STATE OF OREGON
DEPARTMENT OF GEOLOGY AND MINERAL INDUSTRIES
1069 State Office Building
Portland, Oregon 97201

OPEN FILE REPORT 0-75-4

GEOTHERMAL GRADIENT DATA
VALE AREA, MALHEUR COUNTY, OREGON

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Preliminary data from a geothermal project funded by
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1975

GEOTHERMAL STUDIES IN THE VALE AREA, MALHEUR COUNTY, OREGON

Don Hull, Economic Geologist

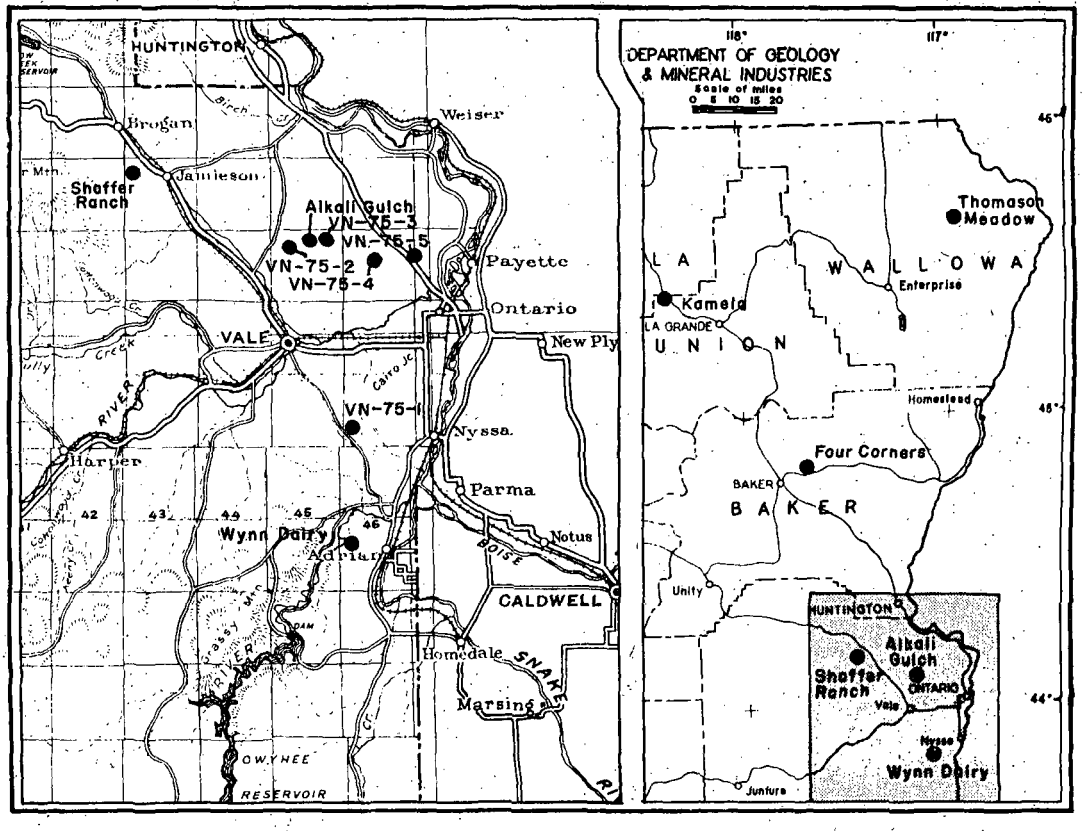
The Oregon Department of Geology and Mineral Industries has been engaged in studies of Oregon's geothermal energy potential for the past 10 years. The results of these activities have been published in The ORE BIN (v. 28, no. 7, p. 125-135; v. 29, no. 11, p. 209-231; v. 34, no. 4, p. 68-71; v. 35, no. 1, p. 6-7). Detailed studies of heat flow have been conducted since 1972 in the vicinity of Vale in northern Malheur County, southeastern Oregon (see map) under contract with the U.S. Bureau of Mines. The studies, initiated by R. G. Bowen in cooperation with Dr. David D. Blackwell of Southern Methodist University, are continuing, and a detailed report is being prepared summarizing the research to date. The preliminary results are being released in the hope they will aid in the exploration for and development of geothermal resources.

The final phase of the current geothermal investigation of the Vale area, consisting of the drilling of five holes to obtain heat-flow data, was completed in May and June 1975. All gradients are uncorrected for topographic effects. Hole locations are shown on the map.

Four of the five holes in the Vale area were drilled to a depth of 152 meters (500 feet) in siltstone of the Idaho Group of Pliocene age. Hole VN-75-2 was drilled in silty claystone from 0 to 95 feet and in altered basalt(?) from 95 feet to a total depth of 203 feet. Drilling was done by a combination of air rotary, down-hole hammer, and coring techniques.

Hole VN-75-2 encountered warm artesian water at a depth of 105 feet which flowed at a rate of 10 to 14 gallons per minute with a temperature of 75°F (24°C) and a well-head pressure of 5 pounds per square inch. The average gradient was measured after the hole had been cemented to stop the artesian flow, but the gradient reflects the presence of the thermal water at shallow depth.

The Department also has a continuing program of measuring temperature gradients in predrilled holes, such as water wells and mineral exploration holes. The results from holes measured from 1971 through 1973 were placed on open-file status in March 1975 (open-file report 0-75-3). Information from holes probed in 1975 to date are included in the following data.



TEMPERATURE-DEPTH LOG

Location Mitchell Butte - Malheur Co. Oregon - NW¼, NW¼, Sec 7, T. 21 S., R. 46 E
Company _____ Drill Hole No. Wynn #1
Date May 5, 1975 Depth Drilled 250 -- Zero Depth 2,260 ft
Probe, Cable, Bridge BR-1 Operator D. Hull
Comments Well N E. of Owyhee R. - near Mitchell Butte hot spr. ; 9' SWL

Depth	Resistance	Temperature	ΔT/Δx	Comments
5m	4958.7 Ω	14.88° C		
			134 °C/Km	
10	4823.9	15.55		
			52	Temp. drifting ±0.02°C in this region Probably
15	4775.0	15.81		
			60	due to convection well and/or
20	4715.5	16.11		
			78	seepage from aquifers
25	4642.0	16.50		
			102	
30	4548.1	17.01		
			112	
35	4446.0	17.57		
			132	
40	4329.5	18.23		
			134	
45	4215.4	18.90		
			138	
50	4102.0	19.59		
			138	
55	3990.0 ± 2Ω	20.28		
			100	
60	3918.3	20.78		
			100	
65	3837.0	21.28		
			96	
70m	3765.0 ± 2Ω	21.76 ≈ 71°F		
50m	4103.0 ✓			
			= 108.2	
	Av grad 15m to 70m = 21.76 - 15.01 / 65			

LOCATION: KAMELA, OREGON
HOLE NUMBER: 1-35S36
DATE MEASURED: 11/15/74

DEPTH METERS	TEMPERATURE DEG C	GRADIENT DEG C/KM
15.C	5.780	.0
20.0	5.760	-4.0
25.0	5.950	38.0
30.0	6.330	76.0
35.0	6.580	50.0
40.0	6.720	28.0
45.0	6.810	18.0
50.0	6.920	22.0
55.0	6.950	6.0
60.0	7.000	10.0
65.0	7.030	6.0
70.0	7.130	20.0

Av. gradient from 10m - 70m: 32.5 °C/Km

LOCATION: THOMASON MEADOW, ORE.
HOLE NUMBER: 3-47826
DATE MEASURED: 11/23/74

DEPTH METERS	TEMPERATURE DEG C	GRADIENT DEG C/KM
10.0	6.140	.0
15.0	6.340	40.0
20.0	6.570	46.0
25.0	6.730	32.0
30.0	6.830	20.0
35.0	6.980	30.0
40.0	7.100	24.0
45.0	7.190	18.0
50.0	7.300	22.0
55.0	7.350	10.0
60.0	7.410	12.0
65.0	7.490	16.0

Average gradient 10m to 65 m . 245 °c/km

LOCATION: BAKER, OREGON
HOLE NUMBER: B-41534
DATE MEASURED: 11/12/74

DEPTH METERS	TEMPERATURE DEG C	GRADIENT DEG C/KM
10.0	10.900	.0
15.0	11.550	130.0
20.0	11.950	80.0
25.0	12.110	32.0
30.0	12.510	80.0
35.0	12.970	92.0
40.0	13.420	90.0
45.0	13.480	12.0
50.0	13.720	48.0
55.0	13.940	44.0
60.0	14.140	40.0
65.0	14.400	52.0
70.0	14.610	42.0
75.0	14.830	44.0
80.0	14.990	32.0
85.0	15.190	40.0
90.0	15.410	44.0
95.0	15.600	38.0
100.0	15.700	20.0
105.0	15.880	36.0
110.0	16.000	24.0
115.0	16.090	18.0
120.0	16.290	40.0
125.0	16.420	26.0
130.0	16.460	8.0

Four Corners B.L.M. well

Average gradient 15-130 m = 42.7 c/km

TEMPERATURE-DEPTH LOG

Location NW¼ NW¼ sec. 30, T. 19 S., R. 46 E., Malheur County
Company Burd Drilling Co. Drill Hole No. VN - 75 - 1
Date June 4, 1975 Depth Drilled 500 ft.-152 m. Zero Depth 2885 ft. elev.
Probe, Cable, Bridge BR-1 / WB-3 Operator E.Widman - D. Hull
Comments Dry hole; no water in PVC inner casing

Depth	Resistance	Temperature	ΔT/Δx	Comments
5 m	5304.5 * ohm	13.24 ° C		
			286°C/km	
10	5000.6	14.67		
			48°	
15	4952.5	14.91		
			68°	
20	4888.2	15.25		
			84°	
25	4801.0	15.67		
			94°	
30	4710.0	16.14		
			96°	
35	4620.0	16.62		
			88°	
40	4538.8	17.06		
			94°	
45	4453.3	17.53		
			92°	
50	4372.7	17.99		
			90°	
55	4294.6	18.44		
			94°	
60	4214.1	18.91		
			90°	
65	4139.7	19.36		
			84°	
70	4070.8	19.78		
			100°	
75	3990.0	20.28		
			94°	
80	3917.4	20.75		
			102°	
85	3838.8	21.26		
			86°	
90	3774.7	21.69		
			76°	
95	3718.5	22.07		
			100°	
100	3647.6	22.57		

TEMPERATURE-DEPTH LOG

Location Lincoln Bench - NW¼ NW¼, sec. 30, T. 19 S., R. 46 E., Malheur County
Company Drill Hole No. VN - 75 - 1
Date June 4, 1975 Depth Drilled 500 ft.-152 m Zero Depth
Probe, Cable, Bridge BR - 1 / WB-3 Operator E. Widman - D. Hull
Comments

Depth	Resistance	Temperature	ΔT/Δx	Comments
100 m	3647.6 ohm	22.57 ° C		
			90 °C/km	
105	3583.3	23.02		
			90	
110	3521.1	23.47		
			92	
115	3458.8	23.93		
			96	
120	3396.2	24.41		
			98	
125	3332.5	24.90		
			100	
130	3268.9	25.40		
			92	
135	3211.8	25.86		
			104	
140	3148.7	26.38		
			96	
145	3091.0	26.86		
			90	
150	3038.3	27.31		

Av. grad. from 15m - 150 m = 91.9 ° C/km
" " " 20m - 150 m = 92.8 ° C/km

* Four or more readings were taken at each depth interval and the resistance values shown were obtained by extrapolating semilog plots of the sets of readings to infinite time.

TEMPERATURE-DEPTH LOG

Location NW¼ of NE¼, sec. 8, T. 17 S., R. 45 E. - Malheur Co., Oregon
Company Burd Drilling Co. Drill Hole No. WN - 75 - 2
Date June 4, 1975 Depth Drilled 203 ft - 62 m Zero Depth 2,365 ft. elev.
Probe, Cable, Bridge BR-1 / WB - 3 Operator E. Widman / D. Hull
Comments

Depth	Resistance	Temperature	ΔT/Δx	Comments
5 m				not read
10	4340.7	18.17 °C.	310° C/km	
15	4079.8	19.72	394	
20	3775.6	21.69	308	
25	3554.0	23.23	158	
30	3447.8	24.02	80	
35	3393.7	24.42	62	
40	3354.0	24.75	38	
45	3329.5	24.92	244	
50	3177.7	26.14	70	
55	3135.1	26.49	30	
60	3117.6	26.64		

Av. grad. 15m - 60 m = 153.7 °C/km
" " 20m - 60 m = 123.8

TEMPERATURE-DEPTH LOG

Location NE¼ of SE¼, sec. 2, T. 17 S., R. 45 E., Malheur County, Oregon
Company _____ Drill Hole No. VN-75-3
Date May 13,1975 4:15PM Depth Drilled 500 ft - 152 m Zero Depth 2,760 ft.
Probe, Cable, Bridge BR-1 / WB-3 Operator D. Hull
Comments _____

Depth	Resistance	Temperature	ΔT/Δx	Comments
5m	4690 ohm	16.25 ° C		
			-390°C/km	
10	5077.1	14.30		
			0	
15	5078.0	14.30		
			32	
20	5043.6	14.46		
			42	
25	5000.7	14.67		
			48	
30	4952.2	14.91		
			60	
35	4892.9	15.21		
			66	
40	4827.4	15.54		
			50	
45	4777.7	15.79		
			64	
50	4716.0	16.11		
			78	
55	4642.4	16.50		
			72	
60	4576.0	16.86		
			84	
65	4498.6	17.28		
			82	
70	4425.0	17.69		
			94	
75	4342.5	18.16		
			108	
80	4249.	18.70		
			88	
85	4175.7	19.14		
			70	
90	4117.4	19.49		
			70	
95	4061.0	19.84		
			84	
100	3993.9	20.26		
			82	
105	3930.3	20.67		

TEMPERATURE-DEPTH LOG

Location
Company Drill Hole No. VN-75-3
Date May 13,1975 4:15 PM Depth Drilled Zero Depth
Probe, Cable, Bridge Operator D. Hull
Comments

Depth	Resistance	Temperature	ΔT/Δx	Comments
105 m	3930.3 ohm	20.67 °C	84 °C/km	
110	3865.4	21.09	94	
115	3793.8	21.56	50	
120	3756.6	21.81	40	
125	3728.2 5:20 PM	22.01		
	Av. grad. 15 m to 120 m =	21.81 - 14.30 /105		
		= 71.5 °C/km		
	(Av. grad. 20-120 m	= 73.5)		

TEMPERATURE-DEPTH LOG

Location NE¼ of SW¼ sec. 16, T. 17 S., R. 46 E., Malheur County, Oregon
Company Burd Drilling Co. Drill Hole No. VN-75-4
Date June 4, 1975 Depth Drilled 500' TD - 152 m Zero Depth 2,520 ft.
Probe, Cable, Bridge WB-3 / BR-1 Operator D.Hull / E. Widman
Comments Current irrigation uphill to south from drill site

Depth	Resistance	Temperature	ΔT/Δx	Comments
5 m	5508.9 ohm	12.32 °C		
			206 °C/km	
10	5279.6	13.35		
			142	
15	5128.8	14.06		
			94	
20	5029.3	14.53		
			148	
25	4880.3	15.27		
			110	
30	4772.3	15.82		
			104	
35	4673.0	16.34		
			96	
40	4583.5	16.82		
			104	
45	4487.2	17.34		
			104	
50	4394.7	17.86		
			110	
55	4299.5	18.41		
			110	
60	4206.1	18.96		
			110	
65	4114.6	19.51		
			108	
70	4026.6	20.05		
			134	
75	3921.5	20.72		
			142	
80	3813.7	21.43		
			112	
85	3730.6	21.99		
			114	
90	3648.6	22.56		
			86	
95	3588.2	22.99		
			114	
100	3509.9	23.56		
			112	
105	3433.3	24.12		

TEMPERATURE-DEPTH LOG

Location _____

Company _____ Drill Hole No. VN-75-4

Date June 4, 1975 Depth Drilled 500 ft. Zero Depth _____

Probe, Cable, Bridge _____ Operator D. Hull / E. Widman

Comments _____

Depth	Resistance	Temperature	ΔT/Δx	Comments
105 m	3433.3 ohm	24.12 °C	138° C/km	
110	3344.0	24.81	124	
115	3264.4	25.43	138	
120	3179.7	26.12	110	
125	3113.6	26.67	118	
130	3043.9	27.26	120	
135	2975.8	27.86	116	
140	2911.1	28.44	124	
145	2844.7	29.06	114	
150	2784.0	29.63		

Av. gradient from 15m - 150m = 115.33°C/km

" " " 20m-150 m = 116.2

TEMPERATURE-DEPTH LOG

Location NW¼ of NE¼, sec. 13, T. 17 S., R. 46 E., Malheur County, Oregon
Company _____ Drill Hole No. VN-75-5
Date June 3, 1975 Depth Drilled 500 ft. - 152 m Zero Depth 2,400 ft.
Probe, Cable, Bridge BR-1 / WB-3 Operator E. Widman / D. Hull
Comments _____

Depth	Resistance	Temperature	ΔT/Δx	Comments
5 m	5614.7 ohm	11.86° c		
			380° C/km	
10	5192.4	13.76		
			66	
15	5122.2	14.09		
			70	
20	5049.4	14.44		
			58	
25	4988.4	14.73		
			66	
30	4922.0	15.06		
			66	
35	4856.8	15.39		
			68	
40	4789.2	15.73		
			68	
45	4724.0	16.07		
			68	
50	4659.7	16.41		
			72	
55	4592.0	16.77		
			72	
60	4526.2	17.13		
			74	
65	4459.5	17.50		
			72	
70	4394.8	17.86		
			74	
75	4330.0	18.23		
			74	
80	4265.5	18.60		
			82	
85	4197.6	19.01		
			74	
90	4135.1	19.38		
			92	
95	4060.1	19.84		
			56	
100	4016.4	20.12		
			86	
105	3948.0	20.55		

TEMPERATURE-DEPTH LOG

Location
Company Drill Hole No. VN -75 - 5
Date June 3, 1975 Depth Drilled 500 ' Zero Depth
Probe, Cable, Bridge ~~MR~~-1 / WB-3 Operator E. Widman / D. Hull
Comments

Depth	Resistance	Temperature	ΔT/Δx	Comments
105 m	3948.0 ohm	20.55 ° C.		
			80° C/km	
110	3886.2	20.95		
			76	
115	3828.1	21.33		
			74	
120	3773.4	21.70		
			78	
125	3716.4	22.09		
			74	
130	3662.6	22.46		
			78	
135	3608.2	22.85		
			74	
140	3556.0	23.22		
			76	
145	3504.1	23.60		
			80	
150	3450.4	24.00		

Av. grad. 15 m - 150 m = 73.4° C/km

Av. grad. 20m - 150 m = 73.5

TEMPERATURE-DEPTH LOG

Location Alkali Gulch (BLM stock well) SE¼ SE¼ sec. 3 T 17 S, R. 45 E
Company Drilled by Winfield Pace Drill Hole No.
Date April 17, 1975 Depth Drilled 650 T.D. Zero Depth
Probe, Cable, Bridge BR-1 Operator R.G. Bowen & D.A. Hull
Comments Water @ ~40 m ; pump tested on Mar. 27 (3 wks. prior to logging

Depth	Resistance	Temperature	ΔT/Δx	Comments
0 5m 12:05	5349.2			
2 ↓ 12:07	5346.7			
4 12:09	5346.0	13.06°C		
6 12:11	5346.6		204°C/KM	
8 10m 12:14	5240.6			
12:16	5214	14.08		
12:18	5195		96	
12:20	5183			
12:23 15M	5068.2	14.56		
12:25	5059.4		54	
12:27	5015.3			
12:30	4990.0			
2 12:33 20m	4982.7	14.83		
4 12:36	4987.1		74	
6 12:37	4926			
8 12:40	4914			
0 12:42 25m	4909	15.20		
2 12:44			88	
4 :46	4907			
6 :49 30m	4851	15.64		
8 :51	4840			
0 :53	4835		78	
2 :55	4832			
4 :58 35m	4770			
6 1:00	4757.5			
8 1:02	8751	16.03		
0 1:04	4747.3			
2 1:06	4744.8		918	
4 40M 1:10	4737			
		17.62		In water
			104	
45M	4345.8	18.14		
			214	
50M	4163	19.21		fluctuating
			296	
55	3920 - 20.78 3959 20.65 3925 20.70	20.69?		fluctuating
			456	
60	3590.2	22.97		
			16	
65	3580	2305		
			4	
70	3577	2307		fluctuating
			0	
75	3577	23.07		
			28	
80	35566	23.21		
			16	
85	3546.2	23.29		
			-8	
90	3552	23.25		
			+32	
95	3530	23.41		fluctuating
			+18	
100	3518	23.50		fluctuating

TEMPERATURE-DEPTH LOG

Page 2

Location Alkali Gulch (BLM stock well)
Company _____ Drill Hole No. _____
Date April 17, 1975 Depth Drilled _____ Zero Depth _____
Probe, Cable, Bridge _____ Operator _____
Comments _____

Depth	Resistance	Temperature	ΔT/Δx	Comments
105M	3503	23.61	22	
110	3487	23.72	18	fluctuating
115	3476	23.81	14	"
120	3466	23.88	—	fluctuating
125	3466	23.88	30	
130	3446.4	24.03	30	fluctuating
135	3425.6	24.18	12	"
140	3418	24.24	22	"
145	3403	24.35	14	"
150	3394	24.42	16	"
155	3383.3	24.50	16	
160	3373	24.58	6	
165	3370	24.61	10	
170	3363.6	24.66	8	
175	3357.7	24.70	4	
180	3355.4	24.72	0	Bottom ?
185	3354.8	24.72		
190	3354.8			

Av. gradient 15 to 175 m = $\frac{10.14°C}{160\ m}$ = 63.4°C/Km

" " 15 to 180m = 61.6 °C/Km

TEMPERATURE-DEPTH LOG

Location SE1/4, sec. 7, T. 16 S, R 43 E. - Malheur Co. - Harry Schaffer Ranch
Company _____ Drill Hole No. _____
Date May 6, 1975 Depth Drilled 404 TD Zero Depth 2,800 ft.
Probe, Cable, Bridge BR-1 Operator D. Hull
Comments SWL @ 155 ft. deep

Depth	Resistance	Temperature	ΔT/Δx	Comments
5m: 0 2:43, 3 2:46, 5 2:48, 7 2:50	5755.0, 5882.-, 5944.-, 5989.- } 6190±	9.53 °C	780 °c/km	Rapid drift
10m: 0 2:53, 3 :56, 5 :58, 7 3:10	5252	13.43	124	" "
15m: 0 3:08, 3 :06, 5 :08, 7 :10	5130	14.05	58	
20m: 0 :13, 3 :18, 5 :19, 7 :20	5068±	14.34	50	
25m: 0 :23, 3 :26, 5 :28, 7 :30	5017±	14.59	46	
30m: 0 :33, 3 :36, 5 :38, 7 :40	4971.4	14.82	44	
35m: 0 :43, 5 :46, 7 :48, 9 :50	4926.0	15.04	42	
40m: 0 :55, 3 :56, 5 :58, 7 4:00	4884.3	15.25	102	
45m: 0 :03, 3 :06, 5 :08, 7 :10, 9 :12	4789.7, ?→4796.2, 4784.9, 4784.8, 4784.7 } 4788.9	15.76	22	
50 m	4961.8	15.87		ck. on way out 4654.3 ± 2.0
55 m	4721.6	16.08	42	
60 m	4683.0 ±1	16.28	40	
65 m	4643.5 ±0.5	16.49	42	Slow drift; probably due to convection
70 m	4638.3 4635.3 ±0.2	16.54	10	ck. 65 m - 4643.0 ck. 70 m again 4634.0
75 m	4622.0	16.61	14	ck 4624.8 on way out - 4621.6
80 m	4614.9 ±0.5	16.65	8	on way out 4608.5
85 m	4566.6	16.91	52	
90 m	4555.5	16.97	16	
95 m	4540.2	17.05	16	

TEMPERATURE-DEPTH LOG

(Gum Cr. Ranch)

Location SE 1/4, sec. 7, T. 16S, R43E. - Malheur Co. - Harry Schaffer Ranch

Company _____ Drill Hole No. _____

Date _____ Depth Drilled _____ Zero Depth _____

Probe, Cable, Bridge _____ Operator _____

Comments _____

Depth	Resistance	Temperature	ΔT/Δx	Comments
95 m	4540.2 Ω	17.05 °C		
			32 C/Km	
100	4511.7	17.21		CK. on way out - 4511.7
			2	
105	4509.2 ±0.2	17.22		
			22	
110	4489.5	17.33		
			12	
115	4479.4	17.39		
			2	
Discrepancy 120	4477.2	17.40 = 63° F		May be on bottom here

5 | 17.40 → 3.48

3.48

31.32

63 °F

17.39

Av. from 15m to 115m = $\frac{17.39 - 14.05}{100} = \frac{3.34}{1} = 33.4$ °C/Km.

17.39

14.05

3.34