

## **Geophysical Union at Quebec City, 1976**

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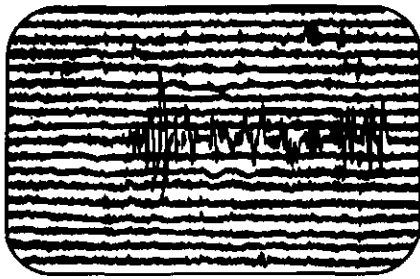
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## Canadian Geophysical Union at Quebec City, 1976

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### Introduction

The Canadian Geophysical Union (CGU) meeting was held in Quebec City from June 13th to 17th, 1976 in conjunction with the joint congress of the Canadian Association of Physicists, the American Physical Society and the Sociedad Mexicana de Fisica. The participants were accommodated in part at the University residences and in part in hotels. Almost all aspects of pure and applied geophysics were dealt with at this meeting with the exception of radiometric methods. This is explained by the fact that radiometric methods were widely discussed at the Canadian Institute of Mining and Metallurgy meeting which was held in April (also in Quebec City).

The technical program included a one-day symposium on electromagnetic methods of exploration, two half-day sessions on paleomagnetic results from North America, a half-day session on mathematical geophysics, a half-day symposium on physical properties of the lower continental and oceanic crust, a half-day session on trends in modern geodesy and a very varied general geophysics session.

### Electromagnetic Methods (EM) of Exploration

The use of airborne single or multifrequency EM systems of mapping resistivity and thickness of surficial

layers was discussed by three specialists (Becker, Fraser and Pitcher) while Barringer showed the advantages of a digital time domain airborne EM system for low level high resolution surveys and West stressed the importance of using numerical models to better understand EM prospecting interpretation problems. The capability of Very Low Frequency (VLF) methods applied to the mapping of permafrost and gold bearing structures was demonstrated by Powell and Middleton respectively. Dowsett indicated the relative advantages and disadvantages of the vertical and horizontal loop EM methods under Canadian Precambrian conditions. Dyck presented instructive applications of EM methods in boreholes and Ghosh a new multi-spectral EM system used to determine the stratification in the ground. McNeill presented the theory and some case histories of EM non-conducting ground conductivity mapping and Lamontagne the application of transient EM methods. Camfield pointed out the use of EM induction method via a magnetometer array and Gough indicated crustal conductivity anomalies related to major zones using a similar magnetometer array. Several mapping surveys in salt mines using radar waves were presented by Unterberger. Strangway concluded this symposium; after remarking that the whole EM frequency spectrum (ELF to radar) had been discussed, he suggested additional recent EM applications which were not mentioned in this symposium (e.g., earthing for antenna design, cryogenic systems for high stability and high sensitivity detectors, electromagnetic soundings in relation to geothermal and environmental problems, use of low ELF emitting stations such as the Sanguine Experiment (76 Hz).

### Paleomagnetic Results from North America

The presentation of the papers in this session was set in chronological order, i.e., from the oldest rock units to the youngest. There were two papers related to Archean paleopole positions (Londry in Noranda, Dunlop in N. W. Ontario), eight papers to Proterozoic paleopole positions (Morris' compilation, Seguin in Labrador Trough, Goodacre in Grenville of N. E. Quebec, Halls in N. Michigan, Pesonen in Michigan, Merz

in Grenville of S. Ontario, Schwarz in Sudbury and Cavanaugh's compilation in the U. S. A.), three Early Paleozoic paleopole positions (Lapointe, Deutsch and Rao, all in Newfoundland) one study on Carboniferous sediments (Roy in New Brunswick) one on Quaternary sediments in British Columbia (Evans) and two on recent volcanic oceanic rocks (Plasse).

The definition of the apparent polar wander path in Archean and Proterozoic rock units is often obscure due to the technical difficulties encountered in distinguishing and separating primary magnetizations and subsequent over-prints. The paleomagnetic results obtained from Lower Paleozoic rock units from Newfoundland suggest the absence of a post-Cambrian rotation of western Newfoundland. Finally, polarity reversals in oceanic basement rocks and geomagnetic excursions in recent sediments were reported.

### Physical Properties of the Lower Continental and Oceanic Crust

In the first paper, Fricker defined the lower crust-upper mantle boundary by measurement of wave group velocities. Beaumont (Dalhousie) determined the rate of isostatic adjustment of the Sverdrup basin to sediment loading. Fountain (Montana) pointed out that seismic velocities of rock sequences are compatible with known cross-sections of the ophiolites and associated metamorphic rock types. Keen (Dalhousie) reconsidered the significance of seismic work and bathymetry upon the crust and uppermost mantle of the mid-Atlantic ridge. Clowes (Univ. of B. C., Vancouver) discussed travel-time and amplitude interpretation of a marine seismic survey in the Explorer Ridge region (NE Pacific). Chapman (Univ. Michigan) investigated variations in lithospheric thickness through the use of steady state heat flow-heat production models. Carmichael (Michigan State Univ.) stressed the influence of high pressure on the magnetic properties of the crust and upper mantle. Purdy (Woods Hole) made a review of the seismic properties of the oceanic crust.

### Mathematical Geophysics

In this session, the following topics were presented:

- Application of asymptotic ray theory to seismic body waves in anisotropic media (Hron, Univ. of Alberta)
- Resonance absorption of gravitational radiation in the Earth's crust (Jensen, McGill)
- Current trends in Canadian seismic risk analysis and their uncertainties (Weichert, EPB, Ottawa)
- Deformation of porous clastic solids (Withers, Univ. of Alberta)
- A variational approach to shear heating (Spanos, Univ. of Alberta)
- A variational approach to long period Earth oscillations (Smylie, York)
- The thermal regime of downwarped lithosphere and the effect of varying the subduction angle (Jones, Univ. of Alberta)
- Gravity zoning of Newfoundland (Miller, Memorial).

The contributions and attendance of graduate students in geophysics (in particular the Univ. of Alberta group) was a welcomed innovation of this session.

### Modern Trends in Geodesy

Variations in gravity due to seasonal ground-water movements in two coastal areas of Eastern Canada were reported by Beaumont. Nyland stressed the importance of repeated geodetic survey for geophysical ends and reported on a geodetic survey used to monitor tectonic measurements in the Peruvian Andes. Gagnon presented an analysis of step by step adjustment procedures for large horizontal geodetic networks. The use of long baseline interferometers as a means of testing the theory of relativity and for geodetic and astronomic measurements was described in two presentations (Cannon). Bower showed the response of an aquifer to an earthquake. John indicated how geoid determination is obtained from astrogeodetic, gravimetric and Doppler satellite data. Lachapelle showed how the determination of deviations from the vertical can be obtained using geodetic data of heterogeneous type and Leclerc explicated the problem of the definition of the vertical coordinate in geodesy.

### General Geophysics

This very tight session included such topics as geomagnetic field, seismic methods and seismicity, terrestrial heat flow and gravity.

Concerning the magnetic field, the presentation of an analytical representation of the geomagnetic field in Canada at year 1975 (Newitt) was followed by an example of subsurface mapping of the Appalachians of Southern Quebec using aerial magnetostatic field data (Seguin). Applications and advantages of a SQUID gradiometer to airborne geomagnetic measurements were discussed by Vrba.

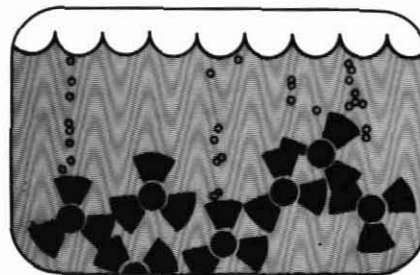
Keith discussed the behaviour of seismic body waves in anisotropic media synthetic seismograms. Using surface waves data, a model of the upper mantle of southern British Columbia was constructed (Wickens). Kunz (New Mexico Univ.) generalized the calculations of Goss-Hänchen shift to apply to a shock-wave type of moving interface. Leblanc reported on 1974 microseismic data from the La Malbaie-Baie St-Paul area and Hearthy on the slowness and azimuth measurements from a temporary array of the same region. Induced seismicity was predicted in the recent Manic 3 dam site. Anglin discussed the nature of the microseismic events.

Hamza (Univ. São Paulo, Brazil) pointed out the relation between heat flow and heat generation through lower continental and oceanic crust; he established a unified interpretation of the dependence on tectonic age. A gravity study of the Manicouagan large circular structure in Eastern Quebec suggests a meteorite impact origin rather than the eroded remains of a resurgent caldron (Sweeney). Finally, Schloessin commented on permanent deformation of the lithosphere by solid Earth tides.

This meeting turned out to be a very interesting one. Many informal exchanges and discussions during, between and after the sessions were the highlights of the congress. The large variety of topics and the high quality of the presentations definitely contributed to this success; the response of the audience was instantaneous.

Abstracts of most of the contributions to this meeting may be found in *Physics in Canada* (v. 32, no. 3) or *Bulletin of the American Physical Society* (v. 21, no. 5, May issue).

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## The Disposal of High Level Nuclear Waste in the Oceans

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### Preamble

A workshop to consider the feasibility of using the sea-bed as a disposal site for highly radioactive nuclear waste was held at Woods Hole, Massachusetts, February 16 to 20, 1976. It was sponsored by the United States Energy Research and Development Agency (ERDA) and Nuclear Energy Agency (NEA) which functions within the Organization for Economic Co-operation and Development (OECD). Canada is a full member of NEA.

The meeting was attended by 37 scientists and observers from Australia, Canada, France, Federal Republic of Germany, Japan, United Kingdom, and United States. All the basic disciplines involved with ocean studies were represented, including engineering and waste management.

In his welcoming remarks Dr. F. Frosch, Associate Director of the Woods Hole Oceanographic Institution emphasized that with diminishing deposits of hydrocarbons as a source of energy, nuclear power will be used until other schemes are developed. However, there are problems with toxicity and the storing of radioactive waste that are not very appealing, not at least to the public. The multiple barrier concept, whereby the waste is sealed off from man by rock or sediment is geologically satisfactory. On the other hand, ocean water alone, regardless of depth, is a poor barrier. However, some countries have fewer