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The Ocean 74 Conference

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Résumé de l'article

Ocean 74, the fifth IEEE International Conference on Engineering in the Ocean Environment, was held in Halifax, Nova Scotia, August 21 to 23, 1974, under the chairmanship of Ï. Ê. Gashus of Nova Scotia Technical College. This was the first time that the annual conference was held outside the USA. 529 people from many different countries attended: 125 papers by authors from 10 different countries were presented.

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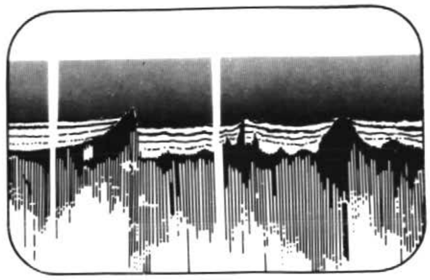
The conference proceedings were made available prior to the conference and this appeared to stimulate discussion periods after each paper.

terrain. A description is given of the pulse system. The dominant frequency of the pulse appears to be about 100 Mhz with significant lower-frequency components. Tests were made at two sites and although the results were not too conclusive, it did point out inherent difficulties in using high frequency EM reflections to delineate massive ice. The tests were carried out when the active layer was present. It is felt that such work, carried out when the active layer is frozen, offers some reasonable chance of success.

The fourteenth and final paper in the symposium describes the "Use of wireline well log information to determine the presence of permafrost" by E. T. Connolly. Thanks to the efforts of the Canadian Well Logging Society, information on well logs has been standardized. Information on temperature borehole logs include the bottom-hole temperature, the temperature when each logging device entered the borehole, the time circulation stopped, the time drilling stopped, the time the tool was on bottom, the temperature observed by a maximum-reading thermometer plus the temperature recorded on the run. With these data, an accurate time-temperature plot can be determined. By combining data from several logging runs at different depths in a well bore, and plotting them against time, one can establish a fairly accurate geothermal gradient for a particular location. Then, by extrapolating this temperature gradient back to the mean annual ground temperature for the location, the depth of permafrost can be estimated at the point at which the temperature gradient crosses the 30° to 32°F temperature point on the plot. Resistivity and sound velocity wireline logs exhibit high values in perennially frozen ground. Unfortunately, the borehole does not have frozen material or soils in its immediate vicinity due to a thaw zone as a result of the drilling. The result is to distort the resistivity and velocity log readings, so that the detection of the base of permafrost tends to be distorted by these methods. Recently logging firms have begun to use normal resistivity spacings in the order of twenty feet to detect the presence of permafrost at a further distance from the well hole. A combination of wireline well logs now make it possible to determine the presence and depth of permafrost in arctic wells with reasonable accuracy.

On the last evening of the symposium, a meeting was attended by 60 participants from industry, government and universities and chaired by L. S. Collett on the "Future problems of permafrost geophysics". Problems of permafrost relating to the industry in the fields of petroleum and mineral exploration, construction, pipelines and drilling were discussed. Excellent notes on these discussions have been prepared by Dr. M. S. King, University of Saskatchewan. Arrangements have been made with Dr. R. J. E. Brown, NRC, to publish these notes by Dr. King and extended abstracts of the papers presented at the symposium in a Technical Memorandum of the National Research Council.

MS received, October 15, 1974.



The Ocean '74 Conference

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Summary
Ocean '74, the fifth IEEE International Conference on Engineering in the Ocean Environment, was held in Halifax, Nova Scotia, August 21 to 23, 1974, under the chairmanship of O. K. Gashus of Nova Scotia Technical College. This was the first time that the annual conference was held outside the USA. 529 people from many different countries attended: 125 papers by authors from 10 different countries were presented.

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Seismic Methods

The papers relating to seismic methods indicated the direction of current developments in reflection seismology in government and private research centres in North America. K. E. Prada described the Woods Hole Oceanographic Institute's single channel seismic profiling system, which utilizes two digital computer sub-systems for data acquisition and storage and processing respectively. Processing operations are conducted in post real-time but on-board the research vessel. A routine operation is the regular acquisition of radio buoy station data for velocity/depth estimation. The processing objectives of this system include dereverberation, signal-to-noise ratio enhancement for deep-layer detection, deconvolution of the bubble pulse waveform, analysis of source signatures, digital filtering, and quantitative measurements of bottom reflectivity. To overcome the limitations inherent in single channel operations, a six channel system is being developed for use in 1975. In this system, processing operations will concentrate on common depth point analysis and velocity/depth estimation.

D. E. Hefler (Bedford Institute of Oceanography) presented some records from a single channel seismic system utilizing a small computer (PDP-11) for real-time signal processing. The computer permitted real-time dereverberation, stacking and display of data, particularly in the deep ocean and on the continental slopes, to be carried out. The application of a simple timing correction to the signal dramatically improved the effectiveness of the simple Backus filter.

D. E. T. Bidgood (Nova Scotia Research Foundation) has obtained excellent results with a deep-towed seismic reflection system consisting of a fathometer and sparker system. He improved resolution and record quality by towing near the ocean floor. Bathymetric resolution was better than 0.3 m and sub-bottom resolution in the order of 1 to 2 m. The fathometer penetrated 1.5 to 3 m of bottom and the sparker source penetrated up to 60 m of bottom. Satisfactory records at speeds of 4 to 7 knots and in wave and swell of 5 to 6 m were obtained.

In a more theoretical treatment of seismic techniques, A. B. Braggeroer (MIT – WHOI) described the use of maximum likelihood or maximum entropy procedures in spectral analysis and array processing. He presented results showing the application of the generalized form of these high resolution methods to a proposed six channel array system under development at Woods Hole Oceanographic Institute.

K. B. Theriault (MIT) presented a mathematical treatment of the problem of estimating the optimum arrival time in exploration seismology. A primary distinction between this method and others used to date is that an explicit model of earth attenuation has been postulated and employed in the derivation of an optimum processor.

Two approaches to future development of seismic systems were discussed. D. D. Abraham (Naval Underwater Systems Centre) described the design and construction of a hydrophone array with accelerometers, inclinometers, depth sensors, and integral amplifiers all operating at ambient pressure. Such a design approach may well lead to greater flexibility in the construction of hydrophone arrays if the pressure cases used to protect the electronic components can be eliminated. R. W. Hutchins (Huntec '70 Ltd.) reviewed a sophisticated application of mathematical techniques in automatic control theory to simulation modelling of 'boomer' type transiently excited plane-piston sources. The outstanding feature of the approach is the ability to predict the near and far field pressure signatures of the acoustic source so that the problem of evaluating transient behaviour in transducer design can be handled at a cost of about $30 per case on a digital computer. Predicted and experimental results agree to within ± 10 per cent.

Sea Floor Topography

Echo sounding directly under the ship and acoustic scanning to either side of the ship are the two methods currently used to map the sea floor. Both methods were dealt with at the conference. One method of achieving a narrow echo sounder beam, hence, high resolution, is to utilize a non-linear sonar system. If two different high frequencies are transmitted simultaneously from small, highly directional transducers, non-linear mixing in the water path produces a low difference frequency, which has a very narrow directional pattern free from side lobes. J. A. Birken (USNOO) described the design criteria for a similar system that has the added feature that one high frequency is swept. The resulting narrow-beam swept-frequency system may be useful for defining sediment types and improve accuracy of ocean floor maps.

Another approach to high-resolution bathymetry was discussed by H. K. Farr (General Instruments Corp.). This system, known as BOS'UN was documented at a previous meeting. Mr. Farr dealt with the problems of acquiring and processing the large quantity of data the device produces. He demonstrated how the processing of such data could produce a final contour chart covering 0.4 square kilometres at a scale of 1:1200 contoured at intervals of 0.6 m. The total processing time was about one hour on a CDC 6000 computer.

P. G. Jollymore (Bedford Institute of Oceanography) described design criteria and some field experiences with a medium range (750 m) side-scan sonar system intended for operation in temperate waters, where thermoclines pose a major problem for such acoustic systems. He illustrated the effectiveness of the design parameters in overcoming this problem with several specimen records, including one which exhibited a large number of iceberg furrow marks on the sea floor near Newfoundland (Fig. 1). A. L. Rolle (Naval Coastal Systems Laboratory) discussed a different approach to side-scan sonar design. His talk concerned the development of an acoustic transducer array that would eliminate the problems associated with maintaining the towed body a constant height off the bottom to minimize distortion. Computer analysis of the design has been completed and has shown that the technique is feasible.

One of the largest and longest range side-scan systems is the Institute of Oceanographic Sciences GLORIA unit, which has a range of 22 km and weighs 6.6 tons in air. The problems of launching, towing, and recovering such a large body and how they were overcome were described by R. H. Edge. His approach should be required reading for anyone contemplating the construction of such a large sea-going towed device.

Oil Exploration and Production

The design and construction of oil exploration equipment that is to be used in areas subject to the effects of ice was given considerable attention at the conference. M. A. Bilello *et al.* (U.S. Army) and S. F. Ackley *et al.* (U.S. Army) presented statistical measurements of ice thickness along the eastern coast of Canada and in the Arctic. D. V. Reddy (Memorial University) and P. S. Cheema (College of Trades and Technology, St. John's, Newfoundland) analyzed the response of a fixed offshore tower to ice-flow loading using, as an input to the model, the driving forces obtained by actual measurements at Cook Inlet, Alaska. They succeeded in obtaining the corresponding power spectral densities of tower displacement. They plan to extend this work to the response of 'truss type' deep-water fixed platforms offshore to moving ice sheets.

J. B. Herbich (Texas A & M University) and P. Versowsky (Chevron Oil Co.) presented their measurements on models of large submerged structures in a wave basin. They found that experimental and theoretical vertical displacement forces agreed closely and that wave steepness is a significant factor in determining the horizontal forces on the structure.

The mechanical design of sub-sea oil structures for operation under severe sea conditions was also examined by A. W. Marks and G. H. Fahlman (Lockheed Petroleum Services Ltd.). They described three systems for placement of ocean floor oil-well completion and production equipment. The system presently being used in the Gulf of Mexico consists of a manned, non-manoeuverable, sub-surface service capsule handled from a modified offshore supply vessel. The second system, which is being designed for operation in the North Sea, will launch and recover the service capsule from a column stabilized semi-submersible. The third system, intended for operation in sea state 6, is in the conceptual stage at present. It may take the form of a submarine to handle the conventional non-manoeuverable service capsule or a mother submarine which launches and recovers a submersible which is capable of mating with sea floor production chambers.

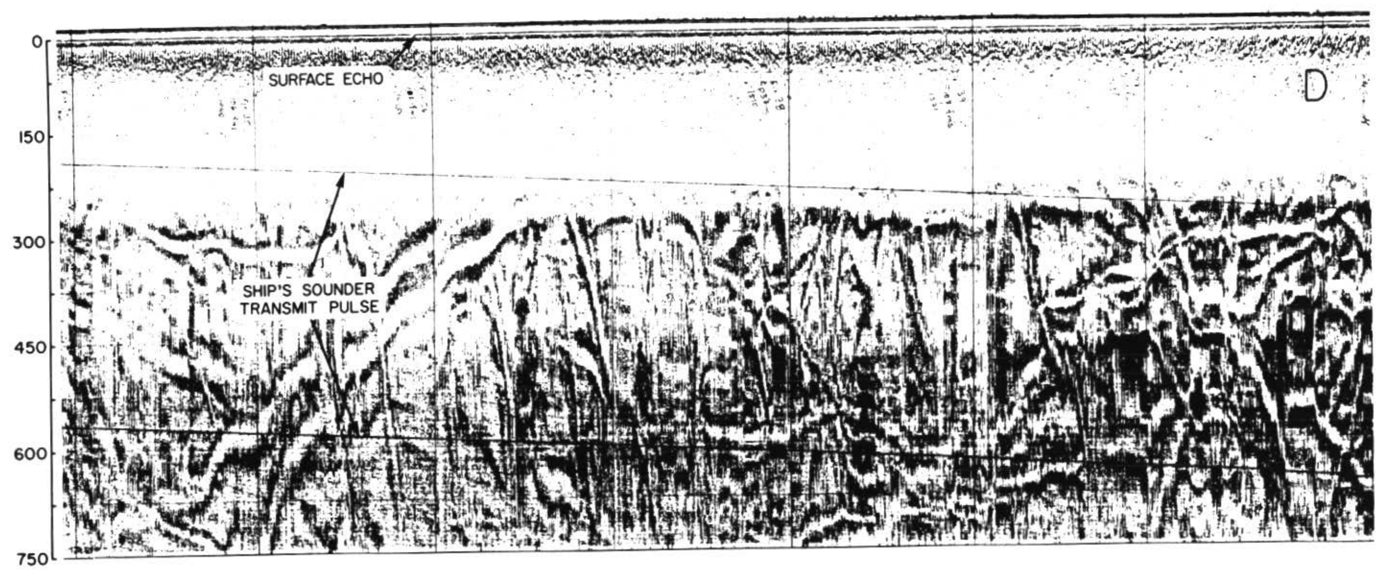

Figure 1

A portion of a record obtained with P. G. Jollymore's medium range side-scan sonar system showing iceberg furrow marks off the north-east coast of Belle Isle, Newfoundland. The side-scan sonar yields a quasi plan view of the ocean floor to either side of the ship's track to a maximum range of 750m as the ship traverses an area. Dark areas on the record represent projections or acoustically hard bottom. Light or white areas represent an acoustic shadow behind projections. In the record illustrated here, only the view to one side of the ship's track is shown. The vertical scale or view perpendicular to the ship's track is exaggerated by 4.8 to 1 relative to the horizontal scale or distance along the track. The white bands represent furrows created by bottom grounding icebergs.

R. Dempster (Memorial University), using measurements of iceberg drift and corresponding wind and current information, developed a simple model to predict the drift path of icebergs. He hopes that with this model and measurements of prevailing wind and current patterns in the vicinity of an oil rig, he can predict the probability of collision. E. G. Banke and S. D. Smith (Bedford Institute of Oceanography) described their attempts at towing small icebergs out of the path of oil rigs. Their aims were to predict the force required to tow an iceberg and to improve iceberg drift prediction models by obtaining appropriate drag coefficients. From data obtained by towing three icebergs at various speeds up to 1 m/s, they found that the water drag coefficient is about 1.2 for Reynolds numbers of 0.7 to 8×10^4.

Another problem associated with oil production in temperate and Arctic waters concerns damage to sea floor installations such as pipelines by bottom-dragging icebergs. T. Chari and J. H. Allen (Memorial University) developed analytical models of iceberg/sediment interaction and tested them in the laboratory. They obtained an expression to estimate the iceberg gouge dimensions for their laboratory model, but found that more knowledge of the strength properties of the bottom sediments is required realistically to estimate such dimensions in the field.

To help put the problem of oil spills into perspective, R. A. Geyer and W. Sweet (Texas A & M University) described their study of naturally occurring hydrocarbons in the Gulf of Mexico and the Caribbean. They found documented evidence of natural seepage of hydrocarbons as early as 1508. Using modern seismic techniques and hydrocarbon 'sniffers', they determined that there was a high correlation between anomalous concentrations of hydrocarbons in the water column and the sub-bottom geological structure in the vicinity.

Bottom Sampling

A. S. Orange *et al.* (Bolt, Beranek and Newman Inc.) discussed a harbour survey they had conducted using: a high resolution, 'boomer-type' sub-bottom profiler called "Acoustipulse" (described at the Ocean '73 conference), which has a resolution of 0.3 m and a penetration of 150 m; a side-scan sonar for quasi-three dimensional representation of the sea floor; a precision fathometer with a resolution of a few centimetres, and; a precision positioning system utilizing radar transponders. The geological data obtained were calibrated by means of test borings at selected sites. The authors indicated that this approach yields a major cost and time advantage over similar data collected solely by more extensive boring.

The design of a pinger suitable for mounting on a geological sampling dredge was described by D. I. Gaunt (Institute of Oceanographic Sciences, Wormley, England). It was explained how the pinger is utilized to monitor the attitude of the dredge and determine whether or not it is in contact with the bottom. This precise control over dredge position relative to the bottom ensures more efficient sample collection.

Habitats and submersibles are recognized as possible tools in a bottom sampling program, but operational costs of the former have always been high and useful working times of the latter low. J. G. English (Memorial University) discussed the long term maintenance requirements and costs for a shallow water habitat for cold northern waters presently being operated by Memorial University. He reported that the cost of operating their habitat, exclusive of salaries was only $4700 last year and a major portion of this was related to support requirements in the cold water environment. With regard to submersible operations, J. B. McBeth (International Hydrodynamics) described how Pices V was used to bury a transatlantic telecommunications cable to depths up to 1 m in water depths to 700 m. While not specifying the precise data, he stated that, in calculating the submersible dive time versus the time at sea, the limiting factors turned out to be weather and reliability of the submersible handling system. It would appear that habitats and submersibles may be coming of age for application in an extensive bottom sampling program.

Positioning at Sea

While not directly a geophysical or geological technique, positioning is an essential requirement of all such operations at sea, since it is essential to know where measurements and samples were taken. The position of the survey vessel and the position of a sampling or measuring instrument must be known. W. H. P. Canner and K. Chan (University of Wales) considered the problem of navigating a vessel. They described a system that, without the aid of a computer, is capable of coupling a navigation system such as radar or a Decca Navigator to a ship's autopilot so that the vessel follows a predetermined path. This system has application during routine survey work.

P. C. Wilson (Comdev Marine) and A. Hittle (Shell Canada Ltd.) outlined a positioning system they have developed that interfaces an atomic time standard with a conventional Decca Lamba hyperbolic navigation system to enable precise offshore positioning in the passive ranging or 'rho-rho' mode. The prototype equipment was tested successfully off the east coast of Canada as part of a major survey operation during the summer of 1973. The chief advantages of the method are: it eliminates the need for the shipboard master transmitter, which takes up space and interferes with sensitive electronic equipment aboard ship; it provides multi-user capability while retaining security from unauthorized use; it reduces propagation anomalies and, hence, increases positioning accuracy; and it increases area coverage.

Sonobuoys are often used in seismic refraction work but their positions are usually not well defined. R. C. Spindel and R. P. Porter (WHOI) described a positioning system used to locate such buoys to within 20 m of bottom-mounted acoustic markers and to within 200 m of the absolute geographic position. The system was used successfully on the Mid-Atlantic Ridge to study micro-earthquakes in the median valley. The problem of positioning sea-floor sampling devices such as rock core drills and sediment corers was discussed by D. L. McKeown (Bedford Institute of Oceanography). The principal advantage of the acoustic technique he described is its ability to function accurately in areas of very rugged topography such as the median valley of the Mid-Atlantic Ridge.

General Assembly

The program concluded with a general assembly where invited speakers presented an overview of the conference and speculated on future trends in oceanography. The session was chaired by A. E. Collin, Assistant Deputy Minister, Ocean and Aquatic Affairs, Government of Canada. Before introducing the invited speakers, Dr. Collin outlined what he believed to be the overriding objective of any ocean resource policy namely the preservation of the oceans' ecological system. He stated that, if environment management coupled with international regulations governing ocean activities were instituted, other components of resource protection would fall into place. He also stated that development of the significant oil and gas industry off Canada's East and Arctic coasts calls for a major commitment in the next five years and that Canada's research activities in this and other oceanographic fields should be in concert with international oceanographic undertakings.

Dr. Frank Snodgrass, a research associate of the Institute of Geophysics and Planetary Studies suggested that the trend in ocean engineering was toward scale oceanographic experimentation. He cited a paper describing installation of the Woods Hole Oceanographic Institute's three-legged mooring as an outstanding example of such work bringing to bear on a major program elements of mechanical engineering, electronic instrumentation, data processing, positioning, and ship handling. He highlighted the extensive use of COSMOS type logic circuits in equipment described at the conference and suggested that this was an indication of the techniques likely to be seen in the future in the development of more complex and reliable electronic systems.

Professor E. M. Wilson, a tidal power consultant from the University of Salford reviewed the conference proceedings concerning tidal power generation, discussed the economic factors associated wtih these projects and discussed the feasibility of power generation by wave action. He suggested that both the technical and economic feasibility of such proposals changes with time and projects such as the Bay of Fundy tidal power proposal should be periodically re-assessed to determine whether or not they have an advantage over alternate sources of power generation.

Dr. Lloyd Dickie, the director of Dalhousie University's Institute of Environmental Studies, stated that the future of ocean engineering research lies in improving resource management rather than devising means of exploitation. He felt, as a biologist, that oceanographic instruments are improving but there is still too little communication between engineers and biologists. He drew parallels between engineering systems and ecological systems and suggested that the engineer could contribute much more to biology than just instrumentation development.

Dr. Joe MacInnis of Underwater Research Ltd. and an adviser to the Ministry of State for Science and Technology provided justification for his belief that it was most important to keep the public informed of oceanographic science and its impact on their lives. He emphasized that the average person should be "as excited about the sea and its potential as the marine scientist himself".

Note:

Copies of the conference proceedings are available from the Institute of Electrical and Electronic Engineers Inc., East 47th Street, New York, New York, 10017 at a cost of $12 for members and $15 for non-members.

MS received, December 2, 1974.

Earth Science Workshop After Five Years

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Summary

The earth science workshop at the University of Western Ontario has now completed five summer sessions and over 100 teachers from across Canada have attended. During the last three years, two Canadian teachers have supervised the development of a Canadian program, with emphasis on methodology with development of classroom exercises and field projects. Approximately one-third of the course is devoted to field trips. Visiting speakers discuss relevant matters of current interest. Present financing is provided by Shell Canada Ltd. Although this workshop is providing a need in the short term for earth science teachers, university-trained teachers will be required as the demand for a course on earth science increases at the secondary school level.

Introduction

In 1970 the Science Council of Canada in its Report No. 18 "Earth Sciences Serving the Nation" recommended that the provincial departments of education encourage the introduction of more earth science into secondary schools and that these departments support the training of teachers to provide them with an adequate knowledge of earth sciences. These recommendations evolved from a brief by the Geological