UNITED STATES DEPARTMENT OF THE INTERIOR

GEOLOGICAL SURVEY

Audio-magnetotelluric Data Release for the Newcastle, Utah Geothermal Area

by

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Purpose

This report is to provide public release of audio-magnetotelluric (AMT) data gathered in a region of geothermal interest near Newcastle, Utah in 1976. Because of the limited amount of data, seven stations, no analysis of the data is presented. However, a brief summary of the AMT method is presented for those not familiar with the method.

Audio-magnetotelluric method

Magnetotelluric (MT) is an electromagnetic sounding method in which variations in earth resistivity as a function of depth are measured (Keller and Frischknecht, 1966). These soundings are obtained by measuring the earth's surface electromagnetic fields at different frequencies. Because lower frequencies penetrate deeper into the earth than higher frequencies before they are absorbed, measurement of the electromagnetic fields over a broad frequency range gives information on resistivity variations with depth. If these measurements are made in the audio-frequency range (7.5 Hz to 18.6 Hz) then the technique is called audio-magnetotelluric (AMT). This method is discussed in detail by Strangway and others (1973) and application and details of the USGS AMT system are given by Hoover and others (1976, 1978) and Hoover and Long (1976).

The depth of exploration of AMT methods is a function not only of frequency, but also of the resistivity of the volume of earth sampled. For a homogeneous earth the maximum depth D of exploration can be approximated by a relationship given by Bostick (1977):

$$D = 355\sqrt{\rho/f} \text{ meters}$$

where ρ is the half-space resistivity in ohm-m, and f is the frequency.

As in any sounding technique, it should be remembered that the earth is being sampled laterally away from as well as vertically below the measuring station. Thus, in areas of complex geology, simple one-dimensional model interpretations give, at best, only a crude average approximation of the vertical distribution of resistivity beneath the sounding site.

The sources of AMT signals may be either artificial or natural. The USGS equipment used in this survey has been designed for use with natural sources. The principal source of natural electromagnetic energy in the audio-frequencies is electrical discharge during lightning storms. Typically, signal strength is low except when generated by local storms, and data quality may be poor, especially in parts of the frequency spectrum where energy is more strongly attenuated (approximately 1 to 4 KHz). The limitations of natural source AMT exploration are discussed more fully by Hoover and others (1978).

Figure 1 shows the locations of the 7 AMT stations measured near Newcastle, Utah. Table 1 lists the apparent resistivity, number of observations, and standard error for each frequency measured. Two soundings were measured at each station, one with a north-south orientation of the telluric dipole and one with an east-west orientation.

References

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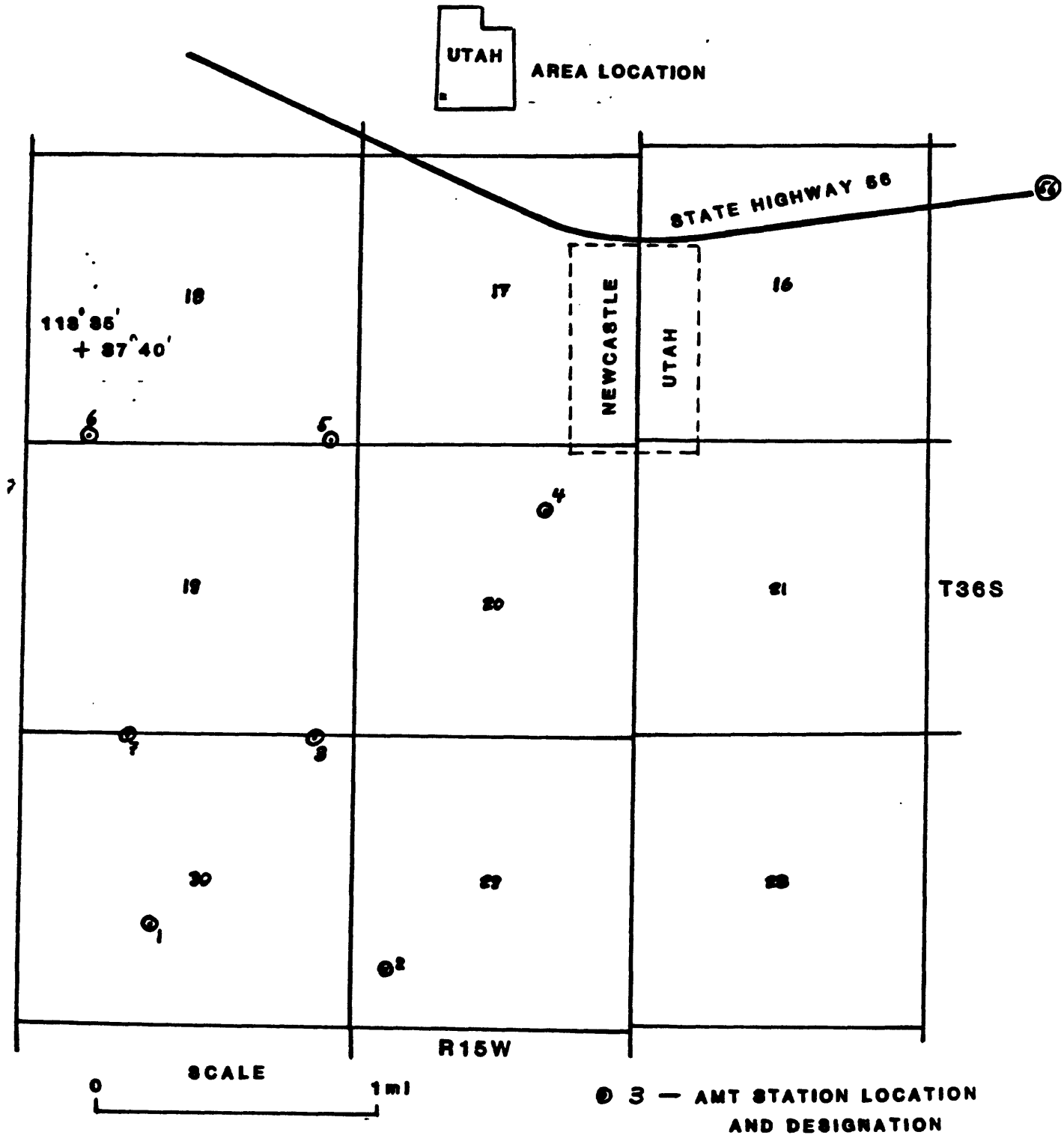

FIGURE 1

AUDIO-MAGNETOTELLURIC STATION LOCATION MAP,

NEWCASTLE,UTAH

TABLE 1

Newcastle Utah U.S. GEOLOGICAL SURVEY A.M.T. DATA LOG

ρa = observed apparent resistivity in ohm-metres
N = number of observations
Er = standard error in ohm metres — = no data

"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
1N-S	ρa	9.8	18.3	17.6	27.9	35.4	44.6	—	—	—	26.9	19.9	—
	N	4	4	8	7	9	5				4	1	
	Er	2.3	4.6	1.6	3.9	1.2	3.4				2.4	—	
1E-W	ρa	23.6	47.0	27.4	32.4	25.7	24.9	—	—	—	9.7	16.6	—
	N	7	9.	9	6	5	4				6	1	
	Er	3.5	6.2	1.7	4.1	1.5	3.2				0.8	—	
2N-S	ρa	20.9	31.4	33.4	25.0	23.1	26.0	—	—	—	13.8	30.7	1.1
	N	8	5.	8	8	8	5				6	1	1
	Er	3.6	4.1	4.3	2.2	2.1	1.7				0.5	—	—
2E-W	ρa	40.8	36.5	36.2	36.3	36.3	18.7	—	—	—	15.1	12.0	1.5
	N	8	3	8	6	6	4				3	1	1
	Er	4.1	4.9	1.7	2.6	4.3	2.3				2.4	—	—
3N-S	ρa	7.7	14.7	11.1	15.8	32.2	—	—	—	—	45.5	—	—
	N	6	3	8	9	7					5		
	Er	2.3	6.5	1.1	2.3	3.9					2.6		
3E-W	ρa	5.3	7.7	7.2	9.0	12.4	—	—	—	—	24.3	—	—
	N	11.	4	5	9	3					6		
	Er	0.6	1.4	1.1	0.6	0.5					2.5		
4N-S	ρa	2.9	6.5	5.1	5.6	8.4	—	—	—	—	18.3	11.1	—
	N	2	3	5	8	6					7	1	
	Er	0.7	0.5	0.5	0.1	0.5					1.1	—	
4E-W	ρa	4.4	4.7	4.5	4.7	9.7	—	—	—	—	2.1	3.0	—
	N	6	4	5	9	8					7	1	
	Er	0.6	1.2	0.4	0.3	0.3					0.1	—	

Newcastle Utah **U.S. GEOLOGICAL SURVEY A.M.T. DATA LOG**

ρa = observed apparent resistivity in ohm-metres
N = number of observations
Er = standard error in ohm metres — = no data

"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
5 N-S	ρa	3.8	4.3	4.5	6.2	5.0	10.7	—	—	—	11.2	25.8	0.7
	N	7	5	6	7	4.	5				7	1	1
	Er	0.6	0.7	0.6	0.6	0.3	1.8				0.4		
5 E-W	ρa	5.8	5.4	6.1	8.5	11.6	15.3	—	—	—	9.2	21.1	1.1
	N	7	7	6	6	7	4				7	1	1
	Er	0.6	0.6	0.5	1.0	0.9	0.9				1.6		
6 N-S	ρa	14.2	11.4	17.7	11.5	20.5	—	—	—	—	31.2	43.9	9.1
	N	7	5	5	7	8					5	1	1
	Er	2.0	1.9	2.8	1.9	1.3					3.2		
6 E-W	ρa	18.1	17.6	17.5	21.8	21.0	—	—	—	—	26.4	67.4	21.9
	N	9	7	8	9	11					7	1	1
	Er	1.3	1.4	2.0	2.1	2.1					1.3		
7 N-S	ρa	13.0	15.0	21.7	27.3	57.0	—	—	—	—	70.7	103	9.6
	N	6	2	9	9	7					9	1	1
	Er	1.9	6.7	1.6	2.1	6.1					2.7		
7 E-W	ρa	15.1	36.2	21.3	33.2	31.9	—	—	—	—	41.5	92.6	2.0
	N	8	2	7	10	6					8	1	1
	Er	1.7	7.5	2.0	2.3	2.9					4.8		
	ρa												
	N												
	Er												
	ρa												
	N												
	Er												