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GEOHERMAL STUDIES IN NORTHERN CANADA
1975 FIELD SEASON

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Geothermal Service of Canada

INTERNAL REPORT #75-2

Division of Seismology and Geothermal Studies
Earth Physics Branch
Department of Energy, Mines and Resources

1975

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Earth Physics Br., E.M.R.

Studies of the underground thermal regime of northern Canada have been continued.

A program of deep borehole temperature measurements in wells either acquired from or suspended by resource companies has been continued. In the field season of 1975, some 17 new sites were logged for the first time making a total of 45 the number of northern wells logged during the year. As a result permafrost thickness measurements are now available for 70 sites in the Canadian north, of which 32 are in the Arctic Islands and 25 in the Mackenzie Delta. The results of these measurements are providing not only a determination of permafrost thickness, important to the regulatory agencies and resource companies but also a new understanding of permafrost dynamics and its relationship to terrestrial heat flow, surface temperature history and surface morphology.

Shallow temperature observations in the Mackenzie Valley have been completed for the present and the emphasis switched to acquiring data in the Arctic Islands and the Keewatin area; in particular along the proposed Polar Gas Pipeline Route. It is

envisaged that observation at the former sites might be repeated in five years time since climatic variation appears to play an important role in determining the surface temperature in marginal permafrost areas. Small programs of shallow temperature observations have been commenced with D.I.N.A. to investigate the frost heave of an artificial island, with D.P.W. to investigate coastal processes at Tuktoyaktuk and with G.S.C. at the Involute Hill south of Tuktoyaktuk.

In the spring a one day seminar on the "Shallow Thermal Regime" was organized in conjunction with the G.S.C. A group of specialists were gathered together to determine the major deficiencies in our understanding of the subject. The general consensus of the meeting was that field measurements are still very necessary because theoretical methods are not yet adequate to predict the thermal regime and that a very great need exists for additional studies of coupled heat and mass transfer under northern conditions. Both of these needs are being partially met through the TEP-2 program of the "Environmental-Social Program on an Arctic Pipeline", co-ordinated by the Geothermal group.

Measurements of the thermal properties of rocks and soils, both frozen and unfrozen are being made on a continuing basis. For many locations no cored material is available on which to make these measurements and drill-cuttings must be used instead. Research is continuing on improved techniques of determining in-situ thermal properties from measurements on the cuttings and the analysis of well-logs.

To investigate the effect of shorelines on permafrost distribution, measurements of underground temperature and thermal properties of rocks have been made at on- and off-shore sites at Little Cornwallis Island, NWT and in the Mackenzie Delta. The distribution of permafrost in the two areas is highly dependent on the surface history in the past hundred thousand years.

In a similar fashion investigations of offshore permafrost in the Beaufort Sea, in conjunction with G.S.C. and the Beaufort Sea Project F-1 of D.O.E., have shown its dependence on past surface temperature history. Perhaps of more concern here to the safety of offshore drilling is the thermal nature of much of the offshore permafrost. Investigations to date indicate that it is degrading and at a temperature marginally below 0°C with the exception of that beneath very shallow water (<20m) and in very deep water (>40m). Beneath deeper water the degrading section may be present at depth but a thin layer of permafrost, more recently aggraded, may also be present near the sea-bottom.

Further techniques of acquiring equilibrium subsurface temperatures in abandoned oil-wells, in diamond-drill holes during drilling halts, in seismic shot-holes, both on- and offshore have been and are continuing to be investigated. Numerical techniques are being applied to the problem of the thermal disturbance of the rock surrounding a well during drilling. An understanding of the physics involved and a mathematical description will maximize the derivable information from our own logs as well as providing a basis for improved drilling techniques and the design of future production wells in northern Canada.

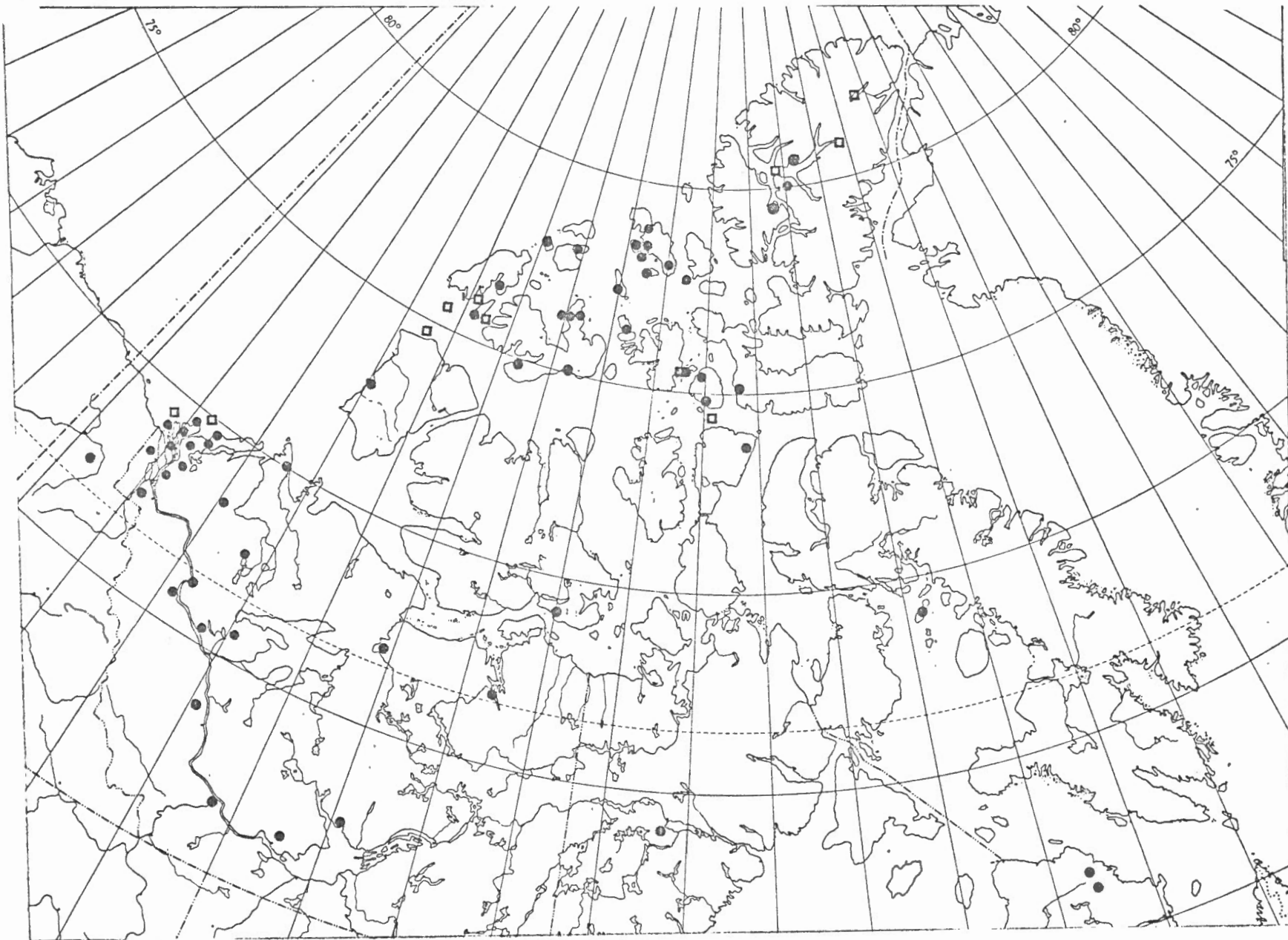
The possible occurrence of natural gas as a frozen hydrate is of increasing concern to northern drillers. Calculated equilibrium temperature curves have been used to predict the possible depth extent of hydrate for gases of different compositions in various areas of northern Canada. The analysis is similar in nature to an earlier attempt to predict the thickness of permafrost.

The enclosed map shows the distribution of current investigations.

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GEO THERMAL STUDIES - 1975



● onshore

◻ offshore