin. Two attempts were made to install it in the Hibernia area during the winter but failed due to logistical reasons.

Personnel Notes

The Subdivision presently consists of five professional, fifteen technical and two support staff members.

M. Walker joined Program Support in June 1980.

F. Ewing retired on March 1, 1981

B. Chapman resigned in May 1980

B. Inkpen resigned to work for Nova Scotia Research Foundation, March, 1981.

Shirley Jollimore appointed Library Clerk, July 1980.

A. Atkinson transferred from A.O.L. in July 1980.

Attendance at Meetings, Conferences, Courses

D. Heffler: OBS Course - October 1980

M. Gorveatt: Mooring Workshop - February 3rd and 4th, 1981

D. Locke: FRAM II Debreifing

Memberships on Committees

K. Manchester

BIO Ships Users Committee

A. Sherin

BIO Computer Users Advisory Committee

M. Gorveatt

AGC Safety Committee

D. Heffler

Side Scan Mosaics Committee

Data Requests

From within Division

General Information	1
Data	100
Samples	93
Open Files	1

- Services Rendered

Subsampling	34
Reproduction	1
Stationary	2
Miscellaneous	7

Outside Division

General Information	4
Data	10
Samples	6
Open Files	Ø

- Services Rendered

Subsampling	5

CENTRAL LABORATORIES AND TECHNICAL SERVICES DIVISION

J. A. Maxwell, Director

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

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

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

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

Membership on Committees

J.A. Maxwell

Branch Management Committee
Departmental Committee on Energy Conservation
Departmental Committee on Employment of Handicapped People Program
Departmental Committee on Employment of Native Peoples Program
Branch Official Languages Coordinator
Canadian Geoscience Coordinator, Canada/Federal Republic of Germany S and T Agreement

Analytical Chemistry

Sydney Abbey

It was a good year for the Section. There was a large increase in numbers of samples analysed in support of Branch scientific projects, there was increased application of newer techniques and instrumentation to the solution of analytical problems, there was increased co-ordination of information on reference materials and increases in the provision of information for the benefit of governmental, academic and industrial organizations in Canada and abroad.

Highlights

Among the various activities of the Section, a great deal of world-wide attention has been drawn to our studies in x-ray fluorescence spectroscopy, on our new combustion infra-red scheme for simultaneous determination of water, sulfur and carbon dioxide in rocks and on our work in "standard" reference materials. Thus the scheme of inter-element correction in x-ray fluorescence developed by one member of the staff has been recommended for general use by one of the world's leading manufacturers of x-ray equipment; a report on x-ray fluorescence by another staff member is being considered for inclusion in a new text-book on the subject by two world-renowned authorities; the assistance of a third staff member has been requested by a half-dozen institutions in adapting our new combined water-sulfur-carbon method; and our latest GSC Paper on reference materials has been reproduced in an international journal and is also to be included in a new text-book on rock analysis.

Concerning the above and other topics, information and assistance has been provided for nine Canadian governmental bodies and crown corporations, five Canadian universities, eleven Canadian industrial and commercial establishments, a multi-national oil corporation, and various groups in the U.S.A., Mexico, Brazil, the U.K., West Germany, Denmark, Senegal, Somalia, India, Bangladesh, Australia and New Zealand.

Work was begun on the evaluation of eight reference rocks from the U.S. Geological Survey for which nothing has been published by the originators since 1972. Preliminary operations were also undertaken toward the preparation of a suite of reference samples of iron-formation rocks.

Personnel Notes

A.G. Douma, who worked in our chemical laboratories for four years, was transferred to a new position in the Economic Geology Division.

Nicole Bertrand was absent for six months on maternity leave.

Al Heinrich, of the Institute of Sedimentary and Petroleum Geology, spent three weeks in our laboratories learning x-ray fluorescence methods.

Carole Veys joined our chemical staff originally as a maternity-leave replacement and is continuing as a full-time employee.

C.T. Wiles, who had worked in several of our laboratories in the past, both as a student and as a term employee, accepted a permanent position in our spectrographic laboratories.

P.J. Lavergne, of the Resource Geophysics and Geochemistry Division, spent several weeks on sulfur determinations in our chemical laboratories.

Attendance at Meetings, Courses, etc.

W.H. Champ

Canadian Chemical Conference, Ottawa
Visits to laboratories of Ontario Geological Survey and Technical Service Laboratories Ltd., Toronto, and of National Research Council, Ottawa, regarding plasma sources.

K.A. Church

Visit to Jarrell-Ash, Waltham, Mass., concerning operation and installation of the proposed new spectrograph.
Visit to National Research Council, Ottawa, regarding plasma sources.

G. R. Lachance

Canadian Spectroscopy Symposium, Toronto
Invited visits, as consultant on x-ray fluorescence, to a Canadian iron mining company and a U.S. manufacturer of energy-dispersive equipment.
Summer course in XRF, State University of New York at Albany, (invited resource person).

R.J. Guillas

Course on microprocessors preceding Canadian Chemical Conference, Ottawa.
Departmental first aid course.
Course on Principles of Management (Algonquin College).

J. G. Sen Gupta

Canadian Chemical Conference, Ottawa
Canadian Spectroscopy Symposium, Toronto

Jocelyne Watson

Departmental first aid course

P.G. Belanger

Computer hardware course, Algonquin College

R.A. Meeds

Computer hardware course, Algonquin College
Visit to National Research Council, Ottawa, regarding plasma sources

Sydney Abbey

Canadian Chemical Conference, Ottawa
Annual Meeting, NRC Advisory Committee on Marine Analytical Chemistry, Ottawa
Federation of Analytical Chemistry and Spectroscopy Societies, Philadelphia (invited Keynote Speaker).

Membership on Committees

W.H. Champ

Editorial Committee, Canadian Journal of Spectroscopy

Serge Courville

Divisional representative, Branch Task Force on Access to information.

G.R. Lachance

Branch Computer Facilities Committee

J.G. Sen Gupta

Organizing Committee, 1981 Canadian Spectroscopy Symposium
Branch Safety Committee

Sydney Abbey

Canadian Certified Reference Materials Project - Member of Co-ordinating Committte and Co-ordinator of Task Force on Rock Samples
International Study Group on Reference Materials.
Geostandards Newsletter - Regional Editor for Canada.
NRC Advisory Committee on Marine Analytical Chemistry.

Special Talks and Lectures

G.R. Lachance

"Observation on frequency-atomic number relations in x-ray spectrometry" - Canadian Spectroscopy Symposium, Toronto
"Simultaneous determination of water, carbon dioxide and sulphur in rocks by and volatilization and non-dispersive infrared spectroscopy" (oral presentation of a paper by J.-L. Bouvier and Sydney Abbey) - Canadian Spectroscopy Symposium, Toronto

J.G. Sen Gupta

"Determination of yttrium and rare earths in rocks for graphite furnace atomic absorption spectrometry" - Canadian Spectroscopy Symposium, Toronto
(The published version of this talk was subsequently reproduced and distributed by a leading manufacturer of atomic absorption equipment.)

Sydney Abbey

"Standard reference materials and what they tell us about reliability in the analysis of rocks and minerals" - Federation of Analytical Chemistry and Spectroscopy Societies, Philadelphia. (Invited Keynote Lecture)

Manuscripts

Five manuscripts for publication in outside journals were submitted by Section staff and accepted by the Division.

Laboratory Notes

Chemical and X-ray Fluorescence

There was a slight increase in the number of samples received, compared to the preceding year; but an increase of nearly 60 per cent in the number of samples completed led to an overall reduction of backlog of 43 per cent. Despite the inevitable instrumental breakdowns, this great increase in productivity is also revealed in other parameters -- e.g chemical determinations (up 49 per cent), x-ray fluorescence determinations (up 83 per cent). Major contributors to these improvements are general refinements and efficiency in x-ray fluorescence, the ability of the water-sulfur-carbon combined system to keep step with the rapid output of XRF, the use of the new microprocessor-equipped atomic-absorption spectrometer and the inauguration of quantitative analysis for certain key elements by means of energy-dispersive XRF. At present, only one of our "everyday" methods (for ferrous iron) is entirely "wet chemical" in that it involves dissolution of the sample followed by a titration, but even that is done with a highly automated titrator.

As usual, samples of unusual composition, containing major concentrations of elements usually present merely as traces, provided special analytical problems. Greatest difficulties were encountered where barium or uranium were present at high levels, but some with high lead, zinc or other normally "trace" elements were also involved.

Attempts were made to simplify and possibly accelerate fluorine and chlorine determinations. Some time-saving was achieved in the conventional method by introducing lithium metaborate as flux, thereby eliminating the leaching step, but the greatest hope for a large increase in productivity rests with a new pyrohydrolytic approach, an investigation under way in collaboration with the Geochemistry Section.

The new atomic-absorption instrument proved to be defective and was replaced by the manufacturer. A number of instrumental problems were eventually overcome and the equipment has found use in nearly all of our atomic-absorption methods, producing results more rapidly than formerly possible and also permitting some work that was not feasible on the old instrument.

Earlier work on rare-earth determinations by graphite-furnace atomic absorption was done on equipment belonging to the Geochemistry Section. More recently, an old graphite furnace was borrowed from CANMET and used on our new a.a. spectrometer. Encouraging results were obtained, but they were limited by the obsolete design of the furnace. At the end of the year, there was still a question whether a more modern graphite furnace should be acquired, or whether future rare-earth work should be contracted-out for analysis by neutron-activation techniques.

Studies continued with the "threaded-rod" method of introducing solid samples into an atomic-absorption flame but progress was impeded by the presence of some metallic impurities in the supporting rods and by difficulty in finding suitable materials for use as calibration standards.

A small, old atomic-absorption instrument, recently in use merely as a source of spare parts, has been given to the Terrain Sciences Division on extended loan. The large, older instrument is still in use, mainly because its modular design provides for greater flexibility than is possible with the highly automated new one.

Modifications to the "fluxer" apparatus permitted a doubling of the rate of production of fused sample discs for XRF analysis. A reduction in the number of "normalizers" led to a slight increase in the rate of output of the XRF spectrometer, but that improvement was lost with increasing instability in the summer months. The possiblity of improving stability by controlling the temperature of cooling water (or even perhaps by improved air-conditioning) is under study at this writing. Plans are well-advanced for the installation of a more modern processing system for output data from the XRF spectrometer, involving a direct link to the big computer at the Computer Science Centre.

In spite of recurrent hardware and software problems with the energy-dispersive XRF system, it has been adapted to some analytical problems -- namely rubidium and strontium for geochronology (a method which may well be superior to isotopic dilution mass spectrometry) as well as a suite of difficult trace elements that cannot ordinarily be resolved by other methods. The equipment is now housed in the same laboratory as the production-oriented wavelength-dispersive system and several additional staff members have been trained in its use. To make room for that equipment, an old, manually-operated spectrometer has been discarded. Some additional structural changes in the laboratory are expected to facilitate the work of both systems.

Spectrographic

There was a dramatic drop (43 per cent) in the number of samples received, compared to the preceding year, a rather surprising development, considering that the chemical and XRF laboratories experienced a slight increase in demand. Fortunately, a 15-per cent increase in output led to more samples being reported than the number received, with a resulting drop in backlog of 54 per cent.

As usual, the air-conditioning system was a continuing source of problems.

Considerable saving was achieved in floor space when the darkroom maze was replaced by a double-door light-trap, but plans for the installation of an improved gas-distribution system have run into repeated difficulties, both with Public Works and their potential contractors.

The highly modified direct-reading instrument, long over-due for replacement, was "nursed along" in the hope that it will survive until something better is within reach. Problems with the DC-arc source were overcome by emergency repairs; it is expected that it will be replaced by the source now used with the Wadsworth photographic instrument. Improvements were made in the "read-out" end, with the introduction of a floppy disc system that permitted elimination of an old teletype and punched-paper tape.

Developments in photographically based methods were directed mainly toward eventual adaptation to the new Ebert-mount spectrograph whose delivery is expected early in 1981-82. A major effort went into further refinement of the former "semi-quantitative" method, now known better as a "general" method. The method is applicable to a much greater variety of matrices than is possible with the trace-element method designed primarily for use with rocks and compositionally similar materials, but it loses in sensitivity where it gains in versatility. However, it is of great value in dealing with the increasing number of samples of unusual composition. Because of the highly

varied compositions that can be handled, the method requires the use of many more spectral lines in order to control the effects of possible interferences.

In the above work, as well as that on the traces-in-rocks method, extensive use has been made of the small microcomputer. About four months after the arrival of the new spectrograph, it is anticipated that both of the above-mentioned methods will be in use on it, and all data conversion from densitometer readings to concentrations will be done by the micro-computer.

Subsequently, it will be necessary to up-date such dormant methods as that for low concentrations of certain elements and that for trace elements in iron-rich matrices. Possible additional work could be done on a method with parameters optimized for the determination of traces of rare earths.

Production Statistics

1. Samples Processed

	Chemical and XRF	Spectro-graphic	Total
Carried from 1979-80	2107	2778	4885
Received in 1980-81	5880	2392	8272
	7987	5170	13157
Completed in 1980-81	6768	3031	9799
Withdrawals, corrections	18	865	883
Carried to 1981-82	1201	1274	2475

Divisional Breakdown of Backlog (No. of samples)

	Chemical and XRF	Spectro-graphic	Total
Central Labs and Tech Services	0	10	10
Cordilleran	0	7	7
Economic Geology	755	603	1358
Institute of Sedimentary and Petroleum Geology	14	14	28
Precambrian	36	145	181
Resource Geophysics and Geochemistry	396	305	701
Terrain Sciences	0	172	172
Others	0	18	18
	1201	1274	2475

2. Comparison with preceding year

		1979-80	1980-81
Samples received:			
	Chemical and XRF	5588	5880
	Spectrographic	4164	2392
		9752	8272
Samples completed:			
	Chemical and XRF	4242	6768
	Spectrographic	2633	3031
		6875	9799
Determinations:			
	Chemical	25258	37754
	X-ray fluorescence	40722	74452
	Spectrographic-semiquantitative	4382	14815
	-quantitative	67186	68727
		114818	195748
Total spectrographic analyses:			
	Qualitative	4	1
	Semi-quantitative	132	541
	Quantitative	2782	2583
		2918	3125
Spectrographic exposures:			
	Photographic - analytical	899	1217
	- development, control	1185	631
	Direct reader- analytical	2899	3232
	- development, control	1875	1271
		6858	6351

Mineralogy

A. G. Plant

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

Highlights

- Mineralogical data for four new minerals, franconite, doyleite, pararealgar and comancheite were submitted to and approved for publication by the International Mineralogical Association. New crystallographic data for the minerals bohdanowiczite, durangite, nordenskiöldine, and nordite were submitted to and accepted as reference standards by the International Centre for Diffraction Data. The GSC reference collection of X-ray specimen mounts and standard powder patterns was increased by the addition of new data for 85 minerals. Optical data obtained from a literature search were compiled for minerals appearing in JCPDS Sets 1 to 23 and submitted to the International Centre for Diffraction Data for publication in the Mineral File.

- Mineralogical support was provided to five members of RGG Division for their presentations at the workshop on 'Uranium in Granites' in Ottawa in November. Other studies in uranium mineralogy included the completion of a report on the alteration products of allanite and a detailed study of the uranium calcium phosphate, ningyoite, that occurs as a major mineral in the Blizzard and Tyee uranium deposits, British Columbia.

- Representation of mineral species in the Systematic Reference Series of the National Mineral Collection increased to approximately 1900, or three-quarters of all known minerals; the type mineral specimens, about 50, were fully catalogued and the data provided to the Royal Ontario Museum for their planned directory of Canadian type specimens; collections of minerals and rocks were made in the South Red Wine and Mann-1 alkalic complexes in central Labrador for reference, study and exchange.

- In addition to normal production the Mineral and Rock Set Preparation Unit responded to special requests for mineral and rock specimens from the Canadian Exhibition Commission, the Canadian Unity Information Office, CANMET, National Museum of Natural Sciences, University of Western Ontario, Dupont Canada Inc., and the Office of the Prime Minister of Malta. Large blocks of gabbro and hornblende syenite were collected, prepared and shipped to the Whiteshell Nuclear Research Establishment, Pinawa to aid their research studies in the Canadian Nuclear Waste Management Program. To provide material for the preparation of the rock and mineral sets, fieldwork was undertaken in British Columbia, Alberta, Saskatchewan, Manitoba, Ontario and Quebec. The work involved more than 26000 km of travel and the collection of 21 tonnes of minerals, rocks, ores and fossils from 55 localities.

- Considerable progress was made in the application of energy dispersive spectrometry to complex matrices involving K, L and M X-ray lines, particularly minerals containing rare earth elements, uranium and thorium.

- To meet the increasing demand for scanning electron microscopy studies in support of many Branch projects, plans were initiated to acquire a second scanning electron microscope. A four-year old, but little used, Cambridge S-180 instrument in excellent working order, was acquired from the Department of Anatomy at the University of Calgary, and was received in Ottawa at the end of March.

Personnel Notes

R.J. Traill, Head of the Mineralogy Section since 1959, retired June 1st after 27 years' service with the Geological Survey. A.G. Plant was appointed Section Head in August.

D.B. Machin was appointed Supervisor of the Sample Preparation and Mineral Separating Laboratories in June, in succession to J.C. Paris who had retired in 1979.

During the year, R. Connelly, S. Frewen, C. Kari, S. Laperriere and R. Tremblay have been employed in term positions. In March, S. Frewen was appointed Sample Curator Assistant to work at the Reference Collection Facility at Tunney's Pasture.

H.R. Steacy received an Incentive Award for suggesting a means of publicising major scientific awards won by EMR personnel.

Attendance at Meetings, Conferences and Courses

H.G. Ansell

- Greater Detroit Gem and Mineral Show, and Meeting of the Mineral Museums Advisory Council, Detroit, Michigan, October 1980
- St. John's Ambulance First Aid Course (EMR sponsored), Ottawa, November 1980
- EMR Field Safety Seminar, Ottawa, January 1981
- EMR Handgun Training Course, Ottawa, January 1981

M. Bonardi

- Meeting of Electron Microbeam Users Group, Ottawa, October 1980
- Workshop on 'Uranium in Granites', Ottawa, November 1980

J.M. Larose

- Prospectors and Developers Association Annual Meeting, Toronto, March 1981

A.L. Littlejohn

- Short course on Fission Tracks in Geology and Chemistry, Ottawa, June 1980
- Workshop on 'Uranium in Granites', Ottawa, November 1980

A.G. Plant

- Short course on Neutron Activation Analysis in the Geosciences, sponsored by the Mineralogical Association of Canada at Dalhousie University, Halifax, May 1980
- Geological Association of Canada/Mineralogical Association of Canada Joint Annual Meeting, Halifax, May 1980
- Microbeam Analysis Society Annual Meeting, Reno, August 1980
- Meeting of Electron Microbeam Users Group, Ottawa, October 1980
- 'Uranium in Granites' meeting and field excursion sponsored by NEA/IAEA, Madrid, October 1980
- Workshop on 'Uranium in Granites', Ottawa, November 1980

- Geoscience Research Seminar, Ontario Geological Survey, Toronto, December 1980
- Meetings at University of Toronto to monitor progress in the establishment of the Ultra Sensitive Analysis Facility, May, July, August, December 1980 and January 1981

G.J. Pringle

- Meeting of Electron Microbeam Users Group, Ottawa, October 1980

H.R. Steacy

- National Research Council of Canada Associate Committee on Meteorites, Ottawa, November 1980

- Tucson Gem and Mineral Show and Meetings of the Mineral Museums Advisory Council and Friends of Mineralogy, Tucson, Arizona, Februgry 1981

A.P. Stenson

- Geological Association/Mineralogical Association of Canada Joint Annual Meeting Halifax, May 1980
- Meeting of the Executive of the Mineralogical Association of Canada, Toronto, October 1980
- Joint Committee on Powder Diffraction Standards (Minerals Subcommittee) - International Centre for Diffraction Data, Swarthmore, Pennsylvania, October 1980

W.U. ter Haar Romeny

EMR Retirement Seminar, Ottawa, February 1981

D.A. Walker

- Scanning Electron Microscopy Conference, Chicago, April 1980
- Geotechnical Information Meeting, Canadian Radwaste Program, Ottawa, May 1980
- Meeting of Electron Microbeam Users Group, Ottawa, October 1980
- Cambridge SEM/Kevex EDS Users Group meeting, Calgary, December 1980

Membership on Committees

A.G. Plant

- G.S.C. Classification Committees
- Canadian representative to NEA/IAEA project committee on "Uranium Favourability by Mineral Analyses"
- Organizing Committee for establishment of an Ultra Sensitive Analysis Facility at the University of Toronto
- Mineralogical Association of Canada representative on the International Mineralogical Association Commission for Cosmic Mineralogy
- Chairman, Microanalysis Group, Spectroscopy Society of Canada

A.C. Roberts

- Organizing Committee for the Twelfth Congress and General Assembly of the International Union of Crystallography, Carleton University, 1981

H. R. Steacy

- Member, National Research Council of Canada Associate Committee on Meteorites, and Chairman of the Education sub-committee
- Chairman, Publicity Committee, Mineralogical Association of Canada
- Director, Friends of Mineralogy
- Branch Library Committee
- Member, Canadian Institute of Mining and Metallurgy, Ottawa Branch Executive Committee

Ann P. Stenson

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

W.U. ter Haar Romeny

- Branch Safety Committee

Special Talks and Lectures

A.G. Plant

- "Applications of scanning electron microscopy to the Canadian Radioactive Waste Disposal Program" at Microbeam Analysis Society annual meeting, Reno, August 1980

D.A. Walker

- "Sample preparation techniques in scanning electron microscopy" to meeting of Electron Microbeam Users Group in Ottawa, October 1980, and to Cambridge-Kevex Users Group Seminar in Calgary, December 1980

Manuscripts

Manuscripts for 5 GSC papers and 9 papers for outside journals were approved for publication by the Division.

Laboratory Statistics

X-ray Diffraction and General Mineralogy

Studies were made in support of 50 Branch projects and outside agencies. X-ray diffraction analyses involved 1251 Debye-Scherrer camera mineral identifications; preparation of 85 reference standard patterns; and 425 X-ray diffractometer chart recordings for mineral identification and examination, including clay analyses. Microscopic examinations and X-ray diffractometer analyses of 162 mineral concentrates were completed in support of the radiometric age determination program. Studies in uranium mineralogy

were completed in support of 12 Branch projects (5 for EG Division, 7 for RGG Division) involving preparation of radioluxographs for 386 rocks and 192 thin sections and 75 days of electron microprobe analysis and scanning electron microscopy.

Curation of Collections

Accessions to the mineral collection totalled 263, including 69 species new to the collection, which is an all-time high for this important accession category. The total species representation is currently around 1900, or about three-quarters of all known minerals . 191 specimens, normally of a specialized nature, were supplied in response to 50 individual requests in support of Branch projects and research elsewhere, mainly in the geosciences. 865 specimens were fully catalogued, including the type specimens. This is about three times the number catalgued in 1979-80 and is due mainly to the contractual assistance of a mineralogist-cataloguer for two months. Consultative services and advice on mineralogical matters outside the Branch consumed three man-weeks of curatorial time. 23 exchanges were conducted with institutions and collectors throughout the world.

Maintenance and services of the rock-collection unit at Tunney's Pastures continued, with direct service to the scientific staff totalling 183 man-days, of which one-half was provided to the Precambrian Division. The Tunney's Pasture repository assumed curatorial responsibility for the drill core accruing from the Nuclear Waste Disposal Program.

Two new specimens were added to the National Meteorite Collection, representing the Mundrabilla and Wolf Creek meteorites of Western Australia. Three specimens and one thin section were provided for meteorite research studies at the University of Alberta and Carnegie Geophysical Laboratory, Washington. Ten suspected meteorites were examined for the public but all proved to be of terrestrial origin. Two meteorite specimens were supplied on exchange to a private collector. The portable meteorite displays were loaned for six events. These included the Central Canadian Federation of Mineralogical Societies' Meeting in London, Ontario, a special exhibition at the Moose Jaw Art Museum and four Semaine des Science exhibitions in Montreal and Quebec City.

Assistance to the Public

Mineralogical services to the public required the identification of 428 specimens of minerals and rocks with the results being communicated in 35 written and 59 verbal reports.

Preparation of Rock and Mineral Sets

Sales of Prospector's Sets of Rocks and Minerals amounted to 5896, compared to 6070 in the previous year. Distribution of these across Canada was as follows:

	1979-80	1980-81
Alberta	763	1198
British Columbia	1600	817
Manitoba	48	52
New Brunswick	369	74
Newfoundland	29	19
Nova Scotia	131	300
Northwest Territories	45	98
Ontario	1448	1517
Prince Edward Island	0	6
Quebec	302	410
Saskatchewan	181	278
Yukon	250	502
GSC Ottawa	349	253
EMR Ottawa	511	275
Others	44	97

Sales of the 120 specimen collection representing the Raw Materials of Canada's Mineral Industry amounted to 192, an increase of 19 over the previous year. At the request of the National Film Board, 65 collections were supplied to accompany Earth Science Filmstrip Kits. Revenue from the sale of all sets and collections, payable to the Receiver General, was $33,509.00.

A display case illustrating the Prospector's Sets and the Economic Collection was loaned to: Moose Jaw Art Museum, University of Waterloo, Concordia University, Expo Quebec, and the National Museum of Natural Sciences, Ottawa.

Sample Preparation and Mineral Separation

Although there was a reduction in the number of samples crushed and ground for chemical analysis, more complex and extensive mineral separation procedures accounted for an increase in laboratory productivity.

	1979-80	1980-81
Samples crushed and ground	5191	3835
Heavy liquid separations	3903	3566
Magnetic separations	1694	3067
Superpanner separations	724	2265
Wilfley table separations	67	115
Final mineral concentrates	295	299

Electron Microbeam Analysis

Analytical studies were provided in support of 34 Branch projects and 4 projects that originated outside of the Branch, and as in previous years these projects encompassed a broad range of geological topics. Although there was a small decrease in the support of these projects, this was necessary to allow sufficient instrument time to be available for essential method development, particularly energy dispersive spectrometry procedures.

Comparison of Annual Mineralogical Service Charges

An internal costing system has been used for several years to record, evaluate and compare services provided to Branch scientists by the three main support service projects of the Section. The dollar values assessed to the services are unreal in the sense that they were assigned arbitrarily in 1970 to approximate minimum costs and have not been reviewed to reflect increased costs as the result of inflation. The figures are of interest in that they indicate the relative amounts of support we provide annually to the various divisions. The values published last year for 1979-80 for projects 770054 and 680023 have been recalculated to allow comparison with values for 1980-81 when changes in time allocation were introduced:

	1979-80 $	1980-81 $
Sample Preparation (770054)		
Economic Geology	2448	7676
Precambrian	23433	37746
Geophysics and Geochemistry	1760	1504
Terrain Sciences	24	728
Central Laboratories and Others	15068	1992
Total	42733	49646
XRD and Mineralogy (680023)		
Economic Geology	11400	5640
Precambrian	2250	2130
Geophysics and Geochemistry	10240	13730
Terrain Sciences	4030	2670
Central Laboratories and Others	8655	8820
Total	36575	32990

Electron Microbeam (620308)

Economic Geology	14925	15425
Precambrian	33825	20175
Geophysics and Geochemistry	6100	8075
Terrain Sciences	15675	15025
Central Laboratories and Others	15650	21500
Total	86175	80200

Totals

Economic Geology	28773	28741
Precambrian	59508	60051
Geophysics and Geochemistry	18100	23309
Terrain Sciences	19729	18423
Central Laboratories and Others	39373	32312
Total	165483	162836

Technical Services Section

R.J. Thibedeau

The design, fabrication, modification and maintenance of equipment of a mechanical and/or electronic nature, in support of Branch laboratory and field projects and operations, is provided by this Section.

This year a total of 236 work orders were received (an increase of 34% over 79/80) of which 192 were completed and 44 carried over, an increase in productivity of 21.5%.

Statistics

The distribution of work load by Division, based upon orders completed is:

CLTS	37%
RGG	23%
PC	20%
TS	7.4%
GID	4.3%
REG	1.3%
EG	1%

Emergency requests for services accounted for the remaining 6% of the work load.

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. The Vancouver based part of the Division is involved in a broad spectrum of research in those parts of the Cordillera mainly southwest and west of the areas of major hydrocarbon potential. Therefore, emphasis is placed on projects that are important for mineral exploration and assessment. Complementary to a study of Tertiary and recent volcanism is investigation of geothermal sources in the Cordillera. The Division maintains an excellent research library which is open to the public and operates a Sales Office where Departmental publications and maps are available. Gross sales in 1980 were approximately $147,000.

Highlights

Bedrock mapping of the Nahanni map-area (105-I) was completed during a major joint program involving 11 staff geologists and geochemists associated with the Integrated Multidisciplinary Pilot Project (IMPP). The bedrock study provides the foundation for continued exploration for strata-bound lead-zinc deposits and for geochemical and metallogenic studies. The integrated study by bedrock and surficial geologists, geochemists and metallogenists is proving to be very successful.

Revision mapping of the Hope-Ashcroft map-areas (92-H and 92-I) has provided evidence that parts of the western Cordilleran "collage" were amalgamated by late Triassic, that is, terranes that originated far apart and far from their present sites were together as long ago as the Triassic. The discovery of Paleozoic fossils (Devonian and Permian) in the Coast Plutonic Complex near Prince Rupert forces a reassessment of the age, origin and metal potential of metamorphic rocks included within the Complex.

The eruption of Mount Saint Helens brought a barrage of requests for information to Dr. Souther who participated in public lectures, open-line radio and television shows and radio and press interviews. The Meager Mountain and Mount Cayley volcanic geothermal prospects continue to show promise and both will see continuing exploration.

A model of the tectonic evolution of the Queen Charlotte Islands and surround-

ing offshore area provides important concepts for the continuation of oil and gas exploration.

Personnel Notes

The Cordilleran Division has an establishment of 40 permanent employees, 28 at Vancouver and 12 at Pacific Geoscience Centre at Patricia Bay. At Vancouver there are 16 scientists and 12 people involved in the operation of administration, sales office, draughting services and library. In addition K.M. Dawson of Economic Geology Division and J.J. Clague of Terrain Sciences Division are stationed at Vancouver and the Division currently is host to L.C. Struik, a visiting fellow.

The Marine Geology Section establishment consists of 7 scientists (one position currently vacant), 4 technicians and one administrative clerk. C.J. Yorath is the section head.

Vancouver Office

R.I. Thompson transferred from ISPG 1 May, 1980.

M.J. Orchard joined the permanent staff on 2 February, 1981.

Elsie Gillis was appointed general office clerk, administration on 12 November, 1980.

Mory Dong was appointed accounts clerk 2 March, 1981.

Pacific Geoscience Centre

D.L. Tiffin resigned 1 August, 1980.

Patrick McLaren joined the staff 1 May, 1980.

Susie Cameron resigned 29 August, 1980.

Clair Denny was appointed clerk-typist 3 November, 1980.

Marjorie Manger was appointed laboratory technician 7 November, 1980.

1980-81
Attendance at Meetings, Conferences, Courses

B.D. Bornhold

Geological Association of Canada, Annual Meeting, Halifax, N.S., May 1980.

American Geophysical Union, Spring Meeting, Toronto, Ont., April 1980.

Pacific Northwest American Geophysical Union, Sidney, B.C., September 1980.

Workshop on the Kitimat Marine Environment, Sidney, B.C., October 1980.

Canadian Pacific Continental Margin Symposium — Sidney, B.C., February 1981.

Course - Chemical Diagenesis of Clastic Sediments, Univ. Calgary, 18-20 Feb. '81.

R.B. Campbell

Annual Meeting, Geological Association of Canada, Cordilleran Section, Vancouver, B.C., February, 1981.

Canadian Society of Petroleum Geologists workshop "The Canadian Pacific Continental Margin", P.G.C., Sydney, B.C., February, 1981.

Cordilleran Geology Workshop, Queen's University, Kingston, Ontario, Feb. 1981.

R.G. Currie

American Geophysical Union, Pacific Northwest Regional Meeting, Pat Bay, B.C. September 25-26, 1980.

American Geophysical Union, Fall Annual Meeting, San Francisco, California, December 7-12, 1980.

H. Gabrielse

Annual Meeting American Association of Petroleum Geologists, Denver, Colorado, June '80.

Field trip in "Suspect terranes" of south-central Cordillera, October '80.

Annual Meeting, Geological Society of America, Atlanta, Georgia, November '80.

Workshop on tectonic map of North America, Austin, Texas, January '81.

Annual Meeting Cordilleran Section, Geological Association of Canada, Vancouver, B.C., February '81.

Workshop on Canadian Pacific Continental Margin, Pacific Geoscience Centre, Patricia Bay, B.C., February '81.

S.P. Gordey

Geoscience Forum - Whitehorse, Y.T., November 30 to December 2, 1980; presentation - Overview of Regional Geology, southern Selwyn Basin, Y.T. and N.W.T. (45 mins.).

J.L. Luternauer

Demand for site specific geologic quidelines which may be inferred from GSC studies of the Fraser Delta has continued apace. At request of Chairman, Provincial Order in Council 908 (Env. Assess. Comm.) have attended 7 meetings and reviewed reports related to:

1. Dredge spoil deposition and habitat restoration experiments involving the creation of artificial islands by Public Works Canada on Fraser tidal flats.

2. Proposed B.C. Hydro gas pipeline crossing along Fraser Delta front. Hydro had made available to GSC deepest cores ever obtained on delta slope.

3. Erection of training walls along Fraser River by Public Works Canada.

P. McLaren

Trends in sediment distributions: a method to predict oil spill movement in the coastal zone. Paper presented at, and published in the Proceedings of the third Arctic Marine Oilspill Program, Technical Seminar, Environment Canada, June 3-5, 1980, Edmonton (p. 417-432).

Presented paper "The coastal sediments of Labrador and their use to predict the movement of an oil spill in the coastal zone" at Labrador Coastal and Offshore Region Workshop, Goose Bay, Labrador, September 1980.

J.W.H. Monger

Attended U.S.G.S. Field trip to S.E. Alaska on Chugach Terrane, September 1980.

Led field trip in southern British Columbia with Terrane Map Group, October '80.

Workshop on new "Tectonic Map of North America"; University of Texas, Austin, Texas, January 26-29, 1981.

Geological Association of Canada, Cordilleran Section, Meeting on "The last 100 Million Years, (Mid-Cretaceous to Holocene) of Geology and Mineral Deposits in the Canadian Cordillera, February 13, 14, 1981.

Pacific Geoscience Centre: "The Canadian Pacific Continental Margin", February 16, 17, 1981.

J.A. Roddick

Northern Cascades, Washington; Field excursion, led by Prof. Peter Misch, University of Washington, May 17-18, 1980.

GAC Cordilleran Section, Annual Meeting, Vancouver, B.C., February 13-14, 1981.

J.G. Souther

Electric Power Research Institute, Annual Meeting, Monterey, California, June 20-27, 1980.

Geological Association of Canada, Cordilleran Section meeting, Vancouver, B.C., February 13-14, 1981.

R.I. Thompson

Geological Association of Canada, Cordilleran Section meeting, Vancouver, B.C., February 13-14, 1981.

H.W. Tipper

G.A.C. Symposium, Vancouver, B.C., February 1981.

J.O. Wheeler

Univ. Alberta - CSPG Course - Geophysics and Tectonics Course, Banff, Alberta, May 5-9, 1980.

Steering Committee of GSA Centennial Project, Boulder, Colorado, May 12, 1980.

Annual Meeting Geological Association of Canada, Halifax, N.S., May 19-21, '80.

Canadian Geoscience Council Meeting, Calgary, Alberta, September 28, 1980.

Geological Society of America Annual Meeting, Atlanta and Steering Committee, GSA Centennial Project, November 17-20, 1980.

Canadian Geoscience Council Meeting, Ottawa, Ontario, December 8-9, 1980.

Workshop on Tectonic Maps, Univ. Texas, Austin, Texas, January 26-29, 1981.

Cordilleran Section, GAC, Vancouver, B.C., February 13-14, 1981.

Pacific Offshore Geoscience Seminar, February 16-17, 1981.

Canadian Geoscience Council Meeting, Toronto, Ontario, March 9, 1981.

G.J. Woodsworth

Geological Association of Canada, Cordilleran Section, annual Symposium, Vancouver, B.C., February 1981.

C.J. Yorath

Eighteenth Annual Conference on Earth Sciences - Earth Movements, Causes and Effects, Banff, Alberta, May 1980.

Geological Association of Canada - Mineralogical Association of Canada, National Meeting, Halifax, N.S., May 1980.

Pacific Northwest Section of American Geophysical Union, Victoria, B.C., September 1980.

Cordilleran Section, Geological Association of Canada, Vancouver, B.C., Feb. '81.

Pacific Geoscience Centre - Canadian Society of Petroleum Geologists Symposium - The Canadian Pacific Continental Margin, Victoria, B.C., February 1981.

Earthquakes - What you always wanted to know but were afraid to ask. A public Forum, Victoria, B.C., March 1980.

Membership on Committees

B.D. Bornhold

Departmental Coordinating Committee on Ocean Mining, Energy, Mines & Resources.

Planning Committee, 1983 Geological Association of Canada Meeting.

R.B. Campbell

Advisory Committee, British Columbia and Yukon Chamber of Mines.

Parks and Education Committees, British Columbia and Yukon Chamber of Mines.

H. Gabrielse

Geological Society of America, Councillor.

Canadian Committee on the Lithosphere, Member.

Revision of the North American Code on Stratigraphic Nomenclature, Committee Member.

S.P. Gordey

British Columbia and Yukon Chamber of Mines - Safety Committee.

S. Leaming

Planning Committee, British Columbia Museum of Mining, Britannia Beach, B.C., Member.

Contributing to display on local and regional geology at museum site thus bringing attention to the work of the Geological Survey of Canada.

J.L. Luternauer

Provincial Order-in-Council 908 Environmental Assessment Committee.

P. McLaren

Member of the Physical Technical Sub-committee for BIOS (Baffin Island Oil Spill program) - Department of Environment.

J.W.H. Monger

President, Cordilleran Section - Geological Association of Canada.

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

Member, Working Group 8, Transects Program.

Associate Editor, Canadian Journal of Earth Sciences and Geoscience Canada.

J.A. Roddick

Editor, Circum-Pacific Plutonism Project; International Union of Geological Sciences - Internation Geological Correlations Program.

J.G. Souther

Meager Creek working group, Program Review Committee and Meager Creek Management Committee.

Scientific authority for 10 geothermal research contracts.

R.I. Thompson

Geological Association of Canada, Annual Meeting, May 1981: Co-chairman of Field Trip Organizing Committee (with D.G. Cook).

H.W. Tipper

North American representative on the International sub-Commission on Jurassic Stratigraphy.

J.O. Wheeler

Vice President, Canadian Geoscience Council for 1980, President for 1981.

Director, Canadian Geological Foundation.

Member, Steering Committee, Geological Society of America, Centennial Project.

G.J. Woodsworth

Member, Advisory Committee on Glaciological and Alpine Nomenclature of the Canadian Permanent Committee on Geographic Names.

Councillor, 1980-81, Geological Association of Canada, Cordilleran Section.

C.J. Yorath

Head, Marine Geology Section, Cordilleran Division, Pacific Geoscience Centre.

Member of Executive, Victoria Chapter, Geological Association of Canada.

Technical Program Chairman, Geological Association of Canada, National Meeting, Victoria, 1983.

Member, Canadian Committee for the Lithosphere.

Co-leader, Canadian Geodynamics Cross-section of Pacific margin.

Co-leader, International Geodynamics Transect Program, Pacific Margin.

Special Talks or Lectures

B.D. Bornhold

"Sedimentation on the Vancouver Island Continental Shelf", Seminar, Institute of Ocean Sciences, Sidney, B.C.

R.B. Campbell

"Structure of the Cariboo Mountains", U.B.C., March 1981.

H. Gabrielse

"Mid-Cretaceous granitic rocks in the Omenica Crystalline Belt"; Annual Meeting Geological Association of Canada, Vancouver, B.C., February 1981.

"Regional geology and tectonics of northwestern British Columbia"; Edmonton Geological Society, Edmonton, Alberta, February 1981.

J.L. Luternauer

By invitation:

Led field trip across Fraser Delta for faculty member students of the University of Calgary and oil company personnel.

Presented talk on "Man's impact on Fraser Delta sediment Circulation" to Greater Vancouver Regional District Planning Group.

Presented talk to Pacific Estuarine Society on "Geologic processes on the Fraser Delta front and their role in the development and destruction of habitats".

P. McLaren

Advised AMOP (DOE) on the use of grain size distributions to provide baseline information on the selection of oil spill sites at Cape Hatt, Baffin Island (23-31 January - Edmonton).

J.W.H. Monger

"The Cache Creek Group in Northern British Columbia - Nature, External Relationships and Tectonic Significance". University of Washington, November.

"The Cordilleran Collage" at Pacific Geoscience Centre, February 17.

J.G. Souther

"Cenozoic geology of the Cordillera", U.B.C., April 3.

"Mt. St. Helens", Webster Show. 1½ hour Television Special (CTV).

"Volcanic Risks", Emergency Planning, Briefing, Robson Square Media Centre, Vancouver, B.C., July 22.

"Mt. St. Helens - a Cascade Volcano Explodes", Physics Colloquium, U.B.C. Physics Department, September 11.

"Volcanic Hazards in the Lower Mainland" - public lecture, Agassiz Research Station, September 24.

"The Eruptions of Mt. St. Helens", G.A.C. evening lecture series, Vancouver, B.C., October 23.

"The Volcanoes Around Us", public lecture, Vancouver Institute, Fall Series, November 29.

"Why Volcanoes Erupt", Chemical Institute of Canada, Evening Lecture, March 31, 1981.

26 Radio Interviews.

2 Open-line radio shows, CKNW.

3 T.V. Specials, CTV, KOMO, CBC.

"Projected Geothermal Energy Development in Canada", Fourth Annual EPRI Geothermal Conference, Monterey, California, June 20-27.

"Geothermal Energy - harnessing volcanic heat", Vancouver Rotary, July 8, Vancouver Hotel.

Geothermal Energy and Meager Creek, Environmental Outdoor Education Conference, Denman Place Inn, Vancouver, B.C., March 13.

R.I. Thompson

Geological Association of Canada, Cordilleran Section meeting: "Status of the Laramide Orogeny".

CIM distinguished lecturer for Nova Scotia: The following talks were presented at Dalhousie, St. Mary's and Memorial Universities.

"Evolution of the northern Canadian Rocky Mountains"
"Pb/Zn deposits of northeastern British Columbia"
"Fold development within the foothills of the northern Rockies".

J.O. Wheeler

Summary and Comment; Symposium "Last 100 Million Years" Cordilleran Section, GAC, Vancouver, B.C., February 1981.

C.J. Yorath

Some aspects of the geology and structural style of the Vancouver Island Continental Margin.; C.J. Yorath and R.G. Currie; Geological Association of Canada, National Meeting, Halifax, N.S., May 1980.

The Apotheosis of Wrangellia. C.J. Yorath, R.L. Chase and E. Irving; Pacific Northwest Section of American Geophysical Union, Victoria, September 1980.

Tectonic history of allochthonous terranes, northern Canadian Pacific continental margin; C.J. Yorath and R.L. Chase; Cordilleran Section of the Geological Association of Canada, Vancouver, B.C., February 1981.

Tectonic history and geological architecture of Queen Charlotte Sound, Hecate Strait and Queen Charlotte Islands; C.J. Yorath; Pacific Geoscience Centre - Canadian Society of Petroleum Geologists Symposium, Victoria, February 1981.

Completed Manuscripts

B.D. Bornhold

Bornhold, B.D.
1980: Surficial sediments on the continental shelf, northwestern Vancouver Island; Geological Survey of Canada, Open File 702.

Bornhold, B.D.
(in press) Sedimentation in Douglas Channel and Kitimat Arm; Jour. Fish. and Aquatic Sciences.

Ludwig, W.J., Krasheninnikov, V. and others
1980: Tertiary and Cretaceous paleoenvironments in the southwest Atlantic Ocean: Preliminary results of Deep Sea Drilling Project Leg 71; Geol. Soc. Amer., Bull., v. 91, p. 655-664.

Macdonald, R.W., Bornhold, B.D. and Webster, I.
(in press) The Kitimat Fjord System: an introduction; Jour. Fish. and Aquatic Sciences.

B.E. Cameron

Cameron, B.E.B.
Biostratigraphy and Depositional Environment of the Escalante and Hesquiat Formations (Early Tertiary) of the Nootka Sound Area, Vancouver Island, British Columbia. G.S.C. Paper 78-9.

Tipper, H.W. and Cameron, B.E.B.
1980: Stratigraphy and paleontology of the Upper Yakoun Formation (Jurassic) in Alliford Bay Syncline, Queen Charlotte Islands, B.C.; in Current Research, Part C, G.S.C. Paper 80-1C, p. 37-44.

Cameron, B.E.B. and Tipper, H.W.
1981: Jurassic biostratigraphy, stratigraphy and related hydrocarbon occurrences of Queen Charlotte Islands, B.C.; in Current Research, Part A, G.S.C. Paper 81-1A, p. 209-212.

H. Gabrielse

Gabrielse, H.
1981: Stratigraphy and Structure of Road River and associated strata in Ware (West Half) map area, northern Rocky Mountains, British Columbia; in Current Research, Part A, Geological Survey of Canada, Paper 81-1A, pp. 201-207.

S.P. Gordey

Gordey, S.P.
Stratigraphic Framework of Southeastern Selwyn Basin, Nahanni map-area, Yukon Territory and District of MacKenzie; Current Research, G.S.C. Paper 81-1A, p. 395-398.

S. Leaming

A manuscript on Jade in British Columbia and Yukon Territory was prepared for C.I.M.M. Special Volume, Industrial Minerals. This has not yet been published.

P. McLaren

McLaren, P., Barrie, W.B., Semples, J.M., Sieffert, R.A., Taylor, R.B. and Thomson, D. Coastal environmental data from eastern Lancaster Sound and north-eastern Baffin Island; Bedford Institute, Data Report Series.

McLaren, P.
An interpretation of trends in grain size measures. Accepted for publication, J. of Sedimentary Petrology.

McLaren, P.
Using the sediments to predict oil spill movement on shorelines. Journal of the Fisheries Research Board of Canada.

McLaren, P.
Hydraulic control of grain-size distributions in a macrotidal estuary-a discussion. Submitted to Sedimentology.

McLaren, P.
River and suspended sediment discharge into Byam Channel, Queen Elizabeth Islands, Northwest Territories, Canada.

J.W.H. Monger

Monger, J.W.H., Coney, P.J. and Jones, D.L.
1980: Cordilleran Suspect Terranes, Nature, v. 288, pp. 329-333.

Monger, J.W.H.
1981: Geology of parts of western Ashcroft map-area, southwestern British Columbia; in Current Research, Part A, Geological Survey of Canada, Paper 81-1A, pp. 185-189.

Monger, J.W.H., Price, R.A. and Muller, J.E.
(in press) Cordilleran Cross-section, Calgary to Vancouver-Geological Association of Canada Guidebook, 157 typewritten pages, 55 figures.

J.A. Roddick

Review: Variscan Geohistory of Northern Japan: The Abean Orogeny, Editors, M. Minato, M. Hunahashi, J. Watanabe and M. Kato, Tokai University Press, 1979, 427 p.: in Geoscience Canada, Sept. 1980, v. 7, p. 129-130.

Geology of Northeast Alert Bay Map Area (92L), scale 1:125,000, G.S.C. Open File 722, December 1980.

Fraser River, British Columbia-Washington, Sheet 92, 1:1 Million Geological Atlas, Map 1386A, Compiled by J.A. Roddick, J.E. Muller and A.V. Okulitch; Co-ordinator, R.J.W. Douglas.

J.G. Souther

(in press) Projected Geothermal Energy Development in Canada, EPRI Journal.

This paper provides a progress report on the status of existing geothermal projects in Canada and, based on existing geological and thermal data, presents an estimate of total potential and rates of development during the next decade.

Souther, J.G., Fritz, P., Clark, I. and Michel, F.
(in press) Isotope Hydrology and Geothermometry of the Mount Meager geothermal area, Geothermal Resources Council.

The paper documents differences in the isotopic make up of surface v.s. hydrothermal waters at Meager Mountain and examines the use of chemical geothermometers to predict subsurface temperatures.

Souther, J.G.
1980: Geothermal Reconnaissance in the Central Garibaldi Belt, British Columbia; in Current Research, Part A, Geol. Surv. Can., Paper 80-1A, p. 1-11.

Volcanic Hazards in the Stikine Region of Northwestern British Columbia, Geological Survey of Canada, O.F. 770.

H.W. Tipper

Tipper, H.W. and Cameron, B.E.B.
1980: Stratigraphy and Paleontology of the Upper Yakoun Formation (Jurassic) in Alliford Bay Syncline, Queen Charlotte Islands, British Columbia; in Current Research, Part C, Geological Survey of Canada, Paper 80-1C.

Tipper, H.W. and Cameron, B.E.B.
1981: Jurassic Biostratigraphy, Stratigraphy and Related Hydrocarbon Occurrences of Queen Charlotte Islands, British Columbia; in Current Research, Part A, Geological Survey of Canada Paper 81-1A, p. 209-212.

Tipper, H.W.
(in press) Offset of an Upper Pliensbachian Geographic Zonation in the North American Cordillera by Transcurrent Faulting; Canadian Journal of Earth Sciences.

J.O. Wheeler

Book Review
1981: Geology of New Zealand in Episodes.

G.J. Woodsworth

Woodsworth, G.J.
1980: Geology of Whitesail Lake (93E) map-area, B.C.; Geological Survey of Canada, Open File 702 (map).

Lewis, T.J. and Woodsworth, G.J.
(in press) Heat generation in the northern Hogen Batholith and nearby plutons of McConnell Creek map-area, B.C.; Geological Survey of Canada, Current Research.

C.J. Yorath

Tectonic history of the Queen Charlotte Islands and adjacent areas; Senior author C.J. Yorath, Junior author, R.L. Chase. Submitted to Canadian Journal of Earth Sciences.

ECONOMIC GEOLOGY DIVISION

G.B. Leech, Director

The Economic Geology Division is responsible for providing information on the non-hydrocarbon mineral resources of Canada: information on the geology of Canadian mineral deposits, on the probable distribution, character and abundance of resources additional to reserves, and on aids to their discovery. The Division provides appraisals of individual commodities, e.g. uranium resources of Canada, and comprehensive appraisals of specific regions. Uranium appraisals are made on a regular schedule, whereas the other appraisals are on an intermittent and increasingly frequent demand basis.

The Division's main activities to carry out this national role are: development of a national data base on the geology of mineral deposits; studies to determine the critical characteristics of individual deposit types and to relate them to those of their local and regional geological environments; development of concepts and methods for evaluating the potential of various regions to contain mineral deposits and guides to their discovery. Interaction with industry, other federal and provincial agencies, and universities is an important aspect of these activities.

The Division comprises five operational groups: Mineral Deposits Geology Section, Uranium Resource Evaluation Section, Geomathematics Section, Mineral Data Bank Section, and a Divisional Headquarters and Special Projects Unit. Its staff of 48 continuing positions and 3 casual person-years includes 24 research scientists, 16 physical scientists, 1 mathematical statistician, and 6 in administrative and technical support.

The Mineral Deposits Geology Section carries the main program of commodity and regional metallogeny other than in uranium. In commodity metallogeny, the geology of specific mineral commodities is studied on a national basis. Major metal commodities receive ongoing study whereas other commodities, selected on the basis of economic and strategic priorities, are studied on a term basis. Regional metallogenic studies, which relate the mineral deposits to the geological features in selected large regions, involve numerous commodities.

The Uranium Resource Evaluation Section specializes in the metallogeny of uranium, which affords links with a number of other commodities through related depositional environments and polymetallic deposits. The Section is

responsible for an annual appraisal of Canadian uranium and thorium resources additional to reserves and for assisting in CANMET'S companion appraisal of reserves.

The Geomathematics Section develops and applies methods for the quantification and statistical treatment of geoscience data in support of projects throughout the Geological Survey. Its main thrust is on mathematical models and statistical techniques applicable to mineral resource evaluation based on the deposit-type approach.

The Mineral Data Bank's main activity is the computerization of mineral deposit data, especially the development of a broad-coverage index-level file (CANMINDEX). It assists in the building and use of commodity-specific files, e.g. for iron which "hang" from the common index-level file, and special purpose files, e.g. for lead isotopes.

The Special Projects Unit undertakes responsibilities in matters such as regional resource evaluations, federal-provincial mineral agreements, and interbranch activities on industrial minerals and deep-sea mineral resources.

Highlights

Highlights of the year's achievements are presented in succeeding sectional reports but certain operations that had impact on the Division as a whole are noted here.

Following on the heels of last year's mineral resource appraisal of a huge area of northern Canada, almost all of the federal territories north of the tree-line, came requirements to appraise areas proposed for National Parks and sites designated for conservation in connecton with the International Biological Programme. An Interdepartmental Working Committee on Northern Mineral and Energy Resource Appraisal, representing Energy, Mines and Resources (Geological Survey of Canada), Indian and Northern Affairs and Environment Canada (Parks Canada), was set up to initiate the appraisals. The Economic Geology Division is represented on the committee and has major responsibilities in the appraisals, namely: development of regional geological syntheses within and relative to which the mineral information is presented and interpreted; appraisal of all non-hydrocarbon resources, co-ordinating inputs from other Divisions as required; and assembly of the reports.

By year-end the Phase I appraisals of two proposed park areas, in Northern Yukon and Ellesmere Island, were in final stages of preparation, a third, Bathurst Inlet, was

under way, and an International Biological Programme site on Bathurst Island had been reported upon.

A mineral resource appraisal of the whole of Yukon Territory was in progress at year-end, input to land claims negotiations being its expected first use. This Yukon study constitutes a new level of resource appraisal, requiring development of new working methods commensurate with the complexity of the geological working base and the abundance and variety of the identified resources.

These resource appraisals demand effort from all parts of the Division, directly from continuing staff and/or indirectly through diversion of person-months to term employees required. Mineral Deposits Geology Section, because of its make-up and size, carries a large share.

Personnel Notes

Lynda Picard-Charron joined the Administrative Office on 12 June, 1980, on transfer from Surveys & Mapping Branch.

Pauline Moyd, who has a wide acquaintanceship with facts and people in the industrial minerals field, retired in December.

Chris Findlay assumed a new position in the Director General's office in December but fortunately continues to be housed with and contribute to the Division.

MINERAL DEPOSITS GEOLOGY SECTION

R.I. Thorpe

The major objectives of the Mineral Deposits Geology Section are to: (a) develop and maintain mineral deposits expertise on a national basis so that questions regarding resource potential or adequacy, whether posed on a national commodity or on a regional basis, can be answered, and (b) contribute to the success of exploration efforts by the mineral industry.

To achieve these objectives, staff of the Section (1) acquire and synthesize data on Canadian mineral deposits types, other than uranium, so that their common characteristics and critical differences are more fully appreciated,

(2) develop and improve genetic models, particularly for major deposit tyes, and test these models by further observation and research,

(3) study deposits of numerous types on a regional basis in

order to better understand their formation in terms of the overall geological evolution of the region,

(4) improve the techniques and criteria used in making appraisals of mineral potential,

(5) assess regions as to their mineral potential.

The first two of these activities are generally pursued through commodity geology projects on a national basis. Major metal commodities receive ongoing study whereas other commodities, selected on the basis of economic and strategic priorities and availability of staff, are studied on a term basis.

The third activity is pursued, currently, in a small number of regional metallogeny projects. These integrate the data and conceptual models developed through commodity metallogenic studies with regional geological information available from published and unpublished sources and generated in the projects by directed field studies.

These Section studies are based on extensive fieldwork supplemented by laboratory studies and by monitoring the national and international literature on mineral deposit geology. Visits to foreign deposits contribute importantly to the ability to appraise mineral potential and to suggest geological settings or target areas in Canada that might warrant exploration.

The resource appraisals are conducted on an ad hoc basis in response to intermittent demands, which necessarily results in some disruption of the commodity-regional metallogeny program.

Mineral Deposits Laboratory

C.R. McLeod

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

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

Preparation of polished sections involves cutting, mounting, grinding, impregnation and regrinding and three stages of machine polishing of the ground surfaces.

Sections are polished for conventional ore microscopic study and for electron microprobe study.

Production statistics for the year are:

Specimens slabbed for:	
Economic Geology Division (includes more than 1400 drill core specimens)	5040
Resource Geophysics and Geochemistry Division	388
Total	5428
Slabbed specimens polished for:	
Economic Geology Division	640
Resource Geophysics and Geochemistry Division	389
Total	1029
Polished sections prepared for:	
Economic Geology Division	450
Precambrian Geology Division	14
Total	464

Mineral separation:

Some 300 samples were processed by various combinations of magnetic, heavy liquid and superpanner methods of concentration to produce monominerallic fractions, primarily for isotopic analyses.

Highlights

Sedimentary environments potentially favourable for the occurrence of shale-hosted lead-zinc deposits in three parts of the Arctic Islands were pointed out in a paper supplementary to an appraisal of a larger Arctic region. It presented the information and rationales used in rating favourably Lower Paleozoic strata in the Hazen Trough of Ellesmere Island, Proterozoic strata in the North Baffin Island Rift Zone, and Aphebian (?) strata in the Foxe Fold Belt, central Baffin Island.

A computerized file on 2240 Canadian molybdenum deposits and occurrences was readied for Open File release. It provides location and index-level geological data for each and, where available, grades and tonnages. A companion map, scale 1:5 million, displays 1389 of them with symbols indicating deposit type and size.

A summary report on Yukon copper deposits and occurrences has been completed. It is illustrated by distribution maps, scales 1:1,000,000 and 1:2,000,000 and accompanied by computer listings with further geological

information on the 370 deposits.

Studies on large low-grade gold deposits in syenite in Matachewan area, Ontario suggest that they are of porphyry gold type.

A joint field investigation (Mineral Deposits Geology, Paleontology and Geochemistry) of carbonate-hosted lead-zinc deposits in the carbonate shelf area bordering Selwyn Basin, Yukon showed that (1) a number of the deposits believed to be in the Cambrian Sekwi formation are in fact in overlying Cambrian strata, and (2) the Goz deposit is in Proterozoic rather than Lower Cambrian strata. Although this new information decreases the metallogenic significance of the Sekwi Formation, it increases that of the Proterozoic carbonate rocks. The latter are now known to contain the Goz and Gayna River deposits, two of the largest carbonate-hosted Pb-Zn deposits in the Mackenzie Mountains.

Compositional variations in selected major carbonate sequences are being examined in an effort, jointly with Esso Minerals Canada, to understand genetic processes responsible for carbonate-hosted lead-zinc deposits. Preliminary statistical studies relate field geological, petrographic and chemical data on the Sekwi Formation and on the Palliser Formation.

Samples collected from the Yava sandstone-lead deposit, Nova Scotia yielded spores that suggest that the deposit is in Canso-Riversdale Group strata, rather than in somewhat younger Pictou Group strata, as had previously been believed. Pending verification that the spores were deposited directly in these beds, and were not detrital from the underlying Windsor Group, this new information could have important exploration implications for sandstone-lead deposits in Cape Breton Island.

Two joint studies of sandstone-lead deposits arose from an interchange with the Geological Survey of Norway. A review summarized the geology of 12 sandstone-lead deposits throughout the world, in strata ranging from the Aphebian to the Cretaceous. The geological features, stable isotope data and physico-chemical principles, were synthesized into a genetic model. The authors concluded that genesis of sandstone-lead deposits involved metal transport by groundwater under, generally, arid conditions. The second study was on lead isotopes in a Norwegian sandstone-lead deposit and the adjacent basement granite. Ten lead isotope determinations on ore galenas and weathered and unweathered basement granites proved almost conclusively that the local basement was the source of the lead in the deposit.

A review of certain aspects of Canadian Shield metallogeny summarizes the general characteristics of massive sulphide, gold, nickel-copper and iron deposits in the Superior, Slave and Churchill provinces. Genetic models proposed for these deposit types indicate present deficiencies and suggest directions for research. They furthermore suggest exploration guidelines worth testing.

Personnel Notes

Dr. Arne Bjorlykke, of the Geological Survey of Norway, completed his year term as visiting scientist in September. Two papers resulted directly from this interchange (see Highlights).

J.M. Franklin presented a keynote address to the International Archaean Symposium at Perth, Australia.

URANIUM RESOURCE EVALUATION SECTION

V. Ruzicka

The Uranium Resource Evaluation Section gathers, generates and interprets information on the geology of uranium-bearing areas and deposits. It is responsible for an annual appraisal of Canadian uranium and thorium resources additional to reserves (Estimated Additional Resources) and for advising CANMET on geological questions related to its companion appraisal of Reasonably Assured Resources. The appraisal encompasses a range from inferred extensions of reserves in identified deposits to prognosticated and speculative resources of less-explored uranium-bearing areas and to areas assumed on geological grounds to be favourable for uranium mineralization. Emphasis is on uranium; thorium resources are evaluated only where they are associated with uranium. The evaluations are based on extensive field and laboratory studies and on materials and documentation provided by the industry, provinces, and universities. The evaluation, conducted in cooperation with CANMET, provinces and Department of Indian Affairs and Northern Development, is an input to the management of Canada's uranium and nuclear energy policy.

Highlights

Appraisal of Canada's uranium and thorium Estimated Additional Resources (i.e., resources in the inferred and prognosticated categories)as of 1979 was completed for 36 areas where these resources are associated with identified deposits. A further 35 areas with speculative resources or

features favourable for the occurrence of uranium were geologically appraised. Again this year the report included first-time appraisals of frontier areas, e.g. Baffin Island. The resulting internal report of some 500 pages, 40 tables and 69 illustrations was submitted on schedule to EMR's Uranium Resource Appraisal Group. Information from it was incorporated in the EMR publication "Uranium in Canada; 1979 Assessment of Supply and Requirements" (Report EP-80-3).

A computer-based Open File on Canadian occurrences of uranium and thorium was published. For 1756 occurrences it provides information on name, location, development status, geological type and character of mineralization. An accompanying map, scale 1:5,000,000, depicts 340 selected occurrences distinguished by deposit type.

Metallogenic studies of Proterozoic basins in the District of Keewatin showed their potential as a poly-metallic province.

Studies on Sustut and Bowser basins in Canadian Cordillera identified them as a uranium province.

A significant association between recently reported phosphatic rocks and uranium has been documented in several areas, such as Athabasca basin, Thelon basin and parts of Yukon.

Studies on spatial and genetic relationships between evaporites and uranium mineralization in the Windsor Group (Atlantic Canada) lead to a 'spin-off' conclusion on a genetic relationship between petroliferous zones and evaporitic carbonates.

Detailed mineralogical, petrochemical and isotopic research on uranium, thorium and rare-earth element mineralization associated with granitic rocks of the Grenville geological province revealed that primary U- and Th-bearing minerals crystallized during an earlier syenitic phase, whereas pyrochlore and accessory (secondary) uraninite enclosed in thick rims of hydrous silicates, calcite, sulphides and fluorite, crystallized during later hydrous quartz-microcline-albite granitic and deuteric phases. Evidence for processes of mobilization and redeposition was documented. An investigation method using backscattered electron images (BEI) was successfully introduced into this research.

The potential for uranium in the East Arm of Great Slave Lake area is enhanced if strata of the Et-Then Group are the same age as those of the Martin Formation at Beaverlodge, as Rb/Sr age determination of 1770 Ma on the Et-Then suggests. Studies of the Nonacho group, between the East Arm and Beaverlodge, showed that it is a possible

source for "Gunnar-type" mineralization in altered rocks beneath it.

Observations on ore-forming processes related to mobilization, migration and capture of uranium and rare-earth elements (REE) in layered and swelling phyllosilicates led to a proposal for utilization of these materials in construction of nuclear waste disposal sites.

Personnel Notes

L. Jones resigned from his position as support geologist to join the Alberta Energy Company Ltd. in June, 1980.

GEOMATHEMATICS SECTION

F.P. Agterberg

The Geomathematics Section's objective is to develop and apply methods for the quantification and statistical treatment of geoscience data in support of projects throughout the Geological Survey. Emphasis is on mathematical models and statistical techniques applicable to mineral resource determination through the deposit-type approach.

The Section was engaged during the year in pilot studies for the geomathematical integration of geological, geophysical and geochemical data from test areas in northwestern Manitoba and southern District of Keewatin.

Projects to which statistical support was given included the GSC-Esso Minerals Canada joint research project and the Radioactive Waste Disposal program.

Highlights

Work in 1980 on the development of methods for regional resource appraisal consisted of the application of geomathematical techniques to data from the Kasmere Lake-Whiskey Jack Lake area in northwestern Manitoba. This region of about 20,000 km^2 is located to the south of a larger test area of about 300,000 km^2 in southern District of Keewatin which, in recent years, has provided a focus for probabilistic mineral resource estimation in the Section.

Nine binary images were constructed for the Kasmere Lake area forming a multi-layered data base of map data in registration with each other for picture elements (pixels) measuring 167 metres on a side. These images represent bedrock geology, aeromagnetic contours, Bouguer anomalies, airborne gamma ray spectrometry data of three types, eskers and sand deposits, and 38 mineral occurrences in the area, respectively. Experiments of image analysis were carried

out to correlate the binary images with one another on a pixel-to-pixel basis.

Cells of 19 x 19 pixels (about 10 km^2) were used to construct 9 "variables", one from each image, for integration with 11 variables representing cell abundance of selected chemical elements. Experiments were performed to reconstruct the map of bedrock geology from the geophysical and geochemical variables. Signals were extracted from the lake sediment geochemical data by the elimination of regional trends and irregular local variability. The signal extracted for uranium shows a relatively strong correlation with the known uranium occurrences.

The Buffon needle problem for which the solution is well known in the theory of geometrical probability was generalized to the situation of unequally spaced parallel strips and needles with preferred orientation. This work is useful to determine the spacing of flight lines for locating anomalies in airborne geophysical surveys.

A statistical model and general purpose computer program were completed for the automatic ranking and scaling of stratigraphic events along a relative time axis. Options added to the computer program are (1) a normality test for comparing individual sections with a regional standard computed from many sections, (2) a marker horizon option to combine chronostratigraphic horizons such as volcanic ash layers with biostratigraphic events which are subject to uncertainty, and (3) a unique event option to incorporate rare but important events observed in a single or relatively few sections. This work is useful for erecting biostratigraphical zonations and the construction of quantitative range charts from micropaleontological well data.

Personnel Notes

S.R. Divi left in September, 1980 on a year's leave of absence to teach at King Abdulazis University in Jeddah, Saudi Arabia.

G.F. Bonham-Carter arrived in December, 1980 to work as a temporary replacement for S.R. Divi.

F.P. Agterberg received an annual best paper award for "Algorithm to estimate the frequency values of rose diagrams for boundaries of map features", published in "Computers and Geosciences".

F.P. Agterberg was chosen by Australia's Earth Resources Foundation to be Esso Distinguished Lecturer. He presented 46 seminars and lectures to universities, industry workshops and government agencies during his three month tour.

Mineral Data Bank Section

D.D. Picklyk

The Mineral Data bank retains overall responsibility for all commodity and metallogenic files of the Economic Geology Division. Curation and maintenance of rock and mineral collections used in research by officers of the Division is also a function of the Data bank. The main assembly of document files and related collections is done by project officers and remains in their control for the duration of the relevant project. Present activities of the section are the assembly, maintenance, retrieval, and manipulation of a computer processable mineral deposit file called CANMINDEX and the curation of specimens collected for completed projects.

Much of the work of the Mineral Data Bank is in support of other projects and contributed to some of the highlights mentioned elsewhere. In particular, Mineral Data Bank staff contributed to resource appraisals of the Yukon by coding, editing and loading of all readily available mineral deposit data. Another example of CANMINDEX-related file activity is the final updating of the copper file for the Northwest Territories, Yukon and North Shore Lake Huron area of Ontario, preparatory to Open File releases.

Approximately 3000 new records were added to the CANMINDEX file during the year bringing the total to 15,000. All specimens in the R. Mulligan research collection were examined and indexed. The specimens in the Whitmore-Nash Manitoba collections were examined and catalogued. The Marmora Iron Mine collection of maps and plans was catalogued and a copy forwarded to National Archives.

The facilities of the Mineral Data Bank for the coding, editing and entry of data are now greatly improved by the move to more spacious quarters early in the year and the installation late in the year of a more powerful data entry terminal and printer.

Personnel Notes

D.G. Rose resigned his position as Operations Manager in September.

R.E. Bretzlaff, after carrying out the duties on an acting basis, was appointed Operations Manager in December.

Attendance at Meetings, Conferences and Courses

F.P. Agterberg

International Geological Congress, Paris, July, 1980.

Ninth Geochautauqua, Miami, FL, January, 1981.

"HABITAT" Advisory Panel, Kansas Geological Survey, Lawrence, KN, January, 1981.

R.E. Bretzlaff

Number Skills Course, Department of Energy, Mines and Resources, February, 1981.

C.F. Chung

NATO Advanced Study Institute for Statistical Distributions in Scientific Works, Trieste, Italy, July-August, 1980.

American Statistical Association Annual Meeting, Houston, August, 1980.

L.M. Cumming

Youth Science Foundation Annual Meeting, Ottawa, October, 1980.

K.M. Dawson

Geological Association of Canada-Mineral Deposits Division field tour of porphyry copper deposits of south-central British Columbia, May, 1980.

Geothermal Field Trip to the Meager Creek Area, Vancouver, Geological Association of Canada-Mineral Deposits Division, November, 1980.

K.R. Dawson

Geological Association of Canada-Mineralogical Association of Canada Annual Meeting, Halifax, Nova Scotia, May, 1980.

S.R. Divi

Geological Association of Canada-Mineralogical Association of Canada Annual Meeting, Halifax, Nova Scotia, May, 1980.

J.M. Duke

Geological Association of Canada-Mineralogical Association of Canada Annual Meeting, Halifax, Nova Scotia, May, 1980.

H.E. Dunsmore

Atlantic Geoscience Society Annual Meeting, Fredericton, New Brunswick, January, 1981.

Prospectors and Developers Association Annual Meeting, Toronto, March, 1981.

O.R. Eckstrand

Geological Association of Canada-Mineralogical Association of Canada Annual Meeting, Halifax, Nova Scotia, May, 1980.

Nickel Sulphide Field Conference, Norway, Sweden, Finland, July, 1980.

National Science Foundation Workshop, Stanford Research Institute, California, January, 1981.

A.G. Fabbri

International Symposium on Machine Processing of remotely sensed data and soil information systems and remote sensing and soil survey, West Lafayette, Indiana, June, 1980.

26th International Geological Congress, Paris, France, July, 1980.

Uranium in Granites Workshop, Ottawa, November, 1980.

D.C. Findlay

Royal Society of Canada Symposium on Arctic Islands Centennial, Yellowknife, N.W.T., August, 1980.

J.M. Franklin

International Archaean (Geochemistry) Symposium, Perth, Australia, May, 1980.

Canadian Institute of Mining and Metallurgy Gold Symposium, Val d'Or-Timmins, September, 1980.

Early Evolution of the Earth's Crust, Johnson Space Center, Houston, November, 1980.

Geological Society of America Annual Meeting, Atlanta, November, 1980.

Ontario Geological Survey Isotope Seminar, Toronto, February, 1981.

S.B. Green

Prospectors and Developers Association Annual Meeting, Toronto, March, 1981.

G.A. Gross

82nd Annual General Meeting of the Canadian Institute of Mining and Metallurgy, Toronto, April, 1980.

54th Annual Minnesota Section Meeting, American Institute of Mining Engineers and 42nd Annual University of Minnesota Mining Symposium, Duluth, MN, January, 1981.

J.A. Kerswill

Scientific Communication and Technical Report Writing, Department of Energy, Mines and Resources, Ottawa, April, 1980.

Newfoundland Department of Mines and Energy Open House, St. John's, Newfoundland, November, 1980.

Canadian Institute of Mining and Metallurgy Annual Meeting, St.John's, Newfoundland, November, 1980.

Uranium in Granites Workshop, Ottawa, November, 1980.

R.V. Kirkham

Geological Association of Canada-Mineralogical Association of Canada Annual Meeting, Halifax, Nova Scotia, May, 1980.

R.M. Laramee

Scientific Communication and Technical Report Writing, Department of Energy, Mines and Resources, April, 1980.

Numbers Skills Course, Department of Energy , Mines and Resources, February, 1981.

G.B. Leech

Canadian Institute of Mining and Metallurgy Annual Meeting, Toronto, April, 1980.

Ontario Geological Survey Geoscience Research Seminar, Toronto, December, 1980.

Prospectors and Developers Association Annual Meeting, Toronto, March, 1981.

J.W. Lydon

Society of Economic Geologists and Geological Society of America Meeting, Atlanta, November, 1980.

Whitehorse Geoscience Forum, Whitehorse, Yukon Territory, November-December, 1980.

Discussion Group Meeting with Ontario Geological Survey on modern hydrothermal solutions, Toronto, January, 1981.

W.H. Poole

Newfoundland Department of Mines and Energy Review of Activities, St. John's, Newfoundland, November, 1980.

New Brunswick Department of Natural Resources Review of Activities, Fredericton, New Brunswick, December, 1980.

Nova Scotia Department of Mines and Energy Review of Activities, Halifax, Nova Scotia, December, 1980.

International Geological Correlation Programme, Caledonide Orogen Project 27 Working Committee Meeting, Fredericton, New Brunswick, January, 1981.

Canada-Newfoundland Mineral Development Program, Geological Mapping Subcommittee Meetings, St. John's, Newfoundland, November, 1980 and Ottawa, February, 1981.

N. Prasad

Uranium in Granites Workshop, Ottawa, November, 1980.

Scientific Communication and Technical Report Writing, Department of Energy, Mines and Resources, April, 1980.

J.Y.H. Rimsaite

International Mineralogical Association 12th Meeting, Orleans, France, July, 1980.

26th International Geological Congress, Paris, France, July, 1980.

International Atomic Energy Agency Uranium Geology Working Groups - 'Chemical and physical mechanisms in the formation of uranium mineralization, geochronology, isotope geology and mineralogy', Working Group I; 'Other uranium deposits', Working Group V - Paris, France, July, 1980.

Scientific Communication and Technical Report Writing, Department of Energy, Mines and Resources, April, 1980.

Uranium in Granites Workshop, Ottawa, November, 1980.

V. Ruzicka

Human Behaviour in the Organization, Public Service Commission, Ottawa, May, 1980.

Uranium in Granites Workshop, Ottawa, November, 1980.

Prospectors and Developers Association Annual Meeting, Toronto, March, 1981.

D.F. Sangster

Geological Association of Canada-Mineralogical Association of Canada Annual Meeting, Halifax, Nova Scotia, May, 1980.

Dahlem Konferenzen, Berlin, West Germany, August-September, 1980.

Ores in Sandstones Workshop, Ottawa, January, 1981.

W.D. Sinclair

Canadian Institute of Mining and Metalllurgy Gold Symposium, Val d'Or-Timmins, September, 1980.

Geoscience Forum, Whitehorse, Yukon Territory, November-December, 1980.

Workshop on Relations of Tectonics to Ore Deposits in the Southern Cordillera, Arizona, March, 1981.

Scientific Communication and Technical Report Writing, Department of Energy, Mines and Resources, April, 1980.

R.I. Thorpe

Canadian Institute of Mining and Metallurgy Gold Symposium, Val d'Or-Timmins, September, 1980.

L.P. Tremblay

56th International Geological Congress, Paris, France, July, 1980.

Special Talks or Lectures

F.P. Agterberg

"Lognormal models for several metals in selected areas of Canada"; International Geological Congress, Paris, July 9, 1980.

"A statistical model for the clustering of biostratigraphic events"; International Geological Congress, Paris, July 13, 1980.

"Probabilistic mineral resource estimation"; presented to the following during the period August 19 - October 21:
Macquarie University, Sydney
Australian Society for Operations Research, South Australian Chapter, Adelaide
Australasian Institute of Mining and Metallurgy, Perth
University of Western Australia, Mathematics Department, Perth
Geological Society of Australia, Queensland Division and Australian Computer Society, Brisbane
Australasian Institute of Mining and Metallurgy, North West Queensland Branch, Mount Isa
University of Sydney, Department of Geology and Geophysics, Sydney
University of Tasmania, Geology Department, Hobart
Monash University, Department of Earth Sciences, Melbourne
University of Melbourne, Department of Geology, Melbourne
Bureau of Mineral Resources, Canberra

"Ore reserve estimation methods"; presented to the following during the period August 18-October 27:
University of New South Wales, Sydney
Macquarie University, Sydney
University of Adelaide, Department of Economic Geology, Adelaide
University of Western Australia, Geology Department, Perth
University of Queensland, Department of Mining and Metallurgical Engineering, Brisbane
Australasian Institute of Mining and Metallurgy, Zeehan, Western Tasmania
University of Tasmania, Geology Department, Hobart
University of Tasmania, Geology Department, Hobart
Canberra College of Advanced Education, Geology Department, Canberra

"Statistical petrology and geochemistry"; presented to the following during the period August 21-October 31:
University of New South Wales, Sydney
University of Adelaide, Department of Economic Geology, Adelaide
University of Western Australia, Geology Department, Perth
University of Tasmania, Geology Department and Geological Society of Australia, Hobart
University of Melbourne, Department of Geology, Melbourne
Research School of Earth Sciences, Australian National University, Canberra
University of Sydney, Department of Geology and Geophysics, Sydney

"Statistics in sedimentary and petroleum geology"; presented to the following during the period August 22-October 14:
University of New South Wales, Sydney
University of Adelaide, Department of Economic Geology, Adelaide
Western Australian Institute of Technology, Geology Department, Perth
University of Queensland, Department of Geology and Mineralogy, Brisbane
University of Newcastle, Department of Geology, Newcastle
Monash University, Department of Earth Sciences, Melbourne
University of Melbourne, Department of Geology, Melbourne.

"Methods and techniques used in the analysis of palaeocurrents"; presented at Macquarie University on August 6 and University of New South Wales on August 22, Sydney, Australia.

"Advanced geostatistical methods"; University of New South Wales, Sydney, August 18, 1980.

"Grade-tonnage relationships of ore deposits"; University of New South Wales, Sydney, August 19, 1980.

"Geochemical crustal abundance models"; University of New South Wales, Sydney, August 21, 1980.

"Statistics in petroleum geology"; Petroleum Engineering Society of Australia, Perth, September 11, 1980.

"Hydrothermal alteration patterns around massive sulphide ores"; University of Newcastle, Department of Geology, Newcastle, September 25, 1980.

"Erection of Statistical fossil zones from paleontogical data"; University of Tasmania, Geology Department, Hobart, October 3, 1980.

"Teaching mathematics to geology students in Tertiary institutions"; Royal Melbourne Institute of Technology, Melbourne, October 8, 1980.

"Relations between regional geology, metallogenetic concepts and geomathematics in mineral potential and resource appraisal"; Bureau of Mineral Resources, Canberra, October 20, 1980.

"Statistics and probabilistic methods in geoscience"; Institute of Advanced Studies, Australian National University, Statistics Department, Canberra, October 22, 1980.

"Probabilistic mineral resource estimation"; Geological Survey of New South Wales, Sydney, August 20, 1980.

"Oil and gas exploration in Australia. Estimation of undiscovered resources"; Esso Australia Limited, Sydney, August 26, 1980.

"Ore reserve estimation. Probabilistic resource appraisal for exploration"; Geopeko, Sydney, August 28, 1980.

"Quantification of map data, mineral deposit files"; Technical and Field Surveys Party, Limited, Sydney, August 29, 1980.

"Quantitative biostratigraphic correlation"; Geological Survey of Western Australia, Perth, September 8, 1980.

"Applications of statistics in geology"; Division of Mathematics and Statistics, Commonwealth Scientific and Industrial Research Organization, Perth, September 11, 1980.

"Estimation of proved, probable and possible reserves"; Esso Australia Limited, Perth, September 11, 1980.

"Geological data processing"; Geological Survey of Queensland, Brisbane, September 18, 1980.

"Ore reserve calculations, semivariograms and kriging"; Mount Isa Mines Limited, Mount Isa, September 22-23, 1980.

"Statistical exploration by multivariate methods"; Carpentaria Exploration, Mount Isa, September 23, 1980.

"Ore reserve techniques"; Mount Lyell Mine, Mount Lyell, Tasmania, September 29, 1980.

"Trend analysis of exploratory bore-hole data"; Electrolytic Zinc Company, Roseberry, Tasmania, September 30, 1980.

"Ore reserve estimation. Statistical exploration"; Broken Hill Proprietary Company Limited, Melbourne, October 8, 1980.

"Role of geostatisticians in geological surveys. Mineral resource estimation"; Bureau of Mineral Resources Geology and Geophysics, Canberra, October 20, 1980.

"Quantification of geoscientific data for mineral exploration"; Hunting Geology and Geophysics, Canberra, October 21, 1980.

"Geostatistical ore reserve estimation"; Woodlawn Mines, New South Wales, October 23, 1980.

"Applications of statistics in geoscience"; Commonwealth Scientific and Industrial Research Organization, Division of Mineral Physics, North Ryde, October 30, 1980.

R.T. Bell

"Uranium in the Cordillera with emphasis on Successor Basins"; Ministry of Energy, Mines and Petroleum Resources, Victoria, November 19-23, 1980.

C.F. Chung

"Problems in Statistical Distributions used for Resource Evaluation"; NATO Advanced Study Institute, Trieste, Italy, July 23, 1980.

"SIMSAG" (System of Interactive Graphic Computer Programs of Multivariate Statistical Analysis for Geological Data); Federal Geological Survey of Germany, Hannover, West Germany, August 05-10, 1980.

"Applications of the Buffon needle problem and its extensions to parallel-line search sampling schemes"; American Statistical Association, Houston, August 11-14, 1980.

K.M. Dawson

"Geological mapping methods and instruments"; presented to students of British Columbia and Yukon Chamber of Mines Prospecting School, Vancouver, October 2, 1980.

"Overview of Cordilleran mineral occurrences in the last 100 million years"; presented at Geological Association of Canada Cordilleran Section Symposium, February 13, 1981 and to Geological Survey of Canada Staff in Ottawa, March 04, 1981.

S.R. Divi

"Multivariate statistical analysis of chemical compositions and associated lithologies of volcanogenic stratabound sulphide deposits in the Canadian Appalachians"; presented at the Correlation of Caledonian Stratabound Sulphides Symposium, Geological Association of Canada-Mineralogical Association of Canada Annual Meeting, Halifax, Nova Scotia, May 19, 1980.

J.M. Duke

"Petrology and Economic Geology of the Dumont Sill, Northwest Quebec"; presented at the Geological Association of Canada-Mineralogical Association of Canada Annual Meeting, Halifax, Nova Scotia, May 1980.

"Genetic Models of Magmatic Sulphide Ore Formation"; University of Waterloo, March 5, 1981.

O.R. Eckstrand

"Ultramafic flows"; lecture in a Short Course on Metavolcanic Rocks, Carleton University, April 28, 1980.

"Systematic Ni-Cu variations in nickel sulphide deposits"; Geological Association of Canada-Mineralogical Association of Canada Annual Meeting, Halifax, Nova Scotia, May 19, 1980.

"Nickel-copper differentiation in nickel sulphide deposits"; Nickel Sulphide Field Conference, International Geological Correlation Program Project No. 161, Turku, Finland, July 29, 1980.

A.G. Fabbri

"Digitizaton and Processing by minicomputer of large regional geological maps and ancillary data on mineral resources"; Purdue University 6th Symposium on Machine Processing of Remotely Sensed Data and Soil Information Systems and Remote Sensing and Soil Survey, West Lafayette, Indiana, June 04, 1980.

"Applications at the interface between pattern recognition and geology"; presented at the International Geological Congress Symposium on Mathematical Geology and Geological Information Science, Paris, July 15, 1980.

"Image Processing of geological and geophysical maps of the Kasmere Lake-Whiskey Jack Lake mineralized area, northwestern Manitoba"; presented at International Geological Congress Symposium on Metallogenesis and Mineral Ores, Paris, July 16, 1980.

"Image processing of coincident black and white patterns from geological and geophysical maps of uranium mineralized areas"; Uranium in Granites Workshop, Ottawa, November 26, 1980.

D.C. Findlay

"Assessment of Non-hydrocarbon Mineral Potential of the Arctic Islands"; Royal Society of Canada Symposium on Arctic Islands, Yellowknife, N.W.T., August 13, 1980.

J.M. Franklin

"Metallogeny of the Archean Portion of the Canadian Shield"; International Archaean Symposium Keynote Speaker, Perth, Australia, May 12, 1980.

"Alteration associated with volcanic-hosted massive sulphide deposits"; Geological Discussion Group, Kalgoorlie, West Australia, May, 1980.

"Genesis of massive sulphide deposits"; Australian Institute of Mining and Metallurgy, Broken Hill, May, 1980.

"Alteration associated with Canadian Precambrian massive sulphide deposits"; University of Tasmania, June, 1980.

"Canadian Precambrian Massive Sulphide deposits"; Australian Institute of Mining and Metallurgy, Mount Isa, June, 1980 and also to the Institute of Mining and Metallurgy of Japan, Tokyo, June, 1980.

S.S. Gandhi

"Uranium and thorium variations in two monzonitic laccoliths in the East Arm of Great Slave Lake, District of Mackenzie"; presented at the Uranium in Granites Workshop, Ottawa, November, 1980.

J.A. Kerswill

"Uranium in granites of Labrador: A geochemical perspective"; with J.W. McConnell (Nfld. Dept. of Mines & Energy) at the Canadian Institute of Mining and Metallurgy Annual Meeting, St. John's, Newfoundland, November 7, 1980.

"Geochemistry and geology of some uraniferous granites in Labrador"; with J.W. McConnell (Nfld. Dept. of Mines & Energy), Uranium in Granites Workshop, Ottawa, November 26, 1980.

R.V. Kirkham

"Copper occurrences in Carboniferous sedimentary sequences of the Atlantic Provinces"; Geological Association of Canada-Mineralogical Association of Canada Annual Meeting, Halifax, Nova Scotia, May, 1980.

J.W. Lydon

"Recent work by the Geological Survey of Canada on stratiform barite deposits of Selwyn Basin", and "The use of theoretical mineral solubility studies in the understanding of epithermal ore deposits"; presented at the Whitehorse Geoscience Forum, Whitehorse, Yukon Territory, November-December, 1980.

Member of Discussion Panel on "How can modern submarine hydrothermal systems help us understand ancient ore deposits?", Toronto, January 12, 1981.

"Volcanogenic and shale-hosted stratiform massive sulphide deposits in a comparison of genetic processes"; Carleton University 4th year Economic Geology Class, February 10, 1981.

N. Prasad

"Comparative petrochemistry of two cogenetic monzonitic laccoliths and genesis of associated uraniferous actinolite-apatite-magnetite veins, East Arm of Great Slave Lake, District of Mackenzie"; joint presentation with S.S. Gandhi at Uranium in Granites Workshop, Ottawa, November 26, 1980.

J.Y.H. Rimsaite

"Selected Mineral Suites and Evolution of Radioactive Pegmatites in the Grenville Structural Province"; 26th International Geological Congress, Paris, July 16, 1980.

"Isotope scanning electron microscope and energy dispersive spectrometric studies of heterogeneous zircons in radioactive granites"; International Mineralogical Association poster session, Orleans, France, July 4-6, 1980.

"Mineralogical and petrochemical properties of heterogeneous granitoid rocks from radioactive occurrences in the Grenville Structural Province"; Uranium in Granites Workshop, Ottawa, November, 1980.

V. Ruzicka

"Some relationships between granitic plutons and distribution of uranium deposits in Canada"; Uranium in Granites Workshop, Ottawa, November 25, 1980.

"An overview of uranium occurrences in Canada"; University of Ottawa, March 19, 1981.

D.F. Sangster

"Physical controls to exhalite deposits in sedimentary terrains"; addressed staff of Houston International Minerals Corp., Houston, November 6, 1980.

"Plate tectonics and mineral deposits"; Addressed the Cordilleran Section of the Geological Association of Canada, Vancouver, November, 1980.

"Geology and genetic features of sandstone-lead deposits"; address to the British Columbia Department of Mines, Victoria, November, 1980.

"A proposal to create a Mineral Deposits Research Centre for Canada"; National Geological Surveys Committee, December, 1980.

"Geological controls on mineral deposits"; short presentation to Hon. J. Erola, Minister of State for Mines, Ottawa, March, 1981.

"A proposal to create a Mineral Deposits Research Centre for Canada"; presentation to Canadian Geoscience Council, March, 1981.

W.D. Sinclair

"Gold deposits of the Matachewan Area, Ontario"; Canadian Institute of Mining and Metallurgy Gold Symposium, Val d'Or, September 22-23, 1980.

L.P. Tremblay

"Characteristics of the Athabasca unconformity-type uranium deposits, Saskatchewan, Canada"; 26th International Geological Congress, Paris, July, 1980.

Membership on Committees

F.P. Agterberg

Canadian Mining and Metallurgical Bulletin, Associate Editor for Mathematical Geology and Geostatistics.

Commission on Tectonics of Ore Deposits Working Group No. 3, Chairman.

Computers and Geosciences, Editorial Advisory Board.

Geo-Processing, Editorial Board.

Global Tectonics and Metallogeny, Associate Editor.

International Geological Correlation Program Project 148, Quantitative Stratigraphic Correlation Techniques, Director.

Syracuse University, Adjunct Professor of Geology.

University of Ottawa, Non-resident Professor and Graduate School member.

J.J. Carriere

Geological Survey of Canada Christmas Party Committee, Chairperson.

C.F. Chung

Branch Computer Facilities Committee, member.

Journal of the International Association for Mathematical Geology, Associate Editor.

L.M. Cumming

Canadian Institute of Mining and Metallurgy (Ottawa Branch), Program Committee Chairman.

Youth Science Foundation, Executive Committee, member representing the Geological Association of Canada.

19th Ottawa Regional Science Fair, Earth Science exhibits, Judge.

K.M. Dawson

Circum-Pacific Map Project, Metallogenic Map Committee, Canadian Cordillera, representative.

Geological Association of Canada, Mineral Deposits Division, Newsletter editor.

Geological Association of Canada, Mineral Deposits Division, Duncan Derry Medal Committee, member.

J.M. Duke

Canadian Geoscience Council Committee on International Scientific Relations, member.

Canadian Institute of Mining and Metallurgy, Ottawa Branch, Executive Committee member.

International Geological Correlation Programme, Project 161 "Sulfide deposits in mafic and ultramafic rocks", participant.

Mineralogical Association of Canada, secretary.

O.R. Eckstrand

Mineralogical Association of Canada, Hawley Award Committee, member.

A.G. Fabbri

International Association on the Genesis of Ore Deposits: Commission on the Tectonics of Ore Deposits, secretary-treasurer; Working Group 3 - Statistical Treatment of Tectonics and Mineral Deposit Data, secretary.

D.C. Findlay

Canada-Newfoundland DREE-EMR Mineral Development Agreement, Evaluation Subcommittee, member.

Centre for Engineering, Scientific and Learned Societies, secretary.

Interdepartmental Working Committee on Northern Mineral and Energy Resource Appraisal, co-chairman.

J.M. Franklin

Canadian Institute of Mining and Metallurgy, Ottawa Branch Executive Committee, member.

Canadian Institute of Mining and Metallurgy, Organizing Committee for Geology Division Field Conference (Val d'Or-Timmins), member.

Geological Association of Canada, Special Volume on "Precambrian Stratiform Ore Deposits", co-editor.

Geoscience Canada, Associate Editor.

Economic Geology, Associate Editor.

S.B. Green

Canadian Institute of Mining and Metallurgy, Ottawa Branch, Executive Committee, member.

G.A. Gross

Canadian Working Group in Applied Geology, Canada-USSR Mixed Commission on Economic, Industrial, Scientific and Technical Cooperation, Coordinator.

Energy, Mines and Resources Coordinating Committee on Ocean Mining (DCOM), member.

International Geological Correlation Programme, Project 91 - Metallogeny of the Precambrian, coordinator; Project 132 - Basins of Iron Formation Deposition, coordinator; Project 111 - Canadian Liaison, Genesis of Manganese Ore deposits, coordinator.

Precambrian Research, Editorial Board.

R.V. Kirkham

Canada-Nova Scotia Mineral Development Subsidiary Agreement, Geotechnical Advisory Subcommittee, member.

R.M. Laramee

Energy, Mines and Resources Computer Science Centre Data Management User's Group, member.

G.B. Leech

Energy, Mines and Resources Uranium Resource Appraisal Group, member.

Committee for the Metallogenic Map of North America, member.

International Association on the Genesis of Ore Deposits, Associate Secretary General.

Interdepartmental Working Committee on Northern Mineral and Energy Resource Appraisal, member.

C.R. McLeod

Energy, Mines and Resources Committee for Ocean Mining, Working Group for Deep Ocean Mining, member.

Geological Survey of Canada, Safety Committee, member.

W.H. Poole

Canada-Newfoundland Mineral Development Program, Geological Mapping Subcommittee, member.

Canada-Nova Scotia Mineral Development Program, Geotechnical Subcommittee, member.

Geological Society of America, Northeastern Section, past-chairman and member of management board.

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

Queen's University Advisory Council on Engineering, Geological Engineering Subcommittee, chairman.

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

Geological Society of America, Symposium on geochronology of the northern Appalachians for annual meeting of Northeastern Section in Bangor, Maine in April, 1981, co-convenor.

V. Ruzicka

Energy, Mines and Resources Uranium Resource Appraisal Subcommittee on Estimated Additional Resources, chairman.

Steering Committee for Nuclear Energy (Organization for Economic Cooperation and Development Nuclear Energy Agency) Steering Group on Uranium Resource, member; Working Party on Uranium Resource, member.

Working Group for Research and Development of the Organization for Economic Cooperation and Development, Nuclear Energy Agency and International Atomic Energy Agency (OECD NEA/IAEA), Subgroup 7C - Metallogeny of Uranium Provinces, chairman.

Elsevier Scientific Publishing Company, Editorial Board of 'URANIUM', member.

D.F. Sangster

Carleton University, Ottawa, Honorary Adjunct Professor.

Geological Association of Canada, Mineral Deposits Division, Councillor.

International Association on the Genesis of Ore Deposits, Chief Treasurer.

International Geological Correlation Programme, Project 60 - Correlation of Caledonian Stratabound Sulphides, Canadian National Representative.

Universite du Quebec a Chicoutimi, M.Sc. Graduate Program Committee, member.

Canada-Germany Scientific-Technical Cooperation Project 3.2.1.7 - Massive and stratiform Cu-Pb-Zn-barite deposits, Canadian Project Leader.

R.I. Thorpe

Mineralogical Association of Canada, Associate Editor.

L.P. Tremblay

Quebec Department of Education FAC (Formation de chercheurs et action concertee) Committee, member.

GEOLOGICAL INFORMATION DIVISION

R.G. Blackadar

The Geological Information Division is responsible for communicating the results of the Branch scientific program to industry, other government agencies and the general public, for maintaining Canada's major earth science library and related information retrieval systems, and for providing an information service to the public on all matters pertaining to geology in Canada.

The division operates through 6 sections, Scientific Editing and Publication Production (which during 1980-81 reported directly to the Division Director), Data Systems, Cartography, Library Services, Technical Photography of Publication Distribution.

In February 1981 the ADM Science and Technology announced that the Canada Centre for Geoscience Data would be transferred to the Geological Survey and this transfer was made on April 1, 1981.

The division provides a comprehensive scientific publication program by means of Geological Survey Memoirs, Bulletins, Economic Geology Reports, Papers, Maps and Open Files requiring in-house capabilities in scientific editing, manuscript preparation, geological cartography and associated photomechanical services and technical photography. We maintain Canada's principal earth science library as a data base for the Survey's research program and for the geoscience community. Information on the Survey's program is disseminated by selling and distributing Geological Survey reports and maps and exchanging them with other institutions; by displays at national and international meetings; by informing the user public of the release of Geological Survey publications and other information releases by means of regular information circulars; and by meeting specific requests for information from the public by means of written communications, publications and direct telephone response on listed technical enquiry number.

During the 1980/81 year conversion to the use of Word Processing Equipment for all our publications was completed. The larger part of the work continued to be done by the staff of the Branch Word Processing Centre although increasing use was made of outside contractors. A change in contractor during the year resulted in an inexperienced firm taking on the complicated typing involved in the production of our reports and the early part of the year saw many delays in publication. The 1979/80 contractor was awarded the 1981/82 contract.

Three volumes of "Current Research" were published during the report period. These comprised 1056 pages and to meet firm publication commitments required the full co-operation of authors, divisional managers, scientific editors, our production editors and the staff of the Word Processing Centre. A major publication "The Coastline of Canada" was released early in 1981. The text preparation for this was done under contract but the design and layout were done by Lorna Firth and Mike Kiel from our production editorial staff and Mike was also responsible for the attractive cover design. Another interesting report published in early 1981 was the Canadian Geoscience Council's report on the teaching of geology and geophysics in Canadian universities. This is one of their ongoing services of special studies which, together with the annual reports of Council are published annually by the Geological Survey on behalf of the CGC. A strike by translators held up the French edition of this study which is now expected by the summer of 1981.

The position of Principal Scientific Editor (English) remained vacant but late in the report period permission was given for staffing action. As a result of this vacancy Peter Griffin and I continued to handle the scientific editorial work of the division in addition to our other duties. Mr. Griffin, and on occasion Mr. J.G. Roberts, acted as division director during my absences and both fulfilled the duties admirably.

Attendance at Meetings, Conferences and Courses

R.G. Blackadar
Geological Society of America, Atlanta, Ga, Nov. 1980

P.J. Griffin
Association of Earth Science Editors, Halifax, N.S., Oct. 1980

L.R. Mahoney
Association of Earth Science Editors, Halifax, N.S., Oct. 1980

Membership on Committees

R.G. Blackadar
Branch management Committee
Chairman, GEOSCAN Management subcommittee, NGSC
Branch co-ordinator, Metric conversion
Branch Library Committee
Geological Society of America Special Publications Committee
Member, Steering Committee, D-NAG.

P.J. Griffin
Branch Handicaped People Program
Department Subcommittee on 1:1 million maps

STATUS OF GEOLOGICAL MANUSCRIPTS ON MARCH 31, 1981

Type of Report	In Process[1]		Published During Year			
	80-81	79-80	80-81	79-80	78-79	77-78
Memoirs	11	9	2	2	2	1
Bulletins	41	32	15	16	11	9
Economic Geology Reports	1	1	0	1	1	1
Miscellaneous Reports	0	0	0	1	1	0
Multicolour Maps	34	-	20[2]	15	20	28
2-Colour Maps	58	-	23	6	-	-
Papers	50	32	34	20	29	34
Open File Reports	-	-	100	110	96	92

[1] Includes I.S.P.G. and T.S. editorial units and reports with Communications. EMR for editing and printing.

[2] Includes only separate available items.

DATA SYSTEMS GROUP

Gwynneth Martin

The objectives of the Data Systems Group are to provide specialist consulting services to Divisions, to advise Branch management on EDP related matters and to provide continuing administration of the operation of Branch systems.

The primary consulting task during the year has continued to be the development of a system for the management of marine geophysical data at the Atlantic Geoscience Centre. In July - October, contract work in Ottawa under Gwynneth Martin's supervision resulted in a detailed design document being produced. This, and the overall project, were reviewed by both scientists and management at A.G.C. before moving on to the next phase of system development, namely coding and testing. As a result of a tender and evaluation of bids a contract for the work was awarded to a Halifax company. During the course of the contract, the technical responsibility for the system will be transferred from the Data Systems Group to A.G.C. personnel.

Smaller projects undertaken included the development of a "user-friendly" plotting package aimed at the needs of economic geologists and the conversion of a digital base of the map of Canada (at 1:5 million) from digitized inches in a DEC file format to geographic units in a CYBER file.

The first steps were also taken to improve the digitizing facilities in the Branch. The approach adopted will allow concurrent digitizing from several tables and improved operator interaction.

The annual EDP report and plan was compiled and submitted to the Department and the Group continued to provide for the operation of the EAI plotter.

Special Talks or Lectures

"A System Design for Marine Geophysical Data Management", Geological Association of Canada/Mineralogical Association of Canada Joint Annual Meeting, Halifax, May 1980.

"Current Systems Development for Management of Marine Geophysical Data at the Atlantic Geoscience Centre, Canada", invited talk at NGSDC/NSF Marine Geology and Geophysics Data Workshop, Boulder, Colorado, November 1980.

Membership on Committees

Member, Departmental EOW Planning and Evaluation Committee

LIBRARY SERVICES

A.E. Bourgeois

CURRENT YEAR ACTIVITIES

1. Technical Services

The Automated Cataloguing system (UTLAS) implemented at the end of FY 79-80 has been operational for one year and, by increasing operational efficiency, has permitted the library to assume an increased workload with no additional person-years.

A major retrospective conversion of records into machine readable data was undertaken and all documents catalogued since 1978 are now in the database.

Several previously poorly controlled collections are now being input into the database thus improving access to them (e.g. Translations, Russian Monographs).

The long awaited "List of Current Serials" was generated from an in-house database of current serial holdings.

2. Information Services

Reference staff has had a busy year introducing the new COMfiche catalogue to users and recommending changes in formats of the fiche catalogue and Accession List to meet client requirements.

Considerable staff time was spent introducing new users to GEOSCAN and promoting it as a primary source of Canadian geological information.

The library was instrumental in CISTI's acquiring GEOREF for mounting on CAN-OLE, an on-line enquiry system which promises to be more cost effective than the currently available Dialog and Infomart systems.

Three major floods in early winter damaged several hundred documents, but a combined freezing and blow drying process saved most of them. The Map Library, hardest hit by the disasters, still looks somewhat the worse for wear.

A good start has been made on the Kardexing, cataloguing and Library of Congress classifying of map series. Map storage space has been increased to reduce over-crowding and to allow for growth of the collection.

PLANNED/PROJECTED ACTIVITIES

1. An increase in the requests for information or advice concerning the GEOREF database is anticipated. The library is committed to providing support for the database when it becomes available on CAN/OLE. This will include advising, training and document support.

2. Retrospective conversion of the card catalogue to machine readable data will continue as person-years become available.

3. An analysis of the automated systems required for increased operational efficiency is to be done. Special consideration will be given to potential uses of the recently purchased MINISIS package.

4. Given additional person-years, the library will undertake the implementation of a program of full bilingual access to the collection.

5. A survey of the GSC division's information needs will be undertaken in order to establish a realistic collection development policy.

6. The map collection will be coded and input on the University of Toronto Library Automation System (UTLAS) and will appear in the Library Catalogue along with the rest of the library acquisitions.

PERSONNEL CHANGES

Ms. Myra Owen, Ms. Alicia Prata and Mr. David Reade have left the library to accept promotion with respectively: Ottawa University, National Museums and Canada Centre for Geoscience Data.

Ms. Judy Wilks replaced D. Reade as the CAN/SDI Librarian.

Ms. Lucie Lalonde was hired on a term basis to assist the Map Librarian.

Ms. Wendy Stark was hired in the new position of Project Librarian.

Ms. Mary Malloy was hired on a term basis as Reference Librarian.

COMMITTEE MEMBERSHIPS

Annette E. Bourgeois

- Editor for the Association of Chief Librarians of National Geological Surveys.
- Branch representatives on the Standing Committee of Chief Librarians of EMR.
- Member of the Council of Federal Libraries.

Judy Wilks

- Library's representative on the CAN/SDI Committee.

Wendy Stark

- Branch representative on the Geoscan Advisory Committee.

Elizabeth Frebold

- Member of the Committee on Conservation/Preservation of Library materials, Council of Federal Libraries.
- Member of the Working Group on Service to External Users, Reader Services Committee, Council of Federal Libraries.

Le'Anne Frieday

- Ottawa-Hull UTLAS User's Committee.

CONFERENCES ATTENDED

Association of Canadian Map Libraries, Annual Conference, 1980, Edmonton.

- Tara Naraynsingh

Canadian Association of Information Science, Annual Conference, 1980, Toronto.

- David Reade
- Annette Bourgeois

Canadian Library Association, Annual Conference, 1980, Vancouver.

- Myra Owen

Geological Information Society (GSA), Annual Conference, 1980, Atlanta.

- Annette Bourgeois

Special Libraries Association, Annual Meeting, 1980, Washington, D.C.

- Elizabeth Frebold.

DESCRIPTION		1978-1979	1979-1980	1980-1981
1. Information Requests		2,978	4,354	6,509
2. Document Delivery				
A Lending		23,594	23,097	26,974
B Borrowing		768	895	569
3. Collection Growth				
A Monographs	(volumes)	1,227	978	1,164
B Serials	(issues)	15,960	12,172	13,099
C Maps	(sheets)	1,674	1,184	1,669
D Microforms	(reels/sets)	94	91	1,147
E Total linear feet		---	---	272.5

GEOLOGICAL CARTOGRAPHY SECTION

J.G. Roberts

To a large extent the section met it's major objectives during the year and productivity was generally good. It is interesting to note that despite a natural reticence by the staff to accept the productivity reporting system, implemented in 1979, there is now in actual fact a feeling of renewed vigour. This is evidenced by the upward flow of ideas and suggestions by the staff for the improvement of work methods and product standardization.

An assessment of our current automated system by the Branch Data Systems Analyst in co-operation with C.S.C. and the Sections operational staff was completed in mid-year, and it was recommended and agreed to bring on-line a second digitizing table to meet expanded Branch requirements for this service. Purchasing of additional memory, interfaces and software was initiated in December. This is Phase I of a five-year system upgrade program and all concerned co-operated to ensure that on-going digitizing of geophysical and geochemical data was not delayed. (see production statistics).

The map checking unit has further developed map edit procedures to include figure drawings and "B" series maps. (see production statistics). It also undertook preliminary preparation of a revised bilingual edition of "Standards and Specification for the Preparation of Geological Maps", and at years end this was 25% complete and should be completed and published in the next fiscal year.

The high priority to replace current conventional colour reproduction with 4 colour printing for most "A" series multi-colour maps had to be delayed because of the heavy workload in the section and the consequent lack of staff to complete the R & D. However, this will continue as and when staff is available. A 300 line dot screen was purchased for duotone figures, illustrations and some "B" series maps. This was also found usefull for toning down excessively detailed topographical monochromes for field use.

Some noteworthy achievements during the year were the production of:

- Revised edition of 900A, Principal Mineral Areas in Canada (30th annual addition).
- Map 1533A, Plutonic Rocks in Ontario
- Maps 1549A, 1550A & 1551A, Sensitivity of Bedrock and Derived Soils to Acid Precipitation - South Central and South Eastern Canada.
- Permafrost Studies Display (16 panels) for G.A.C. - M.A.C. and 4th International Permafrost Conference.

Section strength remained at 54 person years, and manpower functional disposition remained the same as reported in the 2 previous years. There were 2 resignations and 2 retirements during the year. The senior supervisory position in "B" unit was reactivated and staffed in mid-year. All other vacancies were in the staffing process at years end.

There were 298 miscellaneous (Z numbered) drafting jobs completed during the year, which took 10,277 person hours; this included more than 40 book covers. In addition to the normal map production operations, the photo-mechanical unit processed 987 (X numbered) miscellaneous jobs for various authors and Divisions.

A total of 264 requisitions for Linofilm typesetting for Ottawa, Calgary and Dartmouth cartographers were processed through S & M Branch. There were 484 master topographical negatives requisitioned from S & M for reproduction in Photo-mech. for authors and cartographers in Calgary, Ottawa and Vancouver.

Meetings, Seminars, Courses, etc.

- All staff attended 2 in-house seminars sponsored by commercial organizations on dimensional stability of films and new developments in graphic reproduction.
- In October all unit and sub-unit supervisors attended a departmental sponsored 1 day course on employee appraisals.
- Twelve cartographers attended Cartographic technical sessions for 2 days last May, at Algonquin College under the auspices of the Ontario Institute of Chartered Cartographers.
- R. Daugherty and J. Bill completed 3 month evening courses in Human Resources at Algonquin College.
- N. Buck and J. Roberts attended the International Graphic Arts Exposition last May in Chicago to investigate typesetting equipment, photo-mechanical reproduction equipment and materials (2 days).

Membership on Committee

- J. Bill - Member, Cartography Suggestions Award Sub-Committee
- F. Heney - Branch Safety Committee

PRODUCTION DATA

Checking Unit

"A" Series checked at proof stage		27 sheets
"B" Series checked at proof stage		33 sheets
Pocket and page figures and Misc.		57 sheets
	Total	117 sheets

Automated Digitizing

Line Mode for R.G.G. 200 maps	112 days
Point Mode for R.G.G. 27 sheets	28 days
Point Mode for Terrain Sciences 32 maps	10 days
Total	150 days

Total Map projections for internal use calculated in-house and plotted at S & M - 25 sheets.

PRODUCTION DATA (Cont'd)

Maps and illustrations received during the fiscal year:

	1979-80	1980-81
Multicoloured geological maps	14	27
'B' Series maps	31	23
Figure illustrations (pocket)	11	10
Figure illustrations (page)	263	181
Open File maps	244	63
Special Projects (Atlas)	0	5

Maps, illustrations and photo-mechanical work completed by the Cartography Section:

	1979-80	1980-81
Multicoloured geological maps	23	22
'B' Series maps	7	27
Figure illustrations (pocket)	22	56
Figure illustrations (page)	312	366
Open File maps	244	43
Multicoloured maps reprinted	10	5
Preliminary geological maps reprinted	0	2
Figure illustrations (pocket) reprinted	0	5
Indexes to Publications revised	24	26
Camera	6,858	6,893
Contacts		
Films and papers	19,160	18,809
Colour Keys	710	542
Peelcoats	238	378
Scribetches	1	2
Colour Proofs	136	128
Whiteprints	9,117	5,438

Carry-over of maps and illustrations in progress at the end of fiscal year:

	1979-80	1980-81
Multicoloured geological maps	49	63
'B' Series maps	46	42
Figure illustrations (pocket)	28	23
Figure illustrations (page)	273	327
Open File maps	0	20

PHOTOGRAPHIC SECTION

J.W. Kempt

The year 1980 - 1981 has produced a number of changes and improvements in the Photographic Section.

Mr. Maruska and Mr. Lemieux are continuing to develop their talents and polish up their techniques as they acquire additional experience.

In the summer of 1980, Mr. Maruska spent two weeks at the Institute of Photography in Rochester, New York. While there, he expanded his knowledge by solving the various problems encountered in the printing and processing of Ektacolour paper. The institute also introduced him to the dye transfer system of making colour prints from colour negatives.

Making dye transfer prints involves the following:

1. the placement of a colour negative in an enlarger, and

2. the projection of this negative (through a red, a blue, and a green filter) onto a specific construct.

The ultimate result is a matrice treated with three different exposures.

Each matrice is treated with a different dye solution. The matrices are then affixed to a register board.

From these matrices can be printed a number of beautiful, colour fast, fade free, expensive high quality enlargements or prints.

Recent acquisition of a Chromapro II slide duplicator has greatly enhanced our ability to produce colour corrected slides. Coupled with the ability to correct underexposed or overexposed originals it has proven to be one of the best models (if not the best model) on the market today.

Ciba-Geigy, the company that produces Cibachrome (a colour paper utilised to make prints directly from colour slides), has recently put on the market Cibachrome II. The latter, unlike the former, is manufactured on a polyester base (it is less brittle as a result). Consequently, the problem of too much contrast (frequently encountered during utilisation of the original product) no longer has to be tolerated (it has been greatly reduced). Additionally, the speed of the paper has been increased by at least one stop.

Some time this year we shall be purchasing a new macro camera unit for use by Mr. Lemieux. There are two models available, one manufactured by Wild-Leitz, and the second produced by Nikkon.

Both units produce quality photomacrographs up to magnifications to 40 -. Both have the accessories to provide diascopic and episcopic illumination as well as polarized light photography for birefringent specimens.

Variable sub-stage condensers provide Kohler illumination. The Nikkon provides Lieberkuehn mirrors for shadowless lighting. The Wild-Leitz is the more automated of the two.

Both will handle thin sections, polished sections, small crystal, minerals, etc.

Mr. Lemieux will be spending two weeks this summer at the Rochester Institute of Photography increasing his knowledge and skills.

Fossil photography is in the process of change; specimens such as conodonts or ostrocods are now being photographed by use of the scanning election microscope where a much greater degree of definition and depth of field is possible. The larger fossils such as belemnites and ammonites are still being photographed by Miss White.

Dr. Jeletsky is now back at work providing quantities of Belemnites for our Paleophotographer (his recent retirement was only premature).

There appears to be a renewed interest in the production of internegatives from colour slides.

Poor quality encountered in the processing and printing of B&W field roll negatives by some geologists has spurred on this change. A number of geologists are using one camera only, and this camera is loaded with Kodachrome.

The Ilford 2000 automated processer has been in service for approximately one year. Initial problem-s with the equipment and operator have been overcome and both are producing quality prints in a quick and efficient manner. Fortunately, the machine has the ability to process any/all types of resin coated paper which makes it even more of an asset.

The personnel from the March of Dimes Rehabilitation Centre have proved themselves in recent times. This year they annotated over fifteen thousand field roll negatives.

I would like to remind all those using the facilities of the Photographic Section to bring in their work as early as possible before the deadline.

In the last minute rush someone may be left without slides for presentation at a symposium.

G.S.C. PHOTOGRAPHIC SECTION

PRODUCTION REPORT

Supervisor

Annual Report

Month 12 Months Year 1980-1981

PHOTOGRAPHS PRODUCED	B/W NEGS	COLOUR NEGS	COLOUR TRANSP	TOTAL EXPOSED
Equipment-Labs-Portraits-Passports	134		15	149
Continuous tone Mosaic Parts	437	100	3285	3822
Line Copies	1394			1394
Rock & Mineral Specimens	37	20	660	717
Thin Sections	300		152	452
Polished Specimens	2			2
Auto-Radiographs	238			238
Requisition Processing COL. ROLLS			2562	2562
Requisition Processing B/W ROLLS	296			296
Duplicate Slides	22		2625	2647
B/W Negs from Colour Slides	677			677
Fossil Negatives	1289			1289
Field Rolls Tunney's Pasture	380			380
Color Transparencies 4x5			15	15
Color Negatives		24		24
TOTAL PROCESSED	5206	144	9314	14664

PRINTS & ENLARGEMENTS	EXPOSED	PROCESSED	DRIED	
Black and White	10874	10874	10874	
Colour	852	852	852	TOTAL
	11726	11726	11726	35178

Prints & Enlargements Numbered & Stamped	13099	
Prints & Enlargements to outside Agencies	357	
Colour Slides	4641	
B & W Slides	1253	
Slides mounted	6535	
Negatives Opagued	1676	
Negatives Retouched	592	
Prints spotted	469	
Negatives indexed	15197	
Sleeves indexed	138	
Photo Centre - Prints, Enlargements	3636	
		TOTAL
	47593	62237

GRAND TOTAL 97435

ANNUAL REPORT

APRIL 1, 1980 to MARCH 31, 1981

PUBLICATIONS-INFORMATION OFFICE

J.L.L. Touchette

The following publications were received during the year:

Memoirs	2
Memoirs (Reprinted)	2
Bulletins	15
Preliminary Papers	34
Preliminary Papers (Reprinted)	1
Misc.Report Series (Reprinted)	1
Misc. Geology	32
Open Files	4
Open Files (Reprinted)	3
Index to Publications	1
Index to Publications (Reprinted)	1
Maps "A" Series	20
Maps "A" Series (Reprinted)	2
Preliminary Maps	23
Preliminary Maps (Reprinted)	2
Geophysical Series	569
Geophysical Series (Reprinted)	40
Revised Indices to Maps	26

DISTRIBUTION DATA

Maps	105,552
Reports	39,073
Indices, listings, posters, etc.	95,560
Total distribution (free and paid)	240,185

OTHER DATA

Requests for information, publications rock and mineral sets, etc.,		13,585
Visitors	(cash sales 1247)..... (others 2066)	3,313
Notification Lists sent out		19

REVENUE

Derived from sales of reports, maps, rock and mineral sets, photographs, etc.	* $162,670.33
* Unadjusted	
($ value) products supplied to regional offices	56,469.75
TOTAL SALES VALUE	$219,140.08

INSTITUTE OF SEDIMENTARY AND PETROLEUM GEOLOGY

W.W. Nassichuk

INTRODUCTION

The Institute is responsible for the establishment of 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 as well as major deposits of strata-bound minerals. In addition, units of the Division are charged with responsibility for the appraisal of the hydrocarbon and coal resource potential of the country.

The geological framework is being broadly outlined by current mapping and topical studies. These studies, together with paleontological investigations, support exploration for, and assessment of, the non-renewable resources of Western and Northern Canada. Emphasis on energy resources has resulted in development of evaluation programs in both petroleum and coal, each supported by petrological and geochemical research in addition to the regional and paleontological investigations. The geological evaluations contribute to the national inventories on the resources of petroleum and coal.

The Institute is organized into six subdivisions: Regional Geology, Paleontology, Coal Geology, Petroleum Geology, Geological Information and Administration, each comprising several sections; together with the Petroleum Resource Assessment Secretariat.

Regional Geology is charged with carrying out standard mapping, lithostratigraphic and sedimentological studies in the principal sedimentary basins of Western Canada, Northern Mainland, Arctic Islands and adjacent offshore areas. Paleontology ensures precise and consistent biostratigraphic correlation, by refinement, through detailed taxonomic and stratigraphic studies, of the biochronologic scale which serves as the basis for biostratigraphic correlation. The Coal Geology Subdivision is responsible for providing the estimates of Canada's coal resources, for development of the National Coal File by accumulation of data, and for the development of regional models of coal occurrence. The Petroleum Geology Subdivision objectives are to identify the oil and gas resource base of Canada and to determine the probable distribution and potential abundance of oil and gas resources. The Geological Information Subdivision is concerned with processing, publication and dissemination of information on Canada's sedimentary basins and resources. In 1980-81, the Division produced 2 GSC Memoirs, 8 GSC Bulletins, 7 Papers, 9 A-Series maps, 21 reports on Current Research, 34 outside publications, and 15 Open File Reports and Notes.

The Administration Office provides financial services, central registry, stationery and supplies, and office services including the Word Processing Centre. 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 comprises 147 permanent positions. It includes 76 scientific and professional positions, including research and physical scientists, specializing in structural geology, stratigraphy, sedimentology, paleontology, mineralogy, geochemistry, geophysics, coal and petroleum geology; it also includes 8 operational, 35 technical, 3 administrative and 25 administrative support positions.

A repository is maintained for samples, core and other data resulting from both onshore and offshore exploration drilling by industry in the Yukon Territory, the Northwest Territories, including the Arctic Islands and for samples from all provinces and continental shelves of Western Canada. Most of the material is available to the public for free examination and is used by the ISPG in their research.

Personnel Notes

The disruptions caused by the high rate of turnover of scientific and support staff continued. Only sporadic progress made in staffing, and several positions remain unfilled after being vacant almost two years. Thirty-five resignations occurred within the fiscal year and 35 appointments were made.

Major changes occurred in the management of the ISPG during the year. D.F. Stott has returned to scientific research after more than 7 years as Director and W.W. Nassichuk was appointed Director, 7 October 1981. J.E. Brindle was transferred from Ottawa as Head of the Petroleum Geology Subdivision, 1 May 1980. On 9 March 1981 J.E. Brindle was appointed Acting Assistant Director and T.G. Powell, Acting Head of Petroleum Geology Subdivision. B.S. Norford was appointed Acting Head Paleontology Subdivision, 20 October 1980.

The Aministrative group experienced a number of changes during the year.

Pearl Broad, formerly an employee with the Post Office Department, accepted the position of Office Manager, 29 September 1980.

D.A. Budvarson resigned as Accounts Clerk in December 1980. She was replaced by C. Niewert, formelly our Switchboard Receptionist. The new Switchboard Receptionist, Shelley Wilson commenced duties 2 February 1981.

The Word Processing Centre had a greater number of changes than usual. Claudia Thompson left on 25 April 1980 to rejoin our ranks on 18 August 1980. T.D. MacRae commenced employment on 8 September 1980. As typists we saw Barbara Eng, Lynn Mailander, Margaret Brayman, and Hazel Holder come and go during the year. Joni Merrills joined the staff on 26 January 1981.

B.D. Then from the Machine Shop left on 18 July 1980. J.M. Juigalli departed for Victoria, B.C. on August 15, 1980. A. Stadnyk commenced employment at ISPG on 22 September 1980.

Attendance at Meetings, Conferences and Courses

W.W. Nassichuk

Meeting with Comptroller General officers on implementation of IMPAC Program, Edmonton, November 12, 1980.

Saskatchewan Geological Survey's Annual Open House, Regina, November 18, 1980.

Joint meeting Geological Survey of Canada and British Columbia Ministry of Energy, Mines and Petroleum Resources, Victoria, March 16, 1981.

J.E. Brindle

Management Development for Research Managers, St. Adele, P.Q., May 3-16, 1980.

The Canadian Pacific Continental Margin, Patricia Bay Institute, Victoria, B.C., February 16, 17, 1981.

P.L. Greener

Dynamics of Supervision, Winnipeg, Manitoba, June 2-6, 1980.

A.T. Hennessey

Pay Clerk Training, Edmonton, Alberta, November 15-19, 1980.

M. Stadnyk

Administration of Employee Benefits, Vancouver, B.C., June 9-13, 1980.

Special Talks and Lectures

W.W. Nassichuk

Talk to University of British Columbia Geology Department, June 8, 1981, "Upper Paleozoic Stratigraphy in the Sverdrup Basin".

Delivered lecture at Stefansson Symposium, May 1980, "History of Geological Exploration in the Canadian Archipelago" May 1980.

Talk to The University of Calgary, Department of Geology and Geophysics, "Upper Paleozoic Stratigraphy and Biostratigraphy in the Canadian Archipelago", March 25, 1981.

Membership on Committees

W.W. Nassichuk

Titular Member, Subcommissionon Carboniferous Stratigraphy, International Union of Geological Sciences.

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

Chairman, North American Working Group on Middle Pennsylvanian of North America.

Co-Chairman, Working Group on Permian Stratigraphy on Boreal Relations.

Member, Organizing Committee for 3rd North American Paleontological Convention, Montreal, 1982.

Editor, Tectonic Volume (Compte Rendu) Carboniferous Congress.

J.E. Brindle

Member, Energy, Mines and Resources Oil and Gas Co-ordinating Committee.

REGIONAL GEOLOGY SUBDIVISION

D. G. Cook

The objectives of the Regional Geology Subdivision are directed toward the increased understanding of the depositional and deformational history of Proterozoic and Phanerozoic sedimentary rocks of Western and Arctic Canada. The investigations provide the data base essential for the appraisal of the potentialities of these sedimentary suites, both as reservoirs for, and sources of oil and gas, and as host rocks for other economic deposits including coal, potash, lead, zinc and copper.

The Regional Geology Subdivision is organized along geographic lines, partly in response to similar geological problems and partly because of similar logistical problems. It comprises two sections. The Arctic Islands Section is responsible for the sedimentary areas of the Arctic Islands with geological investigations being concerned mainly with Proterozoic and Phanerozoic rocks of the Franklinian Geosyncline, Stable Platform, and Sverdrup Basin. The Mainland Section is concerned with sedimentary regions lying within the prairie provinces, and eastern British Columbia, the Yukon and Mainland Northwest Territories, including the Mackenzie Delta and Beaufort Sea.

The Subdivision also includes the Curation and Technical Services unit which provides curation services for the entire division including rock, fossil, and coal samples. It also monitors and effects the loan of curated materials to the public as directed by the responsible scientific authorities. The technical service mainly relates to the preparation of rock sections for microscopic examination.

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 Territorries, including the Arctic Islands and for samples from all provinces and continental shelves of Western Canada. Some eleven (11) million samples and 21,000 boxes of core are stored at the Institute; the number of samples increases by about 300,000 each year. With the exception of samples from wells in Alberta, all are available to the public for free examination. Files are maintained of all the logs and other data related to more than 70,000 wells drilled in Western and Arctic Canada.

Highlights

- A 1:250,000 scale strip map and structural cross-section extending from the Great Plains through the northern Rocky Mountains to the Pacific Ocean was completed in cooperation with the Cordilleran Division and submitted for publication under the auspices of the Canadian Geodynamics Committee. The eastern part of the cross-section (plains to Rocky Mountains Trench) illustrate 30% horizontal shortening of the sedimentary cover, and documents a Cambrian age graben development, which can be interpreted to represent latest stage of rifting related to early continental margin development.

- Field mapping was completed of two 1:50,000 scale map-areas in the northeast Pine Pass area (93 0). This structural style is basically the same as in areas to the north (94 B,C)

- A gravity study across the Discovery Range adjacent to Norman Wells was completed under contract. Results are compatible with a model involving detachment on Cambrian salt beds, but require 9 km of tectonic transport on an underlying sole fault. Over-thrusting of that extent raises the possibility of trapped hydrocarbons beneath the over-thrust plate. The report will be released on Open File.

- Field work was completed for a stratigraphic study and 1:50,000 scale mapping of the northeast part of NTS 105 O (Niddery Map-area). A geological map compiled at 1:250,000 scale, a structural cross-section, a comprehensive break-down of Lower Paleozoic stratigraphy, and description of several new mineral occurrences were released as an Open File Report.

- Structural mapping at 1:250,000 scale was initiated on southern Ellesmere Island. Significant craton-directed tectonic shortening during Paleozoic and Tertiary orogenies was recognized.

- The Belcher Channel 1:1,000,000 geological atlas map sheet was compiled.

- Radiometric analyses, acquired, indicate the possibility of mid and late Proterozoic plutonism in high grade metamorphic rocks of southern British Columbia.

- A comprehensive compilation of published and unpublished data on evaporitic deposits in western Canada was submitted to Division. The most significant results relate to Cambrian and Devonian deposits. Comparison of Cambrian and Devonian salt basins leads to the interpretation that the Cambrian salt basin may contain potash deposits in the area northeast of Norman Wells. Clarification of correlations of Devonian evaporites and carbonates suggests that the deposits are the result of a gradual rise in sea level (800 m in 36 million years) relative to the North American continent.

- A comprehensive stratigraphic analysis was submited to Division as a GSC Memoir. It deals with Silurian and Devonian strata in and adjacent to the deep-water Prairie Creek Embayment, preserved in the stratigraphic record of southern Mackenzie Mountains.

- Fieldwork was carried out on southern Ellesmere Island and southeastern Axel Heiberg Island. The Mesozoic stratigraphy of this area has been clarified and revised and has been correlated with nearby subsurface sections.

- Upper Triassic to Lower Jurassic strata (principle hydrocarbon-bearing horizon in the Arctic) have been correlated across the Sverdrup Basin. Environments of deposition of these strata have been determined.

- A stratigraphic-sedimentological study of Jurassic-Lower Cretaceous rocks in the subsurface of the Mackenzie Delta area was completed. Detailed correlations were undertaken, new formations proposed, genetically related depositional units and their internal facies relationships identified, and the Sinemurian to Albian geological history outlined.

- A preliminary report on the geology and paleontology of the Tertiary rocks in the Ukalerk C-50 well of the Beaufort Sea was completed. The lithological succession and microfaunal/floral assemblages were described and a major unconformity identified.

Personnel Notes

The Subdivision presently consists of a permanent roster of 19 scientists, 2 technicians, and 5 support staff.

D. G. Cook was appointed Head of the subdivision in May 1980.

D. F. Stott relinquished his position as Director ISPG in order to resume full-time research activities in Cretaceous stratigraphy.

J. W. Kerr resigned his position as a Research Scientist in August 1980. He has gone into private business as a consultant.

G. E. Reinson resigned his position as a Research Scientist, in May 1980. He has gone into private business as a consultant.

B. C. Richards joined ISPG as a term Physical Scientist in September 1980. He has accepted permanent employment as a Research Scientist pending completion of his Ph.D.

M. E. McMechan has been employed as a term Research Scientist, since July 1980.

I. Banerjee has accepted employment as a Research Scientist, and will assume his duties at ISPG in October 1981.

M. W. Ferguson resigned his position as Geological Clerk in September 1980 in order to return to university. He was replaced by E. G. Snow in March 1981.

J.A.P. Meilleur resigned his position as Storesman in the Core and Sample Repository in September 1980 and was replaced by M. F. Johnson the same month.

L. B. Emond, Storesman in the Curation section resigned in November 1980.

L. A. B. Bligh, a Sedimentology Technician resigned in January 1980 to join Petro Canada. He will be replaced by D. R. Armstrong in April 1981.

G. Smith and M. P. Babey joined the Curation section as term employees in June 1980 and January 1981, respectively.

Attendance at Meetings, Conferences and Courses

J. D. Aitken

Canadian Society of Petroleum Geologists, Future Energy Resources Conference, Calgary, Alberta, September 1980.

Geological Society of America, Annual Meeting, Atlanta, Georgia, November 1980.

American Association of Petroleum Geologists, Annual Meeting, Denver, Colorado, June 1980.

L. A. B. Bligh

Southern Alberta Institute of Technology Courses January to April 1980:
- Rocks and Minerals
- Petroleum Geology
- Physical and Historical Geology.

M. P. Cecile

Department of Indian and Northern Affairs Geoscience Forums, Whitehorse, Yukon Territory, and Yellowknife, N.W.T., November 1980.

R. L. Christie

Geological Association of Canada, Annual Meeting, Halifax, Nova Scotia, May, 1980.

International Geologic Correlation Program, Project 156, Phosphorites, Baja, California, Mexico, February, 1981.

D. G. Cook

Canadian Society of Petroleum Geologists, Future Energy Resources Conference, Calgary, Alberta, September, 1980.

Geoligical Society of America, Annual Meeting, Atlanta, Georgia, November 1980.

University of Alberta/CSPG, 18th National Conference on Earth Sciences; Earth Movements, Cause and Effect, May 1980, Banff, Alberta.

J. Dixon

Canadian Society of Petroleum Geologists, Future Energy Resources Conference, Calgary, Alberta, September 1980.

Canadian Society of Petroleum Geologists Seminar: Chemical Diagenesis of Clastic Sediments, Part I, Calgary, Alberta, February 1981.

A. F. Embry

Canadian Society of Petroleum Geologists, Future Energy Resources Conference, Calgary, Alberta, September 1980.

Canadian Society of Petroleum Geologists, Annual Core Conference, Calgary, Alberta, January 1981.

Canadian Society of Petroleum Geologists Seminar: Chemical Diagenesis of Clastic Sediments, Part I, Calgary, Alberta, February 1981.

H. H. J. Geldsetzer

Geological Association of Canada Annual Meeting, Halifax, Nova Scotia, May 1980.

Canadian Society of Petroleum Geologists, Geophysics for Geologists, Calgary, Alberta, April 1980.

J. Wm. Kerr

Geological Association of Canada, Annual Meeting, Halifax, Nova Scotia, May 1980.

University of Alberta/CSPG, 18th National Conference on Earth Science, Earth Movements, Cause and Effect, Banff, Alberta, May 1980.

U. Mayr

Canadian Society of Petroleum Geologists Seminar; Chemical Diagenesis of Clastic Sediments, Part I, Calgary, Alberta, February 1981.

Geological Association of Canada Annual Meeting, Halifax, Nova Scotia, May 1980.

M. E. McMechan

Canadian Society of Petroleum Geologists, Annual Core Conference, Calgary, Alberta, January 1981.

D. W. Morrow

Geological Society of America, Annual Meeting, Atlanta, Georgia, November 1980.

Canadian Society of Petroleum Geologists, Annual Core Conference, Calgary, Alberta, January 1981.

A. V. Okulitch

Workshop on Tectonics of Southeastern Canadian Cordillera, Queens University, January 1981.

Canadian Society of Petroleum Geologists, Future Energy Resources Conference, Calgary, Alberta, September 1980.

L. L. Price.

Canadian Society of Petroleum Geologists, Annual Core Conference, Calgary, Alberta, January 1981.

B. C. Richards

Canadian Society of Petroleum Geologists, Annual Core Conference, Calgary, Alberta, January 1981.

D. F. Stott

Geological Association of Canada Annual Meeting, Halifax, Nova Scotia, May 1980.

Canadian Society of Petroleum Geologists, Future Energy Conference Calgary, Alberta, September 1980.

G. C. Taylor

Workshop on Tectonics of Southeastern Canadian Cordillera, Queens University, January 1981.

University of Alberta/CSPG 18th National Conference on Earth Sciences; Earth Movements, Cause and Effect, Banff, Alberta, May 1980.

G. K. Williams

Canadian Society of Petroleum Geologists, Annual Core Conference, Calgary, Alberta, January 1981.

Membership on Committees

J. D. Aitken

Chairman, Subcommittee on Lithostratigraphic Units, Project to Revise the Code of Stratigraphic Nomenclature, American Commission on Stratigraphic Nomenclature.

Corresponding Member, Precambrian-Cambrian Boundary Working Group, International Union of Geological Sciences.

Member, Canadian Working Group on Precambrian Stratigraphy.

Member, Geological Association of Canada, Membership Committee.

Co-leader, Continental Interior and Basins Volume, Geology and Economic Minerals of Canada, 6th Edition.

M. P. Cecile

Member, ISPG Exhibits Committee

Member, N.W.T.-Yukon Lexicon Committee, Canadian Society of Petroleum Geologists.

Member, Earth Science Advisory Committee, National Earth Science Conference, Banff, University of Alberta/Canadian Society of Petroleum Geologists.

Member, GAC Annual Meeting Committee, Calgary 1981 (Transport Chairman).

R. L. Christie

Member, informal intra-departmental working group on phosphates.

Member, Technical Committee, 3rd International Symposium on Arctic Geology, Canadian Society of Petroleum Geologists 1981.

D. G. Cook

Commissioner, American Commission on Stratigraphic Nomenclature.

Liaison Officer to Alberta Geological Survey.

Co-Chairman, Canadian Society of Petroleum Geologists structural and Tectonic Terms Lexicon Committee.

Member, GAC Annual Meeting Committee, Calgary '81 (Field Trip Co-chairman).

J. Dixon

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

Program Organizer, Sedimentology Division, Canadian Society of Petroleum Geologists,

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

Member, ISPG, Stratigraphic Nomenclature Committee.

A. F. Embry

Chairman, ISPG Stratigraphic Nomenclature Committee

Member, Technical Committee, 3rd Arctic Symposium, Canadian Society of Petroleum Geologists.

Chairman, Publications Committee, 3rd Arctic Symposium, Canadian Society of Petroleum Geologists.

A. F. Embry Cont'd.

Chairman, Sedimentology Division, Canadian Society of Petroleum Geologists.

Member, Student Awards Committee, Canadian Society of Petroleum Geologists.

M. A. Halkett

Member, ISPG Safety Committee

Chairman, ISPG Tour Committee.

M. E. McMechan

Member, ISPG Library Committee.

N. C. Meijer-Drees

President, ISPG McConnell Club.

D. W. Morrow

Member, Lexicon of Stratigraphic Names Committee, Canadian Society of Petroleum Geologists.

A. V. Okulitch

Member, ISPG Library Committee.

D. F. Stott

Co-leader, Continental Interior and Basins Volume, Geology and Economic Minerals of Canada, 6th Edition.

General Chairman, 1983 Joint CSPG-RMAG Conference, Mesozoic of Middle North America from Mexico to the Mackenzie.

G. C. Taylor

Member, GAC Annual Meeting Committee, Calgary '81, (Accommodation Chairman).

H. P. Trettin

Member, Twenhofel Medal Selection Committee, Society of Economic Paleontologists and Mineralogists.

Chairman, ISPG Clay Minerals Committee.

Leader, Arctic Islands Volume, Geology and Economic Minerals of Canada, 6th Edition.

Subdivision Manuscripts

Manuscripts for one GSC Memoir, one GSC Bulletin, one GSC Paper, thirteen A-series Geological Maps, thirteen outside papers, five abstracts, three Current Research Papers, and two Open File reports were submitted for publication or distribution by the subdivision staff during 1980-81. Scientists of the subdivision also submitted geological formation tops to the Department of Indian and Northern Affairs for all northern wells released from confidential status during the report year.

Laboratory Statistics

Curation

"C" numbers issued	6,000
New collections (surface)	5,990
New collections (subsurface)	2,000
Transferred from Ottawa	2,000
Collections catalogued, recorded and shelved	±15,990

Lapidary

Thin Sections, standard	1,526
Thin Sections, large	12
Thin Sections, stained	87
Epoxy impregnation unconsolidated grains and well cuttings	27
Epoxy preliminary impregnation samples	635
Cut and polished specimens	60
Miscellaneous (cuts, polishes, broken section repairs)	74
Special custom large thin sections	12
Special thin sections standard size	58
Special cuts for curation (space reduction)	2,500
Ceremonial retirement plaques	10

Core and Sample Repository

Well samples received:	
Alberta	250,789
British Columbia	96,393
Saskatchewan	13,475
Manitoba	7,704
Northwest Territories	11,025
	379,386
Mechanical logs received:	
Alberta	13,601
British Columbia	1,384
Saskatchewan	2,198
Manitoba	16
Northwest Territories	171
	17,370

Territories core received	367 boxes
Visitors requiring core, samples or related information	2,079

There was a total of 2,670 boxes of core made available for examination, and samples from some 750 wells were requested.

Approximately 11,400,000 well samples and 21,000 boxes of core are on file.

Annual Report 1980-1981

PALEONTOLOGY SUBDIVISION

B. S. Norford

The Paleontology Subdivision is concerned with interpretation of the fossil record preserved in the crust of the earth and is responsible for scientific studies in biostratigraphy, paleoecology and systematic paleontology. These investigations provide data that support regional mapping and stratigraphic studies, and the exploration for hydrocarbons, metals and other non-renewable resources in western and northern Canada. In addition these data contribute to the geological models used in the assessment of these resources. Most of the Subdivision's activities are in the Northwest and Yukon Territories, but an increasingly broader participation in British Columbia and Alberta is being realized. In all these areas, paleontology assumes an extraordinary importance in the evaluation of energy reserves and in the search for stratigraphically controlled mineral deposits.

The Paleontology Subdivision is charged with maintaining standards for effective intrabasinal and interbasinal correlation and is exploring means for improving zonal schemes and improving interpretations of paleo-environments. Fossil groups that display relatively rapid evolutionary changes are important for establishment of models showing significant refinements of time-scales. Similarly, relatively little known fossil groups are being tested within the Subdivision for biostratigraphic potential and application. A large part of the program involves dating, correlation and determination by means of detailed studies of palynomorphs, foraminifers, conodonts and other microfossils and macrofossils recovered from the cuttings and cores derived from wells drilled in the Yukon and Northwest Territories.

The Subdivision consists of three scientific sections. The Micropaleontology Section, through detailed study of microfaunas and microfloras, develops and applies models of biostratigraphic and paleoecological zonations to refine knowledge of the stratigraphy of Phanerozoic rocks in Canada, which contain all of Canada's fossils fuels and a significant proportion of its mineral deposits. The Macropaleontology Section and the Ottawa Paleontology Section use macrofossils for very similar purposes and, in addition, conduct stratigraphic studies in cooperation with other units of the Geological Survey of Canada.

Research and service programs within the Subdivision are closely coordinated with those of the other subdivisions of the Institute, with similar programs of the Atlantic Geoscience Centre, the Regional and Economic Geology Division, and with those of a number of universities in Canada and the United States, France and the United Kingdom. A substantial portion of the functions of the Subdivision is conducted through contracts by consulting companies and by university scientists who are, nonetheless, supervised by the Subdivision. In addition, a number of EMR Research Agreements, arranged with scientists outside the Survey, are administered by the Subdivision.

Highlights

- Detailed taxonomic studies of fossils provide vital benchmarks for biostratigraphic correlation. Such studies completed during the year include:

  Late Cambrian and Early Ordovician conodonts from the Arctic Islands.
  Brachiopods of the Upper Devonian Waterways Formation of Alberta
  Middle Devonian spores, Melville Island, District of Franklin
  Charactophylid and cystiphyllid corals of the Devonian of North America and Australia.

- Subdivision scientists and associated outside experts completed 141 paleontological reports on 1,643 lots of fossils from outcrop and subsurface. These reports were prepared for direct quotation in publications and provided dating and correlation of rock units throughout Canada.

- An important paper integrated geological, palynological and foraminiferal information for the Ukalerk C-50 well, Beaufort Sea, providing environmental interpretations, age determinations and intrabasin correlations for the Cenozoic rocks, including a gas-bearing Oligocene sand unit at depth 2,011 m.

- Field and office studies have revealed a succession of fourteen microfossil assemblages within the Jurassic and Cretaceous sediments of the eastern part of the Sverdrup Basin.

- A field study of trace fossils in northern British Columbia indicated that these can be used for discriminating the Precambrian-Cambrian Boundary within the Stelkuz Formation of the Cassiar Mountains.

- A one-day workshop on the biostratigraphy of the Mackenzie Delta and the Beaufort Sea was given to geologists of the Department of Indian and Northern Affairs, Ottawa.

Personnel Notes

The Subdivision includes 29 positions (19 scientists, 8 technicians, 2 secretaries) and a number of temporary assistants. A. Riccardi, R. Kalgutkar and L. Lee joined the Subdivision during the year but N. W. Ioannides, A. C. Riccardi, E. B. O'Keefe, R. J. Broadfield, M. J. Mangin and R. L. Lennox resigned and W.W. Nassichuk became Director of the Institute so that by the end of the year the Subdivision was considerably below its normal strength.

M. J. Copeland concluded a very effective term as Head of the Ottawa Paleontology Section in March 1981. E. T. Tozer was appointed in his place. B. S. Norford acted as Head of the Subdivision from October 1980.

Attendance at Meetings, Conferences and Courses

Geological Association of Canada, Annual Meeting, Halifax, May 19-21.
M. J. Copeland
A. R. Sweet

Geological Association of Canada, Cordilleran Section, Annual Meeting, Vancouver, B.C. February 10 - 13.
W. S. Hopkins

Fifth International Conferende on Palynology, Cambridge, England, June 30 - July 5th.
D. C. McGregor

Workshop on Geology of Coal fields of southeastern British Columbia, September
A. R. Sweet

Geological Society of America, North Central section, Bloomington, Indiana, May
G. S. Nowlan

Canadian Paleontology and Biostratigraphy Seminar, Fredericton, September.
G.S. Nowlan.

Canadian Society of Petroleum Geologists, Energy Audit of the Eighties, Calgary, September 29-October 1
D. M. McNeil
J. H. Wall

University of Calgary, Oil Sands Geology Course, Oct. 2-3
J. H. Wall

Membership on Committees

E. W. Bamber

North American Study Group, International Subcommission on Permian Stratigraphy, Member

Dinantian Working Group, International Subcommission on Carboniferous Stratigraphy, Member.

ISPG Advisor on Curation.

M. J. Copeland

Geological Survey of Canada Library Committee

Geological Survey of Canada GEOGRAM Committee

Geological Survey of Canada Earth Science Literature Committee (Chairman)

International Research Group on Paleozoic Ostracodes (President).

Paleontology task force, National Inventory Programme, National Museums of Canada

North American Paleontology Convention III Committee

Cultural Property Export and Import Act, Expert Examiner (Paleontology).

W. H. Fritz

Precambrian-Cambrian Boundary Working Group, International Union of Sciences/International Geological Correlation Program, Member.

Cambrian Subcommission, International Union of Geological Sciences, Voting Member.

J. A. Jeletzky

International Union of Geological Sciences, Cretaceous Subcommission, Commission on Stratigraphy, Member.

International Union of Geological Sciences, Commission on Stratigraphy, Working Group on Jurassic-Cretaceous Boundary, Member

Miller Medal Committee, Royal Society of Canada, Chairman.

Mid-Cretaceous events Project (IGCP), Member.

D. C. McGregor

Subcommission on Devonian Stratigraphy, International Union of Geological Sciences, Member

Canadian Association of Palynologists, President

International Commission for Palynology, Vice-President

Commission Internationale de Microflore du Paléozoique (CIMP), Member of Executive and North American Secretary

Hystricospore Working Group, Commission Internationale de Microflore du Paléozoique, Member

North American Devonian Study Group, Member

Palaeobotanical Symposium Committee, Canadian Botanical Association, Chairman

Biostratigraphy Subcommittee for revision of North American Stratigraphic Code, Member

D. H. NcNeil

I.S.P.G. Exhibits Committee, Member.

B. S. Norford

Research Committee, Canadian Society of Petroleum Geologists, Chairman

Working Group on Cambrian-Ordovician Boundary, International Commission on Stratigraphy, Chairman

Advisory Committee on Paleontological Resources, Province of Alberta Department of Culture, Member

B. S. Norford Continued

Dean's Visiting Committee for the Department of Geology, Memorial University of Newfoundland, Chairman.

Senate of the University of Calgary, Senator; Member of Executive Committee Member of Honorary Degrees Committee; Chairman of Spirit Task Force;

Board of Governors of the University of Calgary, Member; Member of Business and Finance Committee

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, Member.

A. W. Norris

Subcommission on Devonian Stratigraphy, International Union of Geological Sciences, Voting Member.

North American Devonian Study Group, Organizing Member.

G. S. Nowlan

Paleontology Division, Geological Association of Canada, Chairman.

Appalachian-Caledonian Orogen Project, Sedimentation/Faunal Provinces Working Group, International Geological Correlation Program, Corresponding Member.

GAC-CSPG Joint Committee on Paleontological Monographs, Member.

A.E.H. Pedder

International Association for the Study of Fossil Cnidaria, Council Member.

Subcommission on Devonian Stratigraphy, International Union of Geological Sciences, Corresponding Member.

North American Devonian Study Group, Member.

T. P. Poulton

I.S.P.G. Nomenclature Committee, Member

I.S.P.G., Chairman of McConnell Club.

A. C. Riccardi

Jurassic Subcommission, International Union of Geological Services, Voting Member.

A.R. Sweet

Advisory Committee on Paleontological Resources, Province of Alberta, Department of Culture, Member.

E. T. Tozer

IGCP National Committee, Secretary.

T. T. Uyeno

North American Working Group on the Devonian System, Member.

J. H. Wall

I.S.PG. Library Committee, Chairman

Journal of Foraminiferal Research, Associate Editor

Admissions Committee, Sigma Xi Chapter, University of Calgary, Member

C.S.P.G. Paleontology Division Subcommittee on Canadian Paleontological Monograph Series, Member.

Special Talks and Lectures

D. C. McGregor

Spores and the Middle-Upper Devonian Boundary; 5th International Conference on Palynology, Cambridge, July 1980.

D. C. McNeil

Foraminiferal biostratigraphy of the Dome-Gulf et al. Ukalerk C-50 well, Beaufort Sea; Canadian Society of Petroleum Geologists, Paleontology Division, October 1980

B. S. Norford

The Cambrian-Ordovician Boundary in Canada and the search for an international standard; University of Calgary, Department of Geology, September 1980.

G. S. Nowlan

Early and Middle Ordovician conodonts and stratigraphy, Romaine and Mihgan Formations, Mingan Islands, Quebec; Geological Society of America, North-Central Section, May 1980 and Canadian Paleontology and Biostratigraphy Seminar, Frederickton, Sept. 1980.

A. R. Sweet

Application of palynology to coal exploration in western and northern Canada; Geological Association of Canada, Annual Meeting, Halifax, May 1980.

Palynology of the Kootenay Group, Crowsnest area; Workshop on geology of coal fields of southeastern British Columbia, Fernie, September 1980.

Laboratory Statistics

Foraminifer Laboratory

The laboratory processed 1,035 samples from outcrop and well material. Of these 967 were for scientific projects led by D. A. McNeil and J. H. Wall and the remainder were for projects led by other GSC scientists.

Conodont Laboratory

A total of 434 samples were processed and residues from 373 samples were picked under the microscope with removal and sorting of the contained conodonts and mounting on slides. Of the total processed, 222 were for projects led by T. T. Uyeno and 212 for projects the responsibility of other GSC scientists.

Palynology Laboratory

The laboratory processed 1,137 surface and subsurface samples. Of these 1,108 were for miospore studies and 29 for megaspore studies. 1,020 samples were for projects led by W. S. Hopins, N. S. Ioannides and A. R. Sweet and 117 were for other GSC projects.

Macropaleontology Laboratory

The prime output consisted of 724 precisely positioned and orientated thin-sections of corals for studies led by A.E.H. Pedder, E. W. Bamber and B. S. Norford. In addition fossils were picked and sorted from 8 acid residues for B.S. Norford and 5 precise replicas were made by moulding and casting techniques. One presentation plaque was made for the Institute Director.

Type specimens catalogued in 1980

Publications	PC.	Camb.	Ord.	Sil.	Dev.	Carb.-Perm.	Trias.	Jur.	Cret.	Tert.	Total	Nfld.	N.S.	Que.	Ont.	Manit.	Alt.	B.C.	Yuk.	NWT	F.
GSC Bulletins																					
Bull. 282 (Pelecypods)								75			75						X	X	X		
Bull. 308 (Brachiopods)					567						567									X	
Bull. 420 (Miospores - Microplankton)									90		90									X	
Bull. 321 (Corals, Conodonts, Trace Fossils)		105	107								212	X			X					X	
GSC Papers																					
79-1C (Ammonites)								4			4							X			
79-15 (Conodonts)						113					113									X	
79-16 (Decapods)								7	19		26						X			X	
80-1A (Ammonites, Palynomorphs, Pelecypods)			33	33	10		14	15	20	54	179							X		X	X
80-1B (Ostracods, Trilobites)			28	17	19						64			X					X	X	
80-1C (Corals, Algae)			54				2	2			58			X				X	X		
Subtotals	-	105	222	50	596	113	16	103	129	54	1388										
Can. J. Earth Sci. (Borings, Microfossils, Coral, Graptolites, Bryozoa, Stromatolites)	8	50	58	37	28	31					212		X	X	X	X	X	X	X	X	X
J. Pal. (Brachiopods, Problematica)				13	4						17								X	X	
Other (Trilobites, Microfossils, Palynomorphs, Fish, Algae)	41	2	13		126	29	-	9	63	-	283		X	X	X			X	X	X	X
Subtotal	49	52	71	50	158	60	-	9	63	-	512										
Total	49	157	293	100	754	173	16	112	192	54	1900										

National Type Collection of Invertebrate and Plant Fossils

Thomas E. Bolton continued as Curator of the National Type Collection of Invertebrate and Plant fossils. A total of 1900 type specimens described in both Geological Survey of Canada (1388) and outside (512) publications were added to the collection in 1980.

Ottawa Laboratories

Lapidary-Paleontology Laboratory	1979-1980	1980-1981
Rock thin sections		
Standard, produced by laboratory	3976	4498
Standard, purchased by contract	985	412
Oriented	116	80
Large	207	107
Polished, produced by laboratory	3	0
Polished, purchased by contract	1100	771
Covered after staining	218	540
Polished rock surfaces	128	59
Rock saw cuts (trim and slab)	12897	9571
Levelled rock surfaces	6338	2042
Fossil thin sections	206	209
Polished fossil surfaces	0	0
Rubber molds of fossils	118	43
Plaster casts of fossils	77	286
Parcels of fossils received	80	96
Parcels of fossils shipped	193	197
Fossil localities catalogued	865	763
Momentos prepared for presentation	15	25
Silicone casts of fossils	40	21

Additional specimens were prepared for electrical rock property studies, autoradiographs, chemical analyses, seismic velocity measurements, museum display, etc.

Conodont Laboratory	1979-1980	1980-1981
Samples processed	439	378
Residues separated and picked	614	465

Paleopalynology Laboratory		
Samples processed	251	270
Slides prepared	271	1083

COAL GEOLOGY SUBDIVISION

D.K. Norris

The role of the Coal Geology Subdivision continues to be that of establishing a sound geoscience base in the coal measures throughout Canada and of providing and maintaining a resource evaluation of Canadian coal deposits in collaboration with the Provinces, with industry and with the Atlantic Geoscience Centre. These activities are designed to meet policy, regulatory and information requirements of the Department of Energy, Mines and Resources.

To fulfil this role, the Subdivision is organized into three sections. The Geology of Coal Section conducts stratigraphic and structural studies of Canadian coal deposits that assist in the establishment of a geoscience data base from which resource evaluations can be made. Insofar as the bulk of increases in the future domestic demand for coal is expected to be for electrical power, a major thrust of the section is in the direction of the geology of low rank coal deposits in western and northern mainland Canada, and of the bituminous coals of Nova Scotia and New Brunswick. The Coal Technology Section is engaged mainly in studies of the petrographic character of coal seams and their application to seam identification, correlation and quality prediction. In addition, the section is studying the trace element content of coal and the maturation of organic material, including coal, in fine-grained, clastic rocks. The Resource Evaluation Section is responsible, alone or jointly with the provinces, for the estimation of the coal resources of Canada in terms of their type of occurrence, nature, quantity, quality and mineability.

Highlights

- The most striking highlight of the year was the large staff turnover, with three resignations and one retirement. A vigorous recruiting campaign, however, has resulted in the hiring of four replacements and action being taken to fill the three remaining vacancies in the Subdivision.

- As part of the on-going coal assessment program, the Branch continues to co-operate with the coal-producing provinces and with industry in the generation and processing of geoscience and resource data as input for the National Coal Inventory. Industry is particularly interested in the Branch's methodology for storing and manipulation of this information and continues to volunteer large amounts of data for processing. These and other data are necessary to meet policy, regulatory and information requirements of the Department in the planning of future development of Canada's coal resources.

- Detailed studies of ancient depositional environments of the coal measures in western Canada are providing new exploration models and are relating recoverability of coal to specific depositional regimes. These investigations as well as those on surface oxidation, trace elements, and mineral matter in coal are arousing considerable interest with coal companies because they are assisting in the delineation of mineable reserves in long-range mine planning and assessment of environmental hazards.

- Nine manuscripts relating to the geology and resource potential of Canada's coal deposits, prepared during the report year, were in various stages of critical reading, and 8 were published. Among them was important notice of the coal resource potential of the Minnes Group in northeast British Columbia.

Personnel Notes

The Subdivision presently consists of a permanent staff of 13 scientists, 2 technicians and one secretary.

Carol Boonstra was promoted from Secretary to the Subdivision to Coal Technician in October, 1980.

Pat Dobell joined the Subdivision in February, 1981 to assist in the processing of industry geological data and to carry out investigations into the identification of plant tissues in various ranks of coal.

J.D. Hughes was promoted to the position of Senior Coal Resource Evaluator and Head of the Resource Evaluation Section in March, 1981.

W. Kalkreuth joined the Coal Technology Section as Petrologist and specialist in brown coals in April, 1980.

L. Kamenka joined the Resource Evaluation Section as Coal Geologist in December, 1980.

B.A. Latour retired from the Geological Survey in December, 1980.

D. Long resigned from the Subdivision in September, 1980 to take a teaching position at Laurentian University.

D. Marchioni resigned in January, 1981 to work with a consulting firm in Australia.

Kathie Mottershead joined the Subdivision as Coal Systems Geologist in March, 1981.

D.K. Norris, with the assistance of C. Boonstra, A.R. Cameron, D.W. Gibson, J.D. Hughes, J.A. Irvine and M. McMechan, led a field trip through the coal measures of the Crowsnest Pass area for the scientific staff of the Institute in September, 1980. Two scientists from the Cordilleran Division in Vancouver, one from the Alberta Research Council and two from the National Energy Board also participated.

B.D. Ricketts joined the Subdivision as Clastic Sedimentologist in February, 1981.

Donna Smith joined the Subdivision as Secretary in January, 1981.

Attendance at Meetings, Conferences and Courses

A. R. Cameron

Attended two meetings of the Canadian Coal Petrographers in Halifax and Ottawa.

Attended the joint GAC/MAC Annual Meeting in Halifax in May, 1980. He was Chairman of the session on western Canadian coals and, with P. Hacquebard, led the field trip through the coal measures of eastern Nova Scotia.

Attended the workshop on the Geology of the Coalfields of southeast British Columbia in Fernie, B.C.

D. W. Gibson

Attended the workshop on the Geology of the Coalfields of southeast British Columbia in Fernie, B.C., in February, 1981.

Participated in the staff field trip to examine modern barrier islands on the east coast of Canada in September, 1980.

Attended the meeting of the International Geological Correlation Program (Correlation of Coal Bearing Formations) in London, June 1980.

J. D. Hughes

Attended the joint GAC/MAC Annual Meeting in Halifax in May, 1980 where he presented a paper on the geology of central Alberta coal deposits.

Participated in the staff field trip to examine modern barrier islands on the east coast of Canada in September, 1980.

Attended the workshop on the Geology of the Coalfields of southeast British Columbia in Fernie, B.C., in February, 1981.

Attended the conference on Computers and Coal, sponsored by the B.C. Ministry of Energy, Mines and Petroleum Resources, in Victoria, B.C., in March, 1981. He also presented a paper on computer processing of geological data.

W. Kalkreuth

Attended the workshop on the Geology of the Coalfields of southeast British Columbia in Fernie, B.C., in February, 1981.

Participated in the staff field trip to examine modern barrier islands on the east coast of Canada in September, 1980.

Attended the Ottawa meeting of the Canadian Coal Petrographers.

L. Kamenka

Attended the workshop on the Geology of the Coalfields of southeast British Columbia in Fernie, B.C., in February, 1981.

D. L. Marchioni

Attended the joint GAC/MAC Annual Meeting in Halifax in May, 1980.

Attended the Annual Meeting of the International Commission on Coal Petrology in Ostrava, Czeckslovakia in April, 1980.

Participated in the staff field trip to examine modern barrier islands on the east coast of Canada in September, 1980.

D. K. Norris

Attended the Annual Meeting of the AAPG in Denver, in June, 1980, where he presented a paper on the hydrocarbon potential of northern mainland Canada.

Attended the conference on Earth Movements sponsored by the Department of Extension, University of Alberta, in Banff, Alberta, in April, 1980.

Attended the Canadian Conference on Coal, in Vancouver, in October, 1980, along with J.A. Irvine and B.A. Latour.

Attended the conference on Computers and Coal, sponsored by the B.C. Ministry of Energy, Mines and Petroleum Resources, in Victoria, B.C. in March, 1981.

Attended the Annual Meeting of the Cordilleran Section of the Geological Association of Canada in Vencouver, B.C., in February, 1981 where he presented a paper on the tectonic evolution of Canadian Cordilleran Orogen.

N. C. Ollerenshaw

Attended the workshop of the Geology of the Coalfields of southeast British Columbia in Fernie, B.C. in February, 1981.

Special Talks or Lectures

D. W, Gibson

"A Review of Geological Research by the Geological Survey of Canada on Coal Measures in Canada" to the International Geological Correlation Program Committee, London, June, 1980.

J. D. Hughes

"Coal and Rock Unit Geometry in the lower Horseshoe Canyon Formation of central Alberta, and its Relationship to Depositional Setting"; GAC/MAC Annual Meeting, Halifax, N.S., May, 1980.

"G.S.C. Methodology relating to the Interpretation, Storage, Organization and Manipulation of Coal Borehole Data"; Conference on Computers and Coal, Victoria, B.C., March, 1981.

D. K. Norris

"Eastern Cordilleran Foldbelt and Foreland of Northern Canada"; AAPG/ SEPM Annual Convention, Cenver, Colorado, June, 1980.

"Transform, Contraction and Extension FAults in the Northern Cordillera of Canada - Their Spatial and Temporal Relationships since Mid-Cretaceous Time"; Cordilleran Section Meeting, Geological Association of Canada, Vancouver, B.C., February, 1981.

N. C. Ollerenshaw

"Geology of the Dominion Coal Block"; Workshop on the Geology of the Coalfields of southeast British Columbia; Fernie, B.C., February, 1981.

Membership on Committees

A. R. Cameron

Nominating Committee, Coal Division, Geological Society of America.

International Committee for Coal Petrology, Member.

Editorial Board of Coal Geology (Elsevier, Amsterdam).

D. W. Gibson

C.S.P.G. Thesis Awards Committee, 1980.

International Geological Correlation Program, member.

J. A. Irvine

ERDS Technical Committee, Member.

Computer Committee, I.S.P.G., Member.

B. A. Latour

Coal Resource and Reserve Assessment Group, Department of Energy, Mines and Resources, Member.

D.G.F. Long

Library Committee Member.

D. L. Marchioni and W. Kalkreuth

Working committee of the International Committee for Coal Petrology, Member.

D. K. Norris

E.M.R. Coal Committee, Member.

N. C. Ollerenshaw

Stratigraphic Nomenclature Committee, I.S.P.G., Member

Coal Technology Laboratory

About 810 pellets of coal and dispersed carbonaceous material were cast and polished. Approximately 65 samples were submitted to outside contractors for chemical analyses and rheological determinations. Additional time was spent by technical staff in updating files on the coal sample collection.

PETROLEUM GEOLOGY SUBDIVISION

The Petroleum Geology Subdivision is responsible for compiling and interpreting the geological information necessary for the evaluation of oil and natural gas for the sedimentary basins of Arctic and Western Canada. Research is also conducted into the mode of origin and occurrence of these commodities to provide necessary background for the evaluation studies. The Subdivision activities in resource evaluation are interrelated with other programs of the Division and is coordinated with the work of other agencies within the Federal Government. Responsibility for these programs is divided among three sections.

The Petroleum Resources Section is primarily responsible for the assessment of Western and Arctic Canada's potential Petroleum Resources and for conducting research on the habitat of oil. Maintenance of computer data files are related to well data, oil and gas pool data and other information are a secondary responsibility. Much of the work of the Section is coordinated through the Petroleum Resources Secretariat with related activities within the Institute's programs and with the Department of Indian and Northern Affairs.

The Geochemistry Section provides scientific services to the Division, develops and published 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 East Coast Offshore and provide data for the Petroleum Resource Evaluation program.

Highlights

- Several major organizational changes were made during the year. The responsibility for development of resource methodology and coordination with the Geological Subcommittee on Resource Potential was transferred along with appropriate personnel to the newly formed Petroleum Resources Appraisal Secretariat. The Data Management Section was transferred to the office of the Assistant Director of the Division.

- The inability to recruit staff for the Petroleum Resources Section was a major constraint on the program. Compilation of Western Canada Oil and Gas Pool maps was completed. A geophysical structure map was completed for the Western Sverdrup Basin.

- Papers were prepared on the early generation of hydrocarbons; on the correlation of petrographic and chemical analyses of sedimentary organic matter; on the occurrence of berthierine in an Arctic soil, and on the mineralogy of Arctic desert soils.

- Adaptation of a technique for analyzing gasoline range hydrocarbons has enabled the degree of thermal diagensis of source rocks and oils and condensates to be determined. Beaufort-Mackenzie samples appear to have been generated close to the reservoir at an early stage of thermal diagenesis whereas several samples from East Coast basins have undergone extensive vertical migration from thermally mature regions.

- High resolution capillary gas chromatographic studies and combined gas chromatograph - mass spectrometer studies have confirmed the presence of diterpenoid compounds in Mackenzie-Delta oils and extracts and the nature of the unusual source (resinite) for these oils.

- Technique development particularly in the area of computers for acquisition and manipulation of geochemical data continues. A computer data acquisition and manipulation system has been added to the gas chromatography - mass spectrometry system. A program for calculating the take-off angle for X-rays generated from a specimen in the scanning electron microscope has been derived and testing for use of the energy dispersive X-ray system on the SEM for full quantitative analysis continues. Calibration of the XRF for full quantitative studies continues by calculation of α - coefficients and pure element intensity constants.

- Quantitative hydrocarbon gas generation studies were undertaken using extensive computer manipulation of existing data files. Initial results show the gas generation occurs at different levels of thermal alteration than was previously proposed.

Personnel Notes

The Petroleum Geology Subdivision employs a permanent staff of 14 scientists, 10 technicians and 1 secretary. The following position are vacant: Head Petroleum Resources Section, Geologist (Arctic Islands), Geologist (Mackenzie-Delta), Geologist (Western Canada), Geologist (Uncon Gas), Secretary and Organic Geochemical Technician.

J. Brindle was appointed Head Petroleum Geology Subdivision but was subsequently transferred to be Assistant Director

T.G. Powell is A/Head Petroleum Geology Subdivision

L.R. Snowdon is A/Head Geochemistry Section

N. Long resigned as Secretary to the Subdivision

J. Dietrich has joined as Geophysicist (Mackenzie-Delta)

J. Krocko joined as Arctic Islands Geologist but has resigned to join Department of Indian and Northern Affairs

N. MacNeil joined as Geophysical Technician

S. Wolf joined as Inorganic Geochemistry technician and subsequently resigned

J. Wong joined as Clay Mineralogy technician

B. Gorham joined as Inorganic Geochemistry technician

S. D'Entremont was promoted within the Geochemistry Section

F. Monnier is working in the Geochemistry Section as a Post-doctoral Fellow funded by the Swiss National Foundation

K. Tazaki is working the Geochemistry Section as a Post-doctoral Fellow funded by NRC.

Attendance at Meetings Conferences and Courses

T.G. Powell

Gordon Research Conference on "Organic Geochemistry", Plymouth, N.H. August 18-22, 1980.

Symposium on "Carbonate Source Rocks", GSA Meeting, Atlanta, November 1980.

Carnegie Institute Washington Conference on "Organic Matter in Ore Deposits", Warrenton, Virginia, November 1980.

L.R. Snowdon

Gordon Research Conference on "Organic Geochemistry", Plymouth, N.H. August 18-22, 1980.

The Canadian Pacific Continental Margin short course, Pacific Geoscience Centre, Sidney B.C., February 16-17, 1981.

A. Densmore

Society Exploration Geophysists Annual Meeting, Houston, November 1980.

CSPG-CSEG Annual Meeting, Calgary, August 1980.

M. Fuglem

Course on "Thermal Recovery Methods for Petroleum by Dr. T. Doscher, USC", Calgary, January 15-15, 1981.

K. Wallace-Dudley

CSPG-CSEG Annual Meeting, Calgary, August 1980.

CSPG Core Conference, Calgary, January 15-16, 1981.

D. Campbell

CSPG-CSEG Annual Meeting, August 1980.

CSPG Core Conference, Calgary, Januany 15-16, 1981.

Special Talks or Lectures

T.G. Powell

"Hydrocarbons in Immature Regimes, Indigenous or Migrated"? Gordon Research Conference on Organic Geochemistry Plymouth N.H., August 18-22, 1980. Also presented ISPG McConnell Club, Science Hour, Atlantic Geoscience Centre, CSPG Geochemistry Division, co-authored by L.R. Snowdon.

"Organic Geochemistry of the Pine Point Lead Zinc Deposit, NWT", Carnegie Institute Washington Conference on "Organic Matter in Ore Deposits", November, 1980.

"Geochemistry of carbonate rocks and oils, Pine Point Barrier, NWT and Silurin, S.W. Ontario". Symposium on carbonate source rocks GSA Meeting, Atlanta, November, 1980.

"Application of Petroleum Geochemistry to Petroleum Resource Evaluation", CSPG Symposium on Evaluation of Petroleum Resources, January, 1981.

Short Course on "Petroleum Geochemistry" given to geologists from EMR, DINA, Ottawa, February 25-27, 1981.

L.R. Snowdon

Review of Petroleum Geochemistry of Beaufort Mackenzie Basin for EMR, DIANA personnel, Ottawa, February 25-27, 1981.

Membership on Committees

T.G. Powell

Canadian Society of Petroleum Geologists, Geochemistry Division, Chairman, Geochemical Society Member Nominating Committee.

Karen Wallace-Dudley

Member Library Committee, ISPG.

Laboratory Statistics

Organic Geochemistry

Analysis of light hydrocarbons and organic carbon:

	79/80	80/81
Light Hydrocarbon Analyses	3,220	2314
Organic Carbon Analyses	4,095	1870
Number of Wells	12	14

Extraction and separation of hydrocarbon fractions, rocks and oils:

	79/80	80/81
Extraction	240	180
Distillations	39	77
Separation	279	269
Gas Chromatographic Analysis	279	365

Kerogen Studies:

	79/80	80/81
Isolation	11	90
Elemental Analysis	15	72
Infra red analyses	68	-
Reflectance pellets	-	208

Source Oil Correlation Studies:

	79/80	80/81
Gasoline range	60	369
Mass Spectrometry	50	80

Inorganic Geochemistry

	79/80	80/81
XRD mineral determinations	3835	7462
Infra red analyses	50	125
XRF analyses	1000	18,722
Thermogravimetric analyses	432	75
Differential thermal analyses		100
Atomic absorption analyses	762	1438
Low temperature ashing	-	352
High temperature ashing	-	870
Miscellaneous (C,P,S, moisture, pH)	50	1443

Scanning Electron Microscopy

		79/80	80/81
Exposures:	Paleontology Subdivision	30	1277
	Petroleum Geology		764
	Regional Geology		290
	Coal Geology		63

Microanalyses:

	79/80	80/81
Regional Geology Subdivision	-	12
Coal Subdivision	-	9

GEOLOGICAL INFORMATION SUBDIVISION

E.R.W. Neale

This subdivision is responsible for communicating the results of the Institute's programs to government, industry, the universities and the general public. This is done chiefly through publications in the Geological Survey's own series and in established national and international scientific and technical journals. Some results are also made available through an Open File system. In support of this objective, the Subdivision maintains capabilities and facilities in scientific editing and information, cartography, technical photography, library services and publication distribution. The Subdivision also communicates with the public and the scientific community 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 participation in the work of committees and associations. An information clipping service on Alberta energy issues was maintained for Communications EMR.

During the past year, the two members of the editorial staff processed 44 reports in the Geological Survey series, 34 outside publications, 15 open file reports and 9 final maps. This involved selection of critical readers and evaluation of their reports, scientific editing, copy-editing and, in most cases, layout and proofreading.

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. This and other short-cuts helped to reduce the backlog to a few months - which remains the current situation. The Cartographic Section was at full strength for the second part of the year. An influx of manuscript maps from Operation Porcupine continued throughout the review year. Work on this project will be completed in 1981. The work of the Section includes both black-and-white and multicoloured illustrations in addition to photomechanical and reproduction work. The large cartographic process camera has enhanced speed and quality of a great variety of our illustrative 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. Production was down slightly this year as resignation of several key scientific personnel slackened demand. Previous backlogs have now been virtually eliminated and deadlines can again be met promptly. 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.

Personnel Notes

Barbara Fischer joined the Cartographic Section in April as a senior draftsperson. She came to us from the Ontario Department of Mines. Barbara is a skier of note.

Stephen Orzeck joined the Cartographic Section as a junior draftsman in July, bringing the unit up to full strength. Stephen is a graduate of Seneca College in Ontario. He adds great strength to the Institute's golf team.

Jean Spirritts, a temporary employee in the Publications Section, won a competition for a newly created, permanent clerkship in that unit.

Fontaine Hwang, library technician and SAIT graduate, joined us in June to replace Suzanne Coutts who left us to join Dome Petroleum as a library clerk.

Dana Frank, librarian, joined us in November, coming from the Conservation Institute of the National Museum in November. She replaced June Graff who, after many years with us left us in June to join Dome Petroleum as head librarian. Subsequently,June departed for Australia.

ATTENDANCES AT MEETINGS, CONFERENCES AND COURSES

M. Jones

Visit to GSC Library (Ottawa, September)

Foothills Library Association, Seminar on word processing machines (Calgary, March)

D. Frank

Foothills Library Association, Seminar on word processing machines (Calgary, March)

Canada Institute for Scientific and Technical Information (CISTI), CAN/SDI seminar (Calgary, February)

Special Libraries Association annual meeting (Washington, D.C., June, 1980)

International Institute for Conservation, Canada Group meeting (Ottawa, July, 1980)

Various CASLIS (Calgary Chapter) luncheon meetings.

F. Hwang

Geology 209, University of Calgary (September-December 1980)

ORBIT (automated search system) (Calgary, November, 1980)

Foothills Library Association, Seminar on word processing machines (Calgary, November)

V.J. Chipper

Introduction to libraries course, Southern Alberta Institute of Technology (October-January)

B. Rutley

National Film Board workshop (Edmonton, January)

W. Sharman

National Film Board workshop (Edmonton, January)

J.W. Thomson

Annual meeting of Ontario Institute of Chartered Cartographers (Toronto, May)

W.P. Vermette

Annual meeting of Ontario Institute of Chartered Cartographers (Toronto, May)

L. MacLachlan

Annual meeting of Canadian Institute of Surveyors (Vancouver, May)

L. Machan

Annual meeting of Association of Earth Science Editors (Halifax, October)

Monthly meetings of the local CASLIS group of C.L.A.

Two meetings of the Society for Technical Communication (Calgary)

Three meetings of Equal Opportunities for Women (P.S.C.) in Edmonton, (May, October and February)

One organizational meeting for setting up of EOW group in Calgary (April)

Western Canada Office Exhibition, show exhibit of word processors, computer-printers and business machines, (April, Calgary)

E.R.W. Neale

Meetings of Canadian Geoscience Council (Calgary, September)

Canadian Society of Petroleum Geologists (Calgary, October)

Geological Association of Canada (Halifax, May)

Geological Society of America - committee meetings (Denver, December, February)

Membership on Committees

L. MacLachlan

Member, Exhibits Committee, 80-81

Member, Advisory Committee on Cartography, Olds College, 1980-81

E.R.W. Neale

Member, Committee on Stratigraphic Nomenclature, 80-81

Chairman, Exhibits Committee, 80-81

Geoscience Canada - associate editor

University of Calgary - Member of the Senate

C.G.C. - Universities Appraisal Committee - co-chairman (terminated December)

APICS - member Atlantic Young Scientists of the Year Committee

G.A.C. Editorial Committee - member

G.S.A. Special Committee on Publication Policy - member

G.S.A. Publications Committee - chairman, 1980-81

C.S.P.G. - Program Chairman - Energy Audit of the 80's (terminated October)

L. Machan

Associate Editor, CSPG Memoir 7

Equal Opportunities for Women (P.S.C.) - I.S.P.G. Rep.

Calgary Solar Energy Society

Special Talks and Lectures

E.R.W. Neale

3 Lectures on "Evolution of the Appalachians" - Structural Geology Class, University of Calgary (January-February)

STATISTICS ON SUBDIVISION ACTIVITIES

April 1, 1980-March 31, 1981

MANUSCRIPT PROCESSING SECTION

Manuscripts & Publications
1/4/80 - 31/3/81

Format	Rec'd	To Ottawa	To Publ.	Printed
Memoirs	1	2		
Bulletins	14	8		10
Papers	8	7		8
81-1B	5	5		5
81-1A	10	10		10
80-1C	6	6		6
Maps	9			
Open files	15	14		15
Outside	34	-	25	

GEOLOGICAL CARTOGRAPHY SECTION

Maps and figures prepared by the Cartographic Section and sent to Ottawa for printing between April 1, 1980 and March 31, 1981 and comparable figures for preceding year.

	1979-1980	1980-1981
Multicolour maps and section sheets	12	13
Figure illustrations (page)	319	178
Figure illustrations (pocket)	31	13

Manuscripts received	1979-1980	1980-1981
Multicolour geological maps	6	6
Figure illustrations (page)	165	261
Figure illustrations (pocket)	15	42

Maps & illustrations in progress at March 31, 1981

	1979-1980	1980-1981
Multicolour geological maps	7	3
Figure illustrations (page)	105	158
Figure illustrations (pocket)	21	3

Miscellaneous drafting which averaged approximately 16% of the total drafting time comprised 554 separate items.

Reproduction services

	1979-1980	1980-1981
Diazo prints	4626	3275
Diazo prints (frame shots)	1082	1304
Di-chrome	155	692

Photomechanical services

Film (sheets, negatives & positive)	3957	3265
Drafting keys on scribecoat	95	114
Blueline on Cronaflex	123	75
Colour proofs	26	30
Peelcoats	128	160
C-1 prints	215	197
KC-5 prints	1029	985
Autopositives (multiple exposure)	360	779
Sepia (dry erasable film)	125	130

Camera services

Film shots (line)	3846	2831
Film shots (halftone)	31	0
Paper	24	12

PHOTOGRAPHY SECTION

Production during the review years 1979-80 and 1980-81

	79/80	80/81
Total number of continouous tone 4 x 5 negatives	1700	1043
Total number of black and white prints	7718	8978
Total number of black and white Contact Sheets	804	633
Total number of colour negatives and prints	308	165
Total number of rolls (20 and 36 exposures) of colour slide film	153	177
Total number of rolls submitted (by staff members) for processing	118	122
Total number of high contrast line negative 8"x10"	40	57

Our library, the second largest geoscience library in Canada, has become established as the major public source in the West of information on energy resources and the geological data base. It serves both Institute scientists and the industrial and academic communities in many ways and handles requests from the general public. Unfortunately, for the second consecutive year, staff shortages forced curtailment of many services and the library was closed to the public for half-days for almost half of the year under review. Additional problems were caused by lack of adequate reproductive facilities for producing catalogue entries. At the end of the year staff was up to full strength and normal services had resumed.

Current level of service to burgeoning downtown industry and to other research institutions that are moving into the area will be difficult to maintain, however, without a net increase in man-hours in the year ahead. Library users from many walks of life in several countries continue to express their appreciation of research and information services rendered. The Library also displays its rare and unusual holdings on a rotating basis for the benefit of staff and visitors.

All publications of the Geological Survey, selected publications of the Surveys and Mapping Branch and certain other pertinent Departmental publications are sold and distributed from our Publications Section. This Section features a self-serve system for topographic maps and an automated selective system for products of the National Air Photo Library. General inquiries from schools, institutions and individuals are handled by this unit. To satisfy their demands, the Publication Section now carries almost all informational pamphlets published by the Department. Once again, the year in review saw a greatly increased demand for maps, reports and general information for regions beyond western Canada. The amenities and the courteous efficient service of the staff not only serve as a convenience to the petroleum industry and the general public but also as an advertisement for the scientific work of the Institute and, in fact, of the entire Department.

HIGHLIGHTS

- The Publications Section established an annual sales record with a 35 per cent increase over the previous fiscal year and it also had a record number of phone inquiries and visits to the office.

- The official Geological Survey exhibit, prepared by ISPG in 1979, appeared in 12 separate exhibitions at universities, agencies and meetings during 1980. It will be refurbished and kept in use during 1981.

- The fourteenth annual "Moving Day Tea" was held in the Library, March 6th, 1981, and was attended by all surviving charter members. Walter Nassichuk, a member in good standing of the alumni association, was on hand to cut the cake.

- An exhibition of books and other gifts brought back from China by Dick Procter, Don Stott and Trevor Powell after their recent visit was displayed in the Library.

- Nine multicoloured maps of the Operation Porcupine series were completed within the year, most within a few months of manuscript submission.

- The Canadian Geoscience Council manuscript report on academic geology and geophysics departments was completed in July 1980. The published version was available for sale in February, 1981

LIBRARY STATISTICS 1979-80, 1980-81

ACQUISITIONS	1979-80	1980-81
Books, etc. acquired by purchase	1028	772
Books, etc. acquired by gift or exchange	1754	959
Maps added	134	137
CIRCULATION		
Books and periodicals (to staff only)	15,570	16,079
Inter-Library Loans		
Borrowed	334	219
Loans and xerox copies provided	687	572
ON LINE SEARCHES	50	25

PUBLICATIONS AND AIRPHOTO SECTION

Office Statistics:

Office Statistics

Breakdown of Deposits:

	1979-80	1980-81
Surveys & Mapping	$48,574.44	$ 75,706.10
Nat.Air Photo Library	5,551.80	9,026.80
GSC Maps	10,427.00	18,576.75
Rock & Mineral Kits	1,290.00	1,395.00
Misc. GSC Materials	2,380.96	2,207.70
GSC Publications	22,556.35	23,882.56
Mineral Development	135.75	125.25
Gravity Maps	395.00	293.25
	$91,311.30	$131,213.41

Breakdown of Accounts:

	1979-80	1980-81
Credit Sales	$47,699.25	$73,709.25
Cash Sales	$45,165.40	$63,114.31
Rec'd. on Acct.	$46,145.90	$68,099.10

Air Photos:
A total of 220 orders (160 prepaid) were forwarded to Ottawa during the year. These consisted of:

26,659 Black and White contact prints
225 Flight Line Index Maps
14 10 X 10 enlargements
12 20 X 20 enlargements
8 30 X 30 enlargements
7 40 X 40 enlargements
24 Transparencies
161 Colour contact prints
4 Colour Infra-red contact prints
8 Photo Catalogues
62 Black and White landsat mosaics
67 Fiche Flight line index maps
6 Diaposatives
1 Colour landsat mosaic

Charge Accounts: No accounts were closed during the year. Twenty-five new accounts were opened making a total of 219 accounts held in this office.

Correspondence and Orders: A total of 2346 orders and enquiries were received by mail during the year.

Telephone Calls: Approximately 13,750 calls were received during the year. Almost 40% of these were enquiries concerning departmental energy programs or requests for addresses and/or materials of western provincial agencies. We were able to satisfy the majority of these requests.

Visitors: A total of 11,403 persons visited the office this year. As in previous years, the majority purchased topographical maps and GSC publications. In addition, classes from a local high school and the technical institute were given tours of the facilities available in this office.

Microfiche Sales: Owing to the great demand for out of print GSC materials in the western provinces, we have produced michrofiche of approximately 24 older reports which are being sold through this office on an experimental basis. It is too early to tell as yet how successful these sales will be.

PETROLEUM RESOURCE APPRAISAL SECRETARIAT

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 resource administration groups of INA and EMR (RMB).

The results of resource evaluation work done by GSC is communicated to a Petroleum Resource Appraisal Panel, chaired by the Senior ADM Energy and consisting of ADM's in Energy, Science and Technology plus representatives from INA and the NEB. Panel meetings are held every 4 to 6 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

- A method for modelling the rate of discovery of oil and gas pools was designed and implemented by Dr. P.J. Lee. He presented the results of his research to an IIASA conference in Laxenbury Austria in July - proceedings to be published.

- Latest available estimates of Canada's Conventional Oil and Gas meeting of the CSPG in October 1980 and released as open file report 767. Authors were Procter, Lee and Skibo.

- Procter and Lee participated in a scientific exchange with the the People's Republic of China during the month of October. Several oil and gas institues in China were visited and talks related to resource assessment were presented by each member of the delegation.

- Three internal papers related to probable supply from heavy oil resources of Alberta were prepared by M. Raicar. The results were presented to the CIMM Edmonton Branch and to the Petroleum Resource Appraisal Panel.

- Procter and Lee presented talks on the GSC Methodology of Petroleum Resource Evaluation to a CSPG Symposium on the subject in January 1980.

- In March, Procter gave a talk to the Association of Professional Engineers, Geologists and Geophysicists of Alberta on Canada's Conventional Gas and Oil Resources in Edmonton.

- Throughout the year presentations concerning the oil and gas resources of the Labrador Shelf, Beaufort Sea, Westcoast Offshore, Heavy Oil, Western Canada Gas were presented to the Petroleum Resource Appraisal Panel by members of the Secretariat.

Personnel Notes

The Secretariat consists of an Executive Director, 4 scientists and a clerk-secretary. To date the following positions have been filled:

R.M. Procter - Executive Director.

P.J. Lee - Senior Geologist - Resource Evaluation Methodology.

M. Raicar - Senior Engineer - Heavy Oil.

D.N. Skibo - Evaluation Systems Geologist.

Attendance at Meetings, Conferences and Courses

R.M. Procter

CSPG Annual Conference, Calgary, Alberta, October 1981.

CSPG Symposium on Resource Evaluation, Calgary, Alberta, January 1981.

CSPG Pacific Margin Conference, Pat Bay, B.C., February 1981.

P.J. Lee

International Institute for Applied Systems Analysis, Laxenburg, Austria, June - July 1980.

CSPG Annual Conference, Calgary, Alberta, October 1980.

CSPG Symposium on Resource Evaluation, Calgary, Alberta, January 1981.

CSPG Pacific Margin Conference, Pat Bay, B.C., February 1981.

M. Raicar

DOE - SPE Tertiary Recovery Symposium, Tulsa, Oklahoma, April 1980.

D.N. Skibo

CSPG Annual Conference, Calgary, Alberta, October 1980.

CSPG Symposium on Resource Evaluation, Calgary, Alberta, January 1981.

Membership on Committees

P.J. Lee

Editor of CSPG special volume, Applied Exploration Mapping Methods.
Member Geological Potential Subcommittee.

M. Raicar

EMR member of Technical Advisory Committee of Computer Modelling Group.

R.M. Procter

Chairman of Geological Potential Subcommittee.
EMR Member of Board of Computer Modelling Group.
EMR Member of Technical Advisory Committee of ERDS.
EMR Member Oil and Gas Coordinating Committee.

Type specimens catalogued in 1980

Publications	PC.	Camb.	Ord.	Sil.	Dev.	Carb.-Perm.	Trias.	Jur.	Cret.	Tert.	Total	Nfld.	N.S.	Que.	Ont.	Manit.	Alt.	B.C.	Yuk.	NWT	F.
GSC Bulletins																					
Bull. 282 (Pelecypods)								75			75						X	X	X		
Bull. 308 (Brachiopods)					567						567									X	
Bull. 320 (Miospores - Microplankton)									90		90									X	
Bull. 321 (Corals, Conodonts, Trace Fossils)		105	107								212	X			X					X	
GSC Papers																					
79-1C (Ammonites)								4			4							X			
79-15 (Conodonts)						113					113									X	
79-16 (Decapods)								7	19		26						X			X	
80-1A (Ammonites, Palynomorphs, Pelecypods)			33	33	10		14	15	20	54	179							X		X	X
80-1B (Ostracods, Trilobites)			28	17	19						64			X					X	X	
80-1C (Corals, Algae)			54				2	2			58			X				X	X		
Subtotals	-	105	222	50	596	113	16	103	129	54	1388										
Can. J. Earth Sci. (Borings, Microfossils, Coral, Graptolites, Bryozoa, Stromatolites)	8	50	58	37	28	31					212		X	X	X	X	X	X	X	X	X
J. Pal. (Brachiopods, Problematica)				13	4						17								X	X	
Other (Trilobites, Microfossils, Palynomorphs, Fish, Algae)	41	2	13		126	29	-	9	63	-	283		X	X	X			X	X	X	X
Subtotal	49	52	71	50	158	60	-	9	63	-	512										
Total	49	157	293	100	754	173	16	112	192	54	1900										

National Type Collection of Invertebrate and Plant Fossils

Thomas E. Bolton continued as Curator of the National Type Collection of Invertebrate and Plant fossils. A total of 1900 type specimens described in both Geological Survey of Canada (1388) and outside (512) publications were added to the collection in 1980.

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 studies, for petrological studies and for paleomagnetic studies throughout Canada.

The objectives of the Division are: To provide a systematic study of the geological framework of the Canadian Shield to standards consistent with the needs for mineral resource 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 regional problems.

The Division is organized into six sections and a special project group. Three of the sections are responsible for the regional geology of the Canadian Shield and are named after the structural provinces in which they work: Bear-Slave, Northern Churchill and Superior Grenville. These sections report their bedrock studies on geological maps at various scales and in reports and scientific 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 Precambrian Division was established in 1979 as a result of the reorganization of the Regional Geology and Economic Geology Division and was reorganized early in 1981 into its present form.

The establishment consists of 62 continuing positions and 13 casual person years, largely used for employment of students for summer field work in the Canadian Shield.

Personnel Notes

J.R. Henderson was transferred from a term to a continuing RES 2 position in December.

A. Ciesielski was transferred from a term to a continuing RES 1 position in December.

S. Tella obtained his Ph.D. degree in August and was transferred from a term PC to a continuing RES position in December.

K. Clark resigned in December from the Paleomagnetic Section to take a position as mine geologist with Algoma Steel Corporation at Wawa, Ontario.

Peter Thompson organized and ran a seminar series (Precambrian High) on Friday afternoons at which staff members and invited guests from local universities gave papers on their current research.

J. Korstgård, lecturer at Aarhus University, Denmark, and specialist on structure and metamorphism of Archean rocks of Greenland, is a Natural Science and Engineering Research Council Visiting Fellow assisting I. Ermanovics in a study of the Archean rocks of the Nain-Makkovik region of Labrador.

J.E. Reesor, former Director of Regional and Economic Geology Division, and following its reorganization, the Precambrian Division, returned to research in the Cordilleran Geology Division in November.

J.C. McGlynn took over the position of the Director of the Division early in January.

ADMINISTRATION

Membership on Committees

J.C. McGlynn

Subcommission on Precambrian Stratigraphy, International Union of Geological Sciences, corresponding member.

Northwest Territories Coordinating Committee on work in the North.

Canadian Working Group on Precambrian Stratigraphy.

Queen's University Advisory Council on Engineering.

Centre for Precambrian Studies, University of Manitoba, Board of Directors.

Manuscripts Submitted

1 GSC Paper and 1 Outside Paper.

BEAR-SLAVE SECTION

J.B. Henderson (Head)

Highlights

A sequence of unconformity-bounded Proterozoic units resting on probable Archean basement in the Hadley Bay area of northern Victoria Island have been tentatively correlated with basal Aphebian rocks of Kilohigok basin at Bathurst Inlet, Helikian rocks of Elu basin in the Bathurst Inlet-Melville Sound area, and late Proterozoic rocks that occur elsewhere on Victoria Island. Comparison of sedimentological data from the Hadley Bay and Bathurst Inlet areas has resulted in the proposal that an east-west trending aulacogen off the Wopmay orogen was present in the Coronation Gulf area while the Kilohigok basin was active.

In the foreland fold and thrust belt of the Wopmay orogen in the eastern Bear Province, a disconformity was recognized that has important tectonic implications. It occurs between continental shelf carbonates and mature sandstones and overlying hemipelagic shales and was recognized by the identification of submarine canyons that cut into the shelf deposits as the shelf was block faulted and foundered. This is interpreted as a result of the descent of the passive continental margin into a west-dipping subduction zone.

In the internal zone of the orogen a series of thrust faults related to late conjugate transcurrent faults have been documented. They appear to control the location and structure of the uranium-bearing basins of post-orogenic sandstone.

In the westernmost Churchill Province near Fort Smith a granitic diapir of batholithic dimensions was recognized that was emplaced into Archean granulite facies granitoid rocks and supracrustal remnants. High temperature-low pressure mineral assemblages suggest the granite was very dry and emplaced at shallow depths. Preliminary dating indicates ages of about 1945 Ma. A relationship is suggested between the emplacement of the granite and the nearby deposition in fault-bounded basins of alluvial fan to lacustrine deposits (Nonacho Group).

Along the eastern margin of the Slave Province several previously unrecognized Archean, mainly intermediate to felsic, volcanic units were outlined. Along part of the Thelon Front, the boundary between the Slave and Churchill Provinces, irregular structural trends assume a more northerly trend that is Archean in age, and a regional lower pressure series Archean metamorphic gradient that increases to granulite grade towards the boundary is superimposed by a Proterozoic

intermediate facies metamorphism. In addition, a Proterozoic cataclastic straight zone was imposed that formed intermediate to the two metamorphisms. To the north, in the region where the boundary is intersected by the Bathurst fault, a north-trending cleavage in both Archean and Proterozoic rocks as well as in northwest-trending diabase dykes, is thought to be related to folding associated with the Bathurst fault, and may be younger than the mylonites at the province boundary.

Attendance at Meetings, Conferences and Courses

H.H. Bostock

Geoscience Forum, Yellowknife, Northwest Territories, December 3-6, 1980.

F.H.A. Campbell

Geological Association of Canada-Mineralogical Association of Canada, Annual Meeting, Halifax, Nova Scotia, May 19-21, 1980.

Canadian-United States Joint Lithosphere Committee meeting, Toronto, Ontario, May 1980.

R.A. Frith

Geological Association of Canada-Mineralogical Association of Canada, Annual Meeting, Halifax, Nova Scotia, May 19-21, 1980.

P.F. Hoffman

Geological Association of Canada-Mineralogical Association of Canada, Annual Meeting, Halifax, Nova Scotia, May 19-21, 1980.

Geological Society of America Annual Meeting, Atlanta, Georgia, November 17-20, 1980.

Workshop on Tectonic Map of North America, Austin, Texas, January 26-29, 1981.

Cordilleran Workshop, Kingston, Ontario, February 1-2, 1981.

M.B. Lambert

Canadian National Committee, International Union of Geodesy and Geophysics meeting, Ottawa, Ontario, April 18, 1980.

Geological Society of America Annual Meeting, Atlanta, Georgia, November 17-20, 1980.

North-American Stratigraphic Nomenclature Committee Annual Meeting, Atlanta, Georgia, November 18, 1980.

P.H. Thompson

Geoscience Forum, Yellowknife, Northwest Territories, December 3-6, 1980.

Membership on Committees

F.H.A. Campbell

Canadian Committee for the International Lithosphere Project.

International Association of Sedimentologists, Organizing Committee, 1982.

R.A. Frith

Precambrian Division, Geological Association of Canada, Secretary-Treasurer.

P.F. Hoffman

Subcommission on Precambrian Stratigraphy, International Union of Geological Sciences.

Geology and Economic Minerals of Canada (EG1), sixth edition, co-leader for Precambrian Shield.

M.B. Lambert

North American Committee on Stratigraphic Nomenclature.

Precambrian Division, Geochronology Committee.

Departmental Field Equipment Committee, GSC representative.

Canadian National Committee, International Union of Geodesy and Geophysics.

P.H. Thompson

Committee on General Instructions for Field Parties.

United Way, canvasser.

Ph.D. Thesis Committee, B. Leatherbarrow - Carleton University.

Special Talks and Lectures

H.H. Bostock

"Recent mapping in the Fort Smith sheet (75D) and implications for the geology in surrounding areas", Geoscience Forum, Yellowknife, N.W.T., December 4, 1980.

F.H.A. Campbell

"Evolution of the Early Proterozoic Kilohigok Basin, N.W.T.", Proterozoic Basins Symposium, Geological Association of Canada-Mineralogical Association of Canada, Annual Meeting, Halifax, Nova Scotia, May 20, 1980.

"Proterozoic rocks of the Bathurst Inlet area, N.W.T. - a tale of two basins", Memorial University, St. John's, Newfoundland and Dalhousie University, Halifax, N.S., March, 1980.

P.F. Hoffman

"Early Proterozoic subduction and collision in Wopmay Orogen, N.W.T.", Lamont-Doherty Geological Observatory, Palisades, New York, April 11, 1980; Petrologist's Club, Carnegie Institution, Washington, D.C., January 6, 1981; Earth Physics Branch, Ottawa, Ontario, March 11, 1981; and Concordia University, Montreal, Quebec, March 26, 1981.

M.B. Lambert

Four lectures on metavolcanic rocks: (1) "Rhyolite domes and flows", (2) "Subaerial pyroclastic flows", (3) "Subaqueous pyroclastic flows", and (4) "Deformed and metamorphosed equivalents of volcanic rocks", Carleton University, Ottawa, Ontario, April 29, 1980.

"Volcanoes of Iceland", Ottawa South Community Centre, May 23, 1980.

"Eruption of Mount St. Helens, 1980", (1) Kiwanis Club of Ottawa, January 16, 1981, (2) Logan Club, GSC, Ottawa, January 28, 1981, (3) City View Kiwanis Club, Ottawa, February 25, 1981, and (4) Manordale School, Nepean, Ontario, February 27, 1981.

"Physical Volcanology", graduate lecture and seminar series, Carleton University, Ottawa, Ontario, January 8 to March 26, 1981.

P.H. Thompson

"The Healey Lake area and the enigmatic Thelon Front", Geoscience Forum, Yellowknife, N.W.T., December 4, 1980, and "Precambrian High" series at GSC, Ottawa, January 19, 1981.

"Regional metamorphism in time and space". lecture for graduate petrology course, Carleton University, Ottawa, Ontario, March 17, 1981.

Manuscripts Submitted

1 GSC Memoir, 1 GSC Paper, 7 Current Research Papers, 1 Open File Map, 3 Outside Papers, 2 Abstracts, 1 Technical Note.

NORTHERN CHURCHILL SECTION

A.N. LeCheminant (Head)

Highlights

North of Baker Lake, 1:250 000 and 1:50 000 mapping added new information about late Archean or early Proterozoic metasedimentary/metavolcanic belts. Several belts contain ultramafic lava flows (komatiites), typically associated with quartzites, mafic to felsic volcanics and iron formations. Metamorphic grade ranges from greenschist to amphibolite. Structural patterns are complex and in one area southeasterly dipping thrust sheets transport sheared plutonic rocks over metasediments. East-west mylonite zones define fault zones, some of which may have been active from late Archean to middle Proterozoic.

U-Pb analyses on zircons from gneisses in southern Keewatin yielded an age of 3330 Ma. This date is the first indication of very old rocks in this part of the Churchill Structural Province and represents a remnant of unknown size consisting of rocks similar in appearance to Kenoran gneisses.

Studies in the central District of Keewatin, southwest of Baker Lake, continued to focus on early to middle Proterozoic intracratonic basins. Dubawnt Group infill sequences in the basins record a complicated history of subaerial volcanism and alluvial fan and braided fluvial sedimentation. High silica rhyolites of the Pitz Formation are probably remnants of the volcanic roof above 1800-1820 Ma epizonal granite plutons that intrude the Dubawnt Group.

Mapping at 1:250 000 scale on Devon and Philpots Islands continued reconnaissance study of northernmost parts of the Churchill Structural Province. Broad correlation of marble-free and marble-bearing gneiss units across Baffin Bay provides additional evidence against major displacement along Nares Strait. A Paleozoic outlier was located on Philpots Island, previously considered to be underlain entirely by Precambrian rocks.

Attendance at Meetings, Conferences and Courses

K.E. Eade

Mineral Resources Division, Manitoba Department of Energy and Mines, Annual Meeting, Winnipeg, Manitoba, November 20, 1980.

Geoscience Forum, Yellowknife, Northwest Territories, December 3-6, 1980.

Prospectors and Developers Association Convention, Toronto, Ontario, March 9-11, 1981.

T. Frisch

Geological Association of Canada-Mineralogical Association of Canada, Annual Meeting, Halifax, Nova Scotia, May 19-21, 1980.

J.R. Henderson

Geological Association of Canada-Mineralogical Association of Canada, Annual Meeting and field trip: contact of Meguma Group and South Mountain Batholith, Halifax, Nova Scotia, May 18-24, 1980.

G.D. Jackson

International Geological Congress, Paris, France, July 7-17, 1980 and Geology of central Switzerland field trip, June 26-July 5, 1980.

A.N. LeCheminant

Geological Association of Canada-Mineralogical Association of Canada, Annual Meeting, Halifax, Nova Scotia, May 19-21, 1980.

Prospectors and Developers Association Convention, Toronto, Ontario, March 9-11, 1981.

Mikkel Schau

Geological Association of Canada-Mineralogical Association of Canada, Annual Meeting, Halifax, Nova Scotia, May 19-21, 1980.

Membership on Committees

T. Frisch

GSC Library Committee.

G.D. Jackson

Precambrian Division, Geochronology Committee.

Mikkel Schau

Geological Association of Canada, Volcanology Division, Secretary-Treasurer.

Precambrian Division, Geochronology Committee, Chairman.

Special Talks and Lectures

K.E. Eade

"Geology of the Kamilukuak Lake area, District of Keewatin, N.W.T.", Geoscience Forum, Yellowknife, N.W.T., December 4, 1980.

"1981 Geological Survey field program", Geoscience Forum, Yellowknife, N.W.T., December 4, 1980.

T. Frisch

"Geology around northern Baffin Bay and its bearing on the question of strike-slip movement along Nares Strait", Queen's University, Kingston, Ontario, January 14, 1981.

"Methods and logistics of Arctic field work", to 2nd year geology class at Queen's University, Kingston, Ontario, January 14-15, 1981.

J.R. Henderson

"The Cumberland Sound metamorphic culmination: a major tectonic element of the Hudsonian Orogen in northeast Canada and west Greenland" (with G.D. Jackson and W.C. Morgan), Geological Association of Canada-Mineralogical Association of Canada, Annual Meeting, Halifax, Nova Scotia, May 19, 1980.

A.N. LeCheminant

"Baker Lake Basin: an Early Proterozoic rift?", Proterozoic Basins symposium, Geological Association of Canada-Mineralogical Association of Canada, Annual Meeting, Halifax, Nova Scotia, May 21, 1980.

W.C. Morgan

"Aphebian Ramah Group, Northern Labrador" (with I. Knight, speaker), Geological Association of Canada-Mineralogical Association of Canada, Annual Meeting, Halifax, Nova Scotia, May 21, 1980.

"The Cumberland Sound metamorphic culmination: a major tectonic element of the Hudsonian Orogen in northeast Canada and west Greenland" (with J.R. Henderson (speaker) and G.D. Jackson), Geological Association of Canada-Mineralogical Association of Canada, Annual Meeting, Halifax, Nova Scotia, May 19, 1980.

Mikkel Schau

"Granulites" lecture, Carleton and Ottawa Universities, March 18 and 31, 1981.

Manuscripts Submitted

1 GSC Bulletin, 4 GSC Papers, 8 Current Research Papers, 5 Open File Maps, 3 Outside Papers and 1 Technical Note.

SUPERIOR-GRENVILLE SECTION

A. Davidson (Head)

Highlights

Reconnaissance mapping in the central part of the Superior Province has concentrated on examination of the dominantly granitoid and migmatitic regions between the better known greenstone belts. A considerable variety of composition is found within these terrains; wide areas previously coloured pink on geological maps will be meaningfully subdivided on the 1:1 000 000 compilations now being prepared. Detailed work on the Kapuskasing Structure indicates a sharply defined, fault-bounded metamorphic grade change on the southeast side and a gradational one to the northwest; greenstone belts and intervening gneiss terrains appear to match up across this structure.

In Labrador, the boundaries of the Archean rocks in the Hopedale Block are now well defined by zones of intense shear, both against the Makkovik Subprovince to the southeast and the Churchill Province to the west. The latter boundary is cleanly cut by plutons of the anorthosite suite.

Reconnaissance mapping in the Grenville Province of Ontario northwest of the 'marble belt' has delineated distinct litho-structural domains, the most prominent of which, the Parry Sound domain, is characterized by a belt of aligned, deformed, pod-shaped masses of anorthosite along the northwest side of a zone of very high grade metamorphism. Throughout the region, zones of intense deformation, in places bounding domains, can be traced for many tens of kilometres. These zones postdate granulite facies metamorphism, but the cataclastic rocks are themselves recrystallized at amphibolite facies; they may have formed under those conditions during deep crustal thrusting.

Attendance at Meetings, Conferences and Courses

K.D. Card

Geological Association of Canada-Mineralogical Association of Canada, Annual Meeting, Halifax, Nova Scotia, May 19-21, 1980.

Geological Society of America Annual Meeting, Atlanta, Georgia, November 17-20, 1980.

North American Commission on Stratigraphic Nomenclature, Annual Meeting, Atlanta, Georgia, November 18, 1980.

A. Ciesielski

Early Evolution of the Earth and Planets Conference, NATO Advanced Studies Institute, University of Newcastle on Tyne, England, March 23-April 3, 1980.

Quebec Department of Mines Seminar of Highlights of 1980 Survey Program, Quebec City, Quebec, November 27-28, 1980.

A. Davidson

Friends of the Grenville meeting and field excursion, Cloyne, Ontario, October 3-5, 1980.

Uranium in granites workshop, Geological Survey of Canada, Ottawa, Ontario, November 25-26, 1980.

Ontario Ministry of Natural Resources Workshop on potential economic development in Grenville Province of Ontario, Dorset, Ontario, February 4-5, 1981.

I. Ermanovics

American Geophysical Union spring meeting, Early Earth History Symposium, Toronto, Ontario, May 22-27, 1980.

Membership on Committees

K.D. Card

North American Commission on Stratigraphic Nomenclature, GSC representative.

Precambrian Subcommittee, International Union of Geological Sciences, corresponding member.

A. Davidson

Precambrian Division, Age Determination Committee.

Selection board for Head of Geochronology Section.

Decade of North American Geology, Precambrian Shield Volume.

Thesis Committees: (1) M.J. Murray, M.Sc., Carleton University.
(2) N.G. Culshaw, Ph.D., University of Ottawa.

I. Ermanovics

Canada-Newfoundland DREE Agreement, mapping subcommittee.

Special Talks and Lectures

K.D. Card

"Evolution of early Proterozoic basins of the Great Lakes region" (with P.K. Sims, USGS and S.B. Lumbers, Royal Ontario Museum), Proterozoic Basins Symposium, Geological Association of Canada-Mineralogical Association of Canada, Annual Meeting, Halifax, Nova Scotia, May 21, 1980.

A. Davidson

"Petrochemistry of the Blachford Lake complex", Uranium in granites workshop, Ottawa, Ontario, November 26, 1980.

"Geology east of Georgian Bay, new data for the Grenville Province", Ontario Department of Natural Resources workshop, Dorset, Ontario, February 1981, and Ontario Geological Survey, invited talk, Toronto, Ontario, February 6, 1981.

I. Ermanovics

"Times of cratonization and isotopic rejuvenation in Superior Province of Manitoba", American Geophysical Union, spring meeting, Early Earth History Symposium, Toronto, Ontario, May 23, 1980.

Manuscripts Submitted

3 GSC Papers, 7 Current Research Papers, 1 Open File Report and 1 Outside Paper.

PALEOMAGNETIC SECTION

W.F. Fahrig (Head)

Highlights

The Section continued its program of conducting paleomagnetic studies in conjunction with geological field studies in the Precambrian Shield.

A report was completed on results for basaltic flows and sediments of the Borden Basin. These have tied the development of the Borden Basin into a continental tensional event which also resulted in Mackenzie magmatism at 1220 Ma. The paleomagnetic work also suggested that Borden sedimentation lasted about 20 Ma. Important new paleomagnetic data have also been obtained on diabase dykes of Borden Peninsula.

A study was completed of paleomagnetism of early Tertiary basalts from Baffin Island. These display evidence of self-reversal.

A paper was prepared on the paleomagnetism of two formations of volcanics and red sediments of Richmond Gulf in which preliminary results for the Sutton Lake inlier and the La Grande 4 outlier were incorporated. The results have led to time-stratigraphic correlations between these areas and the work is being extended towards more easterly Proterozoic outliers in the Archean of northern Quebec and Newfoundland.

Results bearing on the history of vertical movements of the Precambrian Shield were obtained for the Munro area in Ontario. These results suggested that the present surface was at a depth of $6\frac{1}{2} \pm 2$ km 2150 Ma ago. Results of a similar study in the Sudbury area indicate a depth of 10 ± 2 km 1220 Ma ago. It is hoped to arrive at a detailed quantitative picture of these movements and to tie in periods of metamorphism and mineralization.

Attendance at Meetings, Conferences and Courses

W.F. Fahrig

Geological Association of Canada-Mineralogical Association of Canada Annual Meeting, Halifax, Nova Scotia, May 19-21, 1980.

E.J. Schwarz

Geological Association of Canada-Mineralogical Association of Canada Annual Meeting, Halifax, Nova Scotia, May 19-21, 1980.

Membership on Committees

W.F. Fahrig

American Commission on Stratigraphic Nomenclature, Magneto-stratigraphic Group.

Special Talks and Lectures

W.F. Fahrig

"Paleomagnetism of the Bylot Basins: evidence for Mackenzie continental tensional tectonics", Proterozoic Basins Symposium, Geological Association of Canada-Mineralogical Association of Canada Annual Meeting, Halifax, Nova Scotia, May 21, 1980.

E.J. Schwarz

"Paleomagnetism of the Circum-Ungava Belt: east coast of Hudson Bay", Proterozoic Basins Symposium, Geological Association of Canada-Mineralogical Association of Canada Annual Meeting, Halifax, Nova Scotia, May 21, 1980.

Manuscripts Submitted

2 GSC Current Research Papers and 5 Outside Papers.

SPECIAL PROJECTS

Attendance at Meetings, Conferences and Courses

W.R.A. Baragar

Geological Association of Canada-Mineralogical Association of Canada Annual Meeting, Halifax, Nova Scotia, May 19-21, 1980.

Oceanic Volcanoes Symposium, International Association of Volcanology and Chemistry of the Earth's Interior, San Miguel, Azores, August 4-9, 1980.

Geological Association of Canada council meetings, Calgary, Alberta, October 17, 1980 and Saskatoon, Saskatchewan, February 3-4, 1981.

M.J. Frarey

Ontario Geological Survey Geoscience Seminar, Toronto, Ontario, December 9-11, 1980.

F.C. Taylor

Prospectors and Developers Association Convention, Toronto, Ontario, March 9-11, 1981.

Membership on Committees

W.R.A. Baragar

Geological Association of Canada, council member.

International Geological Correlation Programme subgroup: "Volcanology of the Precambrian and its Mineralogy", part of Project 91, "Metallogeny of the Precambrian".

M.J. Frarey

International Union of Geological Sciences Subcommission on Precambrian Stratigraphy.

GSC Committee on Precambrian Nomenclature, Chairman.

F.C. Taylor

Departmental Field Equipment Committee, Chairman.

Special Talks and Lectures

W.R.A. Baragar

"Seal Lake-Keweenawan relations: a geochemical approach", "Precambrian High" Seminar, GSC, Ottawa, March 6, 1981.

Manuscripts Submitted

3 GSC Papers and 2 Outside Papers.

PETROLOGY SECTION

K.L. Currie (Head)

The Petrology Section analyzes rock and mineral assemblages with the object of understanding and quantifying the 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, and a petrographic laboratory which provides services, working space and instruments for petrographic analysis.

Highlights

Mineral assemblages in a range of rock compositions from the Red Wine Mountains of southern Labrador suggest equilibration at temperatures near 1000°C and pressures of 8-15 kilobars. This metamorphic event resulted from regional intrusion of basic magma into the lower crust about 1650 my ago. Although the area is well within the Grenville structural province, subsequent Grenvillian effects appear restricted to low grade retrogression and brittle deformation unaccompanied by significant crustal heating.

K-Ar dating of mafic dykes, sills and volcanics within the Fury and Hecla Group indicate the age of the sedimentary sequence to lie between 0.75 and 1.2 Ga., that is Neohelikian to Early Hadrynian. These dates resolve an earlier conflict between field and geochronological data.

The Aphebian Richmond Gulf graben fits an aulacogen model. Early arkosic terrestrial sediment was derived from an Archean thermal dome, now under Hudson's Bay. These sediments are preserved within the later rift. Subsequent seaward-transported fluvio-deltaic sedimentation, predicted by the model, are absent, possibly due to erosion. The preserved arkosic sediments are older than the mioclinal sediments of the Belcher Islands. Sedimentary loading and compression give a simple explanation for the enigmatic "Great Arc of Hudson's Bay".

Preliminary mapping of sedimentary and volcanic rocks near Crowduck Bay, Manitoba exhibit a pattern of progressive regional metamorphism, disrupted by later northeast-trending faulting.

The region of Saint John New Brunswick exhibits an unusually complete sequence of Precambrian rocks, indicating ages for remobilized cratonic rocks in excess of 1600 my. This old craton was then covered by a platformal assemblage (Green Head Group) which was metamorphosed and intruded about 600 my ago in the vicinity of the present European craton. Subsequent "Caledonian" events have produced reactivation and diapiric uprise of these old rocks.

East of Kisseynew Lake the boundary between the Flin Flon volcanic belt and the Kisseynew appears to be an unconformity along which quartz-rich Kisseynew Gneiss overlies Amisk volcanic rocks. An elongated dome of quartzofeldspathic gneisses within the volcanic belt probably represents a diapiric uprise of supracrustal rocks of uncertain stratigraphic position.

Personnel Notes

At year end the section consisted of 6 Research Scientists and a Visiting Fellow. R.K. Herd transferred from Grenville-Superior section to Petrology Section, January, 1981. J.B. Whalen took up tenure as a Visiting Fellos in February 1981. S.W. Adcock, Carleton University, measured the solubility of granitic rocks in supercritical water in the Section laboratory from October 1980 to March 1981.

Attendance at Meetings, Conferences and Courses

F.C. Chandler

GAC-MAC Annual Meeting, Halifax, May 1980.
Prospectors and Developers Association, Annual Meeting, Toronto, March 1981.

K.L. Currie

GAC-MAC Annual Meeting, Halifax, May 1980.

R.F. Emslie

IGC Paris, France, July 1980.

T.M. Gordon

GAC-MAC Annual Meeting, Halifax, May 1980.
Manitoba Mineral Resources Division, Annual Meeting, Winnipeg, November 1980.

E. Froese

Manitoba Mineral Resources Division, Annual Meeting, Winnipeg, November 1980.

R.K. Herd

GAC-MAC Annual Meeting, Halifax, May 1980.

Membership on Committees

F.C. Chandler

External advisor to A. Legun and B. Zaitlin, M.Sc. candidates, U. of Ottawa.

K.L. Currie

Associate Editor, Canadian Mineralogist.
Associate Editor, Maritime Sediments and Atlantic Geology.
Plutonic Working Group IGCP Project 27, Member.
External advisor to S.W. adcock, Ph.D. candidate, Carleton U.

E. Froese

Adjunct professor, Carleton University.

T.M. Gordon

Branch Computer Facilities Committee.

R.K. Herd

DREE Advisory Committee for Newfoundland, Member.
External advisor to G.M. Dunning, Ph.D. candidate, Memorial University.

Special Talks and Lectures

F.C. Chandler

"Geology of the Late Precambrian Supracrustal Rocks, Fury and Hecla Strait, Baffin Island", GAC-MAC Annual Meeting, Halifax, May 1980.

"Introduction to Redbeds", G.S.C. Workshop on Ores in Sandstones, Ottawa, January 1981.

K.L. Currie

"Anatectic peraluminous granite from the Carmanville region, northeastern Newfoundland", GAC-MAC Annual Meeting, Halifax, May 1980.

R.F. Emslie

"Papakivi granite suites of the Proterozoic", IGC, Paris, France, July 1980.

"Anorthositic suites and Precambrian crustal evolution", Lunar and Planetary Science Institute, Houston, Texas, Feb. 28, 1981.

"Petrology of Labrador anorthositic rocks", Queen's University, Kington, March 1981.

"Petrology of the Proterozoic rapakivi and related A-type granites in Labrador", Queen's University, March 1981.

"Pressure-temperature determination in granulites", Carleton University, Ottawa, March 1981.

E. Froese

Delivered official GSC presentation to the Annual Meeting of the Manitoba Mineral Resources Division, Winnipeg, November 1980.

Delivered a series of lectures on advanced metamorphic petrology, Carleton University, October-March 1980-81.

T.M. Gordon

"Manipulation and display of digitized geological map information", GAC-MAC Annual Meeting, Halifax, May 1980.

"Geology of the Daly Bay complex, N.W.T.", GAC-MAC Annual Meeting, Halifax, May 1980.

"Equations of state of super-critical fluids", Carleton University, March 1981.

R.K. Herd

"Ophiolitic relicts in southwestern Newfoundland", GAC-MAC Annual Meeting, May 1981.

GEOCHRONOLOGY SECTION

R.D. Stevens (Acting Head)

The Geochronology Section undertakes isotopic analyses and computations required for the determination of the geological age of rocks and minerals based on the K-Ar, Rb-Sr and U-Pb isotopic systems. Interpretation of the resulting information leads to an understanding of geological time and correlations which, in turn, constitute essential components in the geological mapping of Canada and evaluation of the national economic mineral potential.

In order to achieve its objectives the Section is equipped with two operational gas-source mass spectrometers for argon isotopic analysis, three operational solid-source mass spectrometers for the isotopic analysis of potassium, rubidium, strontium, uranium and lead, an additional solid-source instrument under construction and a very old, retired, gas-source machine which we recommend for donation or transfer to an appropriate museum as it is an early, somewhat historic instrument.

These instruments are supported by associated chemical, mineralogical and electronic facilities within the Section and by external rock and mineral processing laboratories, XRF, XRD, spectrographic services and an instrument development machine shop. The Section staff comprises five scientists (1 RS, 3 PC's and 1 CH) and six technicians when at full strength. For the 1980-81 fiscal year, however, the RS position has remained vacant and there has consequently been some difficulty in maintaining the expected productivity of the group.

Highlights

The most noteworthy developments during the fiscal year have related to computer controlled automation of the solid-source Rb-Sr mass spectrometer. This goal has been accomplished and the instrument operation is now automated under program control and is attaining the required precision of 0.01%. Routinely automated isotopic analyses of Rb and Sr in geological samples are now in progress on a regular basis. Though the intended precision has been attained, further requirements are in progress to enhance the rapidity of analyses. This relates mainly to developing techniques of data acquisition and processing that will facilitate two complete analyses per day. The methods of doing this have been identified and proven; they are essentially modifications of the data generation and processing portions of the computer programs for both spiked and unspiked Sr isotopic analyses.

The electronic systems developed to accomplish automation are still in the "breadboard" state. They will now be consolidated on printed circuit boards of our design and permanently mounted in the operating console of the mass spectrometer. Improvements to the mass spectrometer hardware are in progress in order to upgrade its operation to match the automation capabilities. These improvements include:

a) A revised collector assembly system which should double the ion beam peak height we are currently obtaining and also minimize or eliminate secondary electron interference which presently causes problems with baseline measurements;

b) the vacuum plumbing required to allow replacement of the mechanical forepump with a liquid nitrogen Vacsorb pump similar to that on the 15" mass spectrometer. This should produce cleaner vacuums by eliminating any traces of forepump oil in the mass spectrometer, and should also prolong the life of the source ion pump;

c) a cold trap to be fitted to the source end of the mass spectrometer. This should greatly improve the vacuum within the source end of the mass spectrometer during analysis by rapidly pumping down the condensibles volatilized from the mass spectrometer filament. This could have the dual beneficial function of reducing the correction to the mass 87 peak for the tail of the mass 88 peak and improving transmission of the ion beam through the source slit system. A cold trap such as this should also tend to prolong the life of the source ion pump.

In zircon U-Pb age determination the detailed sample preparation techniques recorded last year (micro-scale sieving, magnetic fractionation and hand-picking) have been successful in improving the resolution of data on concordia plots, thereby yielding concordia ages of greater certainty. In addition, we have implemented a new hand-picking technique pioneered by T. Krogh at R.O.M. involving "super magnets" (samarium/cobalt alloy) to assist steel pins in sensing and separating grains of very slightly differing magnetic characteristics. Also, an air driven cyclonic abrasion apparatus (another Krogh development) has been constructed in order to grind off the outer zones of zircon crystals, essentially a peeling operation, in order to study the U and Pb isotopic system systematics in zircon cores and rims. This apparatus will be put into operation during the coming year.

An exciting result obtained during the year was the old age found for the Kasba gneisses east of Kasba Lake in the District of Keewatin. The value obtained was 3300 Ma using the U-Pb method on zircon. A co-authored paper concerning these results has been submitted to the Canadian Journal of Earth Sciences.

Personnel Notes

R.D. Stevens continued to serve as Acting Section Head for the entire year. Dr. Otto van Breemen will arrive to fill the position of Section Head as a research scientist on May 1st, 1981.

Field Activities

W.D. Loveridge

Visited the geochronology laboratories of T. Krogh (Royal Ontario Museum),and R. McNutt (McMaster University), and J. Blenkinsop (Carleton University).

R.D. Stevens

Visited the geochronology and mass spectrometer laboratories of P. Reynolds (Dalhousie University), F. Tan (A.G.C. Bedford Insitute of Oceanography), and J. Blenkinsop (Carleton University).

F.B. Quigg

Visited the geochronology laboratories of T. Krogh (Royal Ontario Museum).

R.W. Sullivan

Visited the geochronology laboratory of J. Blenkinsop (Carleton University).

Attendance at Meetings, Conferences and Courses

W.D. Loveridge

American Geophysical Union, 1980 Spring Meeting, Toronto, Ontario, May 22-27, 1980.

R.D. Stevens

Geological Association of Canada/Mineralogical Association of Canada, Joint Annual Meeting, Halifax, May 19-21, 1980.

R.W. Sullivan

The Computer Revolution: a Seminar sponsored by Data General (Canada) Ltd., Ottawa, Ont., Jan. 14, Feb. 3, Mar. 5 and 11, 1981.

Section Manuscripts

1 GSC Paper, 4 GSC Current Research papers,3 papers in outside journals.

Laboratory Statistics

	1979-80	1980-81
Argon extractions	201	190
Argon analyses	202	207
Potassium analyses by isotope dilution	43	77
K-Ar ages reported	181	192
Rb isotopic analyses	386	0
Sr isotopic analyses	30	171
Rb-Sr isochron projects	21	13
Rb-Sr isochron reports	11	8
Pb isotopic analyses	422	293
U isotopic analyses	154	123
Zircon fractions analyzed	127	131

Distinguished Visitors

Visitors to the Geochronology Laboratories during the year included P. Nunes and T. Krogh (Royal Ontario Museum), R. Farquhar (University of Toronto), C. Roddick (Leeds University), P. Kennan (University College, Dublin), S. Clement (University of Regina), G. Derrick (Bureau of Mineral Resources, Australia), D. York (University of Toronto), O. van Breemen (Scottish Universities Research & Reactor Centre, Glasgow), A. Turek (University of Windsor), B. Gulson (C.S.I.R.O., Sydney, Australia), V. Schmitt (PetroCanada, Calgary), J. Cole, D. Menagh and K. Bell (Carleton University), a group of 20 students from the University of Liege, a group of 30 students from Concordia University, the Hon. Mrs. J. Erola, Minister of State for Mines.

RESOURCE GEOPHYSICS AND GEOCHEMISTRY DIVISION

A. G. Darnley, Director

The principal objectives of the Resource Geophysics and Geochemistry Division are to advance exploration technology and provide geophysical and geochemical information to facilitate the discovery, delineation and evaluation of Canada's resource base, with emphasis on metalliferous resources. An important secondary objective is to undertake special investigations pertaining to topical resource-related and environmental problems, such as radioactive waste disposal, offshore permafrost, and acid rain.

The Division serves as a national centre for research and development into geophysical and geochemical methods relating to metalliferous exploration, economic, regional, engineering, and environmental geology. It provides advice on these matters at national and international levels. The foundation for this advisory function is provided by the continuing activities which include: research into, development, testing and experimental use of new geophysical and geochemical methods; the establishment of relevant calibration and standardization procedures; and the progressive development of improved methods of presenting multi-parameter geophysical and geochemical data in an informative manner. The Division is thus in a position to design, manage, operate where necessary, and interpret geophysical and geochemical surveys for a wide variety of applications ranging from purely local to national requirements.

The organization of the division remained basically unchanged during 1980/81, being divided into four subdivisions, a CIDA program office (also responsible for foreign trainees) and the division administrative office. Division strength is 97 p.y. At the year end there were 40 scientists, 36 technical support and 10 administrative support staff, plus five vacancies. Staff are distributed over five floors in 601 Booth Street; at 580 Booth Street; in 401 Lebreton St; the Alert hangar and Building U-61 at Uplands Airport.

Highlights

The individual subdivision reports which follow, each contain their own selection of highlights from the year's work.

Of probably the greatest general interest was the release in March of twenty booklets of the National Geochemical Reconnaissance 1:2 million Coloured Compilation Map Series, providing coverage for about 10 per cent of the area of Canada for about 14 different geochemical parameters. These are designed as a quick reference to geochemical distribution patterns, which are relevant to a wide variety of studies. Judging from reactions already received there is clearly a demand for similar publications to be produced at this scale in the future to summarize other geophysical and geochemical variables on a regional scale.

The airborne magnetic gradiometer system continued to provide spectacular portrayals of near-surface lithology and structure. New results released during the year included the Jan Lake, Saskatchewan, survey, jointly funded by DREE and Saskatchewan. Results were also compiled for an area adjoin-

ing Flin Flon, Manitoba. The Applicon colour plots obtained from each of these areas constitute excellent examples of pseudo-geological maps unrestricted by surface cover.

Two workshops drew an enthusiastic response from their participants. Both endeavoured to bring together different specializations to review the present state of knowledge and establish links for the future. The Uranium in Granites workshop held in November 1980 and convened as a contribution to the international NEA/IAEA uranium exploration R & D activities attracted an audience of 159. It reviewed the geology, geophysics, geochemistry, geochronology, mineralogy, petrology and tectonics of various uraniferous granites.

The Mineral Logging 3-day workshop at the end of March attracted a smaller but diverse group of participants from the exploration and service industries and research organizations. Subsurface borehole-based exploration must inevitably increase in the future and this meeting brought together many of those who will provide the necessary know-how.

Personnel Notes

Dr. E. M. Cameron stood down as Head of the Resource Geochemistry Subdivision at the end of the 1979/80 fiscal year. During the 13 years he had been Head of Geochemistry, regional geochemistry became firmly established as a multi-purpose tool essential for the proper geological description of any region.

Mr. E. H. W. Hornbrook became Acting Head of the Resource Geochemistry Subdivision, effective 24 April, 1980.

CIDA Advisory and Training Services

B. E. Manistre

Despite the new regulations mentioned in last year's annual report, and the use of outside consultants, requests for assistance from CIDA this year remained at about the same level as in 1979/1980. From time to time informal discussions on the inadequacy, or shortcomings, of the present Memorandum of Understanding between EMR and CIDA take place, but there has been no serious attempt to modify its provisions. The role of GSC vis-a-vis CIDA thus remains one of offering assistance to whatever degree can be arranged or negotiated in individual requests.

The status of the various CIDA projects in which GSC is currently involved is as follows:

Brazil

Continuing delays in the delivery of the final products of the main airborne magnetic/radiometric survey were experienced, partly due to the sale of the prime contracting company, Northway Survey Corporation, and the resulting removal of personnel and materials. By March 31st, 1981 however all maps had been delivered to Brazil and a draft of the final report produced.

Because of the policy of DNPM, Brazil, in making copies of the project maps and reports available to the general public, private mining companies have been active in the area and interpretive work on the geophysical and geochemical data has been carried out by the private sector. The general conditions have not however been favourable for the participation of non-Brazilian companies. INCO, for example, has sold its interests in the project area to a Brazilian company.

Pakistan

The selection of a contractor for the interpretation study of the aeromagnetic survey was affected by a new CIDA regulation limiting the size of companies eligible for this kind of work to 50 employees. Designed to encourage the growth of small business in Canada, the regulation effectively barred the main air survey companies from bidding in a field in which there are already few qualified firms.

The contract was awarded to Alan Spector and Associates, Toronto. Assistance in monitoring this work is being provided by Dr. P. J. Hood.

Ivory Coast

This year saw the completion of the interpretation of the magnetic maps in the southern half of the area and delivery of the final report of the photogeology, in French. This essentially completed the phases for which Dr. A. Larochelle has been the technical authority. Subsequent work, including an airborne "input" survey, ground follow-up work and the purchase of equipment has been handled through a management contract with Terra Surveys.

Botswana

This project is now being run by a CIDA recruited team and drilling contractor, with A. E. Buller of Toronto as consultant. GSC involvement is thus minimal, but we remain as advisers to CIDA.

Kenya

At the request of the Kenyan government, GSC was asked to advertize the availability of the project maps to the public. This was done through the G.I.D. monthly circular. At least one major mining company seeking to follow up the work failed to negotiate satisfactory terms with the Kenya government.

Rwanda

A new request for assistance in setting up an airborne radioactive/magnetic survey in western Rwanda was received. This involved reviewing the proposed specifications, assisting with DSS in preparation of the call for contractors' proposals and their subsequent evaluation. The successful contractor has been provided with calibration facilities and advice on the calibration results. Monitoring of the survey in Rwanda will also be supported under the general direction of Dr. K. A. Richardson.

Training

There was an increase in the requests for training attachments received from IAEA through CIDA during the year.

Dr. N. M. Cagatay of Turkey was attached to the geochemical subdivision for three months to study the geochemistry of uranium. Mr. Minhaz Chowdhury of Bangladesh arrived on June 1st, 1980 for a six month attachment, also to study the geochemistry of uranium. Miss L. Ilagan (Phillipines) was awarded a three month program in computer processing of geochemical and geophysical data which has subsequently been extended. Mr. Milan Milojevic (Jugoslavia) spent two weeks with the Radiometrics subdivision following an attachment to Hudson Bay Mining and Smelting Co. Ltd.

Applications received from IAEA and the UN which could not be met or were cancelled included J. A. Carvalho Marques, Portugal; K. K. Mishra, India; Geeta Rana, Nepal; Alexis Dhalloo, Trinidad.

Attachments from sources other than the UN or IAEA included Mr. Liu, Peoples Republic of China, who is spending one year on radiometric surveying techniques.

Lectures and Talks

A. G. Darnley
- Geoscience reconnaissance surveys - Their relevance to exploration. CIM Toronto, April 22, 1980.
- Radioelement 'highs' and gravity 'lows'. NEA/IAEA Uranium Workshop, IGC Paris, July 1980.
- Canada's uranium resources in a world context. CSPG, Calgary, September 29, 1980.
- Uraniferous granites - a miscellany of questions. Uranium in Granites Workshop, Ottawa, November 25, 1980.
- The relationship between radioelement distribution and some major crustal features in Canada. Mineralogical Society, London, U.K. January 16, 1981.

B. E. Manistre
- Some problems of the Nueltin Lake Granites. Uranium in Granites Workshop, Ottawa, November 1980.

Attendance at Meetings and Conferences

A. G. Darnley
- CIM Annual Convention, Toronto, April 21 - 22, 1980.
- KEGS Symposium, Toronto, May 22 - 23, 1980.
- IGC, Paris, July 7 - 16, 1980.
- CSPG Symposium, Energy Audit of the 80's, Calgary, September 28 - October 1, 1980.
- Provincial Ministers of Mines Annual Meeting, Halifax, October 27 - 28, 1980.

- Mineralogical Society of London, Anniversary Meeting, London, January 16-18, 1981.
- EEC-Canada Meeting on Uranium Exploration and Extraction, Brussels, March 17-19, 1981.
- NEA/IAEA Uranium Exploration R & D Group:
  - Non-radiometric geophysics workshop, Toronto, May 23-24
  - Group meeting, Paris, July 17-18
  - Fuel Cycle Committee, Paris, October 13-15, 1980
  - Uranium in Granites Workshop, Ottawa, November 25-26, 1980
  - Group meeting, Paris, March 31-April 1, 1981

B. E. Manistre - Uranium in Granites Workshop, Ottawa, November 25-26, 1980.

Membership on Committees

A. G. Darnley
- Board of Directors, MERI, Montreal
- Chairman, NEA/IAEA Uranium Exploration R & D Group
- Member, EMR URAG Committee
- Chairman, Exploration Technology and Geoscience Standards Subcommittees, National Geological Surveys Committee
- Member, Comptroller-General's Working Group on Operational Control of R & D
- Member, EMR MAC Implementation Group

B. E. Manistre
- Ad Hoc Interdepartmental Committee for the Commonwealth Science Council.

Division Summary of New Information Released to the Public

21 papers in outside journals
7 GSC 'Current Research' reports
2 GSC Papers
20 1:2,000,000 Regional Geochemical Atlases
2 1:250,000 NTS sheets Geochemistry (on behalf of B.C.)
489 Aeromagnetic maps of Canada comprising:
Standard series: 411 at 1:50,000
15 at 1:250,000
Gradiometer series: 63 at various scales
23 GSC Open File Releases (various subjects)
46 Oral presentations

On behalf of CIDA

154 Aeromagnetic maps of Brazil
123 Aeromagnetic maps of Kenya
20 Radiometric maps of Kenya
149 Aeromagnetic maps of Ivory Coast
149 Radiometric maps of Ivory Coast

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 carried out under contract, monitors their execution, and supervises the publication of results. Geological interpretations of the 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

A standard-sensitivity aeromagnetic survey contract was underway in Newfoundland-Labrador during 1980. Line kilometrage flown was 56,103 km bringing the grand total flown in Canada to 8,045,965 line km. 489 aeromagnetic maps were issued during the report year to bring the grand total of such maps issued in Canada to 8799.

The consortium of Photosur Inc., Montreal, and Geoterrex Ltd., Ottawa, completed compilation of the aeromagnetic data for the New Quebec contract, which also completed the full aeromagnetic coverage of the Province of Quebec. A technology transfer process was commenced for the GSC aeromagnetic gradiometer system to enable such surveys to be obtained by the mineral exploration industry from Canadian airborne geophysical survey contractors.

Regional Geophysics Statistics

The status of contract aeromagnetic surveys is summarized in the following table:

Contract	GSC Project	Kilometres Flown 1980	Maps published in 1980/81 1:50,000	1:250,000
Labrador	690072	56,103	46	-
Coppermine	690072	-	157	15
Quebec	730012	-	208	-
Totals		56,103	411	15

A total of 56,103 line kilometres was flown for the Labrador aeromagnetic survey during this last year of the contract. The necessary planning for a new contract to complete northern Labrador was carried out and a briefing session was held on March 23, 1981 in Ottawa. All the maps published during the year were inspected by members of the Contract Surveys staff and this required frequent visits to the offices of the various contractors, namely Photosur Inc. in Montreal, Geoterrex in Ottawa and Questor Surveys in Toronto. In particular the compilation of the data for the New Quebec aeromagnetic contract was completed amounting to 535,755 line kilometres which completes coverage for the province.

Because of the resignation of M. T. Holroyd, the 1:1,000,000 magnetic anomaly map project has been taken over by D. Teskey.

P. H. McGrath continues the compilation of the 1:3,500,000 Magnetic Anomaly Map of Arctic Canada and is on schedule for the map to be published in time for the Arctic Symposium to be held in Calgary during June, 1981. Many previously undiscovered regional features are being delineated as a result of the Arctic Island compilation because it contains a great deal of hitherto unpublished company data supplied by the private sector through the Northern Non-Renewable Resources Branch of the Department of Indian Affairs and Northern Development.

The GSC/NAE aeromagnetic project continued in 1980-1981 with flying operations in the Arctic Ocean and Caribbean. Seven additional lines were flown across the Lomonosov Ridge in May 1980 and the results were presented by P. J. Hood and M. E. Bower in a paper at the AGU meeting in Toronto the same month. The 1980 results proved beyond any doubt that a distinctive magnetic anomaly is associated with the Lomonosov Ridge so that the rock forming the Ridge must in part be igneous. In addition, 31 lines were flown across the continental shelf of Ellesmere Island during the May 1980 operation and also in September 1980.

Between April and September 1980 an extensive test program was flown for the Rockwell N-73 inertial navigation system, including another trip to Alert to test both the N-73 and LTN-51 inertials at high latitudes. Inertial systems are commonly used by aircraft overflying the pole, but to start up a system and align it at high latitudes is quite a different problem; the alignment time is about twice as long as it would be in southern latitudes. Both the systems performed very well, and a couple of survey lines were flown near the pole.

In March 1981 a survey was flown in the Caribbean near Barbados as part of Canada's contribution to the North American magnetic anomaly map. The aircraft then continued on to Bonaire to test the magnetometers and compensation in a low-noise - low-dip angle environment, and to test an experimental accelerometer package.

In the laboratory some useful new programs are in operation. The navigation refly program uses any or all navigation data that was recorded in flight to calculate the most probable position. It can work either forward or backward from a known point, and will be used to refly all the Arctic data. A digital filter/plotter program is an improved version of the Martin-Graham N-100

filter used several years ago. This version takes account of the aircraft ground speed and computes a new set of weights for each line or segment of a flight, thus eliminating errors that could arise from a varying aircraft speed and constant sample rate. This program has been used to analyse the 1976 Caribbean data and the Gulf of Boothia survey.

Queenair Aeromagnetic Gradiometer Project

Statistics for High Resolution Aeromagnetic Gradiometer Surveys

The following high resolution aeromagnetic maps resulting from the Queenair operations were published:

Area	Prov.	Client	Maps published during 1980/81		
			Total Field	Vertical Grad.	Total
Antigonish	N.S.	N.S. D.M.E.	15	15	30
Bowmanville	Ont.	AECL Radwaste	1	1	2
Chalk River	Ont.	AECL Radwaste	1	1	2
Abitibi	Que.	Q.M.R.N.	25	-	25
Killala Lake	Ont.		1	1	2
Kasmere Lake	Man.	U.R.P.	1	1	2
Total			44	19	63

In addition, the following Queenair aeromagnetic surveys were Open Filed:

Open File	Area	Prov.	Release Date	Maps		
				Total Field		Vert.Grad.
719	Jan Lake	Sask.	Dec.19, 1980	9		9
681	Atikokan	Ont.	Apr.25, 1980	4		4
713	Wollaston Lk	Sask.	Aug.18, 1980	6		6
				19		19
		Total			38	

The GSC aeromagnetic gradiometer system was improved during 1980 by locating and rectifying the source of base shifts in the data, thus improving the quality of the data. In preparing for the lower Great Lakes survey that is to begin in the summer of 1981, a Loran C navigation system will be installed in the Queenair. In order that the pertinent position information may be recorded, an interface had to be designed, built and tested that changed the available digital serial data into parallel format. The digital data acquisition system also had to be modified somewhat for this purpose and has also been further improved to permit data to be entered into the system in parallel mode from separate external data sources.

In the past air-to-ground communication via VHF and HF frequencies created problems because transmissions from the aircraft would spoil the magnetic records. Tests conducted this past winter with UHF frequencies have shown that this band of frequencies does not affect the Cs or Rb magnetometers. A UHF transmitter/receiver has therefore been purchased and should improve our operation. The new Geocam survey camera that was purchased last year has been installed and should provide improved flight path film for the 1980 survey season.

Aeromagnetic gradiometer surveys flown in the following areas during the 1980 field season by the GSC Queenair aircraft:

Surveys Flown	Line Km	Client and/or Purpose
Val d'Or, Quebec	4482	Association des Prospecteurs du Quebec
Flin Flon, Manitoba	9016	Manitoba Dept. of Energy and Mines - funded by DREE
Pinawa, Manitoba	300	AECL - Radioactive Waste Disposal Program
Cape Breton Is. N.S.	1626	Comparison test with Geoterrex calculated gradient
Athabasca Basin, Sask	1865	Reconnaissance of the Athabasca Basin

The Flin Flon aeromagnetic gradiometer survey results flown in 1980 were sent to the Manitoba Department of Energy and Mines who had contributed through DREE-funding the majority of the funds to carry out the survey. An evaluation of the results has proven to the members of that organization the value of the technique to their detailed geological mapping program. Consequently the Manitoba Department of Energy and Mines has requested that the coverage be expanded in the next six years to the east over areas with interesting mineral potential as a contribution to their Operation Cormorant.

As a consequence of the increasing acceptance of the aeromagnetic gradiometer technique as a superior tool for detailed geological mapping programs, a plan has been implemented in cooperation with the Ontario Geological Survey supported by DREE-funding to sponsor a Commercial Aeromagnetic Gradiometer System. A set of specifications were first drawn up based on the GSC system and field experience and these were circulated to a dozen airborne geophysical survey contractors and instrument companies prior to a bidder's conference held in Toronto on October 22, 1980. At the briefing the GSC Queenair aircraft was on display together with a representative set of gradiometer results. A Request for Proposals was sent out on December 12, for replies to be received by Paterson, Grant and Watson Ltd., the consultants retained to coordinate the CAGS project, by January 31, 1981. Two companies, Kenting Earth Sciences Ltd. and Questor Surveys Ltd., submitted the best proposals which were rated on a previously-agreed point system. The points for the two proposals were however sufficiently close together that the Technical Committee for the CAGS project was unable to decide which was the better proposal. Moreover the design of the twin boom systems proposed by each company were radically different, so it was decided to ask each company to proceed with the design and fabrication of the boom systems and carry out aerodynamic comparisons to ascertain which was preferable.

Personnel Notes

M. T. Holroyd - Resigned in July 1980 to join Dataplotting Services Ltd. in Toronto.

D. Johnson - Resigned in July 1980 to take a position with the Department of Transport.

Attendance at Meetings, Conferences and Courses

P. J. Hood
- American Geophysical Union, Toronto, May 22-27, 1980 Presented paper entitled "Aeromagnetic gradiometer program of the Geological Survey of Canada: a progress report" with D. Dods, M. T. Holroyd, L. J. Kornik, D. Olson and P. Sawatzky. Also presented paper with M. E. Bower entitled "Aeromagnetic reconnaissance: Lorex Project".
- Squid Applications to Geophysics Workshop, Los Alamos, New Mexico, June 2-4, 1980. Presented paper "Aeromagnetic gradiometry: a superior geological mapping tool for mineral exploration programs".
- Mines Ministers Conference, Halifax, Nova Scotia, October 26-28, 1980.
- Workshop on Magnetic Anomaly Map of North America, Society of Exploration Geophysicists, Houston, November 15-16, 1980. Presented paper entitled "Review of coverage available and current status of national magnetic anomaly maps: Canada".
- Society of Exploration Geophysicists, Houston, November 16-20, 1980.
- Geophysics Workshop, Radioactive Waste Disposal Program, Ottawa, February 12-13, 1981.
- Prospectors and Developers Association Convention, Toronto, March 8-11, 1981. Presented paper entitled "Aeromagnetic Gradiometry: some recent results and future applications".

K. Anderson - Computer System Fundamentals Course, April 14-18, 1980. Staff Development Branch.

S. D. Dods
- Career Orientation Workshop, April 22-May 23, 1980. Staff Development Branch.
- Dynamics of Supervision Course, June 9-13, 1980. Staff Development Branch.

T. R. Flint - Computer Course, Texas Instruments, Chicago.

L. J. Kornik - American Geophysical Union, Toronto, May 22-27, 1980. Presented paper with D. Teskey entitled "Interpretation of aeromagnetic gradiometer surveys in the Wollaston Lake Area, Saskatchewan".

L. Lawley - Introduction to Computers Course, April 9-11, 1980. Staff Development Branch.

P. H. McGrath - Geological Association of Canada, Halifax, May 19-21, 1980.

D. Olson - Computer Course, Texas Instruments, Chicago.

Special Talks and Lectures

P. J. Hood - "Modern mineral exploration techniques" in Mining in Canada program, National Museum of Natural Sciences, Ottawa, February 12, 1981.

W. Knappers - "An aeromagnetic survey of northern Labrador" Atlantic Geoscience Centre, Dartmouth, March 26, 1981.

Membership on Committees

S. D. Dods
- Chairman, Data Display Users Group, Computer Sciences Centre.
- Member, Branch Computer Facilities Committee.

P. J. Hood
- Chairman, Map Compilation Committee, Magnetic Anomaly Map of North America, Society of Exploration Geophysicists.
- Co-chairman, Working Group I-4, Division 1 (Magnetic Anomalies - Land and Sea), International Association of Geomagnetism and Aeronomy.
- Member, Technical Subcommittee for development of Commercial Aeromagnetic Gradiometer System, Minerals Committee, Eastern Ontario Subsidiary Agreement.

D. Teskey - Digital Compilation Subcommittee, Gravity and Magnetic Anomaly Maps of North America, Society of Exploration Geophysicists.

P. H. McGrath - Arctic Group, North American Continent, Ocean Transects Program.

Subdivision Productivity

489 Aeromagnetic Maps
5 Outside Publications
1 Current Research
3 Open File Releases
7 Oral Presentations

RESOURCE GEOCHEMISTRY SUBDIVISION

E. H. W. Hornbrook

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 resources appraisal; by study of new analytical techniques and geochemical instrumentation; and by software development to facilitate interpretation.

The Subdivision is administered in four sections: Exploration Research, Regional Research, Analytical Laboratories, and Standards and Data Services.

Highlights

Publication of National Geochemical Reconnaissance (N.G.R.) data 1:2,000,000 Coloured Compilation Map Series commenced this year with the release of twenty Open Files. The computer mapping package (APPMAP), for the Applicon Colour plotter, was designed by D. J. Ellwood who with Dr. W.B. Coker coordinated the base map digitizing and contour interval selection input from the Subdivision staff. Most of the lake and stream sediment and water data were obtained under the Federal-Provincial Uranium Reconnaissance Program, 1975-1979, but the series also includes similar data from surveys totally funded by Ontario (1979) and British Columbia (1979-1980). Each Open File consists of a number of coloured maps depicting the sample site locations and the areal distribution of approximately 14 variables. Open File areas range from one N.T.S. map sheet, approximately 13,000 km^2, to blocks of combined adjacent map sheets encompassing 140,000 km^2.

The Coloured Compilation Map Series is having, and will have, a substantial impact on regional knowledge bases. Alone, or together with other geoscience data, the 1:2,000,000 maps are being used for mineral exploration, regional interpretations, resource appraisal and more recently environmental assessment (acid rain).

The involvement of Subdivision staff in the Athabasca NEA/IAEA test area continued during the year. The GSC camp at Midwest Lake, Saskatchewan, provided support for over thirty people from EMR, Saskatchewan Research Council, University of Saskatchewan, and some private consulting firms. The work of this and previous years integrated studies are to be discussed at a proposed workshop in late 1981. Willy Dyck's work has shown that Rn provides greater geochemical contrasts than conventional soil geochemical and geophysical methods over the radioactive boulder train at Midwest Lake. Further, his He and Rn studies in drill hole waters imply that anomalous values in groundwaters exist beyond the ore zones providing a much increased target size.

Dr. W. D. Goodfellow and Dr. I. R. Jonasson continued to be actively involved in the Nahanni IMPP study area in the Yukon. Their studies have revealed the presence of extensive low grade apatite mineralization in Ordovician-Silurian chert through use of a field test for P as the PO_4^{-3} ion. The potential exists for economic deposits. The phosphorite unit may also prove to be a useful marker for the Pb-Zn bearing chert units in the Howard's Pass area when these deposits are concealed under barren chert. Their work has also shown that metals and other elements expelled onto the seafloor basin are zoned stratigraphically and laterally about the sulphide zone. The manner in which the zoning is chemically and biochemically controlled may have significant application to exploration for blind sulphide deposits of this type.

Dr. Y. T. Maurice chaired a successful NEA/IAEA Workshop on Uranium in Granites. Twenty-two papers were presented to over 150 people on the characteristics of radioactive granites and their potential for hosting economic uranium deposits. These are currently being edited for publication.

In northern British Columbia, S. B. Ballantyne has developed a genetic model for uranium, base metal and lithophile mineralization associated with the Surprise lake intrusion based on the magmatic evolution of this specialized granite. The disperson and elemental association patterns in the black clastic stratigraphy of the Kechika Trough have also been investigated in order to improve definition of exploration targets. In southern British Columbia, Dr. D. R. Boyle has concluded that the basal type uranium deposits have formed by the infiltration into Miocene fluvial sediments of deep seated structurally controlled groundwaters leaching the Okanagan Highlands Intrusive Complex. These waters are cold, slightly bicarbonated, highly uraniferous, slightly oxidizing and contain sufficient concentrations of Ca, Mg, and PO_4 to account for observed mineralogy.

Dr. E. M. Cameron spent a month in South Africa sampling shaley sediments of the complex early Precambrian sequences to complement his ongoing study of the exogenic sulphur cycle of the Precambrian in Canada.

The Subdivision has acquired a Dionex Ion Chromatograph to provide water data in support of a number of studies (i.e. acid rain). G.E.M. Hall and A. MacLaurin have developed routine methods for surface and interstitial peat waters for determining: F, Cl, NO_2, Br, NO_3, PO_4 and SO_4.

The fourth and last international lake sediment reference standard was collected by J. J. Lynch and co-workers this year. These four standards, scheduled for distribution next year, comprise the first set in a proposed series of international lake and stream sediment, soil and rock standards.

Dr. R. G. Garrett has made progress in placing geochemical interpretation within an exploratory data analysis framework and in the conceptual design of a computer system to carry out the required tasks.

N. G. Lund has completed the development of the Geochemical Information Service System (G.I.S.S.) to the point where most of the Subdivision data is now managed through this central file.

Personnel Notes

Zita LeBlanc - resigned February 9, 1981 after several years of much appreciated effort in the Subdivision Office. Zita is now pursuing a career in motherhood.

After a failure to fill Barry Smee's position with a geochemist, we have changed the position to a CH-2 to acquire another chemist. The failure was largely due to the lack of suitable candidates in this field.

B. O'Connell - left in June, 1979 to be replaced by J. Janveau.

Julian Lee - PDF from New ZEaland, returned home in November 1979 after two years of successful work at the GSC with I. Jonasson.

Sample Preparation Laboratory - GSC

Number of samples prepared	7,120
Crushing/Grinding	6,565
Sieving	2,350
Ball Milling	12,775
Super Panner	530
Frantz	1,330
Heavy Liquid Separations	400

Trace Element Laboratory - GSC

Water Samples Analysed	1,220
Total Determinations on Water Samples	18,168
Rocks, Ores, Sediments & Soils Analysed	4,420
Total Determinations on Solid Samples	48,686

Contract Archiving of N.G.R.-U.R.P. Sample Material

Lake Sediment Samples: Ball Milled, Sieved and Stored in Vials	9,000

Contract Analytical Services

Total Number of Samples	13,300
Total Number of Determinations	88,500

Attendance at Meetings, Conferences and Courses

S. B. Ballantyne
- NEA/IAEA Uranium in Granites Workshop, Ottawa, Nov. 1980.
- 8th Whitehorse Geoscience Forum, Whitehorse, Yukon, December 1980.
- Prospectors and Developers 49th Convention, Toronto, Ontario, March 1981.

D. R. Boyle
- NEA/IAEA Uranium in Granites Workshop, Ottawa, Nov. 1980.

R. W. Boyle
- Alaska Miner's Association Meeting, Anchorage, Alaska, October 1980.

E. M. Cameron
- 8th International Geochemical Exploration Symposium, Hannover, April 1980.

W. B. Coker
- 26th Annual Meeting of the Institute on Lake Superior Geology, University of Wisconsin, U.S.A., May 1980.
- CIM Geology Division, Gold Symposium and Field Excursion Val d'Or-Kirkland Lake-Timmins, September 1980.

R. G. Garrett
- 8th International Geochemical Exploration Symposium, Hannover, April 1980.
- Annual Meeting of the American Statistical Association, Houston, August 1980.
- Prospectors and Developers 49th Convention, Toronto, March 1981.

W. D. Goodfellow
- G.A.C. Annual Meeting, Halifax, May 1980.
- Isotope Workshop, Ontario Geological Survey, Toronto, February 1981.
- Hydrothermal Activity Associated with Ocean Ridges Workshop, Ontario Geological Survey, January 1981.
- Nahanni I.M.P.P. Annual Meeting, Calgary, February 1981.

G.E.M. Hall
- Dionex Ion Chromatography Course, Sunnyvale, California, February 1981.

E.H.W. Hornbrook
- 8th International Geochemical Exploration Symposium, Hannover, April 1980.
- NEA/IAEA meeting on R&D Proposal No. 8, Biogeochemical Exploration for Uranium, Uppsala, Sweden, April 1980.

I. R. Jonasson
- 8th International Geochemical Exploration Symposium, Hannover, April 1980.

N. G. Lund
- Special Course in Data Management Concepts, Ottawa, January 1981
- Prospectors and Developers 49th Convention, Toronto, Mar. 1980.

A. I. MacLaurin - Dionex Ion Chromatography Course, Sunnyvale, California, February 1981.

Y. T. Maurice - NEA/IAEA joint meeting of R & D Proposals Nos. 2 Uranium Favourability by Mineral Analysis and 6 Uranium in Granites, Portugal, October 1980.

- NEA/IAEA Uranium in Granites Workshop, Ottawa, Nov.1980.

Special Talks and Lectures

S. B. Ballantyne - Preliminary lithogeochemical studies of the Surprise Lake intrusion, Atlin, British Columbia, NEA/IAEA Uranium in Granites Workshop, Ottawa, November 1980.

D. R. Boyle - Characterization of intrusive basement complexes as source areas for the formation of sedimentary hosted uranium deposits, NEA/IAEA Uranium in Granites Workshop Ottawa, November 1980.

R. W. Boyle - C.I.M.M. Distinguished Lecturer on Gold. Fourteen lectures on gold and methods of discovery of its deposits have been given across Canada.

W. B. Coker - Regional geochemistry and metallogeny, north shore of Lake Superior, 26th Annual Meeting of the Institute on Lake Superior Geology, May 1980.

- Organic centre-lake sediments - application in the geochemical exploration for gold, Southern Canadian Shield, CIM Gold Symposium, Val d'Or, September 1980.

R. G. Garrett - The measurement and evaluation of variability in stream sediment surveys, 8th International Geochemical Exploration Symposium, Hannover, April 1980.

- Luncheon meeting talk to the Ottawa Chapter of the Canadian Operations Research Society, November 1980.

- Seminar to graduate students, Geology Department, Queen's University, Kingston, Ontario, January 1981.

- A new two-way mixed ANOVA model with an unbalanced nested structure in geology, Annual Meeting of the American Statistical Association, Houston, August 1980.

W. D. Goodfellow - Wall-rock alteration associated with stratibound massive sulphides in the Canadian Appalachians, an Overview, G.A.C. Annual Meeting, Halifax, May 1980.

E. H. W. Hornbrook - An investigation of variability in lake sediment and water surveys, 8th International Geochemical Exploration Symposium, Hannover, April 1980.

Y. T. Maurice - Uraniferous granites and associated mineralization in the Fury and Hecla Strait areas, Baffin Island, N.W.T. NEA/IAEA Joint Meeting, Madrid, October 1980.

Membership on Committees

D. R. Boyle - Member, Geochemical Subcommittee, Canada-Newfoundland Mineral Development Sub-Agreement.

R. W. Boyle - Member, Committee for Information on Mineral Problems, S.E.G.

- Vice President, I.A.G.O.D.
- Member, Subcommittee on Scientific Criteria for Environmental Quality, NRC (Canada)
- Member, Library Committee, G.S.C.

E. M. Cameron - Editor-in-Chief, Journal of Geochemical Exploration

W. B. Coker - Councillor, Association of Exploration Geochemists.

R. G. Garrett - Secretary, Association of Exploration Geochemists.

- Member, Editorial Board of the Journal of Geochemical Exploration
- Member, Editorial Board of the UNESCO publication "Collection and Analysis of Mineral Resource Data"

E. H. W. Hornbrook - Councillor, Association of Exploration Geochemists

- Member, Geochemical Subcommittee, Canada-Newfoundland Mineral Development Sub-Agreement.

Subdivision Productivity

10	Outside Publications
2	GSC Papers
5	Current Research
23	Open File Releases
10	Oral Presentations
14	Lectures: R.W. Boyle, C.I.M.M. Distinguished Lecture Series

RESOURCE RADIOACTIVITY SUBDIVISION

K. A. Richardson

The objectives of this Subdivision are directed toward the development, application and evaluation of radiometric methods of geophysics for mineral exploration and geological mapping. Research and development in instrumentation and geophysical exploration techniques are conducted in airborne, surface and borehole environments. The present emphasis is on gamma-ray spectrometric methods, while ancillary measurements are incorporated to assist in understanding and interpreting the radiation measurements. Experimental surveys are conducted to demonstrate new developments and their application. Calibration facilities are maintained for use by industry, academic and government agencies; advice is provided to users of the facilities in order to improve the standardization of radiation measurements.

Emphasis on borehole logging has increased during the year, culminating in the organization of a highly successful Minerals Borehole Logging Workshop held at the GSC from March 31 to April 2, 1981, and attended by 35 representatives of industry and governments. Additions to GSC calibration and test facilities were four boreholes drilled at Bells Corners and two boreholes at Bancroft; these holes will be used for testing several logging techniques, including hole-to-hole methods. Considerable effort went into evaluating and updating the McPhar RD-500 portable microprocessor based logging system; successful tests of the GSC-developed, high-sensitivity temperature probe were carried out and the technology was transferred to industry.

Airborne spectrometer surveys flown with the GSC Skyvan included detailed surveys in Nova Scotia and over granites in the Mistastin area on the Labrador-Quebec border, and reconnaissance surveys at Deep River, to fill a gap in existing reconnaissance coverage, and on the U.S. border north and west of Lake Superior, for future compilation of URP results with U.S. NURE results to produce radiometric maps of North America.

Compilation of Skyvan survey results from 1978, 1979 and 1980 was delayed due to a complete redesign of data processing software in order to handle efficiently the complete gamma-ray spectral data recorded by the new Skyvan spectrometer system. At the end of the year map production was resumed; from the backlog of 19 surveys, 2 were completed and 7 were in advanced stages of compilation. Most of the backlog should be completed and published in 1981-82.

Studies on the use of the full spectral data collected by airborne gamma-ray spectrometry show that the accuracy of determining equivalent uranium concentrations can be increased by approximately 25%, compared with the conventional four-window technique. Investigation of extending the full spectrum technique for inflight measurement of atmospheric radon daughters disclosed a compilation due to Cesium-137 fallout from the testing of nuclear devices over the past few decades, and also permitted measurement of the amount of fallout.

Ground investigations and interpretation of airborne survey results in the Sharbot Lake area, Ontario, showed that uraniferous pegmatites were related to anatexis of Grenville metasediments along major zones of shearing. In Nova Scotia uranium and thorium variations in granitic rocks were related to differ-

entiation and deuteric alteration, and the radiometric survey data may be used to distinguish areas of potential tin and tungsten mineralization. Potassium enrichment and distinctive radioelement ratios appear to be characteristic of some syenites with associated gold mineralization in the Kirkland Lake area. These investigations indicate possible broader exploration applications of airborne gamma-ray spectrometry in the future. Several papers presented at the NEA/IAEA workshop on "Uranium in Granites" (November 25-26, 1980) showed that GSC spectrometer survey results are widely used, and have been applied to the characterization of many different granite bodies.

Personnel Notes

Conaway, J. G. - Resigned from the Resource Radioactivity Subidivision on June 27, 1980 to accept a position as Manager of Borehole Geophysical Services for McPhar Geophysics in Toronto.

Mwenifumbo, J.C. - After receiving his Ph.D. degree in Geophysics from University of Western Ontario, joined the Resource Radioactivity Subdivision in December 1980 as a Research Scientist, to carry on research in the field of borehole logging.

Attendance at Meetings, Conferences, Courses

Bristow, Q.
- KEGS-AGU 1980 Spring Meeting, Toronto, Ontario, May 1980.
- 3rd Meeting of the NEA/IAEA Working Group in R&D in Uranium Borehole Logging, Vienna, June, 1980.
- Gamma-Ray Logging Workshop, Holiday Inn, Grand Junction, Colorado, February, 1981.

Carson, J. M. - Manufacturer's Course on Computer Planning, Boston, Mass. September 1980.

Conaway, J. G. - KEGS-AGU 1980 Spring Meeting, Toronto, Ontario, May 1980.

Grant, J. A. - Manufacturer's Course on Computer Planning, Boston, Mass. September 1980.

Grasty, R. L.
- Workshop on Glacial Geology and Mineral Exploration, University of Toronto, April, 1980.
- NEA/IAEA Workshop on the Calibration of Instruments used for Gamma-Ray Measurements in Uranium Exploration, Paris, France, November 1980.

Killeen, P. G.
- KEGS-AGU 1980 Spring Meeting, Toronto, May 1980.
- IAEA Consultants Meeting on Logging Techniques for Uranium Exploration, Vienna, June 1980.
- 3rd Meeting of the NEA/IAEA Working Group in R&D in Uranium Borehole Logging, Vienna, June 1980.

- Society of Exploration Geophysicists Annual International Meeting, Houston, Texas, November 1980.
- Gamma-Ray Logging Workshop, Holiday Inn, Grand Junction, Colorado, February 1981.

Richardson, K. A.
- Management Development for Research Managers Course, Sun VAlley Hotel, St.-Adele, May 1980.
- Society of Exploration Geophysicsts Annual Meeting, Houston, Texas, November 1980.

Slaney, V. R.
- Advisory Committee on Remote Sensing, Nova Scotia Land Survey Institute, Ottawa, April 1980.
- Annual Meeting of the Canadian Advisory Council on Remote Sensing, Arnprior, April, 1980.
- Geoscience Working Group Meeting, Ottawa, May 1980.
- Sixth Canadian Symposium on Remote Sensing, Halifax, May 1980.
- Geosat Meetings, Vancouver and Calgary, March 1981.

Special Talks and Lectures

Bristow, Q.
- 'A microprocessor-based software-controlled portable borehole-logging system'. Presented at KEGS-AGU 1980 Spring Meeting, Toronto, May 1980.
- 'Instrumentation for uranium exploration'. Ottawa University Talk, December 1980.
- 'A full spectrum continuous recording gamma-ray spectral logging system'. Presented at Gamma-Ray Logging Workshop Grand Junction, February 1981.
- 'An advanced design microcomputer based portable gamma-ray spectral logger'. Presented at Gamma-Ray Logging Workshop, Grand Junction, February 1981.

Charbonneau, B. W.
- 'Gamma spectrometers and scintillometers calibration and measurement'. Seminar, GSC Ottawa, May 1980.
- 'Radiometric study of three radioactive granites in the Canadian Shield: Elliot Lake, Ontario; Fort Smith, NWT; Fury and Hecla, NWT'. Presented at Uranium in Granites Workshop, Ottawa, November 1980 (IAEA/NEA).

Conaway, J. G.
- 'Problems associated with gamma ray logging for the evaluation of high grade uranium deposits'. Presented at KEGS/AGU 1980 Spring Meeting, Toronto, May 1980.

Ford, K. L.
- 'Geological and geophysical investigations of radioactive pegmatites of the Sharbot Lake area, Eastern Ontario'. Presented at Uranium in Granites Workshop, Ottawa, November 1980 (IAEA/NEA).

Killeen, P. G.
- 'The application of inverse filtering to borehole gamma-ray spectral logging'. Presented at KEGS-AGU 1980 Spring Meeting, Toronto, May 1980.
- 'Gamma spectrometer and scintillometers calibration and measurement'. Seminar, GSC, Ottawa, May 1980.
- 'Variable formation parameters and nonlinear errors in quantitative borehole gamma-ray log interpretation'. Presented at 50th Annual International Meeting of the SEG, Houston, November, 1980.
- 'Canadian calibration facilities for gamma-ray spectral logging'. Presented at Gamma-Ray Logging Workshop, Grand Junction, February 1981.
- 'Calibration and correction methods for KUT logging in Canada'. Presented at Gamma-Ray Logging Workshop, Grand Junction, February 1981.
- 'Reduction and analysis of gamma-ray spectral logs in the field and office as practised at the Geological Survey of Canada'. Given as Chairman of session on Data Reduction and Analysis at Gamma-Ray Logging Workshop, Grand Junction, February 1981.

Memberships on Committees

Cameron, G. W.
- Secretary, Logan Club.

Grasty, R. L.
- Canadian Representative - NEA/IAEA Workshop on Calibration of Gamma-Ray Instruments.
- Departmental Representative - Working Group on 'Radiation in Canada'.

Killeen, P. G.
- KEGS member.
- Chairman, IAEA R&D Working Group on Borehole Logging in Uranium Exploration.
- IAEA Consultant (preparation of manual on borehole logging for uranium).
- Member of ASTM Task Force on Borehole Sensors.
- Member of SPWLA Publications Committee.
- Scientific Authority - UP-S-350 - Proposal by SYGEQ for the development and construction of a borehole logging system for in situ evaluation of coal deposits.

Slaney, V. R.
- Chairman, Logan Club.
- Team Leader, Non-Renewable Resources with the RadarSat Project.
- Canadian co-organizer for COSPAR (IUGS) Symposium to be held in Ottawa in 1982.

- Chairman, Geoscience Working Group, Canadian Advisory Council on Remote Sensing.
- Member, (Geoscience) Sursat Project.
- Member, Advisory Committee on Remote Sensing, Nova Scotia Land Surveys Institute.
- Scientific Authority for unsolicited proposal (Gregory Geoscience) on Athabasca NEA/IAEA study area.

Subdivision Productivity

1 Outside paper
3 Current Research
1 Open File (1:50,000 NTS Radiometric Maps)
14 Oral Presentations

TERRAIN GEOPHYSICS SUBDIVISION

L. S. Collett

The primary objective of the Terrain Geophysics Subdivision is directed toward the development, application and evaluation of electrical and seismic methods for mineral exploration, geological mapping and engineering geology. The subdivision develops new instrumentation in cooperation with industry, devises new techniques for more efficient handling of field data and demonstrates the application of these techniques for solving various field problems.

Involvement with the AECl waste management program continued during the year.

The Subdivision administers the Electrical Methods Section, the Seismic Section and one Special Project.

Highlights

This year saw a continuation of the techniques that were in place the previous year.

At the close of the AECL radioactive waste management geophysics workshop in February 1981, the consensus was that the star of all techniques discussed was the borehole seismic "tube wave". This technique detects zones or regions of permeability in the rock mass and is correlatable with the hydrogeology. The energy from a dynamite source on surface travels through the rock, enters the borehole at the zones of rock fracturing and is detected by geophones in the borehole. This is the only geophysical technique that can directly detect the permeability parameter in rocks. Although it has not been attempted yet, the technique should be very useful in groundwater investigations.

The borehole VLF-EM investigations are showing substantial promise as a fracture detector in the 10-50 m radius around a borehole. This technique along with the radar technique are two devices that have been singled out for further research to meet the objectives of the AECL high level radioactive waste management program.

The fields from the controlled source VLF-EM loop, up to 500 m x 500 m, and operated in the frequency range 15-20 KHz has been used to demonstrate that the results duplicate those from the naval transmitters. With this VLF controlled source transmitter, the coupling of the energy with the strike of rock fractures and conductors can now be controlled. The application of this technique would also apply to borehole investigations. The technique should be useful in mapping geological structures for gold exploration.

Assessment of two deep sounding EM surface units, Geoprobe Maxi-Probe multifrequency system and Geonics EM-37 transient system, has progressed during the year. Two geophysicists, Larry Stephens and Ian Rae, who joined the staff during the year have been busy calibrating these systems against known geology. Although these EM systems were developed for mineral exploration, it is intended to test them for determining the thickness of permafrost in the Arctic.

Work on the permafrost map of the southern Beaufort Sea is continuing. Analyses of the 1300 seismic records from the 1980 CCGS Nahidik cruise have been analysed as well as the front ends of more industry seismic records. Well core data from the Beaufort Sea and jet drilling results at selected sites have been used to check the seismic data. The analyses of the high resolution seismic refraction line across the Beaufort Sea was presented at the Fourth Canadian Permafrost Conference, Calgary, March 2-6, 1981. Information on the depth to the top of permafrost and the ice-bonded layering will be useful for laying out the pipeline routes along the sea floor.

Velocity measurements were made on the sediments on the Scotian Shelf in 200 m water for Defence Research Establishment Atlantic. A seismic refraction eel has been ordered from the Nova Scotia Research Foundation which will be able to withstand pressures in 600 m of water and can be towed at a fixed elevation above seabottom. The velocity information is needed for defence purposes, determining sediment thicknesses and mapping the geology of seabottom sediments in deeper water.

The shallow reflection technique using the Nimbus 1210F has been able to map a buried river valley with overburden thickness up to 200 m along the Niagara Escarpment at Dundas, Ontario. This has been a remarkable achievement because of its resolution capabilities. This feat has attracted a great deal of attention from the engineering and mineral exploration companies. This accomplishment would not have been successful without the ability to transfer the seismic records to a microcomputer, Apple II. Through in-house software development, it was possible to handle the reflection data and display corrected seismic sections. Two papers were presented at the Annual Meeting of the Society of Exploration Geophysicists, Houston, Texas, in November 1980, and has drawn a tremendous response.

The seismic work carried out in the Thelon Basin to determine the sandstone thickness was not encouraging. Prior work in shooting on lakes was successful but this past summer's work was done on land. It is suspected that the permafrost layer may have affected the results on land.

Laboratory studies for the AECL radioactive waste management program on diffusion of radionuclides has shown that there is a critical aperture size where flow exceeds diffusion. This critical aperture is considered to be about 0.3 micrometers. A fracture is hydraulically significant only if its aperture is large enough to allow the flow rate of the radionuclide front to exceed the transport rate of the diffusion front. This critical fracture aperture is in the order of 40-200 micrometers. This laboratory is producing the only factual data of its kind in the AECL program and is referred to by workers in a number of related disciplines.

The radar work is being carried on through an unsolicited proposal to Lakehead University. An impulse radar unit (GSSI Model 8) has been purchased for their use. The emphasis of this work is being directed toward mine safety problems for crack detection in rocks in Northern Ontario mines. The GSC is cooperating with CANMET in this investigation.

Personnel Notes

Ian W. Rae - Joined the Terrain Geophysics Subdivision on March 2, 1981. Mr. Rae graduated from Queen's University with a B.Sc. in Applied Geophysics in May, 1980.

Lawrence E. Stephens - Joined the Terrain Geophysics Subdivision on September 2, 1980. Mr. Stephens came from Earth Physics, Pacific Geoscience Centre, Sidney, British Columbia.

Chijioke E. Waboso -Joined the Terrain Geophysics Subdivision on February 1, 1981. Dr. Waboso completed his Ph.D. at University of Western Ontario in 1980.

Summer Students (GSC)

Peter Freyseng, Peter T. Heeney, Todd Knight, Scott MacRitchie, and Olav Randoja.

Summer Students (AECL)

Gary Johnson, Barry W. Ledrew, Allan J. Marincak, Dell Pohlman, J. Rudi Rincker, and Gordon Shields (Co-op).

Personnel (AECL)

P. J. Chernis - started August 21, 1978; transferred March 31, 1981

B. A. Comyn - started January 16, 1980; transferred March 31, 1981

J. G. Hayles - started December 12, 1978

C. F. Huang - started August 1, 1978

J. Hume - started March 14, 1980

Attendance at Meetings, Conferences, Courses

R. A. Burns
- Pistol Training, January 22, 1981

L. S. Collett
- AECL Geotechnical Information meeting, Ottawa, May 5-6,1980
- American Geophysical Union/KEGS/CGU Spring Meeting, Toronto, May 22-24, 1980.
- Industry, Trade and Commerce meetings, Toronto, June 17, July 24 and December 17, 1980.
- Classification Board, EMR, November 5, 1980.
- Society of Exploration Geophysicists, Houston, Texas, November 16-20, 1980; Luncheon speaker.
- AECL Geophysics Workshop, Ottawa, February 12-13, 1981; gave talk.
- Canadian Occidental Ltd. and Barringer Research Ltd. Toronto; Geonics Ltd., Mississauga, March 12-13, 1981.
- Borehole Logging Workshop, Ottawa, March 31-April 2, 1981; presented paper.

A. V. Dyck
- American Geophysical Union/KEGS/CGU Spring Meeting, Toronto, May 22-24, 1980; gave paper and co-author of a second paper.
- CIMM, Toronto, April 20-23, 1980; gave paper.

J. Frechette
- Rifle and Shotgun Training, Stittsville, May 6-7, 1980
- Motorola Lecture on Microprocessor 6800, Ottawa, May 28,1980.
- Pistol Training, January 22, 1981.

R. M. Gagne
- First Aid Course, November 3-7, 1980.

C. Gauvreau
- Rifle and Shotgun Training, May 6-7, 1980.
- EMR Microcomputer Workshop, May 5-6, 1980.
- Electro 80, IEEE Meeting, Boston, Mass., May 13-15, 1980.
- Motorola Lecture on Microprocessor 6800, Ottawa, May 28,1980.
- Arranged visit to GSC for Electronic Staff (4), CEGEP, Hull, June 6, 1980.
- First Aid Course, November 3-7, 1980.

R. L. Good
- Pistol Training, January 22, 1981.

J. A. Hunter
- American Geophysical Union Spring Meeting, Toronto, May 22-27, 1980; gave paper on Tube Wave with C. Huang.
- Nova Scotia Research Foundation and Defense Research Establishment Atlantic, Dartmouth, N.S. May 15-16, 1980.
- Society of Exploration Geophysicists, Houston, Nov. 16-20, 1980; presented 2 papers.

- Pistol Training, January 22, 1981.
- AECL Geophysics Workshop, Ottawa, February 12-13, 1981.
- Fourth Canadian Permafrost Conference, Calgary, March 2-6, 1981; gave paper and was a session chairman.

T. J. Katsube
- AECL Geotechnical Information Meeting, Ottawa, May 5-6, 1980; presented paper.
- AECL Geophysics Workshop, Ottawa, February 12-13, 1981; presented paper.

A. Overton
- American Geophysical Union Spring Meeting, Toronto, May 26-27, 1980; co=authored paper with J. R. Weber.
- Pistol Training, January 22, 1981.

A. K. Sinha
- AECL Geotechnical Information Meeting, Ottawa, May 5-6,1980.
- American Geophysical Union Spring Meeting, Toronto, May 22-27, 1980.
- Society of Exploration Geophysicists Annual Meeting, Houston, November 16-20, 1980.
- Attended Course on Induced Polarization, University of Arizona, Tucson, January 5-7, 1981.
- Pistol Training, January 22, 1981.
- AECL Geophysics Workshop, Ottawa, February 12-13, 1981; gave two talks.

R. J. Sloka
- Rifle and Shotgun Training, Stittsville, May 6-7, 1980.
- Motorola Lecture on Microprocessor 6800, Ottawa, May 28,1980.

L. E. Stephens
- Pistol Training, January 22, 1981.

Special Talks and Lectures

L. S. Collett
- Mining Luncheon Speaker, Society of Exploration Geophysicists Houston, November 19, 1980; Subject: The Birth of a geophysical method (IP).
- 'Borehole Logs', AECL Geophysics Workshop, February 12, 1981.
- 'Logging Requirements for Radwaste Site Selection', Mineral Logging Workshop, March 31-April 2, 1981.

A. V. Dyck
- 'Quantitative interpretation of wideband drillhole EM surveys for mineral exploration: A test case history' with G. F. West, Am. Geophysical Union, Toronto, May 22-27, 1980; also 'Prototype EM logging tool' with J. Roy, A. Becker and M. Telford.
- 'Quantitative interpretation of drillhole EM surveys in mineral exploration', CIMM Meeting, Toronto, April 22-23,1980.

C. Gauvreau
- Lecturer on Microprocessor Course 'Microprocesseur III' at the CEGEP de L'Outaouais', Hull, Quebec; Fall and Spring Terms.

J. A. Hunter
- 'The correlation of Tube Wave events with open fractures in fluid-filled boreholes' with C. F. Huang, American Geophysical Union, Toronto, May 22-27, 1980.
- Demonstration of modern shallow seismic methods, Civil Engineering Department, Carleton University, June 25, 1980.
- 'Mating the digital engineering seismograph with the small computer - some useful techniques' and with R. A. Burns and R. L. Good; 'Optimum field techniques for bedrock reflection mapping with the multichannel engineering seismograph' at the Society of Exploration Geophysicists Annual Meeting, Houston, November 16-20, 1980.
- 'Recent developments with multichannel digital engineering seismograph' at KEGS (Canadian Exploration Geophysicists ociety), Toronto, January 13, 1981.
- 'Seismic Geophysics in permafrost', Fourth Annual Geological Engineering Workshop, Queen's University, Jan. 23-24, 1981.
- 'Detailed seismic refraction analysis of ice-bonded permafrost layering in Canadian Beaufort Sea' with H.A. MacAulay at Fourth Canadian Permafrost Conference, Calgary, Mar.2-6, 1981; also session chairman.

T. J. Katsube
- 'Some aspects of radionuclide movement through crystalline rocks' given at GSC Tuesday Group, April 15, 1980.
- 'Isolation of nuclear waste by rock mass' with M.M. Wadden and P. J. Chernis at AECL Geotechnical Information Meeting, Ottawa, May 5-6, 1980.
- 'Isolation of nuclear fuel waste by the rock mass', Ottawa Geotechnical Group, January 13, 1981.
- 'Borehole logs interpretation, Pinawa site' at AECL Geophysics Workshop, Ottawa, February 12-13, 1981.
- 'Isolation of nuclear waste by the intact rock mass' lecture at Department of Civil Engineering, University of Ottawa, March 18, 1981.

A. Overton
- 'Intermediate reflection profiles' with J. R. Weber at American Geophysical Union, Toronto, May 26-27, 1980.

A. K. Sinha
- 'Electrical ground surveys at Chalk River' and 'EM surveys at URL site' presented at AECL Geophysics Workshop, Ottawa, February 12-13, 1981.

Membership on Committees

L. S. Collett
- Liaison Officer, IRAP Committee, National Research Council
- Member, Engineering and Groundwater Geophysics, Society of Exploration Geophysicists.
- Coordinator, Geophysics Committee, NEA/IAEA Athabasca Basin Test Study.

C. Gauvreau
- Deputy Chief, Building Emergency Officer.
- Member of Kuhring Prize Committee, NRC/Algonquin College, 1980-85.

J. A. Hunter
- Member, Joint Industry/Government Working Group on Permafrost and Gas Hydrates.
- Member, Permafrost Subcommittee of the NRC Associate Committee on Geotechnical Research.
- Member, Engineering and Groundwater Geophysics, Society of Exploration Geophysicists; chairman of Ad Hoc committee on Digital Recording Standards for Engineering Seismographs.

A. K. Sinha
- Member, Reviews Committee, Society of Exploration Geophysicists.

R. J. Sloka
- Member, GSC Safety Committee

Subdivision Productivity

9 Outside publications
3 Current Research
2 Open File Releases
12 Oral Presentations
4 AECL Reports
2 GSC Reports

TERRAIN SCIENCES DIVISION

J.S. Scott, Director

Introduction

Responsibilities of the Division are directed toward the provision of geoscientific data and interpretive information on the surficial geology and geomorphic processes of the Canadian landmass and for such geotechnical aspects of the bedrock geology as may have a bearing on engineering use of the terrain. Management responsibility and provision of administrative services to the EMR Program for Disposal of High-Level Radioactive Waste is also centred 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 Division is organized into five 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. Engineering Geology Section is responsible for studies of the engineering characteristics of geological materials for engineering or terrain use purposes although current activities are directed exclusively to the EMR Program for Disposal of High-Level Radioactive Waste. Geomorphic Processes 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.

At the end of the report-period the staff comprised 2 Research Managers, 21 Research Scientists, 15 Physical Scientists (3 term), 10 technical support (1 term) and 7 administrative support. Staff of the Division are based primarily in Ottawa with small operational units in Calgary at the Institute of Sedimentary and Petroleum Geology and in the Vancouver Office of the Geological Survey.

During the year the Division approved the following for G.S.C. publication: 1 Chart; 1 Paper; 1 Bulletin; 19 Maps; 2 Open Files; and 4 contributions to Current Research, 80-1 (Pt. C); 8 contributions to Current Research, 81-1 (Pt. A), and 4 contributions to Current Research, 81-1 (Pt. B). In addition 22 papers 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. Remedial work to eliminate seepages occurring in the vicinity of the Coldstream Ranch Well were completed by the installation of a 16 inch diameter casing screened into the principle aquifer. Credit is due to Loraine Morency for the assembly and compilation of much of the subsequent material in this report.

Personnel Notes

Division Headquarters consists of a permanent staff of 2 Research Managers, 1 Research Scientist, 1 Physical Scientist, and 8 support staff. The Unit also supported 1 contract project and 2 Research Agreements.

Attendance at Meetings, Conferences and Courses

B.R. Pelletier

Geological Association of Canada, Halifax, May 1980.

Atlantic Geoscience Society, Fredericton, January 1981.

J.S. Scott

IAEA Advisory Group on Site Investigation for Disposal of Radioactive Waste in Deep Geological Formations, Vienna, May 1980.

Joint Technical Program Committee Meeting, Geological Society of America, Boulder, Colorado, July 1980.

Geological Society of America Annual Meeting; participated as Session Chairman and Chairman-Elect, Engineering Geology Division; Atlanta, November 1980.

Membership on Committees

B.G. Craig

PC Classification Review Committee, Branch Representative

B.R. Pelletier

Intergovernmental Committee on Submersibles, Member

Maritime Sediments, Editor

Canadian Oceanographic Data System, Member

Lancaster Sound Regional Study Working Group, Member

Advisory Committee on Undersea Feature Names, Member

J.S. Scott

Departmental Committee for Research Manager Classification, Member

Engineering Geology Division, Geological Society of America, Chairman

NRC Associate Committee on Geotechnical Research, Member

Management Group for collective agreement between Treasury Board and Professional Institute for Scientific Research Group, Departmental Representative

Special Talks or Lectures

B.R. Pelletier

'Seabed sampling and features in the Canadian offshore', group of 4 lectures to the Hydrography II class, Canadian Hydrographic Service, Ottawa, November 1980.

'Beaufort Sea geomorphology' to the Geology Department, Memorial University of Newfoundland, St. John's, February 1981.

'Glacio-marine sedimentation' and 'Quaternary marine thermokarst' to the Quaternary geology course at Ottawa University, Ottawa, March 1981.

Quaternary Discussion Group

The Quaternary Discussion Group was chaired by L.D. Dyke prior to the appointment of A.S. Dyke in October 1980. The following papers were given during April 1980 to March 1981.

Dr. H. Saunderson, Wilfrid Laurier University, Waterloo — Paleohydraulics of structures in eskers.

Dr. B.R. Pelletier, Terrain Sciences Division, GSC, Ottawa — Geomorphic evolution of the Beaufort Shelf: a working hypothesis.

Dr. W.W. Shilts, Terrain Sciences Division, GSC, Ottawa — Interstadial marine episodes in southern Hudson Bay during the Wisconsin Glaciation based on amino acid dating of shell-bearing tills.

Dr. Jan Janssens, University of Alberta, Edmonton — Fossil mosses and their value in interpreting paleoenvironments.

Dr. G. Prichonnet, University of Québec, Montréal — Recent data on Quaternary events in southeastern Québec: stratigraphy, deglaciation, and water bodies.

Dr. J.R. Mackay, University of British Columbia, Vancouver — Illisarvik - an experiment in the growth of permafrost.

Dr. L.D. Dyke, Terrain Sciences Division, GSC, Ottawa — Rock heave in Arctic Canada.

REGIONAL PROJECTS SECTION

R.J. Fulton (Head)

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

- Quaternary geology and terrain inventory mapping in northern Manitoba was completed this year. Twelve 1:250 000 scale map sheet areas have been done in this region over the past five years. In addition to mapping the distribution of Quaternary deposits, data on the texture and composition of tills have been collected. Because there is little outcrop in the area these drift data are very important to bedrock and exploration geologists.

- Several boreholes were drilled in the area of thick disintegrated granite on Big Bald Mountain in New Brunswick. This was done to obtain samples and further data on the thickness and nature of these "weathered" materials. Controversy surrounds the origin of the disintegrated granite and its significance as an indicator of the nature of Quaternary events which affected the area. During initiation of this project, special techniques were developed to overcome the problems of maintaining circulation while drilling in porous rock without benefit of casing and with economical use of water.

- Mapping of the Dundas Peninsula of Melville Island was started and completed during the past year. This area is important from an engineering standpoint because it lies on the proposed route of the Polar Gas Y-Line for transporting gas from the north. In addition it is the site of the "Winter Harbour Moraine", one of the few glacial features in the Arctic islands that can be bracketed by finite radiocarbon dates. Stratigraphic data were obtained which will permit re-assessment of the significance of the "Winter Harbour Moraine". In addition, submergence limit data were obtained which show different tilts on the north and south sides of the peninsula.

- Surficial geology mapping of the Arnprior sheet was completed this fiscal year. This is the ninth area which has been mapped at a scale of 1:50 000 in the general Ottawa region. The distribution of materials indicated by this work should make it possible to arrive at a new understanding of the Quaternary history of the area. Radiocarbon dates resulting from this work are widely quoted as data which must be taken into account in all studies related to development of the Champlain Sea.

- Compilation of Quaternary map data for the Canadian parts of the Ottawa and Vancouver 1:1 000 000 map sheets (map of the world base) was completed. These maps will be published by the United States Geological Survey along with Quaternary geology maps for conterminous United States. The Geological Survey of Canada is co-ordinating compilation of data for Canadian parts of map sheets which lie astride the United States Border. Data have now been compiled for five of the eleven maps which contain significant areas of Canada.

Personnel Notes

The Regional Projects Section consists of a permanent staff of 11 Research Scientists and 4 Physical Scientists. The Section also supported 5 EMR Research Agreements and 2 contract proposals.

R.D. Thomas resigned from his position with the Division and the Federal Government in April 1980 to take a position with Terrain Analysis and Mapping Services, Ltd.

J-S. Vincent was granted the degree Docteur en Sciences after successfully defending his dissertation at the Université Libre de Bruxelles in June 1980.

Attendance at Meetings, Conferences and Courses

A.S. Dyke

Geological Association of Canada, Halifax, May 1980.

Presented a paper at the 10th Annual Arctic Workshop, Boulder, Colorado, March 1981.

D.R. Grant

Geological Association of Canada, Halifax, May 1980; leader of field excursion (Trip 9) in southwestern Nova Scotia.

INQUA Commission on the Genesis and Lithology of Quaternary Deposits; leader of Field Meeting in southwestern Nova Scotia, August 1980.

Presented a paper at the INQUA Shorelines Commission; NE European Subcommission, Field Conference on "Criteria for the Dating and Correlation of Shorelines", Glasgow, Scotland, September 1980.

M.F. Nixon

Sixth Guelph Symposium on Geomorphology, Guelph, May 1980.

J.J. Veillette

4th Annual Colloquium of AQQUA - Le Quaternaire du Québec, Québec City, September 1980.

J-S. Vincent

4th Annual Colloquium of AQQUA - Le Quaternaire du Québec, Québec City, September 1980.

Membership on Committees

J.J. Clague

INQUA Commission on Genesis and Lithology of Quaternary Deposits, Corresponding Member

INQUA Subcommission on North American Quaternary Stratigraphy, Member

INQUA Commission on Quaternary Shorelines, Subcommission for the Americas, Member

A.S. Dyke

INQUA Commission on Quaternary Shorelines, Subcommission for the Americas, Member

IGCP Project 24, Arctic Canada Working Group, Member

S.A. Edlund

Canadian Committee on Ecological Land Classification, Northlands Ecoregion Working Group, Member

R.J. Fulton

Quaternary Advisory Group to North American Commission on Stratigraphic Nomenclature, Member

Geological Survey of Canada Radiocarbon Dating Committee, Member

Working Group, UNESCO-IGCP Project 73/1/24, Member

Expert Committee on Soil Survey, Agriculture Canada, EMR Representative

N.R. Gadd

Conseil Scientifique, Géographie Physique et Quaternaire, Member

D.R. Grant

INQUA Shorelines Commission, Secretary

Canadian Quaternary Association, Secretary

NSERC Canadian National Committee for INQUA, Secretary

IGCP Project 24, Atlantic Provinces Subgroup, Leader

IGCP Project 61, International Working Group, Member

North American Working Group of the IAG Commission on Recent Crustal Movements, Member

Atlantic Provinces Soil Survey Co-ordinating Committee, Member

O.L. Hughes

Environmental Assessment and Review Panel, Alaska Highway Gas Pipeline Project, Panel Member

A.M. Stalker

Canadian Quaternary Association, Chairman

International Geological Correlation Program, IGCP Project 128, Member

INQUA Subcommittee on North American Quaternary Stratigraphy, Member

S.I.L. Working Group on "International projects on deep coring operations on relict lakes of the world", Member

J-S. Vincent

Association québécoise pour l'étude du Quaternaire, Président

Géographie physique et Quaternaire, Rédacteur adjoint

IGCP Project 24, Western Arctic Symposium, Leader

Special Talks or Lectures

J.J. Clague

'The use of geomorphology in the recognition and evaluation of natural hazards - an example from Yukon Territory' to the Geomorphology Class, Department of Geological Sciences, University of British Columbia, Vancouver, March 1981.

PALEOECOLOGY AND GEOCHRONOLOGY SECTION

W. Blake, Jr. (Head)

The work of the Paleoecology and Geochronology Section is mainly of a laboratory nature, but specialized field studies, such as the coring of lake sediments, are carried out by staff members. In 1980 field work was undertaken in: (1) Quebec and Ontario, (2) Yukon and Alaska, and (3) on Ellesmere Island and in Greenland. These field investigations, together with laboratory studies of previously collected samples, provide 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 gained of the rates at which the environment is changing and of the rates at which processes are occurring.

Highlights

- The Yukon Refugium Project, in which the Section continues to participate (especially with regard to fossil insects, plant macrofossils, and radiocarbon dating) is a major interdisciplinary study involving G.S.C. staff members as well as personnel from the National Museum of Man, the National Museum of Natural Sciences, the University of Alberta, and the U.S. Geological Survey. During 1980 a raft trip was made in Yukon and Alaska to examine critical sections.

- A second interdisciplinary project, also concerned with the extent of ice during the last glaciation, is focussed on the east coast of Ellesmere Island and at selected localities along the northwest coast of Greenland. Participants have come from the University of Helsinki, the University of Copenhagen, the Water Quality Branch (Environment Canada), and Queen's University. Studies of glacial history, fluctuations of sea level, botany, rock weathering, and climatic change (as deduced from the pollen record and lake sediments) are being carried out concurrently with archeological studies by the Arctic Institute of North America.

- A third area of emphasis involves palynological studies over a broad area extending from the Great Lakes to the Maritime Provinces. It is hoped that not only details of vegetation history will emerge from these investigations, but that cross-checking of radiocarbon dating between terrestrial and marine deposits will be possible. One of the chief aims of this project is to resolve certain chronological problems between the Champlain Sea, which formerly occupied the Ottawa-St. Lawrence Lowland, and the Great Lakes area.

- A major paleoecological study of diatoms from a site of probable interstadial age in southern Ellesmere Island has been completed. Attention continues to be focussed on a suite of samples from the Fraser River delta in British Columbia and on the general problem of lakes being affected by acid rain in Ontario and Quebec; in both cases diatoms provide information about changes in the environment.

Personnel Notes

The Paleoecology and Geochronology Section consists of a permanent staff of 4 Research Scientists, 2 Physical Scientists and 2 technicians. The Section also supported 3 EMR Research Agreements and 3 contracts.

J.A. Lowdon continued his half-time involvement with the EMR Program for Disposal of High-Level Radioactive Waste. Following the resignation of W.E. Podolak in November 1980, Mr. Lowdon also took supervision (on an interim basis) of the Division's Sedimentology and Engineering Geology Laboratories.

R.J. Richardson resigned from his position with the Division in January 1981 to take a position with the Alberta Geological Survey, a component of the Alberta Research Council, Edmonton.

Attendance at Meetings, Conferences and Courses

T.W. Anderson

Workshop of the Ontario Group of IGCP Project 158-B, Toronto, May 1980.

Meeting of the Canadian National Committee for INQUA, Quebec City, September 1980.

W. Blake, Jr.

Presented a paper at the Meeting of the NE North American Branch, International Glaciological Society, Montebello, Quebec, March 1981.

Membership on Committees

T.W. Anderson

Geological Survey of Canada Radiocarbon Dating Committee, Member

W. Blake, Jr.

Canadian Journal of Earth Sciences, Associate Editor

Holocene Sub-Commission for the Americas and Greenland (INQUA), Member

Geological Survey of Canada Radiocarbon Dating Committee, Chairman

Geological Survey of Canada Library Policy Committee, Member

J.A. Lowdon

Geological Survey of Canada Radiocarbon Dating Committee, Member

J.V. Matthews, Jr.

Beringian Committee, Member

AMQUA Council, Member

Scientific Committee for a Biological Survey of the Insects of Canada, Member

R.J. Mott

Branch Safety Committee, Member

Special Talks or Lectures

T.W. Anderson

'Paleoecological activities relating to climatic change' to the NMNS Climatic Change Project, Ottawa, December 1980.

W. Blake, Jr.

'Svalbard' to the Arctic Circle Club, Ottawa, March 1981.

Laboratory and Technical Services Statistics

Paleoecology

Reports completed:

Diatom	22
Fossil Arthropod	19
Palynological	13
Plant Macrofossils	26
Wood	46

Geochronology

Determinations completed:

Radiocarbon ages (GSC)	
Geological samples	188
Geochemical samples	13
Carbon 13-Carbon 12 ratios (University of Waterloo - contract)	169
Amino acid determinations (University of Alberta - contract)	11
Amino acid deterinations (University of Colorado - contract)	47

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

- Final compilation of surficial geology of Bylot Island was nearly completed. Careful mapping of maximum altitudes of carbonate erratics foreign to the Island has allowed calculation of the profile of the last major continental ice sheet to affect this Island. Unequivocal evidence has also been found to indicate that the ice cap native to the Island was not in contact with the maximum continental ice sheet at several locations, suggesting that it was not significantly more extensive than at present, even at the height of the last glaciation.

- The first phase of sampling of drift to evaluate effects of acid rain on the Frontenac Arch was completed. Over 900 drift samples have been analyzed for carbonate content and trace element concentrations. Glacial dispersal of Paleozoic erratics and fine grained debris has been responsible for spreading debris with high buffering capacity over much of the eastern part of the region. Significant natural arsenic anomalies have been found in the drift east of Mazinaw Lake and in the Marmora-Deloro area. These anomalies are reflected by modern lake sediment compositions determined some years ago in the same area.

- Several factors have been identified in the vegetation of the Thetford Mines area which lead to varying vegetation reflectivities that are detectable by manipulation of satellite imagery.

- Surficial geology compilation has continued in Keewatin under contract. Over 25 standard 1:250 000 NTS sheets are now completed at 1:125 000 scale.

- Over 1000 samples collected by geologists outside the Section were analyzed for trace-element content and added to the growing regional inventory of till geochemical properties for Canada. Of the samples analyzed, over 500 were collected during bedrock mapping projects and contributed by members of the Precambrian Division.

- Work continued on the geochemistry of peats, of small scale drift dispersal trains and the uranium geochemistry of modern lake sediments in Keewatin.

- Initial phases of the glacial erosion project funded by A.E.C.L. were completed in Keewatin and Québec by making estimates that average erosion depths during last glaciation were 2-6 m. Estimates were based on estimates of volume of debris glacially dispersed from distinctive outcrops divided by area of outcrops exposed to erosion.

Personnel Notes

The Sedimentology and Mineral Tracing Section consists of a permanent staff of 3 Research Scientists, 2 Physical Scientists, and 6 technicians. The Section also supported 2 contract proposals, 1 EMR Research Agreement and 1 NRC Visiting Fellow.

T.L. Gibbs joined the Division in June 1980 and is working in our Sedimentology-Engineering Geology laboratory.

W.E. Podolak resigned from his position with the Division and the Federal Government in November 1980 to take a position with G.M. Canada Ltd., Niagara Falls.

A.N. Rencz's Visiting Fellowship was terminated on August 31, 1980 at which time he was hired as a term casual until his resignation in January 1981 to take a position with Canada Centre for Remote Sensing.

Attendance at Meetings, Conferences and Courses

R.N.W. DiLabio

Presented a paper at the Canadian Institute of Mining and Metallurgy Field Trip re Gold, Val d'Or, Kirkland Lake, Timmins, September 1980.

W.W. Shilts

Presented an invited paper at the 82nd Annual General Meeting of the Canadian Institute of Mining and Metallurgy, Toronto, April 1980.

Presented a paper at the 9th Annual Arctic Workshop, INSTAAR, University of Colorado, Boulder, April 1980.

Presented a paper at the 4th Annual Colloquium of AQQUA - Le Quaternaire du Québec, Québec City, September 1980.

Attended the INQUA Commission on the Genesis and Lithology of Glacial Deposits field symposium, Yarmouth, Nova Scotia, August 1980.

Presented an invited paper at the Dreimanis Day Symposium, University of Western Ontario, London, Ontario, October 1980.

Attended the 6th Biennial Meeting of the American Quaternary Association, Orono, Maine, August 1980.

Presented papers at the CIM Geoscience Forum and at the Territorial Land Use Workshop, Yellowknife, N.W.T., December 1980.

Presented a paper at the 10th Annual Arctic Workshop, INSTAAR, University of Colorado, Boulder, March 1981.

Presented a paper at the 49th Annual Convention of the Prospectors and Developers Association, Toronto, March 1981.

Membership on Committees

J.R. Bélanger

Branch Computer Facilities Committee, Member

Terrain Sciences Divisional Computer Committee, Member

R.N.W. DiLabio

Branch General Instructions for Field Parties Committee, Member

Divisional Display Committee, Member

W.W. Shilts

INQUA Commission on Genesis and Lithology of Quaternary Deposits, Corresponding Member

INQUA, Working Group 9, Glacigene Deposits as Indicators of Glacial Movements, Member

International Geological Correlation Program (Quaternary Glaciations in the Northern Hemisphere), Member

Bilateral Research Consultation Group on Acid Rain (U.S.-Canada), Member

Acid Rain Research, Geological Survey, Co-ordinator

U.S.-Canada terrestrial effects work group - Acid Rain (LRTAP) negotiating committee, Member

Special Talks or Lectures

J.R. Bélanger

'Remote sensing studies in Terrain Sciences' to students and staff of the Department of Earth Sciences, University of Waterloo, Waterloo, October 1980.

'An environmental approach for remote sensing studies' to students of the Nova Scotia Land Survey Institute, G.S.C., Ottawa, November 1980.

W.W. Shilts

'Dispersal of debris by glaciers' and 'Drift prospecting in periglacial regions' to University of Toronto Workshop, Toronto, April 1980.

'Glacial sedimentation' to students of the University of Ottawa, Ottawa, February 1981.

'Principles of drift prospecting' to students of the Department of Geology, University of Alberta, Edmonton, March 1981.

'Economic aspects of glacial geology' to students of the University of Ottawa, Ottawa, March 1981.

Laboratories

Physical Sedimentation Laboratory, Tunney's Pasture

Production from this laboratory was back to normal after the moves of the past few years. It is operating at 3/4 strength because of the loss of the laboratory supervisor, which necessitated a shift of one person to the Drift Chemistry and Mineralogy Laboratory on Booth Street.

Yearly Report

	No. of Samples
Freeze Drying	868
Complete Sieve & Pipette	390
Gravel-Sand-Silt-Clay	653
Hygroscopic Moisture Content	1037
Atterberg Limits	203
Calcite/Dolomite Ratio	260
Total Carbonate (acid dissolution)	821
Munsell Soil Colour	197

Drift Chemistry and Mineralogy Laboratory

Work of this laboratory was hampered by the resignation of the laboratory supervisor who had carried out many of the tests previously done in this laboratory. Much of the work this year was in support of the acid rain project. Much effort is expended by both laboratories in establishing 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)	1810
Dry sieving to <64μm (for carbonate determination)	1450
Heavy Mineral Separations & Slides	200
Carbonate/non-carbonate carbon determinations (Leco carbon analyzer)	1930

ENGINEERING GEOLOGY SECTION

During the year the Section was involved exclusively in a major project to assist Atomic Energy of Canada Limited in determining the feasibility for disposal of high-level radioactive wastes in plutonic crystalline rocks.

Highlights

- Members of the Section contributed to the Radioactive Waste Disposal Program through co-ordination of field activities at Research Areas located at Chalk River and Atikokan, Ontario, Pinawa, Manitoba, and at the site for the new underground research laboratory at Lac du Bonnet, Manitoba, curation of diamond drill core obtained from Research Areas, and operation of a bore-hole television logging system.

Personnel Notes

The Engineering Geology Section presently consists of a permanent staff of 1 Research Scientist and 1 technician.

J.G. Bisson continued his duties as Chief, Building Fire Inspection Officer for the building located at 401 Lebreton Street, Ottawa.

E.B. Owen retired in September 1980 after a 34-year career with the Geological Survey of Canada. During the course of his lengthy career Mr. Owen undertook numerous assignments in engineering geology for other government departments and agencies such as St. Lawrence Seaway Authority, Department of Public Works, Northern Canada Power Commission and Water Resources Branch of Environment Canada and its predecessors.

Attendance at Meetings, Conferences and Courses

P.J. Kurfurst

13th Canadian Rock Mechanics Symposium, Toronto, May 1980.

Membership on Committees

P.J. Kurfurst

EMR/AECL Drilling Committee, Chairman

Underground Research Laboratory Project Management Committee, Member

Underground Research Laboratory Site Evaluation Subcommittee, Chairman

GEOMORPHIC PROCESSES SECTION

J.A. Heginbottom (Head)

The task of the Geomorphic Processes Section is to study the distribution, nature and rates of action of those surface and near surface processes that shape the Canadian land mass. Particular emphasis is placed on exogenic processes and on the study of processes in the permafrost environment of northern Canada. The work of the Section also includes studies related to resource development in the mountains of Western Canada and studies of fluvial processes. Facilities available in the Section include a cold room and an 18 m recirculating flume.

Highlights

- Continued field and laboratory study of frost heaving in bedrock has shown that greatest heave occurs in areas where a relatively deep active layer coincides with a water table close to the surface of an outcrop of jointed rocks. Even in undisturbed rock, a slight dilation takes place in response to excess water pressures.

- A system for visual recognition for terrain disturbance by tracked vehicles is being developed for use in the central low Arctic. The objective is a system simple enough that a vehicle operator can recognize a condition whereby further use of a route will cause unacceptable levels of disturbance and render the ground susceptible to continued erosion.

- Field work for the study of "mud-boil" patterned ground forms in Keewatin has now been completed. Evidence suggests that slope stability in mud-boil fields is enhanced by the presence of the vegetation network around the mud-boils. Slope stability is apparently decreased by changes in soil pH as well as by removal or destruction of the vegetation.

- Field work and aerial photograph interpretation for a terrain inventory map of the Nahanni map area in the Selwyn Mountains, YT and NWT, is largely complete. Surface markers on a large, ice-cored rock glacier near Tungsten, NWT, were relocated. These showed a typically glacier-like flow pattern to exist within the tongue of the glacier. The maximum surface movement determined was 51 m in 17 years.

Personnel Notes

The Geomorphic Processes Section consists of a permanent staff of 1 Research Scientist and 3 Physical Scientists. The Section also supported 2 contract proposals.

T.J. Day resigned from his position with the Division in August 1980 to take a position with the Inland Waters Directorate as Head, Sediment Survey Section.

Attendance at Meetings, Conferences and Courses

T.J. Day

Presented a paper at the Conference on Engineering Problems in the Management of Gravel-bed Rivers, Wales, U.K., June 1980.

L.D. Dyke

Presented a paper at the Arctic Land Use Research Colloquium, Winnipeg, October 1980.

Presented a paper at the Territorial Land Use Workshop, Yellowknife, November 1980.

Presented two papers at the CIM Permafrost Workshop, Yellowknife, December 1980.

J.A. Heginbottom

Public Hearings by EARP Panel, Arctic Pilot Project, Resolute Bay, April 1980 (Technical intervener).

Public Hearings by EARP Panel, Norman Wells Development Project, Yellowknife, August 1980 (Panel member).

Public Hearings, Polar Bear Pass Ecological Site, Ottawa and Yellowknife, September 1980 (Panel member).

Fourth Canadian Permafrost Committee, Calgary, March 1981 (Member of organizing committee).

L.E. Jackson, Jr.

Slope Hazards Workshop and Field Conference on northern Vancouver Island, sponsored by the British Columbia Ministry of the Environment, April 1980.

Membership on Committees

L.D. Dyke

Branch Christmas Party Committee, Chairman

J.A. Heginbottom

Permafrost Subcommittee, NRC Associate Committee on Geotechnical Research, Member

Working Group on Ground Ice, International Commission on Snow & Ice, Member

Commission on the Significance of Periglacial Phenomena, International Geographical Union, Corresponding Member

Terrain Sciences Division Display Committee, Chairman

Interdepartmental Working Group on Proposed IBP Ecological Sites, Member

L.E. Jackson, Jr.

I.S.P.G. Library Committee, Member

I.S.P.G. Safety Committee, Member

Organizing Committee, Member; Field Trips Subcommittee, Chairman

International Conference on Palynology 1984, Member

Special Talks or Lectures

L.D. Dyke

'Damage to home foundations due to downhill creep in expansive soils' to the Ottawa Geotechnical Group, Ottawa, December 1980.

'The influence of sedimentary facies changes on rock deformation' at the Earth Physics Branch, Ottawa, January 1981.

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(to March 31, 1981 as supplied by reporting units)

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