Geothermal Energy

May 1981

ASSESSMENT OF THE GEOTHERMAL ENERGY RESOURCES OF THE MARITIME PROVINCES: DATA COLLECTED IN PHASE I.

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Internal Report No. 81- 9

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Ottawa

1981

A contract was let in the autumn of 1980 to John A. Leslie and Associates Ltd., Bedford, Nova Scotia, to investigate the geothermal energy resources of Nova Scotia and Prince Edward Island. A similar contract for work in New Brunswick attracted no bids, owing to its small size. No attempt was made to collect data in Newfoundland in F.Y. 1980-81, although the author visited Mr. N. French of the Newfoundland Department of Mines and Energy. It was agreed that an effort to collect and compile relevant data for Newfoundland would be appropriate to the aims of both the federal and provincial governments. The current situation is, therefore, that a data collection has been obtained for N.S. and P.E.I., and a contract or contracts should be awarded in the present fiscal year to extend this collection to N.B. and Nfld.

The N.S. and P.E.I. contract resulted in a report, hereafter referred to as the Leslie Report, being presented. It consists of a discussion of the geology of the area under consideration, a compilation of existing data, and a presentation of new temperature data acquired as the opportunity arose. It also includes a very useful set of maps (gravity, magnetics, airborne γ-ray, basement structure etc.). No new data for the assessment of the potential for geothermal energy with hot, dry rock as a heat source, were acquired. This aspect of the work should be given increased emphasis in future phases.

The most important criteria in the assessment of a possible geothermal resource in a sedimentary basin are water temperature and formation porosity and permeability. Porosity and permeability in the various carboniferous basins of the region may be as high as 35-40% and 650-700 millidarcies

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respectively. These high values are reached in the Upper Horton sandstones, particularly in the Inverness area of N.S. (western Cape Breton Island).

Both on-shore and off-shore data were collected. Bottom-hole temperature (BHT) data are usually of very poor quality. However, they are sufficient to show a trend. The on-shore data are plotted in Fig. 1 and the off-shore data are plotted in Fig. 2. The gradient derived from the on-shore BHT data is 17 mKm^{-1}, and for the off-shore data it is 23 mKm^{-1}. Both data sets yield surface temperature intercepts of approximately $10^{o}C$. These values are not particularly encouraging; the on-shore data suggest a depth of greater than 3000m would be necessary for water at $60^{o}C$ to be found. This compares unfavourably with the results from the geothermal test well at Regina, in which water at a temperature of $62^{o}C$ has been detected at a depth of 2210m.

There is, however, evidence that temperatures at depth could be higher than would be predicted from the gradient and intercept values given above. The Leslie Report included data from five new temperature logs in boreholes drilled into sediments in Nova Scotia. These data are displayed in Figs. 3 and 4. The lack of well defined temperature gradients in the holes is indicative of vigorous vertical water flow. It is noted in the Leslie Report that water was flowing over the top of the surface casing in 146-1 and 146-2, and that water flow could be heard in 146-3. In the latter, the gradient below 100m is 27 mKm^{-1}, with a surface temperature intercept of $7.25^{o}C$.

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Five holes drilled into carboniferous sediments were logged in New Brunswick in September 1980 by the author and A.M. Jessop. Vigorous vertical water flow in the boreholes was detected, and in one case visually observed, in three of these holes. Only in two, at Fredericton and Tracy (143 and 144 respectively, Fig. 5) was a thermal gradient definable, with a value of 26.5 mKm^{-1} and surface temperature intercept approximately $6^{o}C$.

It appears, therefore, that a regional thermal gradient of 23-27 mKm^{-1} within the sedimentary basins of the area is present. This regional average gradient needs to be defined much more precisely. More importantly, any areas of anomalously high thermal gradient must be located. Two approaches are desirable to achieve the objective: a thorough hydrological study of the basins, and BHT measurements during drilling of any new holes.

A meeting similar to the one held in Edmonton in February of this year is planned for early June, at which it is hoped that various experts in relevant fields can be brought together to discuss the next phase of this work.

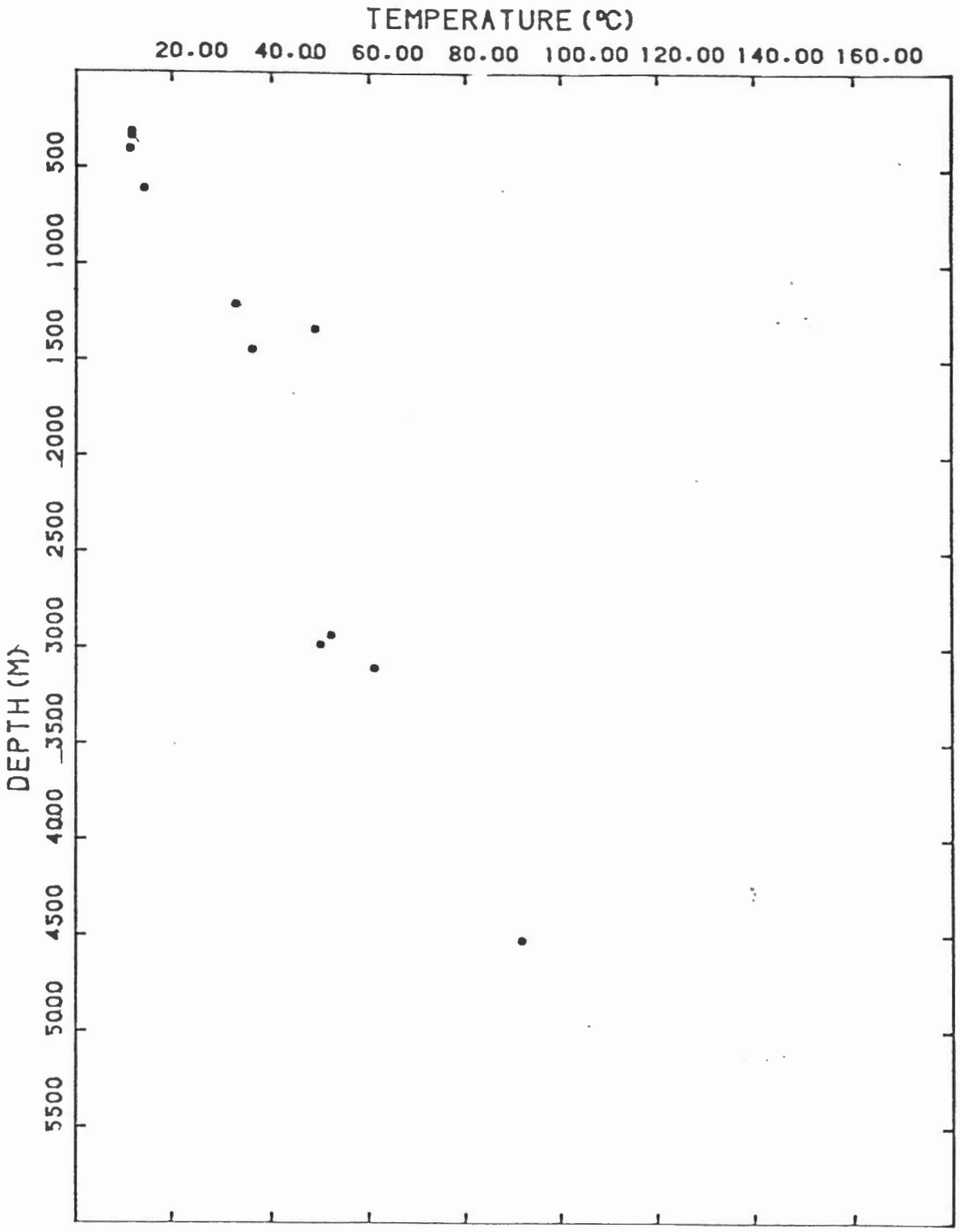

Fig.1 Bottom-hole temperatures versus depth for on-shore wells in Nova Scotia and Prince Edward Island. Linear regression yields a slope of 17.3 mKm^{-1}, with a surface intercept of 8.2°C, and correlation coefficient 0.958, for 11 data points.

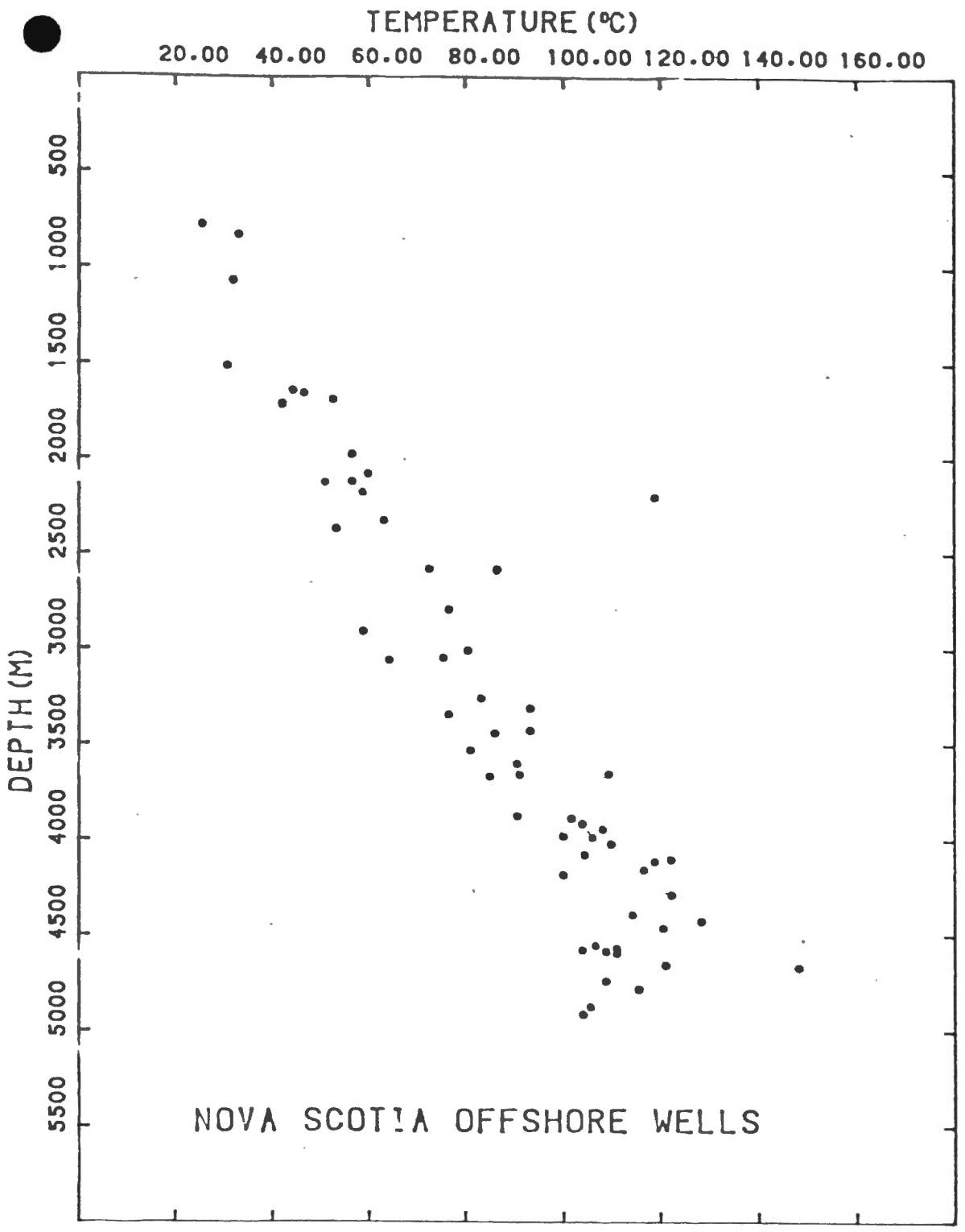

Fig.2 Bottom-hole temperatures versus depth for off-shore wells of the continental shelf off eastern and south-eastern Nova Scotia. Linear regression parameters are: gradient 23.0 mKm^{-1}, surface intercept 10.6°C, correlation co-efficient 0.905 for 60 data points.

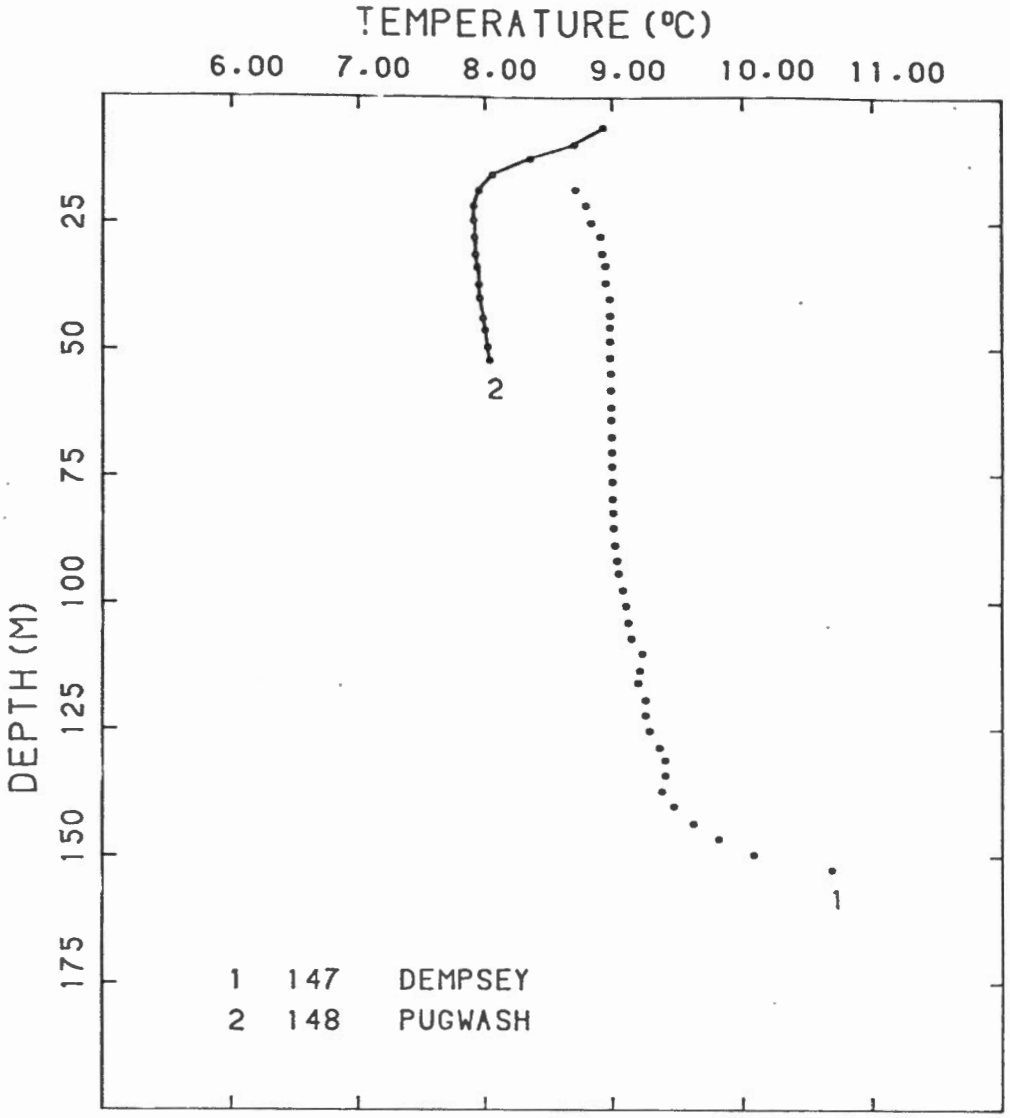

Fig.4 Temperature logs of boreholes near Dempsey, Annapolis Valley, and Pugwash, near Northumberland Strait, N.S.

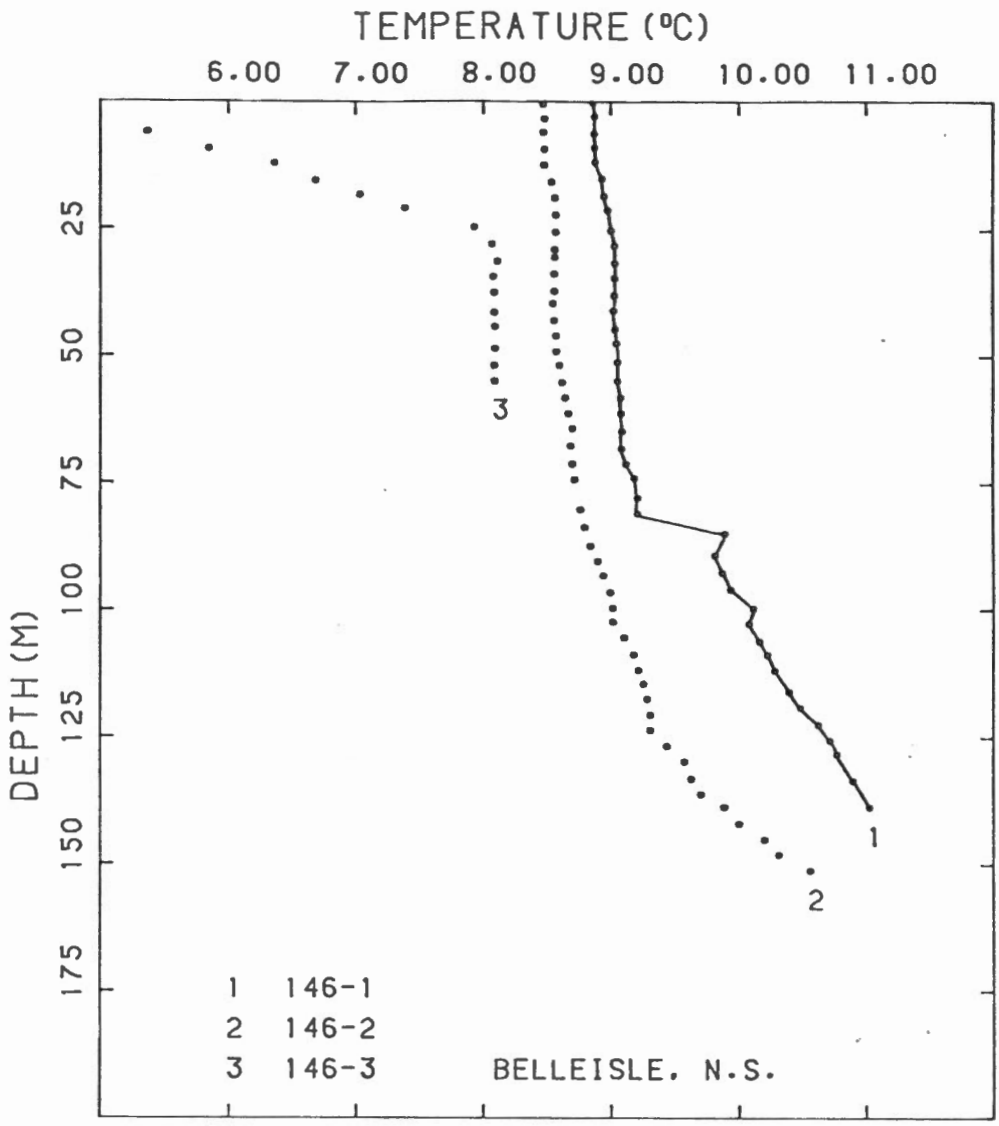

Fig.3 Temperature logs of three boreholes near Belleisle, in the Annapolis Valley, N.S.

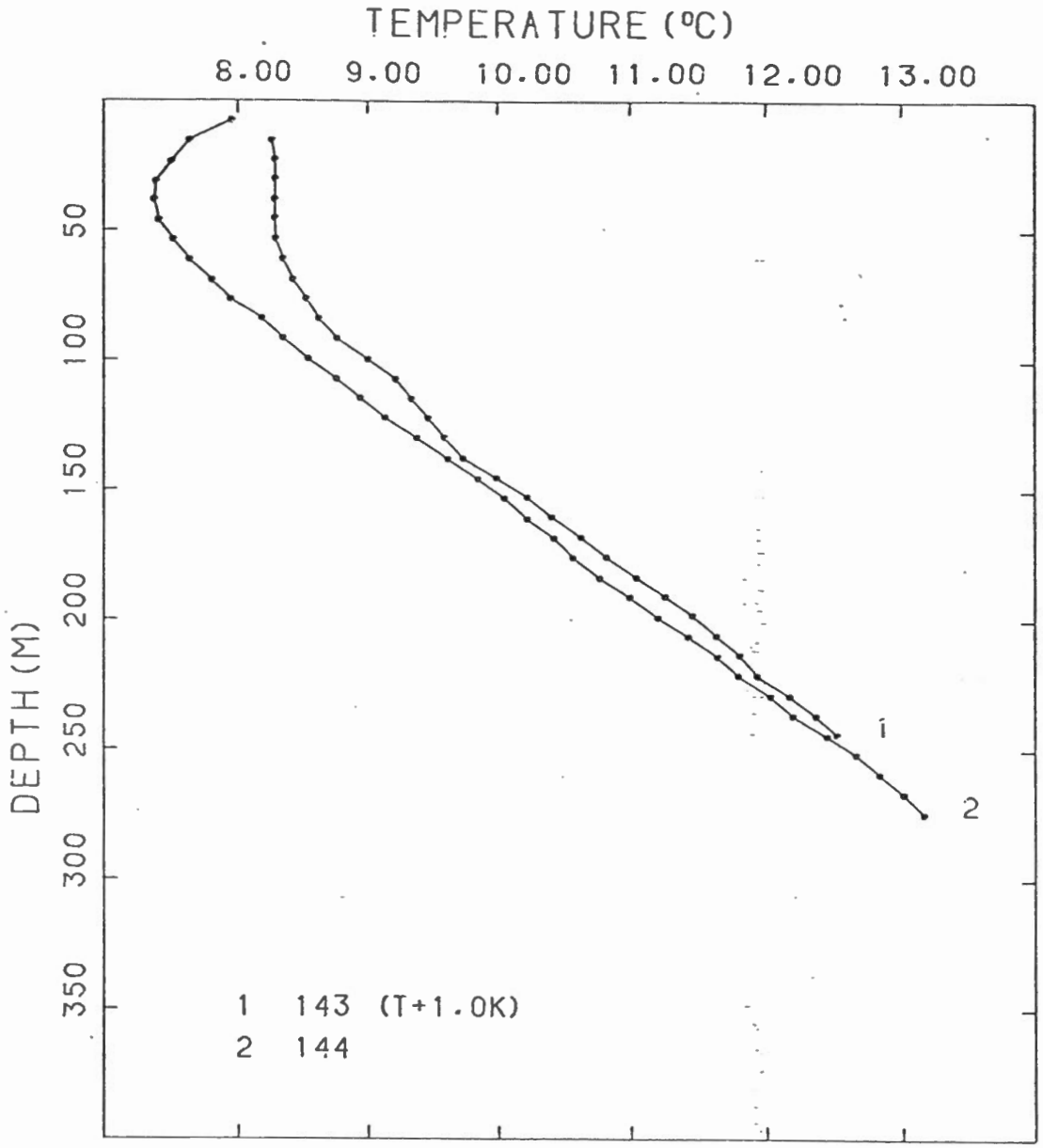

Fig.5 Temperature logs of boreholes near Fredericton (143) and Tracy (144) N.B.