

UNITED STATES DEPARTMENT OF THE INTERIOR

GEOLOGICAL SURVEY

Audio-magnetotelluric and telluric data release  
for the Ten-Lakes Wilderness study area, Montana

by

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Open-File Report 83- 622

This report is preliminary and has not been reviewed for conformity with U.S.  
Geological Survey editorial standards and stratigraphic nomenclature.

1983

## INTRODUCTION

The purpose of this report is to release audio-magnetotelluric (AMT) and telluric traverse (TT) data for the Ten-Lakes Wilderness Study area, Montana. Interpretation of the data will be presented in formal reports to be released later as part of the Geological Surveys Wilderness Studies Program.

## LOCATIONS

The Ten-Lakes Wilderness Study area is located in the northwestern part of Montana east of the town of Eureka (fig. 1) with a northern boundary on the Canadian border. Forty-one AMT stations were established within the adjacent to the study area. The location of each sounding is shown in figure 1.

Two telluric traverses made were on the western border of the study area (fig. 1) oriented in a northeast-southwest direction. Traverse 1 passes AMT station 29, (fig. 1) with details of dipole locations shown in figure 2. Traverse 2 passes by AMT stations 23, 24, and 20, (fig. 1) with details of dipole locations shown in figure 3.

## DATA

The AMT data were obtained using equipment designed and built by the U.S. Geological Survey. Details of the equipment and the method may be found in Hoover and Long (1976), Hoover and others (1978) and Strangway and others (1973). Sounding data are given in appendix 1. At each site two scalar soundings are obtained, one for a north-south orientation of the telluric dipole, (Pns) and the other for an east-west orientation (Pew). 25 meter dipoles were used in the survey.

The telluric traverse data were obtained using equipment designed and built by the U.S. Geological Survey. Details of the equipment have not been published. The telluric traverse method has been described by Beyer (1977) and by Combs and Wilt (1975). Data for traverse 1 are shown in figure 4 and for traverse 2 in figure 5. Each figure shows the relative variation of the telluric voltage (the earth's natural electric potential) observed on each dipole referenced to the first dipole and topography along the profile. Low values of relative telluric voltage indicate areas of lower resistivity (Beyer 1977). In this survey four frequencies, 4.5, 7.5, 16.7, and 25Hz, were used.

## References

- Beyer, J. H., 1977, Telluric and D. C., resistivity techniques applied to the geophysical investigation of Basin and Range geothermal systems: Univ. of Calif. Lawrence Berkeley Lab. report LB2-6325.
- Bostick, F. X., Jr., 1977, A simple almost exact method of MT analysis: in. proc. Workshop on Electrical Methods in Geothermal Explorations, Univ. of Utah Contract 14-08-0001-G-359.
- Combs, Jim, and Wilt, Michael, 1975, Telluric mapping, telluric profiling and self-potential surveys of the Dunes geothermal anomaly, Imperial Valley, California: 2nd United Nations Symposium on Development and Use of Geothermal Resources Proceedings, p. 917-928.
- Hoover, D. B., and Long, C. L., 1976, Audio-magnetotelluric methods in reconnaissance geothermal explorations: Proc. 2nd W. N. Sympos. Devel. Geothermal Resources p. 1059-1064.
- Hoover, D. B., Long, C. L., and Senterfit, R. M., 1978, Some results from audio-magnetotelluric investigations in geothermal areas: Geophysics v. 43, p. 1501-1514.
- Strangway, D. W., Swift, C. M., and Kalmer, R. C., 1973, The application of audio-frequency magnetotelluric (AMT) to mineral exploration: Geophysics v. 38, o. 1159-1175.

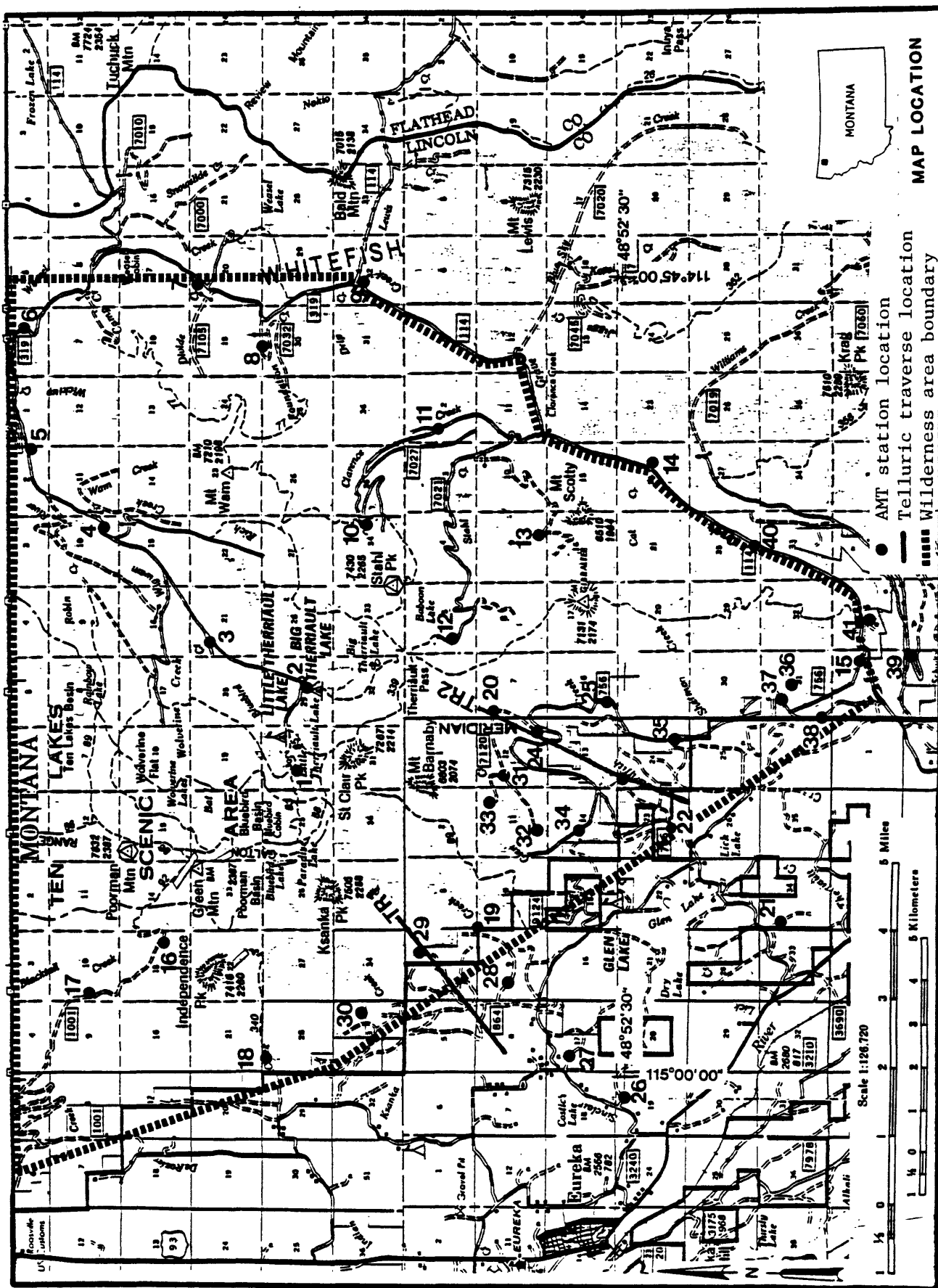


Figure 1. Map showing locations of AMT sounding sites and telluric traverses in the Ten-Lakes Wilderness Study area, Montana.

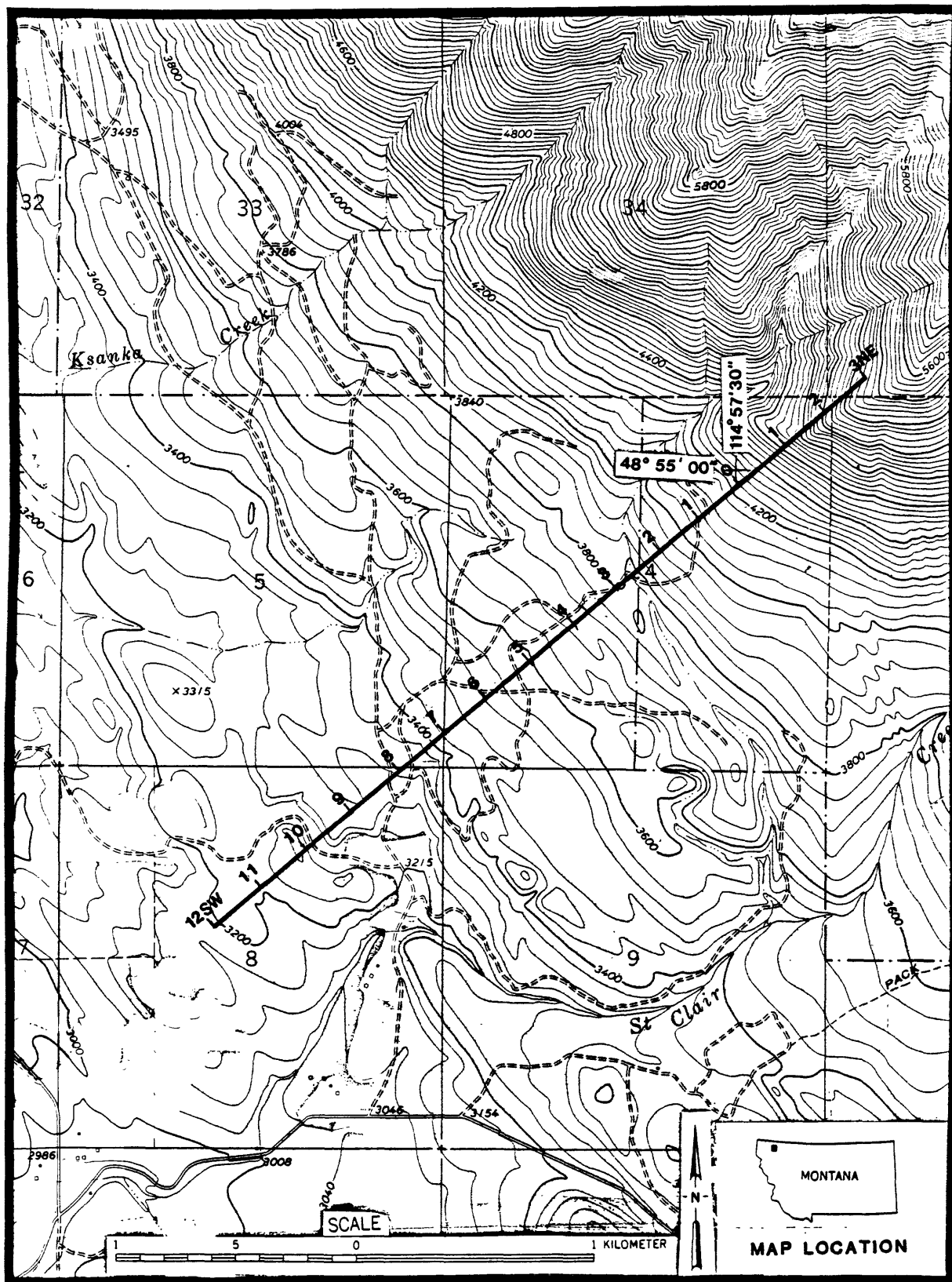


Figure 2. Map showing detailed location of TT No. 1 in the Ten-Lakes Wilderness Study area, Montana. Map base from the USGS Ksanka Peak 7 1/2 minute quadrangle.

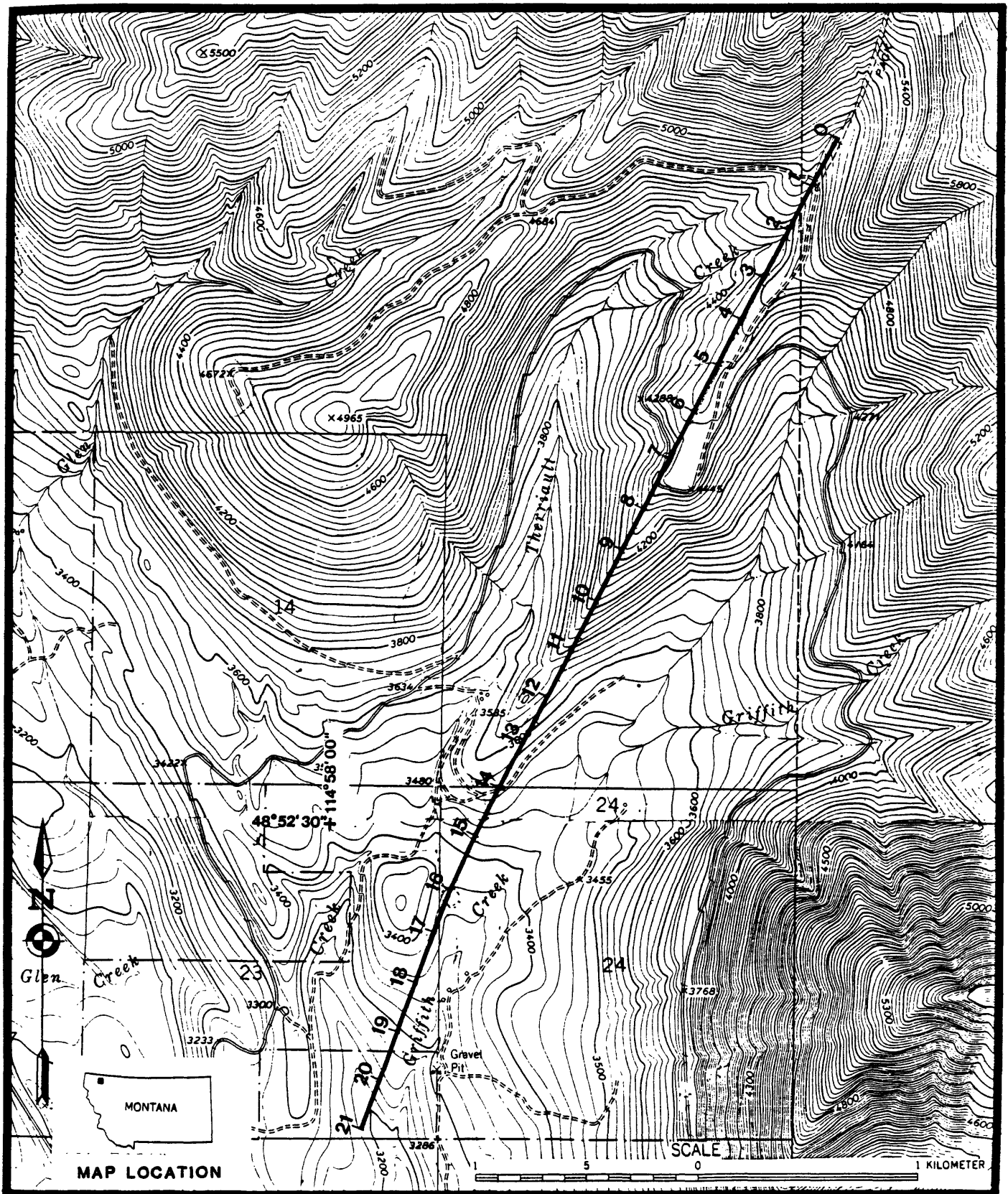


Figure 3. Map showing location of TT No. 2 in the Ten-Lakes Wilderness Study area, Montana. Map base from the USGS Ksanka Peak and Fortime 7 1/2 minute quadrangle.

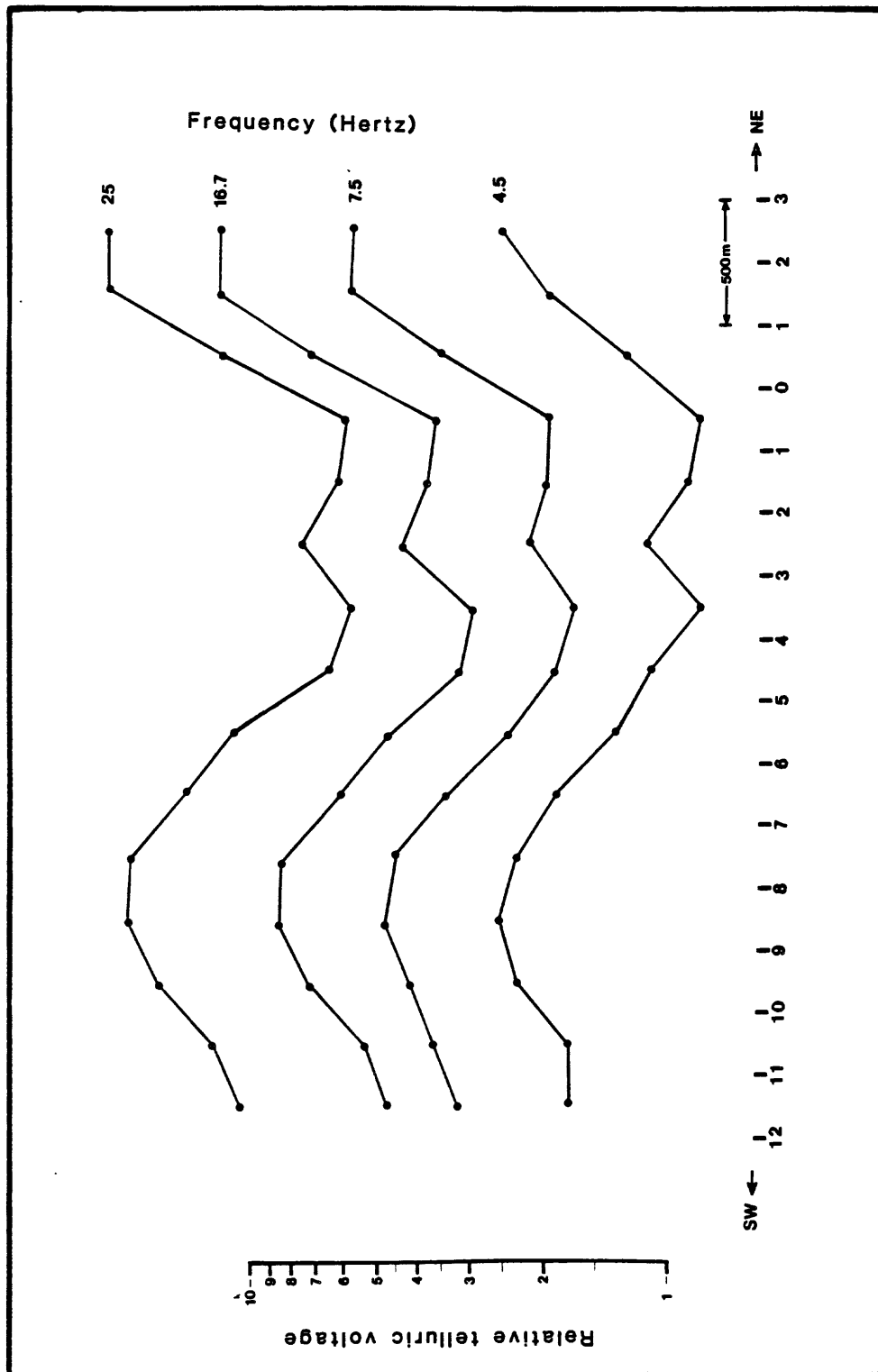


Figure 4. Telluric data for traverse No. 1 Ten-Lakes Wilderness Study area, Montana.



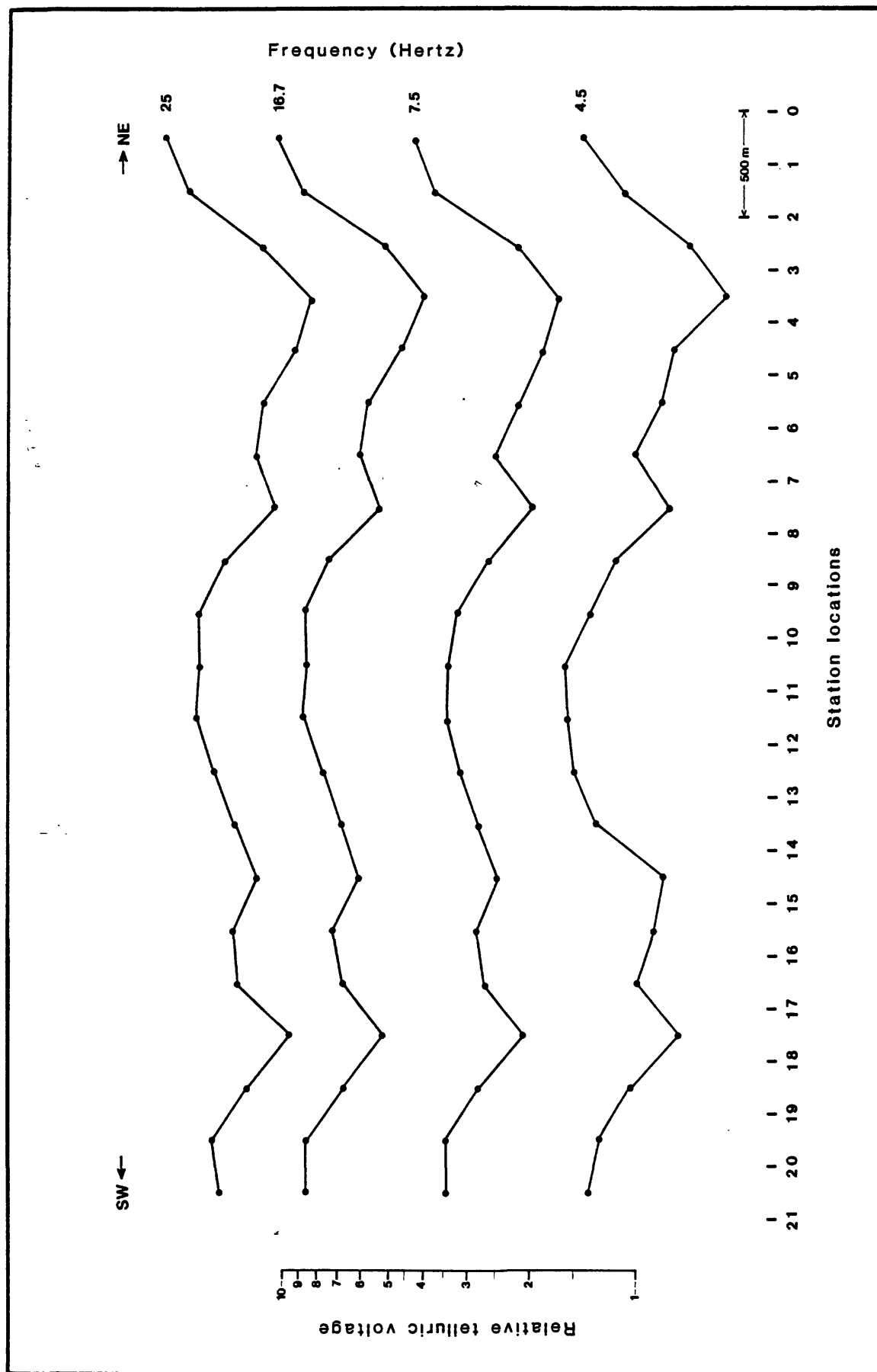


Figure 5. Telluric Data for Traverse No. 2 Ten-Lakes Wilderness Study area, Montana.

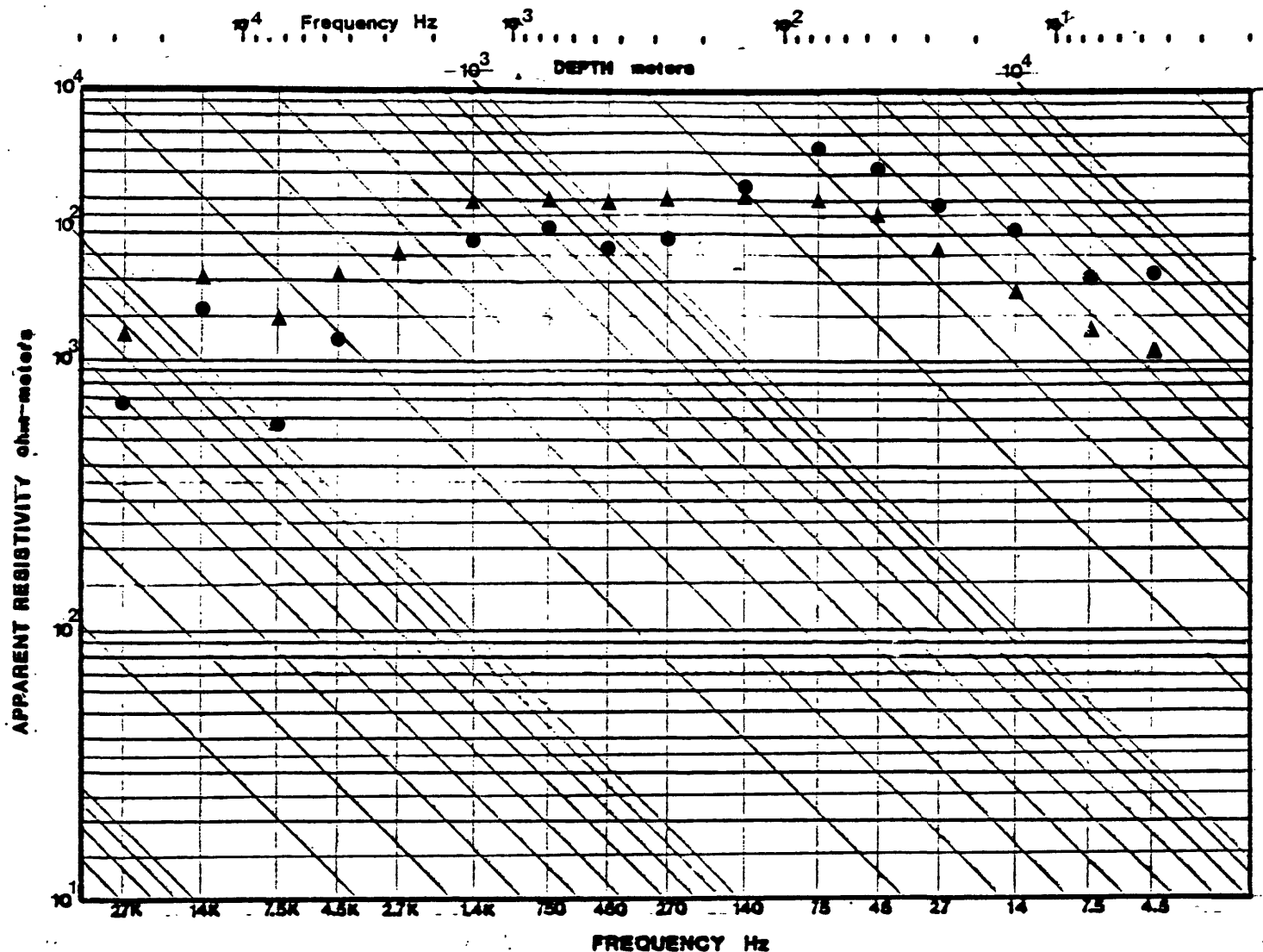
## Appendix 1

Audio-magnetotelluric sounding curves and data for the Ten-Lakes, Montana Wilderness Study area. Each figure shows a graph of both scalar AMT soundings obtained for the indicated station. Diagonal lines on the graph indicate the approximate depth of exploration for any resistivity frequency point. The lines are based on a relationship given by Bostick (1977). Below each graph the data are tabulated. Table heading nomenclature is given below.

Freq $H_z$	Frequency (Hertz)
Pa	Apparent resistivity (ohm-meters)
Na	Number of observations
Error	Standard error (ohm-meters)

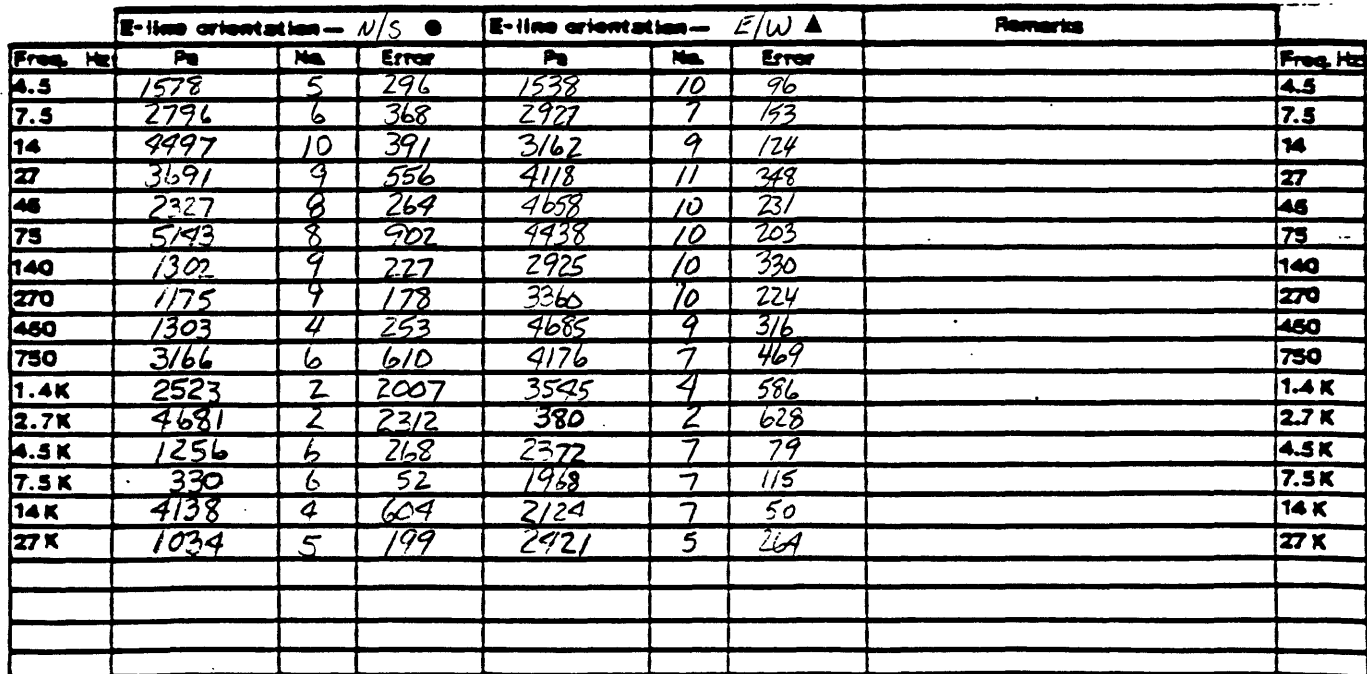
# USGS Scler AMT Data Log

Location 10 Lakes, MT Station 1 Date 8/25/81 Operators DBH, KC



E-line orientation — N/S ●				E-line orientation — E/W ▲				Remarks	Freq. Hz
Freq. Hz	Pa	Ma	Error	Pa	Ma	Error			
4.5	2221	6	624	1133	5	254			4.5
7.5	2114	9	271	1317	9	56			7.5
14	3028	13	137	1790	11	60			14
27	3926	10	255	2612	7	194			27
45	5314	11	220	3494	11	197			45
75	6210	11	157	3926	9	140			75
140	4521	10	126	4032	14	187			140
270	2822	9	140	3895	13	170			270
450	2709	10	237	3904	10	267			450
750	3144	4	328	3963	8	198			750
1.4K	2012	3	414	3990	3	99			1.4 K
2.7K	—	—	—	2541	3	69			2.7 K
4.5K	1246	8	117	2061	8	110			4.5 K
7.5K	569	6	25	1415	9	97			7.5 K
14K	1595	5	164	2002	4	46			14 K
27K	675	6	20	1275	5	130			27 K

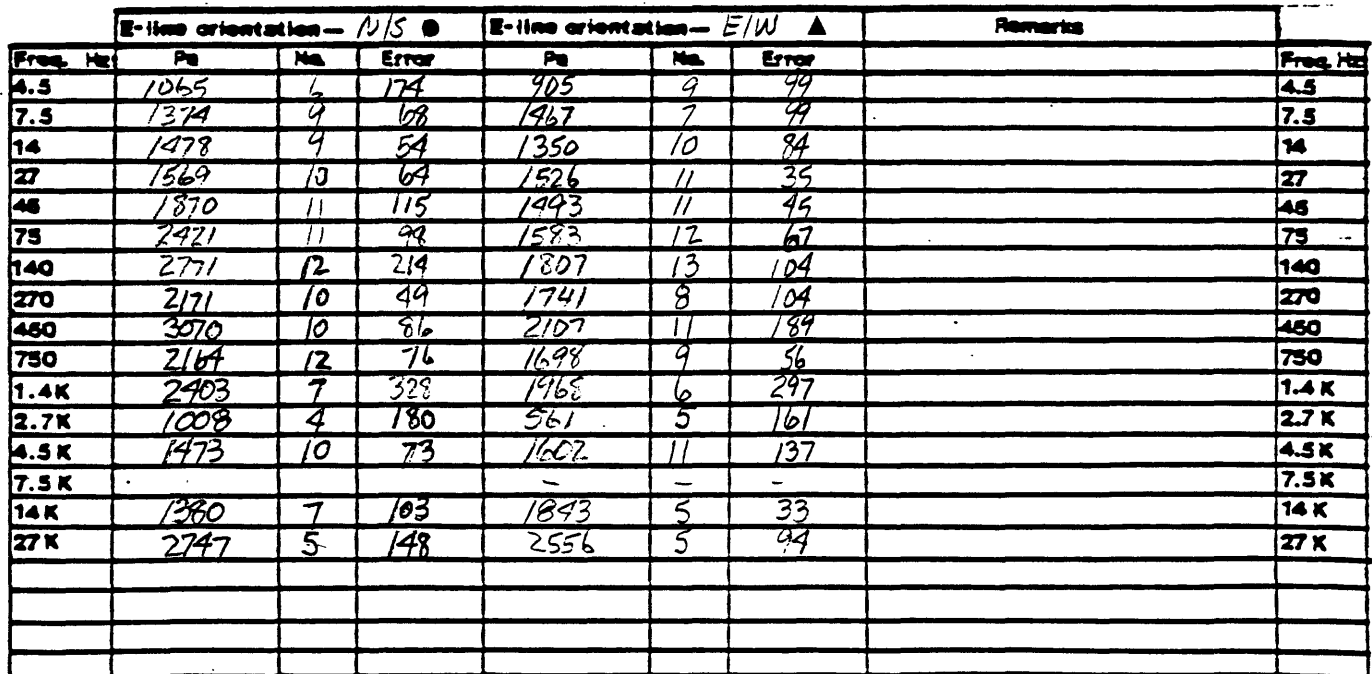
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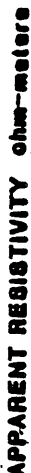
Location 10 Lakes MT Station 3 Date 8/25/81 Operators DBH, KC

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Location 10 Lakes, MT Station 4 Date 8/25/81 Operators DRH KC

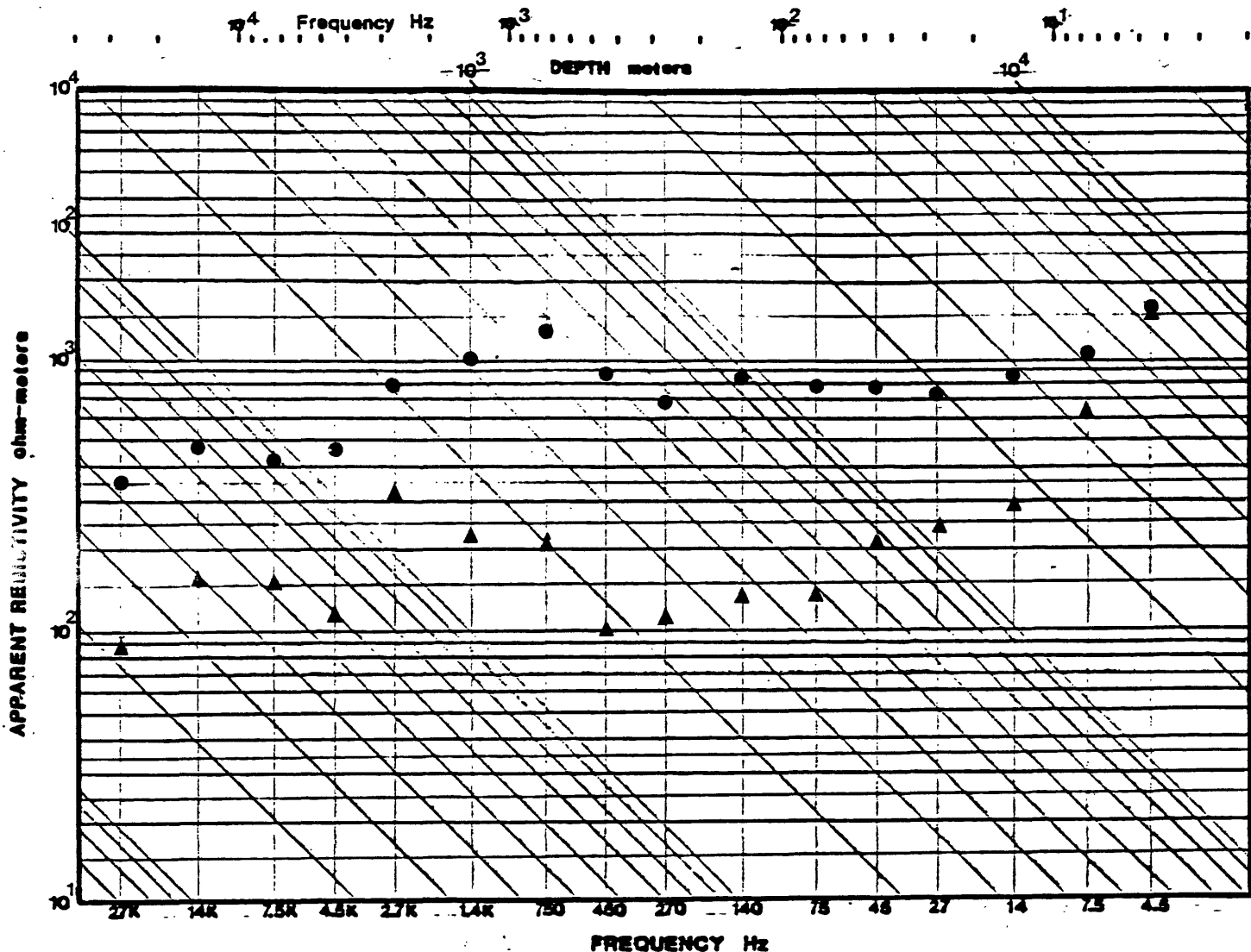


Location 10 Lakes, MT Station 5 Date 8-7-81 Operators DBH, DMEN

14

# USGS Scler AMT Data Log

Location 10 Lake MT Station 6 Date 8-27-81 Operators DBH, DMN

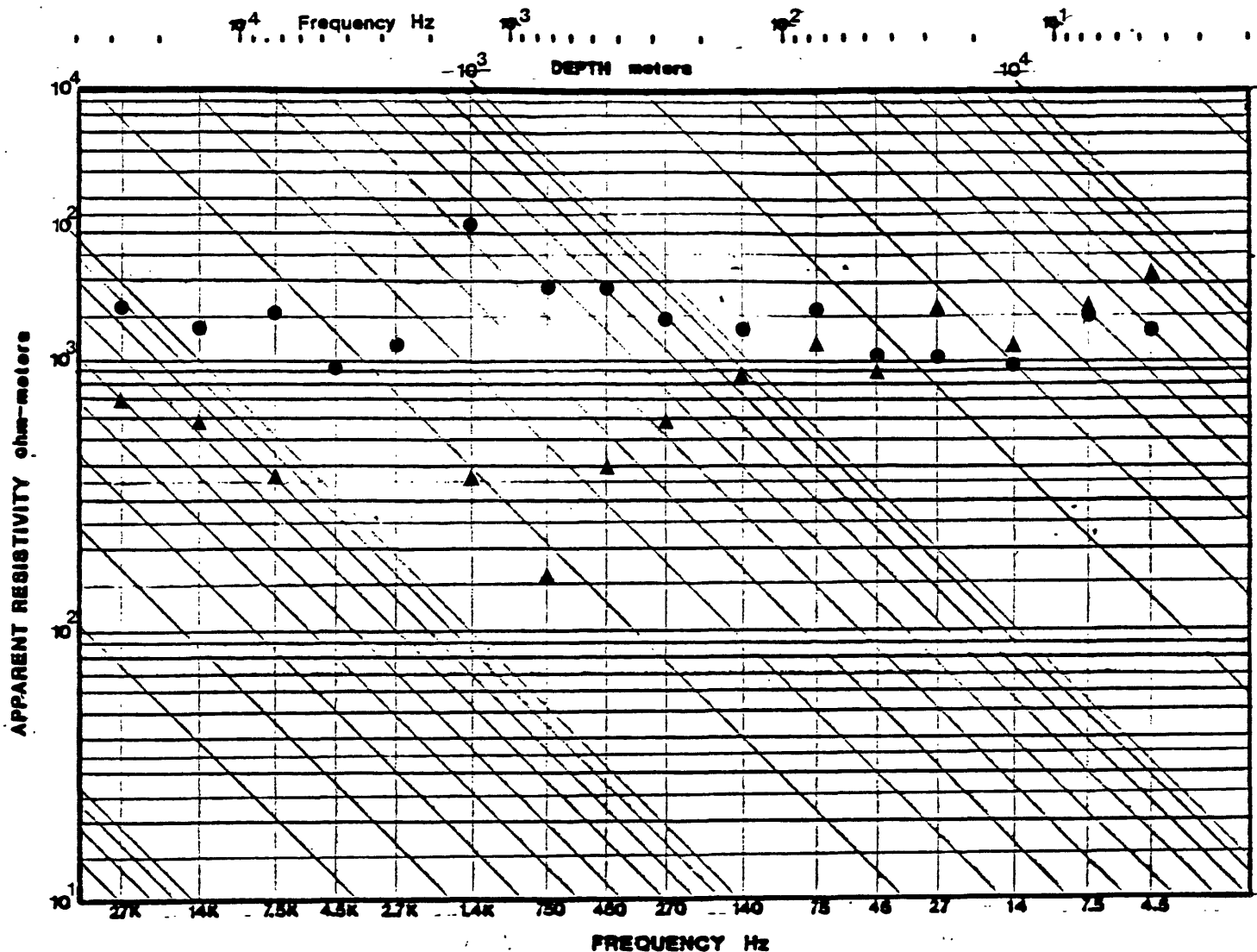


E-line orientation — N/S ●				E-line orientation — E/W ▲				Remarks	Freq. Hz
Freq. Hz	P <sub>a</sub>	M <sub>a</sub>	Error	P <sub>a</sub>	M <sub>a</sub>	Error			
4.5	1683	7	163	1601	7	537			4.5
7.5	1080	5	45	613	11	54			7.5
14	854	9	33	286	9	34			14
27	722	9	19	234	9	16			27
46	714	9	60	222	8	19			46
75	755	10	31	141	11	19			75
140	815	11	45	141	10	7.7			140
270	691	10	28	121	10	11			270
450	894	11	59	94	9	12			450
750	1288	11	52	212	7	31			750
1.4K	997	9	113	230	8	35			1.4 K
2.7K	764	8	34	331	10	23			2.7 K
4.5K	468	11	22	123	11	16			4.5 K
7.5K	408	11	29	158	10	13			7.5 K
14K	481	9	37	159	8	7.0			14 K
27K	398	10	11	85	9	17			27 K



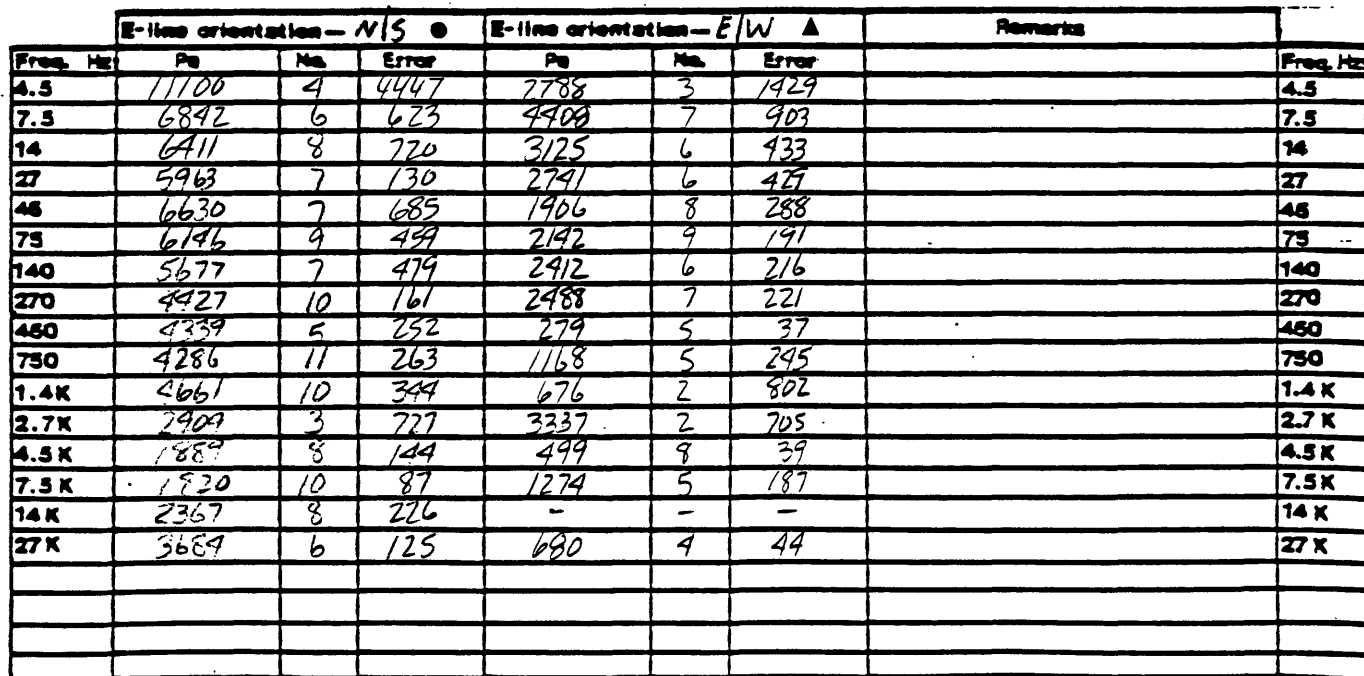
# USGS Scaled AMT Data Log

Location 10 Lakes, MT Station 7 Date 8-27-81 Operators DBH, DMN



E-line orientation — N/S ●				E-line orientation — E/W ▲				Remarks
Freq. Hz	P <sub>a</sub>	No.	Error	P <sub>a</sub>	No.	Error		Freq. Hz
4.5	1354	7	126	2217	9	1276		4.5
7.5	1503	4	130	1587	10	148		7.5
14	968	8	92	1218	4	160		14
27	1050	8	28	1585	7	184		27
45	1018	8	53	887	6	275		45
75	1561	6	239	1150	7	209		75
140	1327	9	106	853	6	105		140
270	1453	6	172	589	7	137		270
450	2454	7	181	380	5	197		450
750	1932	7	112	160	3	84		750
1.4K	3253	5	525	362	3	20		1.4 K
2.7K	1229	3	60	—	—	—		2.7 K
4.5K	907	4	104	—	—	—		4.5 K
7.5K	1510	4	132	362	7	33		7.5 K
14K	1448	3	110	589	3	57		14 K
27K	1680	3	77	690	3	114		27 K

Location 10 Lakes, MT Station 8 Date 8-27-81 Operators DBH, DMN

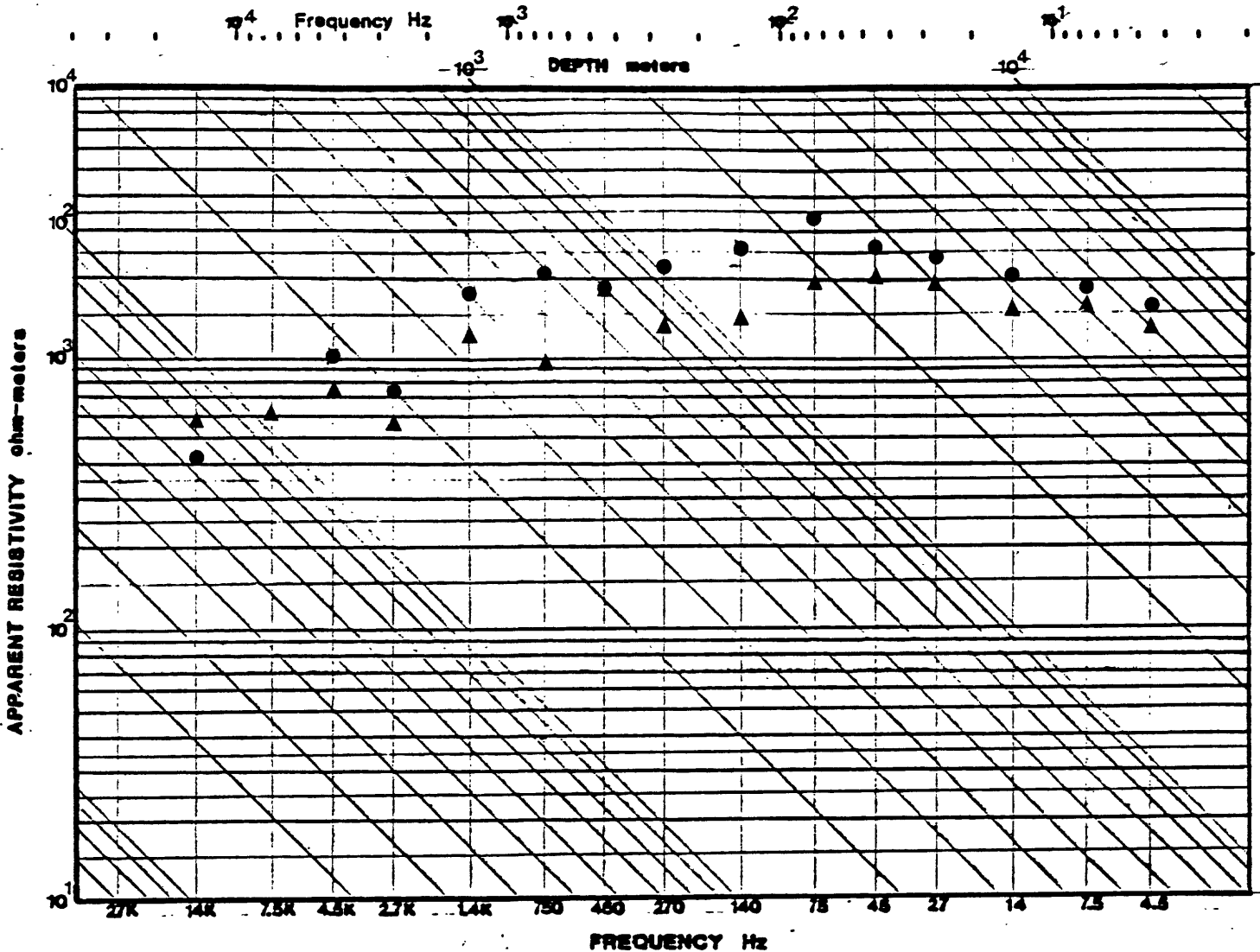


Location 10 lakes MT Station 9 Date 8-27-81 Operators DBH, JMN

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# USGS Sealer A&T Data Log

Location 10 lakes MT Station 10 Date 8-27-81 Operators DBH DMU



E-line orientation -- N/S ●				E-line orientation -- E/W ▲				Remarks
Freq. Hz	P <sub>a</sub>	No.	Error	P <sub>a</sub>	No.	Error		Freq. Hz
4.5	1604	11	239	1332	7	127		4.5
7.5	1959	11	118	1606	9	200		7.5
14	2050	10	128	1525	8	121		14
27	2453	11	124	1937	11	123		27
45	2646	11	244	2018	11	183		45
75	2933	11	137	1919	11	123		75
140	2233	11	210	1935	11	85		140
270	1734	11	56	1374	11	69		270
450	1843	11	45	1814	9	154		450
750	2111	13	219	931	10	64		750
1.4K	1810	11	134	1246	11	92		1.4 K
2.7K	744	10	128	575	11	72		2.7 K
4.5K	1006	10	50	752	10	31		4.5 K
7.5K	-	-	-	618	10	47		7.5 K
14K	423	10	14	590	10	28		14 K
27K	-	-	-	-	-	-		27 K

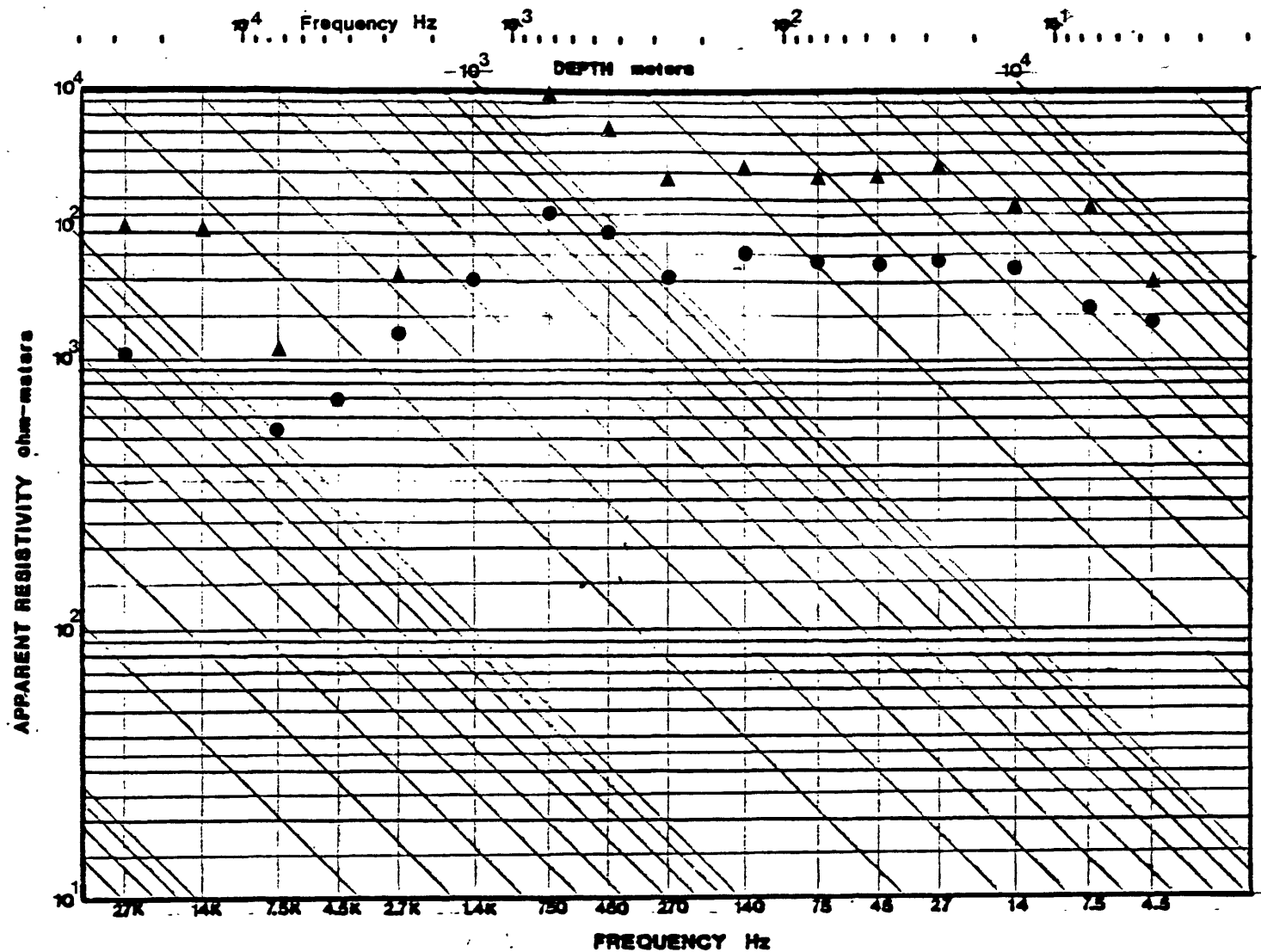
Location 10 Lakes MT Station 11 Date 8-28-81 Operators DBH, DMN



E-iline orientation — N/S ●				E-iline orientation — E/W ▲			Remarks
Freq. Hz	Pa	Ma	Error	Pa	Ma	Error	
4.5	994	5	95	2633	6	213	4.5
7.5	3430	5	547	3239	4	72	7.5
14	3730	8	301	3015	8	87	14
27	3832	9	297	3864	9	117	27
48	3220	8	181	3882	8	126	48
75	3876	5	153	3417	7	166	75
140	—	—	—	—	—	—	140
270	7278	9	146	2665	10	332	270
480	3194	6	225	1563	6	97	480
750	3848	5	452	928	4	15	750
1.4K	2764	3	368	486	4	60	1.4K
2.7K	—	—	—	—	—	—	2.7K
4.5K	353	6	60	176	8	31	4.5K
7.5K	882	8	135	631	11	68	7.5K
14K	824	6	114	1118	6	93	14K
27K	888	4	68	—	—	—	27K

# USGS Scaler AMT Data Log

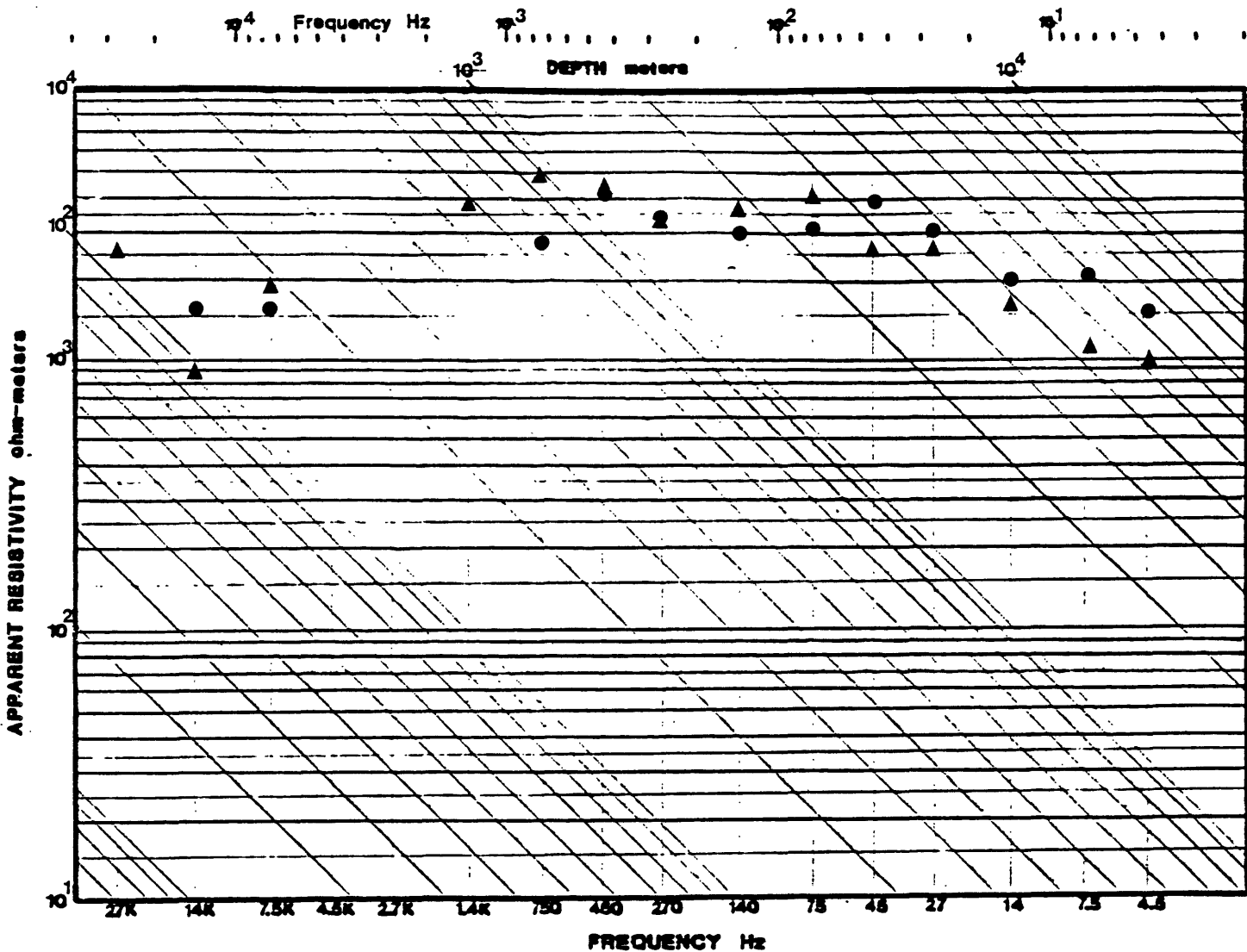
Location 10 Lakes MT Station 12 Date 8-28-81 Operators DB4 DM<sup>c</sup>N



E-line orientation - N/S ●				E-line orientation - E/W ▲			Remarks	Freq. Hz
Freq. Hz	Pa	Ma	Error	Pa	Ma	Error		
4.5	1415	7	278	1900	7	235		4.5
7.5	1672	7	134	3676	7	475		7.5
14	2271	11	150	3696	11	369		14
27	2392	11	121	5907	10	352		27
46	2296	10	337	4905	10	390		46
75	2370	7	195	4753	9	306		75
140	2550	11	312	5015	7	852		140
270	2111	10	293	4894	9	510		270
450	3018	9	182	7212	7	1125		450
750	3548	8	195	9919	8	590		750
1.4K	2042	6	223	-	-	-		1.4 K
2.7K	1291	4	131	2582	2	1286		2.7 K
4.5K	694	3	77	-	-	-		4.5 K
7.5K	532	2	23	1268	1	124		7.5 K
14K	-	-	-	3076	2	0		14 K
27K	1105	5	46	3166	2	.113		27 K

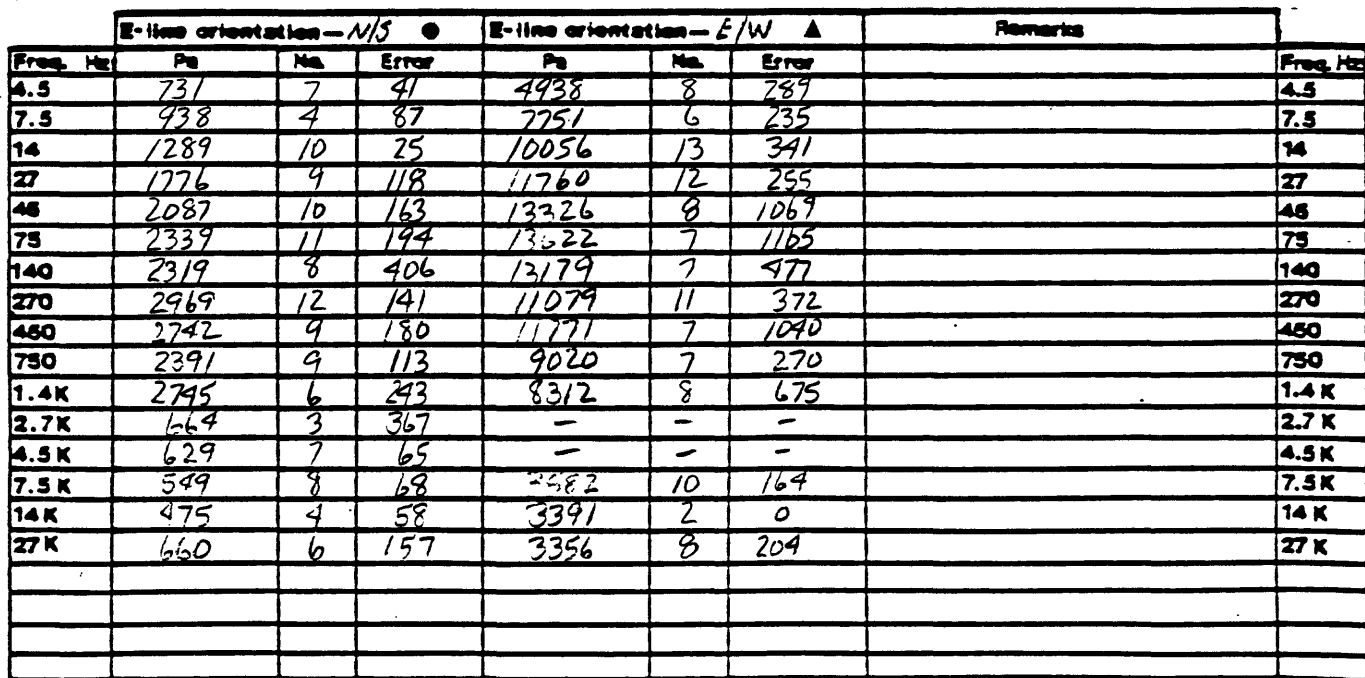
## USGS Scafer ALIT Data Log

Location 10 Lakes MT Station 13 Date 8-28-81 Operators DBH, DMEN



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4.5	1530	9	190	999	7	120	4.5
7.5	2121	9	129	1210	9	105	7.5
14	2091	9	73	1713	9	83	14
27	3019	9	182	2619	9	122	27
48	3910	9	179	2699	10	188	48
75	3089	9	136	9128	10	280	75
140	3004	9	268	3672	8	146	140
270	3436	8	79	3380	9	95	270
480	4107	9	246	4499	9	206	480
750	3302	9	92	4768	8	260	750
1.4 K	—	—	—	3831	11	936	1.4 K
2.7 K	—	—	—	—	—	—	2.7 K
4.5 K	—	—	—	—	—	—	4.5 K
7.5 K	1636	9	93	1873	9	92	7.5 K
14 K	1628	4	192	883	5	112	14 K
27 K	—	—	—	2570	5	86	27 K

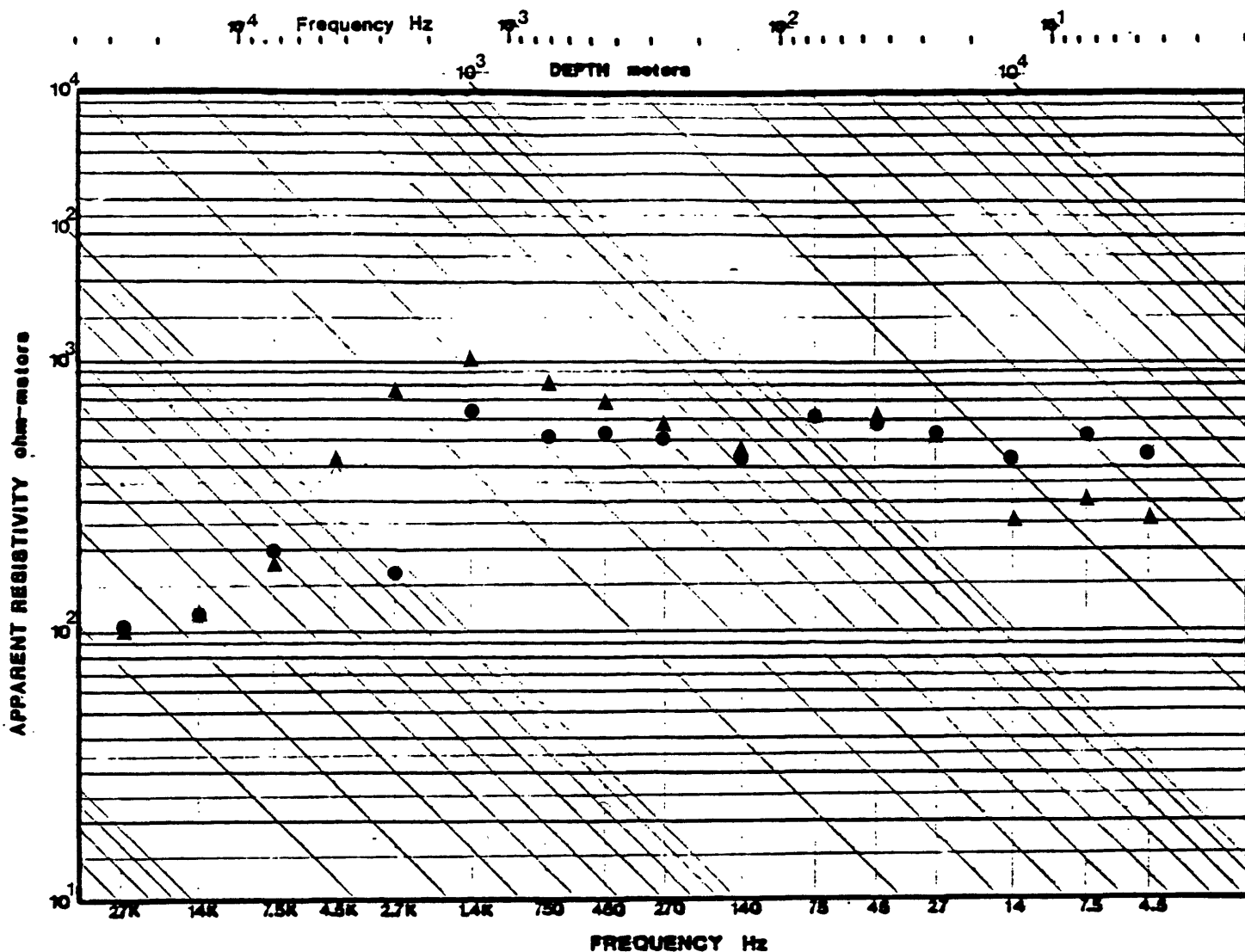
Location 10 Lakes MT Station 14 Date 8-28-81 Operators DBH, DM<sup>EN</sup>





# USGS Sealer ALT Data Log

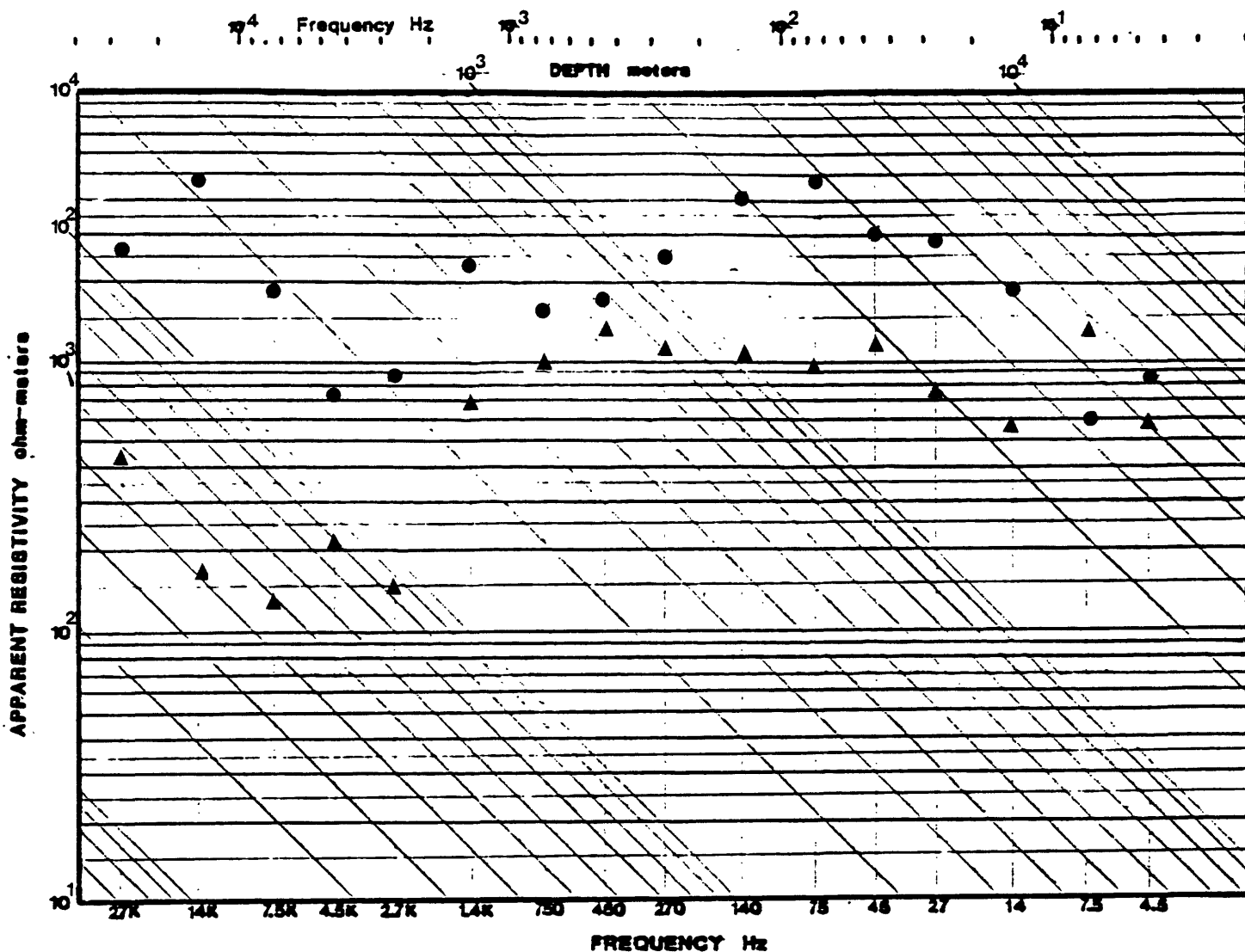
Location 10 Lakes MT Station 15 Date 9-29-82 Operators DBH, DMEN



E-line orientation — N/S ●				E-line orientation — E/W ▲				Remarks	Freq. Hz
Freq. Hz	Pa	No.	Error	Pa	No.	Error			
4.5	460	4	52	305	5	80			4.5
7.5	527	6	82	344	7	49			7.5
14	433	7	48	323	7	29			14
27	512	7	53	526	6	29			27
48	593	7	30	601	7	103			48
75	624	5	23	606	7	35			75
140	493	5	57	481	6	49			140
270	511	5	33	581	5	84			270
480	551	7	28	676	5	80			480
750	541	5	31	805	4	91			750
1.4K	640	5	37	1111	4	178			1.4 K
2.7K	172	3	43	755	4	107			2.7 K
4.5K	401	5	42	408	5	20			4.5 K
7.5K	200	5	8	166	6	10			7.5 K
14K	139	5	8	131	6	7			14 K
27K	111	5	7	100	5	14			27 K

# USGS Scalar ALT Data Log

Location 10 Lakes, MT Station 16 Date 8-29-82 Operators DBH, DMN



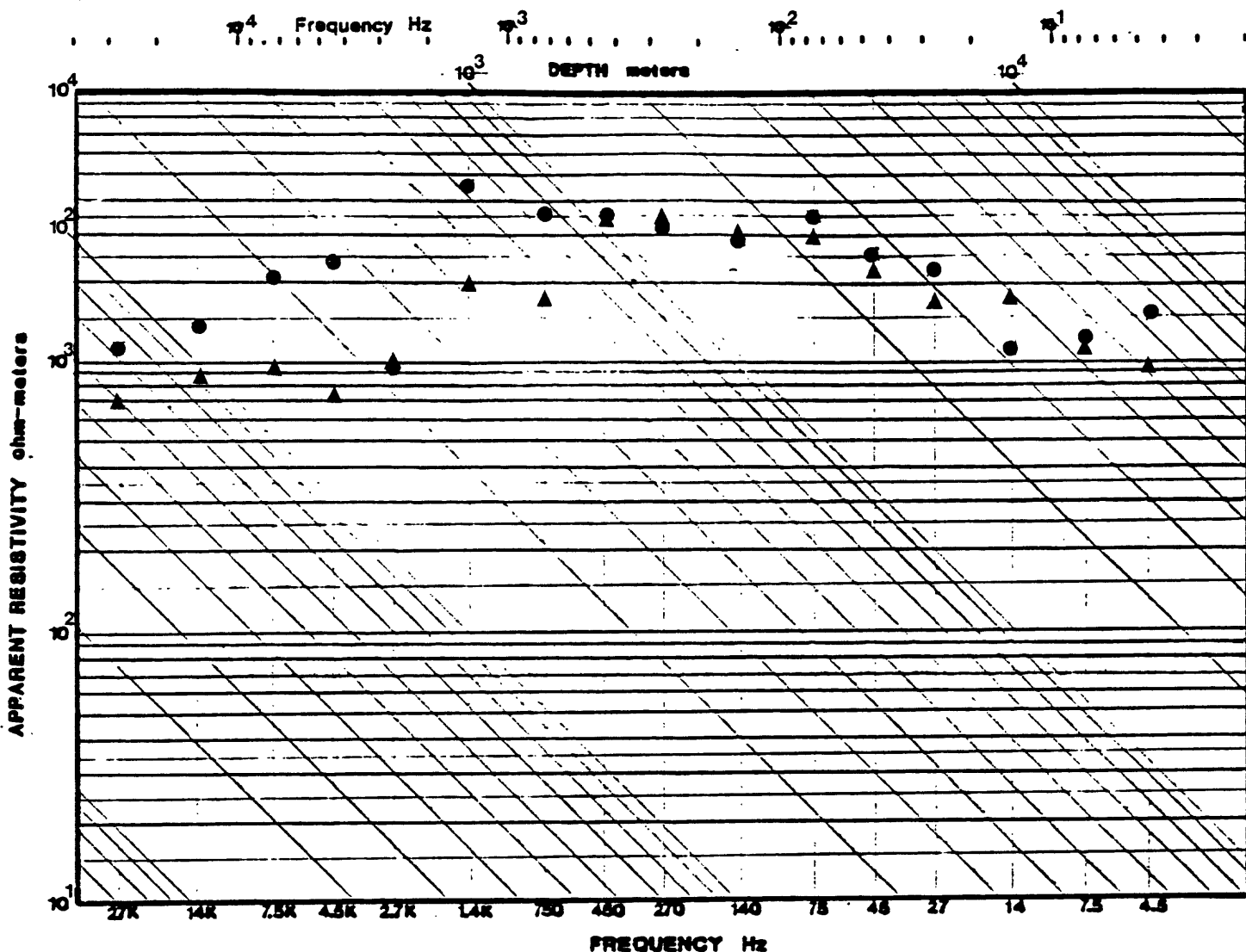
E-line orientation— N/S ●				E-line orientation— E/W ▲			Remarks	Freq. Hz
Freq. Hz	Pa	Ma	Error	Pa	Ma	Error		
4.5	855	1	185	589	3	155		4.5
7.5	609	8	59	1333	8	287		7.5
14	1956	8	326	569	10	62		14
27	2909	7	309	743	7	102		27
48	3015	10	242	1195	10	89		48
75	4938	10	250	932	11	87		75
140	4039	10	380	1026	10	129		140
270	2669	10	310	1167	10	96		270
480	1773	10	268	1346	10	103		480
750	1691	10	213	997	8	32		750
1.4K	1817	2	209	680	7	89		1.4 K
2.7K	874	2	272	148	3	61		2.7 K
4.5K	724	6	82	216	9	31		4.5 K
7.5K	1918	5	382	137	10	19		7.5 K
14K	4862	4	667	161	6	13		14 K
27K	2731	5	350	428	7	52		27 K

Location 10 Lakes, MT Station 17 Date 9-29-82 Operators DBH, DMEN

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# USGS Sealer ALT Data Log

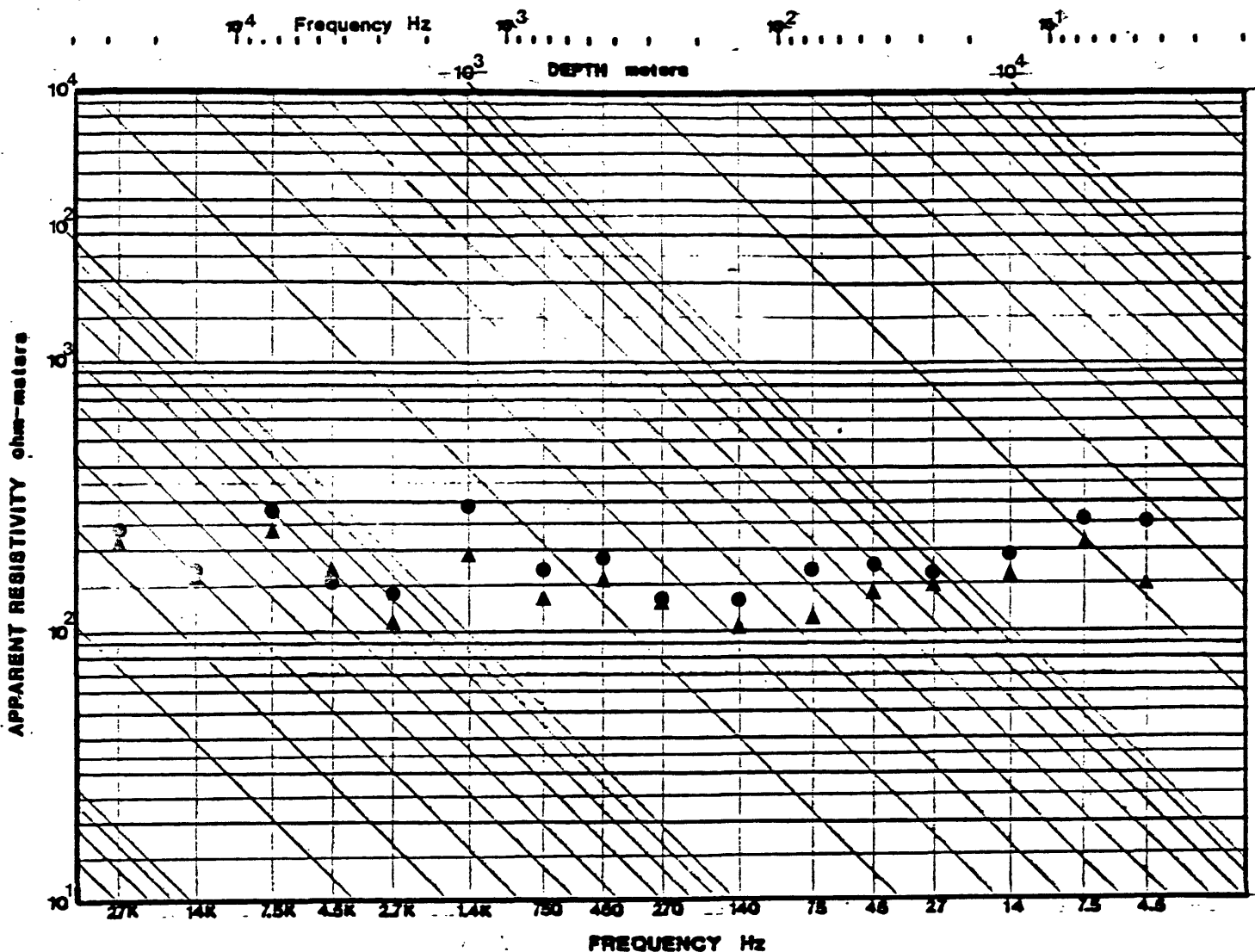
Location 10 Lakes, MT Station 18 Date 8-29-81 Operators DBH, DM<sup>c</sup>N



E-line orientation — N/S ●				E-line orientation — E/W ▲				Remarks
Freq. Hz	Pa	Ma	Error	Pa	Ma	Error		
4.5	1520	9	136	952	10	127		4.5
7.5	1286	8	102	1182	8	53		7.5
14	1726	7	112	1864	12	77		14
27	2227	10	141	1749	10	55		27
46	2671	7	178	2407	10	163		46
75	3430	7	280	2931	10	240		75
140	2923	10	189	3128	8	240		140
270	3141	8	275	3412	10	221		270
460	3609	7	220	3430	6	212		460
750	3635	9	346	1745	11	164		750
1.4K	4587	5	1056	1970	6	196		1.4 K
2.7K	903	2	35	468	6	116		2.7 K
4.5K	2303	9	50	713	4	57		4.5 K
7.5K	2146	9	181	924	4	12		7.5 K
14K	1441	5	90	858	3	38		14 K
27K	1227	8	77	647	6	32		27 K

# USGS Scaler AMT Data Log

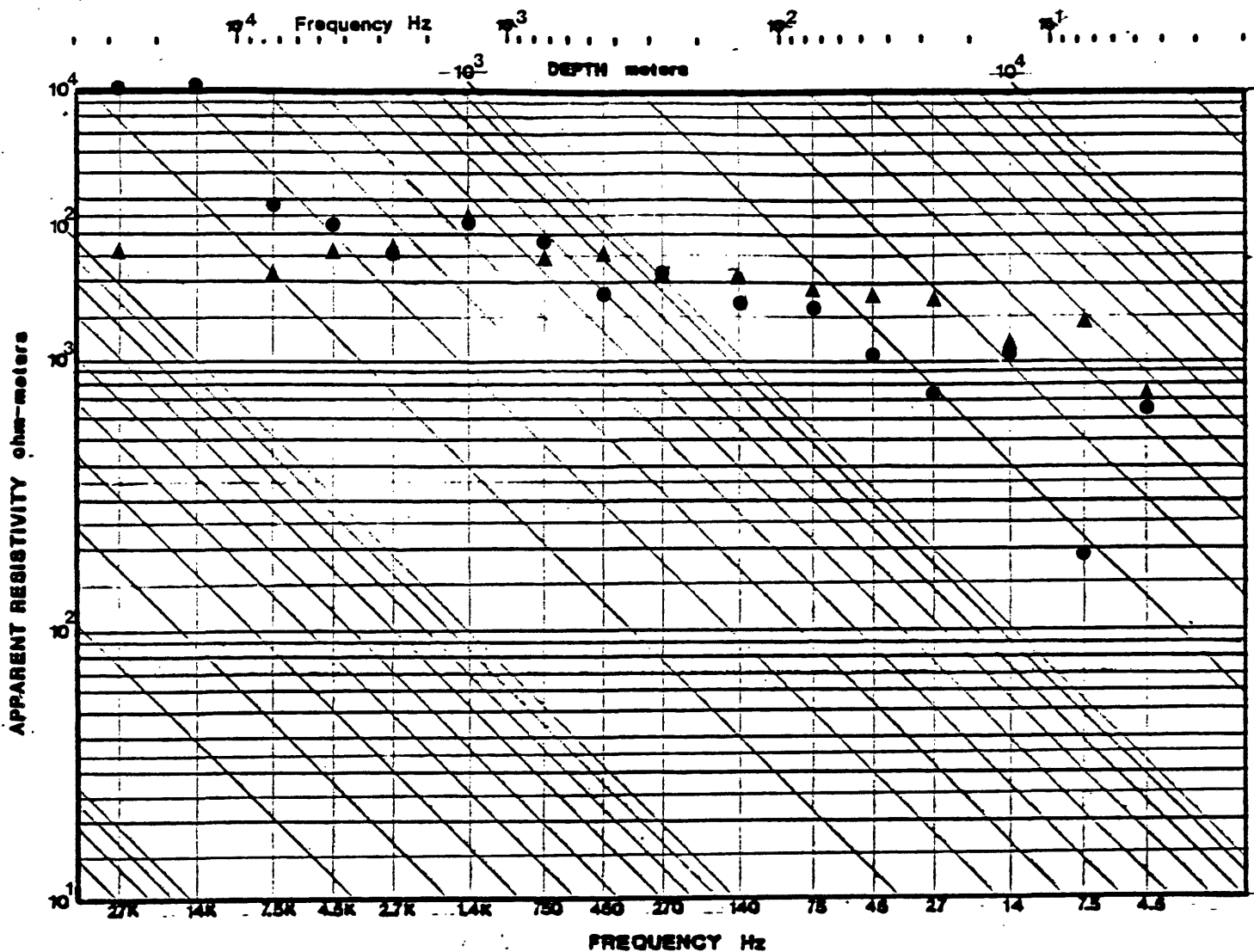
Location 10 Lakes, MT Station 19 Date 8-29-81 Operators DBH, DM<sup>c</sup>N



E-line orientation — N/S ●				E-line orientation — E/W ▲			Remarks	Freq. Hz
Freq. Hz	P <sub>a</sub>	M <sub>a</sub>	Error	P <sub>a</sub>	M <sub>a</sub>	Error		
4.5	251	8	23	147	10	12		4.5
7.5	258	10	16	217	10	6		7.5
14	192	11	7	169	11	9		14
27	166	8	8	147	9	5		27
46	179	10	4	139	12	6		46
75	173	13	6	117	16	5		75
140	135	13	5	108	13	5		140
270	140	15	3	137	16	4		270
460	189	11	7	154	11	5		460
750	171	10	5	137	6	2		750
1.4K	293	12	9	186	11	7		1.4K
2.7K	145	13	7	116	11	5		2.7K
4.5K	157	11	4	170	12	6		4.5K
7.5K	281	9	35	237	5	33		7.5K
14K	174	9	10	164	7	5		14K
27K	242	6	17	204	5	28		27K

# USGS Scaler AMT Data Log

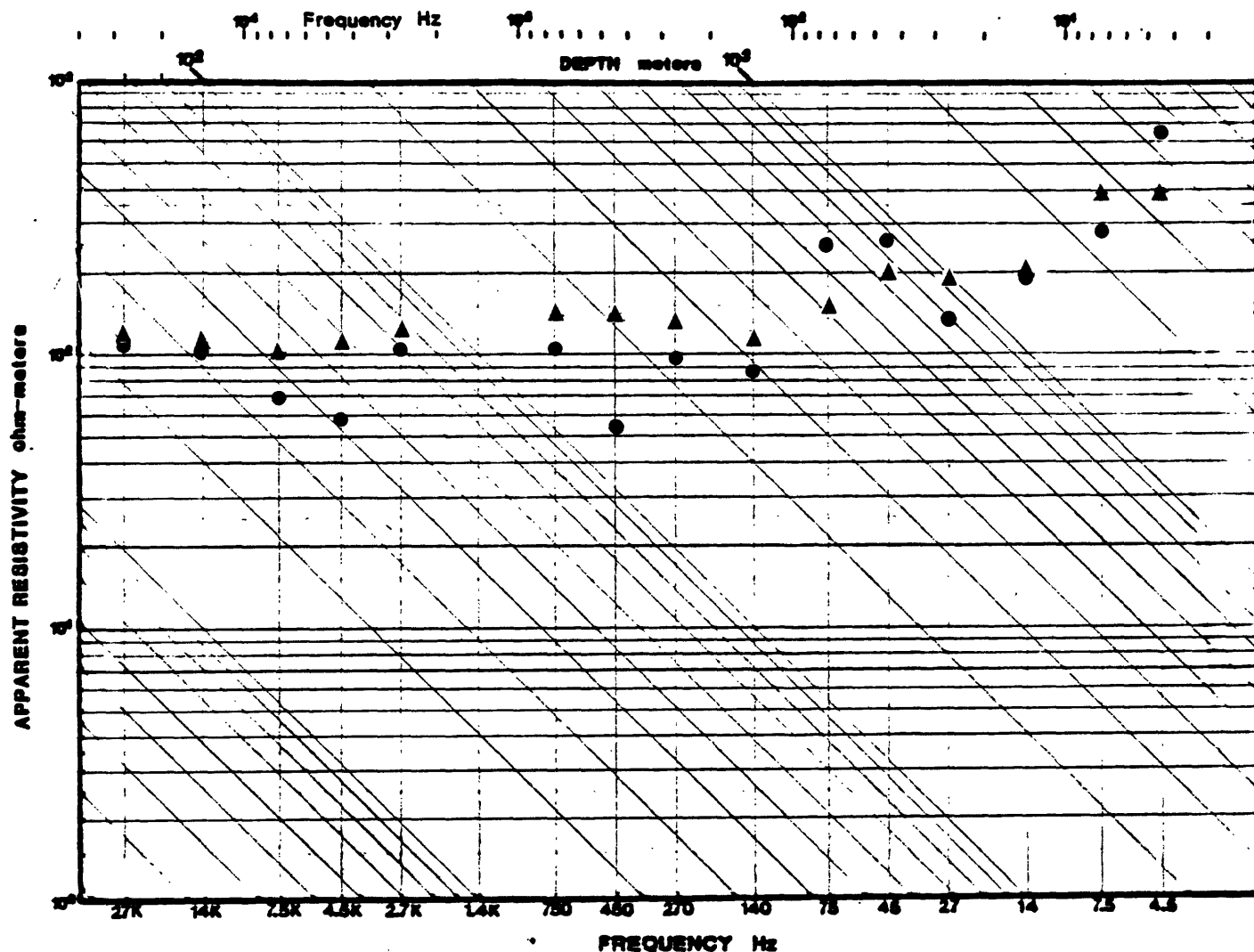
Location 10 Lakes, MT Station 20 Date 9-29-81 Operator DBH, DAIN



E-line orientation - N/S ●				E-line orientation - E/W ▲			Remarks	
Freq. Hz	P <sub>a</sub>	No.	Error	P <sub>a</sub>	No.	Error		Freq. Hz
4.5	634	5	49	707	5	116		4.5
7.5	793	9	14	1459	12	151		7.5
14	1062	7	128	1213	10	57		14
27	742	7	87	1733	11	86		27
46	1023	7	60	1839	9	52		46
75	1558	9	186	1847	11	97		75
140	1683	7	81	2164	11	161		140
270	2182	12	255	2086	11	81		270
460	1842	12	116	2516	10	122		460
750	2793	9	353	2345	11	42		750
1.4K	3197	9	365	3447	12	225		1.4K
2.7K	2559	11	169	2767	8	125		2.7K
4.5K	3258	12	176	2615	10	104		4.5K
7.5K	3855	9	234	2136	7	107		7.5K
14K	10445	7	1049	-	-	-		14K
27K	10592	3	2058	2587	6	87		27K

# USGS Scaled AIT Data Log

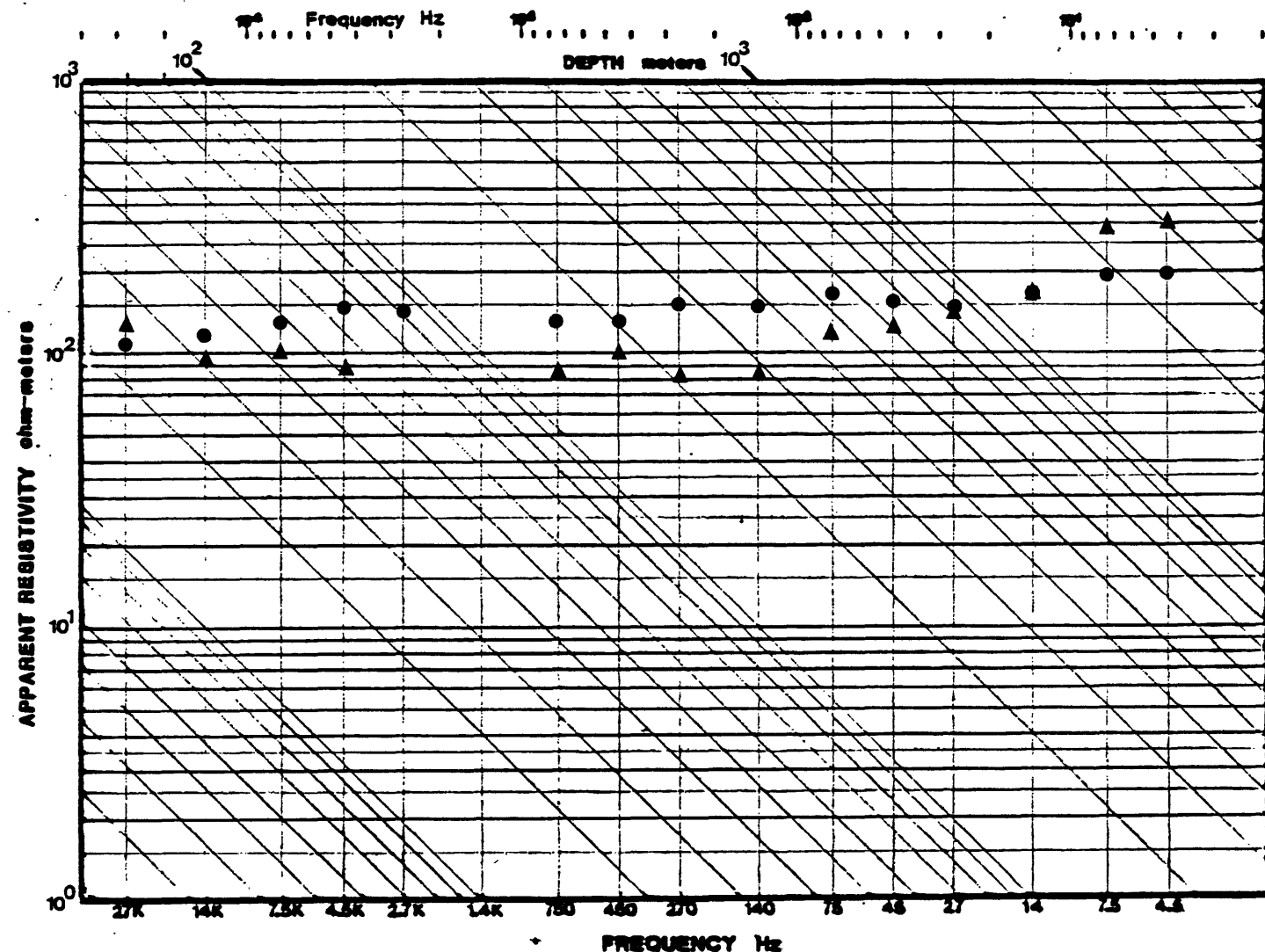
Location 10 Lakes MT Station Z1 Date 8-3-82 Operators DBH MP



E-W orientation - N/S ●				E-W orientation - E/W ▲				Remarks	Freq. Hz
Freq. Hz	Pg	Na	Error	Pg	Na	Error			
4.5	656	11	75.5	376	5	17.0			4.5
7.5	285	10	11.5	373	9	17.1			7.5
14	193	10	8.89	199	8	8.80			14
27	133	10	7.59	190	10	19.7			27
45	253	11	14.6	192	9	7.65			45
75	231	4	27.4	144	10	7.34			75
140	87.3	10	4.91	116	10	5.66			140
270	96.6	9	4.79	127	10	10.8			270
450	53.0	6	4.97	137	10	6.44			450
750	106	2	18.0	136	7	11.0			750
1.4K	—	—	—	—	—	—			1.4K
2.7K	107	6	8.01	127	7	4.33			2.7K
4.5K	58.5	9	3.87	110	10	6.19			4.5K
7.5K	69.2	10	6.25	102	10	6.84			7.5K
14K	107	5	7.12	111	5	2.03			14K
27K	109	3	1.32	112	1	0.00			27K

# USGS Scaler AMT Data Log

Location 10 Lakes, MT Station 22 Date 8-3-82 Operators DBH MB

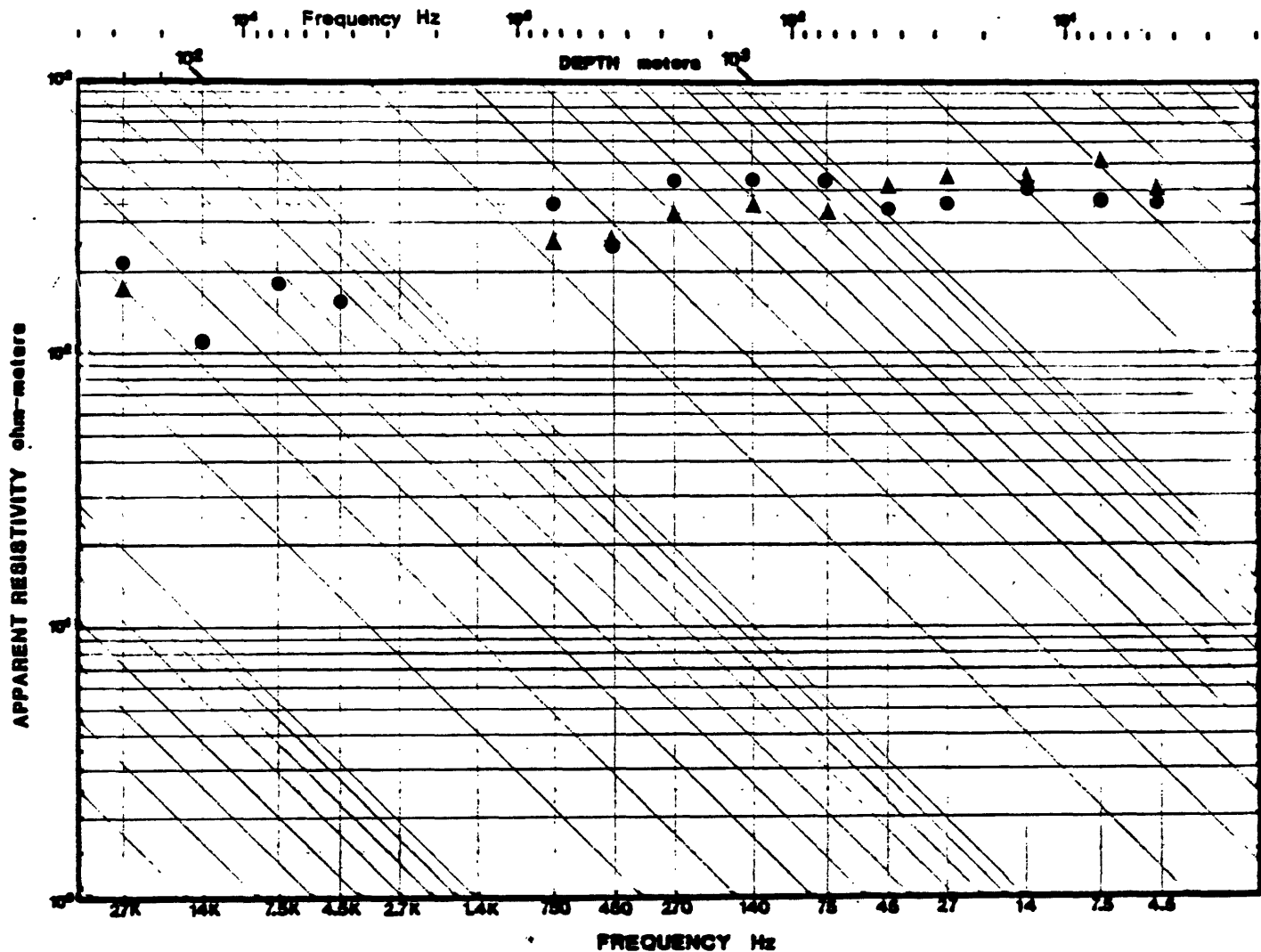


E-tide orientation — N/S ●				E-tide orientation — E/W ▲			Remarks
Freq. Hz	Pa	Ma	Error	Pa	Ma	Error	Freq. Hz
4.5	196	10	21.2	311	11	35.5	4.5
7.5	191	10	12.7	282	10	16.0	7.5
14	172	11	14.4	167	10	5.22	14
27	148	10	4.53	142	10	6.77	27
45	151	10	10.5	127	10	9.73	45
75	165	12	10.5	119	10	12.7	75
140	149	10	15.2	85.5	10	6.44	140
270	151	7	9.97	84.0	8	3.71	270
450	133	3	14.2	101	10	10.3	450
750	135	2	62.3	84.8	6	3.66	750
1.4K	—	—	—	—	—	—	1.4K
2.7K	145	2	11.5	—	—	—	2.7K
4.5K	140	3	25.2	87.5	8	5.41	4.5K
7.5K	133	8	5.94	105	9	6.38	7.5K
14K	121	5	7.96	96.0	5	8.21	14K
27K	113	5	9.06	130	3	3.34	27K



# USGS Sealer A&T Data Log

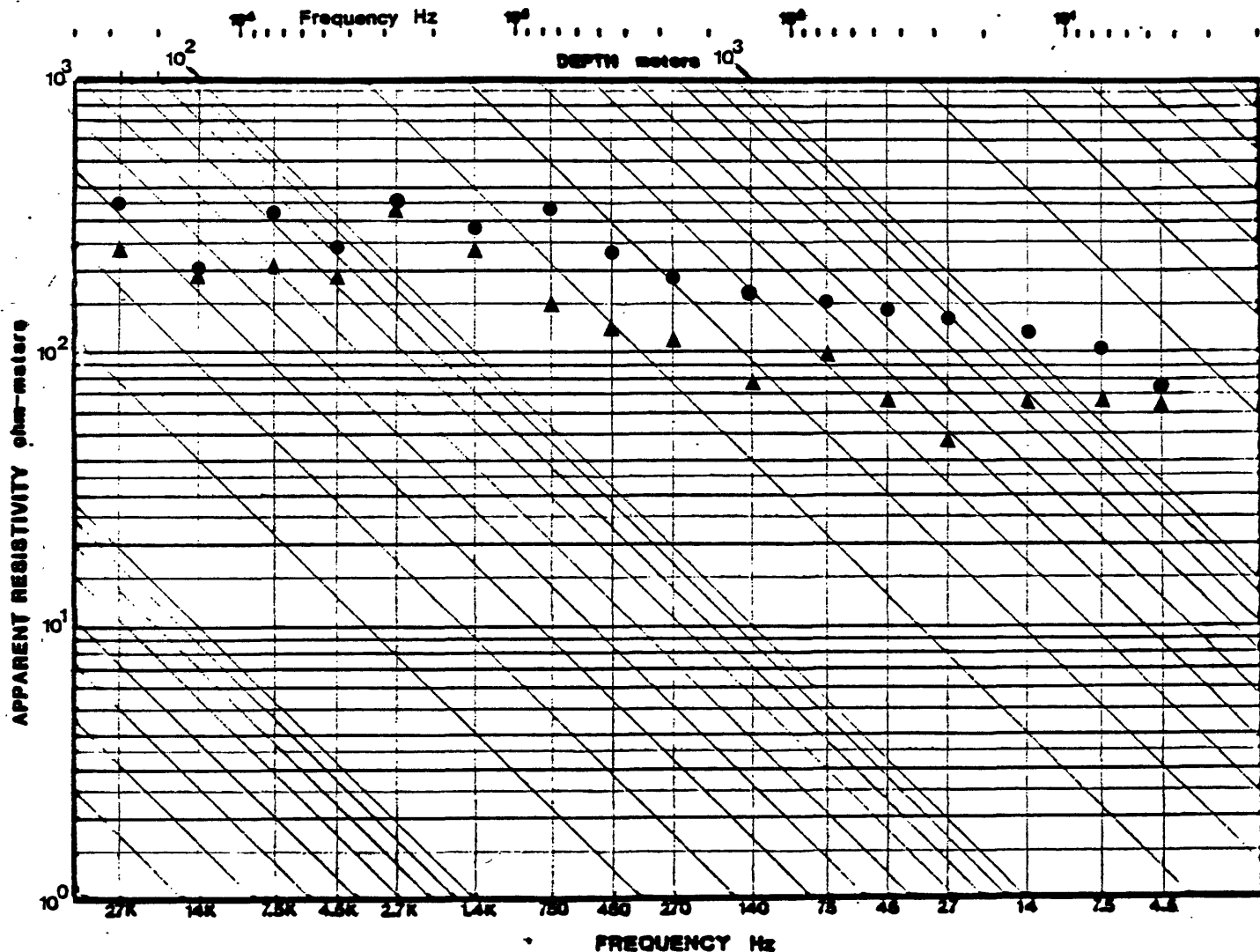
Location 10 Lakes MT Station 23 Date 8-3-82 Operators DBH, MB



E-line orientation — N/S ●				E-line orientation — E/W ▲			Remarks	Freq. Hz
Freq. Hz	P <sub>0</sub>	No.	Error	P <sub>0</sub>	No.	Error		
4.5	355	6	43.5	402	9	20.5		4.5
7.5	355	10	14.7	509	10	22.6		7.5
14	403	10	20.0	431	10	9.84		14
27	352	10	17.9	456	11	16.5		27
45	338	10	13.9	409	10	11.8		45
75	438	11	21.4	331	10	11.6		75
140	426	10	34.2	355	11	17.5		140
270	428	10	32.0	315	10	16.0		270
480	292	7	29.7	257	10	21.6		480
750	351	9	20.9	256	10	11.3		750
1.4K	—	—	—	—	—	—		1.4K
2.7K	—	—	—	—	—	—		2.7K
4.5K	151	6	4.17	—	—	—		4.5K
7.5K	186	10	6.23	—	—	—		7.5K
14K	116	5	14.5	—	—	—		14K
27K	217	5	11.0	175	2	3.51		27K

# USGS Scler AMT Data Log

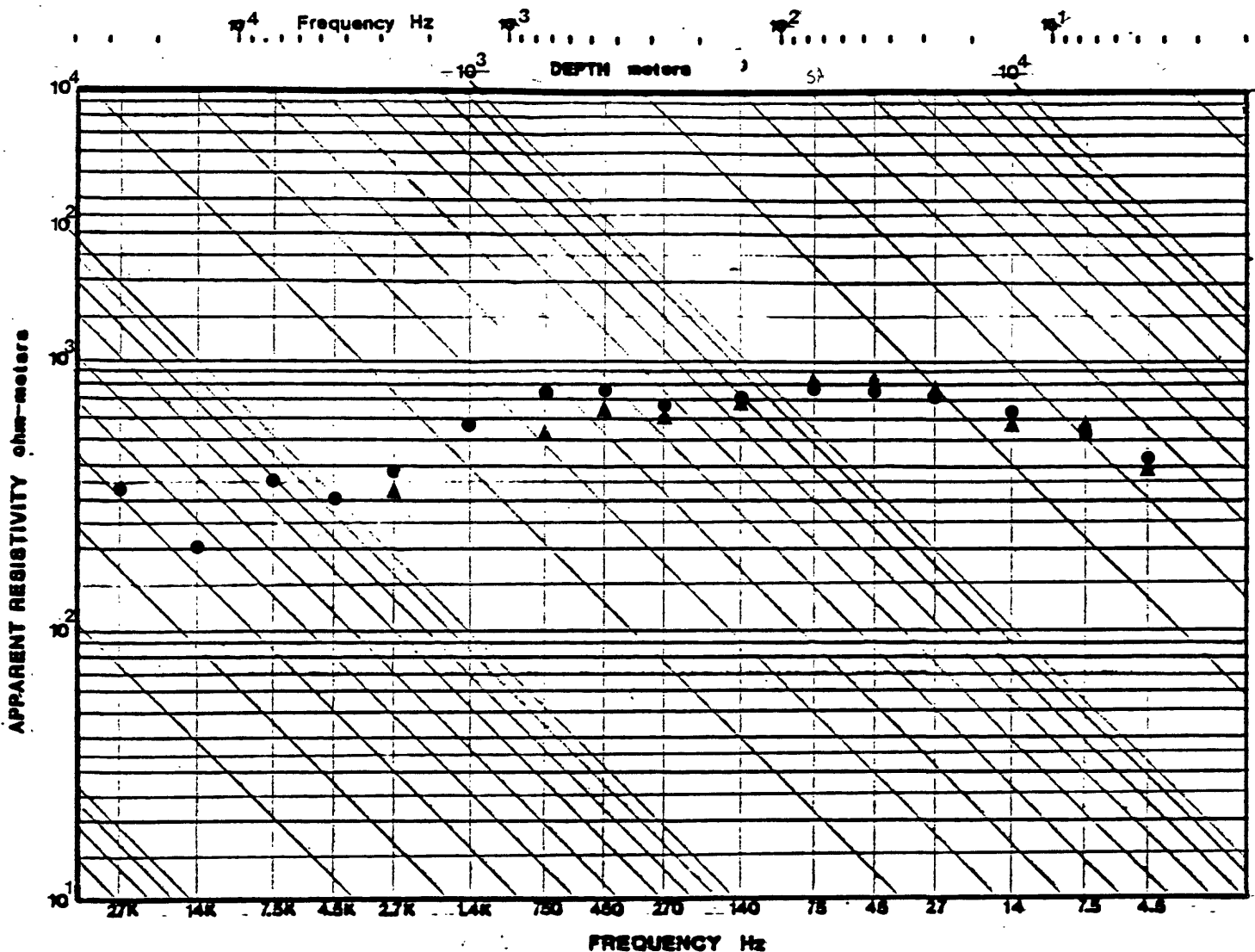
Location 10 Lakes, MT Station 24 Date 8-3-82 Operators DBH, MB



E-line orientation - N/S ●				E-line orientation - E/W ▲			Remarks	Freq. Hz
Freq. Hz	P <sub>a</sub>	N <sub>a</sub>	Error	P <sub>a</sub>	N <sub>a</sub>	Error		
4.5	76.0	9	4.50	64.0	7	6.38		4.5
7.5	108	10	5.10	65.9	10	8.02		7.5
14	122	10	3.94	62.1	9	3.93		14
27	134	10	3.20	48.8	10	4.76		27
45	144	10	7.37	66.2	10	9.30		45
75	154	9	10.4	97.1	9	10.7		75
140	170	10	5.80	75.6	10	7.14		140
270	187	10	5.74	115	12	12.8		270
450	236	10	10.3	123	9	11.6		450
750	332	10	41.3	149	7	12.2		750
1.4K	288	10	24.8	239	4	27.8		1.4K
2.7K	358	7	53.2	314	8	32.5		2.7K
4.5K	296	9	12.5	191	10	22.0		4.5K
7.5K	324	9	8.03	208	8	6.54		7.5K
14K	203	5	15.3	181	5	6.91		14K
27K	352	5	13.0	231	4	5.11		27K

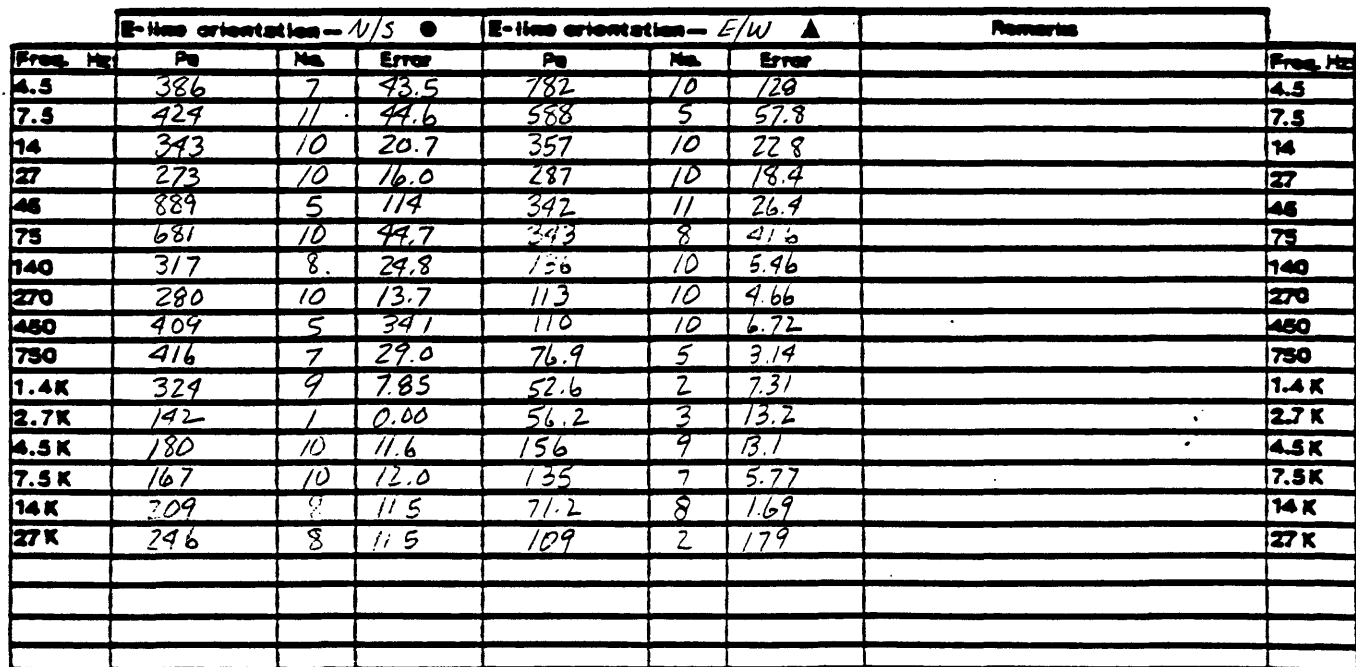
# USGS Scaler AMT Data Log

Location 10 Lakes MT Station 25 Date 8-3-82 Operators DBH MB



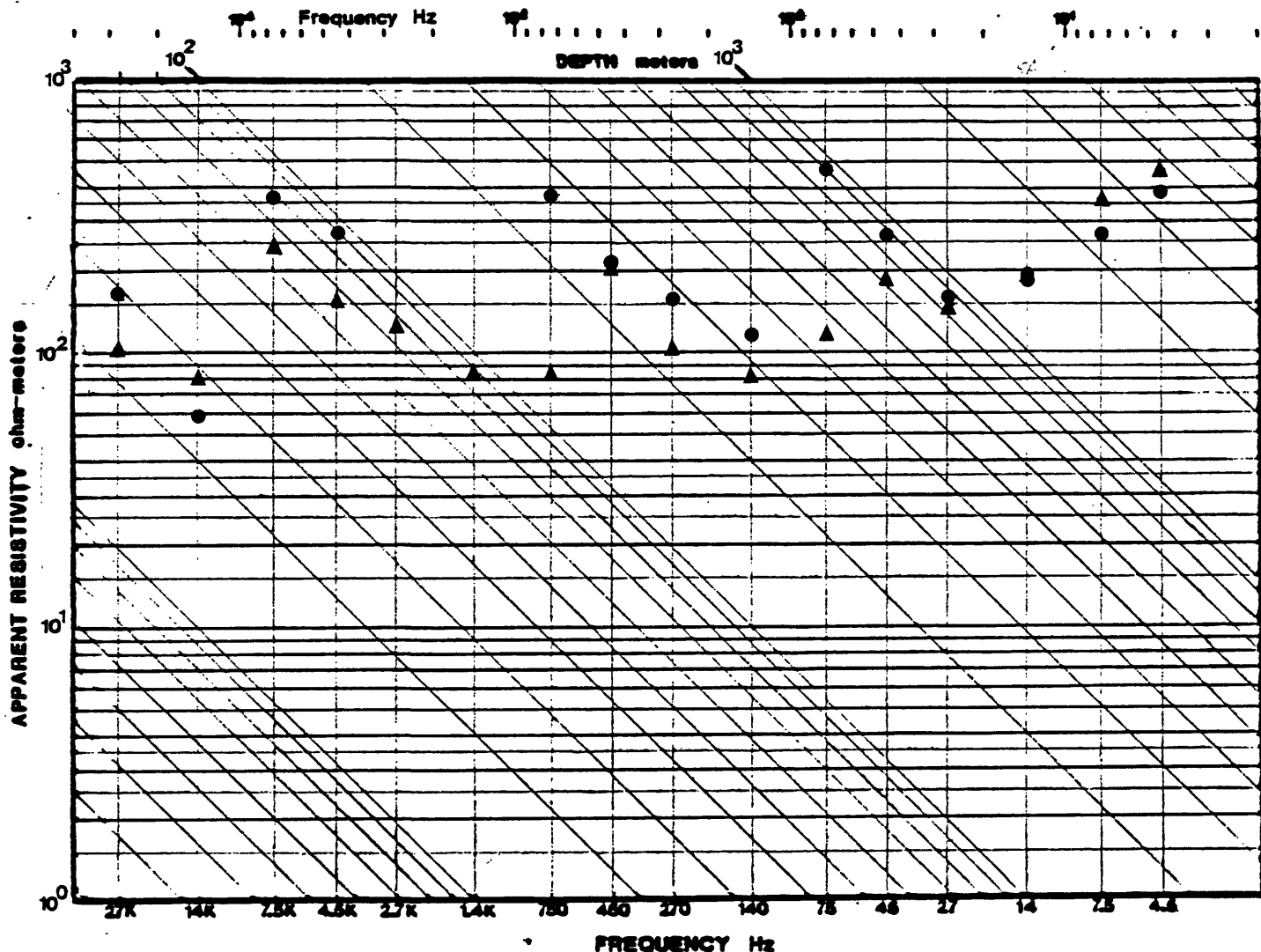
E-line orientation — N/S ●				E-line orientation — E/W ▲				Remarks
Freq. Hz	Pa	Ma	Error	Pa	Ma	Error		
4.5	428	6	59.6	372	9	21.2		4.5
7.5	521	11	35.8	587	10	24.0		7.5
14	628	9	43.4	559	9	23.7		14
27	712	10	16.2	752	10	17.4		27
48	767	10	33.6	802	10	27.7		48
75	762	10	18.9	780	10	41.9		75
140	705	9	24.4	665	10	38.7		140
270	675	10	19.0	592	10	41.4		270
450	757	9	32.7	632	10	24.8		450
750	750	9	33.9	527	10	29.2		750
1.4K	571	8	60.4	—	—	—		1.4 K
2.7K	381	7	24.4	332	5	32.3		2.7 K
4.5K	308	9	17.6	—	—	—		4.5 K
7.5K	367	9	13.8	—	—	—		7.5 K
14K	202	10	8.44	—	—	—		14 K
27K	337	3	14.6	—	—	—		27 K

Location 10 Lakes Station 26 Date 8-4-82 Operators DBH, MB



# USGS Scaler AMT Data Log

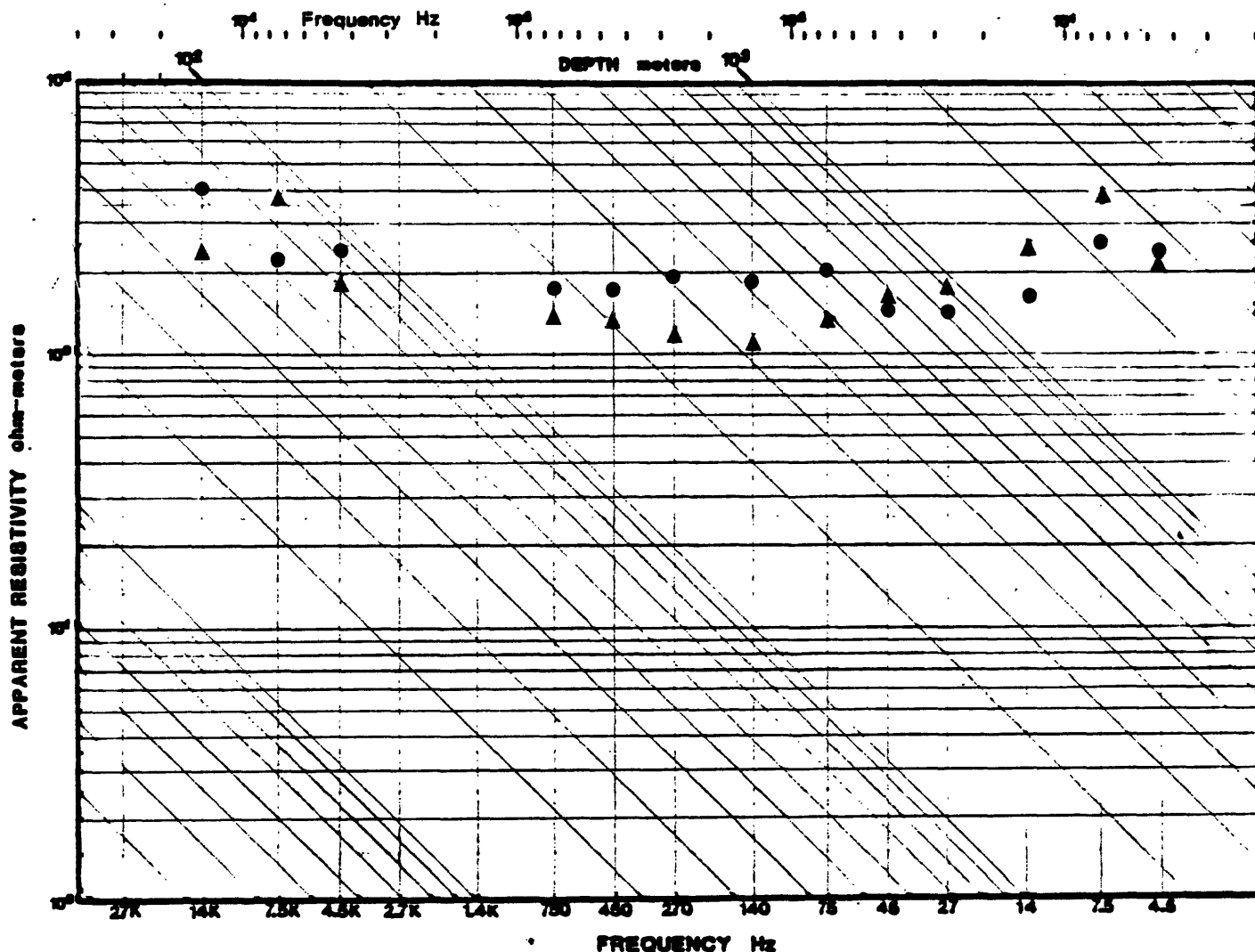
Location 10 Lakes, MT Station 27 Date 8-4-82 Operators DBH, MB



E-line orientation—N/S ●				E-line orientation—E/W ▲				Remarks
Freq. Hz	P <sub>o</sub>	N <sub>a</sub>	Error	P <sub>o</sub>	N <sub>a</sub>	Error		Freq. Hz
4.5	381	9	46.6	469	7	54.5		4.5
7.5	267	10	23.8	364	9	24.0		7.5
14	187	10	10.8	191	10	9.08		14
27	163	10	20.7	147	10	6.57		27
45	267	7	58.0	187	5	21.4		45
75	469	4	157	120	10	12.5		75
140	122	10	4.89	81.9	10	6.26		140
270	159	11	14.4	105	10	7.31		270
450	219	6	29.9	205	5	16.4		450
750	372	3	147	85.2	5	10.6		750
1.4K	—	—	—	85.6	1	—		1.4K
2.7K	—	—	—	128	1	—		2.7K
4.5K	277	8	36.6	158	4	4.12		4.5K
7.5K	365	4	45.9	242	8	25.0		7.5K
14K	590	6	189	81.4	5	3.10		14K
27K	165	5	13.8	101	2	10.3		27K

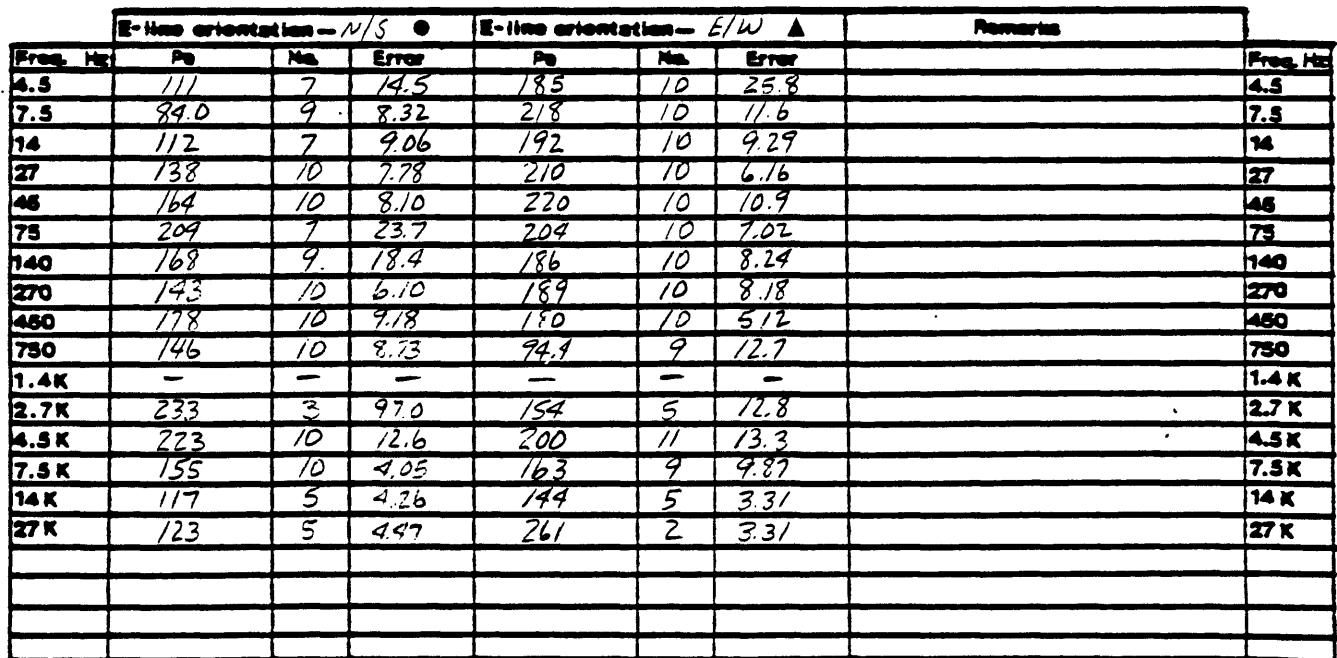
# USGS Scaler AMT Data Log

Location 10 Lakes Station 28 Date 8-4-82 Operators DBH MB



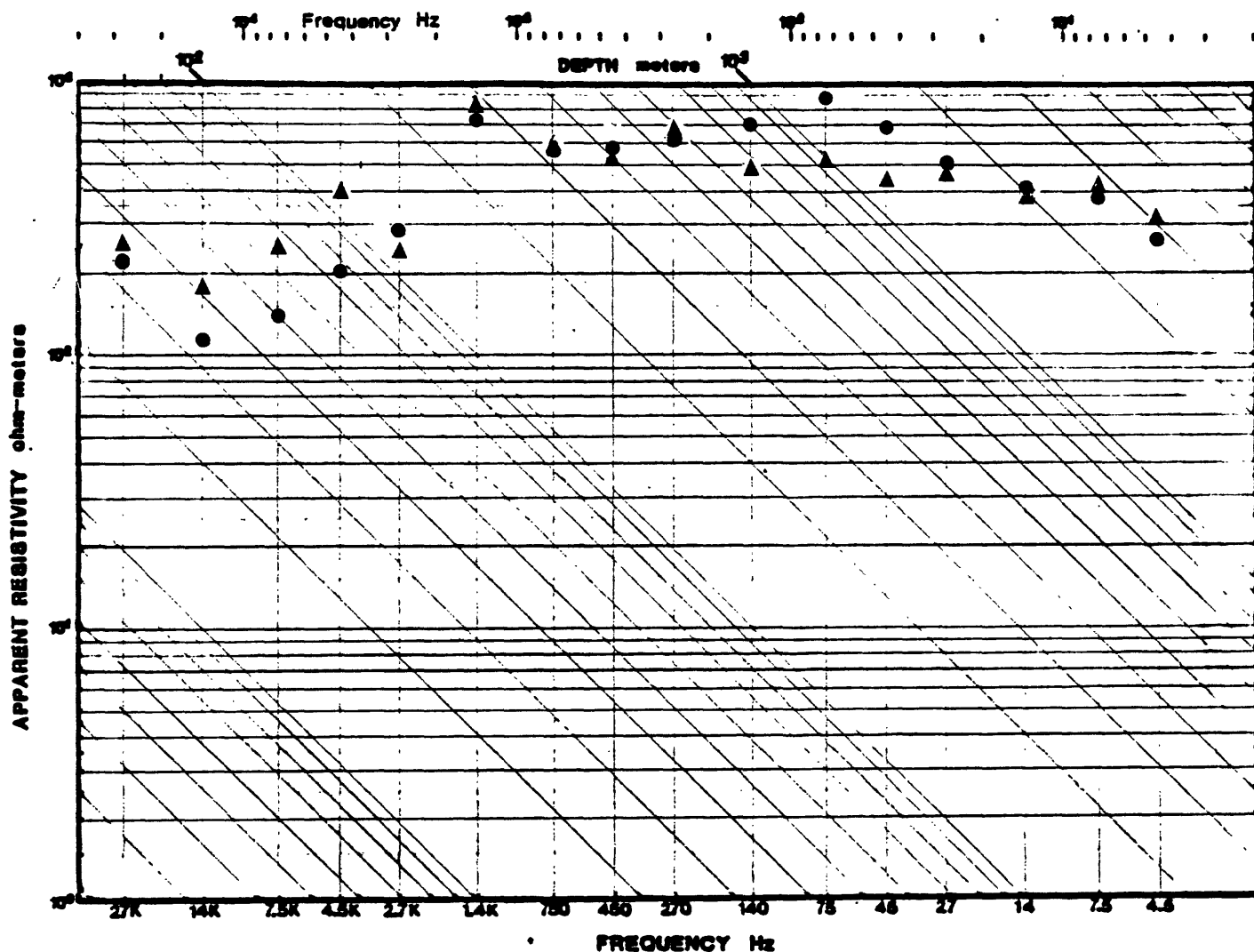
E-line orientation -- N/S $\odot$				E-line orientation -- E/W $\triangle$				Remarks
Freq. Hz	Pa	Ma	Error	Pa	Ma	Error		Freq. Hz
4.5	237	9	29.1	213	5	25.0		4.5
7.5	251	9	29.2	381	9	19.5		7.5
14	155	9	8.97	242	10	17.7		14
27	143	10	8.56	178	10	8.77		27
45	145	11	12.5	168	10	8.28		45
75	205	10	9.94	135	10	8.95		75
140	185	10	8.72	113	10	5.72		140
270	194	10	7.30	120	10	4.35		270
450	174	11	20.7	135	10	17.1		450
750	176	7	20.7	139	10	37.5		750
1.4K	-	-	-	-	-	-		1.4 K
2.7K	-	-	-	-	-	-		2.7 K
4.5K	246	4	31.1	189	5	6.36		4.5 K
7.5K	223	10	20.9	375	10	27.6		7.5 K
14K	409	6	38.4	244	5	7.10		14 K
27K	-	-	-	-	-	-		27 K

Location 10 Lakes, MT Station 29 Date 8-4-82 Operator DBH, MIB



# USGS Sealer A&T Data Log

Location 10 Lakes, MT Station 30 Date 8-4-82 Operators DEH, MB

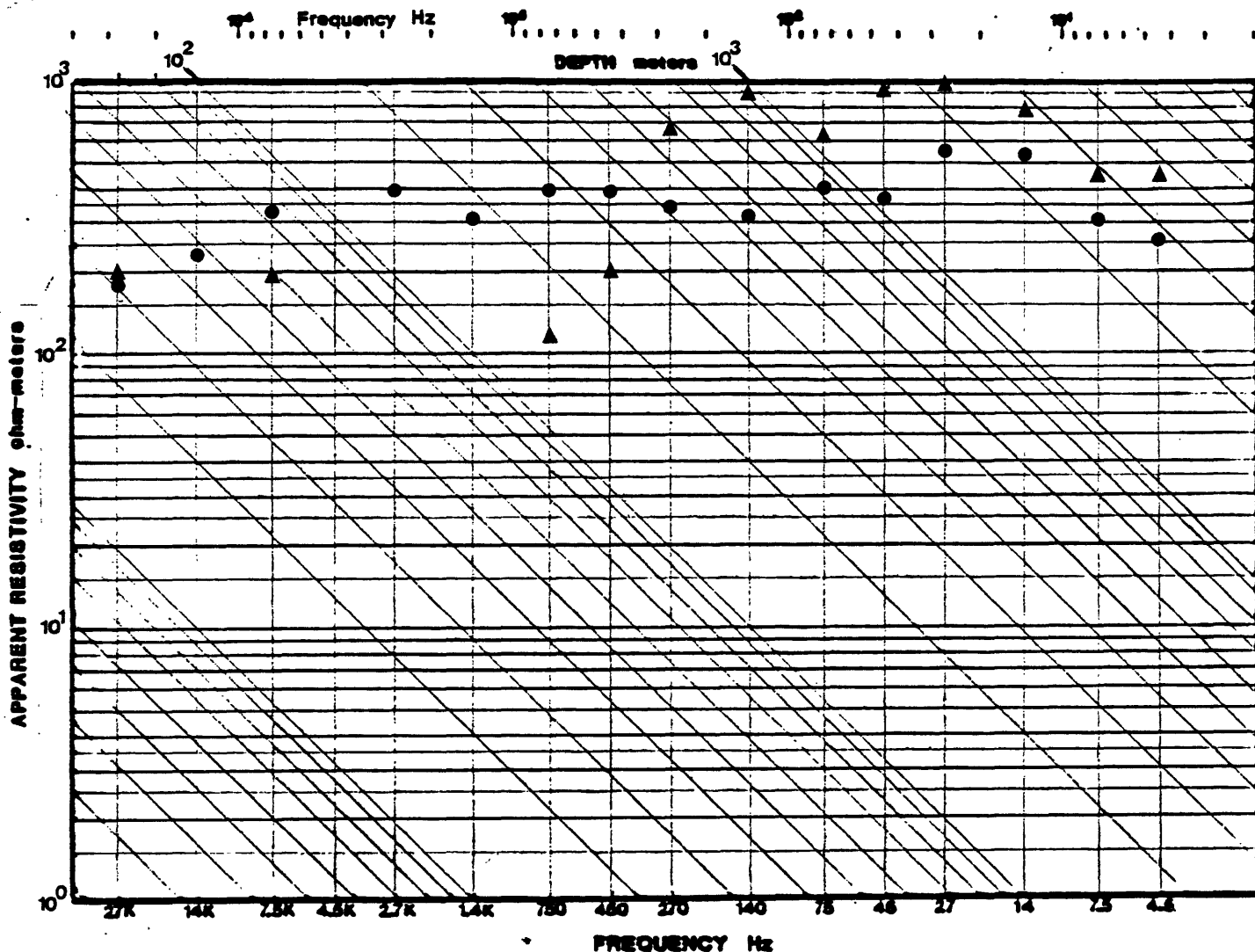


E-line orientation — N/S ●				E-line orientation — E/W ▲				Remarks	Freq. Hz
Freq. Hz	Po	Ma	Error	Po	Ma	Error			
4.5	254	10	23.9	312	10	16.5			4.5
7.5	354	10	14.9	408	10	28.8			7.5
14	410	10	10.0	393	10	23.0			14
27	491	10	14.2	465	10	18.9			27
46	669	10	30.3	492	10	23.3			46
75	143	10	25.8	519	9	31.5			75
140	690	10	27.9	498	10	34.6			140
270	606	10	19.7	628	10	28.5			270
460	568	10	27.9	706	10	25.0			460
750	535	10	21.0	594	8	22.2			750
1.4K	708	6	81.7	836	7	172			1.4 K
2.7K	783	3	19.4	299	8	5.57			2.7 K
4.5K	205	10	8.92	392	10	31.0			4.5 K
7.5K	142	10	2.62	244	9	15.2			7.5 K
14K	111	5	5.65	189	5	5.97			14 K
27K	218	5	5.11	252	4	7.32			27 K



# USGS Scaler AMT Data Log

Location 10 Lake MT Station 31 Date 8-5-82 Operators DBH, MB



E-line orientation - N/S ●				E-line orientation - E/W ▲			Remarks	Freq. Hz
Freq. Hz	Po	No.	Error	Po	No.	Error		
4.5	256	3	52.9	441	2	33.8		4.5
7.5	315	10	19.4	448	7	66.4		7.5
14	534	8	39.0	760	10	45.0		14
27	552	10	37.9	452	10	124		27
45	363	10	33.7	416	10	31.5		45
75	405	10	33.4	636	10	56.3		75
140	321	9	19.4	893	7	83.5		140
270	343	5	22.4	657	5	222		270
450	394	5	54.7	191	3	72.0		450
750	393	6	15.3	113	1	-		750
1.4K	311	5	9.02	-	-	-		1.4K
2.7K	395	4	20.9	-	-	-		2.7K
4.5K	-	-	-	-	-	-		4.5K
7.5K	331	9	24.8	189	8	20.4		7.5K
14K	230	5	10.5	-	-	-		14K
27K	182	5	35.3	198	5	11.3		27K

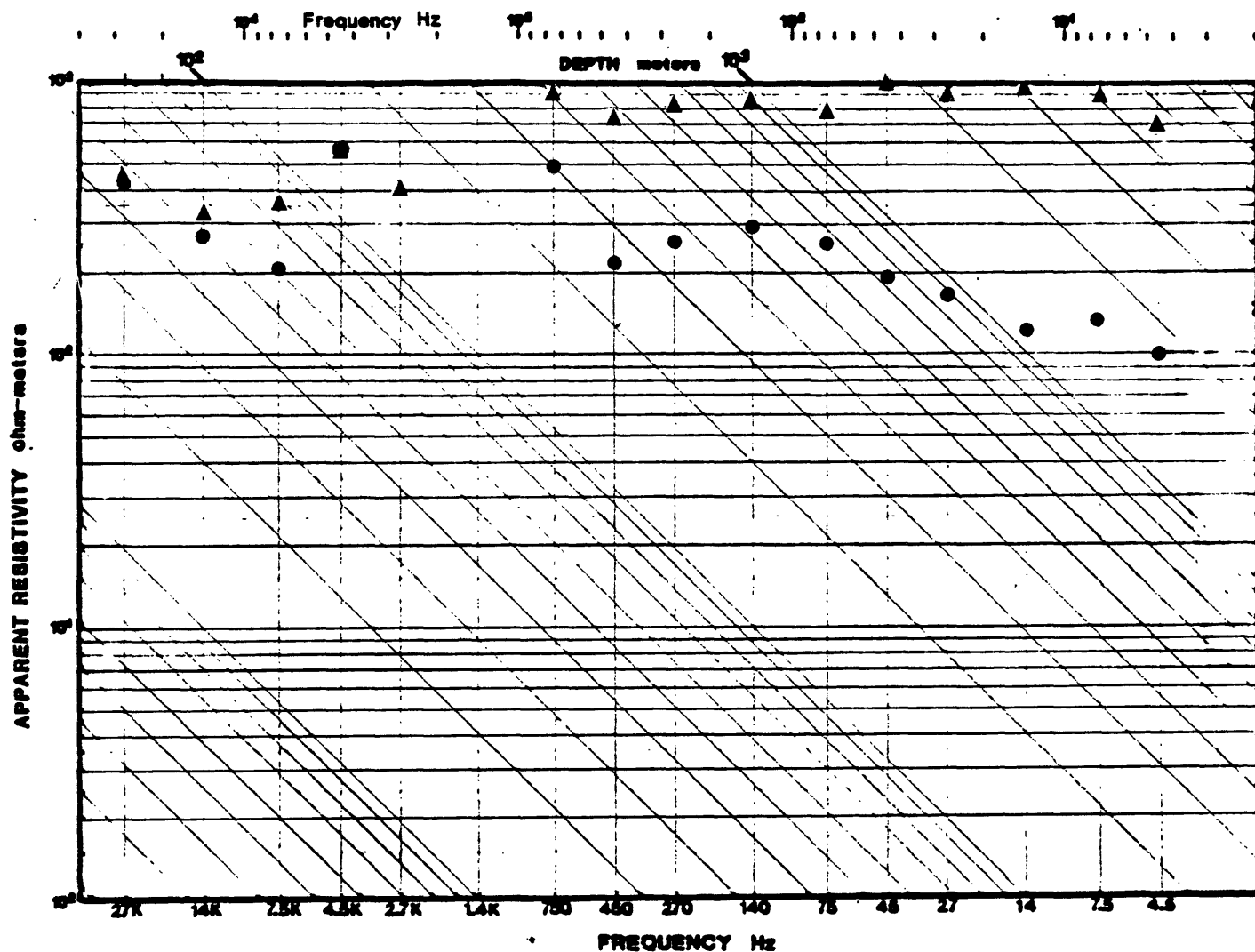
# USGS Sealer AAT Data Log

Location 10 Lakes

Station 32

Date 8-5-82

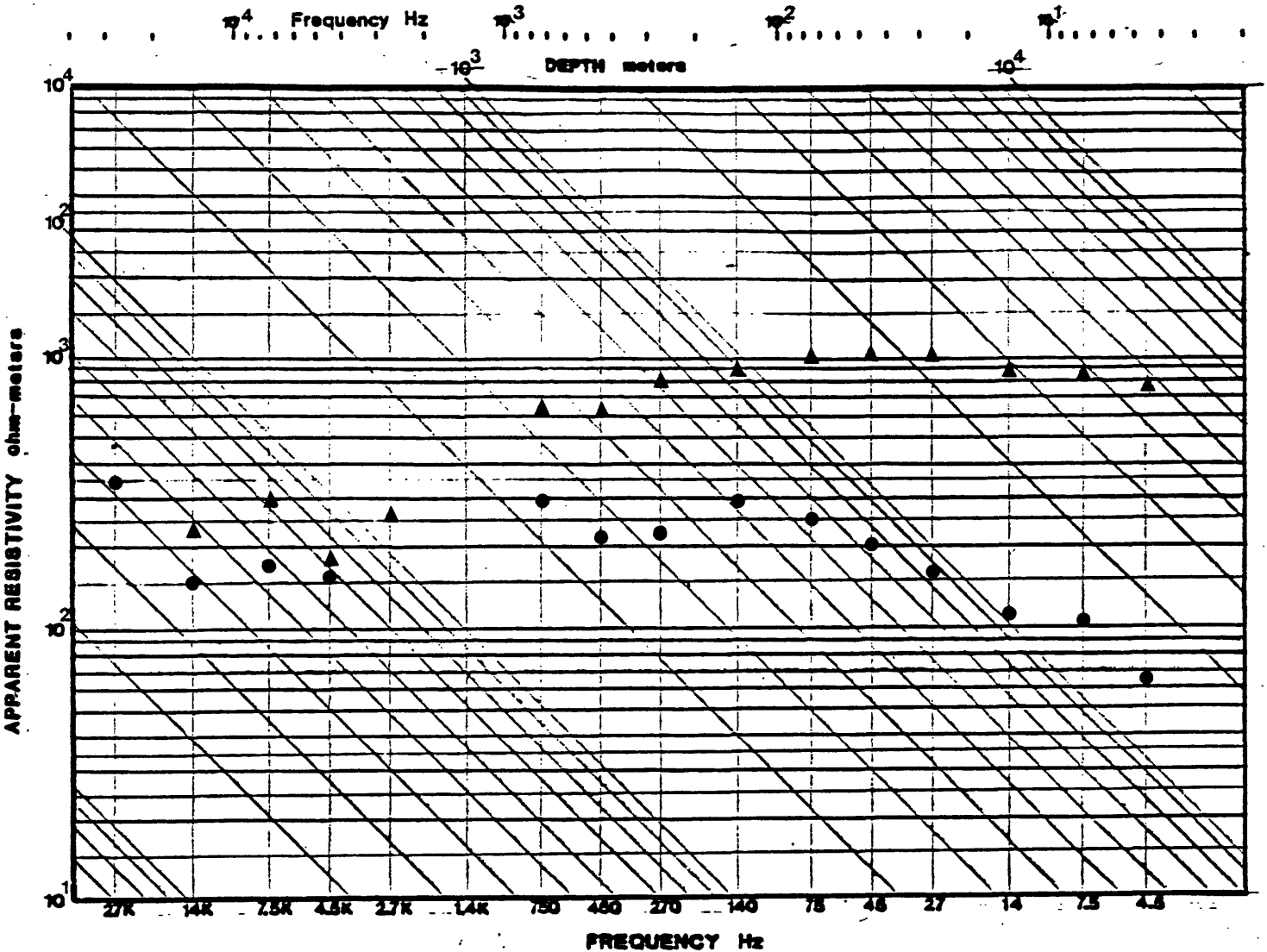
Operator DBH, MB



E-line orientation - N/S ●				E-line orientation - E/W ▲			Remarks	
Freq. Hz	P <sub>a</sub>	N <sub>a</sub>	Error	P <sub>a</sub>	N <sub>a</sub>	Error		Freq. Hz
4.5	96.7	5	10.8	694	12	80.6		4.5
7.5	139	9	9.23	901	8	33.4		7.5
14	127	10	7.65	949	10	48.0		14
27	159	10	4.67	913	10	35.6		27
45	188	14	16.1	1021	10	41.4		45
75	257	10	16.3	789	10	44.0		75
140	293	15	25.1	855	11	40.9		140
270	256	8	20.1	831	10	35.3		270
450	216	4	81.1	751	8	132		450
750	493	1	-	910	10	117		750
1.4K	-	-	-	-	-	-		1.4K
2.7K	-	-	-	411	2	68.6		2.7K
4.5K	576	7	30.0	563	9	49.5		4.5K
7.5K	206	10	7.05	352	10	14.2		7.5K
14K	266	5	11.9	330	5	12.2		14K
27K	410	5	21.7	455	5	12.8		27K

# USGS Scaled A&T Data Log

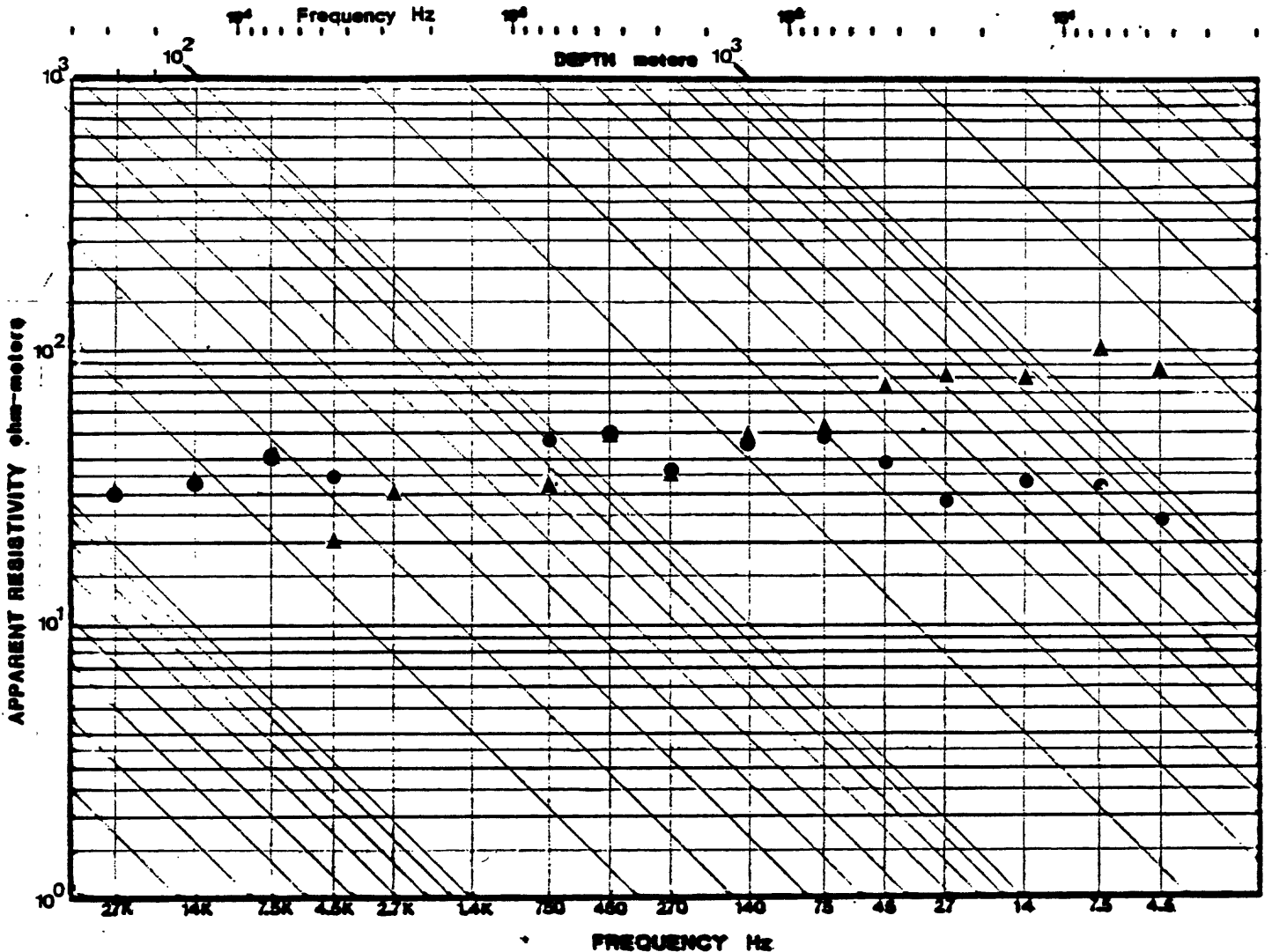
Location 10 Lakes, MT Station 33 Date 8-5-82 Operators DBH, MJB



E-line orientation — N/S ●				E-line orientation — E/W ▲			Remarks	Freq. Hz
Freq. Hz	Pa	Ma	Error	Pa	Ma	Error		
4.5	65.8	11	4.53	791	7	58.0		4.5
7.5	112	10	8.28	891	10	45.8		7.5
14	118	10	7.89	865	10	24.2		14
27	161	10	3.13	1033	10	26.5		27
48	201	9	13.6	1086	10	57.0		48
75	252	10	12.0	1006	10	45.5		75
140	297	10	16.5	886	10	47.7		140
270	226	10	14.9	801	10	43.7		270
450	218	10	31.4	642	11	32.6		450
750	293	7	31.7	647	10	49.6		750
1.4K	-	-	-	-	-	-		1.4K
2.7K	-	-	-	263	3	34.1		2.7K
4.5K	158	10	4.58	184	10	18.1		4.5K
7.5K	173	10	3.29	295	10	13.9		7.5K
14K	151	6	7.07	240	5	51.9		14K
27K	341	6	6.81	465	5	16.1		27K

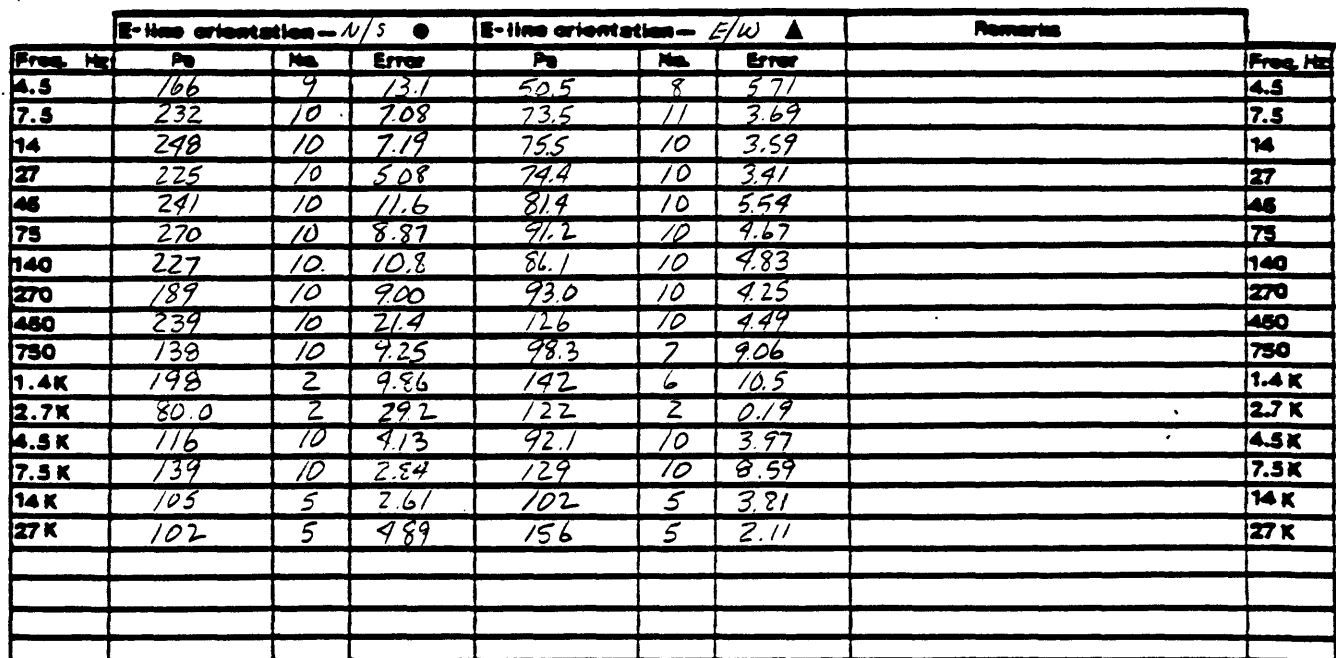
# USGS Scaler AMT Data Log

Location 10 Lakes MT Station 34 Date 8-5-82 Operator DBH MB



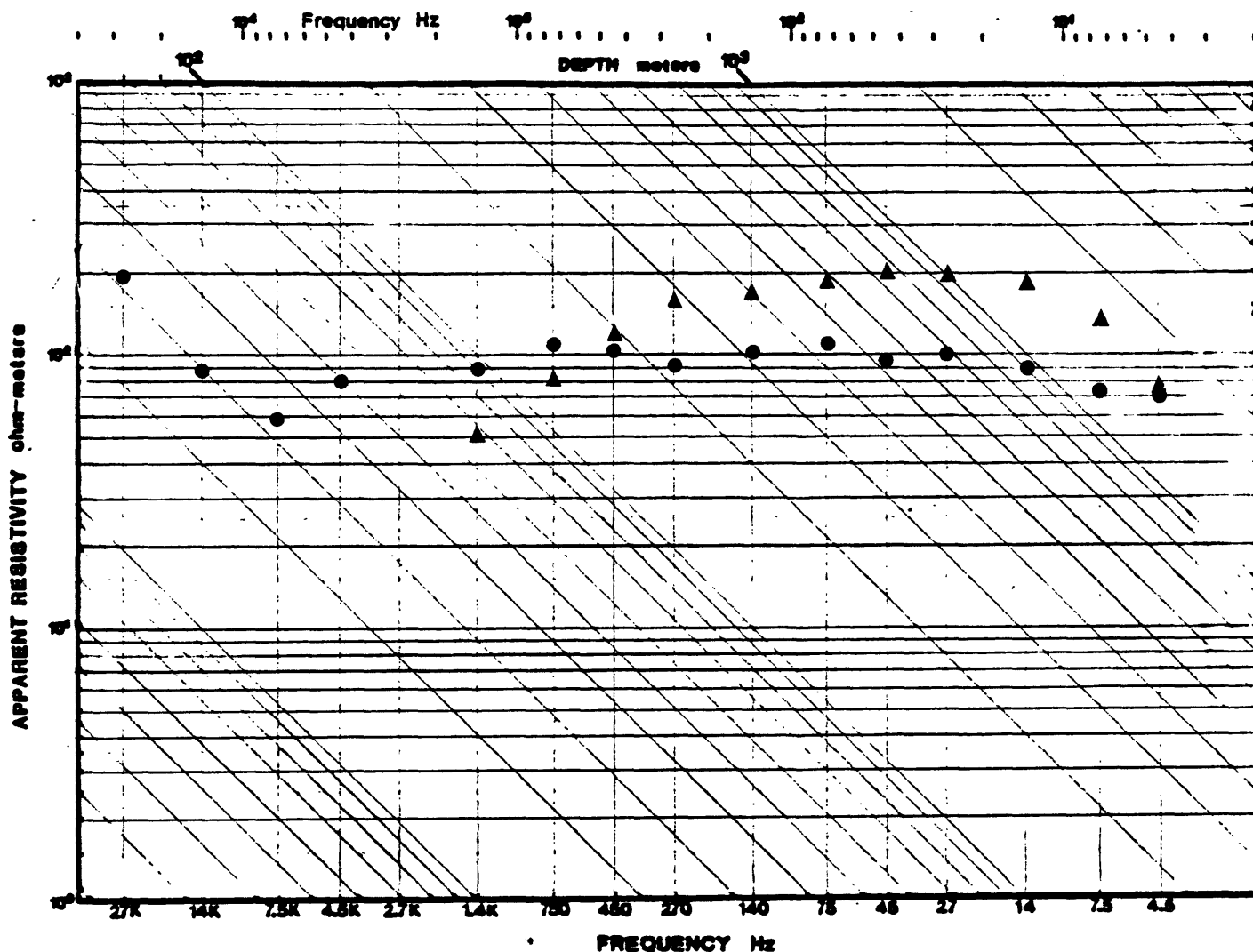
E-line orientation — N/S ●				E-line orientation — E/W ▲			Remarks	
Freq. Hz	Pe	Ma	Error	Pe	Ma	Error		Freq. Hz
4.5	229	10	22.5	855	10	93.3		4.5
7.5	313	10	21.7	1025	10	10.1		7.5
14	328	10	13.9	796	10	39.1		14
27	290	10	13.6	804	10	25.0		27
45	389	10	31.7	748	9	25.9		45
75	470	10	22.2	531	10	27.9		75
140	454	7	15.1	489	11	39.3		140
270	436	10	12.6	367	10	11.4		270
450	503	10	29.8	490	10	30.2		450
750	472	10	28.8	325	9	16.9		750
1.4K	—	—	—	—	—	—		1.4K
2.7K	—	—	—	304	2	3.67		2.7K
4.5K	397	10	7.83	208	10	8.23		4.5K
7.5K	433	10	15.0	413	10	30.6		7.5K
14K	333	10	13.9	335	5	6.84		14K
27K	302	6	17.0	307	5	15.4		27K

Location 10 Lakes, MT Station 35 Date 5-5-82 Operator DBH, MB



# USGS Sealer AWT Data Log

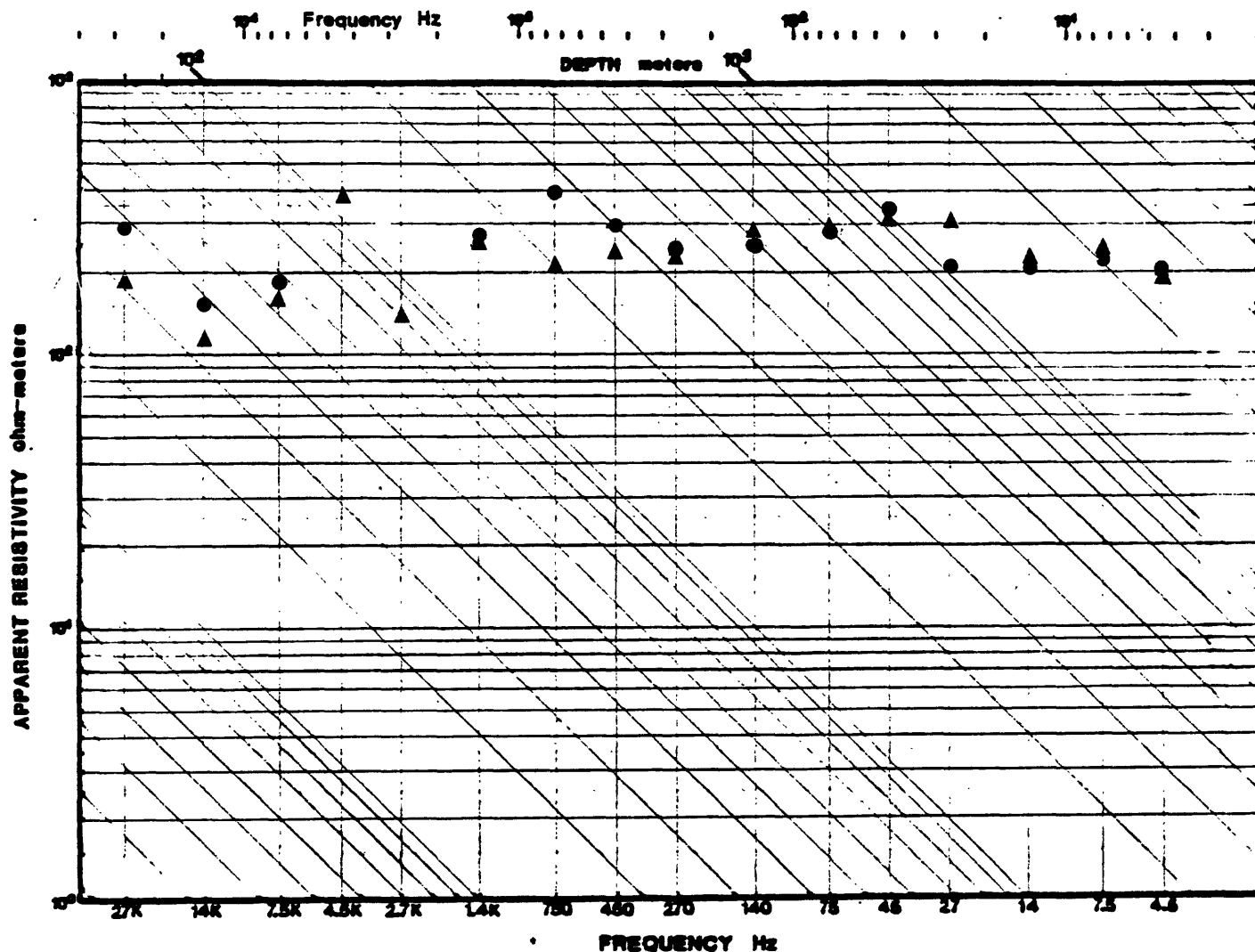
Location 10 Lakes, MT Station 36 Date 8-10-82 Operator DBH, MR



E-line orientation—N/S ●				E-line orientation—E/W ▲				Remarks
Freq. Hz	Po	Ma	Error	Po	Ma	Error		Freq. Hz
4.5	69.0	10	7.49	76.8	10	5.74		4.5
7.5	71.4	10	3.12	137	8	7.93		7.5
14	89.8	10	3.67	187	8	11.8		14
27	99.2	10	1.81	199	10	14.2		27
45	94.4	10	2.90	201	9	10.3		45
75	109	10	2.77	187	10	8.58		75
140	101	10	4.03	161	10	10.2		140
270	92.4	10	3.37	154	8	6.68		270
450	104	8	4.58	118	8	10.8		450
750	110	7	4.15	81.6	10	5.94		750
1.4K	89.3	5	19.6	52.6	3	1.63		1.4K
2.7K	—	—	—	—	—	—		2.7K
4.5K	78.3	8	3.73	—	—	—		4.5K
7.5K	58.3	7	9.25	—	—	—		7.5K
14K	87.9	8	2.93	—	—	—		14K
27K	191	5	10.6	—	—	—		27K

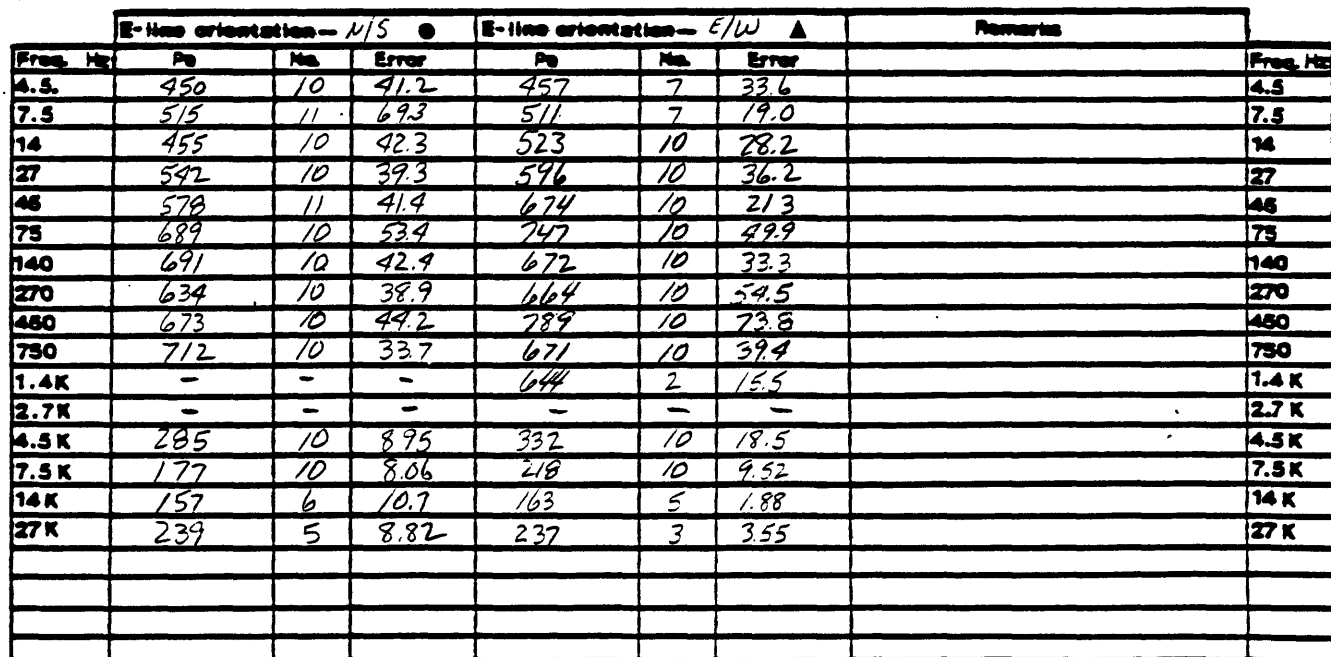
# USGS Scler AMT Data Log

Location 10 Lakes, MT Station 37 Date 8-10-82 Operators DEH, MB



E-line orientation — N/S ●				E-line orientation — E/W ▲			Remarks	Freq. Hz
Freq. Hz	Po	Na	Error	Po	Na	Error		
4.5	203	8	30.3	194	9	15.3		4.5
7.5	224	12	15.4	253	10	12.1		7.5
14	204	10	19.0	225	10	8.12		14
27	211	12	14.1	308	10	6.27		27
45	217	10	9.88	311	10	19.1		45
75	286	10	12.4	296	10	9.76		75
140	256	10	10.5	281	10	13.2		140
270	244	11	14.1	233	9	22.8		270
450	295	9	15.0	239	10	25.4		450
750	391	8	20.8	210	9	10.5		750
1.4K	275	6	25.2	254	5	52.8		1.4 K
2.7K	-	-	-	144	1	-		2.7 K
4.5K	-	-	-	378	10	25.9		4.5 K
7.5K	184	10	6.68	165	10	1.85		7.5K
14K	153	5	6.36	119	5	7.48		14 K
27K	290	5	12.1	191	3	2.45		27 K

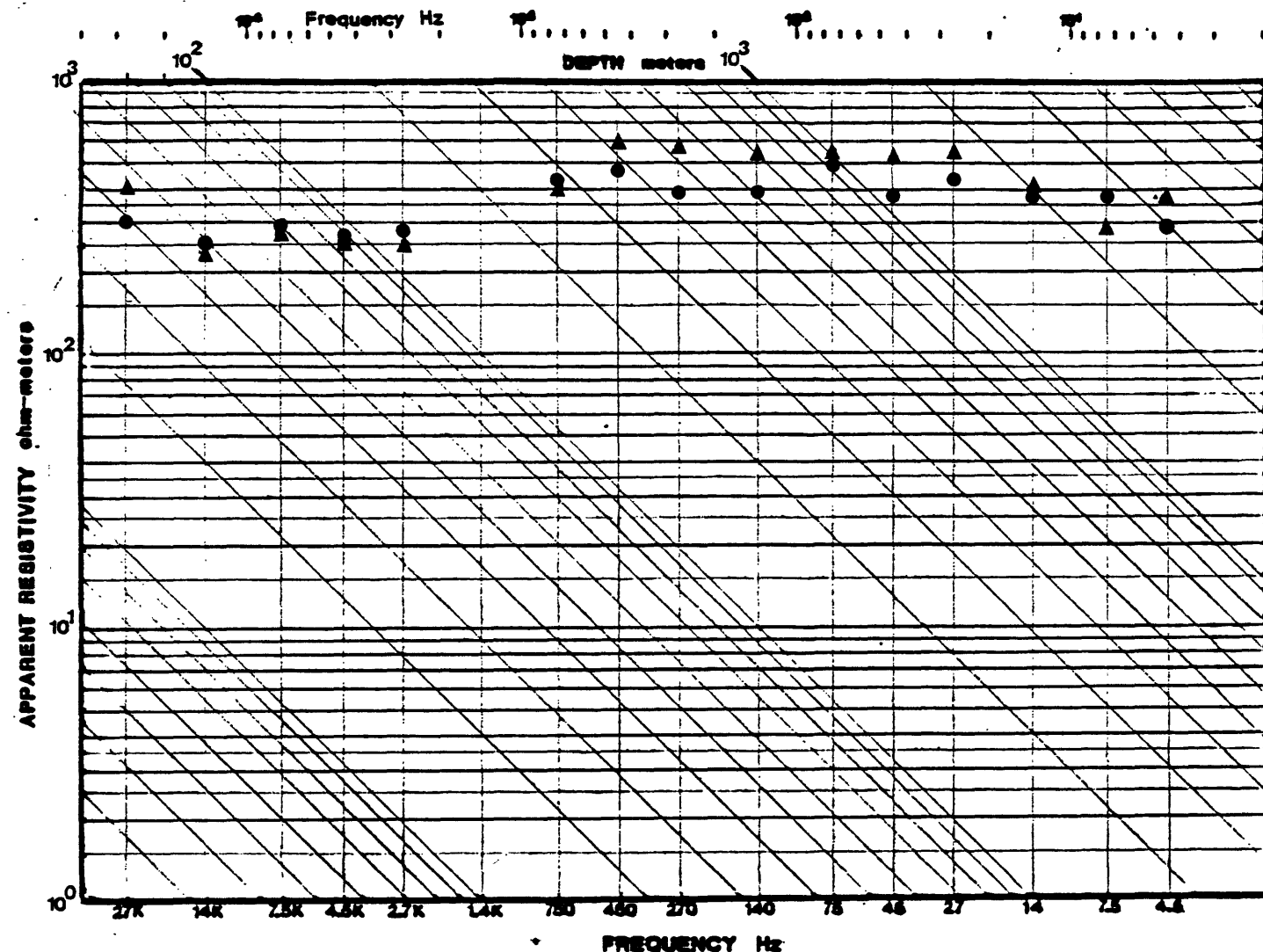
Location 10 Lakes, MT Station 38 Date 8-10-82 Operators DRH, MJB





# USGS Scaler AMT Data Log

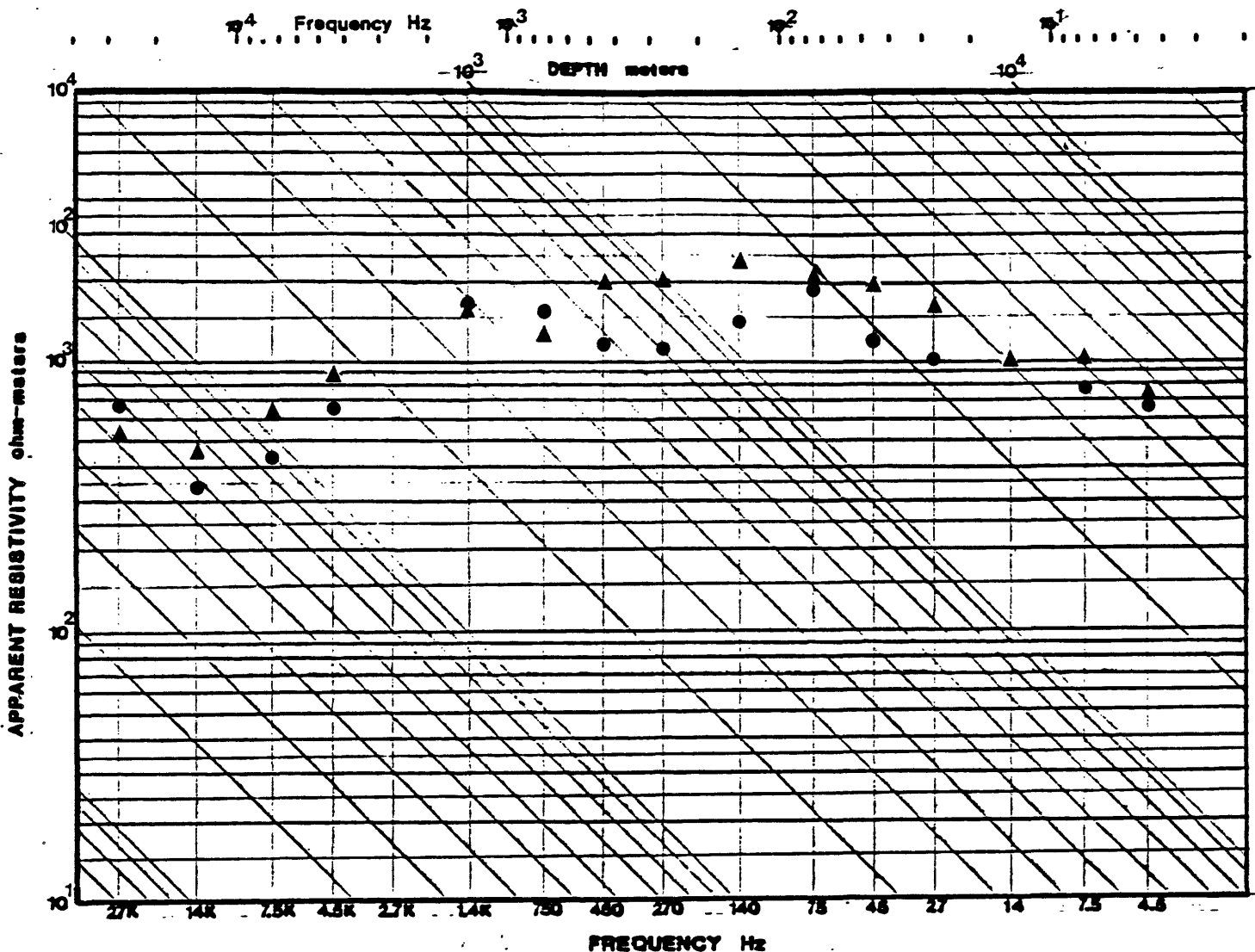
Location 10 Lakes MT Station 39 Date 8-10-82 Operators DEW MD



E-line orientation— N/S ●				E-line orientation— E/W ▲			Remarks
Freq. Hz	Pa	Ma	Error	Pa	Ma	Error	Freq. Hz
4.5	281	10	20.8	377	5	37.7	4.5
7.5	379	10	11.6	287	10	14.5	7.5
14	380	8	10.5	415	8	27.9	14
27	434	9	16.6	559	10	64.4	27
45	388	10	17.2	537	10	33.8	45
75	497	11	9.99	558	9	55.1	75
140	395	10	12.3	545	9	42.1	140
270	274	9	17.0	573	10	20.2	270
450	473	10	20.1	595	8	26.3	450
750	436	10	17.9	391	7	10.9	750
1.4K	—	—	—	—	—	—	1.4K
2.7K	286	6	23.3	244	10	16.9	2.7K
4.5K	261	10	13.3	257	10	12.9	4.5K
7.5K	293	10	37.5	269	9	54.7	7.5K
14K	258	5	20.8	233	5	9.96	14K
27K	303	5	6.75	404	5	6.01	27K

# USGS Scaled AWT Data Log

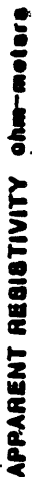
Location 10 Lakes, MT Station 40 Date 8-10-82 Operators DBH, MB



E-line orientation — N/S ●				E-line orientation — E/W ▲			Remarks	Freq. Hz
Freq. Hz	Pg	Ma	Error	Pg	Ma	Error		
4.5	652	6	47.7	743	7	72.7		4.5
7.5	778	9	69.3	1047	10	69.7		7.5
14	1029	10	99.0	1028	10	33.2		14
27	1040	10	53.8	1663	10	66.8		27
48	1247	10	50.2	1958	10	126		48
75	1847	10	92.3	2182	10	80.0		75
140	1425	11	98.5	2359	10	77.2		140
270	1180	10	56.1	2049	10	82.9		270
450	1221	11	97.7	2010	10	38.0		450
750	1633	10	148	1293	10	16.4		750
1.4K	1750	8	79.5	1619	10	31.4		1.4 K
2.7K	—	—	—	628	10	42.5		2.7 K
4.5K	651	10	32.8	880	10	27.8		4.5 K
7.5K	441	10	10.6	639	10	19.4		7.5 K
14K	338	5	15.5	468	7	16.5		14 K
27K	678	5	24.0	529	5	7.09		27 K

## USGS Scafer A&amp;T Data Log

Location 10 Lakes, MT Station 41 Date 8-10-82 Operators DBH, MD



E-line orientation -- N/S ●				E-line orientation -- E/W ▲			Remarks
Freq. Hz	Pg	Ma	Error	Pg	Ma	Error	
4.5	753	10	51.0				4.5
7.5	991	10	39.6				7.5
14	1209	10	26.8				14
27	1249	10	40.1				27
46	1226	10	38.2				46
75	1391	9	42.3				75
140	1016	9	47.7				140
270	811	10	31.6				270
460	1157	7	50.6				460
750	872	10	94.6				750
1.4K	-	-	-	-	-	-	1.4K
2.7K	679	10	32.1				2.7K
4.5K	316	10	26.8				4.5K
7.5K	290	10	10.3				7.5K
14K	195	5	5.04				14K
27K	154	5	3.67				27K