

24  
du 24  
1550-9

JST

Geothermal Energy

February 1981

COORDINATION OF GEOTHERMAL RESEARCH

Alan M. Jessop and Malcolm J. Drury

Internal Report 81- 8

Geothermal Service of Canada  
Division of Seismology and Geothermal Studies  
Earth Physics Branch  
Department of Energy, Mines and Resources  
1981.

This document was produced  
by scanning the original publication.

Ce document est le produit d'une  
numérisation par balayage  
de la publication originale.

## Foreword

This document is circulated as a record of events and plans of the period 2-13 February 1981. It is now known that potential funding levels under the National Energy Programme are considerably lower than we were originally led to believe. The programme planned at that time is presented in its entirety, since the projects are all valid and necessary, and the programme represents the direction in which geothermal energy research must go in order to provide a reasonable level of identification and assessment of geothermal resources in Canada.

The geothermal coordinator and M.J. Drury visited several institutes in western Canada during the period 2nd-13th February 1981. This was the major planning meeting for the year 1981-82, rather later than usual because of continuing uncertainties of funding levels under the National Energy Programme and the conjunction of other tasks in western Canada.

#### CALGARY

On the 2nd and 3rd of February the EMR representatives visited Sproule Associates Limited in order to discuss the current contract for net rock analysis and the forthcoming contract for the study of applications of geothermal energy on the Prairies. The net rock analysis work is progressing well and the work is expected to be finished before the end of the financial year. The existing information on well logs for the Cretaceous sections of many of the Alberta wells had been laid out and the process of assessing the net rock content was well underway. Final details on the format of the data cards were discussed. These cards have a format design to be compatible with the general file of well data maintained by the Geothermal service. The applications contract had not been received by Sproule Associates Limited, but all negotiations were complete and the contract was expected to arrive anytime. The philosophy of the work was discussed and it was agreed that sufficient had been achieved to constitute the first meeting between the contractor and the scientific authority that is specified in the terms of the contract.

#### EDMONTON

The two EMR representatives spent the morning and early afternoon of the 4th of February at the Physics Department of the University of Alberta, in

consultation with F.W. Jones and his assistants. A divided bar is being built with the intention of surveying systematically the thermal conductivities of the major rock units of the sedimentary formations of Alberta. The Geothermal service has provided technical advice on the construction of this equipment, and the equipment so far built shows many similarities with the Earth Physics Branch equipment. The system is expected to be in operation in late March or April. The collection of temperature data from wells in Alberta is virtually complete, the compilers having about 55,000 data from about 25,000 wells. These two projects were discussed in more detail on the following day and are reported in Appendix 1. The EMR representatives went on to visit Gary Briggs of E.B. Hughes Ltd., a service company in Edmonton. Mr. Briggs is a chemist, specializing in the chemical requirements of cement in oil wells. The temperature windows for the setting of cements are not more than about 5 - 10° for any particular chemical content, and he is thus concerned with the accuracy of temperature data. Mr. Briggs is willing to attempt to find wells that the Geothermal Service can log accurately by means of a thermistor probe attached to a commercial logging cable. This technique has been used in the Regina well and has turned out to be very successful. It was agreed that the co-ordinator would provide a letter to Mr. Briggs setting out the technical requirements for such logging and specifying geographical areas in which we would like to obtain opportunities to log.

On Thursday 5th February, 1981 a meeting was held to discuss the future of geothermal energy research in the sedimentary basins of western Canada. The purpose of this meeting was to obtain outside input into the decisions as to the course this research should take and to determine who would like to be involved and the source of the supporting funds. A draft record of this meeting is to be found in Appendix 1. This draft has been circulated to

participants for comments, and a final version will be circulated when comments have been incorporated. The coordinator remained in Edmonton on the 6th and 7th February to attend a meeting of geology students from western universities, and to present, on the Saturday afternoon, a talk on geothermal energy in Canada.

#### VICTORIA

On Monday 9th February the EPB Ottawa representatives visited the Pacific Geoscience Centre at Sidney, B.C. Some time was spent with routine geothermal service affairs, but the major part of the day was spent discussing with J.G. Souther of the GSC Vancouver and T.J. Lewis of PGC a paper on geothermal conditions in the Stikine area of northwestern British Columbia. One purpose of this work is to examine any possible thermal anomaly on the axis of the Stikine volcanic belt. On the 10th February N. Church of MEMPR visited the Pacific Geoscience Centre for discussions on geothermal energy research in the interior of British Columbia. Incorporation into the MEMPR budget for 1981-82 of the request for funds for drilling in one of the sedimentary basins of the Okanagan area seemed to be unlikely. Coupled with uncertainties in the funding levels within EMR, this impeded the process of planning for the coming year. The EMR representatives expressed the hope that MEMPR would be able to undertake this work since they did not expect that item to remain in their budget for 1981-82. Deep drilling in one of the tertiary basins has been identified as the first level of cut from the requested NEP funds.

#### VANCOUVER

On Wednesday 11th February the EMR representatives visited J. Stauder, at B.C. Hydro. Mr. Stauder has been in charge of scientific and exploratory

geothermal work at Meager Creek since the beginning of the B.C. Hydro programme. Most of the discussion centred around the provision of temperature measuring equipment for use in the wells to be drilled during 1981. During 1980 the geothermal service loaned equipment to B.C. Hydro, and T.J. Lewis of PGC was required to make several trips to service equipment. One probe was lost during logging, and the teflon cable for use in high temperature work was broken at about the 900 metre point. The loss of one probe in a long period of intensive work is normal, and the breakage of the teflon cable was caused by attempting to log in a mud-filled hole. It was explained to J. Stauder that owing to its precarious manpower position, the Geothermal Service cannot undertake to service equipment at Meager Mountain in the coming year. However it would do everything in its power to cooperate with B.C. Hydro and to loan equipment where this does not interfere with other operations. Since the Geothermal Service has been taking steps over the last two years to improve the number of bridges in operation, the amount of equipment should not be a problem in 1981. Mr. Stauder agreed with the EMR position and undertook to look into the possibility of having a B.C. Hydro engineer responsible for all temperature logging equipment maintenance and operation, and to keep him at the camp throughout the drilling season.

It was understood that Nevin Sadlier-Brown Goodbrand Limited, the main consultants for B.C. Hydro, are attempting to construct a temperature logging equipment that is similar to and compatible with the Geothermal Service system. Their estimated cost for this seemed to be rather high, but this is a matter for agreement between B.C. Hydro and their consultants.

After leaving B.C. Hydro the EMR representatives visited the offices of Nevin Sadlier-Brown Goodbrand Limited, but unfortunately only a short

discussion was possible because of prior commitments on the part of the consultants.

On the afternoon of 11th February the coordinator visited Simon Fraser University to give a seminar to the Physics Department on geothermal resources in Canada.

On Thursday, 12th February the annual planning meeting was held between the coordinator and the other three project leaders for 1981-82, J.G. Souther, GSC Vancouver, T.J. Lewis, EPB Victoria, and M.J. Drury, EPB Ottawa. This meeting was held at the offices of the GSC, Vancouver. It was considered unfortunate that we did not know the level to which funding would be available during 1981-82, nor did we know whether the request for two man-years would be granted. Thus although the new financial year will soon be upon us, it was impossible to make precise plans.

The contracts of the year 1980-81 were reviewed. The expenditures to date and the final or expected final expenditures were listed, and the full list of projects is shown in Appendix 2. It was noted that the coordinator had not provided funds to the Geological Survey to cover the overhead charged by DSS on contracts. However since DSS is erratic in claiming these charges, it was not clear that any change in the financial encumbrance need be made.

Projects planned for the year 1981-82 are shown in Appendix 3. Indications are included of the first and second levels of cuts in this list to be made if the National Energy Programme provides reduced levels of expenditure as specified in the reduced levels compiled by the task coordinator. There are 29 planned projects for 1981-82, compared with 15 active projects in 1980-81. This is a good illustration of the need for the two man-years that have been requested to provide manpower for servicing contracts and for performing the many tasks that are necessary to maintain a programme of this sort.

Appendix 1

Sedimentary Panel On Geothermal Energy

'SPONGE'

DRAFT RECORD

Meeting of 5 February 1981 at

University of Alberta

Edmonton

A meeting was held at the Dept. of Physics, University of Alberta, on Thursday 5 February 1981, to discuss the future of research into geothermal energy from sedimentary basins in Canada. Representatives of universities, federal and provincial governments, and the consulting industry were present. The notice circulated with invitations, the list of participants, and the proposed agenda are attached to the end of this record.

The convenors of the meeting were F.W. Jones, University of Alberta and A.M. Jessop, Earth Physics Branch, Energy, Mines & Resources.

A.M. Jessop opened the meeting by welcoming the participants and asking each person to identify himself and his affiliation. It was agreed that he should continue to act as chairman of the meeting, and the agenda was adapted as proposed.

1. Opening remarks

The chairman explained that the meeting had been called to obtain opinions on the future course of research into geothermal resources from sedimentary



basins, particularly in the Prairie Provinces and the Mackenzie Valley. One demonstration project is already under way at Regina, and the question must be addressed of how to provide the earth science information needed to encourage further projects and to provide a basis for estimates of exploitable energy. Having decided what is needed, the group could then discuss participation in and support for the programme.

## 2. Review of existing projects.

The chairman asked those present to describe briefly their present work relevant to the geothermal energy programme.

F.W. Jones, University of Alberta, stated that he had two such projects in progress. One of these was the collection of industrial temperature data from well files in Alberta. To date he has about 55,000 data from about 25,000 wells as shown in Fig. 1. This project has been funded by the Province of Alberta, and so far has been restricted to wells within Alberta. The second project is the construction of a divided-bar system for the measurement of thermal conductivity of rocks. The equipment is expected to be operational by the end of March. In addition he is involved in theoretical studies of temperature stabilisation in wells.

L.W. Vigrass, University of Regina, explained the demonstration project now in progress. A geological feasibility study of the Regina-Moose Jaw area was performed in 1977-78. A test well was drilled in January 1979 on the campus of the University to a depth of 2215m, and numerous tests have followed, including a hydrofracturing experiment, flow tests, chemical analysis of formation water, and temperature logging. The second, or reinjection, well will be drilled at a distance of about 1 km from the first well in the summer of 1981. To the present time most of the funding

has come from the federal government, but the second well is to be funded by a sharing arrangement under the 'Federal-Provincial agreement on renewable energy and conservation'. Results of the first well have been generally as good as or better than predicted, with the exception of temperature, which was found to be rather lower than predicted. However it is still feasible to complete the demonstration project. The University of Regina has a commitment to the federal government to install a working demonstration project, but it is not yet possible to present final plans.

M.J. King, University of Saskatchewan, recounted that he has had a contract with EPB to make measurements of thermal conductivity of rocks and soils. Owing to difficulties encountered, this has not achieved the level of success that was hoped for, but he now has a fully operational set of divided-bar equipment. Since his present difficulties are derived from a most uncertain laboratory accommodation situation, he offered to release this equipment, which is the property of EPB, to any other university that would like to use it. A.M. Jessop, for EPB, commented that he appreciated Prof. King's present difficulties, and that he would be happy to see the equipment used elsewhere for a project that meets with EPB objectives. There was no response to Prof. King's offer.

T. McCullough, British Columbia Hydro and Power Authority (BCH), said that his agency's interests are mainly in the field of electrical generation, and so current geothermal exploration in volcanic-areas are of much greater concern than possible low-grade resources from sedimentary areas. However, BCH would like to remain in touch with work in the sedimentary basins.

W. Young, MEMPR, said that his Ministry maintains the drilling records for British Columbia, but that no work is under way to extract data for geothermal research. Records of about 5000 wells are on file, about 50% of which may

prove to contain useful information. The Ministry would be happy to make these records accessible for this purpose.

A.M. Jessop recounted briefly the history of geothermal energy research in sedimentary basins undertaken or sponsored by EPB. The first contracted study by Sproule Associates Ltd., to examine the Geothermal survey of North America and to review the potential for geothermal development in Canada, was performed in the winter 1975-76. This was followed by a second contract that focussed on three chosen areas in southern Saskatchewan, the Calgary area, and the Fort Nelson area. This has been followed by a programme to establish a grid of 225 typical wells on an approximate 80 km grid, to procure lithological logs, and to procure net-rock analysis of the complete sections, in order to be able to summarize the thermal properties of the basin rocks. In addition, Jacek Majorowicz, a visiting postdoctoral fellow has written two papers on past and present thermal conditions beneath the prairies. Copies of one of these were distributed to those who had not already seen it. A map derived from the published thermal gradient maps of the Geothermal Survey of North America was shown. The details of this map are subject to large uncertainties, but it clearly shows a trend in increasing gradient from southwest to northeast, with a marked high gradient anomaly in the Brandon area. It was agreed that a representative of the University of Brandon should have been invited, probably Prof. H. Young. The chairman undertook to contact him.

H.A. Gorrell, Sproule Associates Limited, filled in some of the details of the contracts undertaken for EPB. He recounted how his company had purchased the temperature file of the Geothermal Survey of North America, had related that to the depths of the sedimentary rocks of the prairies, and had estimated the maximum temperatures to be anticipated in the lowest sedimentary

formations. Later the company had purchased net rock analysis data from Canadian Stratigraphic Services Limited, and is now involved in filling the gaps in this data, particularly in Saskatchewan, Manitoba and the Cretaceous parts of the logs from Alberta and British Columbia.

### 3. New Studies and Data Sources

It was generally agreed that there is a very large amount of data on file in various collections concerning the underground conditions of the sediments in the prairies, but this data needs to be assembled, critically reviewed for quality, and applied to the present purpose. At the same time other data such as the thermal properties of rocks does not exist, and must be generated. The largest source of raw data is probably the provincial files of wells drilled for oil and gas exploration, located in Victoria, Calgary, Regina and Winnipeg. It was agreed that the temperature compilation work of F.W. Jones in the province of Alberta should be continued and extended to the other provinces. Temperature data is an essential part of any programme of research into geothermal resources. W. Young had already said that the British Columbia Ministry would be happy to make records accessible, and it is reasonable to assume that the other provinces would also cooperate. Temperature data from oil pools is also available, and it is usually of a higher quality since it is more carefully taken and it is taken in conditions of reasonable equilibrium. These data are not as widespread as the well data since the oil pools are locally distinct entities. Some of these data have already been used by Jacek Majorowicz in his papers. Records of wells north of 60°N are kept at the ISPG in Calgary. Provincial files also contain lithological data and copies of all logs run in the wells.

Water pressure in porous and permeable formations is of interest to this survey, both for prediction of exploitation potential and for analysis of slow natural water migration within the sediments. It is of interest to know the source of the water being produced and the extent to which lateral migration can extend the life of an exploited region. Brian Hitchon felt that the mechanism of water movement and the general picture of water flow is known. The details and the full thermal implications of this water flow remain to be worked out. Maps of hydrological head in each formation are available from Canadian Hydrodynamics Ltd. of Calgary.

A question was asked concerning the scope of the work under discussion. The chairman replied that he considered that only the major potentially producing formations in reasonably populated areas could be examined at the present time. A complete mapping programme will take several years. H.A. Gorell estimated that it would take approximately two months work to define the major deep aquifers in Alberta in order to provide a basis for mapping of temperature and other relevant parameters. At this point the meeting adjourned for lunch, which was generously provided by the Department of Physics at the University Faculty Club.

#### 4. Data Management Display and Publication

After lunch the chairman showed to the meeting a publication entitled "Potential géothermique du Bassin Parisien" a publication of the Bureau de recherches géologiques et minières and ELF Aquitaine, written by B. Housse and P. Maget. This report reviews the geological structure of the Paris basin and contains a series of maps showing the location and extent of the reservoirs, the depth to the roof, the thickness, temperature, hydrochemistry and transmissivity of four reservoirs, the Lusitanian, the Dogger, the Lias and

the Trias. The western Canada sedimentary basin is much larger than the Paris basin, and it would be impossible to map in similar detail in a reasonable time. Furthermore such detail is not justified by the population density or distribution in the prairies. Our immediate task must be the identification and mapping of the major source reservoirs in the prairies and the Mackenzie Valley. The Paris basin report serves as a model for what might be done if that level of detail were justified. An unedited English translation of the text exists, and the chairman undertook to provide copies of this to those participants who did not already have a copy of the report.

The chairman asked the participants to state their interests in taking part in future programmes. F.W. Jones stated that he would like to continue the programme of temperature data extraction and to extend it to neighbouring provinces and territories. It was agreed by the meeting that it makes good sense for this work to be continued at the University of Alberta where the experience and the computer programmes for handling the data are already in place, rather than starting again at some other University. It was felt that this particular project is a key part of the whole programme and that every effort should be made to continue it and to extend it. Both F.W. Jones and M.J. King expressed an interest in the measurement of thermal conductivity of rocks. It was agreed that there is ample work for two institutions in this field, and it was hoped that the present difficulties of accommodation at the University of Saskatchewan could be resolved so that measurements of conductivity could be continued on a research basis rather than a service contract basis. L.W. Vigrass and H.A. Gorrell expressed an interest in the identification of the potentially producing reservoirs preparatory to detailed mapping. It had already been agreed that this was a necessary first step and these two participants agreed to meet together within a few days to discuss

the matter between themselves. Brian Hitchon expressed interest in contributing in the field of water chemistry and it was agreed that this was an important part of the information necessary to encourage geothermal exploitation.

#### 5. Sources of funding

The chairman stated that he, as Co-ordinator of the federal R&D programme in geothermal energy, had some funds available for this purpose. An increase in funds for 1981-82 had been requested but it was not known how successful that request would be. The chairman hoped that the provinces would also contribute towards the support of any programme of research into sedimentary resources, because any resources discovered would be provincial property. The chairman asked for approximate figures of the amount of money needed for the coming year. The figures that emerged were: for temperature data compilation \$30,000 for the University of Alberta; for conductivity measurements \$25,000 for the University of Alberta, and \$10,000 for the University of Saskatchewan; and \$150,000 for aquifer identification and geological and chemical data acquisition at the University of Regina.

L.W. Vigrass and H.A. Gorrell undertook to prepare a proposal on the regional identification of target reservoirs. F.W. Jones had already submitted a proposal for conductivity measurements to the chairman, and he undertook to prepare a proposal for extension of the temperature data collection. The chairman commented that the total sum discussed was more than he expected to have available, and he repeated the hope that some funding would be forthcoming from the provinces.

6. The Future of this group

The chairman asked participants if they thought that this group could fulfill a useful purpose and if it should meet again. It was agreed that the group does indeed have a valuable part to play in the future research into geothermal resources. It should meet again roughly at yearly intervals. Since this meeting was a little late to prepare plans in time to generate proposals that might be funded during the coming year, it was agreed that the group should meet again sometime in October-November of 1981, in order to prepare plans for the year 1982-83. The participants agreed that they would leave it to the discretion of the chairman to set a date and place for the meeting. They also charged the chairman with the responsibility of deciding on a name for the group with a suitable acronym. The result of this may be seen at the head of this record.



Notice of Meeting

Geothermal Energy from sedimentary rocks of western Canada

A meeting of scientists and engineers will be held to discuss present and future work directed towards the identification and assessment of geothermal resources in the sedimentary rocks of western Canada.

The purpose of this meeting are:

1. To identify current research programmes that are relevant to this topic;
2. To determine the needs for new activities and possible performers;
3. To discuss interaction between agencies;
4. To identify potential sources of support.

It is not intended to set up a formal combined programme that will seek and allocate research funds and thus exercise any control over its members. On the contrary, it is intended as an informational and coordinating operation that will leave independent agencies to continue their work but will allow them to focus on a common goal, and to work in cooperation with each other.

Time and Place

University of Alberta, Edmonton, Dept. of Physics.

9:30 a.m. Thursday, 5 February 1981.

All travel and accommodation expenses must be met by the participants.

Objectives of the work to be discussed

To identify and assess the geothermal potential of sedimentary aquifers in Canada:

To outline the thermal state of sedimentary basins, as a means of determining the mechanism of formation of such features:

To develop understanding of the role of water in heat transfer processes within the earth's crust.

Secondary benefits

To provide thermal data of importance to the exploration for and production of hydrocarbon fuels:

To relate present and past thermal conditions to the nature of hydrocarbon deposits, and to develop a further understanding of the formation processes of such deposits.

Participants in the meeting

All those who attended the informal meeting at the University of Regina at the time of drilling are invited to this meeting:

- Prof. F.W. Jones - Institute of Earth and Planetary Physics,  
University of Alberta (IEPP) (Convenor)
- Prof. L.W. Vigrass - Energy Research Unit,  
University of Regina (ERU)
- Prof. M. King - Dept. of Geology,  
University of Saskatchewan (GS)
- M.J. Stauder - British Columbia Hydro and Power Authority.
- Dr. A.S. Judge - Earth Physics Branch,  
Energy, Mines and Resources (EPB)
- Dr. A.M. Jessop - " " " (Convenor)

The convenor will also invite participation by representatives of other interested agencies, in particular the Institute of Sedimentary and Petroleum Geology, and geological branches of Provincial Governments.

It is emphasized that this is a scientific and technical meeting rather than an administrative meeting. However, the convenor will prepare a summary of the main discussions, and all participants should keep their respective administrative colleagues informed.

#### Present status of activities

As a basis for discussion, the convenor has assembled the following brief notes. These are intended as a guide and not as a limit.

#### Collection and acquisition of data - present activities

- Temperature
- The Geothermal Survey of North America. A collection of temperature data throughout North America, mainly taken from files of oil and gas drilling records, completed about 1973, sponsored by AAPG.
  
  - Current data collection by IEPP. A collection of temperature data, taken from Provincial well records in Alberta, to be completed in present form in 1981, sponsored by Dept. of Energy, and Natural Resources, Alberta.
  
  - Acquisition of new data as opportunity arises. Accurate measurements have been made in two wells at Regina and several in the Alberta Foothills by EPB.

Thermal Conductivity - Measurements in progress on samples from University of Regina well, by GS, under contract to EPB.

- Instrumentation being set up at IEPP.
- Estimation by use of net-rock analysis planned by EPB, using data-set now being completed by Sproule Associates Ltd. under contract.

Lithological, hydrological, chemical, radiological data:

- large quantities of data available, but collection and organization for geothermal purposes not yet begun.

Immediate data collection needs

- Completion of Alberta temperature file (IEPP);
- Initiation of systematic conductivity measurement (IEPP);
- Extension of temperature file to other Provinces and Territories;
- Extension of accurate temperature measurement in stable wells (EPB);
- Identification of major aquifers, as targets of resource assessment.

Display of data - now available

Temperature - The Geothermal Survey of North America, gradient maps.

- Canadian Geothermal Data Collection - Northern Wells, Geothermal Series of the Earth Physics Branch, Nos. 1, 3, 6, 10, 11, 1974-1978.

Immediate data display needs

Temperature            - Mapping of the Alberta temperature file in several formats (IEPP) e.g. Temperature at chosen depths from surface, Temperature at chosen elevations, Maximum temperature in sedimentary column, Temperature of identified target aquifers, Gradient from surface to chosen formations, Gradient over chosen lithologic sections, Temperature cross sections.

Conductivity           - Mapping of conductivity variation using net-rock analysis (EPB)

Analysis and Interpretation - present activities

Regina well            - Analysis of thermal, hydrological and chemical data to further the geothermal demonstration project (ERU, EPB)

Prairies region        - Interpretation of thermal and hydrological data in terms of water-borne perturbation to conducted heat flow (EPB, Majorowicz) - project completed.

Publication

Publication of results will be by the normal process of production of reports and papers in scientific and technical journals. It might at some

time in the future be appropriate to organise a symposium at, for example, a Geological Association of Canada meeting and to publish a group of papers together.

A bibliography of relevant documents may be desirable.

As a publication model the convenor suggests:

Potentiel Geothermique du Bassin Parisien, by B. Housse and P. Maget,  
Bureau de Recherche Géologiques et Minière and Elf-Aquitaine, 1976.

Meeting on  
Geothermal Energy from sedimentary rocks of western Canada  
University of Alberta, Thursday 5th February, 1981

Convenors: F.W. Jones and A.M. Jessop

AGENDA

1. Opening remarks - convenors
2. Existing studies
  - University of Alberta
  - University of Regina
  - University of Saskatchewan
  - British Columbia
  - Institute of Sedimentary and Petroleum Geology, EMR
  - Earth Physics Branch, EMR
3. New studies and data sources
  - Temperature
  - Lithology
  - Hydrology
  - Thermal conductivity
  - Others
4. Data management, display and publication
5. Sources of funding
6. Future of this group

Participants

Dr. M.J. Drury

Earth Physics Branch, Energy, Mines & Resources Canada, Ottawa, K1A 0Y3  
613-995-5490

Mr. H.A. Gorrell

Sproule Associates Ltd., 505-2nd Street S.W., Calgary, Alberta, T2P 1N8  
403-269-7451

Mr. S. Harding

Sproule Associates Ltd., 505-2nd Street S.W., Calgary, Alberta, T2P 1N8

Dr. Brian Hitchon

Alberta Research Council, 11315, 87th Avenue, Edmonton, Alberta

Dr. A.M. Jessop

Earth Physics Branch, Energy, Mines & Resources Canada, Ottawa, K1A 0Y3  
613-995-5490

Prof. F.W. Jones

Institute of Earth and Planetary Physics, Dept. of Physics, Univ. of  
Alberta, Edmonton, Alberta, T6G 2J1  
403-432-3467

--Temporarily: Dept. of Geology & Mineralogy, Parks Road, Oxford,  
England, OX1 3PR



Prof. M.J. King

Dept. of Geological Sciences, University of Saskatchewan, Saskatoon,  
Saskatchewan  
306-343-2757

Dr. Foscolof

Institute of Sedimentary & Petroleum Geology, Energy, Mines & Resources  
Canada, 3303 33rd Street N.W. Calgary, Alberta, T2L 2A7  
403-284-0110

Mr. T. McCullough

System Engineering Div., British Columbia Hydro and Power Authority, 555  
West Hastings Street, Vancouver, British Columbia, V6B 4N3  
604-663-2753

Mr. J. Sworder

Angus Butler Engineering Ltd., 11055 107th Street, Edmonton, Alberta,  
T5H 2Z6

Mr. W. Young

Ministry of Energy, Mines & Petroleum Resources, Parliament Buildings,  
Victoria, British Columbia

Prof. L.W. Vigrass

Energy Research Unit, University of Regina, Regina, Saskatchewan, S4S 0A2  
306-584-4269

Appendix 2

Status of projects in 1980-81

1.1 Surface geology and radiometric mapping of Coryell syenite - project abandoned owing to defection of graduate student involved. The Geology Dept. at University of British Columbia have been very apologetic, and would like another chance when a new student can be found. We would still like to have this work done, and a student project seems to be the best way of achieving it. It is included in our project list for 1981-82.

Paid \$0 Final cost \$0

1.2 Potassium-Argon dating of selected volcanic rocks - a continuing project, gradually building up a systematic history of volcanic activity in Canada.

Paid \$0 Expected final cost \$6930

1.3 Drilling in Okanagan - a successful drilling project, aimed at the measurement of thermal gradient on the margins of two Tertiary sedimentary basins in the Okanagan area.

Paid \$55,584. Expected final cost \$58,000

1.4 Resistivity at Mt. Cayley - a single line dipole-dipole resistivity survey near recent intrusive features on the south side of Mt. Cayley. Results showed anomalies near the intrusives.

Paid \$22,810 Final cost \$22,810

1.5 Drilling at Mt. Cayley - a successful drilling project on the south side of Mt. Cayley, aimed at the detection of increasing thermal gradients in the general area of the intrusives mentioned above.

Gradients encountered were 62 and 94 mK/m, compared with an average of 58 mK/m in the Squamish Valley. The contrast will be greater when topographic corrections are applied.

Paid \$75,068      Final cost \$75,068

- 1.6      Pipe to preserve holes drilled by outside agencies - no opportunities have arisen and funds have been used to increase work on item 1.5.

Paid \$0      Final cost \$0

- 1.7      Water and rock sampling - basically an operating fund to permit sample collection on an opportunity basis.

Paid \$3436      Final cost \$3436

- 1.8      Measurement of temperature during drilling projects - merged with 1-11 and 2.5 below under one contract.

- 1.9      Investigation of Montereion Hills area - in view of discouraging geological indications and start of new work in the Atlantic region this project was postponed. Since it is a populated area we will continue to seek University interest, but a major effort is not warranted.

Paid \$0      Final cost \$0

- 1.10      Investigations of the Atlantic region - a data gathering contract for Nova Scotia and Prince Edward Island, the separate new Brunswick part being much too small to attract commercial interest. The data supply is very small.

Paid \$9358      Expected final cost \$13,860

- 1.11      Survey of mercury vapour in soils - a geochemical tool for the detection of a thermally volatile element. This was the main part of a contract combining 1.8 above and 2.5 below.

Paid \$12,656      Expected final cost \$19,992

- 1.12 Shallow seismic survey on Mt. Cayley - a tool for siting the diamond drill holes of item 1.5.  
Paid \$1560 Final cost \$1560
- 1.13 Hydraulic fracturing of rocks - a theoretical and laboratory study of the effect of existing fractures on the propagation of hydraulically induced fractures.  
Paid \$656 Expected final cost \$17,394
- 2.1 Alteration studies of core from Mt. Meager - a geochemical and petrological study of the cores, yielding information on the geothermal reservoir and on the mechanism of mineral deposition.  
Paid \$9098 Expected final cost \$19,298
- 2.2 Magnetomagnetic resonance study at Mt. Meager - a test of a developing technique at sites previously tested by the magnetotelluric method.  
Paid \$8500 Expected final cost \$16,526
- 2.3 Seismic monitoring at Mt. Meager - correspondence with foreign experts indicated that this is not normally a successful technique for evaluating geothermal reservoirs. However, seismic monitoring as a detector of potential volcanic or land-slide hazard remains to be addressed on other programmes.  
Paid \$0 Final cost \$0
- 2.4 Thermal conductivity of cores - a contract with a university to provide routine measurement of thermal conductivity. This is now producing some results, but it is not a satisfactory process.  
Paid \$0 Expected final cost \$5000
- 2.5 Magnetometer survey on axis of Garibaldi Volcanic Belt - combined with 1.8 and 1.11 above in single contract.

2.6 Hydrological testing of selected samples - reduced in scope because of lack of samples. Funds used in other items.

Paid \$643 Expected final cost \$643

3.1 Temperature logging at Regina - no activity owing to delay in approval of second well.

Paid \$0 Final cost \$0

3.2 Completion of net-work analysis data set - work progressing well and first data received and tested.

Paid \$0 Expected final cost \$57,375

3.3 Investigation of reported temperature anomalies - no activity owing to lack of reported anomalies and late delivery of probe components.

Paid \$0 Final cost \$0

3.4 Feasibility of geothermal application in north-eastern British Columbia - delayed pending results of study commissioned by British Columbia Ministry of Mines and Petroleum Resources.

Paid \$0 Final cost \$0

Miscellaneous items

|  |           |
|--|-----------|
| Modernisation of field instrumentation for temperature measurement | \$ 3,600  |
| Premier Geophysics Ltd. - balance of contract let mainly           |           |
| on 1980-81 NEP funds   | \$ 535    |
| DSS charges, 6 1/4% of contracts                                   | \$ 18,000 |
| Travel of coordinator and contract supervisors                     | \$ 11,400 |
| Materials and Supplies   | \$ 10,000 |
| Total expenditures expected  | \$361,427 |
| Funds available  | \$360,000 |

The difference in these figures will be taken up by small perturbations in costs of contracts not yet completed. In particular, DSS are very slow in claiming their overhead costs, only \$5624 having been claimed to date.

Appendix 3

Projects planned for 1981-82

Project 1 - Identification and assessment of geothermal resources in non-volcanic terrain

Project leader - T.J. Lewis

Item 3

|     |   |               |
|-----|---|---------------|
| 1.1 | Deep drilling to examine temperature and hydrological state in one of the Tertiary basins of the Okanagan area. One hole will be drilled to a depth of 1500m or more. Costs include drill supervision and temperature measurement during drilling.  | \$200,000 (1) |
| 1.2 | Shallow drilling in the interior. A line or grid of shallow holes of 100-200m will be drilled as cheaply as possible, in order to detect significant anomalies in temperature gradient. Costs include site selection, geological evaluation and surface sample collection for estimation of thermal conductivity. | \$200,000     |
| 1.3 | Pipe to preserve diamond drill holes drilled for other purposes as they become available.   | \$10,000      |
| 1.4 | Geological and radiometric mapping of the Coryell syenite, north of Grand Forks in the area of the drilling of 1978. This is the same item as 1.1 of 1980-81, which was not completed.  | \$12,000      |
| 1.5 | A hydrological study of a Tertiary sedimentary basin, probably the same basin chosen for the drilling of item 1.1. This will form a good thesis project for a graduate student.   | \$15,000      |
|     | DSS overhead, 6 1/4% of contracts.  | \$27,000      |
|     | Other operating, including materials and supplies, travel etc.  | \$25,000      |
|     | TOTAL   | \$489,000     |

Project 2 - Identification and assessment of geothermal systems  
associated with recent volcanic activity

Project leader - J.G. Souther

Items

|      |  |              |
|------|--|--------------|
| 2.1  | Contribution of development of Linear Scanning Electrode System (LSES) by Premier Geophysics Ltd., started under NEP 1980-81 funding | \$63,000     |
| 2.2  | Alteration studies of core from drilling at Mt. Meager, a continuation of existing work  | \$15,000     |
| 2.3  | Trace element chemical analysis of cores from Mt. Meager   | \$4,000      |
| 2.4  | Resistivity measurement at Mt. Cayley using LSES   | \$50,000     |
| 2.5  | Drilling for temperature gradient on volcanic axis between Mt. Meager and Mt. Cayley   | \$80,000 (2) |
| 2.6  | Temperature measurement during drilling of item 2.5  | \$10,000 (2) |
| 2.7  | Geological mapping of Anaheim Volcanic Belt. Energy project share of GSC helicopter contract, estimated at 60 hr                     | \$20,000     |
| 2.8  | Logistic costs of magnetic deep sounding crew  | \$2,500      |
| 2.9  | Mercury in soil survey in Anaheim Volcanic Belt  | \$5,000      |
| 2.10 | Resistivity measurements in Anaheim Volcanic Belt, using LSES  | \$50,000     |
| 2.11 | Seismic monitoring of eastern end of Anaheim Volcanic Belt (G.C. Rogers)   | \$11,000     |
| 2.12 | Multi-frequency magnetotelluric survey of Anaheim Volcanic Belt (L.K. Law)   | \$30,000     |
| 2.13 | Potassium-Argon dating of volcanic centres   | \$8,000      |
| 2.14 | Isotope hydrological tests of selected samples   | \$5,000      |
| 2.15 | Drainage hydrology   | \$5,000      |
|      | DSS overhead, 6 1/2% of contracts  | \$22,500     |
|      | Other operating, including materials and supplies, travel etc.   | \$5,000      |
|      | TOTAL  | \$386,000    |



Project 3 - Geothermal energy from sedimentary basins

Project leader - A.M. Jessop

Items

|     |   |              |
|-----|---|--------------|
| 3.1 | Thermal conductivity of rocks of the western sedimentary basin                  | \$25,000     |
| 3.2 | Temperature logging at Regina and other locations as the opportunity arises     | \$30,000     |
| 3.3 | Temperature data acquisition  | \$30,000     |
| 3.4 | Reservoir mapping   | \$65,000 (2) |
|     | DSS overhead, 6 1/4% of contracts   | \$7,500      |
|     | Other operating, mainly travel for project operation and programme coordination | \$15,000     |
|     | TOTAL   | \$172,500    |

Project 4 - Geothermal resources of the Atlantic Region

Project leader - M.J. Drury

Items

|     |   |              |
|-----|---|--------------|
| 4.1 | Analysis of airborne gamma-ray data   | \$5,000      |
| 4.2 | Collection of existing data in New Brunswick and Newfoundland, with acquisition of new data on basis of opportunity | \$25,000     |
| 4.3 | Casing to preserve holes drilled for other purposes   | \$5,000      |
| 4.4 | Surface gamma-ray survey in support of airborne data  | \$10,000     |
| 4.5 | Hydrological study of Cumberland Basin  | \$40,000 (2) |
|     | DSS overhead, 6 1/2% of contracts   | \$5,000      |
|     | Other operating, mainly travel  | \$5,000      |
|     | TOTAL   | \$95,000     |

Summary

|                       |             |
|-----------------------|-------------|
| Proposed expenditures |             |
| Project 1             | \$489,000   |
| Project 2             | \$386,000   |
| Project 3             | \$172,500   |
| Project 4             | \$95,000    |
| Total                 | \$1,142,000 |

|                              |             |
|------------------------------|-------------|
| Funds available or requested |             |
| Continuing Panel             | \$360,000   |
| NEP Request                  | \$795,000   |
| Total                        | \$1,155,000 |

The difference in the totals will be resolved as these proposals are converted into working contracts. All estimates are subject to adjustments as contracts are negotiated.

Items marked (1) or (2) are the items to be deleted in the first level and second level of cuts if the request for NEP funds is not fully met.