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Résumé de l'article

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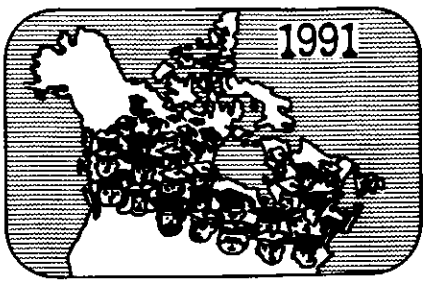

The Next Decade of Earth Science Research In Canadian Universities: Proceedings of the Earth Science Workshop, 1981

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Summary
A workshop on university earth science research was held in Ottawa, January 1981. The meeting, partly sponsored by NSERC was attended by about 100 earth scientists.

Perhaps the most impressive result of the workshop was the spirit of cooperation of the participants and the expression of concerns that if we are to improve our science on the national and international scenes, then we must coordinate efforts as far as possible and as rapidly as possible. There is a great need for increased funding levels in the science but a widely held view was that this may be achieved best by establishing some large projects (mega-projects) which will integrate efforts from a large spectrum of members of our community and which will lead to "state of the art" conclusions on problems of vital concern to our science and to national objectives in mineral resources. Examples of the types of projects considered were three dimensional studies of the crust (lithoprobe), sedimentary basins and continental margins.

It was recognized that universities cannot do the job alone but there should be a coordinated effort from government, industry and the universities. But universities have a unique role to play in that a large population of intelligent young people are available to work on new thrusts and be trained in exciting science. Universities also have wide ranging facilities which can be turned to such mega-projects. The general feeling of the participants was that project selection and fund raising should be coordinated through the Geoscience Council of Canada with each group doing those parts of the projects for which they were uniquely suited.

Other important conclusions of the workshop were that there is need for increased effort in mineral resources, research in the North and environmental studies. Concern was expressed over the small number of the new senior research fellowships being awarded in our science. It was also agreed that Canada should and must take part in international research in drilling in the ocean margins and that there is urgent need to review the status of present and future research involving Canadian ships for marine research.

Finally Fyfe notes the large degree of agreement on areas of concern which resulted from the St. Jovite meeting of EMR and the report of the Canadian Committee for the Dynamics and Evolution of the Lithosphere which appear in this volume.

Proceedings of the Workshop
At Halifax, In May 1980, a meeting of the Council of Chairmen of Canadian Earth Science Departments (CCCESD) decided that a Workshop should be held on Earth Science research in Canadian Universities. It was recognized that research in Universities cannot be separated from research by Government and Industry, but there is a need to examine the University effort separately, as well as considering integrated national programmes. The Earth Sciences play a vital role in Canada's social and economic affairs, which is not adequately reflected by present levels of funding. The Universities are an essential component of geoscientific activity; they provide the skilled manpower and much of the fundamental research on which more applied studies are based. Earth Scientists at Canadian Universities should therefore take the initiative to plan long-term research and, together with government and industrial colleagues, seek additional funding for approved projects.

W.S. Fyfe (U. Western Ontario; then Chairman, CCCESD) and B.R. Rust (U. of Ottawa) were nominated to organize the Workshop. Once approval and partial financial support had been obtained from the Natural Sciences and Engineering Research Council (NSERC), they solicited comments from all NSERC grant holders in the Earth Sciences, and from departments, via their Chairmen. Based on the comments received, Fyfe and Rust appointed eleven group leaders to take charge of discussions during the Workshop. The group leaders received copies of submissions relevant to their fields, and they invited participants to make up their groups. Chairmen of Earth Science departments were also invited. The Participants at the Ottawa Workshop are given in Appendix 1.

The Workshop took place at the University of Ottawa on 23-25 January, 1981. Group discussions took place on the 24th, resulting in group reports, which were typed, duplicated and made available to participants the same evening. On the 25th each group leader presented the outlines of his group's conclusions, and discussion of each report followed. A list of proposals put forward by the groups is included here as Appendix 2. It was approved that Fyfe should report the preliminary results to the next meeting of the Geoscience Council.

An initial report on the Workshop was circulated to all the above participants for further comment. Reflecting the nature of the Workshop, the initial report was mainly an integrated statement of topics discussed, leaving many conclusions to be drawn later. After receipt of comments, a revised report was sent to all NSERC grantees in Earth Sciences, and to Department Chairmen. The revised report emphasized issues to be addressed at a meeting on May 13 at the University of Calgary. This meeting was open to all geoscientists, and was preceded by a meeting of CCCESD, who made recommendations to the open meeting. The topics emphasized were: (1) Major New Projects, (2) Strategic Grant Categories, (3) Major Field Logistics, (4) University Research Fellowships, (5) The Earth Science Grant Selection Committee of NSERC and (6) Research Centres.

Major New Projects
It was unanimously agreed that funding be sought for one or more major new research projects. Several principles were established:

1) The new funding must be additional to established programmes: Operating, Strategic Grants, etc.
2) The project(s) should be applied to geoscience problems in Canada, and should have long-term benefit to Canada. This country has unique contributions to make to the Earth Sciences because of its northern terrane, extensive shield exposure and continental margins.

3) The project(s) should involve as many discipline groups as possible, and should combine the efforts of University, Government and Industry geoscientists.
4) The project(s) should adopt new approaches, not previously tried elsewhere. Separately funded feasibility studies should precede project implementation.

There is no doubt that project Lithoprobe is now in the most advanced stage of study because of the work of the Canadian Lithosphere committee (see report in this issue).

Strategic Grants
The meeting recommended that NSERC establish additional categories for Strategic Grant funding. After discussion, it was agreed that Mineral Deposits and Northern Development be proposed as new categories, and that Environmental Toxicology be expanded to include a wider range of Environmental Studies. The meeting regarded this proposal as entirely separate from the Major Project proposal outlined above.

Major Field Logistics
A subcommittee of NSERC is studying the need for special funding to support the costs of field work in remote areas. The meeting strongly endorsed this move, and encouraged researchers to indicate such costs on Operating Grant applications in the meantime.

University Research Fellowships
The meeting strongly endorsed the present NSERC initiatives but the meeting recommended that NSERC make two changes in its procedure for awarding these fellowships: (1) Applications be screened by discipline sub-committees. (2) Fellowships be awarded to various disciplines in proportion to the basic funding of these disciplines as long as candidates of appropriate calibre are identified by the screening committee.

Earth Science Grant Selection Committee
The meeting recommended that: (1) The committee not be split; (2) The committee not be expanded significantly.

Research Centres
The meeting recognized the problem that faces NSERC in the need to rationalize funding of equipment and other resources into regional centres. The University Earth Science Community is willing to cooperate with rationalization. NSERC could help by providing a list of equipment held at Universities, with an indication of those installations where outside work may be undertaken.

A Proposed Mechanism for the Introduction of Major Projects
The following timetable was agreed for the choice, assessment and implementation of major new project(s): (1) A committee be established by the Canadian Geoscience Council by August 1, 1981, with the following suggested representation: Federal government (3); Provincial governments (3); Universities (3); Industry (3). (2) Projects are hereby solicited, to be submitted to the CGC committee by October 15, 1981. Two projects were discussed during the Ottawa Workshop, i.e. Lithoprobe (see following article) and Continental Margin Studies (see Appendix 3). Others will receive equal consideration. (3) The committee prepares a draft proposal with a priority list by December 1981. It appoints separate committee(s) of experts to make six month feasibility study of chosen project(s). (4) June 1982. Project(s), supported by detailed feasibility studies are submitted to government agencies for funding.

There was much discussion on the nature of funding for a project costing perhaps $30 million. The concensus was that best results would be achieved if efforts of Industry, Universities and Government agencies were integrated, with University funding coming through NSERC, and EM&R funds through direct Government channels.

Appendix 1: Participants of the Ottawa Workshop

NSERC representatives:
Dr. T. Ingraham, Director of Programmes
Dr. J. Lillycrop

General Group: Leader: C.R. Barnes (Waterloo)
W. Fyfe (Western Ontario)
B. Rust (Ottawa)
G.V. Middleton (McMaster)
A.J. Baer (Ottawa)
J. Malpas (Memorial)

Paleontology: Leader: G. Norris (Toronto)
W.G. Caldwell (Saskatchewan)
R.L. Carrol (McGill)
O.A. Dixon (Ottawa)
R.J. Elias (Manitoba)
C. Stearn (McGill)
R. Stockey (Alberta)
A.C. Lenz (Western Ontario)
J.P. Noble (New Brunswick)
C. Rodriguez (Windsor)
B.D. Chatterton (Alberta)

Physical Geography/Quaternary: Leader: H.M. French (Ottawa)
M. Church (British Columbia, and represented Simon Fraser)
D. Ford (McMaster)
B. McCann (McMaster)
J. Davis (McMaster)
J. Gardner (Waterloo)
B. Kay (Guelph)
W. Chesworth (Guelph)
P.G. Johnson (Ottawa)

Geotechnical: Leader: R.M. Quigley (Western) deputised by D. Shields (Manitoba) at Workshop
D. Eisenstein (Alberta)
L. Finn (British Columbia)
D. Fredlund (Saskatchewan)
B. Landanyi (Ecole Polytechnique)
G. Lefebvre (Sherbrooke)
R. Mitchell (Queen's)
P. Selvadurai (Carleton)
J. Gale (Waterloo)

Marine Geoscience: Leader: D. Piper (Dalhousie)
P. Wangersky (Dalhousie)
J. Hall (Dalhousie)
P. LeBlond (British Columbia)
W. Denner (Memorial)
R. Hesse (McGill)
B. Greenwood (Toronto)
B. Sundby (U. Québec, Rim.)

Sedimentology/Stratigraphy: Leader: R.G. Walker (McMaster)
J.A. Donaldson (Carleton)
H. Hendry (Saskatchewan)
M. Desjardins (INRS-Pétrole)
G.V. Middleton (McMaster)
P. Schenk (Dalhousie)
A.D. Miall (Toronto)
J. Lajoie (Montreal)

Structure/Tectonics: Leader: P.F. Williams (New Brunswick)
T. Calon (Memorial)
G. Borradaile (Lakehead)
M. Stauffer (Saskatchewan)
J. Starkey (Western Ontario)
G. Ranalli (Carleton)
C. Hubert (Montreal)
W.K. Fyson (Ottawa)

Geophysics: Leader: D.I. Gough (Alberta)
E.R. Kanasewich (Alberta)
C.R. Beaumont (Dalhousie)
A.E. Beck (Western Ontario)
R.M. Clowes (British Columbia)
D. Dunlop (Toronto)
Z. Hajnal (Saskatchewan)
D.H. Hall (Manitoba)
D.W. Oldenburg (British Columbia)
R.D. Russell (British Columbia)
D.W. Strangway (Toronto)
C.F. West (Toronto)
D.T.A. Symons (Windsor)
P. Vaníček (New Brunswick)
W.H. Cannon (York)

Mineral Deposits: Leader: G. Perrault (Ecole Polytechnique)
D. Assad (Laval)
R.W. Hutchinson (Western Ontario)
A.J. Sinclair (British Columbia)
F. Langford (Saskatchewan)

Petrology/Mineralogy: Leader: P.L. Roeder (Queen's)
G. Skippen (Carleton)
G. Woussen (U. Qué., Chicoutimi)

M. Fleet (Western Ontario)
J. Nicolls (Calgary)
R. Martin (McGill)
B. Clark (Dalhousie)
Geochemistry: Leader: H.J. Greenwood (British Columbia)
C.M. Scarfe (Alberta)
J.R. Kramer (McMaster)
H. Schwarcz (McMaster)
I. Nicol (Queen's)
I. Hutcheon (Calgary)
C. Brooks (Montreal)
G. Anderson (Toronto)
W. Nesbitt (Western Ontario)
S. Kumarapeli (Concordia)
W. Jolly (Brock)

Appendix 2 Summary of proposals made by each discipline group during the Ottawa Workshop

(1) Geochemistry

a) The group indicated acute need for improved instrumental analysis, and stressed the need for one or more major, integrated, regional studies. These should be comprehensive, of crustal scale, and involve all aspects of Earth Science from geophysics and geochemistry to sedimentology and paleontology.

b) A similar integrated study of surficial deposits, to include geochemical aspects such as: surface and ground water chemistry, soil and weathering processes, exploration geochemistry and environmental toxicology.

c) Geochemical aspects of the sea and large lakes: marine geochemistry, seabed mining, sea/sea-floor interaction; water chemistry of lakes and rivers; natural and commercial evaporites; waste disposal and nutrient cycling.

d) Planetary studies should not be neglected, but could be pursued largely through collaboration with non-Canadian organizations.

e) Experimental determination of fundamental geochemical parameters must be maintained. Knowledge of basic thermodynamic, thermochemical and kinetic constants is essential for quantitative understanding of geochemical processes.

(2) Geophysics

a) The group suggested, and gave strong support for Project Lithoprobe. Two smaller, but still major projects were proposed:

b) Measurement of present-day crustal motions and planetary dynamics by very long baseline interferometry.

c) Establish a pool of major geodetic equipment, e.g. Global Positioning System receivers.

(3) Geotechnique

Research needs were identified to solve engineering problems, and to develop geotechnical processes, for example:

a) Physical properties and behaviour of frozen soils need researching in order to design storage embankments and marine facilities founded on permafrost.

b) Foundation behaviour in poor ground conditions, with particular emphasis on impoundment dams.

c) Field observations of tunnel behaviour.

d) Geotechnical and hydrogeological aspects of waste disposal, including mine and nuclear wastes.

e) Understanding and improving low permeability characteristics in oil and gas reservoirs.

f) Improving efficiency and recovery in underground mining by use of back fill (which also alleviates surface waste problems).

g) Seismicity in relation to pipelines and offshore structures.

h) Behaviour of offshore structures (dynamics, soil-structure interaction).

i) Behaviour of rocks and soils (including tarsands) at high and low temperature.

(4) Marine Geoscience

Canadian University geoscientists could make a special contribution to several projects: sea-ice dynamics; iceberg scour; continent-ocean transform margins; aseismic subduction.

Canada missed great opportunities by not contributing to the Deep Sea Drilling Project; it will lose even more if it stays out of the Ocean Margin Drilling Project. It was therefore recommended that NSERC contribute to the costs required to join OMDP, so that drilling sites may be chosen in the continental margin off Canada.

Lack of ship time is a major problem. To alleviate it, the following were recommended:

a) NSERC press for an accelerated research ship-building programme.

b) NSERC seek formal representation on bodies responsible for the allocation of ship time.

c) NSERC investigate providing increased ice-breaker time for oceanographic research.

Oceanic equipment is very expensive, and easily lost. Positioning is another problem. It was recommended that NSERC:

d) Develop cooperative arrangements with Government agencies to contribute to the capital cost of major sea going equipment (<$100 K) in exchange for guaranteed University priority use of such equipment for part of the year.

e) Support greater accessibility to remote sensing data for the University community, and also make representations to the U.S. Government that the degradation of GPS accuracy for civilian uses be minimized.

f) Adopt a policy of automatically replacing NSERC-funded equipment lost or damaged on cruises, with certain provisos.

(5) Mineral Deposits

The group stressed the need for an integrated effort to understand the total geological picture of areas in which ore bodies occur. Suitable areas include the Selwyn basin, the Abitibi greenstone belt or the Athabasca basin. Another approach is to investigate concepts important to mineral deposition, such as:

a) Hydrothermal-hydrologic systems using isotope geology, fluid inclusions and studies of seafloor hydrothermal circulation.

b) Subaqueous exhalative processes, which are important to base metal concentration in various geological environments.

c) The study of ore deposits in relation to processes which have changed at various stages of the Earth's development, such as iron formations, uranium deposits, etc.

(6) Mineralogy/Petrology

a) The group advocated major integrated studies of orogenic belts, to include deep crustal seismology, structural geology, stratigraphy, petrology and metallogeny.

b) They echoed the concern of the geochemists for fundamental research on the physics and chemistry of earth materials (see (1) e) above). Studies should include surface properties and atomic structures.

c) Experimental mineralogy and petrology should be encouraged, including research on amorphous substances (liquids, glasses and metamict materials).

(7) Paleontology

The group identified research needs in several fields:

a) Improved taxonomy as it is an essential prerequisite for all other aspects of paleontological research.

b) New models of evolution, postulating rapid macro-evolutionary change followed by stasis, need to be tested against high precision biostratigraphic data from continuous sections.

c) The influence of ecology on fossil ranges needs to be better understood through studies of organism-sediment relationships.

d) The understanding of regional paleogeography with good time control is needed to assess the role of migration in changes of biota.

e) Inter-continental comparisons are needed to detect world-wide influences on biotal change.

f) The relationship between paleontological data and the geochemistry of fossils and enclosing sediments can yield important environmental information.

g) Studies of continuous cratonic to oceanic sequences and epicratonic basins using surface data and deep cores will be critical for solving the problems outlined above.

(8) Physical Geography/Quaternary
The group identified need for research in the following areas:

a) Observed and projected effects of atmospheric pollutants on climate. The effect of cities on climate.

b) Slope instability, shoreline erosion, sediment mobility of rivers and coasts.

c) Natural climatic, hydrologic and glaciologic fluctuation.

d) Nutrient cycling by farming and forestry.

e) Refining and applying new methods in Quaternary dating to extend the oceanic record on to the continents.

f) Remote sensing.

The group also expressed concern over the problems of field work in the North, where environmental systems are unique, and vulnerable to severe damage by permafrost and other effect. Canada should be making a major effort in this region, but is falling short in many respects.

g) Problems related to pipeline installation, agriculture and settlement in the North.

h) Studies of Arctic hydrology, climatology and muskeg.

(9) Sedimentology/Stratigraphy
Research topics were identified as follows:

a) Studies of basins in relation to plate tectonics and geochronologic dating and paleomagnetic stratigraphy.

b) Studies in relation to accumulation of hydrocarbons, coal, ore deposits and industrial minerals.

c) Studies of diagenesis in relation to basin analysis, low temperature geochemistry, and to hydrocarbon and metal accumulations.

d) The integration of facies models for various modern and ancient depositional environments.

e) The regional and global correlation of events by seismic stratigraphy. These require better definition, using biostratigraphic methods within the megafacies depositional model approach.

f) Experimental work should be expanded, especially that using prototype-scale hydraulic monitoring in coastal and shallow marine areas.

g) Work on recent sediments should be expanded in collaboration with geomorphologists and marine geoscientists.

h) A need for integrated research on basin analysis. The group suggested the creation of a Research Centre for this purpose.

(10) Structure and Tectonics
The group identified a need for structural input into a variety of geological problems from petrology to mineral deposits. Plate tectonics is central to much of our understanding of geological processes, but more research is needed on rock deformation. Three approaches should be followed:

a) Observation of deformed rocks in the field and by use of modern tools, including SEM and STEM.

b) Experimental deformation of rocks, minerals and analogues.

c) Analytical and scale modelling of rock deformation.

Appendix 3
Major Projects already outlined

(1) Project Lithoprobe. (see following article)

(2) Continental Margin Studies. The extent of Canada's continental margin makes it an obvious target for major research projects. Much of it is ice-bound, requiring different technology from the Ocean Margin Drilling Program under development in the U.S. A drilling ship with ice-breaking capacity would be very expensive, and could only be developed jointly by Industry, Government and the Universities. Nevertheless, it could have major socio-economic impact on the national energy situation, and would also complement the OMDP. It might therefore be used as a bargaining point to gain access for Canadian scientists to OMDP at reduced cost. As with Lithoprobe, continental margin drill core would provide research material for a wide range of Canadian geoscientists.

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