GL02792

16 Feb 81

Mike — any comments (in a day or so)? D.F.

A CONTINUATION OF THE EVALUATION OF GEOTHERMAL RESOURCES IN NEBRASKA

A Proposal Submitted
to
Division of Geothermal Energy
U.S. Department of Energy
by
University of Nebraska
Lincoln, Nebraska 68588
To Extend Contract DE-AS07-79ET27205
University Account 87-040-562

Administrative Units:
Conservation and Survey Division (State Surveys)
Institute of Agriculture and Natural Resources
University of Nebraska-Lincoln
Department of Geography-Geology
University of Nebraska-Omaha

Proposal Period: Two years starting April 1, 1981
Funding: $249,979

Principal Investigators:
Dr. William D. Gosnold, Jr.; Department of Geography-Geology, UN-O
Mr. Duane A. Eversoll; Nebraska Geological Survey,
Conservation and Survey Division, UN-L

Project Coordinator:
Dr. Marvin P. Carlson, Assistant Director
Conservation and Survey Division
(402) 472-3471

Marvin P Carlson
Marvin P. Carlson
Project Coordinator

2/10/81
Date

Introduction

The goals of the State Coupled Resource Assessment Program in Nebraska under the current contract, DE-AS07-79ET27205, which covers the time period April 1, 1979 through March 31, 1981 are as follows:

(1) Compile existing data on the geothermal regime of Nebraska.

(2) Drill and log about 30 shallow (150 meter) heat flow holes.

(3) Prepare appropriate maps to display the results of the study.

These goals have been reached with considerable success and the results of the study indicate the existence of an extensive low-temperature geothermal resource beneath Nebraska as well as several regions with indications of unique heat flow values. These regions are perceived as due to conditions such as large scale flow of warm waters from the Kennedy basin in South Dakota and the Denver Basin in Colorado and Wyoming.

Current knowledge of the resource is general, but that knowledge could be increased and refined considerably by continued investigations. This request summarizes the results of the current study and proposes continued investigations to be conducted as a two year extension to the current contract.

Summary of Results

Existing data were assimilated during the first year of the contract. Data were assembled from a number of published sources including regional heat flow studies (Roy et. al., 1972; Combs and Simmons, 1973; Sass et. al., 1976), a silica-geothermometry study (Swanberg and Morgan, 1979), the A.A.P.G. geothermal gradient map of North America (U.S.G.S., 1976), and geological

studies by the Nebraska and South Dakota geological surveys (Souders, 1976; Schoon and McGregor, 1974). In addition, the compilation of the bottom-hole temperatures of about 13,000 petroleum exploration wells has yielded significant information. During the project, access was obtained and temperature gradients measured in 34 additional shallow holes. Twenty-seven heat flow holes were drilled and logged and the final heat flow determinations are being made.

The interpretation of these data is given in Figure 1 which is essentially a draft of the user-oriented map that is one project goal. The figure is a temperature contour map for a depth of one kilometer with the constraint that the isotherms lie within sedimentary formations that could potentially produce large amounts of water. After three-fourths of Nebraska overlie a potential geothermal resource with temperatures greater than 40°C at a depth of one kilometer. The 50°C isotherm lies at depths ranging from 0.85 to 1.4 kilometers within the resource area and the 40°C isotherm occurs at depths ranging from 0.6 to 1.0 kilometers.

In summary, a general review and inventory has been completed for available data representing the geothermal regime in Nebraska. These data are being compiled into report form and as a general resource map for the state. In additional site specific data have been collected which support the results of the general inventory program.

Proposed Investigation

Although the presence of an extensive low-temperature geothermal resource has been documented in Nebraska significant questions remain about the resource. These questions are relevant to both the technical verification of the geothermal system as well as data enhancement for potential utilization of the resource. The following project areas are proposed for the continuation of the evaluation of the geothermal resources in Nebraska.

1. Bottom-hole Temperatures. The inventory of available bottom-hole temperature (BHT) data has been completed for 85 of the 93 counties in Nebraska. The remaining counties have large concentrations of data related to productive oil and gas fields. Selected data has been reviewed in these local areas and could be summarized for input suitable for regional analysis. However, these local data sets could provide valuable insight into substate aquifer systems. It is proposed to accomplish a complete inventory rather than to select representative data. All BHT data along with pertinent time and depth information will have been compiled and stored on the Division's internal computing system. Output programs have been installed and tested which can provide the tabulation products relevant to resource assessment.

2. Aquifer Characteristics. Although Nebraska has an abundance of high-yield, good quality aquifer systems, potential quantity/quality limitations should be characterized for substate regions. It is proposed to assemble the available water quality data and relate these data to the appropriate geothermal systems. The petroleum industry has performed a large number of drill-stem-tests for some of the deeper aquifer systems which could indicate local flow potential. To the extent possible, these quality/quantity data will be interpreted as to their influence on aquifer utilization for a geothermal resource. Products will include tables, maps, and diagrams pertinent to a user audience.

3. Well Logging-Field Verification. The heat flow patterns delineated during the current inventory have been substantiated by logging of actual temperature gradients in both shallow and deep wells. Available water supply wells and water level observation wells were measured in addition to those test wells drilled specifically for temperature measurement. It is proposed to continue this data inventory of shallow temperature gradients

to more specifically define substate areas. During our current contract, a pilot study investigated the availability of selected deep wells. In cooperation with the Nebraska Oil and Gas Commission, four deep wells were selected and logged at our request by the University of Wyoming. The results from these logs are given in Figures 2-6 and confirm the existence of the high subsurface temperature projected for the area. It is proposed to expand this data gathering activity to both verify site-specific conditions and to further document our other inventory programs.

4. Computer-oriented Data Translation. A variety of state-wide data sets have been assembled which could be relevant to inventory and assessment of geothermal resources. These include direct character measurement as well as indirect tabulations of geophysical data. An example of the latter are the large number of regional data sets for gravity data. The BHT and drillstems test data generated by the petroleum industry are other examples. It is proposed to collect, evaluate qualitatively and integrate these data sets into our resource assessment program. A major analytical effort will be applied by integrating the BHT data with the deep well logging activity. The inherent limitations of the BHT data from the petroleum industry forestall direct utilization for resource assessment although there are uniform characteristics within the data set. As the result of the other ongoing project activities, Nebraska will have a complete inventory of BHT data tied to the geohydrological framework as well as a selected base of measured deep well temperature data. All of these data will be computer-compatable. It is proposed to use these Nebraska data to develop software programs for translating the industry data into real value temperature information. The success of these programs would allow this capability to be applied by other states which have undergone petroleum explorations

5. Public Service and User Application. During the current program the general public, through the media, have been kept informed of the project activity. Both the field projects and press releases have created interest from the potential user audience. A major product will be the 1:500,000 state maps currently being compiled. The subprojects proposed under the extended program will allow products to be produced for both substate regions and for potential methodology of utilization. The data collection and interpretation projects should allow the preparation of aquifer maps in response to local interests. Both project data and material available nationally will be utilized to prepare information brochures pertinent to potential Nebraska utilization of geothermal energy.

Budget Detail: April 1, 1981-March 31, 1983

Wages (Percent of effort-Two Years)			88,962
Geophysicist	45%	21,862	
Research Ass't	100%	29,500	
Programmer	15%	9,600	
Hourly		28,000	
Benefits (14%)			12,455
Contractual Services			50,000
Deep well logging		40,000	
Geophysical Analysis		10,000	
Operations			15,500
Expendable Supplies		2,000	
Report preparation		3,500	
Computer time		10,000	
Travel			15,100
Transportation		9,000	
Subsistance		6,100	
Total Direct			182,017
Indirect (UNO-37%, UNL-38%)			67,962
Total Budget			249,979

During the period April 1, 1981 to March 31, 1983 the University of Nebraska will contribute $25,000 in costs to this investigation by supporting the efforts provided by the following University staff.

Marvin P. Carlson, Project Coordinator	$ 9,000
William D. Gosnold, Jr., Principal Investigator	12,000
Duane A. Eversoll, Principal Investigator	4,000

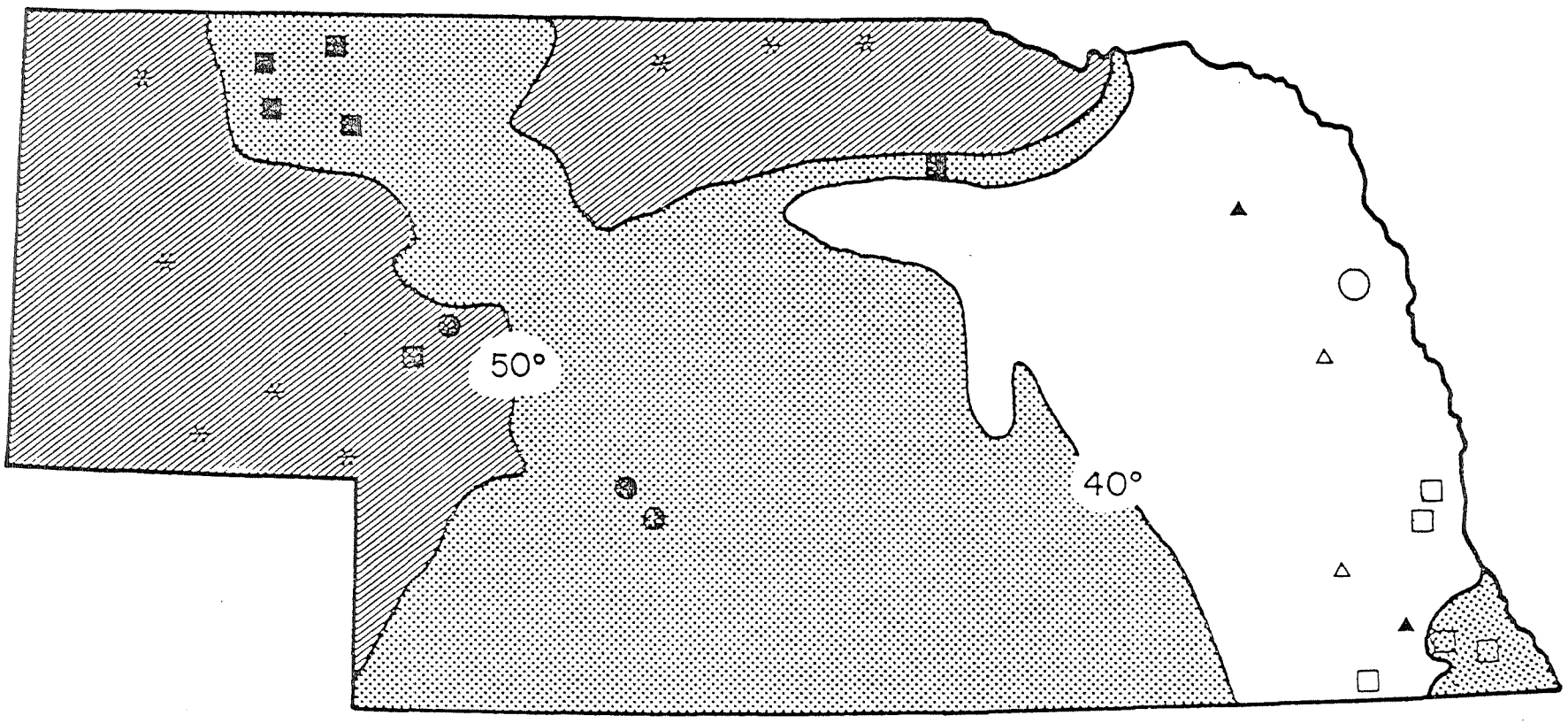

Figure 1. The temperature contours indicate where the 40 and 50 °C isotherms lie at a depth of one kilometer and in a sedimentary formation that could produce water. The symbols are heat flow data. Key: (Units are mW/ m^2) ○ = 30-50; □ = 50-60; △ = 60-70; ● = 70-80; ■ = 80-100; ▲ = 100-120; * > 120.

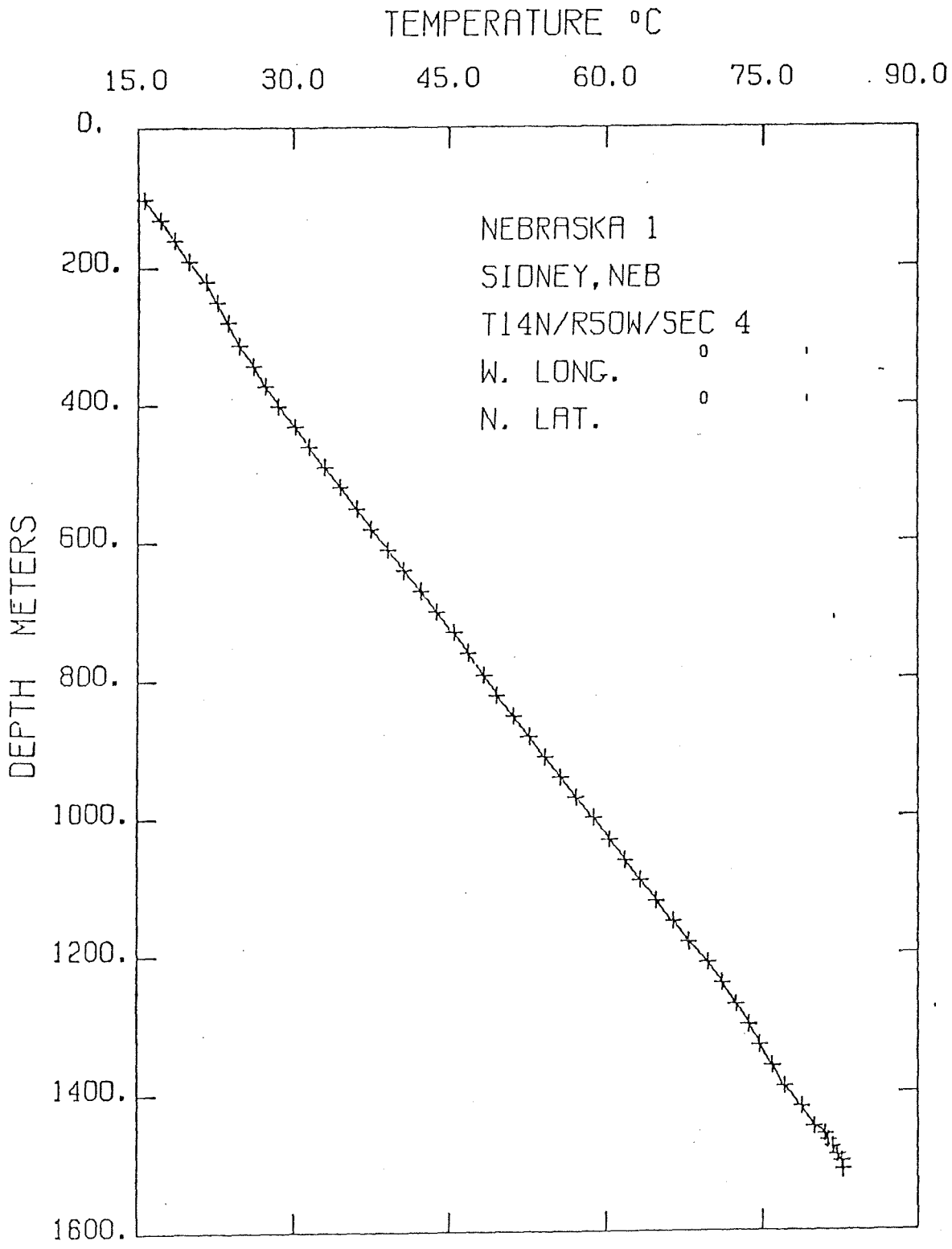
TEMPERATURE °C
15.0
30.0
45.0
60.0
75.0
90.0
0.
200.
400.
600.
800.
1000.
1200.
1400.
1600.
DEPTH METERS
NEBRASKA 1
SIDNEY, NEB
T14N/R50W/SEC 4
W. LONG.
N. LAT.

Figure 2

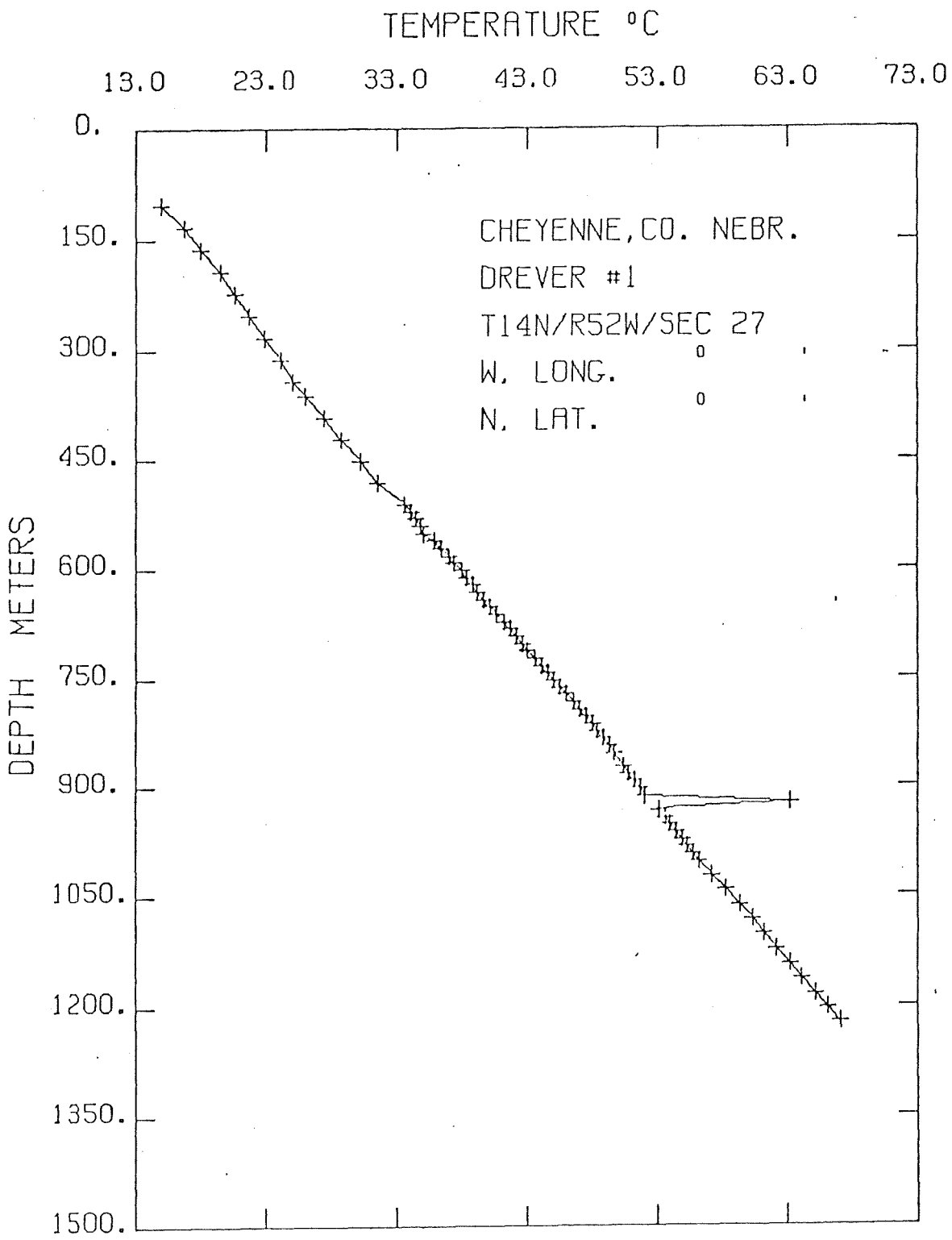
TEMPERATURE °C
13.0
23.0
33.0
43.0
53.0
63.0
73.0
0.
150.
300.
450.
600.
750.
900.
1050.
1200.
1350.
1500.
DEPTH METERS
CHEYENNE, CO. NEBR.
DREVER #1
T14N/R52W/SEC 27
W. LONG.
N. LAT.

Figure 3

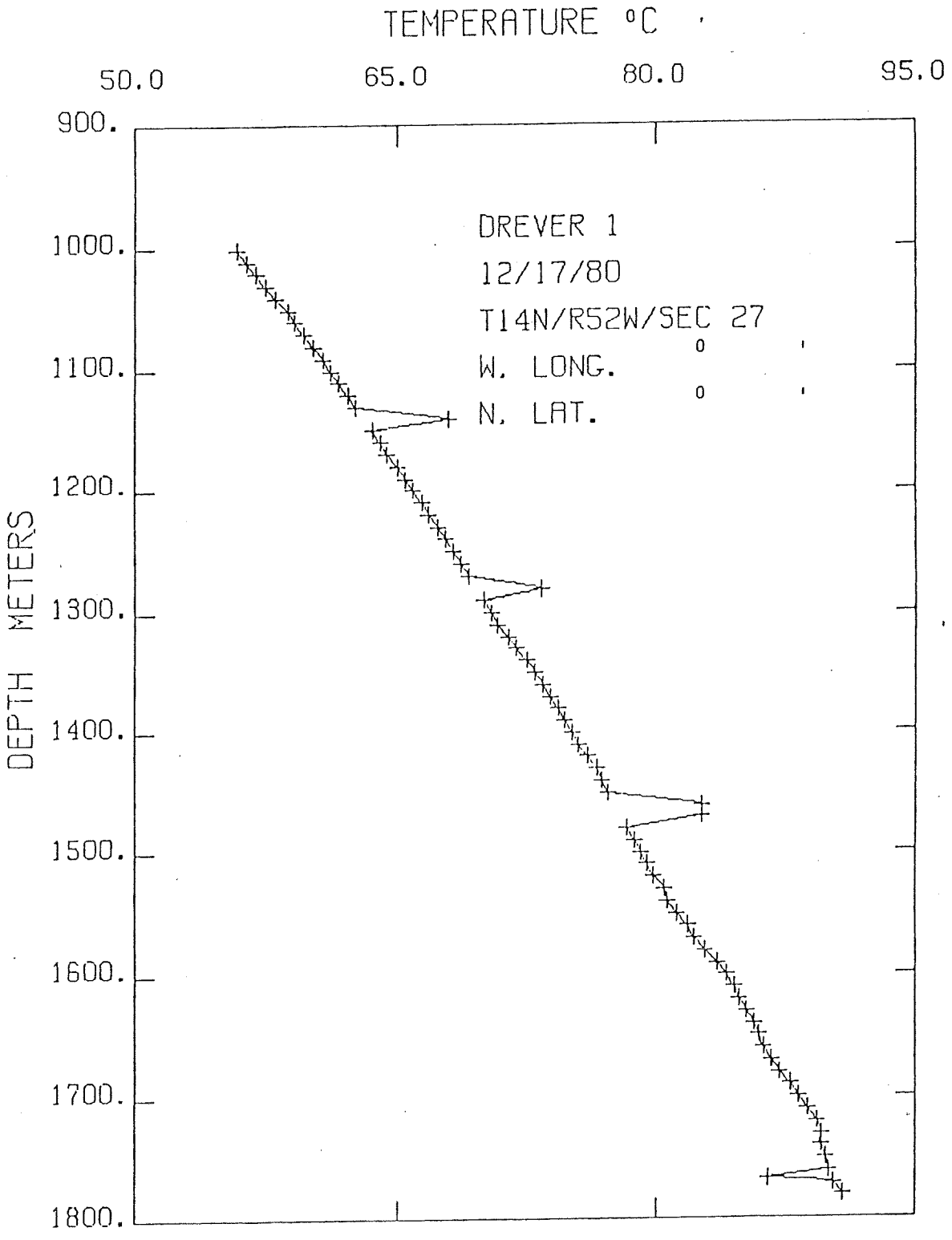
TEMPERATURE °C
50.0
65.0
80.0
95.0
900.
1000.
1100.
1200.
1300.
1400.
1500.
1600.
1700.
1800.
DEPTH METERS
DREVER 1
12/17/80
T14N/R52W/SEC 27
W. LONG.
N. LAT.

Figure 4

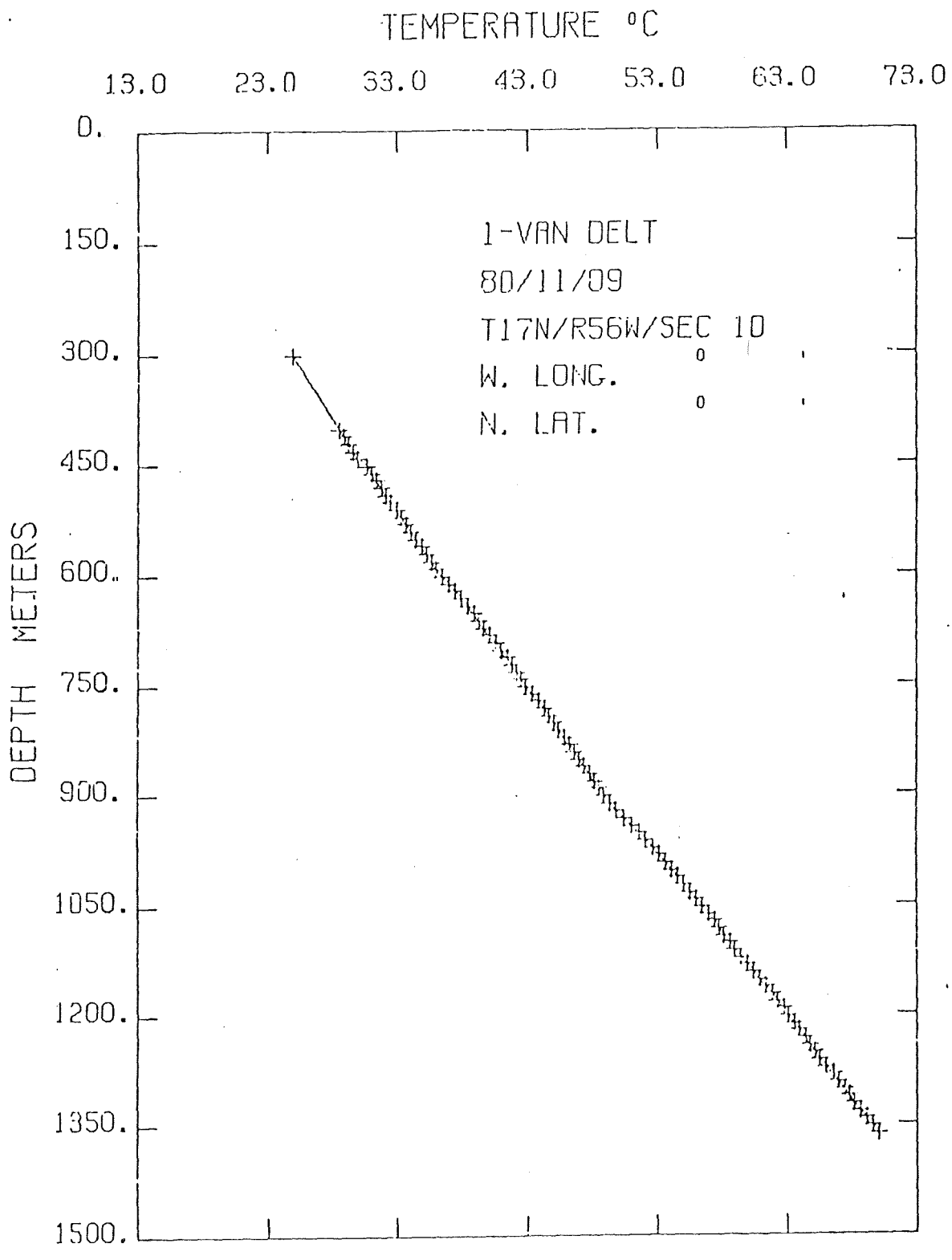
TEMPERATURE °C
13.0
23.0
33.0
43.0
53.0
63.0
73.0
0.
150.
300.
450.
600.
750.
900.
1050.
1200.
1350.
1500.
DEPTH METERS
1-VAN DELT
80/11/09
T17N/R56W/SEC 10
W. LONG.
N. LAT.

Figure 5

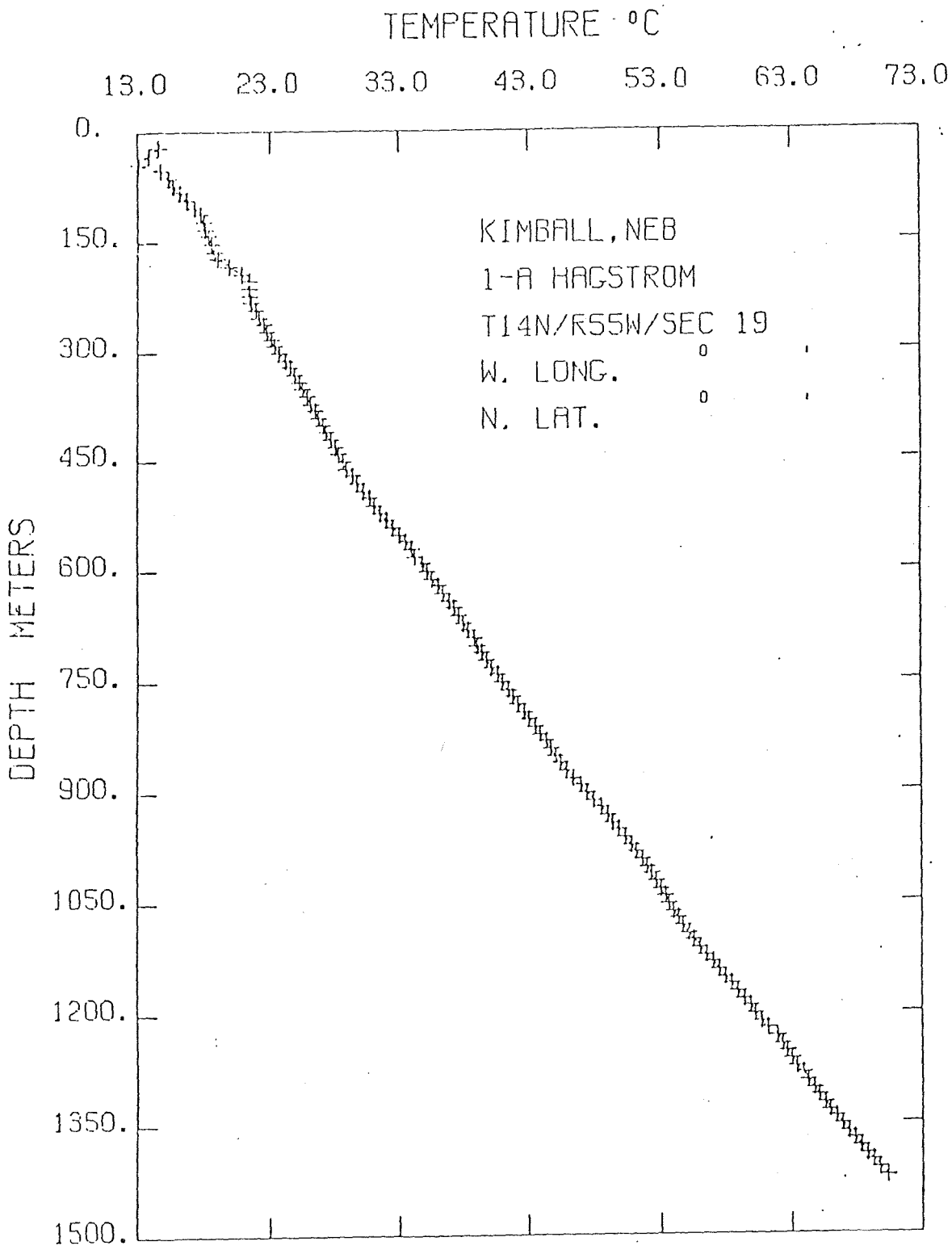
TEMPERATURE °C
13.0
23.0
33.0
43.0
53.0
63.0
73.0
0.
150.
300.
450.
600.
750.
900.
1050.
1200.
1350.
1500.
DEPTH METERS
KIMBALL, NEB
1-A HAGSTROM
T14N/R55W/SEC 19
W. LONG.
N. LAT.

Figure 6