

MYS

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COORDINATION OF GEOTHERMAL RESEARCH

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Division of Seismology and Geothermal Studies
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Department of Energy, Mines and Resources
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Meeting with B.C. Hydro

A meeting was held on 11 December 1979 at the offices of the G.S.C., Vancouver, between technical personnel of B.C. Hydro and E.M.R. Present were J. Stauder of B.C. Hydro and J.G. Souther, T.J. Lewis, M.J. Drury and A.M. Jessop of E.M.R.

The status of the drilling at Meager Mountain was reviewed. Two rigs were then on site. The large rig, complete with blow out preventers and other safety equipment had completed holes No. 1 and 2. The smaller rig, which arrived later, was working on hole No. 3 beyond the western boundary of the electrical anomalies. Hole No. 1 was blocked by cement that had set rapidly and unpredictably during a grouting operation. The hole remains filled with cement, but it will be drilled out for temperature measurement by the smaller rig after the completion of hole No. 3. The bottom hole temperatures, obtained daily before the start of the drilling shift are shown in Fig. 1. The curve shows a temperature inversion, possibly of similar origin to that encountered in the hole on the north side of the mountain in 1978. The cementing problems have prevented the deepening of the well sufficiently to observe any subsequent return to a positive gradient.

Hole No. 2 was stopped for safety reasons at 367m when the observed temperature was 193°C, or within 50K of the boiling point curve. The data are shown in Fig. 2. This curve shows no maximum, but it does show a change in gradient at about 300 m. This is interpreted as the boundary between conductive heat flow in the upper layer of rock, the fractures in the rock being totally sealed by deposited silica, and the lower layer of dynamic refracturing and resealing of fractures, where conductive heat flow is

enhanced by limited convective transfer. In the first nine days after the end of drilling, the bottom-hole temperature recovered from drilling disturbance to 202°C, but it was not established that this recovery was complete. At the same time, convective transfer in the well itself had caused heating of the water between about 200m and total depth. This heating was expected to extend further and to reach an equilibrium situation where heat travelling up the well by convection is lost laterally to the walls of the well. However, measurements by T.J. Lewis of EMR on 30 January 1980 showed no further heating within the well at 280 m depth. This will be carefully monitored by B.C. Hydro to make sure that temperature cannot reach the boiling point at any depth.

Operations at Meager Mountain were to stop on 22 December, and are to be restarted in March 1980. It is hoped that the drilling on the south side of the mountain will be completed by the end of May and that a start will be made on the north side in June.

The technique of drilling slim holes by a diamond drill for temperature and other observation has been taken further at Meager Mountain than in any other geothermal area. Thus information on zones close to a reservoir has been obtained by this relatively inexpensive method that is normally obtained only by means of a large-scale rotary drilling system at much greater cost. J. Stauder has been in frequent contact with groups working in the western U.S.A., and has found considerable interest in the Meager Mountain operation. He claims that difficulties with cementing are often encountered by experienced geothermal drillers, and that the rapid setting that has twice caused problems in hole No. 1 is difficult to avoid at high temperature and in an environment of imperfectly known chemistry. B.C. Hydro would now like to use the experience of this work to assemble a drilling system to be kept

together for further work and to be used as a model of this technological development. The present rig has been assembled on an ad hoc basis, and the blow-out-preventer assembly is rented. This is a key part of the safety equipment, and the assembly now in use is not of the best design for this work.

J. Stauder raised the question of Federal support for this drilling system development. I replied that it seemed to be a suitable proposal to be submitted to the Federal Provincial Agreement system. Stauder agreed in principle but he is pessimistic, since he considers that the Provincial Govt., as distinct from B.C. Hydro, and particularly J. Hill of the late Energy Commission have not been in favour of geothermal work under the F.P.A. It was asked whether the resulting drill rig would be available for drilling under contract in other areas: the answer seems to be no, it would be kept for internal work by B.C. Hydro.

Energy Panel Funds

A meeting was held on 11 December 1979, at the office of the GSC, Vancouver to review the status of projects in 1979-80 and to allocate funds to projects in 1980-81. Present were J.G. Souther of GSC and G. Rogers, L.K. Law, M.J. Drury, T.J. Lewis and A.M. Jessop of EPB.

The status of projects during 1979-80 is as follows:

1. Delineation of Regional Geothermal Anomalies
 - 1.1 Preliminary investigation of geothermal potential of the Montereion Hills. No action owing to low priority for existing funds.
 - 1.2 Geological and radiometric surface mapping of Coryell Intrusives.

Contract let to University of British Columbia for \$11,575, scientific monitor J.G. Souther. First invoice recently received for \$4844.

Summer field work done, consisting of mainly geological mapping, very

few radiometric observations made. Little or no progress since end of field operations but J.G. Souther is to pursue.

- 1.3 Diamond drilling for temperature and other measurement in young intrusives. No action owing to lack of funds.
- 1.4 Magneto-telluric surveys at Meager Mountain and in Squamish Valley. Contract let to MERI for \$45,029, scientific monitor G. Niblett. Paid so far \$21,880. Field work completed and analysis in progress, final report due 1 March 1980. (Received 14 February, 1980).
- 1.5 Water and rock sampling activities, to be used as required by J.G. Souther. The major expense has been a set of air photographs of Mt. Cayley, a volcanic centre similar to Meager Mountain and about 60 km to the south. Total expenditure \$2,975.
- 1.6 Microprobe analysis of volcanic minerals. No action owing to lack of funds, but savings from 2.1/2.2 below now provide \$4000. Scientific monitor J.G. Souther.
- 1.7 Potassium-Argon dating of volcanic rocks. Contract let to University of British Columbia for \$6,500, scientific monitor J.G. Souther. Work complete, awaiting invoice.
2. Identification and Assessment of Geothermal Resources
 - 2.1/ Alteration and fission track studies of core from Meager Mountain.
 - 2.2 Contract let to Geotex Ltd. for \$18,656, scientific monitor J.G. Souther. Because the drilling programme produced less core than was anticipated, the contract is to be reduced to \$7,411; \$4000 has been allocated to 1.6 above, and \$4,358 has been added to 3.1 below.
 - 2.3 Radon surveys at Meager Mountain. No action.
 - 2.4 Mercury surveys at Meager Mountain. No action.

- 2.5 Isotope hydrology at Meager Creek. Contract let to University of Waterloo for \$32,253, scientific monitor J.G. Souther. Field work complete and analysis in progress.
3. Geothermal energy from sedimentary basins
 - 3.1 Hydrofracturing of Regina well. Contract let to University of Toronto for \$129,796, scientific monitor A.M. Jessop. Work completed and final report received 23 January 1980. Paid so far \$103,601. A request for a cost overrun on rig and equipment costs of \$4,358 has been received. This will be met by means of the savings on project 2.1/2.2.
 - 3.2 Completion and testing of Regina well. Contract let to Univ. of Regina for \$102,116, scientific monitor A.M. Jessop. Paid so far \$85,855. Work completed and final report due.
 - 3.3 Temperature logging at Regina. One log run in July 1979, and waiting for equipment to run second log. Cost so far \$3,419. Scientific operator A.M. Jessop.
 - 3.4 Data acquisition in Western Canada Sedimentary Basin. No action due to lack of funds.

During 1979-80 roughly two thirds of the Panel funds available was allocated to the testing and hydrofracturing at Regina. A similar fraction of the 1978-79 fund was also allocated to Regina, but a special allocation at that time was used for contracted work at Meager Mountain. In 1979-80 all the main line of work at Meager Mountain was done by B.C. Hydro, with Federal input under the FPA. In 1980-81 the costs in Regina are expected to be placed under an FPA, so that the work in the cordillera can receive a much greater share of the available Panel funds than in the last two years. Activities, with supervisors and fund allocations were set up as follows:

1. Delineation of Regional Geothermal anomalies

Continuing activities:

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| 1.1. Geological and radiometric mapping of Coryell intrusives | J.G. Souther |
| Radiometric instrumentation and direction by T.J. Lewis. | \$12K |
| 1.2. Potassium - Argon dating of volcanic centres. | J.G. Souther |
| | \$ 7K |

New activities:

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| 1.3. Drilling of young intrusive rocks, to determine temperature gradients in a second area of high heat generation. | T.J. Lewis |
| | \$70K |
| 1.4. Resistivity survey at Cayley Mountain, a single line reconnaissance survey along the line of Shovelnose Creek. | J.G. Souther |
| | \$25K |
| 1.5. Drilling at Cayley Mountain, a 400 m hole on south side, closer to the mountain than the 1977 drilling, which provided a reference measurement. | J.G. Souther |
| | \$35K |
| 1.6. Pipe to preserve holes in areas of suspected high temperature gradient and transportation and installation costs. | T.J. Lewis |
| | \$10K |
| 1.7. Water and rock sampling as need and opportunity arises. | J.G. Souther |
| | \$ 5K |
| 1.8. Monitoring of temperatures during drilling projects 1.3 and 1.5 | T.J. Lewis |
| | \$10K |
| 1.9. Preliminary study of Monteregeion Hills. Low priority item, subject to progress of geophysical surveys now being planned elsewhere. | M.J. Drury |
| | \$15K |
| 1.10. Preliminary study of Maritimes intrusives. Probably to be superseded by action under Federal-Provincial Agreements. | M.J. Drury |
| | \$15K |

1.11. Mercury survey in a recent volcanic belt, probably the Anaheim Belt or the Alert Bay Belt on Vancouver Island.	J.G. Souther
	<u>\$10K</u>
Total - Project 1	\$214K
2. Identification and assessment of geothermal resources	
Continuing activities:	
2.1. Alteration studies of core from Meager Mountain and other drilling.	J.G. Souther
	\$ 9K
New activities:	
2.2. Magneto-magnetic resistivity survey at Meager Creek at sites occupied by magneto-telluric survey.	L.K. Law
	\$15K
2.3. Literature study of seismic monitoring for reservoir activity, to be extended to survey if appropriate.	G.C. Rogers
	in-house
2.4. Thermal conductivity of rock cores from various drill sites.	T.J. Lewis
	\$ 2K
2.5. Magnetic survey in the vicinity of Meager Mountain.	L.K. Law
	<u>\$ 5K</u>
Total - Project 2	\$31K
3. Geothermal energy from sedimentary basins	
Continuing activities:	
3.1. Temperature logging of Regina well and second well if drilled	A.M. Jessop
	\$10K
3.2. Acquisition of net-rock analyses.	A.M. Jessop
	\$40K

New activities:

3.3	Investigation of temperature anomalies subject to opportunity.	A.M. Jessop
		\$15K
3.4	Feasibility study of geothermal potential in NE British Columbia	A.M. Jessop
		<u>\$20K</u>
	Total - Project 3	\$85K

Summary

	\$K
1. Regional geothermal anomalies	214
2. Identification and assessment of resources	31
3. Sedimentary basins.	85
D.S.S. charges, 6% of contracts	20
Travel and operating expenses	<u>15</u>
Total	365
Funds available	360

It is anticipated that the small difference in the totals will be adjusted to zero as refinements in the costs become available. It is essential that all activity supervisors let me know changes in expected costs as soon as possible. If costs rise above projected levels or if new activities are introduced a discussion of priorities will be necessary in order to determine which activities will be delayed until 1981-82.

Meetings in Regina

Two meetings were held in Regina on 17 December 1979, at the University. The first involved J. Klassen of D.P.W., Ottawa, L. Vigrass of the Univ. of Regina, J. Postlethwaite, of Univ. of Saskatchewan, and M. Drury and A. Jessop of E.M.R.

Although the plan to move part of the Dept. Agriculture to a new building at Lethbridge and to use geothermal heating has been shelved, D.P.W. maintain an interest in the use of geothermal water for space heating in the Prairies. The meeting was called to investigate the possibility of sponsoring some work in the subject of corrosion of hardware by geothermal fluids, but the available funds were from the year 1979-80. It was agreed that J. Postlethwaite would submit a proposal to L. Vigrass for transmittal to D.P.W. The proposal would provide for a literature study, a plan for cathodic protection of the well casing, and a programme of corrosion coupon studies, using the well water. The completed proposal was sent to D.P.W. on 27 December 1979.

The second meeting was attended by J. Hutchinson of the Dept. of Mineral Resources of Saskatchewan, L. Vigrass, M. Drury and A. Jessop. The subject for discussion was the drilling of the second well for the Regina demonstration project. Mr. Hutchinson expressed the opinion that the drilling can be described as research, and thus is not a suitable item for funding under the Federal-Provincial agreement on Renewable Resources. The others present argued that the research aspects of the second well are very minor, that the element of uncertainty or risk is minimal, and that the drilling is truly described as part of the demonstration project. This makes it a suitable item for inclusion in the F.P.A. We believe that Mr. Hutchinson accepted our arguments.

Arrangements have been made to run a conventional E.P.B. temperature log in an old well on the north side of the city of Regina, about 10km from the University campus. This well is not as deep as the geothermal well, but it will be useful to compare gradients and to confirm that the geothermal well is not in a small scale anomalous area. Temperature logs of both this well and the University well are planned for early February 1980, and will be reported later.

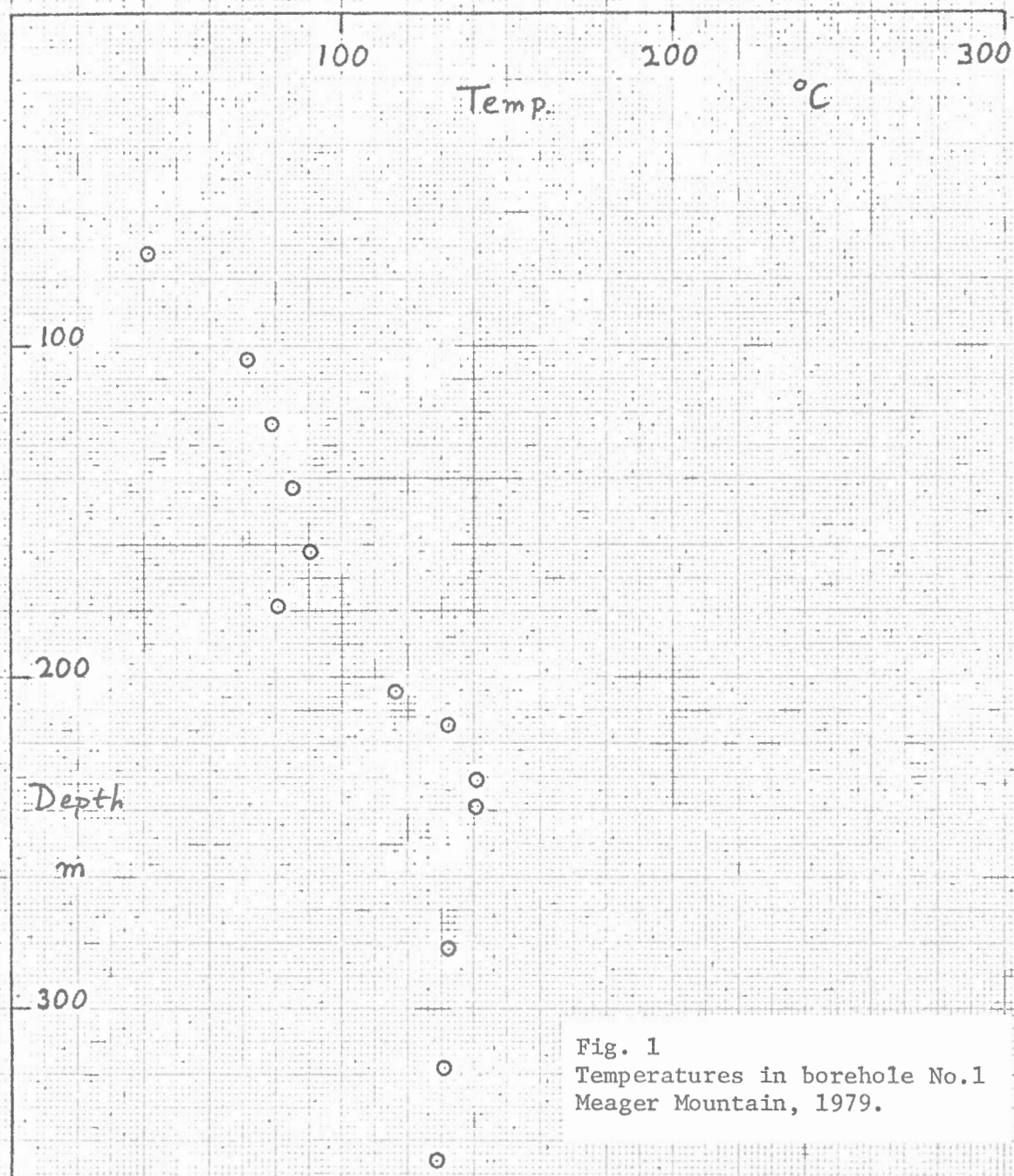


Fig. 1
 Temperatures in borehole No.1
 Meager Mountain, 1979.

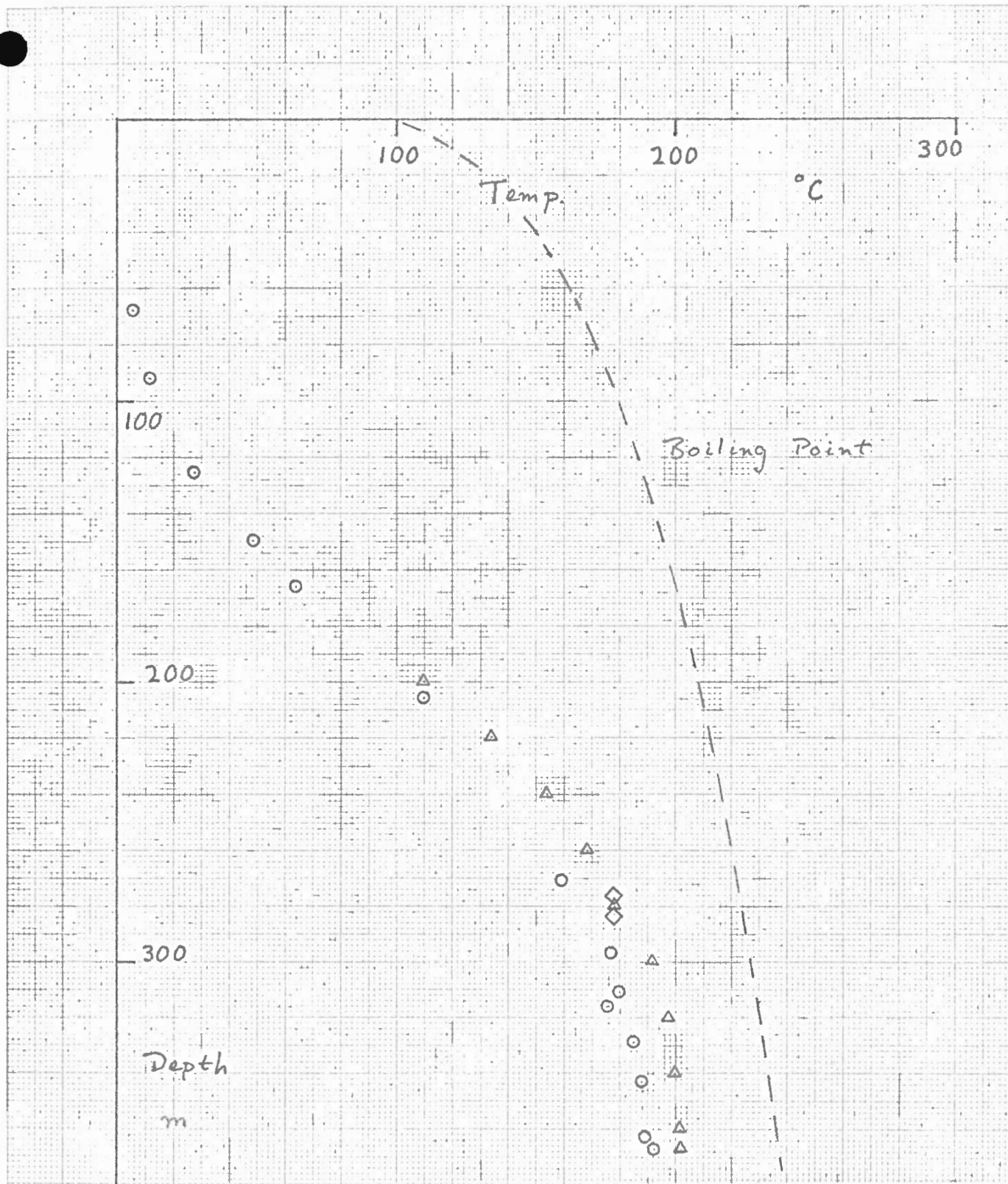


Fig. 2
 Temperatures in borehole No.2
 Meager Mountain, 1979

- During Drilling
- △ 6 Dec. 1979
- ◇ 30 Jan. 1980

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