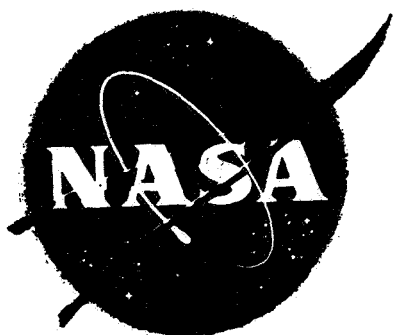


NASA REMOTE SENSING PROJECT

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Technical Letter # 13



Mackay School of Mines
University of Nevada
Reno, Nevada

05-1013

MACKAY SCHOOL OF MINES

UNIVERSITY OF NEVADA

RENO, NEVADA

Ground Data Investigations
Mt. Lassen, Site 56-Mission 76

by

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and Staff of the University of Nevada

Prepared for the
National Aeronautical and Space Administration

TECHNICAL LETTER 13

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TABLE OF CONTENTS

Introduction -----	1
Index Map of Ground Data Stations MX 76 -----	2
Radiometric and Surface Temperatures -----	3
Soil Moisture -----	10
Microwave Radiometer Measurements -----	14
Spectral Intensity Measurements -----	21
Cinder Density Study -----	23
Seismic Cinder Depth Study -----	25

INTRODUCTION

The data embodied in this report was gathered on the Mt. Lassen test site, #56, in preparation for, during and immediately after, the overflights of July 1968.

Flights 4 and 5 of mission 76 were flown at 1100 and 0400 P.D.T. on July 18th and 19th respectively. The CV240, NASA 926, aircraft flew six runs down each of two lines both day and night, making a total of 24 runs.

The prime instrument for the mission is the MR62-MR64 microwave radiometer system. The Reconofax LV and both ektachrome I.R. (color I.R.) and Plus X (black and white) photography was flown as supplementary instruments to the radiometers. The radar scatterometer was also flown as a secondary instrument. Microwave radiometry was obtained for look angles of 10 , 30 , and 45 for both vertical and horizontal polarizations day and night. Four ground stations were manned during both flights to provide ground truth data, and Jet Propulsion Laboratory and Space General Microwave systems were operating at the time of the overflights.

Figure 1

GROUND DATA STATION

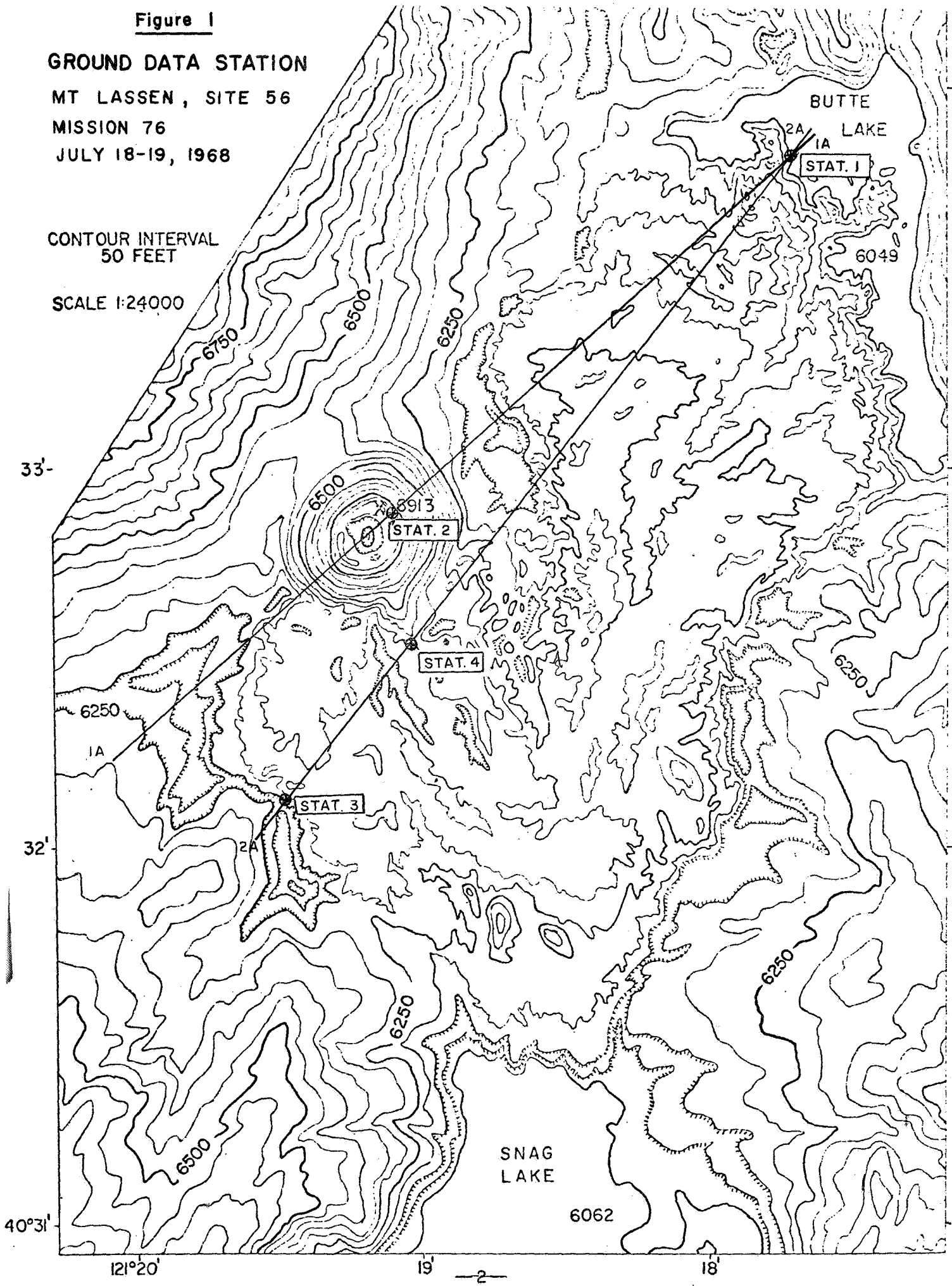
MT LASSEN, SITE 56

MISSION 76

JULY 18-19, 1968

CONTOUR INTERVAL
50 FEET

SCALE 1:24000



Mt. Lassen - Site #56
 Mission #76 Flight #4
 #1 Butte Lake

July 18, 1968

RADIOMETER (8-14μ) READINGS

DIGATIC READINGS

WEATHER DATA

Time	Run	Microwave Polarization	Basalt Part Shade	Basalt	Basalt Part Shade	Basalt	N Slope	Trees-Distance	Basalt - Sun	Sky	14" deep rock	4" deep rock	1" deep rock	1/4" deep rock	Air	Relative Humidity	Wind Velocity	Wind Direction	Clouds
11:20	1	10E	36.6	11.8	31.1	38.8			>45	<-25	19.3	27.7	43.1	46.4	26.2	29%	0		none
11:28	2	10E	38.3	11.8	27.8	39.4		22.3	>45	<-25	19.3	27.9	43.0	46.2	23.7		2	E	
11:34	3	10H	33.8	12.8	28.9	40.0		22.3	>45	<-25	19.2	28.2	42.6	46.4	24.7				
11:40	4	10H	33.8	12.3	24.0	38.8		22.3	>45	<-25	19.3	28.5	42.6	46.2	25.0				
11:46	5	30E	33.2	10.0	24.5	35.5		22.3	>45	<-25	19.3	28.7	42.9	47.1	25.5				
11:54	6	30E	33.2	13.4	26.7	36.6		23.4	>45	<-25	19.2	29.0	42.3	47.7	25.0	31%			
12:01	7	30H	36.6	12.3	25.6	38.8		23.4	>45	<-25	19.1	29.4	43.1	46.9	25.4				
12:07	8	30H	38.8	13.4	26.2	37.7		23.4	>45	<-25	19.2	29.6	43.4	49.0	25.4				
12:14	9	45E	35.5	12.8	26.7	37.2		22.8	>45	<-25	19.2	29.9	43.9	50.5	25.7				
12:21	10	45E	36.6	12.3	26.7	36.6		22.8	>45	<-25	19.2	30.2	44.0	49.7	26.0				
12:28	11	45H	36.6	13.4	27.8	36.0		22.8	>45	<-25	19.3	30.5	45.0	49.8	25.8				
12:34	12	45H	35.5	12.8	28.9	36.6		23.4	>45	<-25	19.2	30.7	45.0	49.3	23.8				
12:41	13	10E	38.8	13.4	30.0	37.2		23.4	>45	<-25	19.3	30.9	45.6	49.8	25.8	31%	4	E	none
12:48											19.3	31.0	46.0	51.0	27.2				

Table 1

*Lake Temperatures 9:15 = 18.4
 9:30 = 19.0
 12:00 = 20.6
 13:00 = 21.2

All temperatures in degrees C

Mt. Lassen - Site #56
 Mission #76 Flight #4

#3 West 2A
 July 18, 1968

WEATHER DATA

<u>Time</u>	<u>Run</u>	<u>Microwave Polarization</u>	<u>DIGATIC READINGS</u>				<u>Relative Humidity</u>
			<u>2' cinder</u>	<u>8" cinder</u>	<u>2" cinder</u>	<u>1/4" cinder</u>	
11:33	1		18.1	20.4	37.5	56.8	33.4
11:35	2		18.1	20.5	37.8	57.2	31.9
11:40	3		18.1	20.5	38.1	58.2	33.4
11:44	4		18.1	20.6	38.7	58.0	32.9
11:54	5		18.1	20.7	39.4	58.5	33.8
12:00	6		18.1	20.8	40.0	58.2	32.7
12:07	7		18.1	21.0	40.7	61.1	30.4
12:15	8		18.1	21.1	41.4	60.6	32.2
12:22	9		18.1	21.2	41.9	61.6	34.2
12:29	10		18.1	21.3	42.3	61.6	34.8
12:35	11		18.1	21.4	42.9	62.6	34.5
12:42	12		18.1	21.7	43.8	61.7	36.0

28%

All temperatures in degrees C

Table 1 con't

Mt. Lassen - Site #56
 Mission #76 Flight #4
 Test Node #4

July 18, 1968

WEATHER DATA

RADIOMETER (8-14μ) READINGS

DIGATIC READINGS

Relative Humidity

Wind Velocity

Basalt Air temp.
 Site #3
 Basalt Air temp.
 Site #3
 Basalt Air temp.
 Site #3
 Air
 Site #2
 1/2" cinder
 Site #2
 2" cinder
 Site #2
 6" cinder
 Site #2
 18" cinder
 Site #2
 Site #1 Air
 Site #1
 1/2" cinder
 Site #1
 2" cinder
 Site #1
 4" cinder
 Site #1
 12" Cinder
 Site #1

Microwave Polarization
 Basalt
 Grey Cinder
 Red Cinder

Run
 Time

10:50	18.1	20.1	28.9	45.3	32.2	20.3	18.5	24.9	56.5	35.5	14.8	15.0	27.2	24%	0-5
10:57															
11:01															
11:15															
11:35															
11:40															
11:45															
12:00															
12:10															
12:15															
12:30															
12:35															
12:45															
13:00															
13:30															

Table 1 con't

*Site #4 Base of Cinder Cone 13:00 Air, 36.0, 4" 29.0, 12" 17.0
 All temperatures in degrees C

Mt. Lassen - Site #56
 Mission #76 Flight #5
 #1 Butte Lake

July 19, 1968

Time	Run	RADIOMETER (8-14u) READINGS						DIGATIC READINGS				WEATHER DATA				
		Microwave Polarization	Rock - Close	Water	Rock - mid	Rock - distant	Trees	14" deep rock	4" deep rock	1" deep rock	1/4" deep rock	Air	Relative Humidity	Wind Velocity	Wind Direction	Clouds
02:30			14.6	10.6	14.0	12.9	11.8	24.8	21.1	15.7	14.5	14.6	62%	2	SE	none
03:03	1	10E	14.0	10.6	12.9	11.8	13.4	24.6	20.6	15.2	14.1	13.5		5	SE	none
03:09	2	10E	14.0	10.6	15.0	11.8	12.0	24.6	20.5	15.2	14.1	14.0				
03:16	3	10H	14.0	11.2	14.6	11.8	12.9	24.5	20.3	15.0	13.9	13.5				
03:24	4	10H	14.6	10.0	14.0	11.2	12.9	24.5	20.2	14.9	13.8	13.2				
03:32	5	30E	15.0	11.8	14.0	11.2	11.8	24.4	20.1	14.8	13.7	13.1				
03:39	6	30E	12.9	11.2	14.6	11.2	11.5	24.4	20.0	14.6	13.6	13.0				
03:47	7	30H	12.9	9.4	15.0	11.8	11.8	24.3	19.8	14.6	13.5	13.0				
03:55	8	30H	11.8	9.4	14.6	11.8	11.8	24.3	19.7	14.6	13.3	12.5		5	SE	none
04:04	9	45E	15.0	10.8	14.6	11.2	11.2	24.2	19.6	14.5	13.2	12.3				
04:13	10	45E	12.9	9.4	11.2	10.0	11.2	24.1	19.4	14.1	13.1	12.5				
04:22	11	45H	12.9	11.8	12.9	11.2	11.2	24.0	19.3	14.0	13.0	12.8				
04:30	12	45H	12.9	8.8	13.4	11.2	11.8	23.9	19.1	13.9	12.8	12.3	65%	5	SE	none
04:43								23.9	18.9	13.7	12.6	11.9				

Table 1 con't

*Lake temperature 03:00 = 15.0
 All temperatures in degrees C

Mt. Lassen - Site #56
 Mission #76 Flight #5
 #2 Cinder Cone

July 19, 1968

<u>Time</u>	<u>Run</u>	<u>Microwave Polarization</u>	<u>RADIOMETER (8-14μ) READINGS</u>			<u>WEATHER DATA</u>	
			<u>Basalt + Cinder-distance</u>	<u>Cone</u>	<u>Wind Velocity</u>	<u>Clouds</u>	
02:50			10.0	6.0	1-3	none	
03:00			9.4	5.5			
03:06	1	10E	8.8	5.0			
03:11	2	10E	8.8	4.4			
03:19	3	10H	7.7	3.8			
03:27	4	10H	7.2	3.3			
03:36			6.6	3.3			

All temperatures in degrees C

Table 1 con't

Mt. Lassen - Site #56
 Mission #76 Flight #5
 Test Node #4

July 19, 1968

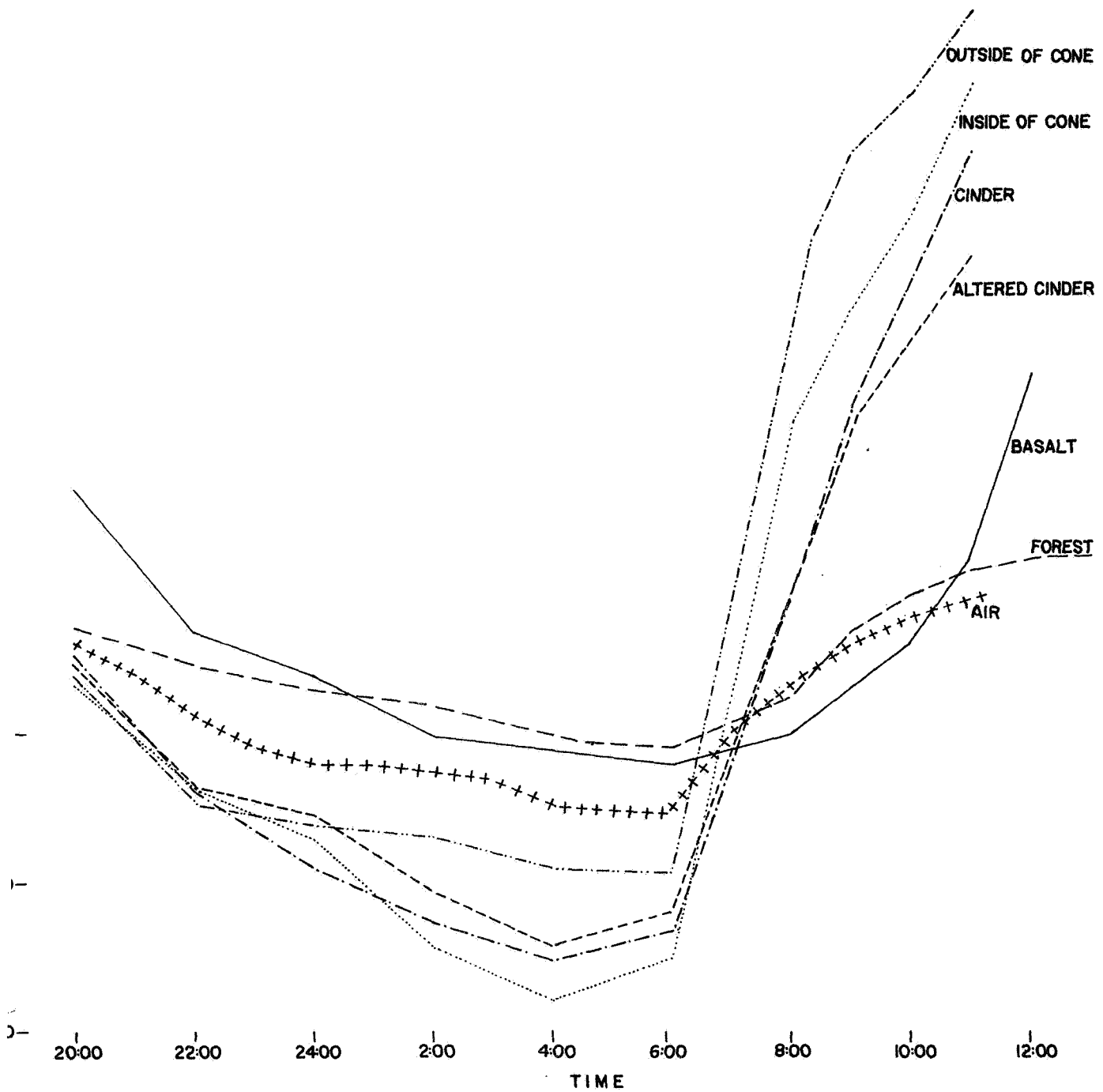
DIGATIC READINGS

RADIOMETER
 (8-14μ) READINGS

Time	Run	Microwave Polarization	Basalt	Grey Cinder	Red Cinder	Site #1 12: cinder	Site #1 4" cinder	Site #1 2" cinder	Site #1 1/2" cinder	Site #1 Air	Site #2 18" cinder	Site #2 6" cinder	Site #2 2" cinder	Site #2 1/2" cinder	Site #2 Air	Site #3 Basalt Air temp.	Site #3 at 3'	Site #3 Basalt Air Temp.	Site #3 at 2'	Rel. Humidity
03:05						20.5	17.9	14.8	8.0	7.9	22.0	22.5	16.7	5.2	8.0	16.8	17.0	9.3		85%
03:10	2	10E																		
03:15	3	10H																		
03:20			13.4	5.5	5.8	20.7	17.7	14.5	7.8	7.0	22.0	22.3	16.2	5.0	6.5	16.2	16.4	10.5		
03:25	4	10H																		
03:30																				
03:40	6	30E																		
03:45			12.8	5.2	5.5															
03:50																				
03:55	8	30H																		
04:05	9	45E																		
04:11			12.3	4.4	5.0															
04:20																				
04:25																				
04:30	12	45H																		
04:35			10.0	3.3	4.4															
04:45																				
04:50																				

Table 1 con't

All temperatures in degrees C



DIURNAL RADIOMETRIC TEMPERATURES - JULY 24-25, 1968
 MT. LASSEN - CINDER CONE

Figure 2

SOIL MOISTURE

The following soil moisture determinations were made in the lab from field samples sealed in steel cans. The 100 to 150 gram samples were opened, weighed, dehydrated by roasting for 2½ hours at 105° C and reweighed for moisture loss. The cans were cleaned and weighed and their weight subtracted from the wet and dry weights before weight percent moisture was calculated. Experimentation has shown that well sealed samples will retain their moisture for as much as a month. All of the samples reported here were processed within 72 hours after having been taken.

Samples N1056-N1119 were taken during the overflights along the flight lines (see figure 1). Samples N1120-N1131 were taken on the cinder cone several days later as back up data and should be regarded as approximate moistures (see table 2). However, no rain or abnormal temperatures occurred either before the overflight or between the overflight and the second sampling of the cinder cone so that both sets of samples represent equilibrium conditions and can be approximately correlated.

Mt. Lassen

July 18, 1968

<u>Sample No.</u>		<u>Wt. Percent Moisture</u>
N1056	(Line 1A Day surface)	0.00
N1057	(Line 1A Day 2")	0.07
N1058	(Line 1A Day 6")	1.51
N1059	(Line 1A Day 8")	5.53
N1060	(Line 1B Day surface)	0.07
N1061	(Line 1B Day 2")	0.08
N1062	(Line 1B Day 6")	1.45
N1063	(Line 1B Day 8")	4.39
N1064	(Line 1C Day surface)	0.08
N1065	(Line 1C Day 2")	0.13
N1066	(Line 1C Day 6")	2.51
N1067	(Line 1C Day 8")	4.65
N1068	(CM-1 surface)	0.05
N1069	(CM-1 2")	0.15
N1070	(CM-1 6")	0.33
N1071	(CM-1 12")	4.42
N1072	(CM-2 surface)	0.07
N1073	(CM-2 2")	0.22
N1074	(CM-2 6")	5.01
N1075	(CM-2 12")	5.37
N1076	(CM-3 surface)	0.00
N1077	(CM-3 2")	0.00
N1078	(CM-3 6")	3.23
N1079	(CM-3 12")	4.67
N1080	(CM-4 surface)	0.02
N1081	(CM-4 2")	0.15
N1082	(CM-4 6")	3.02
N1083	(CM-4 12")	5.68
N1084	(CM-5 surface)	0.11
N1085	(CM-5 2")	0.91
N1086	(CM-5 6")	3.67
N1087	(CM-5 12")	7.19

Table 2

Mt. Lassen

July 19, 1968

<u>Sample No.</u>		<u>Wt. Percent Moisture</u>
N1088	(CC #1 surface)	0.00
N1089	(CC #2 surface)	0.04
N1090	(CC #3 surface)	0.02
N1091	(CC #4 surface)	0.01
N1092	(Line 1A Night surface)	0.18
N1093	(Line 1A 2")	0.00
N1094	(Line 1A 6")	0.04
N1095	(Line 1A 8")	1.07
N1096	(Line 1B Night surface)	0.26
N1097	(Line 1B Night 2")	0.05
N1098	(Line 1B Night 6")	0.06
N1099	(Line 1B Night 8")	1.94
N1100	(Line 1C Night Surface)	0.35
N1101	(Line 1C Night 2")	0.09
N1102	(Line 1C Night 6")	0.14
N1103	(Line 1C Night 8")	1.29
N1104	(CM-1A surface)	0.06
N1105	(CM-1A 2")	0.08
N1106	(CM-1A 6")	1.42
N1107	(CM-1A 12")	3.88
N1108	(CM-2A surface)	0.13
N1109	(CM-2A 2")	0.22
N1110	(CM-2A 6")	4.09
N1111	(CM-2A 12")	5.99
N1112	(CM-4A surface)	0.09
N1113	(CM-4A 2")	0.08
N1114	(CM-4A 6")	3.28
N1115	(CM-4A 12")	5.42
N1116	(CM-5A surface)	0.57
N1117	(CM-5A 2")	0.33
N1118	(CM-5A 6")	6.65
N1119	(CM-5A 12")	9.70

Table 2 con't

Mt. Lassen
Cinder Cone
July 24-25, 1968

<u>Sample No.</u>	<u>Wt. Percent Moisture</u>
N1120 (CCM-1 surface)	0.04
N1121 (CCM-1 2")	0.19
N1122 (CCM-1 6")	5.61
N1123 (CCM-1 12")	14.45
N1124 (CCM-2 surface)	0.31
N1125 (CCM-2 2")	2.08
N1126 (CCM-2 6")	10.20
N1127 (CCM-2 12")	9.46
N1128 (CCM-3 surface)	0.10
N1129 (CCM-3 2")	0.06
N1130 (CCM-3 6")	7.39
N1131 (CCM-3 12")	7.83

Table 2 con't

J.P.L. MICROWAVE RADIOMETER MEASUREMENTS

The 9.2 GHz portable microwave radiometer, built by Jet Propulsion Laboratories, was operated at the site during the overflights to obtain ground information on microwave temperatures. During the day flight, flight #4, ground based radiometer runs were made on water in Butte Lake and on an heterogeneous pile of blocky basalt, during the pre-dawn flight, flight #5, only the basalt was used as a target. The targets were examined at look angles of 10° , 30° and 45° , the same as those of the airborne MR 62, MR 64 system. The partially reduced tabular data includes instrument parameters as well as the microwave temperatures, listed in the column marked T_3R .

Figure 3 shows a plot of microwave temperature with varying look angle for water during flight 4. Figures 4 and 5 show temperature vs. look angle plot for the blocky basalt on flights 4 and 5 respectively. The lower temperatures at 30° look angle are due to the particular blocky surface used as a target and should not be taken as representative of all the basalt surfaces. The rough irregular surfaces also account for the generally depolarized signal and the relative independence of temperature and look angle out to at least 45° .

Reduced Radiometer Data

Mt. Lassen
July 18, 1968

Horizontal: TB(COR) -1.42
T(CAL) 30.72
Vertical: TB(COR) -2.35
T(CAL) 30.37

Table 3

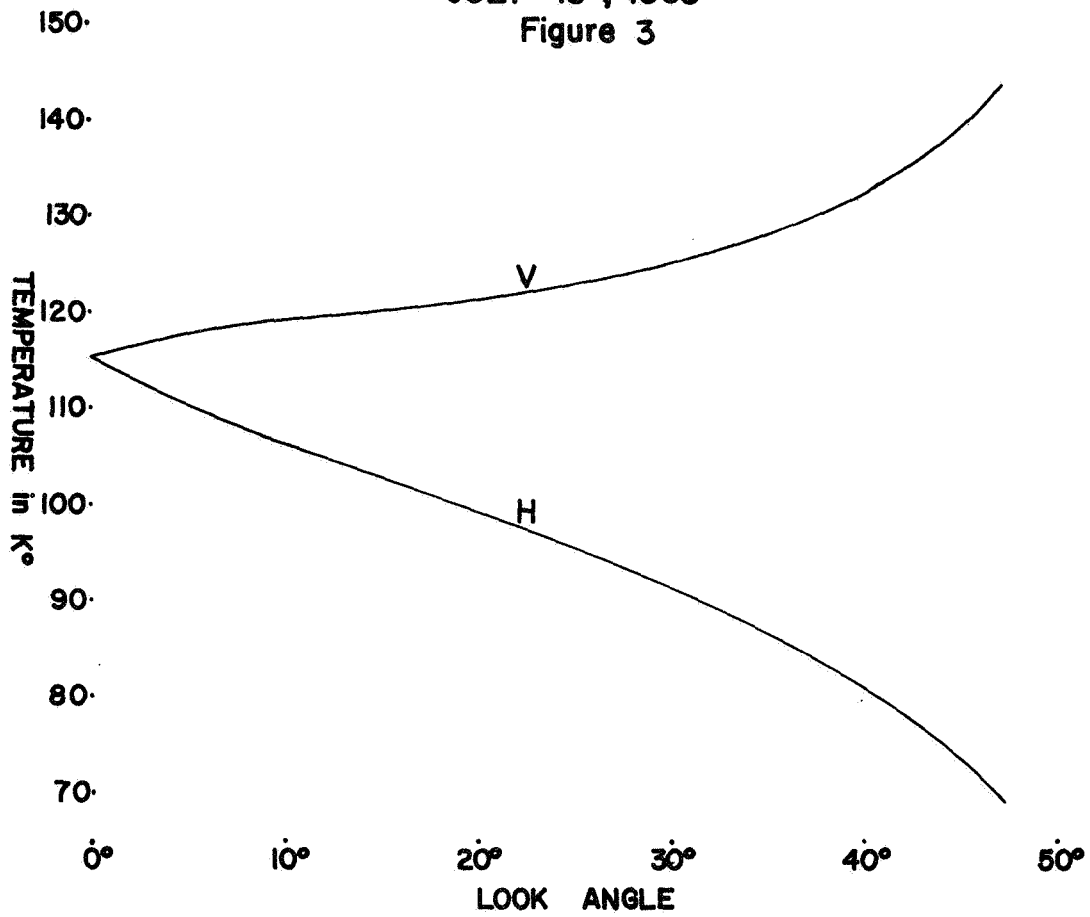
SITE	TIME	T _{3R}	T ₁	Butte Lake		ΔTB	COMMENTS
				α	Water Site X		
	09:50	119.09	298.20	89.00	.287	.031	10°V
	09:55	125.34	298.50	88.11	.286	.053	30°V
	10:00	139.14	298.80	88.78	.291	.018	45°V
	10:03	-10.50	298.90	90.37	.274	.059	180°V
	10:15	106.46	299.50	88.19	.276	.110	10°H
	10:18	91.62	301.10	89.07	.277	.045	30°H
	10:20	73.97	301.00	89.61	.276	.134	45°H
	10:25	-2.79	298.20	93.53	.266	.014	180°H
Basalt Site							
	11:26	278.77	305.00	91.08	.256	.055) In error 10°H
	11:30	267.02	305.00	92.98	.250	.465) T.C. wire 30°H Run 2
	11:36	271.60	305.00	94.18	.245	.113) shorted 45°H
	11:43	-12.79	315.80	95.27	.237	.281	ok 180°H
	12:00	288.28	316.00	91.60	.233	.137	Run 6 10°V
	12:02	283.30	316.00	93.37	.236	.126	30°V
	12:05	288.79	316.00	93.50	.232	.187	45°V
	12:10	-12.37	316.00	95.37	.232	.243	180°V
	12:40	-12.86	319.00	96.67	.222	.073	180°V
	12:42	291.13	318.00	93.60	.227	.089	45°V
	12:45	286.61	318.30	93.58	.226	.070	30°V
	12:47	291.65	318.50	93.23	.225	.107	10°V
	12:55	291.79	318.50	95.75	.222	.110	10°H
	12:58	282.26	317.80	95.55	.220	.096	30°H
	13:00	287.64	317.90	95.21	.220	.033	45°H
	13:04	-16.76	318.50	98.75	.215	.315	180°H

SITE	TIME	T ₃ R	T ₁	α	\bar{X}	ΔT_B	COMMENTS
	14:35	-8.62	315.50	99.64	.228	.070	180°H
	14:40	289.17	315.90	96.92	.236	.112	45°H
	14:44	285.17	315.90	97.62	.235	.117	30°H
	14:46	294.04	315.90	97.29	.232	.043	10°H
	14:54	293.56	316.00	95.67	.231	.043	10°V
	14:58	290.14	316.00	96.21	.232	.226	30°V
	15:02	293.41	316.00	96.32	.231	.067	45°V
	15:04	-9.71	316.50	98.24	.234	.260	180°V
Basalt Site July 19, 1968							
	02:28	-8.13	295.50	96.21	.288	.101	180°V
	02:31	270.74	296.50	91.74	.290	.005	45°V
	02:36	265.03	298.00	92.34	.292	.037	30°V
	02:40	268.19	299.00	90.72	.292	.068	10°V
	02:48	266.86	300.90	90.75	.291	.054	10°H
	02:52	260.87	301.90	90.73	.290	.018	30°H
	02:55	265.22	302.10	91.70	.290	.037	45°H
	02:59	-10.49	302.50	93.97	.283	.012	180°H
	03:06	264.60	304.20	91.67	.290	.073	45°H
	03:10	260.88	306.00	90.94	.292	.018	30°H
	03:15	266.54	307.00	91.66	.292	.011	10°H
	03:24	267.57	308.50	90.25	.292	.036	10°V
	03:30	264.63	308.20	90.94	.290	.005	30°V
	03:32	269.67	308.20	90.24	.290	.032	45°V
	03:35	-9.87	308.20	92.52	.285	.005	180°V
	03:45	269.15	309.20	90.79	.289	.163	45°V
	03:48	263.88	309.20	90.41	.286	.099	30°V
	03:52	266.04	309.50	91.46	.288	.069	10°V
	03:59	263.24	309.50	91.41	.286	.014	10°H
	04:03	258.89	310.00	91.69	.285	.123	30°H
	04:09	263.44	310.10	92.71	.284	.060	45°H
	04:11	-16.19	310.10	95.51	.281	.091	180°H

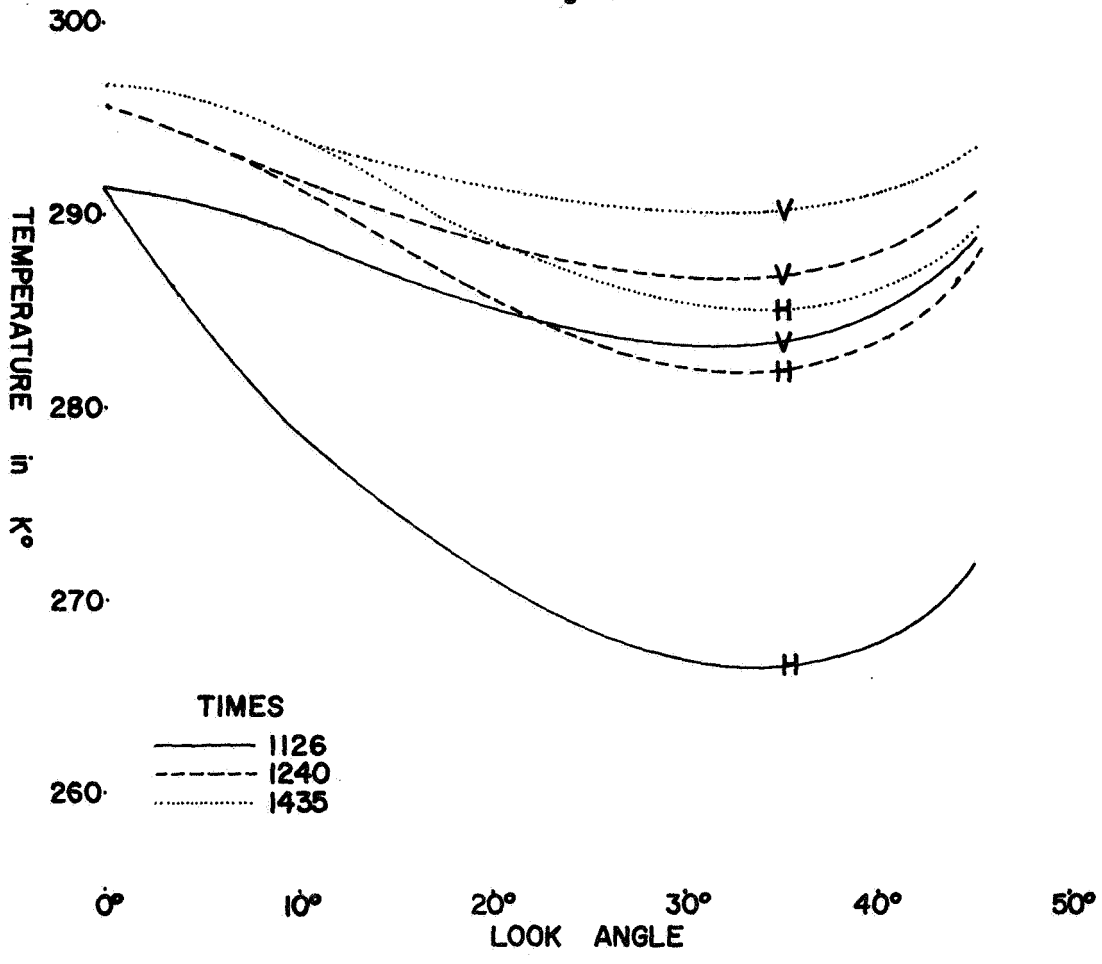
Table 3 con't

<u>SITE</u>	<u>TIME</u>	<u>T_{3R}</u>	<u>T₁</u>	<u>α</u>	<u>\bar{X}</u>	<u>ΔTB</u>	<u>COMMENTS</u>
	04:15	263.03	310.20	92.68	.287	.171	45°H
	04:19	257.80	310.20	92.38	.285	.134	30°H
	04:22	264.43	310.20	92.16	.285	.100	10°H
	04:30	264.32	310.20	91.88	.285	.060	10°V
	04:34	262.59	310.50	91.89	.285	.018	30°V
	04:37	262.65	311.00	92.46	.288	.134	45°V
	04:40	-13.44	311.00	94.98	.281	.014	180°V
							Run 11
							Run 12

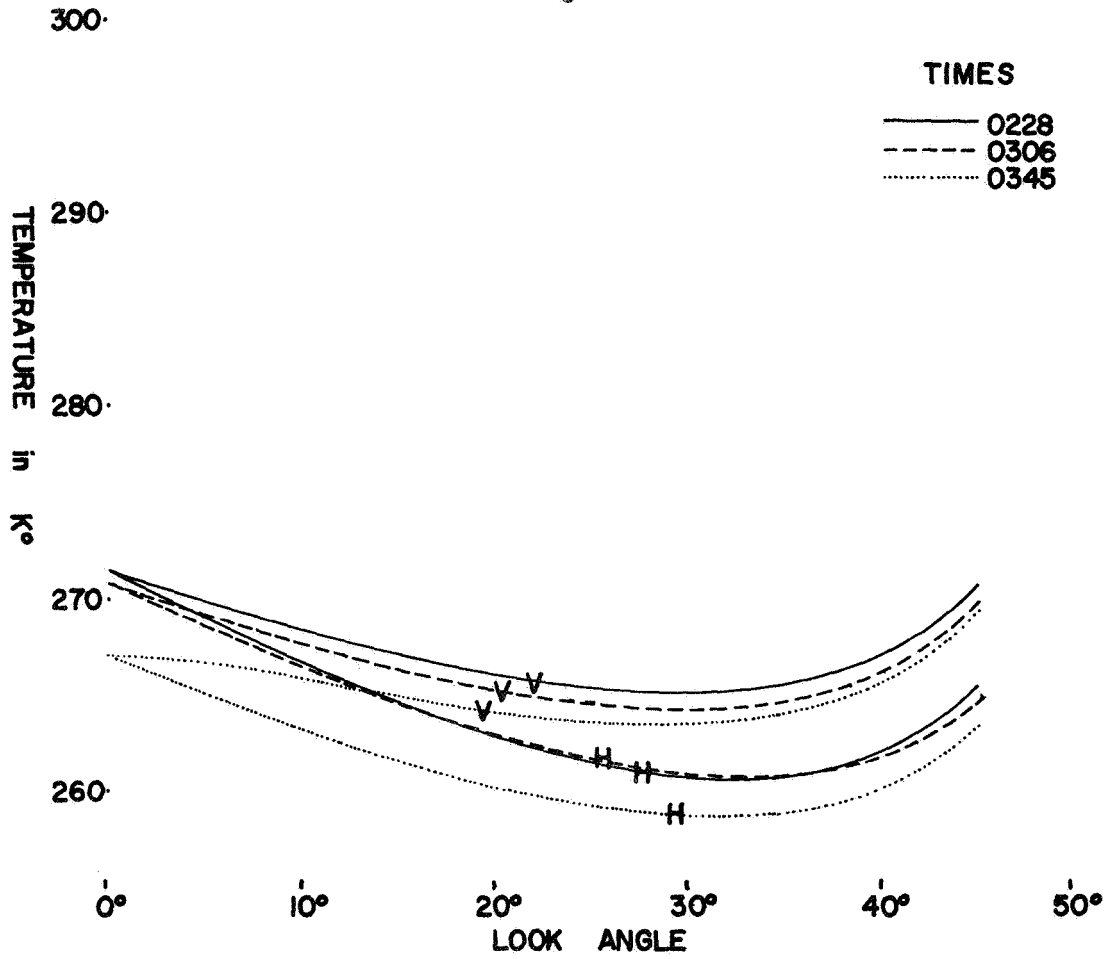
9.2ghz MICROWAVE TEMPERATURES
WATER - BUTTE LAKE
JULY 18 , 1968
Figure 3



9.2ghz MICROWAVE TEMPERATURES
 BASALT - BUTTE LAKE
 JULY 18 , 1968
 Figure 4



9.2ghz MICROWAVE TEMPERATURES
 BASALT - BUTTE LAKE
 JULY 19 , 1968
 Figure 5

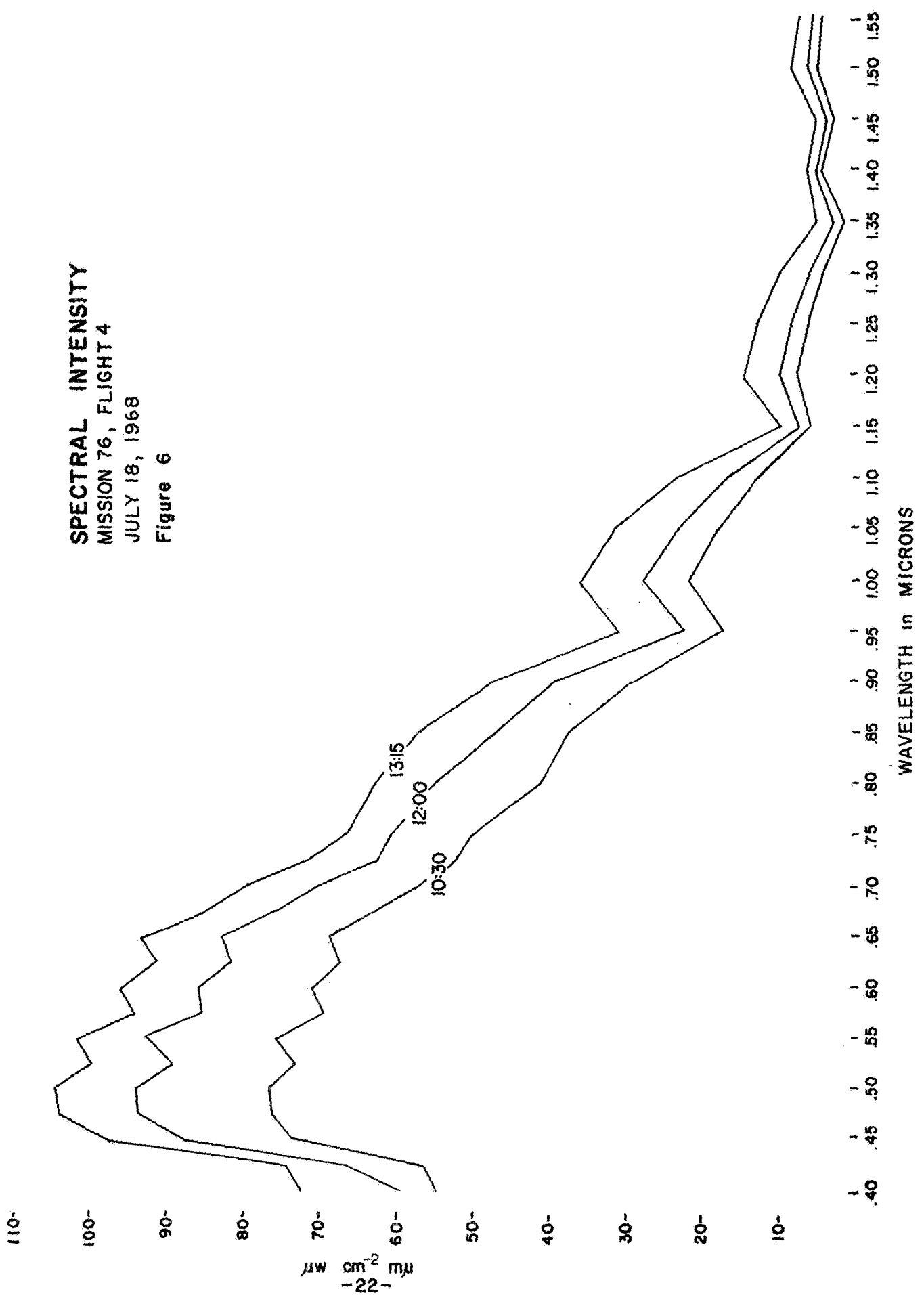


VISIBLE AND NEAR-INFRARED SPECTRAL INTENSITY MEASUREMENTS

Spectral intensity data is obtained with an ISCO visible and near-infrared spectrometer in the ranges .38 to 1.55 microns. The curves presented here are generated from measurements taken at .25 μ intervals from .40 μ to .75 μ and .05 μ intervals in the range .75 μ to 1.55 μ . The readings are not closely enough spaced to delineate absorption bands. The curves are designed to show only the major broad characteristics of the spectra and not fine detail.

The spectral intensity plots made during the day flight are sky spectra corrected for instrument response to give true intensities in microwatts per square centimeter per millimicron (see figure 6).

SPECTRAL INTENSITY
MISSION 76, FLIGHT 4
JULY 18, 1968
Figure 6



DENSITY AND POROSITY MEASUREMENTS

In situ bulk density measurements are made with a gamma probe. A series of four runs are made and averaged for each determination. The instrument is calibrated using a standard granite block. The effective depth over which the probe integrates density in cinder is approximately 6" to 8".

Approximate porosity is calculated from the density measurements. The calculations assume a solid rock density of 2.8 grams per cubic centimeter, as approximated from mineral compositions.

DENSITY

Mt. Lassen - cinder

Table 4

<u>Site</u>	<u>d in lb/ft³</u>	<u>d in g/cm³</u>	<u>% porosity</u>
D-1	92.5	1.48	44.2
D-2	99.5	1.59	40.0
D-3	97.0	1.55	41.6
D-4	99.5	1.59	40.0
D-5	98.0	1.57	40.8
D-6	94.5	1.51	43.1
D-7	91.0	1.45	45.3
D-8	98.0	1.57	40.8
			41.9=Average

SEISMIC CINDER DEPTH STUDY

Two easily differentiable types of cinder occur in the area around the cinder cone. The black fresh cinder and the vari-
gated altered cinder seem to be basically similar in depth and composition, the only difference being the oxidation state of the iron.

Surface probing has been done on the cinder and shallow seismic work done on both the basalt flows and cinder in order to try and determine depths and vertical discontinuities.

The surface probing failed to show either bedrock or significant vertical change in any of approximately 100 test holes pushed to a depth of two to three feet. The holes did show that just after the disappearance of the last of the snow, moisture lay 4" to 9" below the surface of the cinder. It also showed that a small amount of mechanical transport occurs in the cinder fields and that each of the small cinder hills is flanked by an apron of detrital cinder washed from the tops of hills. This apron of sorted cinder is between 4" and 12" on the sides of the hills and in the small drainages.

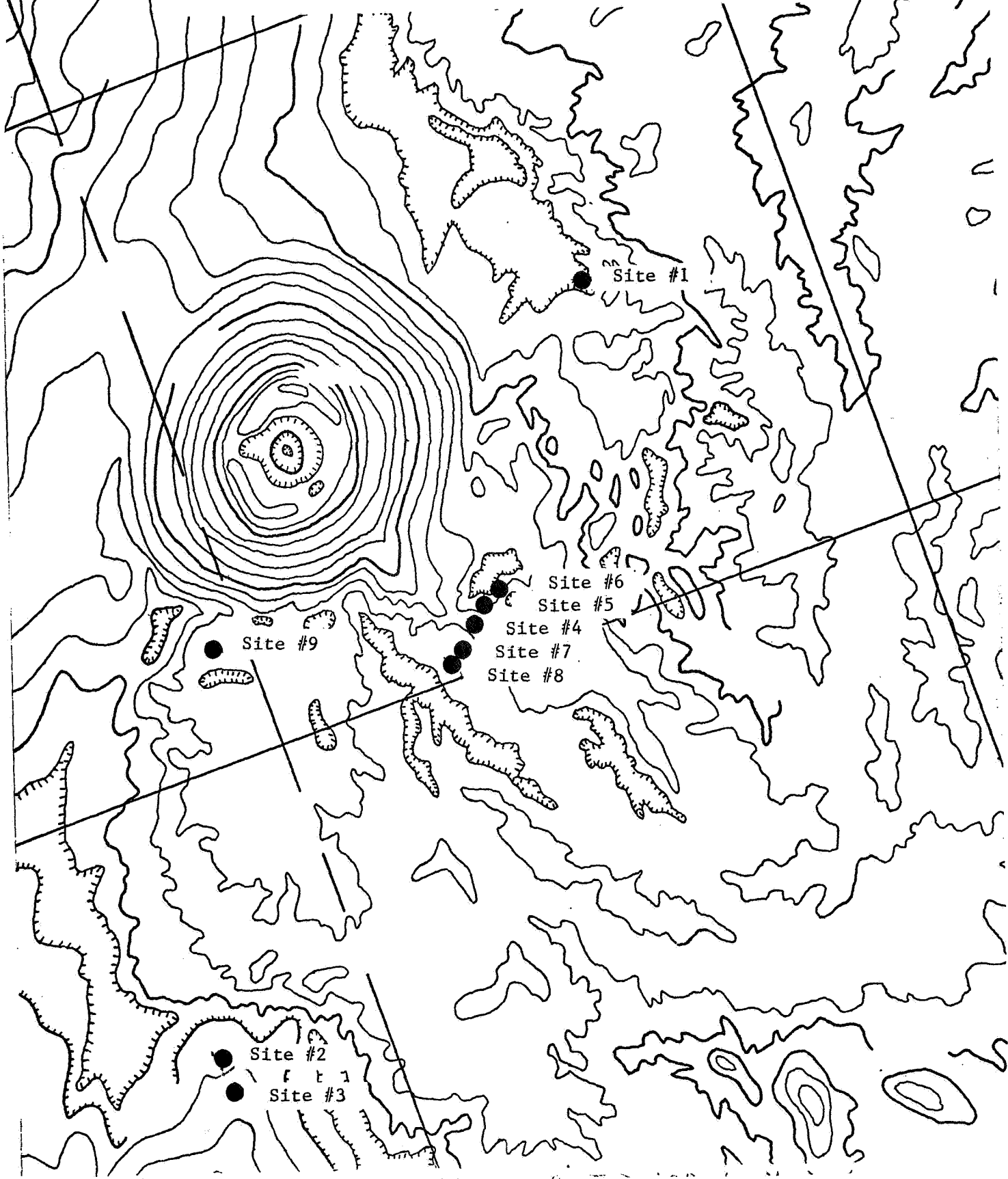
The shallow seismic data shows rather consistent velocities on both the cinder and the lava flows, thus, it is impossible to differentiate blocky lava from cinder by this method. Figure 7 shows the locations of the shallow seismic sites. Most of the velocities fall into three ranges: 400-900fps, 1000-1200fps and 3100-3800fps; these are interpreted as dry uncompacted material, moist semicompact material, and either

a dense basement or an unknown material below the water table respectively. In three of nine sites the low velocity surface layer was noted. At the other sites it was either too thin to be recorded or the geophones were buried below the layer to make better contact. At only two sites were layers with velocities intermediate to the above ranges encountered. These velocities probably represent an intermediate water content or is a compaction phenomenon. Table 5 shows the velocities of the various layers at the various sites. Figure 8 indicates graphically the depths at which the various velocities were encountered.

Table 5

	Vsurf	V ₁	V ₂
#1	-	1160	3700
#2	-	1105	3700
#3	-	1100	3650
#4	-	1000	-
#5	450	1070	-
#6	700 (925)	1280	-
#7	-	1100	3150
#8	700	-	3750
#9	780	1200(1410)	-

CINDER CONE AREA - MT. LASSEN
INDEX OF SEISMIC SITES
Figure 7



INTERPRETED VERTICAL PROFILES FROM SEISMIC DATA , CINDER CONE AREA - MT. LASSEN

Figure 8

