

Current Research

Volume 8, Number 1, April 1972

URI: https://id.erudit.org/iderudit/ageo08_1res01

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Publisher(s)

Maritime Sediments Editorial Board

ISSN

0843-5561 (print)

1718-7885 (digital)

[Explore this journal](#)

Cite this document

(1972). Current Research. *Atlantic Geology*, 8(1), 36–42.

Current Research

Memorial University's Marine Geology Research Program compiled by ROGER M. SLATT.

A marine geology research program, emphasizing marine sedimentology, was recently initiated at Memorial University of Newfoundland's Department of Geology. Laboratory facilities for this program include a fully equipped sedimentology laboratory for routine preparation and analysis, X-ray diffractometer, X-ray fluorescence spectrometer, differential thermal analyzer, atomic absorption spectrophotometer, and scanning electron microscope. To date, cruises have been by boat charter or through arrangement with Memorial's Ocean Engineering Department. However, the Geology Department plans to purchase a 42-foot vessel in September, 1972.

Major emphasis of the marine geology program is being placed on coastal and nearshore sedimentary processes, since Newfoundland's many fiords and embayments afford excellent opportunities for such research. A basic sedimentological study is to be conducted in a minimum of one Newfoundland bay per year. This will involve detailed sampling and bottom profiling followed by textural and mineralogical analysis of sediments. Routine chemical analyses including major and trace metal, carbonate, and organic matter content will also be conducted.

The first bay chosen for study was Conception Bay, a fiord near St. John's, Newfoundland. Sampling and bottom profiling was carried out in June, 1972. Laboratory analyses are now in progress. Preliminary results suggest: (1) active sedimentation in the bay is negligible, (2) several distinct sedimentary environments are present, (3) sediments include those glacially and glacio-fluvially transported from adjacent land masses as well as those transported shoreward from the shelf.

Suites of sediment samples from the Labrador shelf, northeast and central Newfoundland shelf, and Grand Banks of Newfoundland, which were obtained from Bedford Institute of Oceanography, Fisheries Research Board of Canada, oil companies, and during a cruise by Memorial's Ocean Engineering Department, are also being studied.

On the Labrador shelf, sediments have been found to range from sands to silty clays and a hornblende-hypersthene-garnet heavy mineral assemblage probably extends the length of the shelf. A cruise is planned for July - August, 1972 to obtain spot samples from fiords along the Labrador coast in order to evaluate provenance of shelf sediments.

On the northeast Newfoundland Bank (outer northeast Newfoundland shelf), sediments range from silty sands on the bank top to silty clays on the flanks. Several rock types have been dredged from the area including a Cretaceous or Tertiary(?) glauconitic subarkose that is thought to underlie the bank. Correlation of glauconite in surficial sediment with glauconite in the subarkose suggests mapping of surficial glauconite might prove a valuable indicator of underlying Coastal Plain sediments on the shelf.

On the central Newfoundland shelf, beach/dune sands have been identified by textural analysis and scanning electron microscopy. The sands lie in 90 metres of water approximately 100 miles due east of St. John's. A detailed study with the scanning electron microscope of shelf sands from Labrador to the Grand Banks is planned to delineate relict sediments and sedimentary environments.

A joint study of Leg 18 Deep Sea Drilling Project cores is currently underway with the Department of Geology, Dalhousie University.

The desired objectives of Memorial University's marine geology program are to provide an understanding of sedimentary processes in the Newfoundland coastal environment and Newfoundland and Labrador shelves, to expand ongoing marine research in the Atlantic Provinces, and to stimulate research in marine sedimentology.

Ice-Ocean-Ship Study in the Canadian Arctic - E.O.S. Routing Study, Pond Inlet, 1972 compiled by J. TERASMAE.

During the Arctic spring of 1972 a series of measurements will be made on the sea-ice at Pond Inlet at the north shore of Baffin Island. Measurements of composition, geology, structure and physical properties of the ice, together with meteorology will be related to getting an idea of the Arctic sea-ice conditions which will affect shipping in many of the channels between the Arctic Islands and any ships carrying oil and LNG from the new discoveries in the Arctic as well as from the enormous ore deposits will have to use Arctic channels. A great deal has to be learned about the sea-ice conditions so that properly designed ships can be routed most practically and economically through the Arctic channels. The observations of sea-ice characteristics will be related to various airborne, shipborne, or fixed installation remote sensing methods and this will

ultimately allow improved surveillance of Arctic sea-ice conditions.

The Department of Geological Sciences at Brock University, St. Catharines, and the Geophysical Institute of the University of Muenster, West Germany, are participating jointly in the investigations, with personnel representing institutes from Helsinki, Finland, and from Hamburg, Bremen and Berlin rounding out the technical expertise of the whole group. All scientists and students expect to move on May 9th to the community of Pond Inlet on Baffin Island, where arrangements have been made with the local Council of Pond Inlet to provide accommodation and supporting services. An on-the-job training program for Inuit residents of Pond Inlet will be carried out in order to train and qualify local ice and weather observers for future service.

The funding, management, and logistics of this study is carried out under the auspices of the E.O.S. Project, a West German Industry/Government Research and Development Project. With support from Canadian Government and Industry to Brock University, the E.O.S. Project is part of an Industry/Government/University effort dealing with high-risk development of new technologies for the future.

The need to carry out investigations related to the transportation of bulk cargoes from the Arctic was expressed by the Minister of the Department of Energy, Mines and Resources, the Honourable Donald S. MacDonald, in the debate on the Speech from The Throne on February 24, 1972.

The measurements taken on the Arctic sea-ice this summer will provide some of the answers to a variety of problems and will have in the long run an extremely beneficial effect upon the economy of the country.

Gulf of St. Lawrence Project - General Statement.

The objectives of the proposed study are: (1) The understanding of the systems operating in the Gulf of St. Lawrence area in terms of physical, chemical, geological and biological oceanography, meteorology, and socio-economics; (2) The establishment of the technological feasibility of environmental control in terms of fresh water inflow, ice cover, climate and biological productivity.

The need for such an understanding is forced upon us by the degree to which man's activities have already altered the Gulf by changing profoundly the seasonal balance of fresh water inflow through hydro-electric development, by the pouring in of pollutants of all kinds, and by unbalanced fishing pressures which have disturbed the natural system; also by the fact that we are now in a position seriously to consider environmental control in an area the size of the Gulf of St. Lawrence. It is urgent that the Gulf systems be thoroughly understood before further changes are brought about inadvertently. To do this it is necessary: (a) to assess the extent of the changes that have already occurred in the Gulf system, particularly those due to man's activity; (b) to shed light on the complex interaction between various parts of the system, for example between commercial fishing catches and regulation of fresh water inflow; and (c) to provide insight into the possibility and consequences of intentional manipulation of the system.

Several important benefits will follow from the application of the results of this study, namely: (1) the ability to predict trends in climate and biological production; (2) the control of the ice cover, at least over a longer period than the present open shipping season; (3) the maintenance of sustained yields of renewable resources; (4) the containment and restriction of pollution; (5) the development of new resources, in particular through the introduction of aquaculture; (6) in short, the unified environmental and resource management of the system.

The Project is a good example of co-ordination and joint operation by a diverse group of government and university agencies and industry, directed to the study of a major environmental system. The Department of the Environment is the lead agency, and participating in the Project are other Federal Departments, the Governments of Quebec and the Atlantic Provinces, eleven universities in Quebec, Ontario and the Atlantic Provinces, the National Museums of Canada, and various industrial concerns.

The peak of the field research is planned to start late in 1973 and to continue for 18 months, thus spanning two winters. Certain studies, however, will start in 1972, particularly in biology and in meteorology. It is emphasized strongly that the Gulf Project is a unit; that is to say, no part of it is independent of the others and all parts will be synthesized into a whole system.

The program looks to the future, in an area which is now an exclusive Canadian fishing zone and the most important of our partially enclosed seas. The Gulf is the principal sea access to our largest cities and to over 60% of the population of Canada, and it supplies 40% of all Canadian fish landings. It is therefore highly appropriate that this Project, which will no doubt be the first of several such studies, should focus on the Gulf. It will develop expertise that could

afterwards be used for the solution of similar problems across the country, for example in the Fraser Valley, in Hudson Bay, and in the Arctic Ocean.

The estimated total of new funds required is about \$10 million.

The Co-ordinator and Scientific Leader of the Project is Dr. Max Dunbar of McGill University at present stationed at the Bedford Institute of Oceanography, Dartmouth, Nova Scotia. The Steering Committee of the Project consists of the following: Dr. R.W. Trites (Chairman), Mr. D.A. MacLean, Mr. J.W. Maxwell, Dr. P. Meyboom, Mr. N.G. Perret, Dr. B.S. Muir, Dr. R.E. Munn, Dr. A. Walton, and Dr. M.J. Dunbar.

Department of Energy, Mines and Resources, Ottawa.

Energy, Mines and Resources Minister Donald S. Macdonald tabled in the House of Commons recently a list of the types of environmental investigations being pursued by various government departments and agencies this year under direction of the Task Force on Northern Oil Development.

The investigations form part of a three-year study by the Government of Canada at a cost of \$15 million.

Project No. 1 - Aquatic Ecological Studies:

The specific objective of this survey work is to use aquatic plants and animals as indicators of disturbance. By this means it will be possible to identify river and stream areas that will be sensitive to disturbance. A more general objective is to improve our knowledge of aquatic plants and animals and their habitats because these organisms are important as "early warning" sensors of environmental changes, including those changes that can be expected to accompany pipeline construction activities in the vicinity of streams and rivers. These surveys will be conducted by the Fisheries Research Board.

Project No. 2 - Fish Surveys - Mackenzie Valley:

The object of this work is to obtain an inventory of fish species and to determine their migration routes, times of migration, and location of spawning areas. This information will be used to specify how pipeline routes, timing, and construction methods for stream crossings can be made to minimize disruptions to fish migrations, spawning areas and food sources of the fish. Studies by the Fisheries Research Board are a necessary part of this latter question of how to minimize damage to food sources of fish. The work will be conducted by the Fisheries Service.

Project No. 3 - Fish Surveys - Yukon Territory:

Same as for No. 2 above, but with regard to the Yukon Territory.

Project No. 4 - Stream Flow Surveys:

Data collected in this project will indicate possible flood magnitudes and thus areas where pipelines might be prone to rupture by floods and also river-level forecasts for barge traffic. Additional information is also required, at the request of the Fisheries Service and the Fisheries Research Board, on sediment conditions because these influence the quality of fish spawning areas. The work will be conducted by the Water Survey of Canada.

Project No. 5 - Survey of Ice Effects:

The main objective of this project is to determine the location and magnitude of ice jamming and ice scour along rivers and streams to be crossed by pipelines. A second objective is to obtain a better knowledge of river channel and river flow characteristics to assist with the preparation of precautionary measures needed in areas of stream crossings. This work will be conducted by the Hydrologic Sciences Division of DOE (Department of the Environment).

Project No. 6 - Water Quality Surveys:

The identification of sensitive aquatic habitats, by the Fisheries Research Board, is dependent upon information on the water quality characteristics and nutrient status of the main river and its tributaries. Such information can be used to identify areas where the productivity of aquatic organisms, including fish, is dependent upon a periodic or regular flush of dissolved and suspended nutrients, with the intention that such areas should receive minimal disruption during pipeline construction activities. This work will be carried out by the Water Quality Division of DOE.

Project No. 7 - Wildlife Ecological Studies:

This project will result in the production of maps that show locations of fur-bearer production areas, areas of ungulate production, migration and breeding, and other kinds of wildlife habitat that are of importance to northern residents. Because of the international importance of migratory birds, attention is also being given to the identification of waterfowl production and staging areas. This mapping project will establish units of the proposed pipeline routes that are of insignificant importance to wildlife and will grade those habitats that are significant so that route selection and special protective measures can be specified. The work will be conducted by the Canadian Wildlife Service.

Project No. 8 - Vegetation Studies:

Documentation of relationships between vegetation, landform and permafrost and mapping of terrain units that vary in their sensitivity to surface disturbance will allow identification of sediments of a pipeline route that will be most susceptible to serious thermal erosion or flow-slides. Studies of vegetation in relation to the restoration of stability to the active layer after there has been a disturbance will assist with the formulation of requirements for replacement of vegetation or other forms of insulation after a disturbance such as a pipeline excavation. The mapping and description of existing forest and non-forest vegetation will assist in the identification of areas of special ecological interest which should be protected during pipeline construction. This work will be conducted by the Canadian Forestry Service.

Project No. 9 - Topographic Mapping and Air Photography:

Preparation of air photographs and topographic maps required for various environmental investigations relating to pipelines in the Mackenzie area will be continued in 1972-73 by the Surveys and Mapping Branch through industrial contracts. By the end of the year air photography will be complete and more than half of the maps will be ready.

Project No. 10 - Earthquake Hazard, Temperature Characteristics of Permafrost:

In order to provide an adequate estimate of seismic risk to pipelines, processing of seismic data for the region will be continued at an accelerated rate during 1972-73 by the Earth Physics Branch. The Earth Physics Branch will also continue to provide information on temperature and thermal properties of near surface materials, as an input to the investigation of permafrost and terrain stability by Geological Survey of Canada (Project No. 12).

Project No. 11 - Terrain Inventory Surveys:

Systematic surveys and mapping of terrain conditions in the Mackenzie pipeline area by the Geological Survey of Canada will be continued in 1972-73, providing information on near surface earth and rock materials, landforms, permafrost and ground ice, muskey, including river bank, coastal and nearshore conditions. By the end of the year preliminary maps at 1:125,000 scale will be available for the whole area. This work involves integrated surveys in which investigations of soils, vegetation and hydrology by various agencies are conducted in conjunction with the geological work.

Project No. 12 - Permafrost Terrain Properties, Performance and Hazards:

The Geological Survey of Canada will continue, complete and commence a variety of investigations of the properties, stability and instability of the ground under permafrost conditions in the Mackenzie area. They include engineering study of properties of frozen materials, stability of slopes and related terrain hazards; development of geophysical methods for locating frozen materials, stability of slopes and related terrain hazards; development of geophysical methods for locating frozen ground; and case histories of permafrost terrain disturbance.

Project No. 13 - Terrain Sensitivity Rating & Mapping:

During 1972-73, development and production of terrain sensitivity maps will be continued by the Geological Survey of Canada. These maps will relate terrain performance to disturbance involved in pipeline and related land use preliminary Atlas-type maps providing a simplified terrain classification will be available for the Mackenzie pipeline area within the year. Preparation of more detailed maps will continue.

Project No. 14 - Evaluation of Line Pipe and Pipeline Steel:

During 1972-73, the Mines Branch will continue evaluation of line pipe of Canadian and foreign manufacture, with special reference to Arctic conditions and will commence development of higher strength pipe. This investigation will contribute to structural safety of gas and oil pipelines in the north and thus reduce the possibility of environmental pollution through pipeline rupture.

Project No. 15 - Land disturbance studies in the Boreal Forest Region in the Mackenzie River Valley:

An appraisal of vegetation, soils and landform relationships with particular reference to the erosion hazard created by the removal of forest cover and other construction activities. The work will be carried out in collaboration with the Geological Survey of Canada. The results will assist in determining terms and conditions to be set for the construction and operation of pipelines.

Project No. 16 - Vegetation studies in the Lower Mackenzie Valley Region:

The project will investigate the extent of thermokarst and thermal erosion as a function of vegetative cover and soil composition in order to develop guidelines to minimize terrain damage. Vegetative regeneration techniques as a means of stabilizing areas of thermokarst and thermal erosion will also be studied.

Project No. 17 - Disturbance studies in the Lower Mackenzie River Region:

This project will investigate the maintenance, degradation and restoration of ecosystems exposed to surface disturbance in regions of continuous and discontinuous permafrost. Roads, winter roads, seismic lines and well drill sites will be investigated. The results will be used to predict the ecological consequences of pipeline construction and to develop guidelines for route selection and construction and operational procedures.

Project No. 18 - Energy Budget Components in Arctic Environment:

Measurements of physical parameters, including soil moisture content, soil density, solar radiation, atmospheric temperature and humidity, will be carried out in disturbed and undisturbed areas of the lower Mackenzie River in order to develop an understanding of the effect of basic physical features, including the extent of surface disturbance, on the stability of permafrost. The results of these studies will assist in determining terms and conditions to be set for the construction and operation of pipelines and in the identifying of areas to be avoided when selecting pipeline routes.

Project No. 19 - Land Based Oil Spills:

Investigations will be carried out on methods of prevention, containment and recovery of oil spills; on the ecological consequences of oil spills; and on techniques of ecological restoration after oil spills and clean-up work. The results of the studies will assist in determining conditions to be set concerning possible oil spills.

The Arctic Petroleum Operators Association is collaborating in this project by preparing a statistical analysis of the incidence and type of pipeline failure in North America. This analysis will be evaluated with a view to estimating the risk of failure in different kinds of terrain along the proposed pipeline route.

Project No. 20 - Waste Disposal Study:

This project is for the purpose of determining the best methods for effective disposal of waste from mobile exploration camps and semi-permanent construction camps. It will be carried out in co-operation with the Public Health Engineering division of the Department of the Environment. The findings of the study will be of paramount importance in setting anti-pollution terms and conditions to be followed during construction and operation of pipelines.

Project No. 21 - Information Bank:

The project will develop a computerized bibliographic file of information pertaining to the proposed pipeline development. The file will function as an information storage and retrieval system and will be capable of being continuously updated.

Project No. 22 - Terrain Surveys & Mapping:

This work will consist of a geological mapping of the broad area through which the pipeline corridor is expected to run and the development of a methodology for producing a terrain sensitivity index. The index will provide a measure of the environmental impact of different land use activities. The results will facilitate the selection of a pipeline route and the setting of terms and conditions for pipeline construction and operation. The work will be carried out by the Geological Survey of Canada on behalf of DIAND (see project nos. 11, 12 and 13 - Department of Indian Affairs and Northern Development).

Project No. 23 - Regional Economic Impact Study:

The objectives of the study are to gain information: to indicate the benefits and costs of pipeline development to northern residents, Territorial and Federal Governments; to provide an information base for assessing the submission of private industry making applications for the construction of large diameter pipelines in the Territories; to assist northern residents in participating in economic developments resulting from projected pipeline(s) construction and maintenance; to provide information necessary to the development of Government policies for the optimization of economic benefits and potentials during both the short and long term periods of pipeline(s) development and maintenance in the Yukon and Northwest Territories and the minimization of any detrimental effects; and to provide information required by the Territorial Governments for development planning.

This project is being carried out by the Economic Staff Group of DIAND and is being co-ordinated with the National Economic Impact Study being carried out by the Economic Committee of the Task Force on Northern Oil Development.

Project No. 24 - Regional Socio-Economic Impact Study:

This project which is supplementary to the Regional Economic Impact study outlined above is to assist in providing information about possible socio-economic consequences of a proposed pipeline, to consider the implications of a pipeline for local social and economic expectations in the effected communities and the possible emergence of social problems of various kinds. It will assist in developing recommendations for policy to maximize economic and social benefits for native northerners and minimize negative consequences of pipeline development. This aspect of the study is being conducted by the Northern Science Research Group of DIAND.

Project No. 25 - Archaeological Studies:

The purpose of this study is to identify in advance locations of archaeological and historical significance which will require special consideration and treatment in the selection of pipeline routes, and in the setting of terms and conditions under which a pipeline may be constructed and operated. The project will be co-ordinated by Northern Economic Development Branch of DIAND and will be carried out in co-operation with the National Museum of Man and the Territorial governments.

Project No. 26 - Sociological Study:

The purpose of this study is to make an assessment of the effects of the planning and proposed construction of the Alyeska pipeline and to relate what is happening in Alaska to what may happen in Canada. The primary objective will be to identify unfavourable results and permit action to be taken to avoid similar unfavourable results in Canada. This project will be under the direction of the Northern Science Research Group of DIAND.

Project No. 27 - Program Management Advisory Group:

This is to provide for the various administrative costs of the operations of an Advisory Group to the Environmental-Social Committee of the Task Force on Northern Oil Development.

Project No. 28 - Program Management:

This is to provide for the various administration and management costs of the central co-ordinating unit, i.e. Environmental-Social Program, Northern Pipelines. The unit is responsible for the co-ordination of the work of the Departments of Energy, Mines and Resources; Environment; Indian Affairs and Northern Development; the Northwest Territories and the Yukon Territory. The unit is also the primary point of contact with northern groups, industry, conservation organizations and other interested agencies. It will be responsible for making recommendations for pipeline routes and for co-ordinating the development of terms and conditions under which pipelines may be constructed and operated.

Project No. 29 - Program Management:

Professional and other services to cover the costs of critical path charting of the work in progress, special reports and publications, public information program, and other special studies, including financial support of planning and sociological studies to be carried out by the governments of the Northwest Territories and the Yukon Territory.

Project No. 30 - Pipeline Regulations:

The purpose of this project is to develop appropriate regulations and control measures concerning: the design, construction and operation of pipelines to minimize erosion; drainage along pipeline ditches to prevent washouts; construction methods in permafrost with different types of soil. Much of this work involves determining the ways and means of translating the findings of other investigations into actual technical requirements of pipeline construction and operation. The project will be carried out by the National Energy Board.

Environment Canada News Release - Unusual Charts Show Eastern Seabed.

New Atlantic coast geological charts brimming with data of interest to ocean scientists, engineers, industrialists and fishermen have been published by Environment Canada's Water Management Service. The charts are contained in a set of four scientific papers, part of a continuing series prepared by scientists and cartographers of the Marine Sciences Directorate.

Two of the papers analyze and illustrate the seabed geology of areas noted for fishery operations: Northumberland Strait in the Gulf of St. Lawrence, and the Banquereau and Misaine Banks off the coast of Nova Scotia. They cover not only the depth and contours of the ocean floor, but also the composition of its surface layer.

Marine engineering projects, such as the installation of oil drilling rigs, construction of causeways or pipelines, or dredging of sand and gravel, may find this information useful as a guide to the composition, bearing strength and shape of the sea bottom. The data can assist government agencies by identifying the nature and extent of bottom materials and providing a basis for deciding where permits may safely be issued for excavation of materials for building or dredging.

Other uses include: for fishermen, by showing such features as the edges of fishing banks and the type of bottom, indicating the most effective kind and location of fishing gear; and for environmental protection, by indicating conditions to be taken into account in cleaning up oil and other polluting materials.

The third paper in the current set provides a three-dimensional view of the continental margin of eastern North America. The fourth paper details the coastline of Chedabucto Bay, N.S., site of the serious ARROW oil spill in 1970.

The complete papers, including charts, may be ordered (at \$3.00 each) from: Hydrographic Chart Distribution Office, Marine Sciences Directorate, Environment Canada, Ottawa, Ontario, K1A 0E6 (Telephone: 613/994-5594).

Papers are listed as follows: Marine Science series:

- No. 3 - "Surficial Geology of Banquereau and Misaine Banks Map Area", by Brian MacLean and Lewis H. King.
- No. 4 - "A Reconnaissance of the Coastline of Chedabucto Bay, N.S.", by E.H. Owens.
- No. 5 - "Surficial Geology of Northumberland Strait", by Kate Kranck.
- No. 9 - "Three-dimensional Representation of Submarine Relief - Continental Margin of Eastern North America", by David Monahan.

Issued earlier in this series:

- No. 1 - "Surficial Geology of Halifax-Sable Island Map Area", by Lewis H. King.