USGS-OFR--79-1308

DE82 906054

UNITED STATES DEPARTMENT OF THE INTERIOR

GEOLOGICAL SURVEY

Audio-magnetotelluric data log and station-location
map for the Ennis Hot Springs area, Montana

by

Carl L. Long and Robert M. Senterfit

Open-File Report 79-1308

1979

NOTICE

PORTIONS OF THIS REPORT ARE ILLEGIBLE. It
has been reproduced from the best available
copy to permit the broadest possible avail-
ability.

This report is preliminary and has not been
edited or reviewed for conformity with U.S.
Geological Survey standards.

MASTER

DISTRIBUTION OF THIS DOCUMENT IS UNLIMITED

PURCHASE ORDER NO. 03X-46503

RECEIVED 9-3-82

DISCLAIMER

This report was prepared as an account of work sponsored by an agency of the United States Government. Neither the United States Government nor any agency Thereof, nor any of their employees, makes any warranty, express or implied, or assumes any legal liability or responsibility for the accuracy, completeness, or usefulness of any information, apparatus, product, or process disclosed, or represents that its use would not infringe privately owned rights. Reference herein to any specific commercial product, process, or service by trade name, trademark, manufacturer, or otherwise does not necessarily constitute or imply its endorsement, recommendation, or favoring by the United States Government or any agency thereof. The views and opinions of authors expressed herein do not necessarily state or reflect those of the United States Government or any agency thereof.

DISCLAIMER

Portions of this document may be illegible in electronic image products. Images are produced from the best available original document.

Four days were spent collecting 20 audio-magnetotelluric (AMT) soundings in the area of the Ennis Hot Springs, Mont. (fig. 1). These soundings were made to assist in a regional evaluation of the geothermal potential of the Ennis Hot Springs area.

Scalar resistivities from the data log (table 1) are indicative of thermal water altering the Quaternary alluvium to the southeast. The alteration extends over an area of 1.5 km by 4 km. The geothermal system is probably along a north-south range fault between the Precambrian gneiss and the Tertiary gravels. The scalar resistivities also indicate a northwest trend that may be an intersecting fault. Therefore any geothermal potential would probably be in the area near the existing hot spring, with a possible extent to the northwest of 1 km and to the southeast some 3 km.

Figure 1 - Audio-magnetotelluric station location map of Ennis Hot Springs area, Montana.

Table 1 - U.S. GEOLOGICAL SURVEY A.M.T. DATA LOG - Continued

pa = observed apparent resistivity in ohm-meters

N = number of observations

Er = standard error in ohm meters

- = no data

Ennis, Montana

OCT, 1978

"NOTE" - Telluric line orientation indicated with station numbers.

Sta. No.	FREQUENCY												
		7.5	10	14	27	76	285	685	1.2K	3.3K	6.7K	10.2K	18.6K
5 _S	pa	19.7	34.0	20.0	56.3	65.5	69.8	-	-	-	107.	112	61.8
	N	6	5	8	5	5	5				6	1	1
	Er	2.53	3.26	1.96	12.3	12.9	4.59				4.18	-	-
5 _W	pa	17.2	25.9	23.2	46.3	81.4	62.1	-	-	-	139.	125.	119.
	N	6	5	6	5	6	6				5	1	1
	Er	2.69	6.28	3.03	5.82	19.5	9.17				17.1	-	-
6 _S	pa	40.3	38.8	30.4	46.5	24.1	42.8	-	-	-	93.2	65.6	47.5
	N	6	5	6	5	6	6				7	3	1
	Er	9.04	4.56	6.09	6.48	0.87	5.02				4.03	1.66	-
6 _W	pa	31.7	37.2	30.2	46.3	44.9	26.4	-	-	-	127.	72.8	70.0
	N	5	6	5	6	6	6				6	1	1
	Er	5.04	6.16	3.88	3.13	6.87	1.19				5.92	-	-
7 _S	pa	28.8	34.0	24.9	36.8	29.2	26.9	-	-	-	53.4	37.0	23.1
	N	7	7	6	6	6	4				5	7	1
	Er	2.74	4.06	5.23	2.20	0.26	0.46				2.74	1.76	-
7 _W	pa	28.7	10.2	11.7	11.6	15.2	11.9	-	-	-	108.	117.	50.0
	N	7	7	6	7	6	5				5	7	1
	Er	7.57	1.00	0.54	0.75	0.92	1.38				14.4	9.02	-
8 _S	pa	200.	222.	191.	210.	104.	43.4	-	-	-	55.2	80.7	42.6
	N	5	5	6	5	6	5				4	3	1
	Er	21.7	8.83	24.6	39.3	0.43	1.48				3.55	15.0	-
8 _W	pa	39.0	33.5	31.0	23.2	11.7	7.05	-	-	-	161.	357.	74.2
	N	6	6	5	5	4	4				3	3	1
	Er	4.34	3.92	2.18	1.47	0.65	0.13				6.83	147.	-

Table 1 - U.S. GEOLOGICAL SURVEY A.P.I. DATA LOG - continued

pa = observed apparent resistivity in ohm-meters

N = number of observations

Er = standard error in ohm meters

- = no data

Ennis, Montana

OCT., 1978

"NOTE" - Telluric line orientation indicated with station numbers.

Sta. No.		FREQUENCY											
		7.5	10	14	27	76	285	685	1.2K	3.3K	6.7K	10.2K	18.6K
9 N S	pa	9.44	-	9.48	17.4	27.5	31.6	-	-	-	173.	75.6	62.4
	N	6	7	7	6	6	6				5	6	1
	Er	2.69		1.46	1.38	0.95	0.90				16.3	3.26	-
9 E W	pa	13.7	12.3	8.64	9.34	19.4	20.3	-	-	-	174.	198.	89.1
	N	7	6	5	6	7	6				5	3	1
	Er	1.37	1.46	1.03	0.56	1.23	2.83				6.41	20.4	-
10 N S	pa	723.	1164.	1002.	285.	86.2	148.	-	-	-	91.1	48.7	27.5
	N	5	4	3	4	5	4				5	4	1
	Er	83.3	45.2	54.6	77.0	8.26	30.5				2.42	2.71	-
10 E W	pa	281.	435.	377.	113.	118.	133.	-	-	-	128.	111.	83.6
	N	6	4	4	4	4	4				4	4	1
	Er	40.0	62.6	80.5	16.2	13.8	28.7				3.55	9.82	-
11 N S	pa	2437.	2510.	3080.	1728.	1083.	584.	-	-	-	303.	138.	152.
	N	7	6	6	6	5	5				6	1	1
	Er	167.	223.	552.	84.8	30.2	44.4				19.8	-	-
11 E W	pa	1181.	1227.	1326.	985.	766.	487.	-	-	-	244.	75.1	606.
	N	6	6	5	6	6	6				5	1	1
	Er	69.3	234.	226.	181.	59.4	622				13.8	-	-
12 N S	pa	2206.	2538.	1584.	1523.	722.	594.	-	-	-	272.	158.	122.
	N	6	7	6	6	5	5				4	1	1
	Er	102.	427.	272.	126	67.7	34.8				9.84	-	-
12 E W	pa	1374.	1358.	1142.	1243.	972.	297.	-	-	-	398.	285.	245.
	N	4	4	5	5	5	4				3	1	1
	Er	99.2	497.	144.	149.	143.	3.85				-	-	-

Table 1 - U.S. GEOLOGICAL SURVEY A.M.T. DATA LOG - Continued

pa = observed apparent resistivity in ohm-meters

N = number of observations

Er = standard error in ohm meters

- = no data

Ennis, Montana

OCT., 1978

"NOTE" - Telluric line orientation indicated with station numbers.

		FREQUENCY											
Sta. No.		7.5	10	14	27	76	285	685	1.2K	3.3K	6.7K	10.2K	18.6K
13 ^N _S	pa	13.0	—	16.3	19.0	—	52.9	—	—	—	37.6	31.0	20.6
	N	8		7	7		8				7	4	1
	Er	1.73	3.66	1.39	1.93		3.20				1.29	3.02	—
13 ^E _W	pa	148.	170.	201	264	134	83.2	—	—	—	54.7	16.2	22.8
	N	7	6	7	7	8	7				7	1	1
	Er	14.3	30.1	9.58	28.4	2.9	4.61				1.70	—	—
14 ^N _S	pa	20.5	32.6	32.4	26.8	25.5	79.5	—	—	—	24.0	46.6	12.6
	N	5	6	5	6	5	5				6	1	1
	Er	0.97	7.01	7.50	1.00	2.72	9.51				1.29	—	—
14 ^E _W	pa	21.3	37.7	40.8	47.5	43.8	52.1	—	—	—	32.9	75.1	49.7
	N	6	5	5	5	4	5				5	1	1
	Er	2.05	1.76	11.8	4.26	5.58	1.41				2.54	—	—
15 ^N _S	pa	16.7	26.4	28.8	39.8	41.2	61.9	—	—	—	40.0	47.4	24.9
	N	7	7	6	6	6	6				5	1	1
	Er	2.52	1.90	3.48	3.28	1.38	1.56				1.50	—	—
15 ^E _W	pa	11.0	15.5	16.7	26.0	30.8	38.1	—	—	—	22.7	61.4	48.2
	N	7	7	6	6	5	5				5	1	1
	Er	1.47	2.04	1.23	3.10	0.74	5.09				2.57	—	—
16 ^N _S	pa	15.8	30.0	18.4	23.5	—	30.8	—	—	—	19.0	145.	61.9
	N	6	8	6	6		6				3	3	1
	Er	3.46	3.90	0.65	1.25		0.66				16.6	13.1	—
16 ^E _W	pa	16.3	22.8	15.7	21.0	31.9	41.5	—	—	—	313.	291.	—
	N	6	6	13	7	5	3				3	3	
	Er	1.66	4.73	0.78	1.32	2.99	4.10				8.10	21.8	

Table 1- U.S. GEOLOGICAL SURVEY A.M.T. DATA LOG-Continued

pa = observed apparent resistivity in ohm-meters

N = number of observations

Er = standard error in ohm meters

- = no data

Ennis, Montana

OCT, 1978

"NOTE" - Telluric line orientation indicated with station numbers.

Sta. No.		FREQUENCY											
		7.5	10	14	27	76	285	685	1.2K	3.3K	6.7K	10.2K	18.6K
17 ^N	pa	22.5	34.4	23.7	31.0	37.2	33.1	-	-	-	171	58.3	59.8
	N	5	5	5	6	6	6				6	1	1
	Er	0.98	1.44	1.23	3.00	5.18	1.75				7.23	-	-
17 ^E	pa	10.7	12.7	20.5	20.4	21.9	27.3	-	-	-	214	184	63.0
	N	6	6	6	6	7	5				5	1	1
	Er	0.47	1.95	1.79	1.90	1.99	1.09				10.0	-	-
18 ^N	pa	42.4	42.5	114	229	293	-	-	-	-	142	73.9	50.2
	N	10	7	5	5	5					4	4	1
	Er	7.85	11.7	22.6	32.8	10.9					18.6	2.0	-
18 ^E	pa	15.9	65.7	42.5	234	264	-	-	-	-	304	227	66.4
	N	6	5	8	5	5					4	3	1
	Er	3.49	8.78	10.4	16.8	17.9					6.98	81.9	-
19 ^N	pa	272	314	192	189	53.5	41.6	-	-	-	63.6	43.0	39.8
	N	5	5	7	7	6	1				5	7	1
	Er	26.5	13.6	10.4	16.3	2.07	-				4.15	1.60	-
19 ^E	pa	61.1	108	93.7	49.9	25.8	15.1	-	-	-	168	127	56.4
	N	7	5	6	6	6	1				5	1	1
	Er	14.0	25.5	23.8	8.54	2.12	-				9.16	-	-
20 ^N	pa	13.0	12.2	8.28	5.69	5.45	18.6	-	-	-	85.1	56.7	44.5
	N	8	6	8	5	8	5				8	8	1
	Er	1.42	2.45	0.82	0.33	0.21	1.83				6.11	2.21	-
20 ^E	pa	3.38	4.12	3.85	3.40	4.09	10.6				157	165	3.11
	N	7	7	6	8	8	6				5	5	1
	Er	0.48	0.42	0.49	0.31	0.30	0.97				385	16.3	-