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PRELIMINARY GEOLOGY AND
GEOTHERMAL RESOURCE POTENTIAL
OF THE
WESTERN SNAKE RIVER PLAIN
OREGON

by

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DISCLAIMER

This report has not been edited for complete conformity with Oregon Department of Geology and Mineral Industries standards. Data in this document are preliminary and are subject to change upon further verification.

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INTRODUCTION

The study area is located at the western boundary of a large, arcuate topographic low, stretching across the width of southern Idaho, known as the Snake River Plain (Figure 1). Limits of the study area were arbitrarily set at the boundaries of available U.S. Geological Survey (USGS) topographic maps at latitudes $44^{\circ}15'00''$ on the north and $43^{\circ}52'30''$ on the south and at longitude $117^{\circ}30'00''$ on the west and at the Oregon-Idaho border on the east. This study, performed under U.S. Department of Energy (USDOE) Contract No. DE FC07-79E727220, was undertaken to estimate the geothermal potential of the area using various methods including compilation of existing data, photo-lineament analysis, well and spring geochemistry, and accrual of geothermal-gradient data.

Geographically, the study area is comprised of a 1622 km^2 (625 mi^2) area of low, grass- and sagebrush-covered rolling hills cut in an east-west and north-south fashion by canyons of the Malheur River and Willow and Bully Creeks, respectively. The eastern boundary area is relatively flat, comprised mainly of the Snake River flood plain. The major population centers are the cities of Ontario (pop. 8,950) at the eastern edge of the study area, Vale (pop. 1,900) in the south-central portion, and a number of small farming and service-related communities along major highways throughout the area.

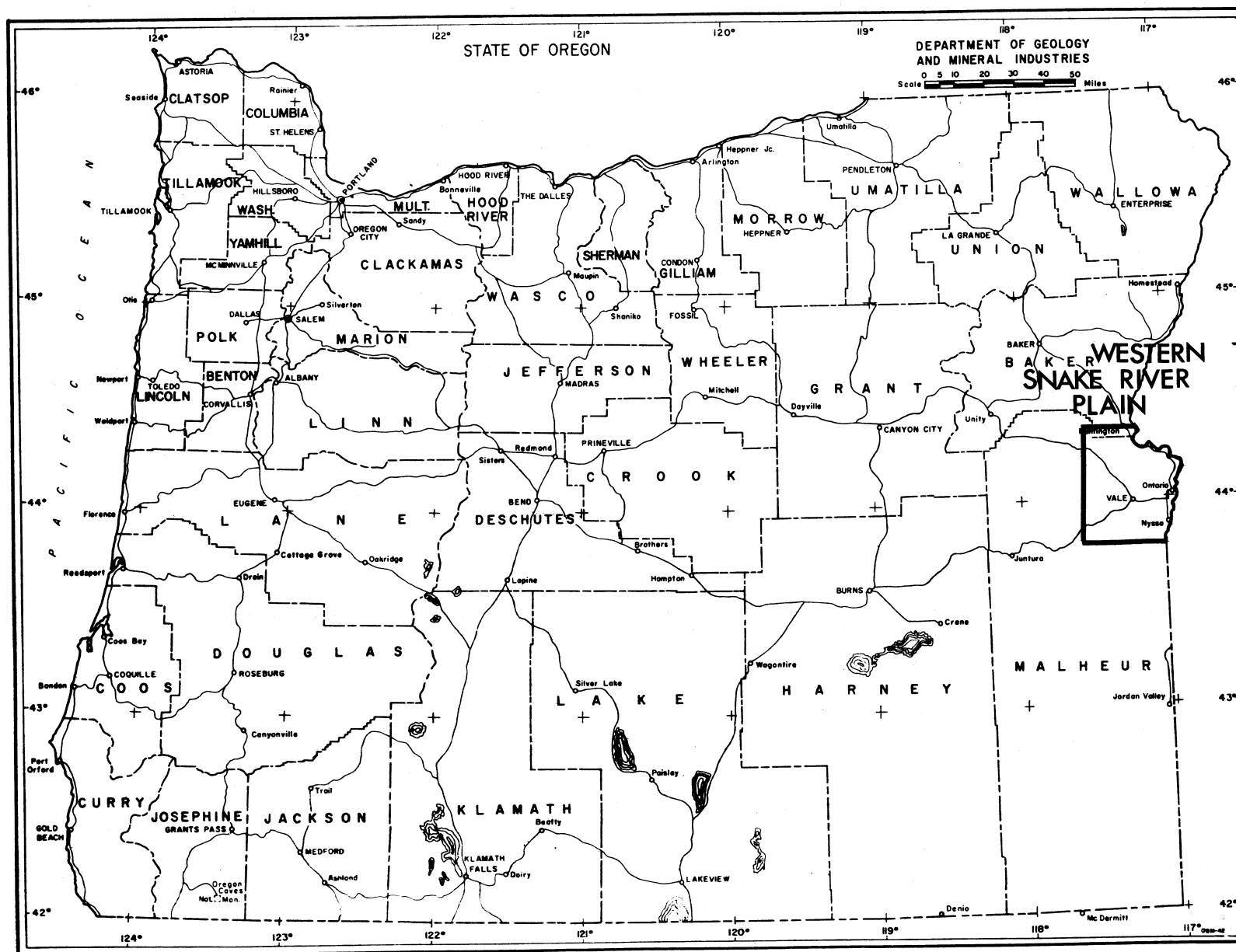


Figure 1: Map showing location of study area.

GEOLOGY

Introduction

The geologic map (Plates I and II) of this area is a generalization based on a compilation of a number of older graduate theses maps (Carlat, 1954; Calkins, 1954; Weeden, 1963; Kittleman, 1962), several reconnaissance studies (Corcoran and others, 1962; Newton and Corcoran, 1963; Brooks and others, 1976; and Walker, 1977), and several geophysical studies (Lillie, 1977; Boler, 1979; Couch and Baker, 1977; Couch, 1977; and Couch, 1978). Cross-sections are based on the compiled map and oil, gas, and geothermal well logs available through DOGAMI. In compiling the map, a number of difficulties arose concerning stratigraphy and absolute ages. Most problems were resolved by dispensing with the use of formation names and using generic names only. Absolute ages for rocks in the study area, however, are nonexistent in the public domain and are therefore not available to resolve a number of stratigraphic problems.

Stratigraphy

The geology of the area is characterized by Pliocene lacustrine and fluvial sediments with intercalated thin flows of olivine flood-basalt downwarped toward the east off a core of older Tertiary and Pre-Tertiary rocks to the north and west. These Pliocene units (map units *Tpst*, *Tpb*, *Tpob*) have been grouped into one large unit known as the Idaho Group (Corcoran and others, 1962). This unit has been mapped east across Idaho into southern Montana, and has been mapped and correlated west into the Harney Basin and beyond (Walker, 1977). Within the study area, it is the dominant surface unit.

Underlying the Idaho Group is a unit of Miocene flood basalts with minor tuffs and sediments (unit *Tmb*). This unit has been mapped north into the Colum-

bia River Basalt Group and south into the Steens Mountains Basalt, both of which are considered time-stratigraphic equivalents. This unit, which according to oil and gas drilling records has been downwarped several thousands of feet to the east, is locally termed the Owyhee Basalt. Age of this unit in the study area is not known; however, K/Ar dates taken from rocks found to the south indicate an age of approximately 13.4 to 13.6 m.y. for some flows.

Overlying and intruding the Owyhee Basalts and Idaho Group are a number of rhyolites, basalts, dikes, and mafic vents. The age and detailed stratigraphic relationships of these units are not clearly known. However, their distribution suggest a relationship with the structures of the underlying units.

Structural geology

The structures of the study area are poorly known. Several geophysical studies (Bowen and Blackwell, 1975; Lillie, 1977; Couch and Baker, 1977, etc.) have been made in an attempt to delineate the structural geology of the area using gravity and magnetics; however, very little has ever been mapped at the surface to corroborate. The structures that have been mapped are the Bully Creek Fault (Plate I) and the small folds and faults immediately to the east and south. Also mapped have been several small faults in the north-central portion of the map (Plate II) and a broad, south-plunging anticline northwest of Ontario. The remaining faults shown on the geologic map have been inferred from geophysical studies or from aerial-photo interpretation.

The general structural trend of the area (both mapped and inferred) is northwest-southeast with the regional dip down toward the east. Faulting appears to be normal in relative offset, however Lawrence (1976) interprets the Willow Creek Fault as a right-lateral termination fault of the Basin-Range Province.

Faulting has formed a number of graben and horst structures which have subsequently, in some instances, been gently folded into broad, plunging anticlines and synclines.

The geothermal system present in the area is undoubtedly fault-controlled. The reader is directed to a number of publications which discuss the relationship of geophysics, structures, and the geothermal system. These publications are: Bowen and Blackwell, 1975; Lillie, 1977; Couch and Baker, 1977; Couch, 1974; Couch, 1978; Couch and others, 1975; Lillie and others, 1975; and Lillie and Couch, 1979.

GEOPHYSICS

A number of geophysical studies have been made of the Western Snake River Plain (see previous section on Structural Geology). Three of these studies are presented, at least in part, for evaluation in this study. They are: (1) a 1:62,500 aeromagnetic study performed by the Oregon State University Geophysics Group (Boler, 1970; Couch, 1978) presented as Plate IV; (2) a 1:250,000 complete Bouguer gravity study also performed by the Oregon State University Geophysics Group (Lillie, 1977; Couch and Baker, 1977) which is coupled with a photo-lineament study on Plate III, and (3) an audio-magnetotelluric apparent resistivity study performed by Long, Hoover, and Bramsoe, 1975, of the USGS, presented as Figures 2, 3 and 4.

Detailed interpretation of the gravity and aeromagnetic studies have been carried out in the aforementioned texts and the reader is directed to them for complete analysis. No additional interpretation of the data is attempted for this study.

The audio-magnetotelluric apparent resistivity study performed by Long and others (1975) delineates an area of low resistivity (high conductivity) in the area surrounding the city of Vale. This anomaly, however, shows considerable distortion over the frequency spectrum, ultimately splitting into two resistivity lows in the lower frequencies (i.e., deeper probing) aligned along a north-west-striking axis. This northwest-striking structure is interpreted as being the extension of the Willow Creek Fault proposed by Bowen and Blackwell (1975), and other authors. The relative distortion of closed anomalies between east-west and north-south telluric lines of similar frequencies is interpreted to be probably a function of the northwest strike of the Willow Creek Fault versus the

Figure 2:

AUDIO-MAGNETOTELLURIC APPARENT RESISTIVITY MAP

(From Long and others, 1975)
27 Hertz

Resistivity in ohm-meters

- 2.5 Telluric line north-south
- 6.3 Telluric line east-west

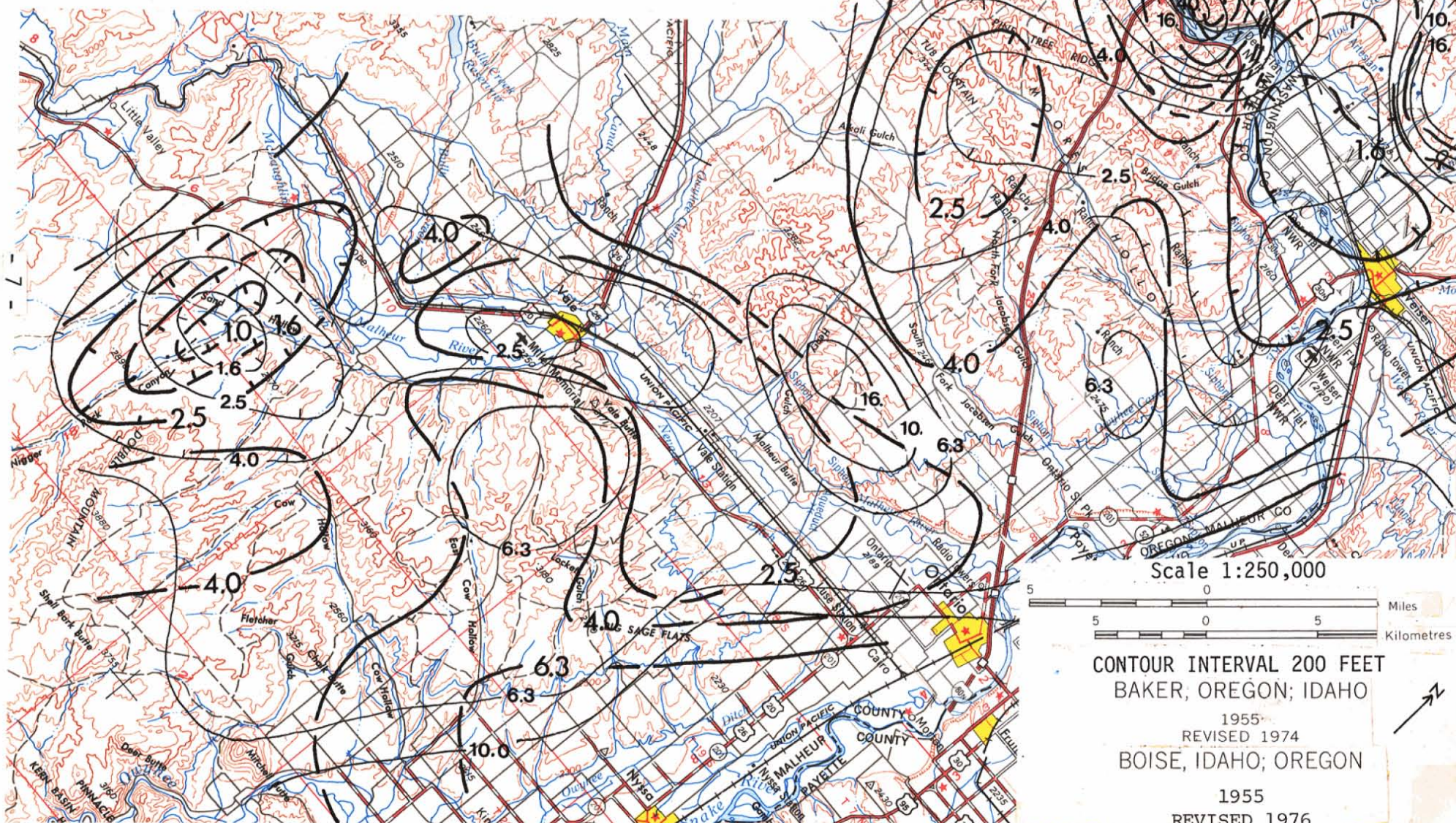


Figure 3:

**AUDIO-MAGNETOTELLURIC
APPARENT RESISTIVITY MAP**

(From Long and others, 1975)
14 Hertz

Resistivity in ohm-meters — 1.6 Telluric line north-south
— 2.5 Telluric line east-west

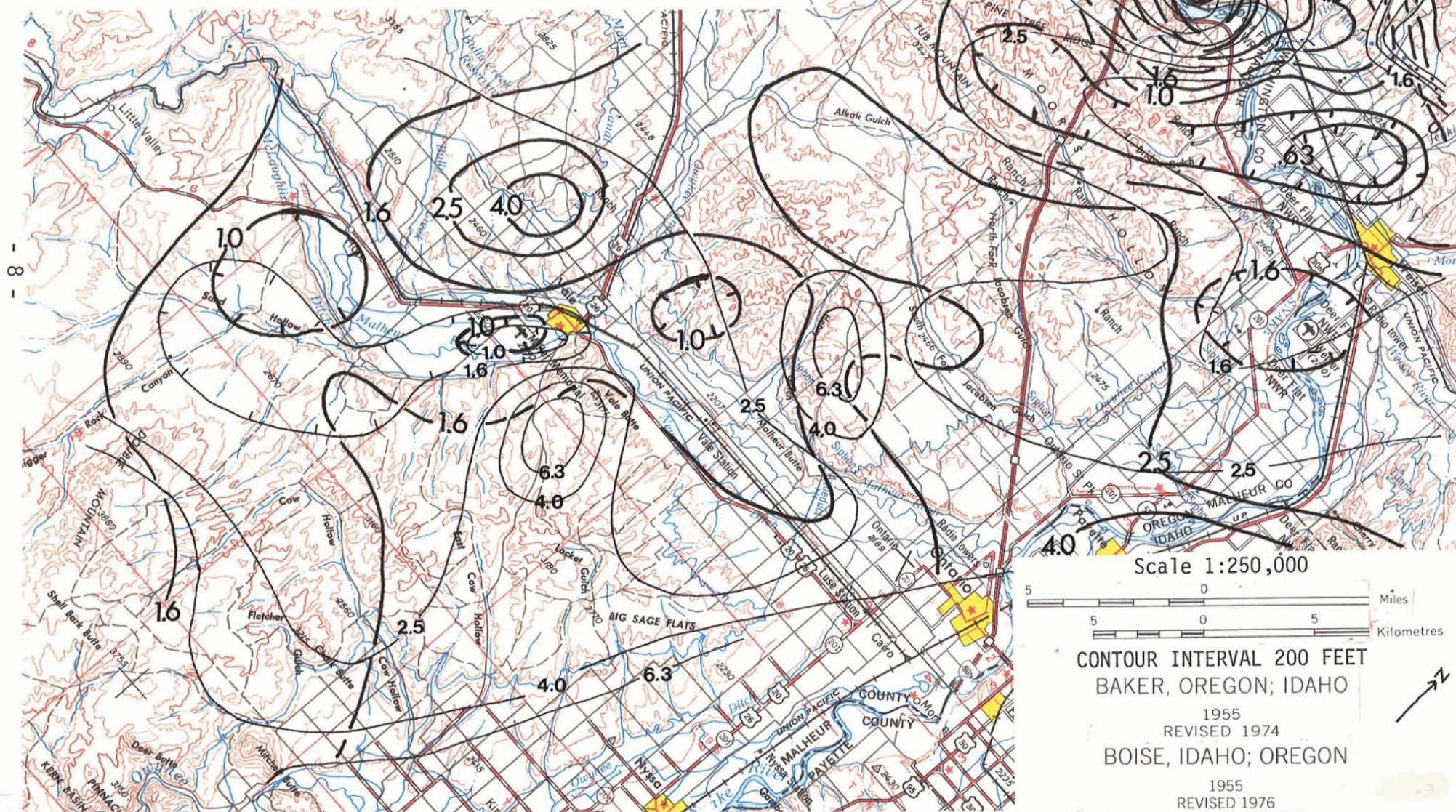
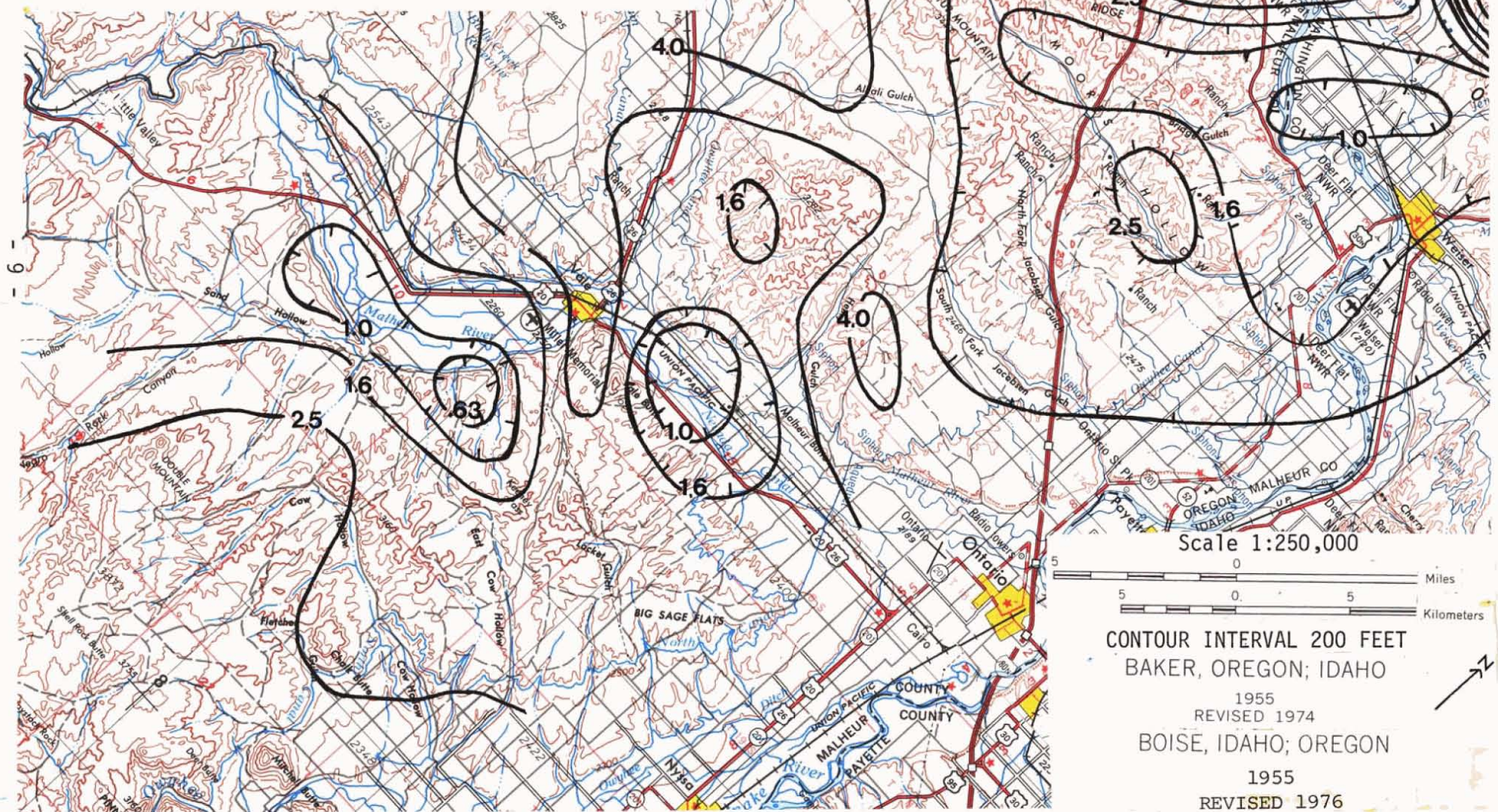


Figure 4: AUDIO-MAGNETOTELLURIC
APPARENT RESISTIVITY MAP

(From Long and others, 1975)
7.5 Hertz

Resistivity in ohm-meters



strike of the telluric lines. Bowen and Blackwell's Malheur River Fault, which has been interpreted to intersect the Willow Creek Fault at Vale hot springs, may also be adding to the observed distortions.

Detailed interpretation of any of the aforementioned geophysical studies cannot be made without a high degree of confidence in a physical geological model. Therefore, all geophysically-biased modelling should be constrained by detailed geologic mapping of the study area.

WATER CHEMISTRY

During the period of this reconnaissance study, seventeen springs and wells were sampled and their waters analyzed. This brings to twenty-six the number of analyses available for evaluation in this report (Table 1). These analyses were then used to calculate minimum reservoir temperatures (Table 2) using standard formulae for geothermometry. The methods used in these analyses, together with references, are included as Appendix A. Our reconnaissance of the area indicates a large number of thermal anomalies; however, many of these wells and springs were not sampled, due to time constraints.

Sampling temperatures ranged from near boiling for Vale and Neal Hot Springs down to 13.8°C for a cold spring near the southern end of the project area. The natural water of the area is a neutral to rather basic water of a mixed-ion type with a total dissolved solid content of less than 1000 mg/l. Silica and sodium are the major cations with sulfate and bicarbonate being the major anions. This relatively "clean" water is typical of eastern Oregon systems and shows characteristics of Basin-Range deep circulation fluid-dominated systems, though a magmatic component to the water cannot be ruled out from our analysis. Detailed analyses of hot and cold systems of the area, including gas and isotopic analyses, must be made before interpretations relating to provenance, recharge, and circulation patterns can be made.

Table 1. Spring and well chemistry of Vale and western Snake River Plain--Continued.
All measurements are in mg/l, except for pH or as indicated. nt = not tested;
tr= trace.

	North Harper BLM Well	BLM Vines Hill Well	Baschur Well	Harper Warm Springs	Deer Butte Hot Spring	Luce Hot Springs
Location	19S/45E/ 90Db	19S/43E/ 22Dd	19S/43E/ 30Bb	19S/42E/ 20Ab	21S/45E/ 14Dd	24S/37E/20
Date sampled	6/76	6/80	6/80	6/80	6/80	/72
Temp. ($^{\circ}$ C)	36	29	69	28	79	63
pH	8.0	8.3	8.5	7.5	9.0	7.43
Conductance μ mhos/cm	714	763	724	644	510	1330
Alkalinity X_h as mg/l HCO_3 X_c as mg/l CaCO_3	157 _c	281 _c	108 _c	260	72	nt
Hardness as mg/l CaCO_3	nt	4	8	194	9	nt
Total dissolved solids	476	467	539	553	438	nt
SiO_2	40	46.0	58.6	70.2	102.8	110
Na	134	167	140	55.8	97.3	240
K	2.2	8.1	3.1	15.0	3.1	9.7
Ca	30	2.2	3.7	46	3.7	34
Mg	0.5	0.4	<0.05	19.8	0.2	0.5
Cl	4.3	11.2	74.0	33.0	22.4	140
As	0.05	0.082	0.007	0.065	0.013	0.04
B	0.26	0.798	4.573	1.331	0.541	6.6
Li	0.21	0.13	0.11	<0.1	<0.1	0.27
F	1.61	3.1	7.0	0.4	14.7	4.8
Fe (total)	0.05	<0.05	<0.05	0.56	1.87	<0.02
Al	0.05	<0.1	<0.1	0.16	4.0	nt
HCO_3	nt	nt	nt	nt	nt	160
PO_4	0.13	0.074	0.008	0.024	0.008	0.21
SO_4	121	83.3	100	34.2	95.8	290
NO_3	0.14	0.32	<0.02	0.02	0.19	nt
NH_4	0.25	0.88	1.72	0.14	0.32	0.514

Table 1. Spring and well chemistry of Vale and western Snake River Plain--Continued.
All measurements are in mg/l, except for pH or as indicated. nt = not tested;
tr = trace.

	<u>Mitchell Butte Hot Spring</u>	<u>Mitchell Butte Hot Spring</u>	<u>Keith Cameron Artesian Well</u>	<u>Keith Cameron Artesian Well</u>
Location	21S/45E/ 12Aa	21S/45E/ 12Aa	21S/46E/ 33Da	21S/46E/ 33Da
Date sampled	/72	6/80	3/77	6/80
Temp. ($^{\circ}$ C)	62	48	46	44
pH	8.69	9.2	9.5	9.4
Conductance μ mhos/cm	559	720	670	578
Alkalinity X_h as mg/l HCO_3 X_c as mg/l CaCO_3	nt	70 _c	77 _c	80 _c
Hardness as mg/l CaCO_3	nt	13	nt	3
Total dissolved solids	nt	555	443	430
SiO_2	94	80	44	41.6
Na	110	141	124	123
K	1.6	2.2	0.8	0.9
Ca	4.6	5.9	1.8	2.1
Mg	<0.1	0.07	0.1	<0.05
Cl	28	34	12	12.6
As	<0.01	0.012	0.01	0.012
B	0.49	1.095	0.31	0.265
Li	0.03	<0.1	0.04	<0.1
F	10	11.6	2.7	2.6
Fe (total)	<0.02	0.1	<0.1	<0.05
Al	0.015	0.19	0.1	<0.1
HCO_3	72	nt	nt	nt
PO_4	0.12	0.024	0.02	0.010
SO_4	130	167	164	171
NO_3	nt	0.55	0.02	<0.02
NH_4	0.386	0.19	0.8	0.97

Table 1. Spring and well chemistry of Vale and western Snake River Plain--Continued. All measurements are in mg/l, except for pH or as indicated. nt = not tested; tr = trace.

	Cecil McCormick Well	Vale Hot Springs	Vale Hot Springs	Vale Hot Springs	Neal Hot Springs	Neal Hot Springs
Location	21S/46E/ 34Bc	18S/45E/ 20Dc	18S/45E/ 20Dc	18S/45E/ 20Dc	18S/43E/ 9Ba	18S/43E/ 9Ba
Date sampled	6/80	/74	8/74	6/80	/72	6/80
Temp. ($^{\circ}$ C)	36	73	90	85	87	88
pH	6.7	7.47	8.3	7.2	7.32	7.8
Conductance μ mhos/cm	610	1530	1400	1400	1010	1000
Alkalinity X_h as mg/l HCO_3 X_c as mg/l CaCO_3	75 _c	143 _h	196 _c	135 _c	nt	173 _c
Hardness as mg/l CaCO_3	4	nt	117.8	80	nt	22
Total dissolved solids	421	nt	882	850	nt	756
SiO_2	40.4	130	82	74.4	180	129.2
Na	122	310	190	232	190	186
K	0.8	16	13.2	12.4	16	15.3
Ca	1.9	19	31.2	25.6	8.8	8.9
Mg	<0.05	0.8	7.4	3.8	0.2	0.2
Cl	12.3	360	153.1	270	120	118
As	0.014	nt	<0.005	0.034	0.02	0.049
B	0.265	9.4	nt	7.33	4.1	4.4
Li	<0.1	0.28	nt	0.22	0.3	0.26
F	2.6	6.1	2.8	4.3	9.4	9.2
Fe (total)	<0.05	<0.02	<0.05	0.88	<0.02	<0.05
Al	0.15	0.017	<0.01	1.85	0.008	<0.1
HCO_3	nt	nt	nt	nt	198	nt
PO_4	0.005	nt	0.88	0.119	0.21	0.016
SO_4	167	100	71.1	101	120	102
NO_3	<0.02	nt	0.77	0.58	nt	0.04
NH_4	0.94	1.0	0.64	0.86	1.0	0.85

Table 1. Spring and well chemistry of Vale and western Snake River Plain--Continued.
All measurements are in mg/l, except for pH or as indicated. nt = not tested;
tr = trace.

	<u>Bully Creek</u> <u>Warm Spring</u>	<u>Bully Creek</u> <u>Warm Spring</u>	<u>Snively</u> <u>Hot Springs</u>	<u>Snively</u> <u>Hot Springs</u>
Location	18S/43E/ 4Da	18S/43E/ 4Da	21S/45E/ 22Bd	21S/45E/ 22Bd
Date sampled	6/77	6/80	6/80	6/80
Temp. ($^{\circ}$ C)	37	33	57	57
pH	7.8	7.6	9.2	nt
Conductance μ mhos/cm	115	400	500	nt
Alkalinity X_h as mg/l HCO_3 X_c as mg/l CaCO_3	37 _c	184 _c	69 _c	nt
Hardness as mg/l CaCO_3	44.5	139	6	nt
Total dissolved solids	181	318	356	360
SiO_2	99	82	70.2	72.8
Na	1.4	30	93	110
K	0.4	6.7	1.1	<2.5
Ca	37	32.4	2.7	4
Mg	15	13.8	<0.05	<0.5
Cl	0.5	3.1	19.5	14
As	0.02	0.023	0.016	<0.625
B	0.15	<0.20	0.511	0.4
Li	0.04	<0.1	<0.1	<0.05
F	0.7	0.5	14.8	15
Fe (total)	0.4	0.06	<0.05	<0.025
Al	0.28	<0.1	<0.1	<0.625
HCO_3	nt	nt	nt	nt
PO_4	nt	0.018	0.005	nt
SO_4	1.0	24	91.7	96
NO_3	0.06	0.04	0.02	nt
NH_4	0.28	0.13	1.88	nt

Table 1. Spring and well chemistry of Vale and western Snake River Plain--Continued. All measurements are in mg/l, except for pH or as indicated. nt = not tested; tr = trace.

	Brown's Hot Water <u>Seeps</u>	Brown's Warm Well <u>Warm Well</u>	Brown's Cold Spring <u>Cold Spring</u>
Location	21S/45E/ 14Dc	21S/45E/ 14Dc	21S/45E/ 14Dc
Date sampled	6/80	6/80	6/80
Temp. ($^{\circ}$ C)	52.2	62.2	13.8
pH	nt	nt	nt
Conductance μ mhos/cm	nt	nt	nt
Alkalinity X_h as mg/l HCO_3 X_c as mg/l CaCO_3	nt	nt	nt
Hardness as mg/l CaCO_3	nt	nt	nt
Total dissolved solids	450	442	902
SiO_2	113.4	98.4	51.3
Na	117	128	229
K	3	3	4
Ca	2	30	63
Mg	<0.5	<0.5	19
Cl	22	24	20
As	<0.625	<0.625	<0.625
B	0.5	0.5	0.3
Li	<0.05	<0.05	0.06
F	14.3	13	1.6
Fe (total)	<0.025	0.08	0.06
Al	<0.625	<0.625	<0.625
HCO_3	nt	nt	nt
PO_4	nt	nt	nt
SO_4	112	138	299
NO_3	nt	nt	nt
NH_4	nt	nt	nt

Table 1. Spring and well chemistry of Vale and western Snake River Plain--Continued.
 All measurements are in mg/l, except for pH or as indicated. nt = not tested;
 tr = trace.

	Alkali Flat Geothermal Well	Jack Roberts Well	Farrell Peterson Artesian Well
Location	17S/45E/ 8Aa	18S/45E/19	20S/46E/ 24Bc
Date sampled	5/75	3/77	3/77
Temp. ($^{\circ}$ C)	24	17	13
pH	8.3	8.1	8.0
Conductance μ mhos/cm	2400	nt	nt
Alkalinity X_h as mg/l HCO_3 X_c as mg/l CaCO_3	115 _c	337c	660 _c
Hardness as mg/l CaCO_3	42.5	40.5	44
Total dissolved solids	1381	570	818
SiO_2	32	71	82.4
Na	482	156	256
K	6.7	21	23
Ca	16.4	13.7	13.3
Mg	0.5	2.0	2.8
Cl	598	21.3	25
As	0.001	<0.005	0.01
B	14	0.3	2.0
Li	0.4	0.22	0.55
F	2.2	0.5	1.2
Fe (total)	0.1	0.1	0.1
Al	0.01	0.19	0.07
HCO_3	nt	412	806
PO_4	0.01	0.32	0.03
SO_4	135.2	77	0.4
NO_3	0.03	3.57	0.03
NH_4	0.92	2.78	8.75

Table 2. Geothermetric calculations* of minimum reservoir temperatures for selected thermal waters of Vale and western Snake River Plain

	<u>North Harper BLM Well '76</u>	<u>BLM Vines Hill Well '80</u>	<u>Baschun Well '80</u>	<u>Harper Warm Spring '80</u>	<u>Deer Butte Hot Spring '80</u>
Flow rate liters/min.	nc	nc	nc	nc	nc
Measured temperature °C	36	29	69	28	79
Na:K °C	75	129	162	161	121
Na:K:Ca 1/3 β °C	95	162	120	208	130
Na:K:Ca 4/3 β °C	47	161	102	87	98
Na:K:Ca Mg corrected °C	nc	121	nc	50	nc
SiO ₂ conductive °C	92	98	109	118	139
SiO ₂ adiabatic °C	94	99	109	117	134
SiO ₂ chalcedony °C	61	68	80	90	112
SiO ₂ opal °C	-23	-17	-7	0.26	18

*Methodology for calculations presented in Appendix A. nc = not calculated.

Table 2. Geothermetric calculations* of minimum reservoir temperatures for selected thermal waters of Vale and western Snake River Plain--Continued.

	<u>Luce Hot Springs '72</u>	<u>Mitchell Butte Hot Spring '72</u>	<u>Mitchell Butte Hot Spring '80</u>	<u>Keith Cameron Artesian Well '77</u>	<u>Keith Cameron Artesian Well '80</u>
Flow rate liters/min.	200	60	60	nc	nc
Measured temperature °C	63	62	48	46	44
Na:K °C	119	70	73	39	43
Na:K:Ca 1/3 β °C	137	99	103	78	81
Na:K:Ca 4/3 β °C	96	72	79	71	71
Na:K:Ca Mg corrected °C	nc	nc	nc	nc	nc
SiO ₂ conductive °C	143	134	125	96	93
SiO ₂ adiabatic °C	137	130	122	97	95
SiO ₂ chalcedony °C	116	107	97	66	63
SiO ₂ opal °C	22	14	6	-19	-21

*Methodology for calculations presented in Appendix A. nc = not calculated.

Table 2. Geothermetric calculations* of minimum reservoir temperatures for selected thermal waters of Vale and western Snake River Plain--Continued.

	<u>Cecil McCormick Well '80</u>	<u>Vale Hot Springs '74</u>	<u>Vale Hot Springs '74</u>	<u>Vale Hot Springs '80</u>	<u>Neal Hot Springs '72</u>
Flow rate liters/min.	nc	nc	nc	nc	90
Measured temperature °C	36	73	90	85	87
Na:K °C	39	132	151	134	163
Na:K:Ca 1/3 β °C	78	157	160	152	180
Na:K:Ca 4/3 β °C	70	135	107	112	151
Na:K:Ca Mg corrected °C	nc	nc	79	111	nc
SiO ₂ conductive °C	92	152	126	121	173
SiO ₂ adiabatic °C	94	145	124	119	162
SiO ₂ chalcedony °C	61	127	99	93	151
SiO ₂ opal °C	-22	31	7	3	50

*Methodology for calculations presented in Appendix A. nc = not calculated.

Table 2. Geothermetric calculations* of minimum reservoir temperatures for selected thermal waters of Vale and western Snake River Plain--Continued.

	<u>Neal Hot Springs '80</u>	<u>Bully Creek Warm Spring '77</u>	<u>Bully Creek Warm Spring '80</u>	<u>Snively Hot Springs '80</u>
Flow rate liters/min.	90	76	76	nc
Measured temperature °C	88	37	33	57
Na:K °C	162	266	241	61
Na:K:Ca 1/3 β °C	179	148	188	93
Na:K:Ca 4/3 β °C	148	nc	62	69
Na:K:Ca Mg corrected °C	nc	54	51	nc
SiO ₂ conductive °C	152	137	126	118
SiO ₂ adiabatic °C	145	132	124	117
SiO ₂ chalcedony °C	127	110	99	90
SiO ₂ opal °C	30	16	7	0.26

*Methodology for calculations presented in Appendix A. nc = not calculated.

Table 2. Geothermetric calculations* of minimum reservoir temperatures for selected thermal waters of Vale and western Snake River Plain--Continued.

	Alkali Flat Geothermal Well '75	Jack Roberts Well '77	Farrell Peterson Artesian Well '77	Brown's Hot Water Seeps '80	Brown's Warm Well '80	Brown's Cold Spring '80
Flow rate liters/min.	nc	nc	nc	nc	nc	nc
Measured temperature °C	24	17	13	52.2	62.2	13.8
Na:K °C	68	198	168	95	91	77
Na:K:Ca 1/3 β °C	108	199	186	128	107	99
Na:K:Ca 4/3 β °C	109	147	160	114	55	54
Na:K:Ca Mg corrected °C	nc	138	43	nc	nc	nc
SiO ₂ conductive °C	82	119	127	144	136	103
SiO ₂ adiabatic °C	85	117	124	139	132	104
SiO ₂ chalcedony °C	51	90	99	118	109	73
SiO ₂ opal °C	-31	1	8	23	16	-13

*Methodology for calculations presented in Appendix A. nc = not calculated.

GEOHERMAL-GRADIENT AND HEAT-FLOW DATA*

The temperature gradient and heat-flow results for the Western Snake River Basin area are shown in Table 3. Included in the table are the township/range-section and latitude and longitude location of each hole. In addition, the hole name, date of logging used and collar elevation are included for each hole. As overlays on Plate I and II, the bottom hole temperature, maximum depth, corrected temperature gradient, and (where available) corrected heat flow are shown. These values are also listed in the table, as are the depth interval and average thermal conductivity used for calculation of the gradient and heat flow. The values are given in SI units. To transform units, $1 \times 10^{-6} \text{ cal/cm}^2\text{sec (HFU)} = 41.84 \text{ mWm}^{-2}$, $1 \times 10^{-3} \text{ cal/cm sec}^{\circ}\text{C (TCU)} = 0.4184 \text{ Wm}^{-1}\text{K}^{-1}$. Also $1^{\circ}\text{C/km} = 1 \text{ mKm}^{-1} = 18.2^{\circ}\text{F/100 ft}$. The temperature-depth measurements themselves for each hole are presented in Appendix B. Corrected gradient and corrected heat flow are values for which the topographic effects have been removed. These are not significant for most of the sites studied.

The holes are ranked in terms of the quality of the gradient or heat-flow information, from high quality (A), to good quality (B), to marginal quality (C), to data with some problems (D), to data for which no useful temperature gradient or heat flow can be estimated (X). Most of the thermal conductivity measurements were made on cutting samples, although some measurements of thermal conductivity on samples of the Idaho Group siltstones were made with a needle-probe technique. The holes were drilled for a variety of purposes including water, uranium exploration and geothermal exploration.

The Western Snake River Basin has been the site of extensive high-temperature geothermal resource exploration. In the exploration so far, shallow and intermediate depth holes (up to 2,000 ft) have been drilled and no geothermal discoveries

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Table 3. Geothermal-gradient data, western Snake River Basin area, Oregon.

Twn/Rng- Section	N Lat. Deg.Min.	W Long Deg.Min.	Hole # Date	Collar Elev.	Bottom Temp. (°C)	Depth Interval (m)	Avg. TC $\text{Wm}^{-1}\text{K}^{-1}$	# TC	Uncorr. Gradient °C/km	Corr. Gradient °C/km	Corr. HF mWm^{-1}	Q HF
15S/43E- 34CD	44-12.93	117-26.45	MCBRIDE 6/24/80	866	21.49	20.0 85.0 .0 250.0			81.4 2.5 46.0 - 81.0			D X
16S/43E- 10DB	44-11.50	117-26.10	JQRM 10/ 2/72	758	20.85	30.0 115.0	(1.17)		71.2 1.5	71.2	84	B
16S/43E- 7D	44-11.39	117-29.49	BAMS 5/ 6/75	850	17.39	65.0 115.0 15.0 65.0	(1.17)		18.0 5.1 48.8 7.3	7.3 48.8	59	B B
16S/43E- 15DA	44-10.64	117-25.79	JQNR 10/ 5/72	758	28.15	25.0 105.0 105.0 230.0	(1.17)		38.6 7.0 70.5 3.0	38.6 70.5	84	C B
16S/43E- 13DD	44-10.44	117-23.20	VALE 10/ 4/72	768	24.96	50.0 130.0 130.0 170.0	(1.17)		51.5 5.0 94.7 2.7	51.5 94.7	114	C B
16S/43E- 23DD	44- 9.43	117-24.44	JQMR 10/ 1/72	749	25.25	40.0 110.0 110.0 170.0	(1.17)		61.8 2.2 99.5 13.0	61.8 99.5	117	C B
17S/45E- 2DA	44- 7.30	117-10.00	UN-75-3 5/13/75	814	22.01	50.0 125.0	1.05 .04		82.0 1.1	82.0	88	A
17S/45E- 3DD	44- 6.84	117-11.24	BLMSW 5/ 9/75	774	24.64	10.0 35.0 10.0 185.0	(1.17)		63.0 - 75.0		74- 87	C C

Table 3. Geothermal-gradient data, western Snake River Basin area, Oregon--Continued.

Twn/Rng- Section	N Lat. Deg.Min.	W Long Deg.Min.	Hole # Date	Collar Elev.	Bottom Temp. (°C)	Depth Interval (m)	Avg. TC $\text{Wm}^{-1}\text{K}^{-1}$	# TC	Uncorr. Gradient °C/km	Corr. Gradient °C/km	Corr. HF mWm^{-1}	Q HF
17S/45E- 8AA	44- 6.48	117-14.90	UN-75-2 6/ 4/75	721	18.17	30.0 60.0	1.26		(183.0)	(183.0)	233	C
17S/43E- 9CB	44- 6.18	117-27.52	JQW 10/ 2/72	866	17.01	10.0 35.0	(1.17)		134.2 12.0	134.2	160	B
17S/44E- 11DC	44- 6.08	117-17.36	JQPW 10/ 6/72	719	51.32	10.0 370.0	(1.17)		94.4 2.2	94.4	109	B
17S/46E- 13AA	44- 5.78	117- 1.59	UN-75-5 10/22/75	732	24.00	50.0 150.0	1.05 .04		76.5 .3	76.5	79	A
17S/46E- 16CA	44- 5.41	117- 5.86	UN-75-4 6/ 4/75	762	28.44	25.0 140.0	1.05		115.4 7.0	115.4	121	B
17S/44E- 31BB	44- 3.21	117-23.08	JQBLM 10/14/72	829	19.46	15.0 70.0	(1.17)		85.7 2.2	85.7	100	B
18S/47E- 4B	44- 2.15	116-58.52	JOHANSON 6/27/80	658	17.31	15.0 59.0	(1.17)		71.7 2.1	71.7	84	C
18S/47E- 4DC	44- 1.50	116-58.20	ONTCTYPK 8/19/77	655	24.95	55.0 150.0	(1.17)		88.4 .2	88.4	105	A
18S/44E- 23AA	43-59.78	117-17.33	HIATT 7/ 2/80	765	20.25	20.0 92.0	(1.17)		91.8 3.2	91.8	108	B
18S/44E- 21BA	43-59.65	117-20.31	VWQRB 10/11/72	760	18.88	25.0 85.0	(1.17)		66.8 1.1	66.8	79	B
18S/45E- 20CB	43-59.35	117-14.48	VALECTY1 7/ 7/77	684	18.14	30.0 40.0	(1.17)		123.2 2.8	112.0	130	G
18S/44E- 21DB	43-59.33	117-20.47	RANDLE 7/ 2/80	783	16.17	25.0 49.0	(1.17)		61.4 .7	61.4	73	C

Table 3. Geothermal-gradient data, western Snake River Basin area, Oregon--Continued.

Twn/Rng- Section	N Lat. Deg.Min.	W Long Deg.Min.	Hole # Date	Collar Elev.	Bottom Temp. (°C)	Depth Interval (m)	Avg. TC Wm ⁻¹ K ⁻¹	# TC	Uncorr. Gradient °C/km	Corr. Gradient °C/km	Corr. HF mWm ⁻¹	Q HF
18S/45E- 21CB	43-59.20	117-13.30	TS-RDH 11/30/76	678	57.99	15.0	1.17		145.5			G
						310.0			6.1			
						15.0	1.05		200.4			G
						65.0			6.7			
						65.0	1.30		143.2	140.0	182	G
						230.0	.04		7.5			
						230.0	1.47		116.0	114.0	167	G
						310.0	.10		7.7			
18S/45E- 20CC	43-59.10	117-14.55	GRIGGS 6/25/80	683	26.54	10.0	(1.17)		135.7	135.6	159	G
						100.5			3.0			
18S/46E- 21CC	43-59.08	117- 6.18	LEE 7/ 8/77	692	17.79	35.0	(1.17)		115.6	110.0	130	C
						45.0			12.1			
18S/45E- 30AB	43-58.80	117-15.05	VALECTY2 7/ 7/77	681	16.64	7.5	(1.17)		82.2	78.0	92	B
						55.0			.7			
18S/45E- 29BA2	43-58.75	117-14.12	VALE CW2 7/30/80	682	34.97	.0	(1.17)		526.0	400.0	47	G
						38.0						
18S/45E- 29BA1	43-58.70	117-14.17	VALE CW1 7/29/80	683	21.18	10.0			100.4			X
						17.5			2.0			
18S/45E- 32AB	43-57.87	117-13.87	COLERICK 8/ 1/80	698	29.18	10.0	(1.17)		197.6	190.0	222	G
						70.0			10.4			
19S/46E- 5BD	43-56.83	117- 6.93	WINEBRGR 7/ 3/80	808	29.26	15.0	(1.17)		96.6	96.5	114	C
						90.0			3.0			
						90.0			34.0	34.0		X
						260.0			2.6			
						10.0	(1.17)		60.0	60.0	70	C
						269.5						

Table 3. Geothermal-gradient data, western Snake River Basin area, Oregon--Continued.

Twn/Rng- Section	N Lat. Deg.Min.	W Long Deg.Min.	Hole # Date	Collar Elev.	Bottom Temp. (°C)	Depth Interval (m)	Avg. TC Wm ⁻¹ K ⁻¹	# TC	Uncorr. Gradient °C/km	Corr. Gradient °C/km	Corr. HF mWm ⁻¹	Q HF
19S/45E- 11BC	43-55.97	117-10.95	BLMN-WW 6/10/76	816	36.49	10.0 85.0	(1.17)		259.3 2.3	236.9 2.0	276	G
19S/45E- 9DB	43-55.85	117-12.82	N HARPER 7/ 7/77	860	34.33	20.0 170.0 170.0 205.0	(1.17)		105.9 .5	132.0	155	B
							(1.17)		78.2 3.2	98.0	114	B
19S/44E- 9DD	43-55.50	117-19.51	JQP-1 6/18/73	701	22.95	35.0 160.0	(1.26)		71.5 .5	71.5	88	B
19S/45E- 11CC	43-55.47	117-11.02	CH-1 8/23/72	835	25.63	30.0 65.0	(1.26)		185.7 1.6	176.1 1.6	222	G
19S/46E- 18DB	43-55.00	117- 7.95	SNW 6/10/76	844	29.54	20.0 150.0	(1.17)		104.1 .7	104.0	121	G
19S/46E- 15DC	43-54.78	117- 4.21	NC-WW 10/27/76	771	18.02	55.0 150.0			3.7 .7			D
						20.0 55.0	(1.17)		77.1 29.4	77.1	90	D
19S/45E- 14DC	43-54.62	117-10.42	CB-16 9/ 7/72	910	37.25	20.0 145.0	(1.26)		175.2 1.1	158.3 .8	197	G
19S/46E- 13CD	43-54.62	117- 2.23	CO-WW 11/ 4/76	707	15.88	12.5 37.5	(1.17)		135.4 2.2	129.0	151	G
19S/44E- 19	43-54.22	117-22.36	WP-1 8/ 8/30	777	46.30	31.0 395.0	(1.26)		87.3	87.3	109	B
19S/44E- 22DA	43-54.12	117-18.33	SAP 3 7/ 2/80	713	19.30	10.0 79.0	(1.26)		80.8 1.3	76.0	95	B
19S/44E- 22CA	43-54.03	117-19.17	SAP 2 7/ 2/80	716	16.30	10.0 62.5			37.5 3.5			D

Table 3. Geothermal-gradient data, western Snake River Basin area, Oregon--Continued.

Twn/Rng- Section	N Lat. Deg.Min.	W Long Deg.Min.	Hole # Date	Collar Elev.	Bottom Temp. (°C)	Depth Interval (m)	Avg. TC $\text{Wm}^{-1}\text{K}^{-1}$	# TC	Uncorr. Gradient °C/km	Corr. Gradient °C/km	Corr. HF mWm^{-1}	Q HF
19S/44E- 21DD	43-53.77	117-19.72	SAP 1 7/2/80	713	24.47	5.0 40.0 40.0 135.0 5.0 143.0	(1.26)		101.0 4.0 73.8 1.4 80.6 4.8	76.0	95	C C B
19S/46E- 30BB	43-53.70	117-15.65	UN-75-1 6/4/75	879	27.31	20.0 150.0	(1.26)		92.6 .2	99.5 .2	126	G
19S/45E- 25BB	43-53.69	117-9.64	RDH-F 7/24/72	813	29.08	30.0 70.0	1.26 .02		232.6 7.1	213.6 6.4	268	G
19S/45E- 22DB	43-53.97	117-11.67	GULF 7/24/72	843	27.24	30.0 115.0	1.30 .05		110.4 .3	98.9 .3	126	G
19S/45E- 26BD	43-53.44	117-10.70	GULF 7/25/72	822	34.69	30.0 175.0	(1.26)		119.3 .6	114.0 .5	142	G
19S/45E- 28BD	43-53.39	117-12.95	CB-14 6/14/73	872	20.87	10.0 90.0	(1.26)		70.8 1.5	76.5 1.5	96	B

of high temperatures has been announced. Exploration has focused on three areas. One of these is a major zone of high heat flow and geothermal gradient extending southeast from the Vale Hot Springs for a distance of at least 10 km. The extension of the Vale Hot Spring anomaly was initially discovered during an earlier phase of the Oregon geothermal program (Bowen and Blackwell, 1975), and the data from these earlier studies have been previously published (Bowen et al., 1976; Blackwell et al., 1978). We have continued data-collection in this area and have added several holes to the data-set previously published.

Exploration of additional high-temperature sites has been focused in T 17S/ R 44E in the vicinity of Willow Creek and in T 17S/ R 43E in the vicinity of Bully Creek. Only sparse data for these areas are shown in the table and map because most of the data are proprietary.

A deep exploration hole was drilled in the town of Ontario at the eastern margin of the area. This hole went to a depth of over 3000 m. The temperatures were high (in excess of 175°C) in the hole, but no fluid could be produced from below 2000 m. We measured a temperature of 91.8°C at a depth of 1 km in this hole after equilibrium.

The geothermal gradient is high over the whole area. The minimum gradient is on the order of 60°C/km and the average is 75 to 90°C/km. Hence, medium-temperature resources are likely to occur anywhere in the area at a depth between 1 and 1.5 km. In the areas of shallow anomalies, temperatures suitable for low temperature use may occur at depths as shallow as 300 to 500 m. The anomalies themselves seem to be associated with faults which allow leakage of warmer water from porous units at depth to near the surface. The units which tend to carry fluid are the basalts and interbedded coarse grained clastic rocks. Aquicludes are generally the siltstones of the Idaho group.

CONCLUSIONS AND RECOMMENDATIONS

With its high population density and large agricultural industry the Western Snake River Plain is one of the most important moderate-temperature geothermal resource areas in Oregon. And, with the possibility of a high temperature component (over 150°C), it may prove to have electrical generation potential. At present the rate of geothermal activity in the area is high with a deep (3 km) hole just completed by Ore-Ida, Inc. in the Ontario area, considerable industry drilling activity in the Vale - Bully Creek area, and a number of large-scale direct-use projects (alcohol plants, mushroom nurseries, greenhouses, etc.) scheduled to come on line in the immediate future.

The rate of activity is high; however, in attempts to locate a resource for utilization, failure is more common than success, and with the high expense of drilling \$15-30/ft., failures can be very costly. The reason for most exploration failures is poor understanding of the physical nature of the resource system. With this in mind, the following steps are recommended to raise the level of geologic confidence to an acceptable level:

1. Detailed (scale 1:24,000 for greater) geologic and photo-geologic mapping of the Western Snake River Plain making use of BLM or industry-generated low level aerial photography -- to define the distribution and ages of rock and volcanic centers and to identify structures which control the geothermal systems.
2. Refining existing complete Bouguer gravity data to a more detailed scale (1:62,500), and production of a residual anomaly gravity map to

better define the physical geologic model and its relation to the geothermal system.

3. An extensive spring and well sampling program, including isotopic analysis -- to define individual reservoirs and systems and to accurately predict subsurface conditions.
4. A program of at least twenty 500-ft. gradient/stratigraphy holes, ten in the Ontario area and ten in the Vale area, followed by a program of at least ten 2,000-ft. gradient holes -- to model heat flow and directly test geothermal aquifers.

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APPENDIX A

Formulas used in calculations

Na:K (revised):
$$t^{\circ}\text{C} = \frac{1217}{\log (\text{Na}/\text{K}) + 1.483} - 273.15 \text{ (Fournier, 1979)}$$

Na:K:Ca:
$$t^{\circ}\text{C} = \frac{1647}{2.24 + F(T)} - 273.15 \text{ (Fournier and Truesdell, 1973),}$$

where $F(T) = \log (\text{Na}/\text{K}) + [\beta \log (\sqrt{\text{Ca}}/\text{Na})]$,
 $\beta = 1/3$ if $t > 100^{\circ}\text{C}$, and $4/3$ if $t < 100^{\circ}\text{C}$,
 $t^{\circ}\text{C}$ = calculated reservoir temperature,
 and concentrations are expressed in molality.

Magnesium correction ratio:

$$R = \frac{(\text{milliequivalents Mg})}{(\text{milliequivalents Mg}) + (\text{milliequivalents Ca}) + (\text{milliequivalents K})} \times 100$$

If $R < 5$ or > 50 , no calculation was made. For R between 5-50,

$$\Delta t_{\text{Mg}} = 10.66 - (4.7415)(R) + [(325.87)(\log R)^2] - [(1.032 \times 10^5)(\log R)^2/T] -$$

$$[(1.968 \times 10^7)(\log R)^2/T^2] + [(1.605 \times 10^7)(\log R)^3/T^2],$$

where R = magnesium correction ratio expressed in equivalents,

Δt_{Mg} = the temperature correction that is subtracted from
 the Na:K:Ca $1/3 \beta$ calculated temperature,

T = Na:K:Ca $1/3 \beta$ calculated temperature in $^{\circ}\text{K}$.

Or Δt_{Mg} can be obtained by using the graph compiled by Fournier and Potter (1979).

SiO_2 temperature calculations (Fournier and Rowe, 1966):

SiO_2 (conductive),
$$t^{\circ}\text{C} = \frac{1309}{5.19 + \log (\text{SiO}_2)} - 273.15$$

SiO_2 (adiabatic),
$$t^{\circ}\text{C} = \frac{1522}{5.75 + \log (\text{SiO}_2)} - 273.15$$

SiO_2 (chalcedony),
$$t^{\circ}\text{C} = \frac{1032}{4.69 + \log (\text{SiO}_2)} - 273.15$$

SiO_2 (opal),
$$t^{\circ}\text{C} = \frac{731}{4.52 + \log (\text{SiO}_2)} - 273.15,$$

where SiO_2 is expressed in mg/l.

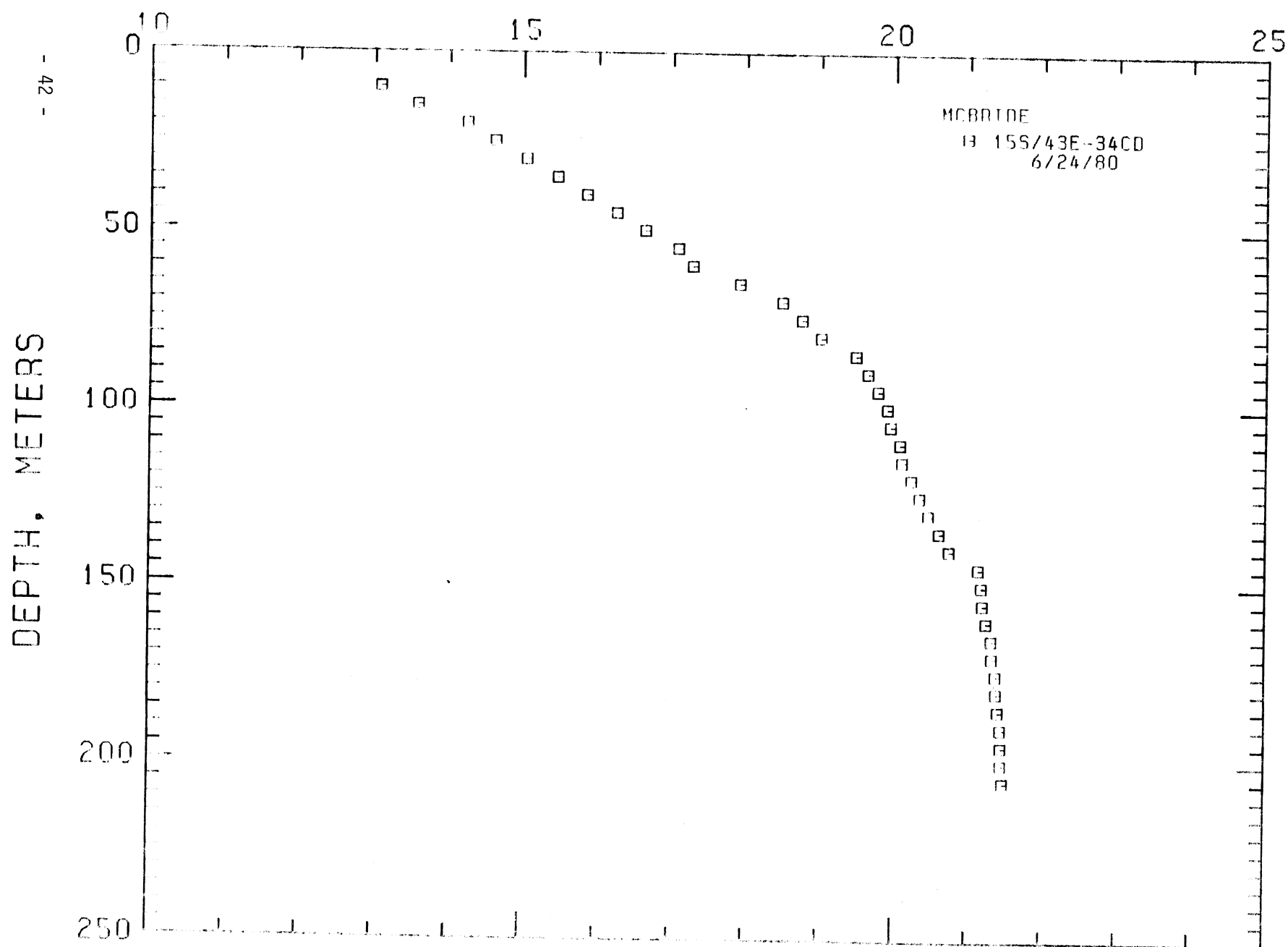
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APPENDIX B
Geothermal-gradient data

DEPTH FEET	LOCALITY: POSEIDON, OREFOOT 155.49E 30.0			EARTHQUAKE EPICENTRE	
	HOLE NUMBER: 111110			DATE RECORDED: 6/27/80	
	DEPTH FEET	TEMP C	TEMP F	DEPTH DEG. C (111)	DEPTH DEG. F (111)
10.0	32.8	12.00	53.54	0.0	0.0
15.0	33.2	12.50	56.41	0.0	0.0
20.0	35.6	11.20	52.63	1.1	2.1
25.0	42.0	14.00	57.19	7.5	4.5
30.0	50.1	15.00	59.02	91.0	4.6
35.0	114.0	15.80	60.41	91.0	1.6
40.0	139.2	15.00	60.51	73.0	4.3
45.0	147.6	16.20	61.27	92.0	4.5
50.0	164.0	16.00	61.95	76.0	4.2
55.0	180.4	17.00	62.76	90.0	4.9
60.0	195.8	17.20	63.12	40.0	2.2
65.0	213.2	17.90	64.26	1.6	6.9
70.0	233.6	18.40	65.28	114.0	0.3
75.0	246.0	18.70	65.77	54.0	3.6
80.0	262.4	19.00	66.24	52.0	2.7
85.0	280.8	19.40	67.08	21.0	2.2
90.0	295.2	19.60	67.37	22.0	1.8
95.0	311.0	19.70	67.62	20.0	1.7
100.0	322.0	19.90	67.86	1.0	1.1
105.0	334.1	19.90	67.24	0.0	0.1
110.0	340.8	20.00	68.16	1.0	1.1
115.0	347.2	20.11	68.20	4.0	0.0
120.0	354.6	20.20	68.41	16.0	1.4
125.0	400.0	20.20	68.63	22.0	1.7
130.0	465.4	20.40	68.95	24.0	1.7
135.0	492.8	20.50	69.17	0.0	1.7
140.0	499.2	20.80	69.37	12.0	1.5
145.0	505.6	21.10	70.07	38.0	1.3
150.0	522.0	21.10	70.14	0.0	0.4
155.0	534.1	21.20	70.18	4.0	0.2
160.0	541.2	21.20	70.27	1.0	0.7
165.0	547.6	21.30	70.39	14.0	0.8
170.0	557.0	21.30	70.41	0.0	0.1
175.0	564.0	21.30	70.50	10.0	0.0
180.0	568.0	21.40	70.57	2.0	0.1
185.0	573.0	21.40	70.57	0.0	0.3
190.0	579.0	21.40	70.65	0.0	0.3
195.0	583.0	21.40	70.65	0.0	0.1
200.0	606.0	21.40	70.65	0.0	0.0

TEMPERATURE, DEG C



LOCATION: VALLEY, OREGON
HOLE NUMBER: 16-43S10
DATE MEASURED: 10/2/72

Water well

DEPTH METERS	DEPTH FEET	TEMPERATURE		GEOTHERMAL GRADIENT	
		DEG C	DEG F	DEG C/KM	FEET/DEG F
5.0	16.4	14.490	58.08	.0	.0
10.0	32.8	14.340	57.81	-30.0	-60.7
15.0	49.2	14.430	57.97	18.0	101.2
20.0	65.6	14.630	58.33	40.0	45.6
25.0	82.0	14.830	58.69	40.0	45.6
30.0	98.4	15.050	59.09	44.0	41.4
35.0	114.8	15.280	59.50	46.0	39.6
40.0	131.2	15.510	59.92	46.0	39.6
45.0	147.6	15.790	60.42	56.0	32.5
50.0	164.0	16.110	61.00	64.0	28.5
55.0	180.4	16.460	61.63	70.0	26.0
60.0	196.8	16.760	62.17	60.0	30.4
65.0	213.2	17.160	62.89	80.0	22.8
70.0	229.6	17.760	63.97	120.0	15.2
75.0	246.0	18.380	65.08	124.0	14.7
80.0	262.4	18.630	65.53	50.0	36.4
85.0	278.8	18.880	65.98	50.0	36.4
90.0	295.2	19.120	66.42	48.0	38.0
95.0	311.6	19.580	67.24	92.0	19.8
100.0	328.0	19.760	67.57	36.0	50.6
105.0	344.4	19.970	67.95	42.0	43.4
110.0	360.8	20.550	68.99	116.0	15.7
115.0	377.2	20.850	69.53	60.0	30.4

LOCATION: VALL. OREGON
HOLE NUMBER: 16-43S13
DATE MEASURED: 10/4/72

Water well

DEPTH METERS	DEPTH FEET	TEMPERATURE		GEOTHERMAL GRADIENT	
		DEG C	DEG F	DEG C/KM	FEET/DEG F
5.0	16.4	12.900	55.22	.0	.0
10.0	32.8	13.970	57.15	214.0	8.5
15.0	49.2	15.130	59.23	232.0	7.9
20.0	65.6	16.130	61.03	200.0	9.1
25.0	82.0	16.300	61.34	34.0	53.6
30.0	98.4	16.550	61.79	50.0	36.4
35.0	114.8	16.800	62.24	50.0	36.4
40.0	131.2	16.930	62.47	26.0	70.1
45.0	147.6	17.110	62.80	36.0	50.6
50.0	164.0	17.300	63.14	38.0	48.0
55.0	180.4	17.540	63.57	48.0	38.0
60.0	196.8	17.770	63.99	46.0	39.6
65.0	213.2	18.010	64.42	48.0	38.0
70.0	229.6	18.360	65.05	70.0	26.0
75.0	246.0	18.590	65.46	46.0	39.6
80.0	262.4	18.880	65.98	58.0	31.4
85.0	278.8	19.150	66.47	54.0	33.7
90.0	295.2	19.430	66.97	56.0	32.5
95.0	311.6	19.650	67.37	44.0	41.4
100.0	328.0	19.930	67.87	56.0	32.5
105.0	344.4	20.210	68.38	56.0	32.5
110.0	360.8	20.460	68.83	50.0	36.4
115.0	377.2	20.670	69.21	42.0	43.4
120.0	393.6	20.870	69.57	40.0	45.6
125.0	410.0	21.120	70.02	50.0	36.4
130.0	426.4	21.340	70.41	44.0	41.4
135.0	442.8	21.740	71.13	80.0	22.8
140.0	459.2	22.250	72.05	102.0	17.9
145.0	475.6	22.740	72.93	98.0	18.6
150.0	492.0	23.330	73.99	118.0	15.4
155.0	508.4	23.860	74.95	106.0	17.2
160.0	524.8	24.280	75.70	84.0	21.7
165.0	541.2	24.660	76.39	76.0	24.0
170.0	557.6	24.960	76.93	60.0	30.4

LOCATION: VALL. OREGON
HOLE NUMBER: 16-43S15
DATE MEASURED: 10/5/72

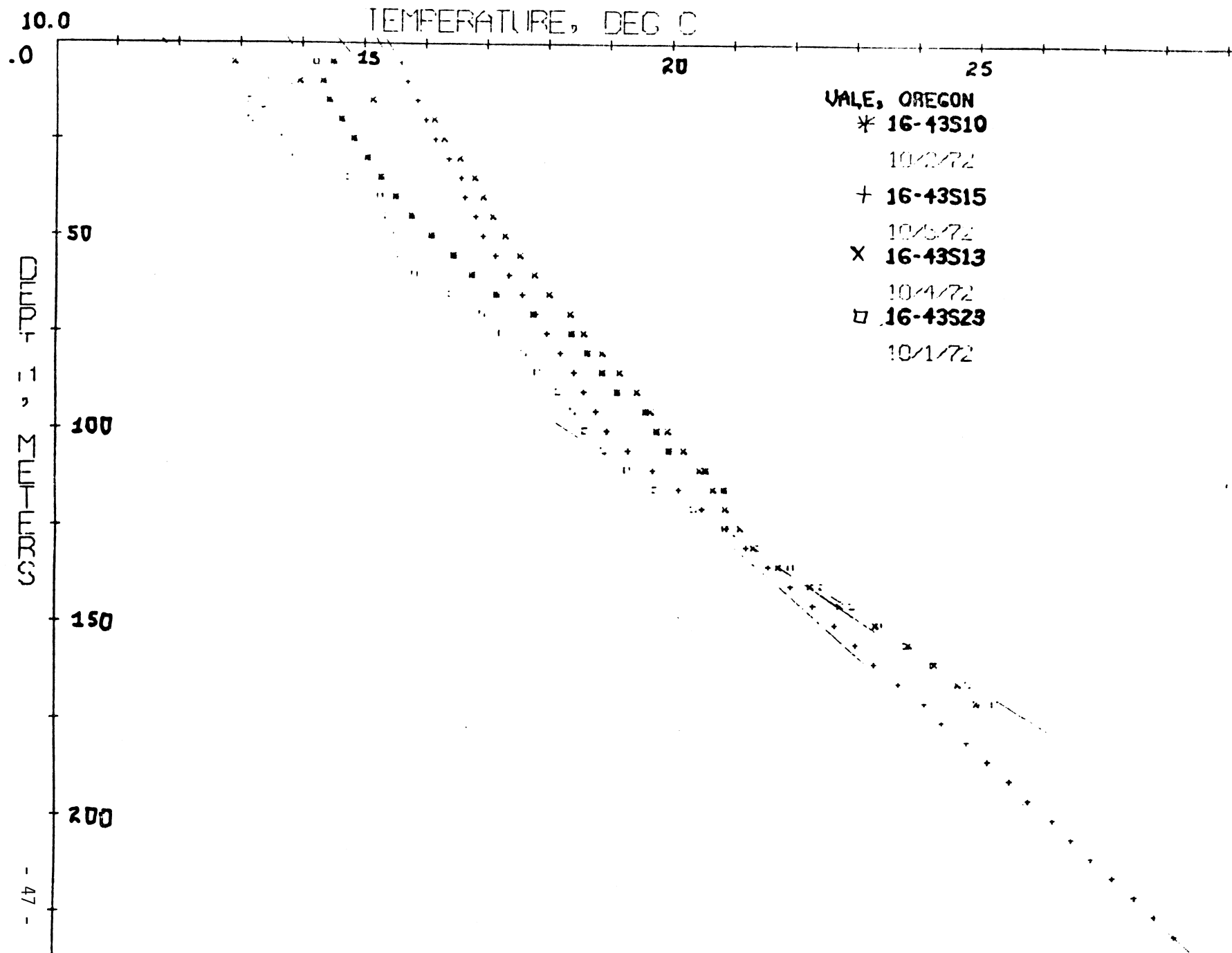
water well

DEPTH METERS	DEPTH FEET	TEMPERATURE		GEOTHERMAL GRADIENT	
		DEG C	DEG F	DEG C/KM	FEET/DEG F
5.0	16.4	15.590	60.06	.0	.0
10.0	32.8	15.700	60.26	22.0	82.8
15.0	49.2	15.860	60.55	32.0	56.9
20.0	65.6	16.000	60.80	28.0	65.1
25.0	82.0	16.150	61.07	30.0	60.7
30.0	98.4	16.370	61.47	44.0	41.4
35.0	114.8	16.580	61.84	42.0	43.4
40.0	131.2	16.640	61.95	12.0	151.9
45.0	147.6	16.810	62.26	34.0	53.6
50.0	164.0	16.940	62.49	26.0	70.1
55.0	180.4	17.130	62.83	38.0	48.0
60.0	196.8	17.360	63.25	46.0	39.6
65.0	213.2	17.580	63.64	44.0	41.4
70.0	229.6	17.800	64.04	44.0	41.4
75.0	246.0	17.980	64.36	36.0	50.6
80.0	262.4	18.210	64.78	46.0	39.6
85.0	278.8	18.410	65.14	40.0	45.6
90.0	295.2	18.590	65.46	36.0	50.6
95.0	311.6	18.770	65.79	36.0	50.6
100.0	328.0	18.970	66.15	40.0	45.6
105.0	344.4	19.300	66.74	66.0	27.6
110.0	360.8	19.710	67.48	82.0	22.2
115.0	377.2	20.110	68.20	80.0	22.8
120.0	393.6	20.490	68.88	76.0	24.0
125.0	410.0	20.890	69.60	80.0	22.8
130.0	426.4	21.220	70.20	66.0	27.6
135.0	442.8	21.580	70.84	72.0	25.3
140.0	459.2	21.950	71.51	74.0	24.6
145.0	475.6	22.300	72.14	70.0	26.0
150.0	492.0	22.660	72.79	72.0	25.3
155.0	508.4	22.990	73.38	66.0	27.6
160.0	524.8	23.300	73.94	62.0	29.4
165.0	541.2	23.710	74.68	82.0	22.2
170.0	557.6	24.110	75.40	80.0	22.8
175.0	574.0	24.400	75.92	58.0	31.4
180.0	590.4	24.800	76.64	80.0	22.8
185.0	606.8	25.130	77.23	66.0	27.6
190.0	623.2	25.500	77.90	74.0	24.6
195.0	639.6	25.790	78.42	58.0	31.4
200.0	656.0	26.200	79.16	82.0	22.2
205.0	672.4	26.490	79.68	58.0	31.4
210.0	688.8	26.810	80.26	64.0	28.5
215.0	705.2	27.160	80.89	70.0	26.0
220.0	721.6	27.520	81.54	72.0	25.3
225.0	738.0	27.830	82.09	62.0	29.4
230.0	754.4	28.150	82.67	64.0	28.5

LOCATION: VALL. OREGON
HOLE NUMBER: 16-43S23
DATE MEASURED: 10/1/72

Water well

DEPTH METERS	DEPTH FEET	TEMPERATURE		GEOTHERMAL GRADIENT	
		DEG C	DEG F	DEG C/KM	FEET/DEG F
5.0	16.4	14.230	57.61	.0	.0
10.0	32.8	13.490	56.28	-148.0	-12.3
15.0	49.2	13.160	55.69	-66.0	-27.6
20.0	65.6	13.170	55.71	2.0	911.1
25.0	82.0	13.700	56.66	106.0	17.2
30.0	98.4	13.880	56.98	36.0	50.6
35.0	114.8	14.760	58.57	176.0	10.4
40.0	131.2	15.260	59.47	100.0	18.2
45.0	147.6	15.380	59.68	24.0	75.9
50.0	164.0	15.510	59.92	26.0	70.1
55.0	180.4	15.580	60.04	14.0	130.2
60.0	196.8	15.810	60.46	46.0	39.6
65.0	213.2	16.410	61.54	120.0	15.2
70.0	229.6	16.910	62.44	100.0	18.2
75.0	246.0	17.240	63.03	66.0	27.6
80.0	262.4	17.610	63.70	74.0	24.6
85.0	278.8	17.820	64.08	42.0	43.4
90.0	295.2	18.160	64.69	68.0	26.8
95.0	311.6	18.390	65.10	46.0	39.6
100.0	328.0	18.600	65.48	42.0	43.4
105.0	344.4	18.900	66.02	60.0	30.4
110.0	360.8	19.280	66.70	76.0	24.0
115.0	377.2	19.740	67.53	92.0	19.8
120.0	393.6	20.360	68.65	124.0	14.7
125.0	410.0	20.870	69.57	102.0	17.9
130.0	426.4	21.440	70.59	114.0	16.0
135.0	442.8	21.940	71.49	100.0	18.2
140.0	459.2	22.470	72.45	106.0	17.2
145.0	475.6	22.950	73.31	96.0	19.0
150.0	492.0	23.370	74.07	84.0	21.7
155.0	508.4	23.820	74.88	90.0	20.2
160.0	524.8	24.250	75.65	86.0	21.2
165.0	541.2	24.820	76.68	114.0	16.0
170.0	557.6	25.250	77.45	86.0	21.2



LOCATION: VALE, OREGON
 HOLE NUMBER: 17-44S31
 DATE MEASURED: 10/14/72

water well

DEPTH METERS	DEPTH FEET	TEMPERATURE		GEOTHERMAL GRADIENT	
		DEG C	DEG F	DEG C/KM	FEET/DEG F
5.0	16.4	13.430	56.17	.0	.0
10.0	32.8	13.850	56.93	84.0	21.7
15.0	49.2	14.510	58.12	132.0	13.8
20.0	65.6	14.990	58.98	96.0	19.0
25.0	82.0	15.630	60.13	128.0	14.2
30.0	98.4	15.920	60.66	58.0	31.4
35.0	114.8	16.390	61.50	94.0	19.4
40.0	131.2	16.930	62.47	108.0	16.9
45.0	147.6	17.390	63.30	92.0	19.8
50.0	164.0	17.700	63.86	62.0	29.4
55.0	180.4	18.060	64.51	72.0	25.3
60.0	196.8	18.430	65.17	74.0	24.6
65.0	213.2	19.020	66.24	118.0	15.4
70.0	229.6	19.460	67.03	88.0	20.7

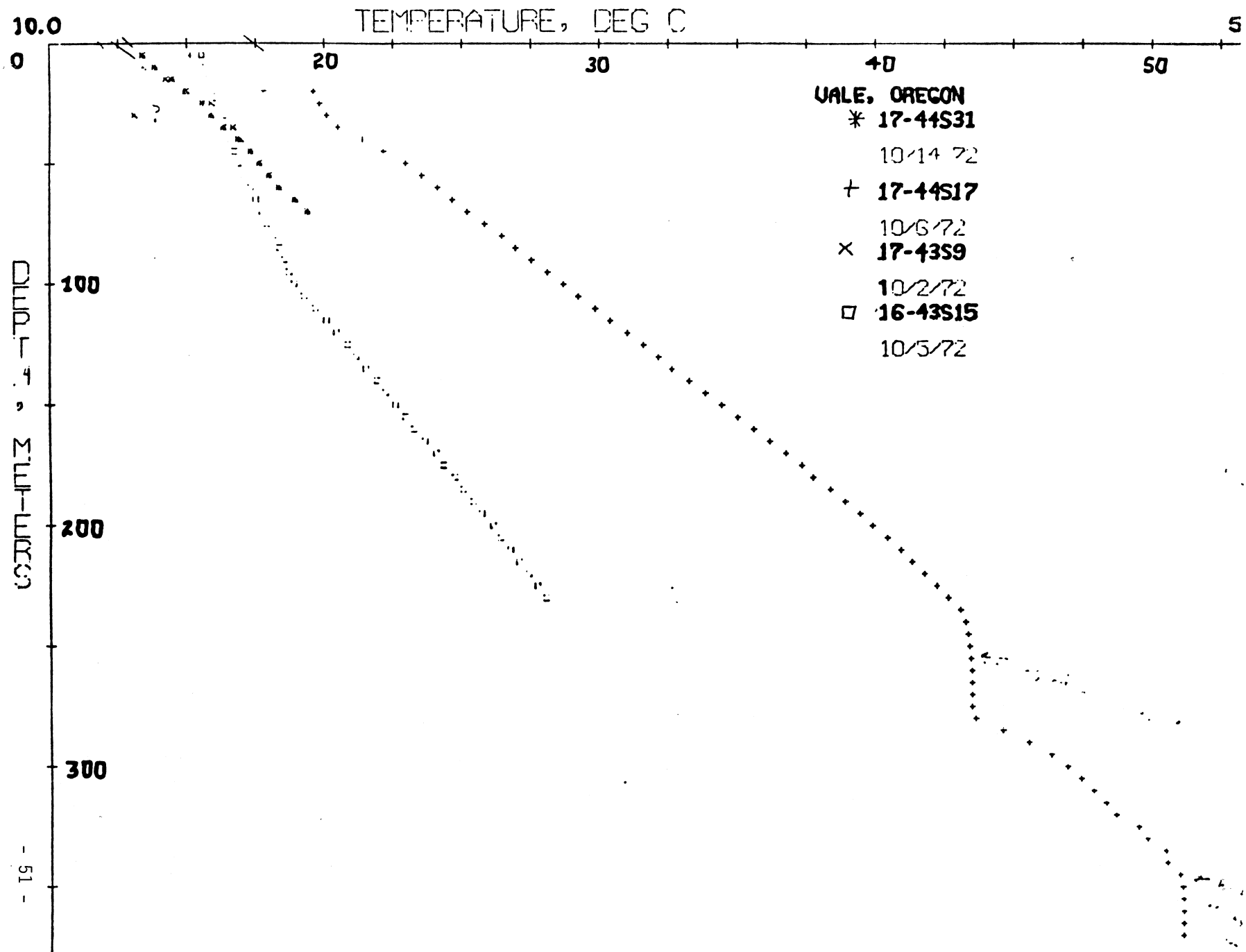
LOCATION: VALL. OREGON
HOLE NUMBER: 17-44917
DATE MEASURED: 10/6/72

11

DEPTH METERS	DEPTH FEET	TEMPERATURE		GEOTHERMAL GRADIENT	
		DEG C	DEG F	DEG C/KM	FEET/DEG F
5.0	16.4	15.180	59.32	.0	.0
10.0	32.8	17.080	62.74	380.0	4.8
15.0	49.2	19.640	67.35	512.0	3.6
20.0	65.6	19.680	67.42	8.0	227.8
25.0	82.0	19.900	67.82	44.0	41.4
30.0	98.4	20.160	68.29	52.0	35.0
35.0	114.8	20.590	69.06	86.0	21.2
40.0	131.2	21.490	70.68	180.0	10.1
45.0	147.6	22.240	72.03	150.0	12.1
50.0	164.0	23.070	73.53	166.0	11.0
55.0	180.4	23.630	74.53	112.0	16.3
60.0	196.8	24.220	75.60	118.0	15.4
65.0	213.2	24.760	76.57	108.0	16.9
70.0	229.6	25.290	77.52	106.0	17.2
75.0	246.0	25.930	78.67	128.0	14.2
80.0	262.4	26.540	79.77	122.0	14.9
85.0	278.8	27.040	80.67	100.0	18.2
90.0	295.2	27.630	81.73	118.0	15.4
95.0	311.6	28.240	82.83	122.0	14.9
100.0	328.0	28.830	83.89	118.0	15.4
105.0	344.4	29.360	84.85	106.0	17.2
110.0	360.8	30.000	86.00	128.0	14.2
115.0	377.2	30.520	86.94	104.0	17.5
120.0	393.6	31.170	88.11	130.0	14.0
125.0	410.0	31.750	89.15	116.0	15.7
130.0	426.4	32.270	90.09	104.0	17.5
135.0	442.8	32.750	90.95	96.0	19.0
140.0	459.2	33.410	92.14	132.0	13.8
145.0	475.6	33.970	93.15	112.0	16.3
150.0	492.0	34.590	94.26	124.0	14.7
155.0	508.4	35.160	95.29	114.0	16.0
160.0	524.8	35.750	96.35	118.0	15.4
165.0	541.2	36.320	97.38	114.0	16.0
170.0	557.6	36.890	98.40	114.0	16.0
175.0	574.0	37.480	99.46	118.0	15.4
180.0	590.4	37.920	100.26	88.0	20.7
185.0	606.8	38.510	101.32	118.0	15.4
190.0	623.2	39.070	102.33	112.0	16.3
195.0	639.6	39.600	103.28	106.0	17.2
200.0	656.0	40.070	104.13	94.0	19.4
205.0	672.4	40.610	105.10	108.0	16.9
210.0	688.8	41.080	105.94	94.0	19.4
215.0	705.2	41.520	106.74	88.0	20.7
220.0	721.6	41.950	107.51	86.0	21.2
225.0	738.0	42.410	108.34	92.0	19.8
230.0	754.4	42.820	109.08	82.0	22.2
235.0	770.8	43.260	109.87	88.0	20.7
240.0	787.2	43.440	110.19	36.0	50.6

LOCATION: VALLEY, OREGON
 HOLE NUMBER: 17-43S9
 DATE MEASURED: 10/2/72

DEPTH METERS	DEPTH FEET	TEMPERATURE		GEOTHERMAL GRADIENT	
		DEG C	DEG F	DEG C/KM	FEET/DEG F
5.0	16.4	13.440	56.19	.0	.0
10.0	32.8	13.460	56.23	4.0	455.6
15.0	49.2	14.260	57.67	160.0	11.4
20.0	65.6	15.030	59.05	154.0	11.8
25.0	82.0	15.920	60.66	178.0	10.2
30.0	98.4	13.150	55.67	-554.0	-3.3
35.0	114.8	16.760	62.17	722.0	2.5
40.0	131.2	17.010	62.62	50.0	36.4



LOCATION: BOISE AMS, OREGON

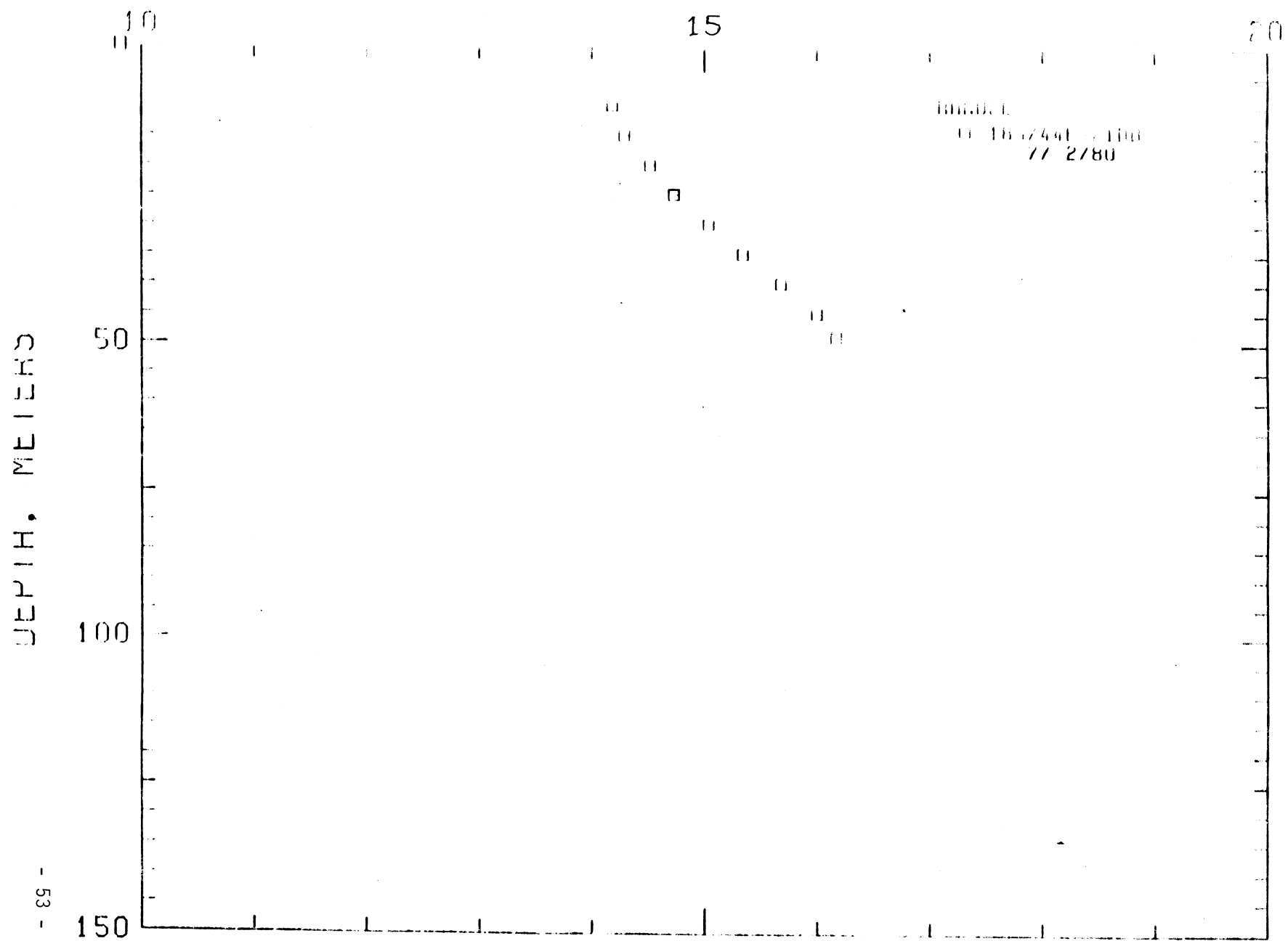
18S/44E-21DB

HOLE NAME: RANDLE

DATE MEASURED: 7/ 2/00

DEPTH METERS	DEPTH FEET	TEMPERATURE		GEOTHERMAL GRADIENT	
		DEG C	DEG F	DEG C/M	DEG F/100 FT
10.0	32.8	14.180	57.52	0.0	0.0
15.0	49.2	14.290	57.72	22.0	1.2
20.0	65.6	14.520	58.14	46.0	2.5
25.0	82.0	14.730	58.51	42.0	2.3
30.0	98.4	15.040	59.07	62.0	3.4
35.0	114.8	15.340	59.61	60.0	3.3
40.0	131.2	15.690	60.22	68.0	3.7
45.0	147.6	16.000	60.80	64.0	3.5
49.0	160.7	16.170	61.11	42.5	2.3

TEMPERATURE, DEG C



LOCATION: BOISE BAS, OREGON

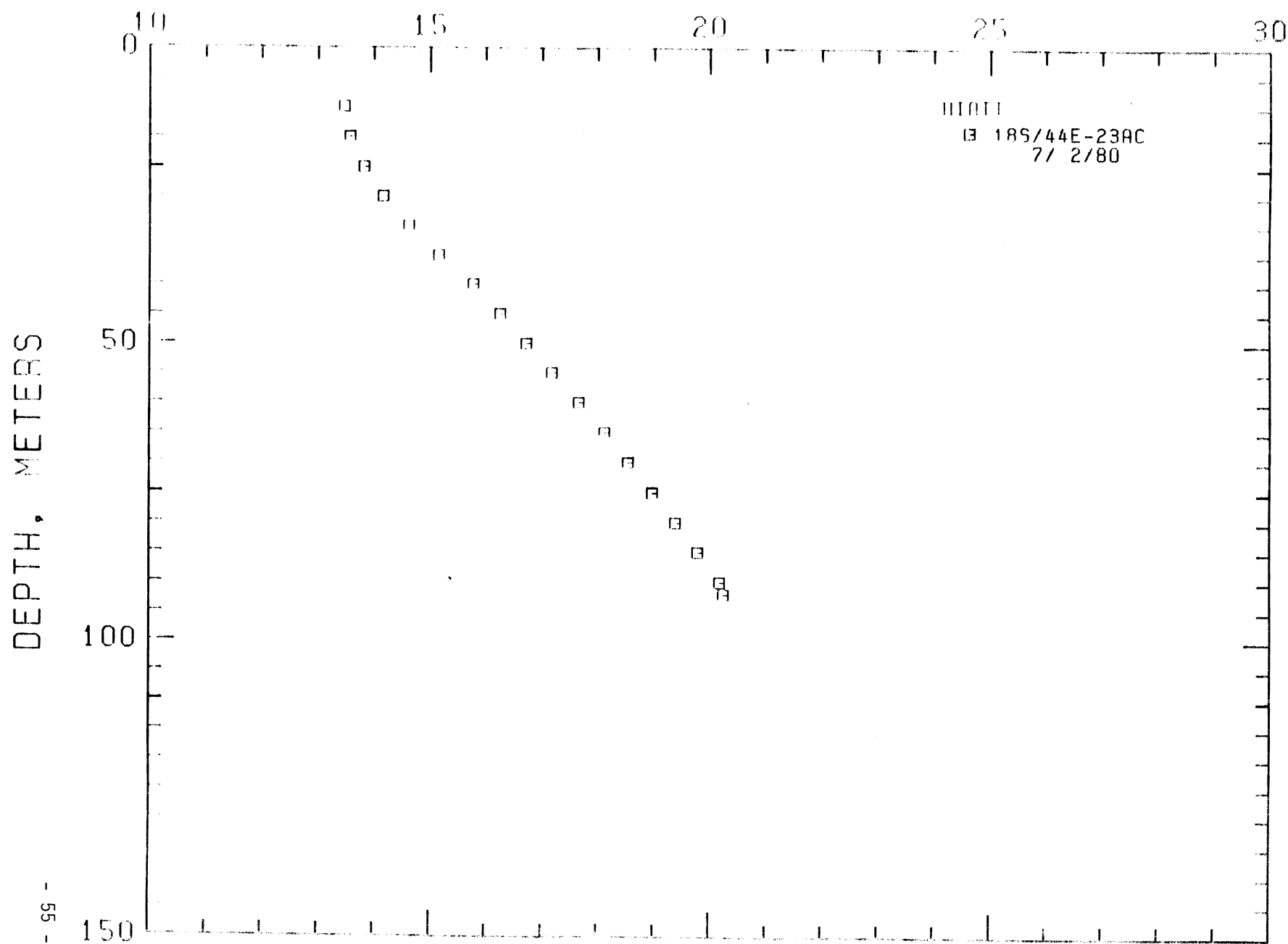
193-44E-230C

HOLE NAME: HIATT

DATE MEASURED: 7/ 2/80

DEPTH METERS	DEPTH FEET	TEMPERATURE		GEOTHERMAL GRADIENT	
		DEG C	DEG F	DEG C /M	DEG F /100 FT
10.0	32.8	13.470	56.25	0.0	0.0
15.0	49.2	13.590	56.44	22.0	1.2
20.0	65.6	13.920	56.89	59.0	2.7
25.0	82.0	14.170	57.51	60.0	1.7
30.0	98.4	14.670	58.39	98.0	5.0
35.0	114.8	15.170	59.31	109.0	5.9
40.0	131.2	15.780	60.40	122.0	6.7
45.0	147.6	16.260	61.27	96.0	5.0
50.0	164.0	16.730	62.11	94.0	5.2
55.0	180.4	17.190	62.94	92.0	5.0
60.0	196.8	17.670	63.81	96.0	5.3
65.0	213.2	18.130	64.63	92.0	5.0
70.0	229.6	18.550	65.39	84.0	4.6
75.0	246.0	18.990	66.16	86.0	4.7
80.0	262.4	19.390	66.90	82.0	4.5
85.0	278.8	19.790	67.62	80.0	4.4
90.0	295.2	20.180	68.32	78.0	4.3
92.0	301.8	20.350	68.45	35.0	1.9

TEMPERATURE, DEG C



LOCATION: BOISE AFB, OREGON
18S/45E-200C

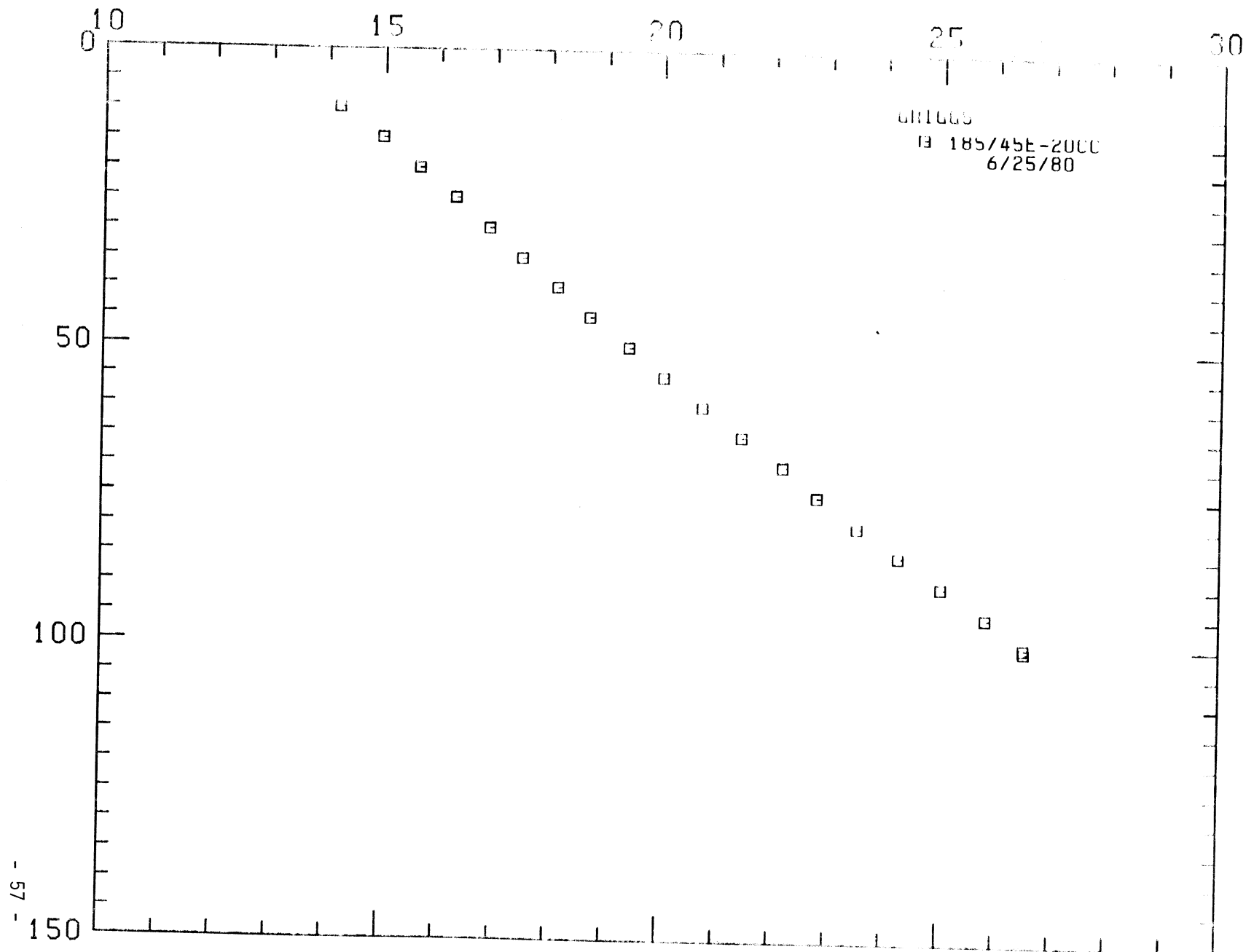
HOLE NAME: GRIGGS

DATE MEASURED: 6/25/00

DEPTH METERS	DEPTH FEET	TEMPERATURE		GEOTHERMAL GRADIENT	
		DEG C	DEG F	DEG C/1M	DEG F/100 FT
10.0	32.8	14.190	57.54	0.0	0.0
15.0	49.2	14.970	58.95	1.6.0	8.6
20.0	65.6	15.630	60.13	1.2.0	7.2
25.0	82.0	16.200	61.30	1.0.0	7.1
30.0	98.4	16.890	62.40	1.2.0	6.7
35.0	114.8	17.400	63.46	1.16.0	6.5
40.0	131.2	18.130	64.63	1.0.0	7.1
45.0	147.6	18.710	65.68	1.16.0	6.4
50.0	164.0	19.420	66.96	1.42.0	7.8
55.0	180.4	20.050	68.09	1.76.0	6.9
60.0	196.8	20.740	69.33	1.08.0	7.6
65.0	213.2	21.450	70.61	1.42.0	7.8
70.0	229.6	22.190	71.94	1.48.0	8.1
75.0	246.0	22.810	73.06	1.24.0	6.8
80.0	262.4	23.530	74.35	1.44.0	7.9
85.0	278.8	24.270	75.69	1.48.0	8.1
90.0	295.2	25.040	77.07	1.54.0	8.5
95.0	311.6	25.840	78.51	1.60.0	8.8
100.0	328.0	26.520	79.74	1.56.0	7.5
100.5	329.6	26.540	79.77	40.0	2.2

TEMPERATURE, DEG C

GRIGGS
13 185/45E-2000
6/25/80



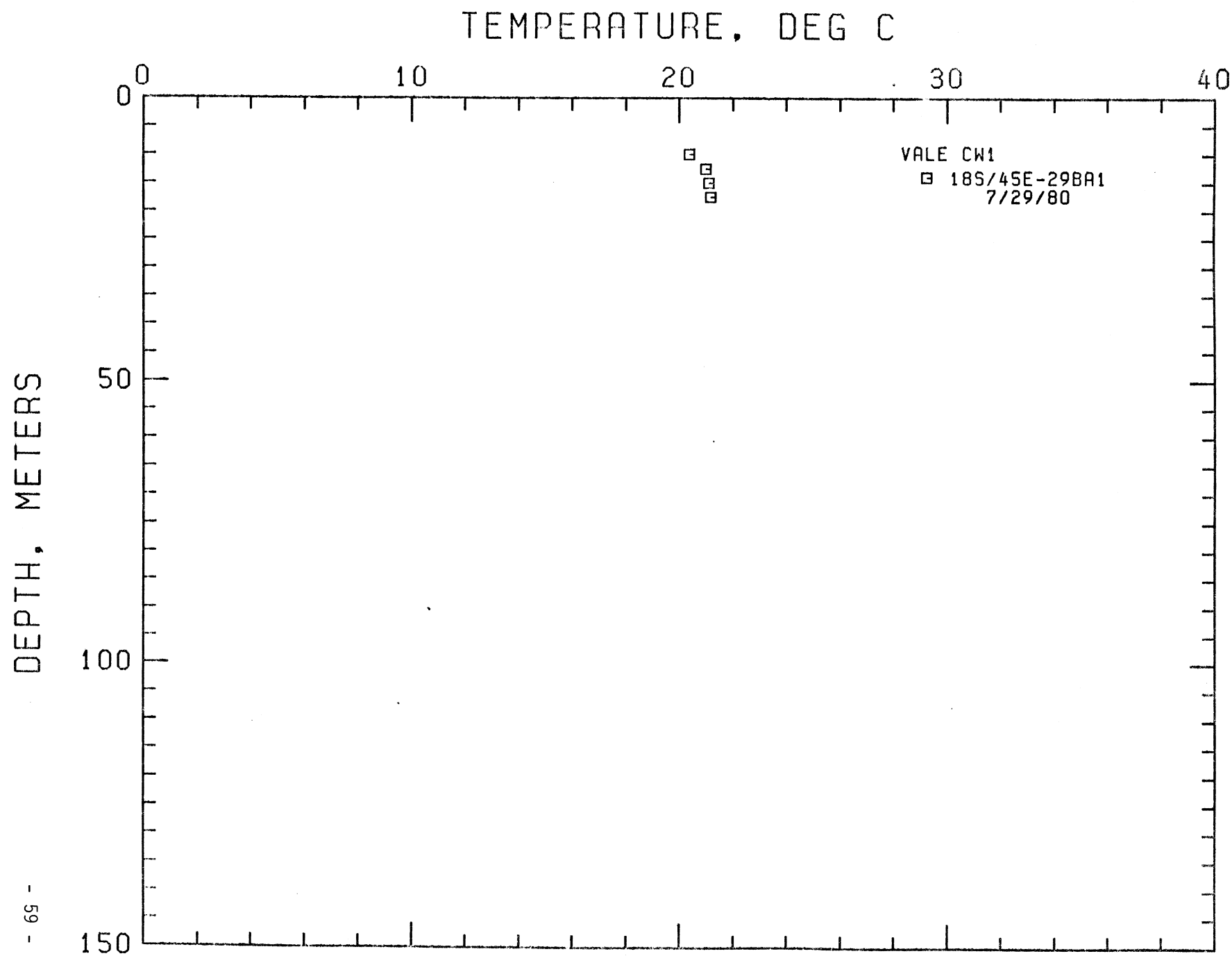
LOCATION: BOISE AMS, OREGON

18S/45E-29DA1

HOLE NAME: VALE CW1

DATE MEASURED: 7/29/80

DEPTH METERS	DEPTH FEET	TEMPERATURE		GEOTHERMAL GRADIENT	
		DEG C	DEG F	DEG C/KM	DEG F/100 FT
10.0	32.8	20.380	68.68	0.0	0.0
12.5	41.0	21.010	69.82	252.0	13.8
15.0	49.2	21.120	70.02	44.0	2.4
17.5	57.4	21.180	70.12	24.0	1.3



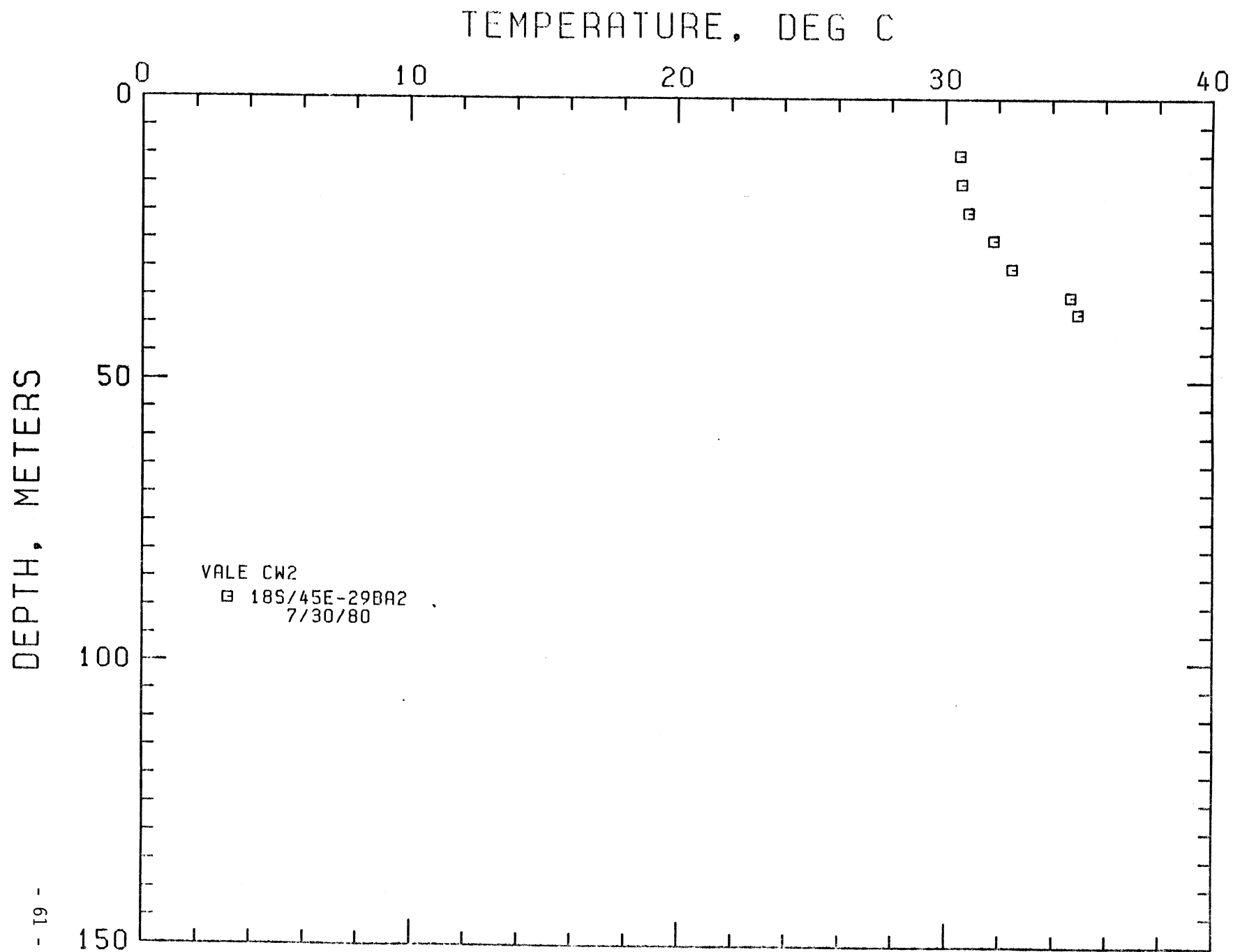
LOCATION: BOISE AMS, OREGON

18S/45E-29BA2

HOLE NAME: VALE CW2

DATE MEASURED: 7/30/80

DEPTH METERS	DEPTH FEET	TEMPERATURE		GEOTHERMAL GRADIENT	
		DEG C	DEG F	DEG C/KM	DEG F/100 FT
10.0	32.8	30.570	87.03	0.0	0.0
15.0	49.2	30.620	87.12	10.0	0.5
20.0	65.6	30.870	87.57	50.0	2.7
25.0	82.0	31.820	89.28	190.0	10.4
30.0	98.4	32.510	90.52	138.0	7.6
35.0	114.8	34.690	94.44	436.0	23.9
38.0	124.6	34.970	94.95	93.3	5.1



LOCATION: BOISE AMS, OREGON

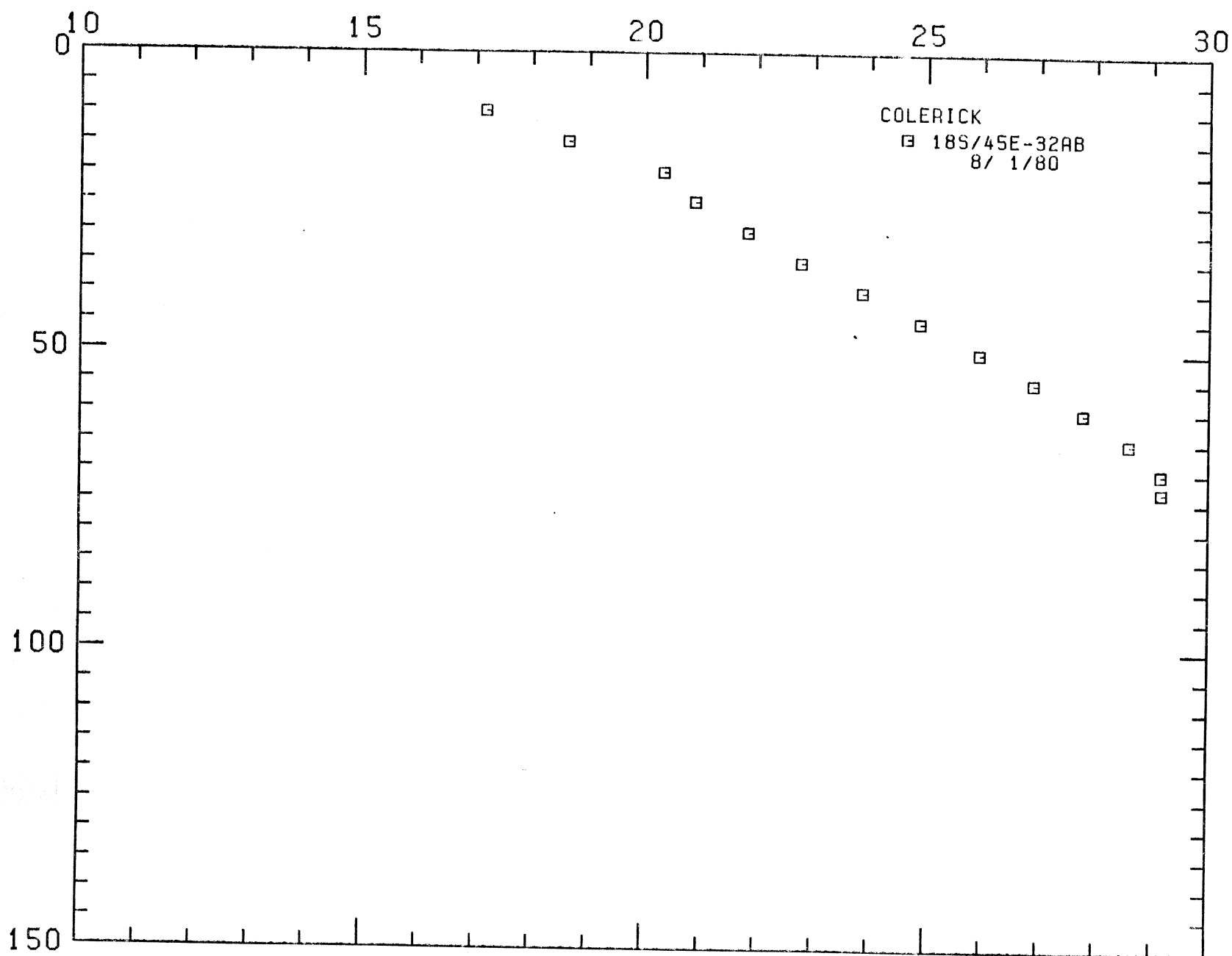
18S/45E-32AB

HOLE NAME: COLERICK

DATE MEASURED: 8/ 1/60

DEPTH METERS	DEPTH FEET	TEMPERATURE		GEOTHERMAL GRADIENT	
		DEG C	DEG F	DEG C/KM	DEG F/100 FT
10.0	32.8	17.180	62.92	0.0	0.0
15.0	49.2	18.640	65.55	292.0	16.0
20.0	65.6	20.330	68.59	338.0	18.5
25.0	82.0	20.890	69.60	112.0	6.1
30.0	98.4	21.830	71.29	188.0	10.3
35.0	114.8	22.780	73.00	190.0	10.4
40.0	131.2	23.860	74.95	216.0	11.9
45.0	147.6	24.890	76.80	206.0	11.3
50.0	164.0	25.940	78.69	210.0	11.5
55.0	180.4	26.900	80.42	192.0	10.5
60.0	196.8	27.780	82.00	176.0	9.7
65.0	213.2	28.590	83.46	162.0	8.9
70.0	229.6	29.160	84.49	114.0	6.3
73.0	239.4	29.180	84.52	6.7	0.4

TEMPERATURE, DEG C



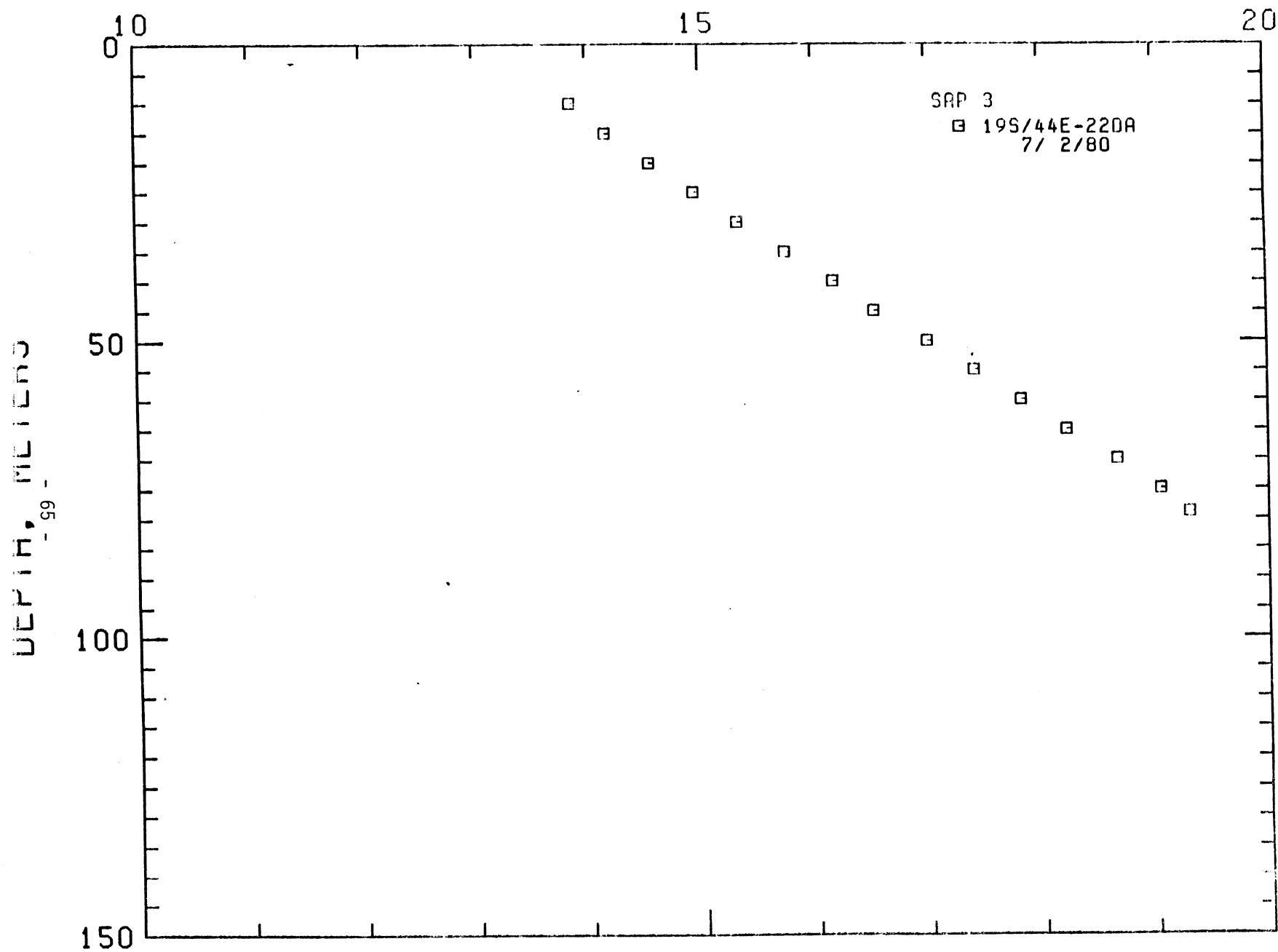
LOCATION: BOISE AMS, OREGON
19S/44E-22DA

HOLE NAME: SAP 3

DATE MEASURED: 7/ 2/80

DEPTH METERS	DEPTH FEET	TEMPERATURE		GEOTHERMAL GRADIENT	
		DEG C	DEG F	DEG C/KM	DEG F/100 FT
10.0	32.8	13.860	56.95	0.0	0.0
15.0	49.2	14.170	57.51	62.0	3.4
20.0	65.6	14.560	58.21	78.0	4.3
25.0	82.0	14.950	58.91	78.0	4.3
30.0	98.4	15.330	59.59	76.0	4.2
35.0	114.8	15.750	60.35	84.0	4.6
40.0	131.2	16.170	61.11	84.0	4.6
45.0	147.6	16.530	61.75	72.0	4.0
50.0	164.0	17.000	62.60	94.0	5.2
55.0	180.4	17.410	63.34	82.0	4.5
60.0	196.8	17.820	64.08	82.0	4.5
65.0	213.2	18.220	64.80	80.0	4.4
70.0	229.6	18.670	65.61	90.0	4.9
75.0	246.0	19.050	66.29	76.0	4.2
79.0	259.1	19.300	66.74	62.5	3.4

TEMPERATURE, DEG C



LOCATION: BOISE AMS, OREGON

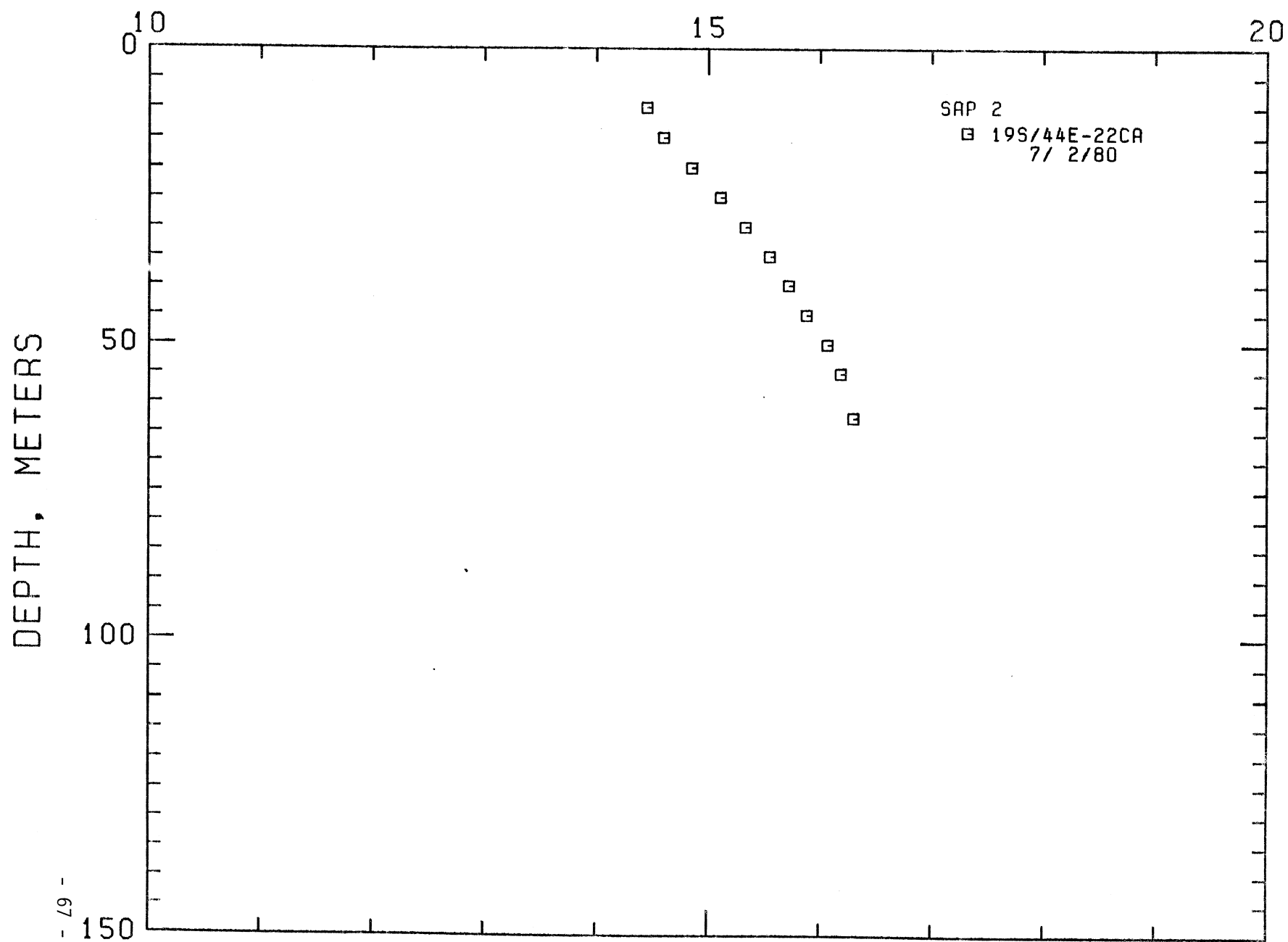
19S/44E-22CA

HOLE NAME: SAP 2

DATE MEASURED: 7/ 2/80

DEPTH METERS	DEPTH FEET	TEMPERATURE		GEOTHERMAL GRADIENT	
		DEG C	DEG F	DEG C/KM	DEG F/100 FT
10.0	32.8	14.450	58.01	0.0	0.0
15.0	49.2	14.600	58.28	30.0	1.6
20.0	65.6	14.850	58.73	50.0	2.7
25.0	82.0	15.110	59.20	52.0	2.9
30.0	98.4	15.330	59.59	44.0	2.4
35.0	114.8	15.550	59.99	44.0	2.4
40.0	131.2	15.720	60.30	34.0	1.9
45.0	147.6	15.880	60.58	32.0	1.8
50.0	164.0	16.070	60.93	38.0	2.1
55.0	180.4	16.190	61.14	24.0	1.3
62.5	205.0	16.300	61.34	14.7	0.8

TEMPERATURE, DEG C



LOCATION: BOISE AMS, OREGON

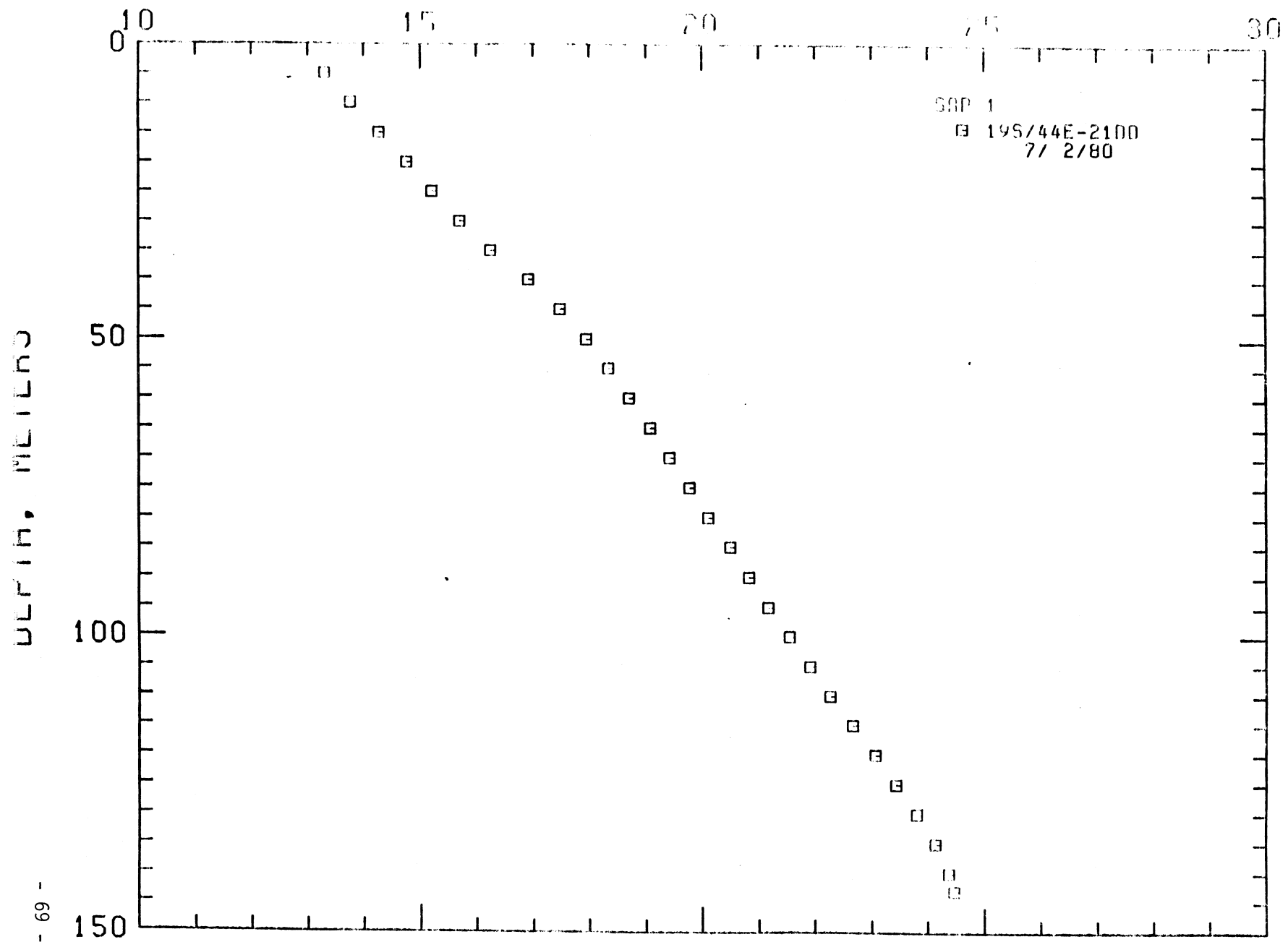
19S/44E-21DD

HOLE NAME: SAP 1

DATE MEASURED: 7/ 2/80

DEPTH METERS	DEPTH FEET	TEMPERATURE		GEOTHERMAL GRADIENT	
		DEG C	DEG F	DEG C/KM	DEG F/100 FT
5.0	16.4	13.310	55.96	0.0	0.0
10.0	32.8	13.770	56.79	92.0	5.0
15.0	49.2	14.270	57.69	100.0	5.5
20.0	65.6	14.770	58.59	100.0	5.5
25.0	82.0	15.210	59.38	89.0	4.8
30.0	98.4	15.700	60.26	98.0	5.4
35.0	114.8	16.250	61.25	110.0	6.0
40.0	131.2	16.920	62.46	134.0	7.4
45.0	147.6	17.490	63.48	114.0	6.3
50.0	164.0	17.950	64.31	92.0	5.0
55.0	180.4	18.340	65.01	78.0	4.3
60.0	196.8	18.710	65.68	74.0	4.1
65.0	213.2	19.080	66.34	74.0	4.1
70.0	229.6	19.430	66.97	70.0	3.8
75.0	246.0	19.780	67.60	70.0	3.8
80.0	262.4	20.110	68.20	66.0	3.6
85.0	278.8	20.500	68.90	78.0	4.3
90.0	295.2	20.830	69.49	66.0	3.6
95.0	311.6	21.180	70.12	70.0	3.8
100.0	328.0	21.550	70.79	74.0	4.1
105.0	344.4	21.920	71.46	74.0	4.1
110.0	360.8	22.270	72.09	70.0	3.8
115.0	377.2	22.670	72.81	80.0	4.4
120.0	393.6	23.070	73.53	80.0	4.4
125.0	410.0	23.440	74.19	74.0	4.1
130.0	426.4	23.810	74.86	74.0	4.1
135.0	442.8	24.140	75.45	66.0	3.6
140.0	459.2	24.380	75.88	48.0	2.6
143.0	469.0	24.470	76.05	30.0	1.6

TEMPERATURE, DEG C



LOCATION: BOISE AMS, OREGON

195/46E- 5BD

HOLE NAME: WINEBRGR

DATE MEASURED: 7/ 3/80

DEPTH METERS	DEPTH FEET	TEMPERATURE		GEOTHERMAL GRADIENT	
		DEG C	DEG F	DEG C/KM	DEG F/100 FT
10.0	32.8	13.790	56.82	0.0	0.0
15.0	49.2	14.620	58.32	166.0	3.1
20.0	65.6	15.320	59.58	140.0	2.7
25.0	82.0	15.050	60.59	112.0	6.1
30.0	98.4	16.300	61.34	84.0	4.6
35.0	114.8	16.640	61.95	69.0	3.7
40.0	131.2	17.120	62.82	96.0	5.3
45.0	147.6	17.560	63.61	88.0	4.8
50.0	164.0	18.140	64.65	116.0	6.4
55.0	180.4	18.380	65.09	40.0	2.6
60.0	196.8	18.940	66.09	112.0	6.1
65.0	213.2	19.590	67.26	130.0	7.1
70.0	229.6	20.070	68.13	96.0	5.3
75.0	246.0	20.460	68.83	79.0	4.3
80.0	262.4	21.030	69.89	118.0	6.5
85.0	278.8	21.520	70.74	94.0	5.2
90.0	295.2	22.130	71.83	122.0	6.7
95.0	311.6	22.290	72.12	32.0	1.8
100.0	328.0	22.560	72.61	54.0	3.0
105.0	344.4	22.790	73.02	46.0	2.5
110.0	360.8	23.330	73.99	109.0	5.9
115.0	377.2	23.550	74.39	44.0	2.4
120.0	393.6	23.600	74.48	10.0	0.5
125.0	410.0	23.650	74.57	10.0	0.5
130.0	426.4	23.700	74.66	10.0	0.5
135.0	442.8	23.700	74.80	16.0	0.9
140.0	459.2	23.860	74.95	16.0	0.9
145.0	475.6	23.950	75.11	18.0	1.0
150.0	492.0	24.060	75.31	22.0	1.2
155.0	508.4	24.170	75.51	22.0	1.2
160.0	524.8	24.300	75.74	26.0	1.4
165.0	541.2	24.410	75.94	22.0	1.2
170.0	557.6	24.570	76.23	32.0	1.8
175.0	574.0	24.750	76.55	36.0	2.0
180.0	590.4	24.930	76.87	36.0	2.0
185.0	606.8	25.100	77.18	34.0	1.9
190.0	623.2	25.290	77.52	38.0	2.1
195.0	639.6	25.490	77.88	40.0	2.2
200.0	656.0	25.710	78.28	44.0	2.4
205.0	672.4	25.950	78.71	48.0	2.6
210.0	688.8	26.140	79.05	38.0	2.1

LOCATION: BOISE AMS, OREGON

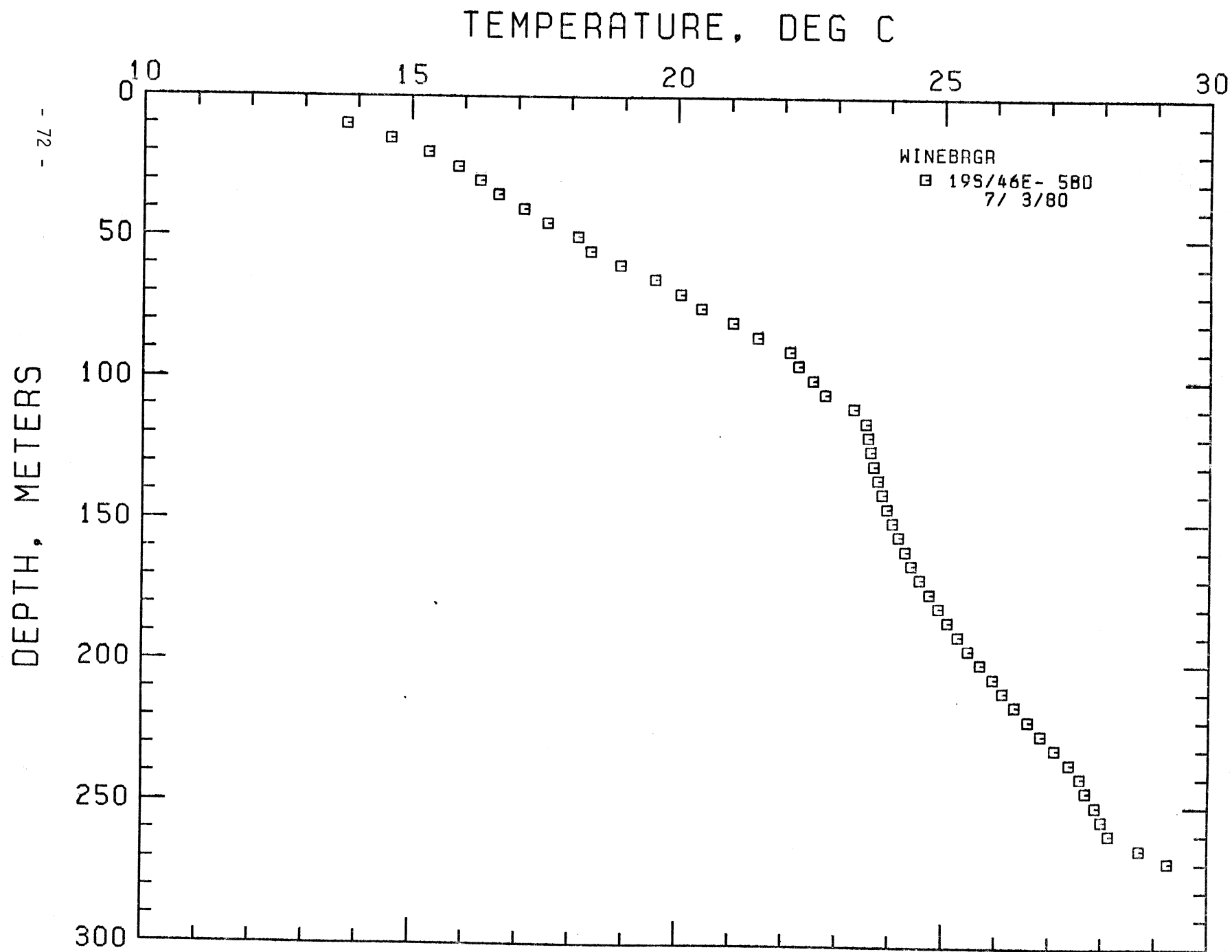
PAGE 2

19S/46E- 5BD

HOLE NAME: WINEBRGR

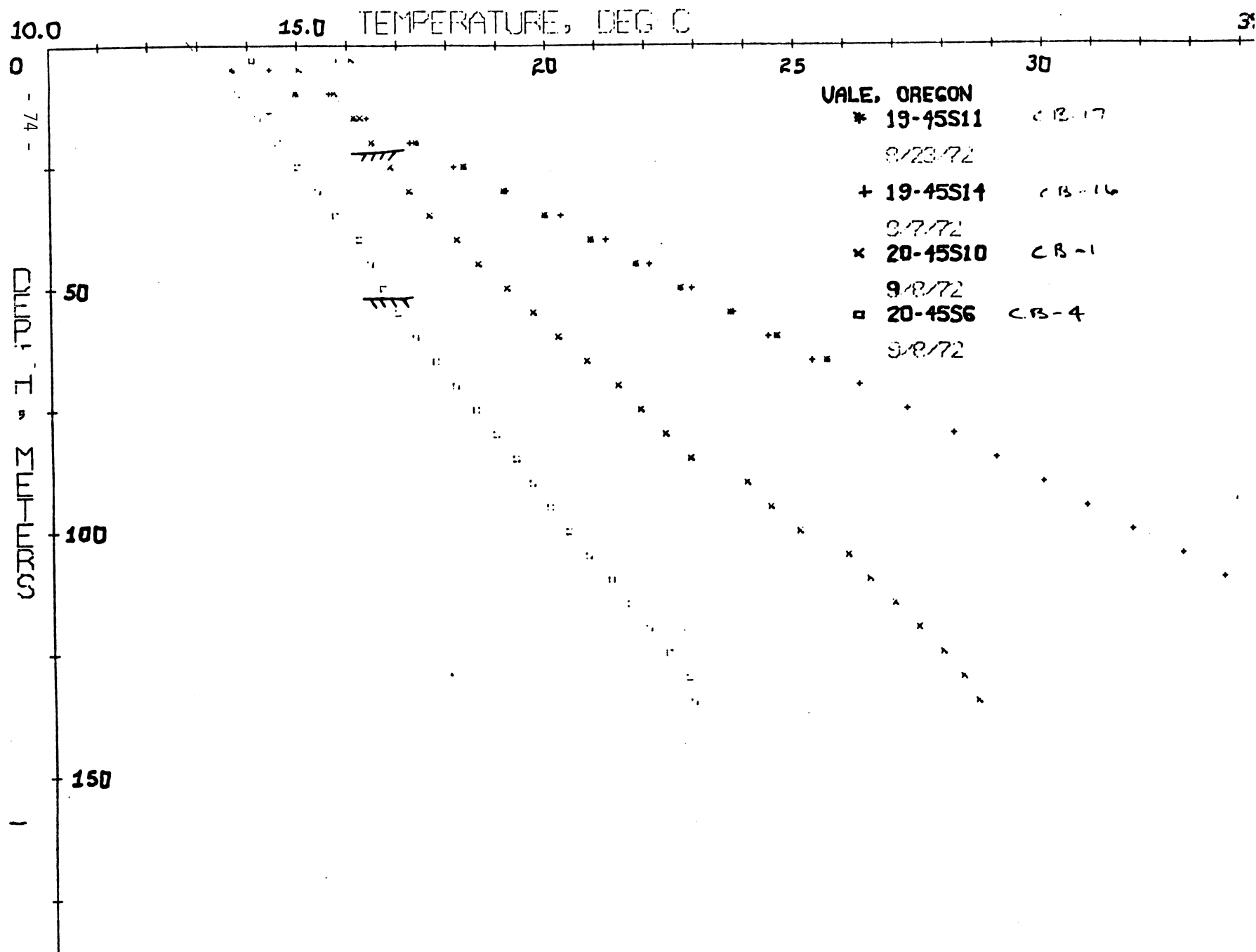
DATE MEASURED: 7/ 3/80

DEPTH METERS	DEPTH FEET	TEMPERATURE		GEOTHERMAL GRADIENT	
		DEG C	DEG F	DEG C/KM	DEG F/100 FT
215.0	705.2	26.370	79.47	46.0	2.5
220.0	721.6	26.620	79.92	50.0	2.7
225.0	738.0	26.860	80.35	48.0	2.6
230.0	754.4	27.120	80.82	52.0	2.9
235.0	770.8	27.390	81.30	54.0	3.0
240.0	787.2	27.600	81.68	42.0	2.3
245.0	803.6	27.700	81.86	20.0	1.1
250.0	820.0	27.880	82.18	36.0	2.0
255.0	836.4	28.000	82.40	24.0	1.3
260.0	852.8	28.140	82.65	28.0	1.5
265.0	869.2	28.720	83.70	116.0	6.4
269.5	884.0	29.260	84.67	120.0	6.6



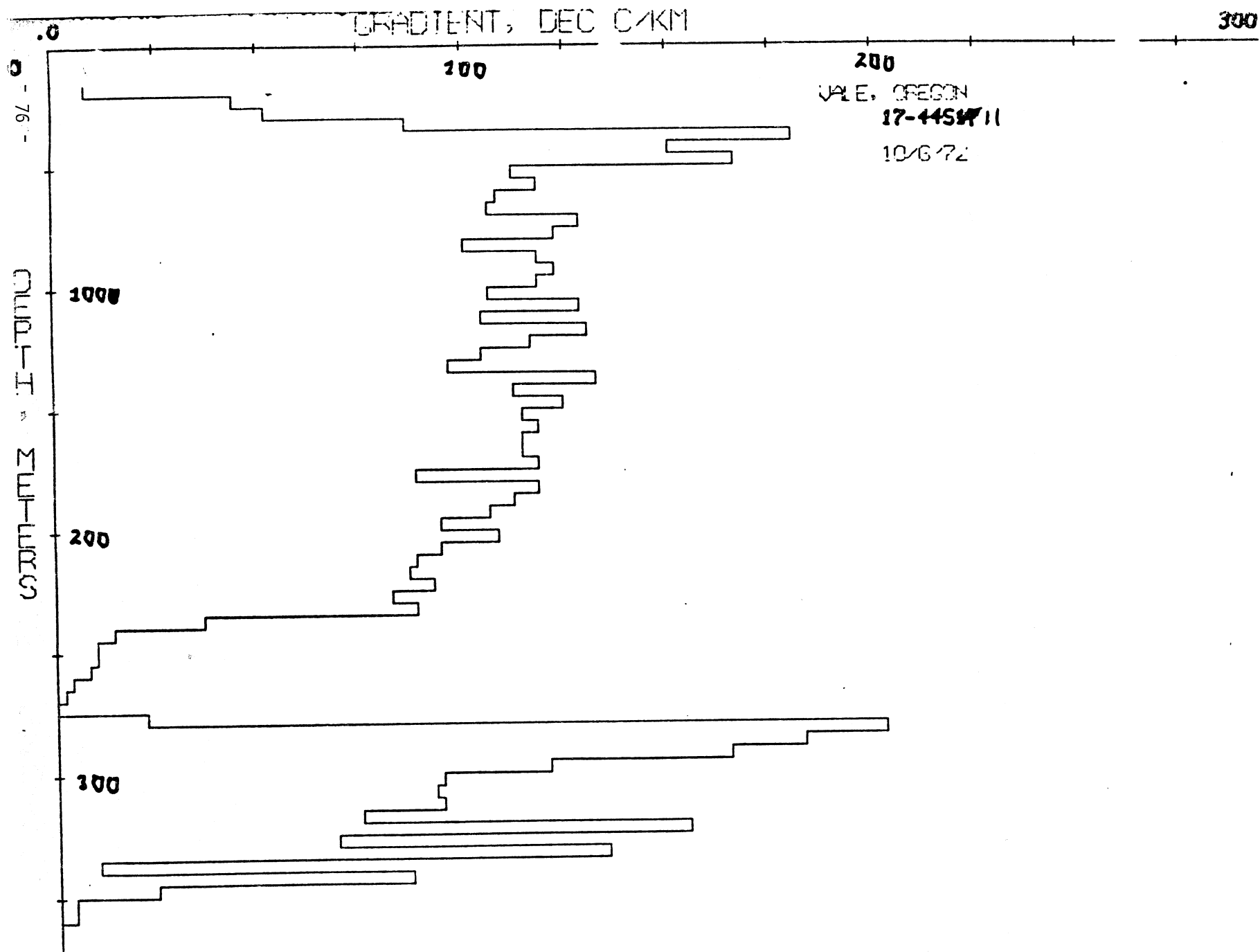
LOCATION: VALE, REGION
 HOLE NUMBER: 19-45S14
 DATE MEASURED: 9/7/72

DEPTH METERS	DEPTH FEET	TEMPERATURE		GEOTHERMAL GRADIENT	
		DEG C	DEG F	DEG C/KM	FEET/DEG F
3.0	9.8	15.800	60.44	.0	.0
5.0	16.4	14.460	58.03	-670.0	-2.7
10.0	32.8	15.640	60.15	236.0	7.7
15.0	49.2	16.400	61.52	152.0	12.0
20.0	65.6	17.280	63.10	176.0	10.4
25.0	82.0	18.140	64.65	172.0	10.6
30.0	98.4	19.190	66.54	210.0	3.7
35.0	114.8	20.300	68.54	222.0	3.2
40.0	131.2	21.210	70.18	132.0	10.0
45.0	147.6	22.080	71.74	174.0	10.0
50.0	164.0	22.930	73.27	170.0	10.7
55.0	180.4	23.750	74.75	194.0	11.1
60.0	196.8	24.450	76.01	140.0	13.0
65.0	213.2	25.330	77.59	176.0	10.4
70.0	229.6	26.270	79.29	138.0	9.7
75.0	246.0	27.230	81.01	192.0	9.6
80.0	262.4	28.130	82.67	184.0	9.0
85.0	278.8	29.000	84.20	170.0	10.7
90.0	295.2	29.940	85.89	138.0	9.7
95.0	311.6	30.830	87.49	178.0	10.0
100.0	328.0	31.730	89.11	130.0	10.1
105.0	344.4	32.730	90.91	200.0	9.1
110.0	360.8	33.550	92.39	164.0	11.1
115.0	377.2	34.320	93.78	154.0	11.8
120.0	393.6	35.060	95.11	148.0	12.3
125.0	410.0	35.800	96.44	148.0	12.3
130.0	426.4	36.540	97.77	148.0	12.3
135.0	442.8	37.200	99.05	142.0	12.3



LOCATION: VALL BREGON
HOLE NUMBER: 17-44S II
DATE MEASURED: 10/6/72

DEPTH METERS	DEPTH FEET	TEMPERATURE		GEOTHERMAL GRADIENT	
		DEG C	DEG F	DEG C/KM	FEET/DEG F
245.0	803.6	43.510	110.32	14.0	130.2
250.0	820.0	43.560	110.41	10.0	182.2
255.0	836.4	43.610	110.50	10.0	182.2
260.0	852.8	43.650	110.57	8.0	227.8
265.0	869.2	43.670	110.61	4.0	455.6
270.0	885.6	43.680	110.62	2.0	911.1
275.0	902.0	43.680	110.62	0.000000000000.0	
280.0	918.4	43.790	110.82	22.0	82.8
285.0	934.8	44.800	112.64	202.0	9.0
290.0	951.2	45.710	114.28	182.0	10.0
295.0	967.6	46.530	115.75	164.0	11.1
300.0	984.0	47.130	116.83	120.0	15.2
305.0	1000.4	47.600	117.68	94.0	19.4
310.0	1016.8	48.060	118.51	92.0	19.8
315.0	1033.2	48.530	119.35	94.0	19.4
320.0	1049.6	48.900	120.02	74.0	24.6
325.0	1066.0	49.670	121.41	154.0	11.8
330.0	1082.4	50.010	122.02	68.0	26.8
335.0	1098.8	50.680	123.22	134.0	13.6
340.0	1115.2	50.730	123.31	10.0	182.2
345.0	1131.6	51.160	124.09	86.0	21.2
350.0	1148.0	51.280	124.30	24.0	75.9
355.0	1164.4	51.300	124.34	4.0	455.6
360.0	1180.8	51.320	124.38	4.0	455.6
365.0	1197.2	51.320	124.38	0.000000000000.0	
370.0	1213.6	51.320	124.38	0.000000000000.0	

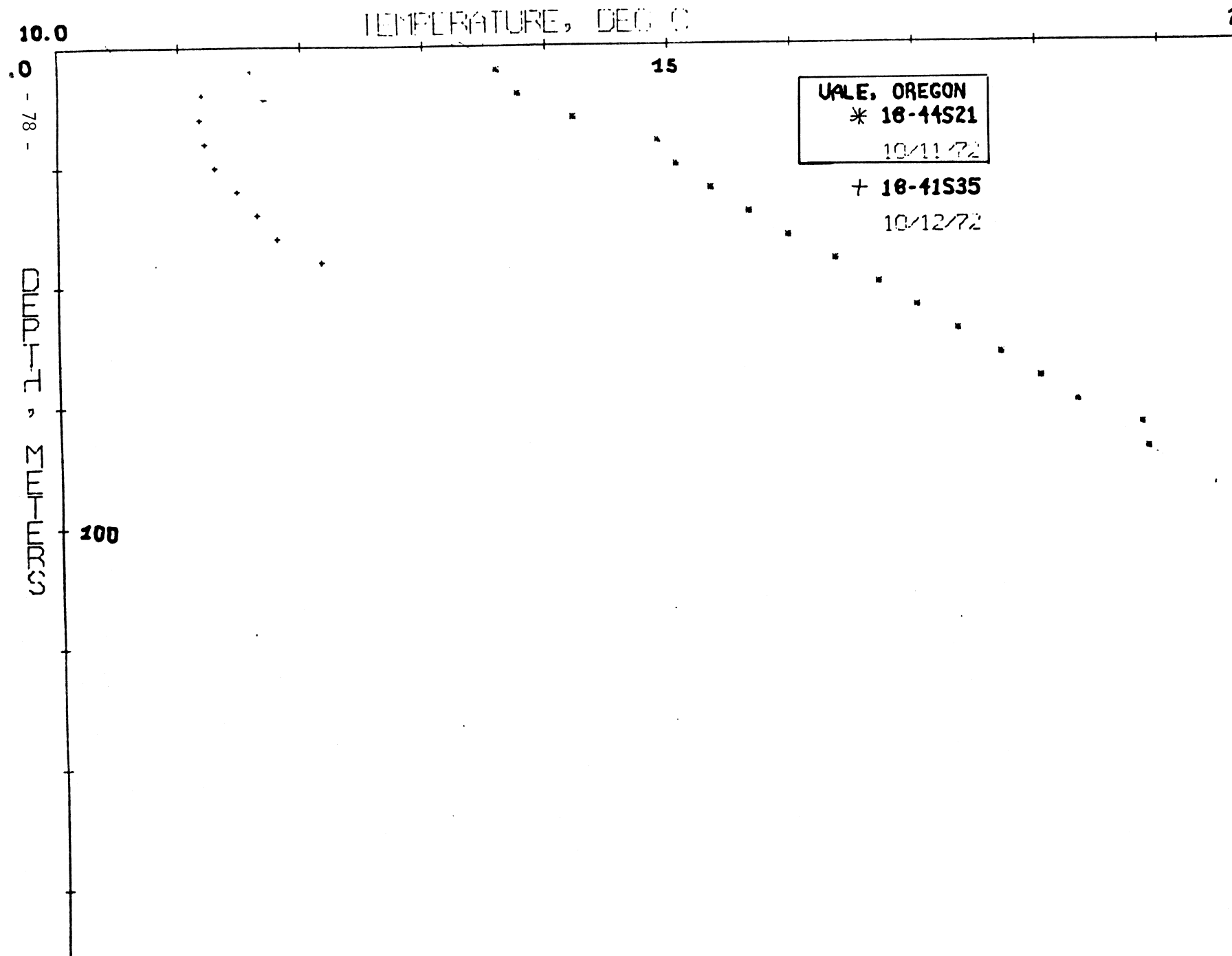


LOCATION: VALE, OREGON
HOLE NUMBER: 18-44S21
DATE MEASURED: 10/11/72

Water Well

DEPTH METERS	DEPTH FEET	TEMPERATURE		GEOTHERMAL GRADIENT	
		DEG C	DEG F	DEG C/KM	FEET/DEG F
5.0	16.4	13.600	56.48	.0	.0
10.0	32.8	13.770	56.79	34.0	53.6
15.0	49.2	14.220	57.60	90.0	20.2
20.0	65.6	14.910	58.84	138.0	13.2
25.0	82.0	15.060	59.11	30.0	60.7
30.0	98.4	15.340	59.61	56.0	32.5
35.0	114.8	15.650	60.17	62.0	29.4
40.0	131.2	15.970	60.75	64.0	28.5
45.0	147.6	16.350	61.43	76.0	24.0
50.0	164.0	16.700	62.06	70.0	26.0
55.0	180.4	17.010	62.62	62.0	29.4
60.0	196.8	17.340	63.21	66.0	27.6
65.0	213.2	17.690	63.84	70.0	26.0
70.0	229.6	18.010	64.42	64.0	28.5
75.0	246.0	18.310	64.96	60.0	30.4
80.0	262.4	18.830	65.89	104.0	17.5
85.0	278.8	18.880	65.98	10.0	182.2

average '72



LOCATION: VALL, OREGON
HOLE NUMBER: 19-45S22
DATE MEASURED: 8DGM1

DEPTH METERS	DEPTH FEET	TEMPERATURE		GEOTHERMAL GRADIENT	
		DEG C	DEG F	DEG C/KM	FEET/DEG F
25.9	85.0	17.600	63.68	.0	.0
56.4	185.0	21.000	69.80	111.5	16.3
86.9	284.9	24.500	76.10	114.8	15.9
117.4	384.9	27.400	81.32	95.1	19.2

11.0

TEMPERATURE, DEG C

36

0

15

20

25

30

VALE, OREGON

* 19-45S26 CB-11

ODGMI

+ 19-45S22 CB-12

ODGMI

x 20-45S10 CB-1

ODGMI

□ 19-45S25 CB-21

ODGMI

* 23-44S5 or Bow BASIN

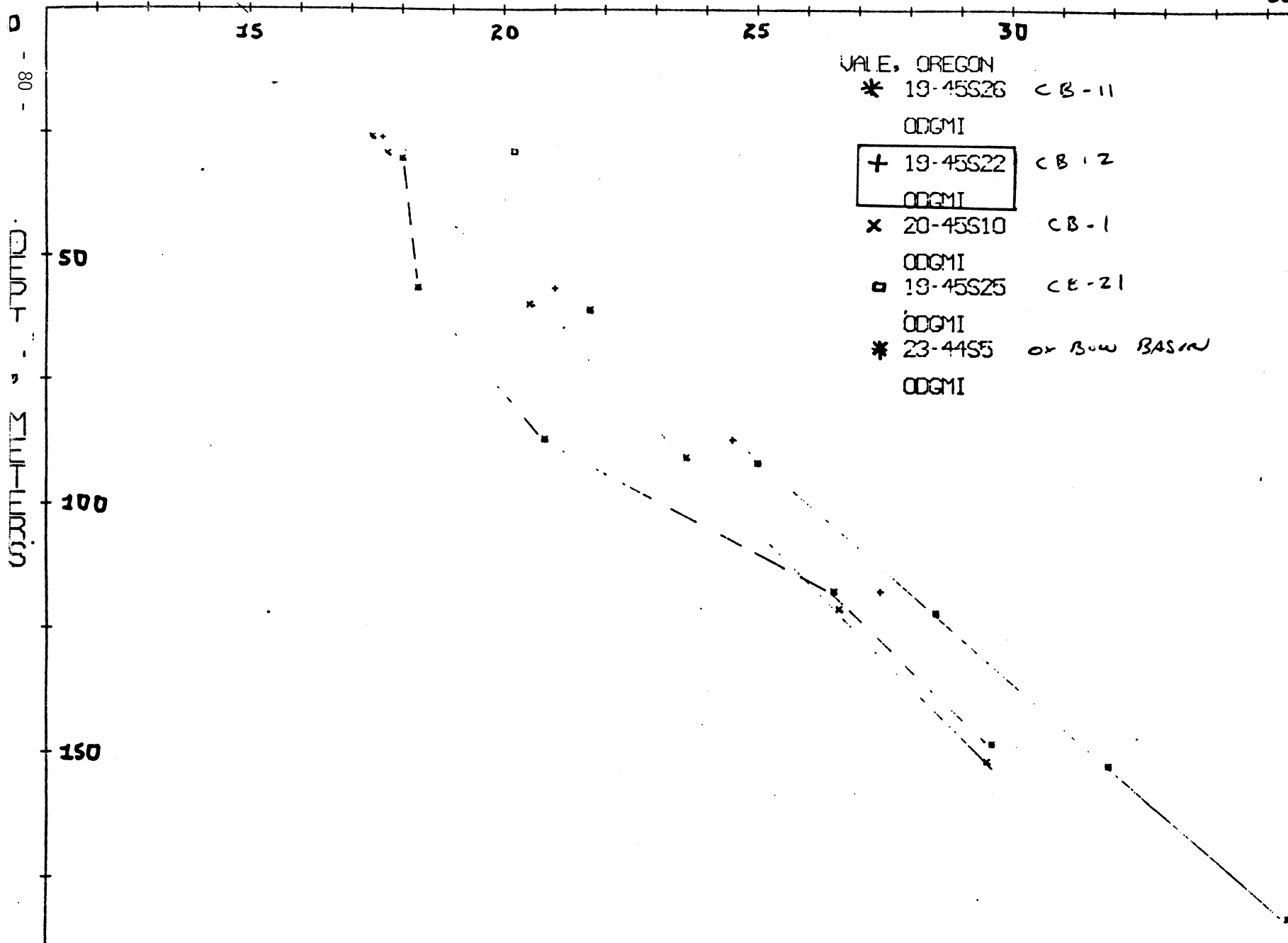
ODGMI

DEPTH, FEET

50

100

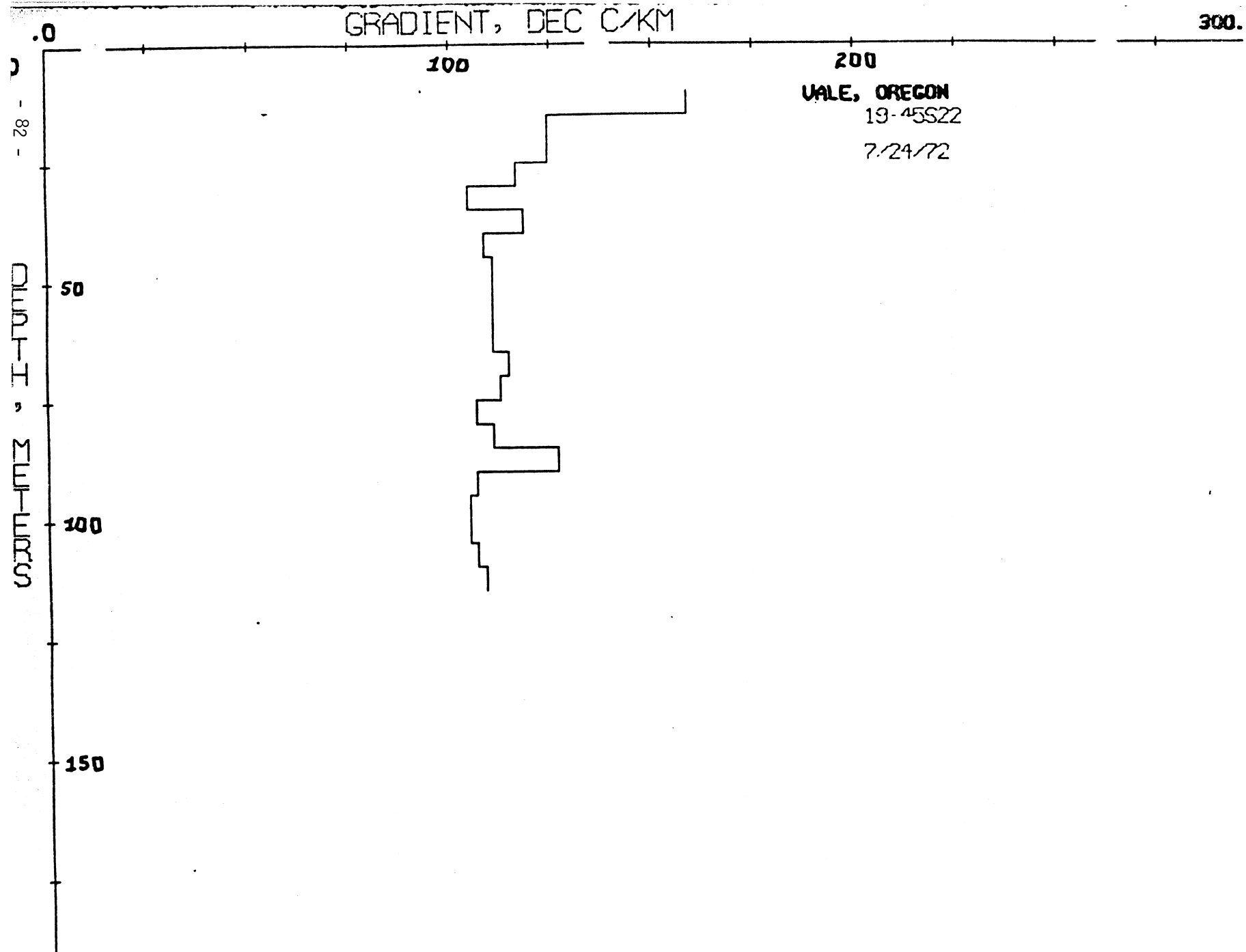
150



LOCATION: VALLEY, OREGON
HOLE NUMBER: 19-45S22
DATE MEASURED: 7/24/72

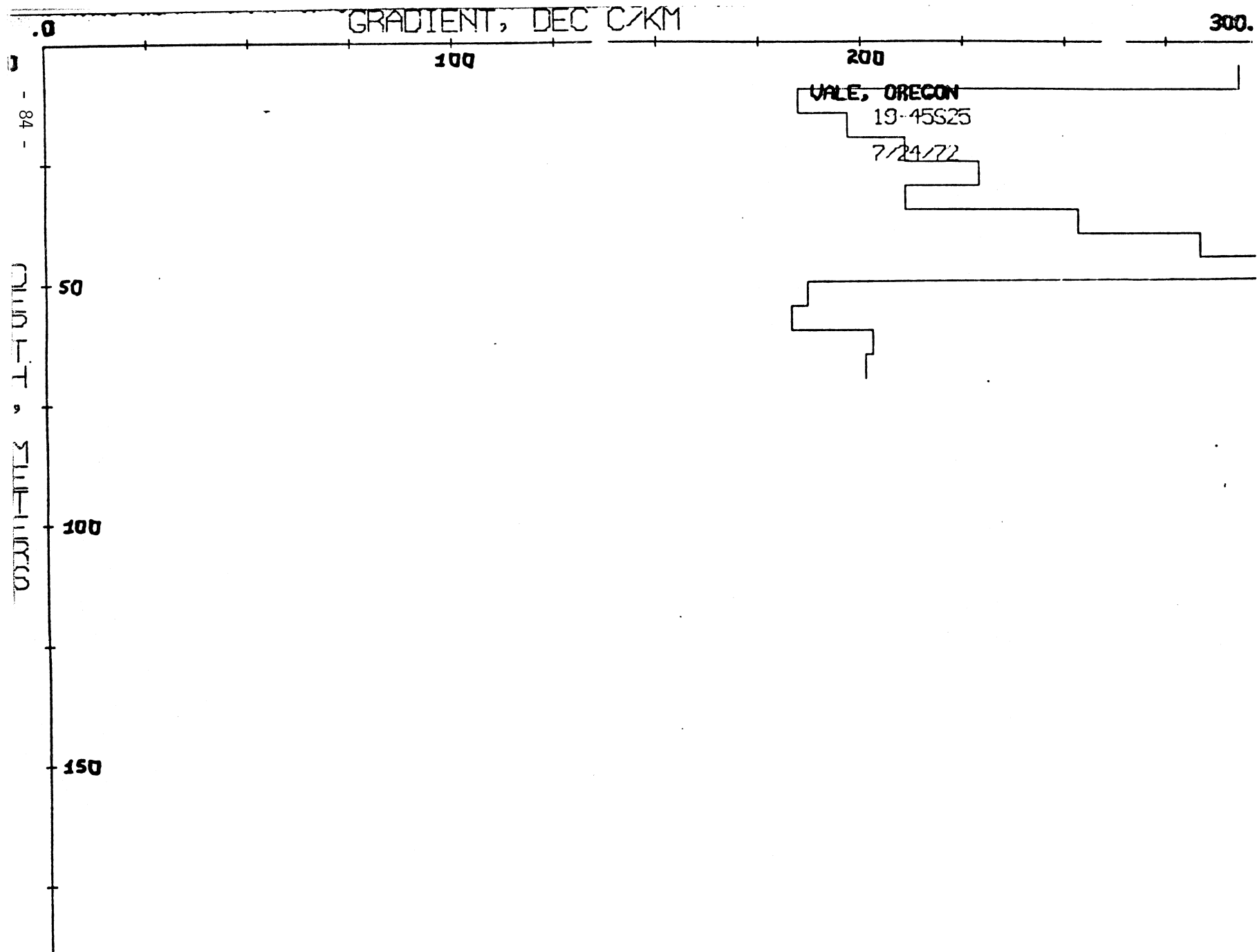
same site as CB 12

DEPTH METERS	DEPTH FEET	TEMPERATURE		GEOTHERMAL GRADIENT	
		DEG C	DEG F	DEG C/KM	FEET/DEG F
3.0	9.8	13.580	56.44	.0	.0
5.0	16.4	13.620	56.52	20.0	91.1
10.0	32.8	15.300	59.54	336.0	5.4
15.0	49.2	16.090	60.96	158.0	11.5
20.0	65.6	16.710	62.08	124.0	14.7
25.0	82.0	17.330	63.19	124.0	14.7
30.0	98.4	17.910	64.24	116.0	15.7
35.0	114.8	18.430	65.17	104.0	17.5
40.0	131.2	19.020	66.24	118.0	15.4
45.0	147.6	19.560	67.21	108.0	16.9
50.0	154.0	20.110	68.20	110.0	16.6
55.0	180.4	20.660	69.19	110.0	16.6
60.0	196.8	21.210	70.18	110.0	16.6
65.0	213.2	21.760	71.17	110.0	16.6
70.0	229.6	22.330	72.19	114.0	16.0
75.0	246.0	22.890	73.20	112.0	16.3
80.0	262.4	23.420	74.16	106.0	17.2
85.0	278.8	23.970	75.15	110.0	16.6
90.0	295.2	24.600	76.28	126.0	14.5
95.0	311.6	25.130	77.23	106.0	17.2
100.0	328.0	25.650	78.17	104.0	17.5
105.0	344.4	26.170	79.11	104.0	17.5
110.0	360.8	26.700	80.06	106.0	17.2
115.0	377.2	27.240	81.03	108.0	16.9



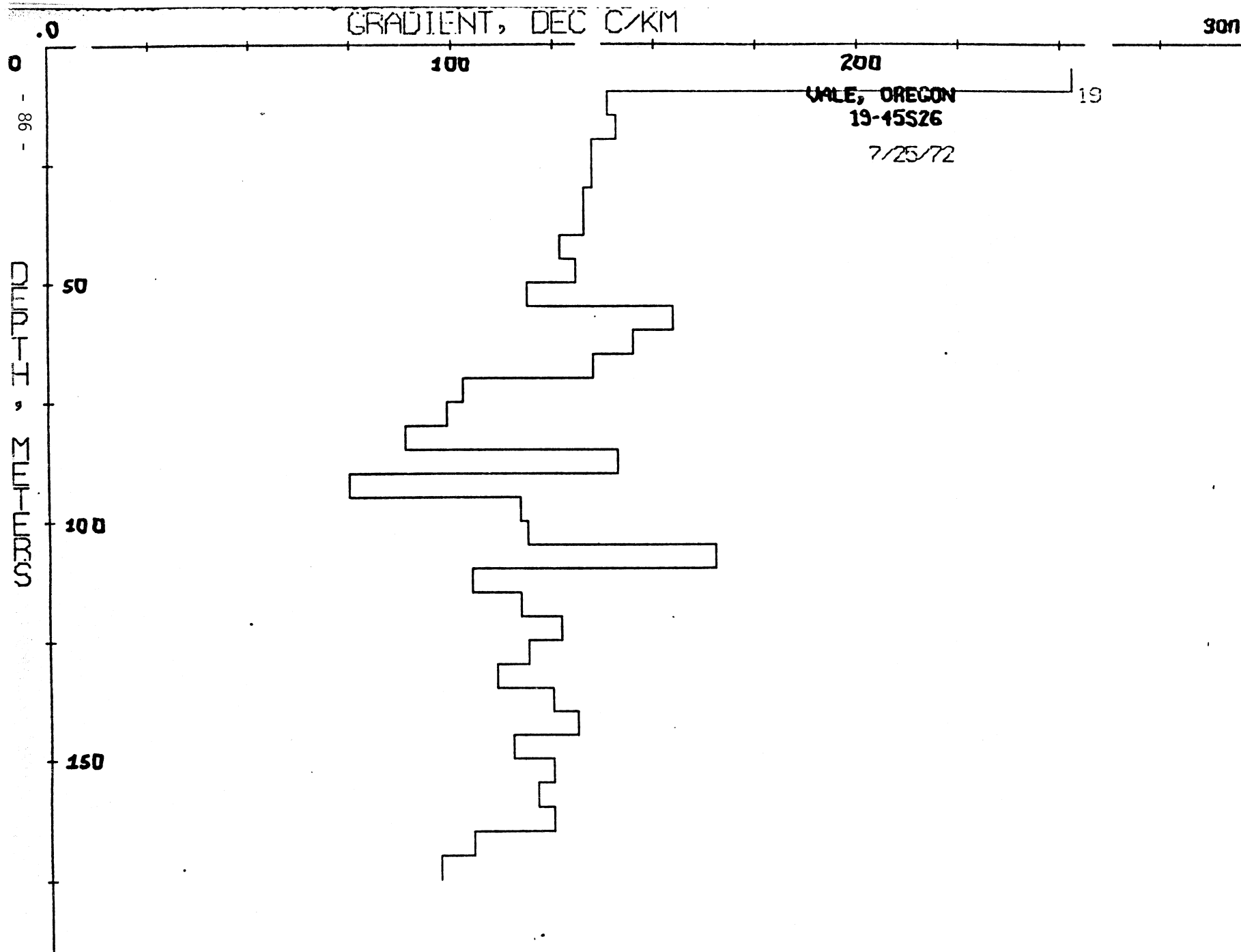
LOCATION: VALLEY, OREGON
 HOLE NUMBER: 19-45S25
 DATE MEASURED: 7/24/72

DEPTH METERS	DEPTH FEET	TEMPERATURE		GEOTHERMAL GRADIENT	
		DEG C	DEG F	DEG C/KM	FEET/DEG F
3.0	9.8	14.250	57.65	.0	.0
5.0	16.4	14.410	57.94	30.0	22.8
10.0	32.8	15.870	60.57	292.0	5.2
15.0	49.2	16.790	62.22	134.0	9.0
20.0	65.6	17.770	63.99	196.0	9.3
25.0	82.0	18.820	65.88	210.0	8.7
30.0	98.4	19.960	67.93	228.0	8.0
35.0	114.8	21.010	69.82	210.0	8.7
40.0	131.2	22.270	72.09	232.0	7.2
45.0	147.6	23.680	74.62	232.0	6.6
50.0	164.0	25.230	77.41	310.0	5.9
55.0	180.4	26.160	79.09	136.0	9.8
60.0	196.8	27.070	80.73	132.0	10.0
65.0	213.2	28.080	82.54	202.0	9.0
70.0	229.6	29.080	84.34	200.0	9.1



LOCATION: VALL, OREGON
HOLE NUMBER: 19-45S26
DATE MEASURED: 7/25/72

DEPTH METERS	DEPTH FEET	TEMPERATURE		GEOTHERMAL GRADIENT	
		DEG C	DEG F	DEG C/KM	FEET/DEG F
3.0	9.8	13.420	56.16	.0	.0
5.0	16.4	13.300	55.94	-60.0	-30.4
10.0	32.8	14.560	58.21	252.0	7.2
15.0	49.2	15.250	59.45	138.0	13.2
20.0	65.6	15.950	60.71	140.0	13.0
25.0	82.0	16.620	61.92	134.0	13.6
30.0	98.4	17.290	63.12	134.0	13.6
35.0	114.8	17.950	64.31	132.0	13.8
40.0	131.2	18.610	65.50	132.0	13.8
45.0	147.6	19.240	66.63	126.0	14.0
50.0	164.0	19.890	67.80	130.0	14.0
55.0	180.4	20.480	68.86	118.0	15.4
60.0	196.8	21.250	70.25	154.0	11.8
65.0	213.2	21.970	71.55	144.0	12.7
70.0	229.6	22.640	72.75	134.0	13.6
75.0	246.0	23.150	73.67	102.0	17.9
80.0	262.4	23.640	74.55	98.0	18.6
85.0	278.8	24.080	75.34	88.0	20.7
90.0	295.2	24.780	76.60	140.0	13.0
95.0	311.6	25.150	77.27	74.0	24.6
100.0	328.0	25.730	78.31	116.0	15.7
105.0	344.4	26.320	79.38	118.0	15.4
110.0	360.8	27.140	80.85	154.0	11.1
115.0	377.2	27.660	81.79	104.0	17.0
120.0	393.6	28.240	82.83	116.0	15.7
125.0	410.0	28.870	83.97	126.0	14.5
130.0	426.4	29.460	85.03	118.0	15.4
135.0	442.8	30.010	86.02	110.0	16.6
140.0	459.2	30.630	87.13	124.0	14.7
145.0	475.6	31.280	88.30	130.0	14.0
150.0	492.0	31.850	89.33	114.0	16.0
155.0	508.4	32.470	90.45	124.0	14.7
160.0	524.8	33.070	91.53	120.0	15.2
165.0	541.2	33.690	92.64	124.0	14.7
170.0	557.6	34.210	93.58	104.0	17.5
175.0	574.0	34.690	94.44	96.0	19.0



LOCATION: BOISE AMS, OREGON

19S/46E/180B

HOLE NUMBER: SWW

DATE MEASURED: 6/10/76

DEPTH METERS	DEPTH FEET	TEMPERATURE		GEOTHERMAL GRADIENT	
		DEG C	DEG F	DEG C/KM	DEG F/100 FT
10.0	32.8	14.680	58.42	.0	.0
20.0	65.6	15.560	60.01	58.0	4.8
30.0	98.4	16.600	61.88	104.0	5.7
40.0	131.2	17.730	63.91	113.0	6.2
50.0	164.0	18.720	65.70	99.0	5.4
60.0	196.8	19.700	67.46	98.0	5.4
70.0	229.6	20.770	69.39	107.0	5.9
80.0	262.4	21.850	71.33	108.0	5.9
90.0	295.2	22.920	73.26	107.0	5.9
100.0	328.0	24.080	75.34	116.0	6.4
110.0	360.8	24.880	76.78	80.0	4.4
120.0	393.6	25.790	78.42	91.0	5.0
130.0	426.4	26.910	80.44	112.0	6.1
140.0	459.2	28.210	82.78	130.0	7.1
150.0	492.0	29.170	84.51	96.0	5.3
160.0	524.8	29.540	85.17	37.0	2.0

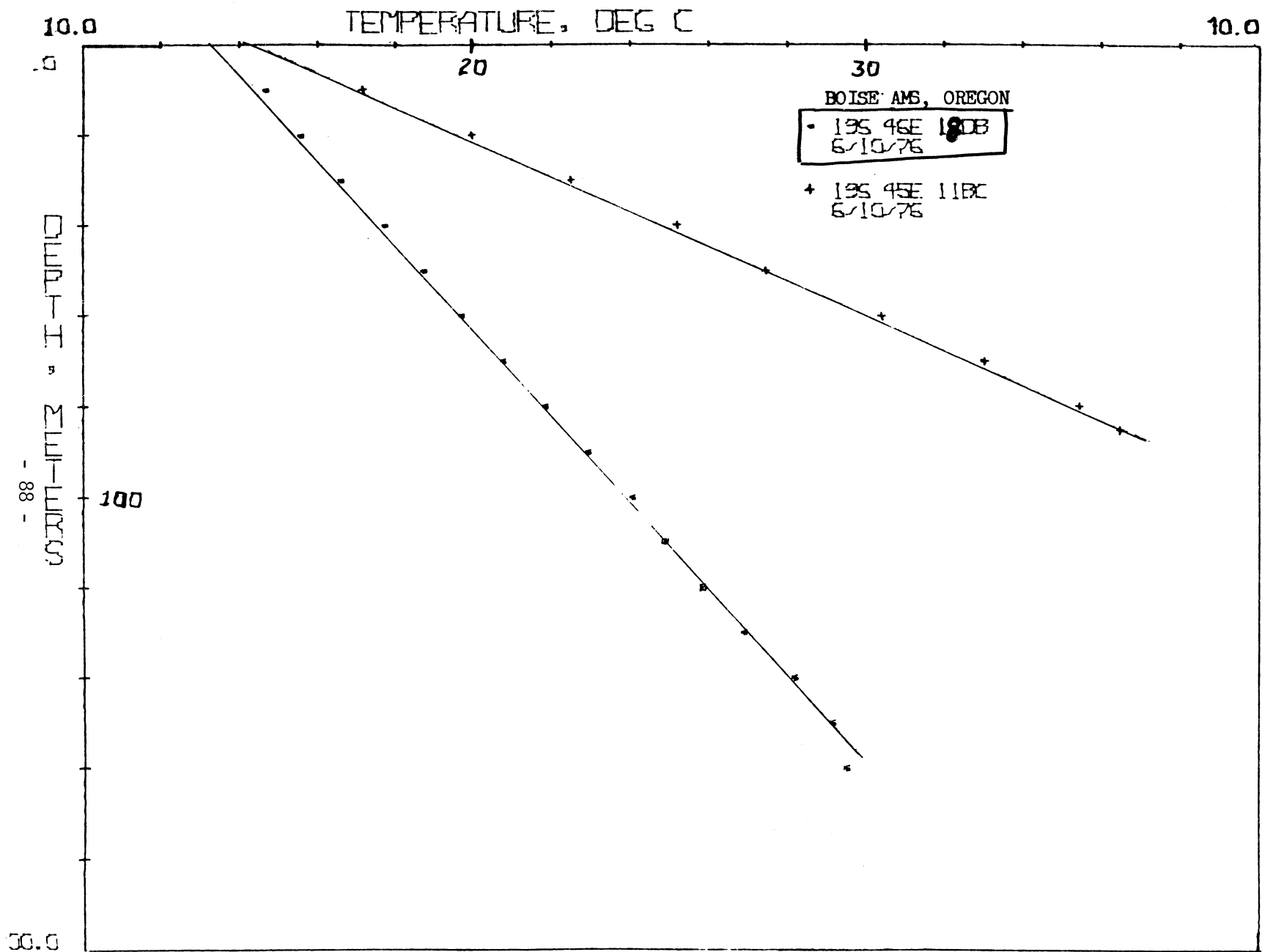
LOCATION: BOISE AMS, OREGON

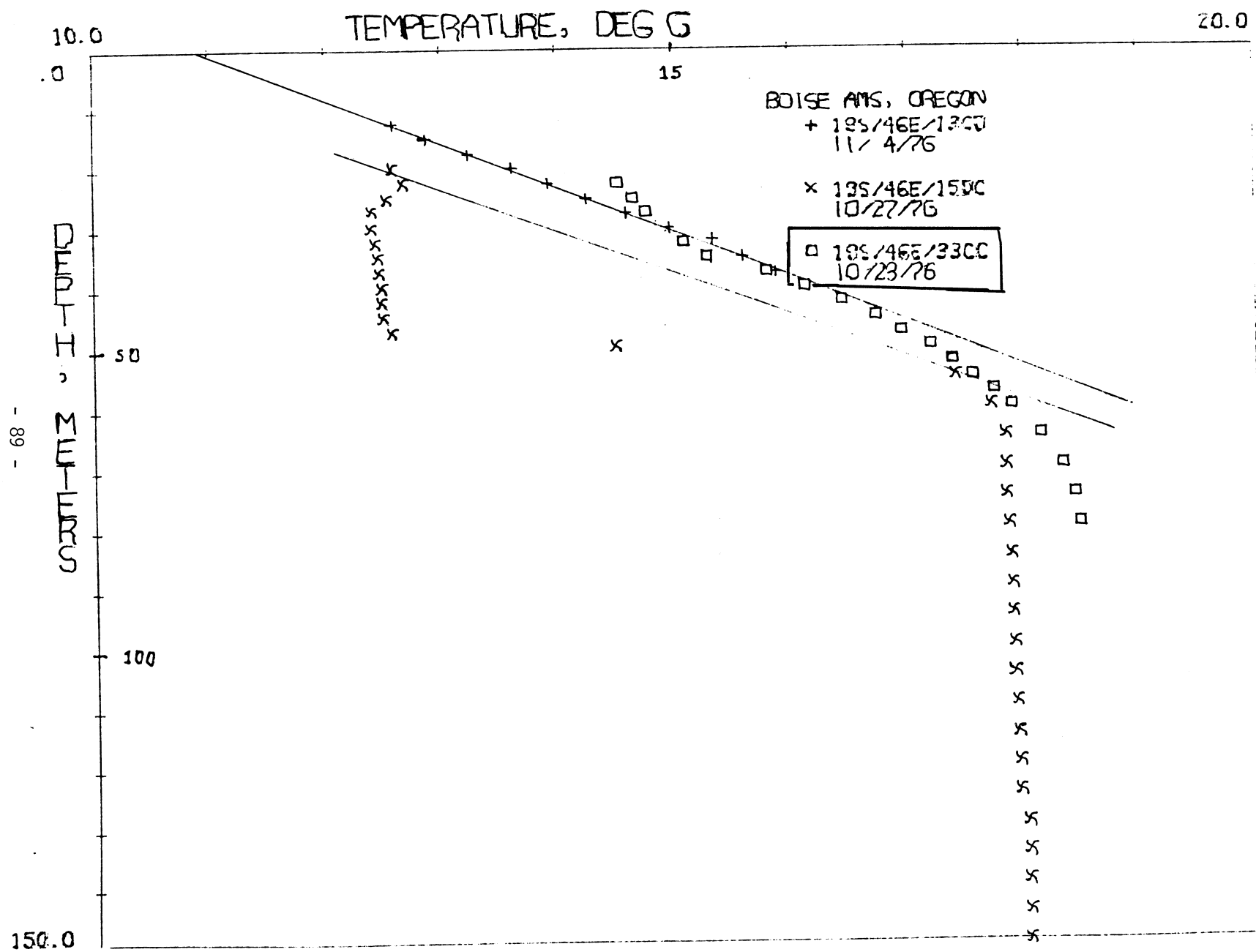
19S/46E/33CC

HOLE NUMBER: CA-WW

DATE MEASURED: 10/29/75

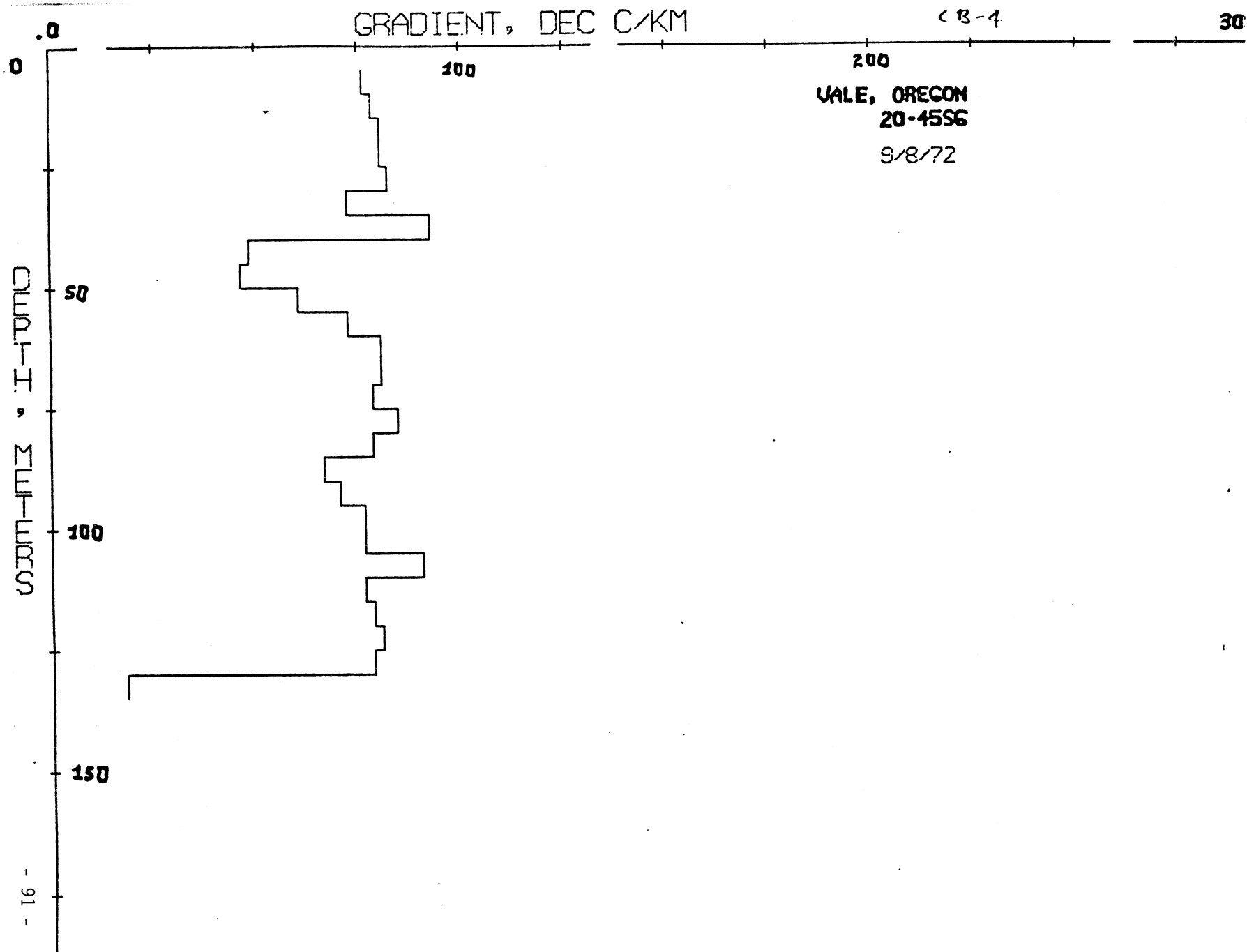
DEPTH METERS	DEPTH FEET	TEMPERATURE		GEOTHERMAL GRADIENT	
		DEG C	DEG F	DEG C/KM	DEG F/100 FT
22.5	73.8	14.520	58.14	.0	.0
25.0	82.0	14.650	58.37	52.0	2.9
27.5	90.2	14.770	58.59	48.0	2.6
30.0	98.4	14.900	58.82	52.0	2.9
32.5	106.6	15.090	59.16	76.0	4.2
35.0	114.8	15.290	59.52	80.0	4.4
37.5	123.0	15.800	60.44	204.0	11.2
40.0	131.2	16.120	61.02	128.0	7.0
42.5	139.4	16.450	61.61	132.0	7.2
45.0	147.6	16.730	62.11	112.0	6.1
47.5	155.8	16.960	62.53	92.0	5.0
50.0	164.0	17.200	62.96	96.0	5.3
52.5	172.2	17.390	63.30	76.0	4.2
55.0	180.4	17.570	63.63	72.0	4.0
57.5	188.6	17.740	63.93	68.0	3.7
65.0	213.2	18.140	64.65	53.3	2.9
60.0	196.8	17.890	64.20	50.0	2.7
70.0	229.6	18.330	64.99	44.0	2.4
75.0	246.0	18.430	65.17	20.0	1.1
80.0	262.4	18.480	65.26	10.0	.5





LOCATION: VALE, REGION Gulf CB-4
HOLE NUMBER: 20.556 20-4586
DATE MEASURED: 9/8/72

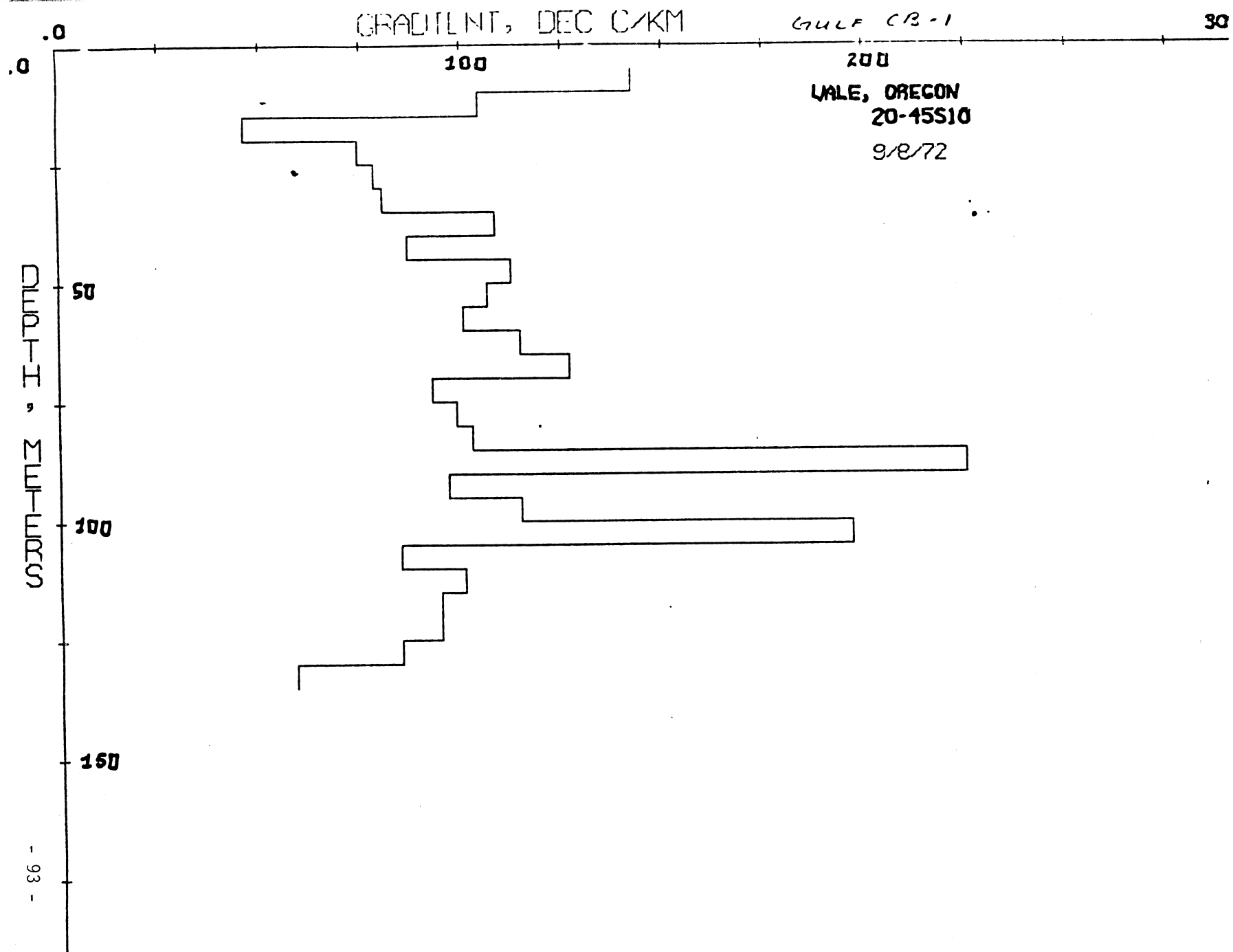
DEPTH METERS	DEPTH FEET	TEMPERATURE		GEOTHERMAL GRADIENT	
		DEG C	DEG F	DEG C/KM	FEET/DEG F
3.0	9.8	14.110	57.40	.0	.0
5.0	16.4	13.420	56.16	-345.0	-5.3
10.0	32.8	13.500	56.84	76.0	24.0
15.0	49.2	14.190	57.54	78.0	23.4
20.0	65.6	14.590	58.26	80.0	22.8
25.0	82.0	14.990	58.98	80.0	22.8
30.0	98.4	15.400	59.72	82.0	22.2
35.0	114.8	15.760	60.37	72.0	25.3
40.0	131.2	16.220	61.20	92.0	19.8
45.0	147.6	16.460	61.63	48.0	38.0
50.0	164.0	16.690	62.04	46.0	39.6
55.0	180.4	16.990	62.58	50.0	30.4
60.0	196.8	17.350	63.23	72.0	25.3
65.0	213.2	17.750	63.95	80.0	22.8
70.0	229.6	18.150	64.67	80.0	22.8
75.0	246.0	18.540	65.37	78.0	23.4
80.0	262.4	18.960	66.13	84.0	21.7
85.0	278.8	19.350	66.83	78.0	23.4
90.0	295.2	19.680	67.42	66.0	27.6
95.0	311.6	20.030	68.05	70.0	26.0
100.0	328.0	20.410	68.74	76.0	24.0
105.0	344.4	20.790	69.42	76.0	24.0
110.0	360.8	21.240	70.23	90.0	20.2
115.0	377.2	21.620	70.92	76.0	24.0
120.0	393.6	22.010	71.62	78.0	23.4
125.0	410.0	22.410	72.34	80.0	22.8
130.0	426.4	22.800	73.04	78.0	23.4
135.0	442.8	22.890	73.20	18.0	101.2



LOCATION: VALE, REGION
HOLE NUMBER: **20-45810**
DATE MEASURED: 9/8/72

Core 1

DEPTH METERS	DEPTH FEET	TEMPERATURE		GEOTHERMAL GRADIENT	
		DEG C	DEG F	DEG C/KM	FEET/DEG F
3.0	9.8	16.110	61.00	.0	.0
5.0	16.4	15.040	59.07	-535.0	-3.4
10.0	32.8	15.750	60.35	142.0	12.5
15.0	49.2	16.270	61.29	104.0	17.5
20.0	65.6	16.500	61.70	46.0	39.6
25.0	82.0	16.870	62.37	74.0	24.6
30.0	98.4	17.260	63.07	78.0	23.4
35.0	114.8	17.660	63.79	80.0	22.5
40.0	131.2	18.200	64.76	108.0	16.9
45.0	147.6	18.530	65.33	86.0	21.2
50.0	164.0	19.190	66.54	112.0	16.3
55.0	180.4	19.720	67.50	106.0	17.2
60.0	196.8	20.220	68.40	100.0	18.2
65.0	213.2	20.790	69.42	114.0	16.0
70.0	229.6	21.420	70.56	126.0	14.5
75.0	246.0	21.880	71.38	92.0	19.3
80.0	262.4	22.370	72.27	98.0	18.6
85.0	278.8	22.880	73.18	102.0	17.9
90.0	295.2	24.000	75.20	224.0	8.1
95.0	311.6	24.480	76.06	96.0	19.0
100.0	328.0	25.050	77.09	114.0	16.0
105.0	344.4	26.030	78.85	196.0	9.3
110.0	360.8	26.450	79.61	84.0	21.7
115.0	377.2	26.950	80.51	100.0	18.2
120.0	393.6	27.420	81.36	94.0	19.4
125.0	410.0	27.890	82.20	94.0	19.4
130.0	426.4	28.310	82.96	84.0	21.7
135.0	442.8	28.600	83.48	58.0	31.4



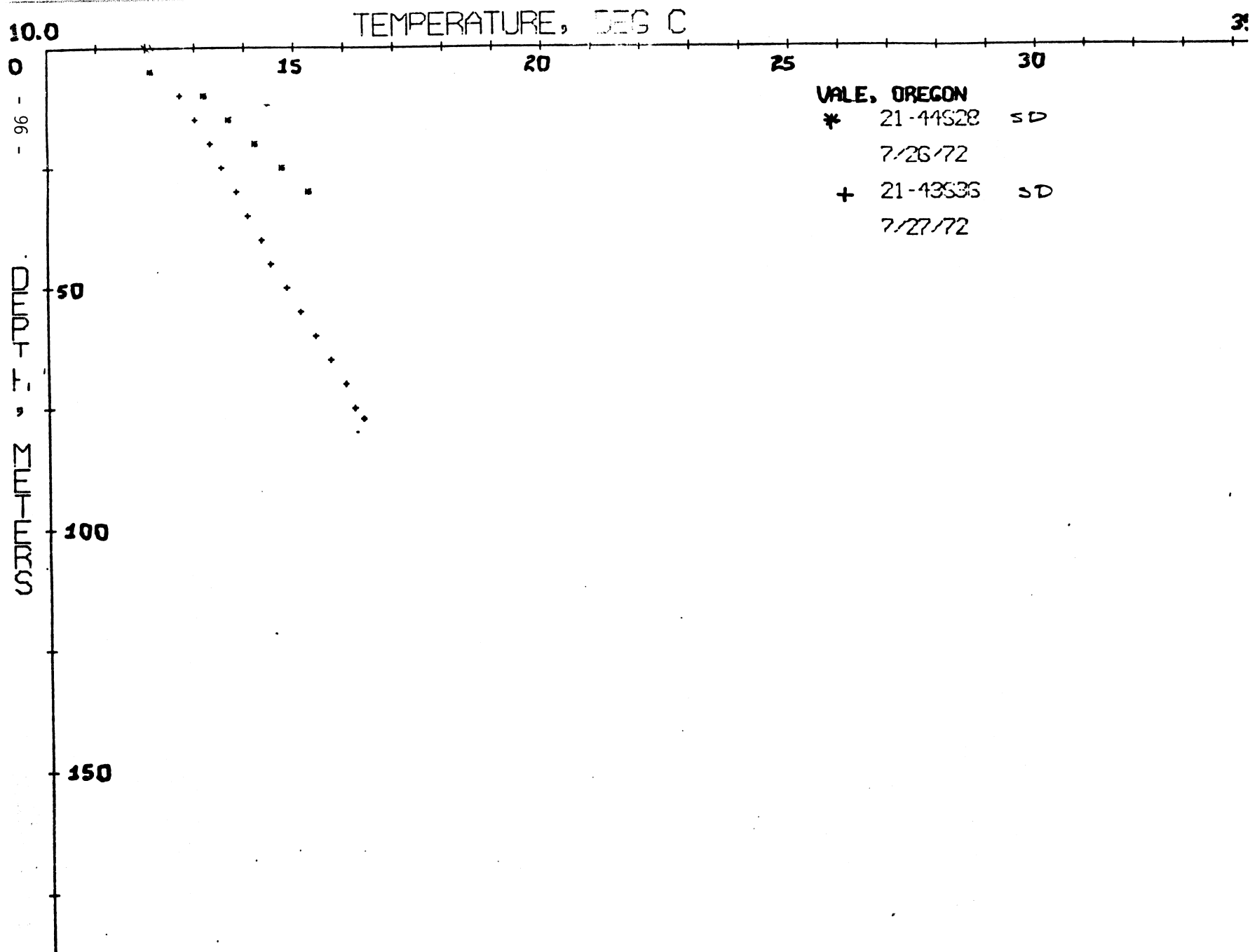
LOCATION: VAL D OREGON
HOLE NUMBER: 21-43S36
DATE MEASURED: 7/27/72

DEPTH METERS	DEPTH FEET	TEMPERATURE		GEOTHERMAL GRADIENT	
		DEG C	DEG F	DEG C/KM	FEET/DEG F
3.0	9.8	12.410	54.34	.0	.0
5.0	16.4	12.110	53.80	-150.0	-12.1
10.0	32.8	12.710	54.88	120.0	15.2
15.0	49.2	12.990	55.38	56.0	32.5
20.0	65.6	13.300	55.94	62.0	29.4
25.0	82.0	13.530	56.35	46.0	39.6
30.0	98.4	13.830	56.89	60.0	30.4
35.0	114.8	14.060	57.31	46.0	39.6
40.0	131.2	14.320	57.78	52.0	35.0
45.0	147.6	14.500	58.10	36.0	50.6
50.0	164.0	14.820	58.68	64.0	28.5
55.0	180.4	15.100	59.18	56.0	32.5
60.0	196.8	15.410	59.74	62.0	29.4
65.0	213.2	15.700	60.26	58.0	31.4
70.0	229.6	15.990	60.78	58.0	31.4
75.0	246.0	16.180	61.12	38.0	48.0
76.5	250.9	16.260	61.27	53.3	34.2

LOCATION: VALLEY, OREGON
HOLE NUMBER: 21-44S28
DATE MEASURED: 7/26/72

GLUE SURMOUNT

DEPTH METERS	DEPTH FEET	TEMPERATURE		GEOTHERMAL GRADIENT	
		DEG C	DEG F	DEG C/KM	FEET/DEG F
3.0	9.8	12.180	53.92	.0	.0
5.0	16.4	12.090	53.76	-45.0	-40.3
10.0	32.8	13.170	55.71	216.0	8.4
15.0	49.2	13.680	56.62	102.0	17.3
20.0	65.6	14.210	57.58	106.0	17.2
25.0	82.0	14.740	58.53	106.0	17.2
30.0	98.4	15.270	59.49	106.0	17.2



LOCATION: BOISE AMS, OREGON

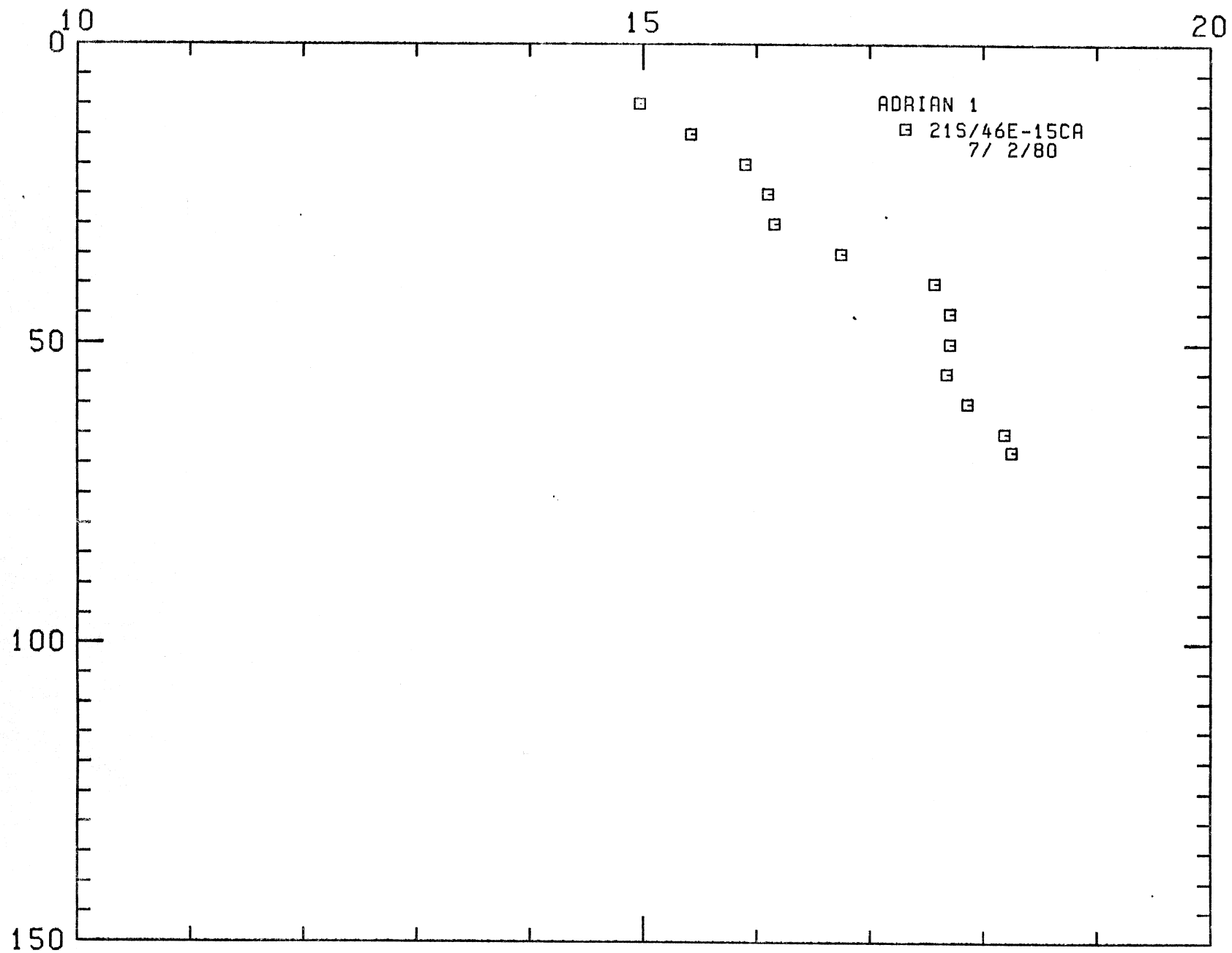
21S/46E-15CA

HOLE NAME: ADRIAN 1

DATE MEASURED: 7/ 2/80

DEPTH METERS	DEPTH FEET	TEMPERATURE		GEOTHERMAL GRADIENT	
		DEG C	DEG F	DEG C/KM	DEG F/100 FT
10.0	32.8	14.970	58.95	0.0	0.0
15.0	49.2	15.420	59.76	90.0	4.9
20.0	65.6	15.900	60.62	96.0	5.3
25.0	82.0	16.100	60.98	40.0	2.2
30.0	98.4	16.160	61.09	12.0	0.7
35.0	114.8	16.750	62.15	118.0	6.5
40.0	131.2	17.570	63.63	164.0	9.0
45.0	147.6	17.710	63.88	28.0	1.5
50.0	164.0	17.710	63.88	0.0	0.0
55.0	180.4	17.680	63.82	-6.0	-0.3
60.0	196.8	17.860	64.15	36.0	2.0
65.0	213.2	18.190	64.74	66.0	3.6
69.0	223.0	18.250	64.85	20.0	1.1

TEMPERATURE, DEG C



LOCATION: BOISE AMS, OREGON

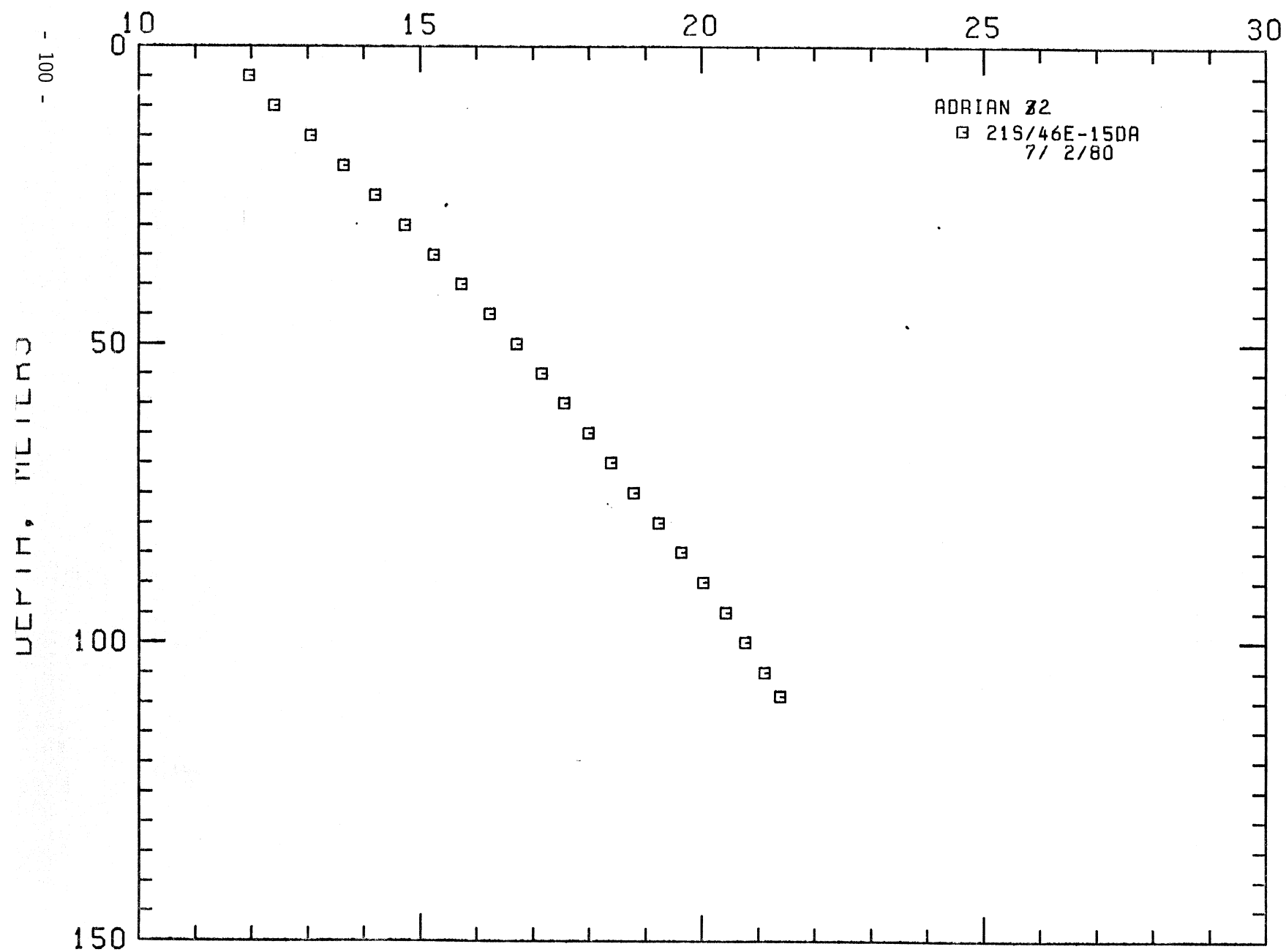
21S/46E-15DA

HOLE NAME: ADRIAN #2

DATE MEASURED: 7/ 2/80

DEPTH METERS	DEPTH FEET	TEMPERATURE		GEOTHERMAL GRADIENT	
		DEG C	DEG F	DEG C/KM	DEG F/100 FT
5.0	16.4	11.970	53.55	0.0	0.0
10.0	32.8	12.410	54.34	88.0	4.8
15.0	49.2	13.060	55.51	130.0	7.1
20.0	65.6	13.640	56.55	116.0	6.4
25.0	82.0	14.200	57.56	112.0	6.1
30.0	98.4	14.730	58.51	106.0	5.8
35.0	114.8	15.250	59.45	104.0	5.7
40.0	131.2	15.740	60.33	98.0	5.4
45.0	147.6	16.240	61.23	100.0	5.5
50.0	164.0	16.720	62.10	96.0	5.3
55.0	180.4	17.160	62.89	88.0	4.8
60.0	196.8	17.570	63.63	82.0	4.5
65.0	213.2	18.000	64.40	86.0	4.7
70.0	229.6	18.400	65.12	80.0	4.4
75.0	246.0	18.800	65.84	80.0	4.4
80.0	262.4	19.240	66.63	88.0	4.8
85.0	278.8	19.640	67.35	80.0	4.4
90.0	295.2	20.040	68.07	80.0	4.4
95.0	311.6	20.430	68.77	78.0	4.3
100.0	328.0	20.780	69.40	70.0	3.8
105.0	344.4	21.120	70.02	68.0	3.7
109.0	357.5	21.390	70.50	67.5	3.7

TEMPERATURE, DEG C



LOCATION: BOISE AMS, OREGON

22S/46E-12DD

HOLE NAME: GEERTSON

DATE MEASURED: 7/29/80

DEPTH METERS	DEPTH FEET	TEMPERATURE		GEOTHERMAL GRADIENT	
		DEG C	DEG F	DEG C/KM	DEG F/100 FT
15.0	49.2	15.880	60.58	0.0	0.0
20.0	65.6	16.200	61.16	64.0	3.5
25.0	82.0	16.540	61.77	68.0	3.7
30.0	98.4	16.790	62.22	50.0	2.7
35.0	114.8	17.090	62.76	60.0	3.3
40.0	131.2	18.400	65.12	262.0	14.4
45.0	147.6	18.800	65.84	80.0	4.4
50.0	164.0	19.260	66.67	92.0	5.0
55.0	180.4	19.780	67.60	104.0	5.7
60.0	196.8	20.240	68.43	92.0	5.0
65.0	213.2	20.890	69.60	130.0	7.1
70.0	229.6	21.270	70.29	76.0	4.2
75.0	246.0	21.810	71.26	108.0	5.9
80.0	262.4	22.410	72.34	120.0	6.6
85.0	278.8	22.930	73.27	104.0	5.7
90.0	295.2	23.350	74.03	84.0	4.6
95.0	311.6	23.820	74.88	94.0	5.2
100.0	328.0	24.350	75.83	106.0	5.8
105.0	344.4	24.850	76.73	100.0	5.5
110.0	360.8	25.360	77.65	102.0	5.6
115.0	377.2	25.760	78.37	80.0	4.4
120.0	393.6	26.220	79.20	92.0	5.0
125.0	410.0	26.750	80.15	106.0	5.8
130.0	426.4	27.320	81.18	114.0	6.3
135.0	442.8	27.800	82.04	96.0	5.3
140.0	459.2	28.220	82.80	84.0	4.6
145.0	475.6	28.730	83.71	102.0	5.6
150.0	492.0	29.250	84.65	104.0	5.7
155.0	508.4	29.770	85.59	104.0	5.7
160.0	524.8	30.160	86.29	78.0	4.3
165.0	541.2	30.700	87.26	108.0	5.9
170.0	557.6	31.010	87.82	62.0	3.4
175.0	574.0	31.410	88.54	80.0	4.4
180.0	590.4	31.980	89.56	114.0	6.3
185.0	606.8	32.600	90.68	124.0	6.8
190.0	623.2	33.140	91.65	108.0	5.9
195.0	639.6	33.850	92.93	142.0	7.8
200.0	656.0	34.380	93.88	106.0	5.8
205.0	672.4	35.030	95.05	130.0	7.1
210.0	688.8	35.510	95.92	96.0	5.3
215.0	705.2	35.920	96.66	82.0	4.5

LOCATION: BOISE AMS, OREGON

PAGE 2

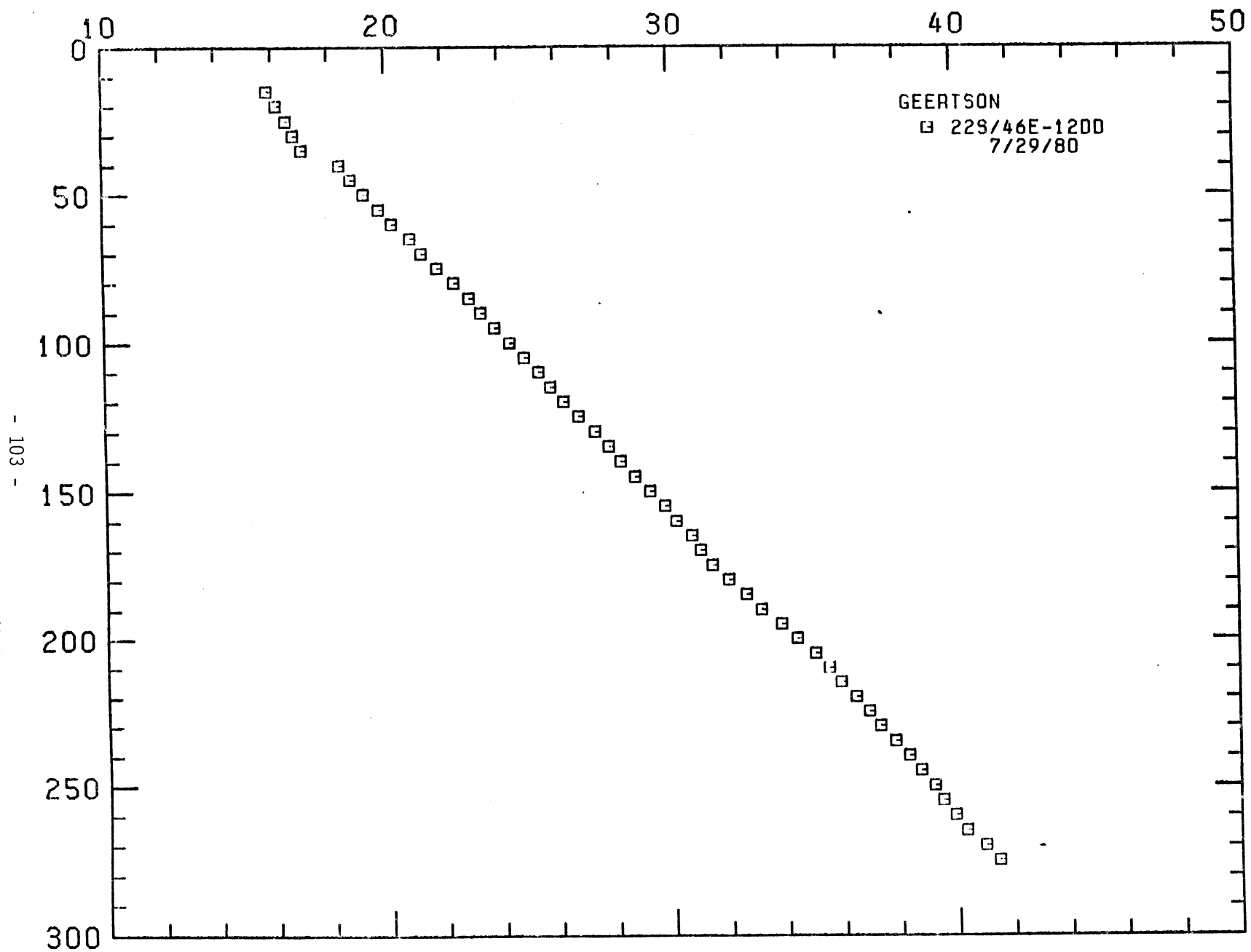
22S/46E-12DD

HOLE NAME: GEERTSON

DATE MEASURED: 7/29/80

DEPTH METERS	DEPTH FEET	TEMPERATURE		GEOTHERMAL GRADIENT	
		DEG C	DEG F	DEG C/KM	DEG F/100 FT
220.0	721.6	36.440	97.59	104.0	5.7
225.0	738.0	36.900	98.42	92.0	5.0
230.0	754.4	37.300	99.14	80.0	4.4
235.0	770.8	37.820	100.08	104.0	5.7
240.0	787.2	38.290	100.92	94.0	5.2
245.0	803.6	38.710	101.68	84.0	4.6
250.0	820.0	39.190	102.54	96.0	5.3
255.0	836.4	39.490	103.08	60.0	3.3
260.0	852.8	39.930	103.87	68.0	4.0
265.0	869.2	40.310	104.56	76.0	4.2
270.0	885.6	40.970	105.75	132.0	7.3
275.0	902.0	41.440	106.59	94.0	5.2

TEMPERATURE, DEG C



LOCATION: VALE, OREGON
HOLE NUMBER: 18-41S35
DATE MEASURED: 10/12/72

- Water well

DEPTH METERS	DEPTH FEET	TEMPERATURE		GEOTHERMAL GRADIENT	
		DEG C	DEG F	DEG C/KM	FEET/DEG F
5.0	16.4	11.590	52.86	.0	.0
10.0	32.8	11.190	52.14	-80.0	-22.8
15.0	49.2	11.170	52.11	-4.0	-455.6
20.0	65.6	11.210	52.18	8.0	227.8
25.0	82.0	11.290	52.32	16.0	113.9
30.0	98.4	11.470	52.65	36.0	50.6
35.0	114.8	11.630	52.93	32.0	56.9
40.0	131.2	11.790	53.22	32.0	56.9
45.0	147.6	12.150	53.87	72.0	25.3

LOCATION: DREWSLEY, OREGON
HOLE NUMBER: 21-3511A
DATE MEASURED: 9/11/73

DEPTH METERS	DEPTH FEET	TEMPERATURE		GEOTHERMAL GRADIENT	
		DEG C	DEG F	DEG C/KM	FEET/DEG F
10.0	32.8	9.750	49.55	.0	.0
15.0	49.2	10.550	50.99	160.0	11.4
20.0	65.6	10.960	51.73	82.0	22.2
25.0	82.0	11.250	52.25	58.0	31.4
30.0	98.4	11.440	52.59	38.0	48.0
35.0	114.8	11.690	53.04	50.0	36.4
40.0	131.2	11.870	53.37	36.0	50.6
45.0	147.6	12.070	53.73	40.0	43.6
50.0	164.0	12.300	54.14	46.0	39.6
55.0	180.4	12.470	54.45	34.0	53.6
60.0	196.8	12.680	54.82	42.0	43.4
65.0	213.2	12.950	55.31	54.0	33.7
70.0	229.6	13.180	55.72	46.0	39.6
75.0	246.0	13.420	56.16	48.0	38.0
80.0	262.4	13.690	56.64	54.0	33.7
85.0	278.8	13.920	57.06	46.0	39.6
90.0	295.2	14.170	57.51	50.0	36.4
95.0	311.6	14.430	57.97	52.0	35.0
100.0	328.0	14.700	58.46	54.0	33.7

LOCATION: VALLEY, OREGON
HOLE NUMBER: 23-44SS
DATE MEASURED: 8DGM1

Ox-Bow Basin
now has windmill on site

DEPTH METERS	DEPTH FEET	TEMPERATURE		GEOTHERMAL GRADIENT	
		DEG C	DEG F	DEG C/KM	FEET/DEG F
25.9	85.0	17.400	63.32	.0	.0
56.4	185.0	18.300	64.94	29.5	61.7
86.9	284.9	20.800	69.44	32.0	22.2
117.4	384.9	26.500	79.70	187.0	9.7
147.8	484.9	29.600	85.28	101.7	17.9

LOCATION: BOISE AMS, OREGON
 18S/45E-20CB
 HOLE NUMBER: VALECITY
 DATE MEASURED: 7/ 7/77

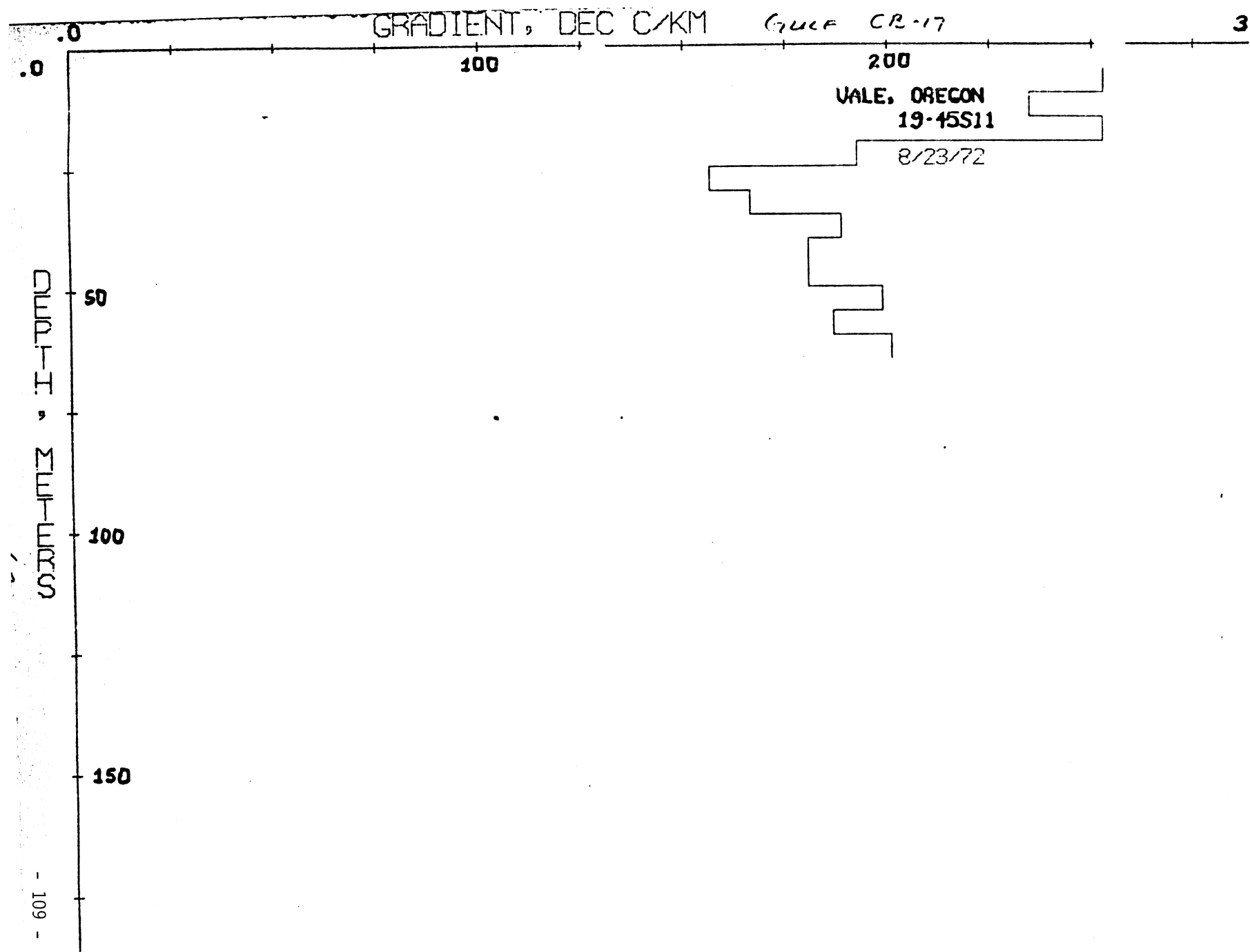
DEPTH METERS	DEPTH FEET	TEMPERATURE		GEOTHERMAL GRADIENT	
		DEG C	DEG F	DEG C/KM	DEG F/100 FT
7.5	24.6	16.430	61.57	0.0	0.0
10.0	32.8	16.340	61.41	-36.0	-2.0
12.5	41.0	16.340	61.41	0.0	0.0
15.0	49.2	16.360	61.45	8.0	0.4
17.5	57.4	16.390	61.50	12.0	0.7
20.0	65.6	16.460	61.63	28.0	1.5
22.5	73.8	16.460	61.63	0.0	0.0
25.0	82.0	16.450	61.61	-4.0	-0.2
27.5	90.2	16.680	62.02	92.0	5.0
30.0	98.4	16.910	62.44	92.0	5.0
32.5	106.6	17.220	63.00	124.0	6.8
35.0	114.8	17.570	63.63	140.0	7.7
37.5	123.0	17.840	64.11	108.0	5.9
40.0	131.2	18.140	64.65	120.0	6.6

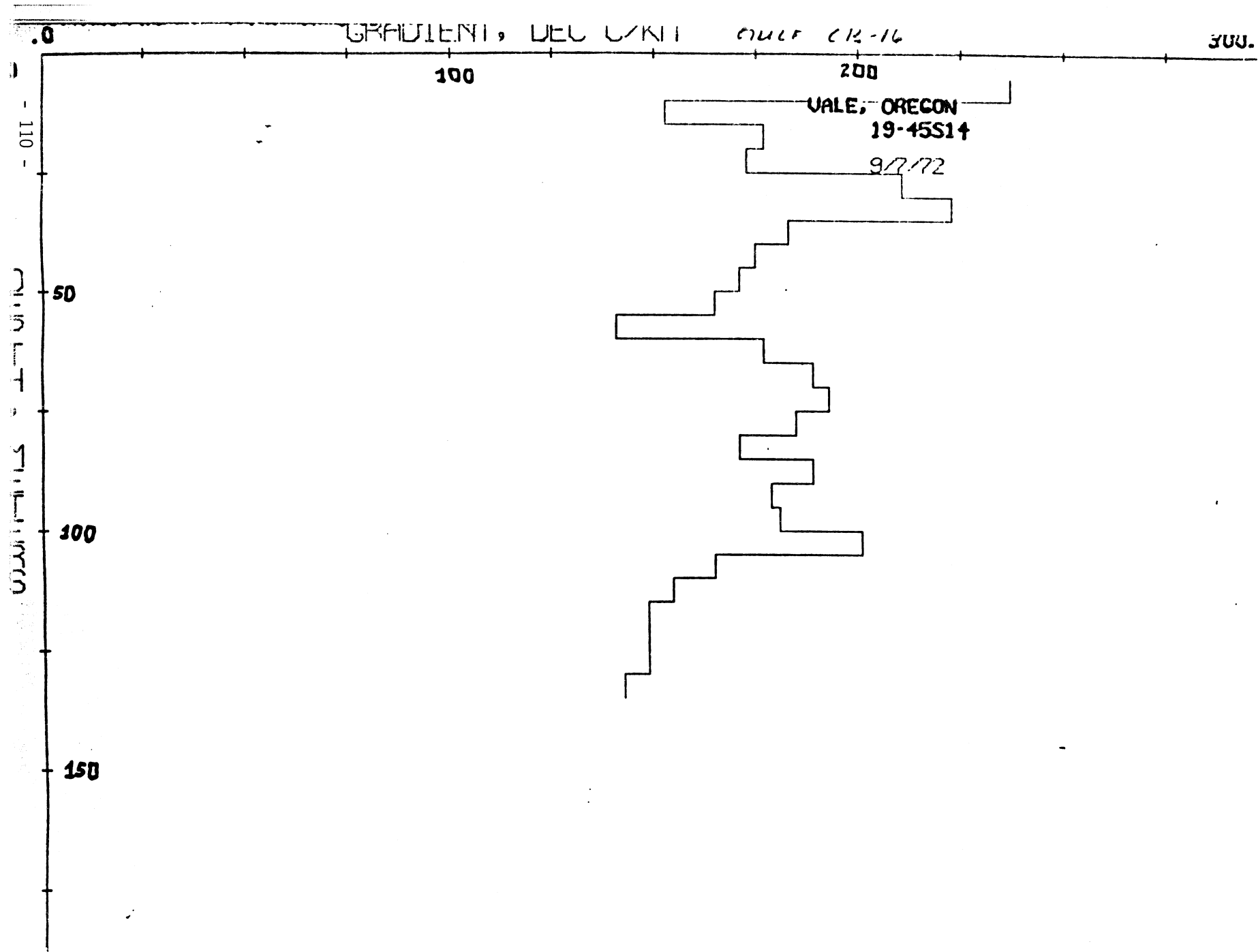
LOCATION: BOISE AMS, OREGON
 18S/45E-30AB
 HOLE NUMBER: VALECITY
 DATE MEASURED: 7/ 7/77

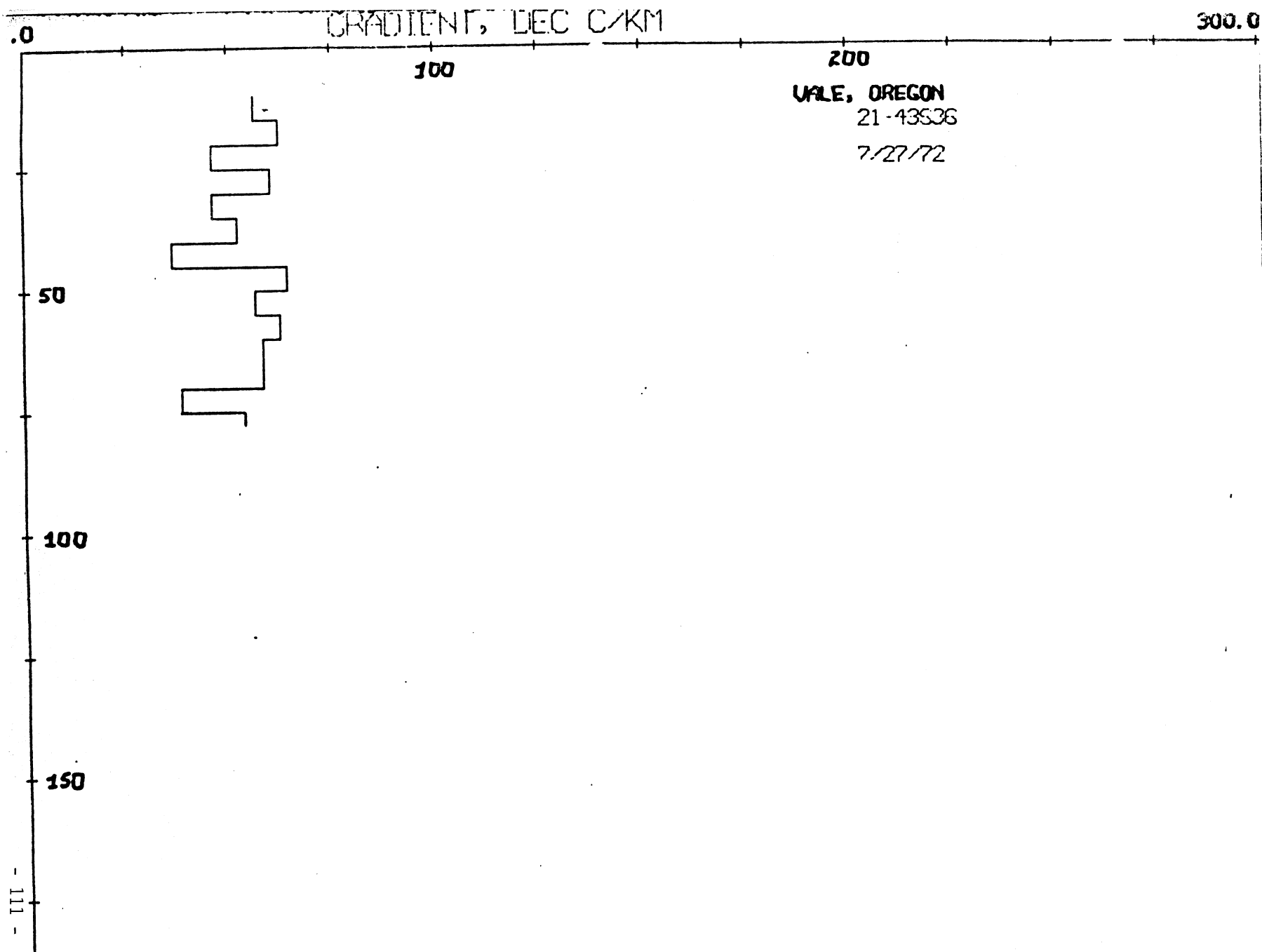
DEPTH METERS	DEPTH FEET	TEMPERATURE		GEOTHERMAL GRADIENT	
		DEG C	DEG F	DEG C/KM	DEG F/100 FT
7.5	24.6	12.570	54.63	0.0	0.0
10.0	32.8	12.880	55.18	124.0	6.8
12.5	41.0	13.060	55.51	72.0	4.0
15.0	49.2	13.300	55.94	96.0	5.3
17.5	57.4	13.450	56.21	60.0	3.3
20.0	65.6	13.640	56.55	76.0	4.2
22.5	73.8	13.800	56.84	64.0	3.5
25.0	82.0	14.030	57.25	92.0	5.0
27.5	90.2	14.260	57.67	92.0	5.0
30.0	98.4	14.440	57.99	72.0	4.0
32.5	106.6	14.640	58.35	80.0	4.4
35.0	114.8	14.860	58.75	88.0	4.8
37.5	123.0	15.070	59.13	84.0	4.6
40.0	131.2	15.250	59.45	72.0	4.0
42.5	139.4	15.510	59.92	104.0	5.7
45.0	147.6	15.720	60.30	84.0	4.6
47.5	155.8	15.900	60.62	72.0	4.0
50.0	164.0	16.110	61.00	84.0	4.6
52.5	172.2	16.240	61.23	52.0	2.9
55.0	180.4	16.640	61.95	160.0	8.8

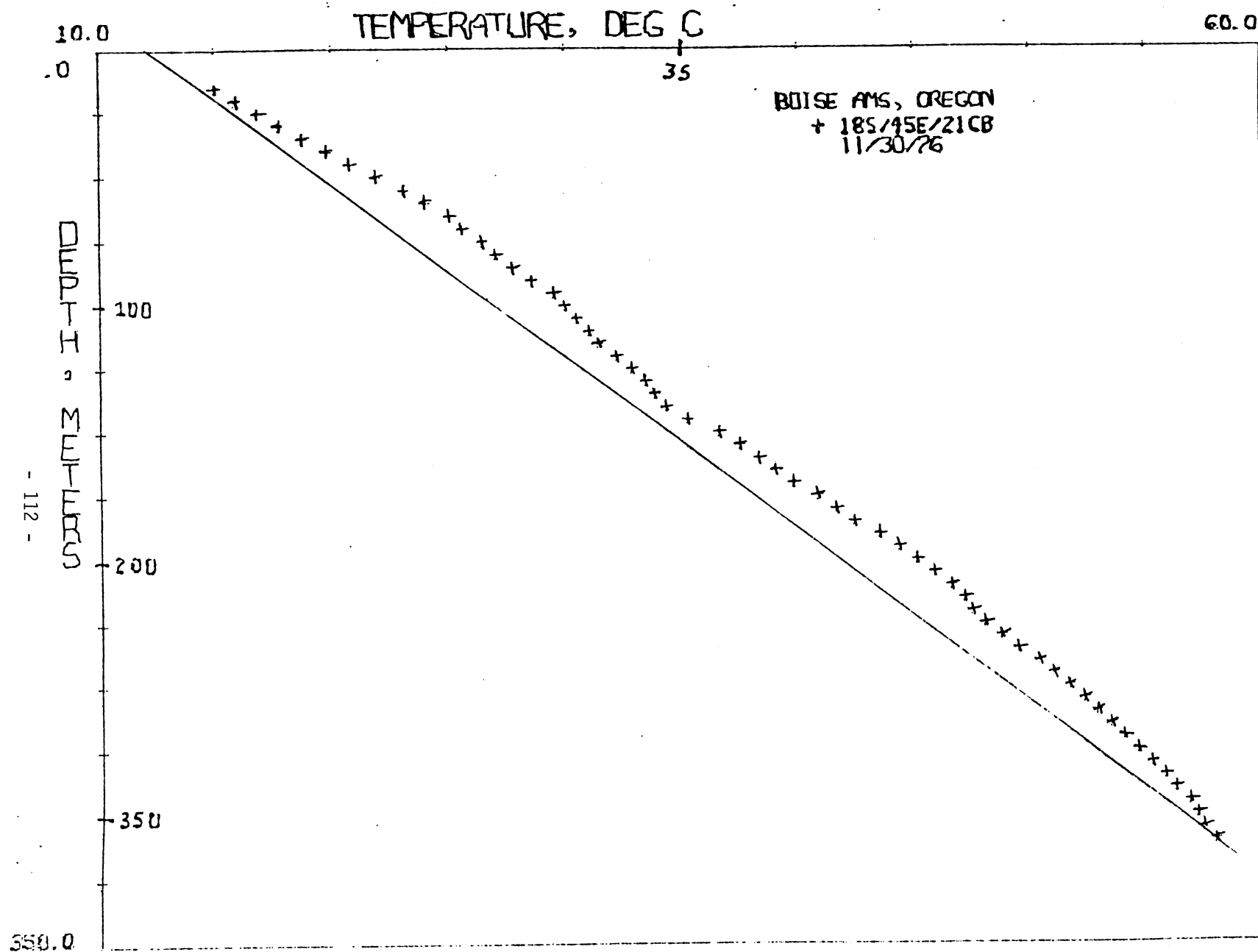
LOCATION: BOISE AMS, OREGON
 18S/46E-21CC
 HOLE NUMBER: LEE
 DATE MEASURED: 7/ 8/77

DEPTH METERS	DEPTH FEET	TEMPERATURE		GEOTHERMAL GRADIENT	
		DEG C	DEG F	DEG C/KM	DEG F/100 FT
7.5	24.6	15.310	59.56	0.0	0.0
10.0	32.8	15.400	59.72	36.0	2.0
12.5	41.0	15.490	59.88	36.0	2.0
15.0	49.2	15.550	59.99	24.0	1.3
17.5	57.4	15.660	60.19	44.0	2.4
20.0	65.6	15.750	60.35	36.0	2.0
22.5	73.8	15.790	60.42	16.0	0.9
25.0	82.0	15.880	60.58	36.0	2.0
27.5	90.2	16.100	60.98	88.0	4.8
30.0	98.4	16.260	61.27	64.0	3.5
32.5	106.6	16.420	61.56	64.0	3.5
35.0	114.8	16.560	61.81	56.0	3.1
37.5	123.0	16.950	62.51	156.0	8.6
40.0	131.2	17.300	63.14	140.0	7.7
42.5	139.4	17.380	63.28	32.0	1.8
45.0	147.6	17.790	64.02	164.0	9.0









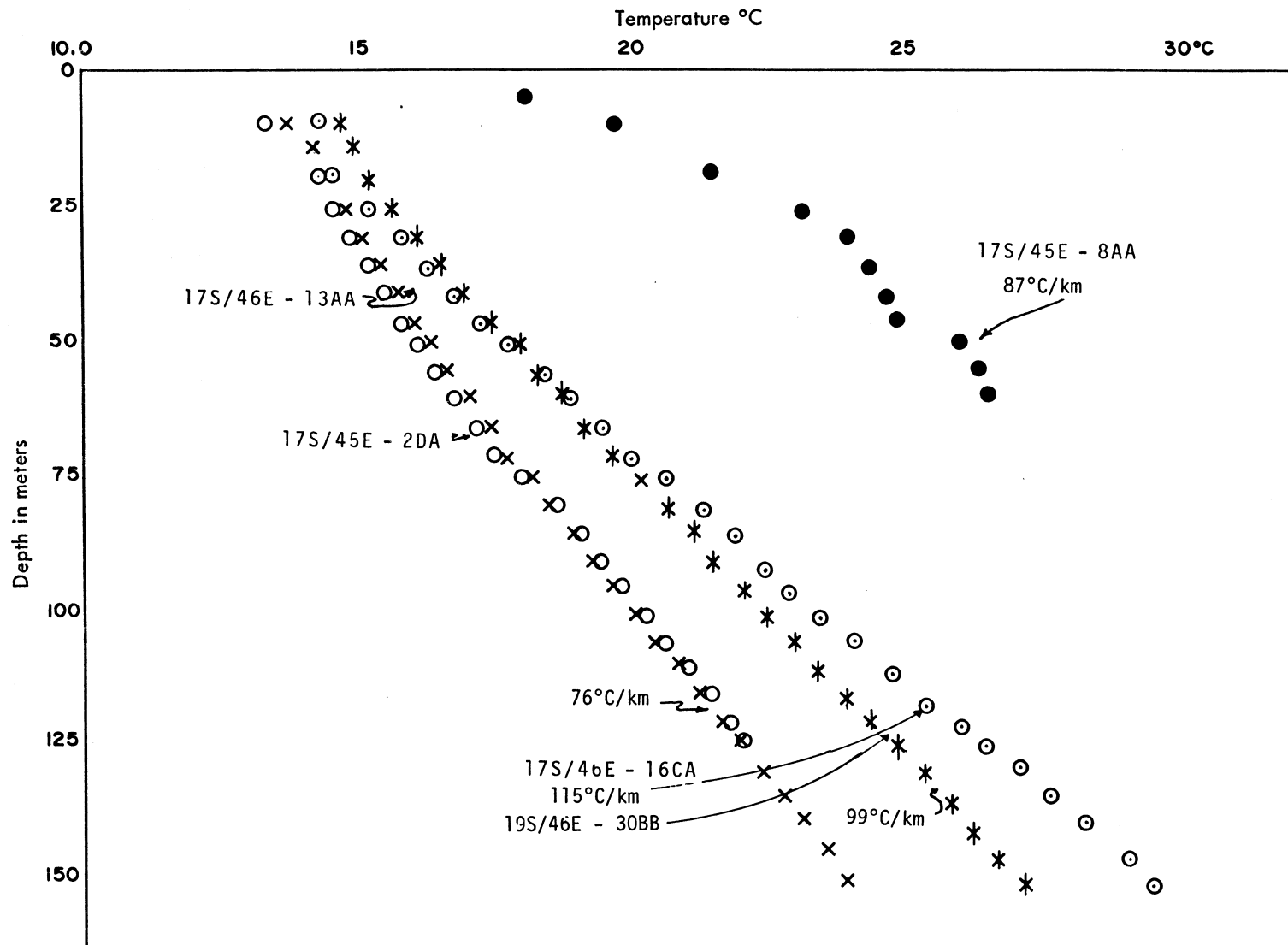


Figure 6. Temperature-depth plots for holes drilled by Oregon Department of Geology and Mineral Industries.

