Geothermal Energy

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# COORDINATION OF GEOTHERMAL RESEARCH

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Division of Seismology and Geothermal Studies
Earth Physics Branch
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1980.

A.M. Jessop and M.J. Drury visited Halifax and Fredericton during the week of 24-28 March, 1980, in order to discuss with Provincial Government personnel and others the initiation of studies of the geothermal energy potential of the Atlantic area.

Nova Scotia

A meeting was held on 25 March at the offices of the Nova Scotia Research Foundation. Present were: E. Blanchard and D. Rankin, and D. Bidgood of NSRF, W. Potter and C. MacGillivray, of the Nova Scotia Department of Energy and Resources, and the two representatives from E.M.R.

Mr. Potter explained that he was responsible for the general management of projects in the field of renewable energy resources within NSDER. A. Jessop explained his role of Coordinator of geothermal energy R&D for EMR, and went on to state that he saw two possible forms of geothermal resources in Nova Scotia:

1. low grade heat in aquifers within the sedimentary basins;
2. hot dry rock in areas of granitic intrusions of high potassium, uranium and thorium content.

The technology for item 1 is already in existence and is being used economically in France. The technology for item 2 is under development in the U.S.A. and economic use in this context is some years in the future.

W. Potter reviewed the various drilling programmes in Nova Scotia of the recent past and immediate future, and methods of acquiring temperature data or of ensuring that temperature measurements be made were discussed.

It was agreed that:

1. The initial requirements are a) a compilation and interpretation of all relevant existing data, and b) a programme of acquisition of new data as opportunities are provided by drilling in various parts of the Province.
2. A Jessop and D. Rankin would meet the following day to draw up draft specifications for both activities.
3. The data compilation could be done by a student during the summer, possibly a fourth year student who could use the data for an honours thesis. The cooperation of a university geologist or geophysicist would be sought.
4. The data acquisition would be done under contract, possibly by NSRF.
5. Funding by the Province from DREE grants will be considered, with technical advice from both Provincial and Federal agencies. Alternatively, funding from Energy Panel funds is possible.
6. The interests of the other Maritime Provinces will be determined and cooperative programmes will be considered.

On the following day D. Rankin and A. Jessop produced a draft statement of a Technical Programme. This document is to be circulated to all concerned before a final version is completed. The draft is attached to this report as Appendix 1.

New Brunswick

On 27 March M. Drury and A. Jessop visited D. Gemill, a geologist with the Dept. of Natural Resources in Fredericton. Mr. Gemill is familiar with the geological structure of New Brunswick, and he holds some of the data files of

the drilling records. Although interested in the topic, particularly the sedimentary basin aspects, he spoke with the caution of a scientist who already has a full load of projects to maintain.

The amount of data on file in New Brunswick is probably less than in Nova Scotia, and it is concentrated in the Moncton sub-basin, which may be the deepest and most promising area. A programme of drilling in the Carboniferous rocks of the main part of the basin, between Fredericton and the east coast has included 12 holes to depths in excess of 1000 ft. (330 m). Of these, six may be still open and available for logging, and the Geothermal Service will attempt to fit this into its summer field plans.

A visit was also made to the University of New Brunswick to speak to Prof. K. Burke. Although interested in the topic, he also expressed a reluctance to become involved due to work-load. However, he is capable of giving scientific advice to the Provincial Government.

On 28 March a visit was made to the office of Mr. J. Williamson, Deputy Minister for Energy, Dept. of Natural Resources. The idea of geothermal energy had been raised before, but no one had taken any significant steps to look into it. Mr. Williamson was interested in initiating a small research programme, but he foresaw difficulties in finding the personnel to carry it out in New Brunswick. The style of project suggested for Nova Scotia was described to him, and he asked to see the final Technical Programme document (Appendix 1). It was pointed out that the Province could rely on technical advice from the Federal Government and might consider cooperation with Nova Scotia. Mr. Williamson asked about developments in the New England States, since New Brunswick has good contact with them. We replied that, although extensive geothermal work is going on in the Maryland - Virginia - North

Carolina area, very little is heard about New England, and we undertook to enquire about this. The mechanics of Provincial funding under Federal programmes or direct Panel funding were discussed, but no decisions were made.

Appendix 1

Geothermal Energy Research in Nova Scotia

Technical Programme

Objectives

The principal objective of this programme is to examine geothermal resources as an economic energy supply in Nova Scotia. Since there is no evidence of Tertiary volcanism in the Atlantic geological province, only hot water in sedimentary aquifers or hot dry rock within Palaeozoic intrusives are probable. Both styles of geothermal resource can be expected to supply heat for space heating or industrial use. Generation of electrical power from either style of resource is only conceivable if unexpected geological conditions are found or if future technological or economic developments make it possible.

Detailed objectives are as follows:

1. Sedimentary basins:
   - to identify aquifer formations capable of supplying 50 $m^3$/hr or more of water at 50°C or higher temperature from each well for at least 30 years;
   - to map the lateral extent, depth and thickness of such formations;
   - to record the physical characteristics of porosity and permeability of the rock, chemical composition of the water, the temperature distribution, and direction and rate of water migration;
   - to relate the existing geothermal resources to potential industrial or domestic energy applications.

2. Hot dry rock:

   - to identify areas of anomalously high temperature in rocks of low porosity and permeability;
   - to map the temperature field where temperature exceeds 100°C;
   - to record physical characteristics of fracture density, resistance to fracture and the stress field, and the petrological nature of the rock;
   - to relate the known hot rock to the developing technology of utilisation and to potential energy applications.

Method of procedure

In each of the two parts of the Technical Programme there are three modes of operation:

A. Compilation and assessment of existing data;

B. Acquisition of new data on an opportunity basis;

C. Initiation of geothermal exploration.

These are listed in order of increasing cost. Only modes A and B are proposed during 1980-81. It is anticipated that mode A will be substantially completed by the late winter of 1980-81, and that mode C will be considered at that time. Mode B will probably continue throughout the entire programme.

A. Compilation of existing data

1. Sedimentary basins.

   The following items of data should be assembled:

   a. Any temperature data, in the form of logs, bottom hole temperatures or drill stem test readings, from all holes drilled

for oil, gas, coal or evaporites, on- or off-shore. These data are usually kept in the files of the Provincial regulatory agency. Quality of the data is highly variable.

b. Any logs revealing porosity or permeability of the formations.

c. Pressure data derived from static hydraulic head or drill stem test records, or any other indications of lateral water migration patterns.

d. Data on chemical composition of formation waters.

e. Seismic profiles, gravity surveys, lithological data or any other information revealing the depth and formation structure of the basins.

f. Petrological information of the basement rocks, particularly content of potassium, uranium and thorium and the heat generation by radioactive decay of these elements.

2. Hot dry rock.

a. Any temperature data in holes drilled for uranium or other minerals, including data assembled by Dalhousie University and the Earth Physics Branch for heat flow studies.

b. Any data on content of potassium, uranium and thorium from petrological sources or measured by chemical or laboratory gamma-ray analysis or by airborne gamma-ray survey, including data assembled by Dalhousie University and the Earth Physics Branch.

c. Any data on thermal transfer properties of rocks, probably only available from the above named agencies.

d. Geological and geophysical information and maps indicating the extent and total thickness of granitic rocks, either exposed at the surface or concealed beneath other rocks or overburden.

B. Acquisition of new data on opportunity basis

This mode of operation will include the addition of any new data that conform to the lists above, but it will mainly consist of taking steps to generate data at reasonable cost that would not otherwise have been generated. This will require good and timely cooperation of all parties, and particularly the Dept. of Mines who will first be aware of opportunities arising and can best persuade exploration units to make extra measurements or to allow time for others to make measurements.

1. Sedimentary basins

   a. Temperature data:

      i) Temperature logs in completed holes to an accuracy of 1K although the mud temperature is not truly representative of rock temperature;

      ii) Bottom hole temperatures, to an accuracy of 1K, taken throughout the sequence of logging runs;

      iii) Temperature readings taken during drill stem tests;

      iv) Temperature logs in stable shut-in holes, taken with heat flow equipment to an accuracy of 10 mK.

   b. Drill stem tests in aquifer formations suspected of adequate porosity and permeability.

   c. Chemical analysis of samples of formation water.

   d. Laboratory gamma-ray analysis of samples of basement rock. This may necessitate a few metres of extra drilling.

   e. Measurements of thermal conductivity, which could be done by Earth Physics Branch or its contractors on cuttings or core samples.

2. Hot dry rock

   a. Temperature data:

      i) Temperature logs by commercial logging tools if a logging unit is brought to the hole.

      ii) Temperature logs by heat flow equipment, normally requiring that the hole be left complete with surface casing and in a condition to remain open.

   b. Data on content of potassium, uranium and thorium, requiring the collection of core samples of 500g for laboratory analysis. The typical general rock is of more interest than localised anomalies or ore-grade zones.

   c. Data on thermal conductivity, which could be obtained by Earth Physics Branch or its contractors, requiring the collection of core samples of 10 cm length.

Programme Management

It is anticipated that the work will be done under contract to the Nova Scotia Dept. of Energy and Resources by the Nova Scotia Research Foundation, a University or another geological consulting agency. Work under operating mode A will be done by a team consisting of a Programme Manager employed by the contractor and possibly two students employed for the summer of 1980. Work under operating mode B will be done by the contractor, by sub-contractors such as well-logging companies, or by University or Government scientists or technicians as appropriate.

A report consisting of a catalogue of data compiled under operating mode A and a brief report of activities under operating mode B should be prepared by

31 March 1981. An interpretation of the data available and recommendations for operations in 1981-82 should be included.

It is recommended that the Nova Scotia Dept. of Energy and Resources should set up a Technical Steering Committee, consisting of at least the Programme Manager and representatives of the Nova Scotia Dept. of Energy and Resources, and the Federal Dept. of Energy, Mines & Resources. This Committee should meet at the beginning of the operations, at a time to discuss the above mentioned reports, and at such other times that become necessary.

The Provinces of New Brunswick, Prince Edward Island or Newfoundland may wish to set up similar programmes of geothermal energy research. The possibility of cooperation at any stage of the work should be borne in mind.