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RESULTS OF GEOPHYSICAL STUDIES
ON THE MCMURDO
TO SOUTH POLE TRAVERSE

by Edwin S. Robinson

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The University of Wisconsin
Geophysical and Polar Research Center
6021 South Highland Road
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Madison 5, Wisconsin



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Results of Geophysical Studies on the
McMurdo to South Pole Traverse

Introduction

Geophysical studies were conducted on the McMurdo to South Pole Traverse which departed from McMurdo Sound on December 10, 1960 and completed the journey to the South Pole on February 12, 1961. The traverse route is shown in Figure 1.

The scientific program was carried out between station 100 and the South Pole since the section between McMurdo Sound and station 100 had been studied by previous traverse parties. The party consisted of eight men: three geophysicists, three glaciologists, and two traverse engineers. Two Tucker Sno-Cats Model 843, and one Sno-Cat Model D742-AN were used. The D742-AN Sno-Cat was mounted with a power drill rig for use in drilling seismic shot holes. Supplies were carried in Rolli-Trailers and 1 ton sleds towed by the Sno-Cats.

The group traveled from station 100 to the South Pole in two parties, approximately 5 km apart. Stops were made every hour for minor stations; the rear party occupied the position previously occupied by the lead party. Two days were spent traveling approximately 60 nautical miles, then a 1-day major station was established for more detailed scientific work.

Fourteen major stations and 267 minor stations were made. The following are scientific studies included in this report:

- 1) Barometric altimetry at all stations.
- 2) Seismic reflection and refraction recordings at major stations.
- 3) Gravimetric observations at all stations.
- 4) Magnetic observations at all stations.

This report presents the methods and results of data reduction and a brief discussion of the results. The glaciological and meteorological studies will be discussed elsewhere.

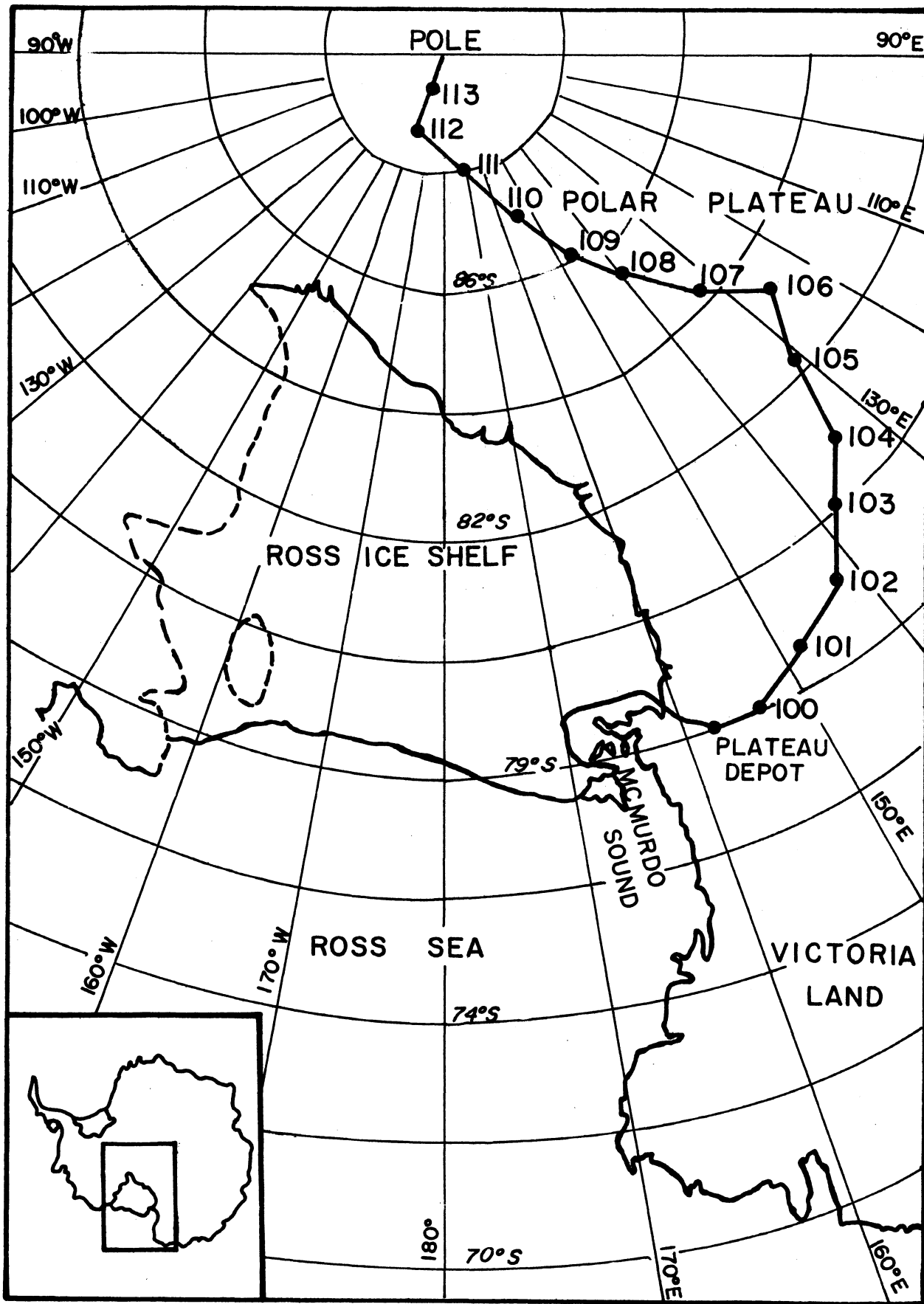


FIGURE 1: MAP SHOWING TRAVERSE ROUTE

Surface Elevation Determination

Ice surface elevation was determined by summing up the corrected differences between altimeter readings of instruments occupying adjacent stations. Readings were obtained simultaneously by radio contact and/or synchronized watch times. In addition, readings were obtained simultaneously with both vehicles at the same site at the beginning and the end of each day.

Model FA 181 Wallace and Tiernan Altimeters, graduated in 5-m intervals and read to the nearest meter, were used. In the leading vehicle Serial No. 15813B was used throughout the traverse, with Serial No. DD03489 included from station 111 to the South Pole. In the rear vehicle instruments No. 15814B and No. 15816B were read throughout. In both vehicles instrument temperatures, ambient air temperature, wind speed, and wind direction were recorded at all sites.

The readings were first corrected for instrument temperature from the charts accompanying the meter. Comparisons were then made of the instrument readings when they were read at the same time and at the same location. No. 15814B and No. 15816B were located side by side with No. 15816B reading about 8 m higher during late December and early January. This difference decreased, and by the middle of January the altimeter readings were nearly the same. Late in January and in early February No. 15814B read about 5 m higher than No. 15816B. The difference appeared to be elevation dependent. About the same differences were observed between No. 15813B and No. 15814B while No. 15813B and No. 15816B were consistent, suggesting that the calibration of No. 15814B was in error for the elevation ranges encountered.

In the interval method used this error in calibration probably was not so serious as was the daily scattering of altimeter differences. If, for example, the readings taken simultaneously at the same site showed No. 15813B to be 3 m higher at the start and at the end of a day's travel, this value of 3 m was subtracted from all the No. 15813B readings before the differences were obtained. However, if the initial difference were 3 m and the final difference, after a 12-stop day, were 7 m then the change from 3 m to 7 m was interpolated, assuming the difference to be linear. If in reality the difference were 3 m until the 12th stop, then through instrument or observational error jumped to 7 m, the error accumulated during the 12-stop run would be 22 m. The differences used have been those between the pair of instruments that showed more consistent initial and final readings. Table 1 lists the differences between instruments in different vehicles for all the observations.

Table 1

Altimeter Differences, beginning and
end of daily runs.

Date	No. of Minor Stations	Differences			
		<u>15813-15814</u>	<u>15813-15816</u>	<u>15816-009489</u>	<u>15814-009489</u>
29 Dec.	2	2, 8 m	1, 2 m		
29 Dec.	4	8, 9	2, 4		
30 Dec.	10	9, 7	3, 0		
31 Dec.	10	9, 11	0, 5		
2 Jan.	4	7, 8	-1, 2		
3 Jan.	11	4, 11	-3, 2		
4 Jan.	7	8, 11	0, 2		
6 Jan.	10	12, 6	2, -2		
7 Jan.	11	10, 8	2, 0		
9 Jan.	11	9, *	1, *		
10 Jan.	11	9, 8	0, 3		
11 Jan.	4	5, 8	3, 4		
12 Jan.	11	7, 6	4, 5		
13 Jan.	8	5, 6	5, 3		
14 Jan.	5	5, 5	3, 4		
15 Jan.	11	6, 4	5, 4		
16 Jan.	5	2, 7	3, 3		
18 Jan.	10	4, 4	6, 5		
19 Jan.	11	1, 5	3, 3		
21 Jan.	11	3, 1	5, 4		
22 Jan.	10	0, 5	5, 4		
25 Jan.	2	-3, 6	2, 8		
26 Jan.	5	2, 5	4, 6		
27 Jan.	11	2, 3	4, 3		
28 Jan.	5	2, 4	2, 6		
31 Jan.	10	4, 5	5, 5		
2 Feb.	10	3, 3	4, 5		
3 Feb.	11	3, -3	5, *		
4 Feb.	8	-4, -6	5, -1		
6 Feb.	5	-5, -1	2, 4	10, 9 m	17, 14 m
6 Feb.	3	-1, -2	4, 3	9, 12	14, 17
7 Feb.	11	-2, -4	7, 2	7, 9	16, 15
8 Feb.	2	-4, -4	2, 2	8, 9	14, 18
8 Feb.	2	-4, 1	2, 7	9, 8	18, 14
10 Feb.	3	-5, 4	2, 6	9, 6	6, 8
10 Feb.	3	4, 1	6, 5	6, 10	8, 14
11 Feb.	6	1, 4	6, 7	5, 4	10, 7
12 Feb.	7	2, *	5, *	5, *	8, *

*No Readings Made.

1st reading is difference at start (vehicles together).

2nd reading is difference after "number of minor stations" (vehicles together again).

15813, 009489 in lead vehicle.

15814, 15816 in back vehicle.

After the altimeter differences had been obtained between stations, these figures were corrected for air temperature using a graph of multiplication factors based on the following figures:

-10° C., 0.928; -20° C., 0.892; -30° C., 0.857 and -40° C., 0.821

Corrections for horizontal pressure gradient were made using daily charts of the 700 millibar surface prepared by the International Antarctic Analysis Center in Melbourne, Australia.

The differences between minor stations were then added for the accumulated changes. Using a value of 2282 m at station 100 (station 84 of the 1958-59 Victoria Land Traverse), the elevation at the South Pole was 2832 m. From two different studies made by the Polar Analysis Group at the U. S. Weather Bureau, comparisons were made of the upper atmosphere parameters between the South Pole data and data at Little America and at Ellsworth Station. An average figure of 2800 m was obtained by this method for the elevation at the South Pole (Rubin, personal communication). Reliable figures cannot be given for the probable error of the results in either the altimetry or meteorological method but they might be estimated as accurate to about 50 m. For the sake of uniformity the value of 2800 m has been adopted for the South Pole elevation. The 32-m adjustment was done by linear distribution over the traverse route. The adjusted values of all minor and major stations are given in Appendix I.

Navigation

Positions of all major stations and some minor stations were determined by sun shots, the normal procedure being 3 sun shots approximately 2 hours apart. The positions of the intermediate minor stations were obtained by interpolation between sun shot positions using Sno-Cat odometer readings which were taken at every station. Appendix I lists station positions; the underlined values indicate sun shot positions. A more detailed discussion of position determination is given by Meyer (1961).

Seismic Investigations

Reflection shooting. Seismic reflection recordings for ice thickness determination were made at fourteen stations. Reflections from the ice-rock interface were identified at eleven stations, the quality ranging from excellent to poor, depending on the extent of prolonged surface noise interfering with the reflected signal.

Shots of from 0.5 Kgm. to 4 Kgm. of Nitramon explosive were fired in the center of a 735-m spread with 30.5-m geophone spacing. Shot holes varied from 28 m to 41 m in depth and were bored with a mechanical auger. Houston Technical Laboratories 7000B seismic equipment was used. Twelve of the geophones had a resonant frequency of 7 cps and the others were of 20 cps and 30 cps.

Various amplification settings and frequency pass bands were used for recording. The highest reflection signal to noise ratio resulted from a pass band between 210 cps and 320 cps. Best reflections were obtained by firing a small charge in as deep a hole as it was possible to drill, using high amplification and high pass band settings.

Ice thickness was calculated from reflection arrival times corrected for velocity variation with depth (discussed in section on refraction shooting). Range of error was estimated on the basis of two sources: 1) reading error in picking arrivals (± 5 milliseconds; or ± 10 m) and 2) use of different velocities (± 40 m). Ice thickness, rock surface elevation, and reflection times are given in Table 2.

Dip calculation was possible only for station 110 where a rock surface dip of 3° in a N30W direction was measured.

Table 2

<u>Station</u>	Seismic Reflection Results		<u>Arrival Time</u> sec.
	<u>Ice Thickness</u> m	<u>Rock Surface Elevation</u> m	
101	2540 ± 50	- 170	1.33 (A)* 1.336 (C) 1.331 (D)
102	2920 ± 50	- 515	1.523 (A) 1.524 (B)
103	2975 ± 50	- 575	1.551 (B) 1.552 (C)
104	2410 ± 50	+ 170	1.260 (A) 1.258 (B) 1.260 (C)
105	3050 ± 60	- 295	1.592 (C) 1.584 (D) 1.588 (E)

Table 2 con't.

Seismic Reflection Results			
<u>Station</u>	<u>Ice Thickness</u> m	<u>Rock Surface Elevation</u> m	<u>Arrival Time</u> sec.
106	2760 ±50	+ 130	1.443 (S) 1.438 (T)
107	3520 ±70	- 725	1.83 (A) 1.84 (B) 1.825 (C) 1.84 (D)
108	2650 ±50	+ 170	1.39 (A) 1.383 (B) 1.388 (D)
109	No Reflection		
110	2790 ±50	+ 170	1.458 (A) 1.457 (B) 1.457 (C)
111	1985 ±60	+1110	1.04 (B) 1.049 (C) 1.05 (D)
112	2600 ±50	+ 405	1.366 (D) 1.364 (E)
113	No Reflection		
114	2840 ±50	- 40	1.467 Kapitza 1959, 1.468 1 mile grid north 1.466 of South Pole
	2880 ±50	- 80	1.508 Robinson & Thiel 1959, 3 miles grid north of South Pole

* letters designate particular record

Refraction shooting. Seismic refraction shooting was undertaken at eight stations to determine P-wave velocity variation with depth, and maximum P-wave velocity in ice. Refraction profile distances are given in Table 3. For comparison between stations values of mean P-wave velocity were obtained at each seismic station by making a straight line least square fit of travel time points from first arrivals on the five most distant traces on reflection records (Table 4). Arrivals, picked from records with the aid of a magnifier, are considered accurate to ± 0.0002 seconds.

Table 3
Summary of P-Wave Refraction Profile Distances

<u>Station</u>	<u>Profile</u> meters	<u>Geophone Spacing</u> meters
105	0-366	30.5
106	0-18	$\frac{1}{2}$
"	15-311	2
"	300-990	10
108 ¹	5000-5735	30.5
" ¹	10,000-10,735	30.5
109	300-2735	30.5
110 ₁	0-366	30.5
" ¹	15,000-15,735	30.5
111	0-365	30.5
"	0-18	$\frac{1}{2}$
"	0-246	2
"	0-194 (S-waves)	2
112 ²	700-5300	30.5
"	12,000-12,735	30.5
"	0-12	$\frac{1}{2}$

¹Unusable record because charge did not completely detonate

²Following arrivals used: P, PP, PPP, PPPP, P PPPP

Table 4

Velocities Computed From Last Five Traces of Reflection Records

<u>Station</u>	<u>Velocity</u> m/sec.	<u>Shothole Depth</u> meters
101	3370	28.0
102	3478	32.8
103	3592	37.8
104	3738	35.9
105	3779	36.2
106	3751	39.6
107	3555	38.3
108	3584	38.9
109	3697	38.7
	3756	
110	3470	39.5
111	3482	38.7
112	3164	41.4
113	3177	34.6
South Pole	3161	38.0

Travel time curves were plotted for each refraction profile. Travel time curves for short distances are shown in Figure 2. Velocities were picked from the curves at distances near to the shot by laying a straight edge tangent to the curve. At greater distances, where velocity change over the spread was small, a straight line was fitted to the travel time points by a method of least squares to obtain average velocity over the spread. The velocity-distance points were used to compute velocity-depth points by the Herglotz-Bateman-Wiechert numerical integration (Appendix 2 and Figure 3). The velocity-depth data were used to calculate vertical travel times to depths of maximum energy penetration (Table 5).

Table 5

Vertical Travel Times One Way to Various Depths

<u>Station</u>	<u>Depth</u> m	<u>Time</u> sec	<u>Velocity</u> m/s	<u>Depth</u> m	<u>Time</u> sec	<u>Velocity</u> m/s
105	73	.028	3840	75	.028	3880
106	73	.031	3810			
109	73	.033	3520	108	.061	3921
110	73	.032	3360	80	.034	3460
111	73	.033	3400	80	.035	3480
112	73	.035	3140	180	.064	3895
112	--	----	----	325	.102	3905

At station 109 the refraction profile was continued to a distance of 2.7 km where a cross spread velocity of 3921 ± 30 m/s was recorded at a depth of approximately 180 m. The one-way vertical travel time to this depth was 0.061 sec. At station 112 the refraction profile was carried out to 13.7 km using first arrivals and multiple arrivals. A cross spread velocity of 3895 ± 30 m/s was recorded at 5-km distance and the depth of penetration was about 325 m. At 13.7 km a velocity of 3905 ± 30 m/s was recorded, but since there were no records for distances between 5 km and 12 km it was assumed that the velocity of 3905 m/s was reached shortly beyond 5 km. Vertical travel time one-way to 325 m depth was .102 sec. at station 112.

Using the velocity data from station 109, ice thickness is given by the formula:

$$H = \left(\frac{T}{2} - 0.061\right) 3921 + 180,$$

and using data from station 112, the formula is:

$$H = \left(\frac{T}{2} - 0.102\right) 3905 + 325,$$

where H = ice thickness in meters,

T = reflection time in seconds corrected to the surface from measured uphole time.

Ice thickness at each reflection station was calculated from both formulas. A preferred value was selected on the basis of a comparison of the velocity computed from the reflection record with similar velocities measured at stations 109 and 112.

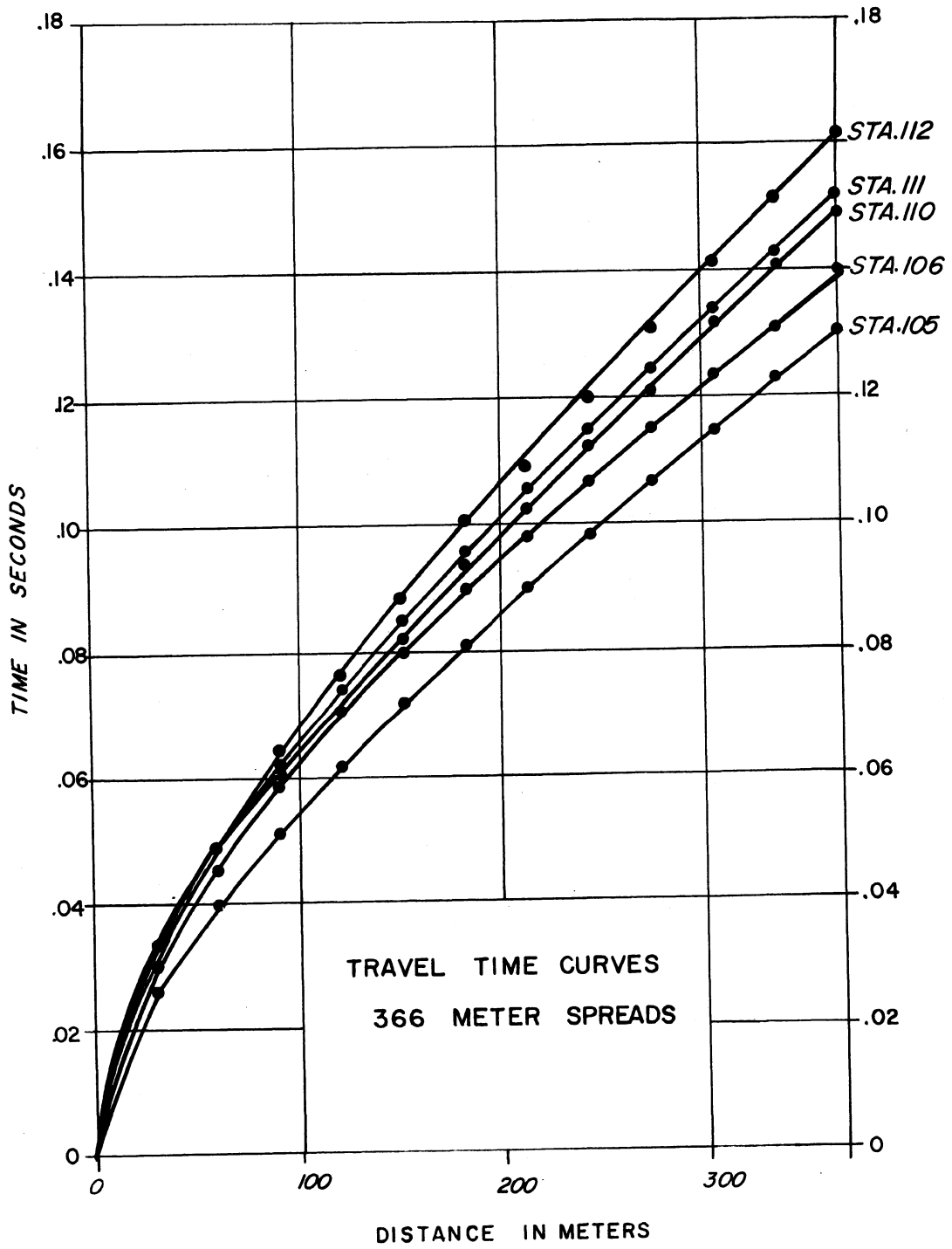
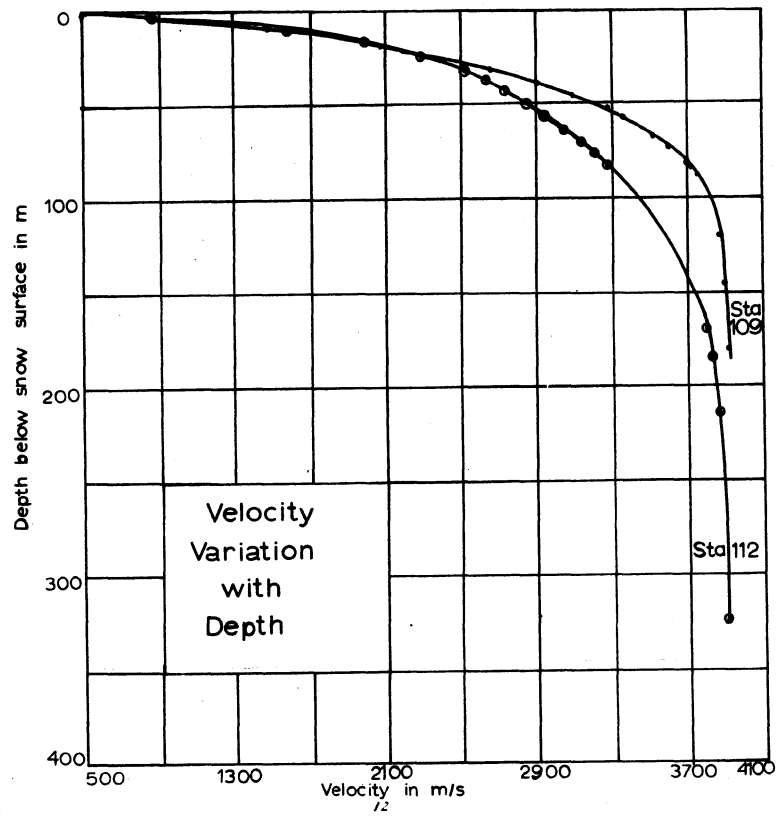


FIG.2

FIGURE 3



The high maximum velocity (3921 m/s, 3905 m/s) probably decreases with depth because of a positive downward temperature gradient. Since no wide angle reflection recordings were made and the temperature depth profile through the ice cap is unknown, an average velocity value could not be calculated. An estimated error in ice thickness determination caused by selection of too high a velocity was calculated by assuming a linear temperature gradient from -50°C near the surface to 0°C at the base. The average temperature of -25°C corresponds to a P-wave velocity of 3850 m/s taken from the table presented by Robin (1958). Using this as an average velocity, it is seen that such a temperature gradient would cause, at most, a 40-m error in ice thickness calculation.

It is interesting to note the relatively low velocities at station 101 and stations 112, 113 and the South Pole (Table 4). These may indicate areas of differing meteorological conditions since soft snow surfaces were encountered in these areas.

Gravity Data Reduction

Gravity observations were made with LaCoste and Romberg Geodetic Gravity Meter No. 4, which has a range of over 6,000 mgals and was calibrated on the North American Standardization Range during June 1960. The internal temperature of the meter was maintained at $48.7^{\circ}\text{C} \pm 0.1^{\circ}\text{C}$ by an electrical thermostat operating from the 24 volt Sno-Cat circuit.

Observed gravity was calculated from a datum of 982.9919 gals at the McMurdo pendulum station (Behrendt, et al., 1962). An observed gravity value of 982.3282 gal, recorded at the South Pole gravity station, agreed within 0.8 mgal with the value of 982.3274 gal established by repeated flights between McMurdo and the South Pole. Prior to traverse departure a drift of 0.15 mgal was observed from October 12, 1960 to December 9, 1960 at the McMurdo pendulum station. Therefore meter drift was considered negligible over the 65-day period of the traverse.

Values of observed gravity and free air anomalies are tabulated in Appendix 1. Elevation error of ± 50 m will introduce a ± 15 mgal uncertainty in free air anomalies.

Bouguer anomalies were calculated for each station where a seismically determined ice thickness was available (Table 6). When rock was above sea level the standard Bouguer correction was applied using mean density to sea level appropriate for the known ice-rock column. An additional correction was required where the rock surface was below sea level, corresponding to the density deficiency between ice and rock similar to calculation of Bouguer anomalies at sea. Densities of 2.67 gm/cc and 0.9 gm/cc were assumed for rock and ice respectively.

Table 6

Bouguer anomalies McMurdo Pole Traverse

<u>Station</u>	<u>Bouguer anomalies</u> mgal ±15 mgal
101	-122
102	-101
103	- 96
104	-113
105	-155
106	-139
107	- 84
108	-129
109	---
110	-191
111	-177
112	-152
113	---
Pole	-131

Rock Surface Elevations

Relative rock surface elevations were obtained for each minor station by multiplying the free air anomaly by 13.5 meters/milligal; this constant was calculated from the Bouguer correction formula for an infinite slab. This method assumes that differences in free air anomalies are caused only by changing rock surface elevation, thus error is introduced by incorrect density assumptions, topographic effects, and variations in the degree of isostatic compensation. Elevations (Appendix 1) were adjusted to agree with seismic measurements by linear distribution of discrepancies. Bentley (1962) has shown that the constant, 13.5 m/mgal, probably minimizes the topographic relief and that a more realistic relationship can be obtained by approximating topography by linear features rather than infinite slabs. Consequently, rock elevations in Appendix 1 can be considered to express minimum topographic variation between seismic stations.

Magnetic Data Reduction

The program of magnetic observations included measurement of the total (F), vertical (Z), and horizontal (H) components of the magnetic field, inclination and declination at twenty-four sites using a CARL magnetometer (developed by the Canadian Applied Research Laboratory); measurement of total field intensity at intervals of approximately 0.8 kilometers along the traverse route commencing at Plateau Depot and terminating at the South Pole using a Varian M-49 precession magnetometer; measurements of relative changes of the vertical intensity component at every station involving the use of two Askania-Werke torsion magnetometers. Methods and results of the survey using the CARL magnetometer are reported by Meyer (1961). This report covers discussion of the work done with the Varian M-49 and the Askania-Werke instruments.

The Varian M-49 magnetometer was tested during the 1960 winter at Scott Base and McMurdo Station. Normal heptane was used for the hydrogen sample in the sensing head and because of its high volatility, had to be replenished periodically. This instrument was successfully operated with the temperature of the sensing head ranging from -50°C to $+10^{\circ}\text{C}$, however, it was necessary to have the electronic package at a temperature greater than -10°C in order for the electronic elements to function properly. The sensing head was mounted on a small fiberglass sled which was towed behind the vehicle and the signal was passed through 120 feet of cable from the sled to the electronic package inside the vehicle. Power for the instrument was supplied by two 6-volt silver cadmium batteries which could be charged from the 24-volt Sno-Cat circuit through a charging unit provided with the instrument.

Askania-Werke torsionmagnetometer No. 590623 was read each week during the 1960 winter in the Absolute Magnetics Hut at Scott Base. Weekly variations were corrected from vertical (Z) component magnetograms, and were plotted against temperature to determine the correction curve for the instrument. Drift was considered negligible over the period of the observations. The instrument was not operated in its temperature compensated range, and Figure 4 shows the variation resulting from changing temperature. It was not possible to obtain sufficient readings with Askania-Werke No. 590645 to draw a similar temperature curve; however, it was operated within its range of temperature compensation as defined by the instruction manual.

Scale constants (Table 7) for both instruments were determined at several times during the winter and at the beginning and the end of the traverse using a Helmholtz coil.

Table 7

Measured Scale Constants for
Askania-Werke Torsionmagnetometers

Meter No. 590623

<u>Date</u>	<u>Scale Constant</u> γ /degree twist	<u>Temperature</u> °C
July 12, 1960	265.6	-25
Oct. 27, 1960	265.3	- 4
Dec. 3, 1960	272.2	+ 2
Dec. 28, 1960	269.9	-18
Feb. 13, 1961	263.2	+19

Meter No. 590645

Oct. 27, 1960	275.6	- 4
Dec. 3, 1960	275.3	+ 2
Dec. 28, 1960	275.6	-18
Feb. 13, 1961	269.9	+20

The Varian M-49 is a proton precession magnetometer which is read in absolute units of total field intensity hence subsequent data reduction is not required. Throughout the traverse there was a discrepancy of approximately 200 gammas in total field intensity between values obtained with the Varian M-49 and with the CARL magnetometer however, when the CARL instrument was returned to the U.S.A., a fault in its construction was found which accounted for much of this discrepancy. Since the Varian M-49 values agreed with the values at the magnetic observatories at Scott Base and the South Pole and since the instrument functioned properly throughout the traverse, values obtained with it are considered reliable.

Absolute vertical intensity values (Z) were calculated for each major station (Table 8) and at overnight stops where the data were available by using total intensity values measured with the Varian M-49 and inclination values (I) measured with the CARL magnetometer in the equation $Z = F \sin I$; where Z = vertical field intensity, F = total field intensity, I = angle of inclination. Since the Varian M-49 and the CARL magnetometer were not read simultaneously Z values were calculated using averages of all the Varian M-49 observations and all the angles of inclination. Upper and lower limits, calculated using the highest F value with the greatest angle of inclination and the lowest F value with the smallest angle of inclination, are taken as an indication of the range of magnetic variation over the time spent at a station.

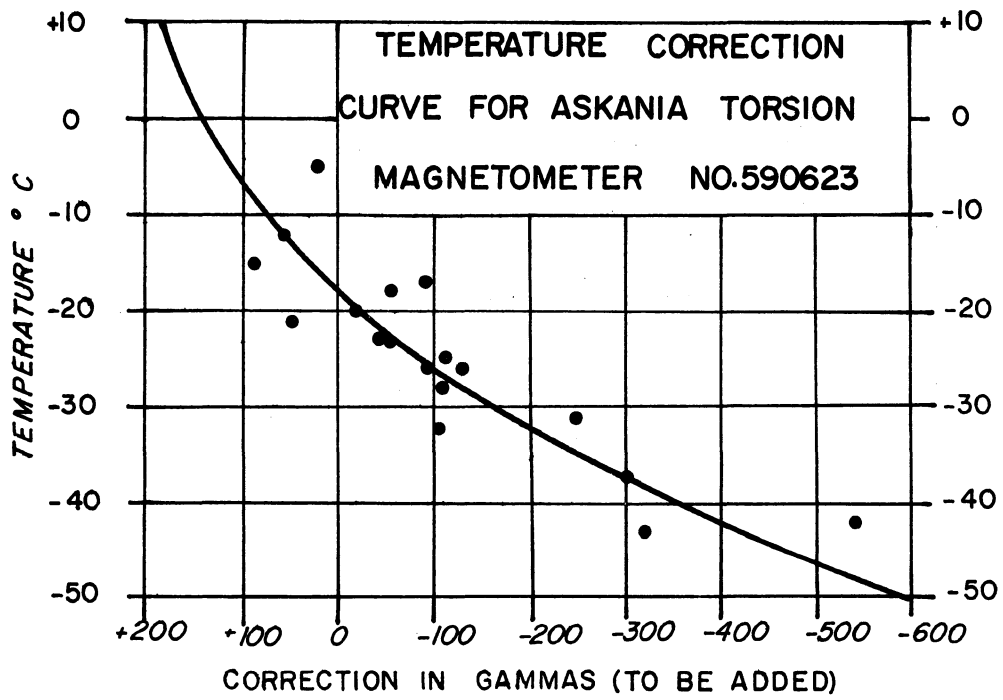


FIG.4

Table 8

Values of Absolute Vertical Intensity (Z)

<u>Station</u>	<u>Average Z</u> gammas
100.0	65404 ±100
100.6	65229 ±100
101.0	64765 ±40
101.15	64546 ±40
102.0	64508 ±50
103.0	64002 ±50
104.0	63278 ±40
105.0	62117 ±40
105.5	61758 ±50
106.0	60910 ±40
107.0	61033 ±60
107.9e	60819 ±150
108.0	60461 ±50
109.0	60282 ±50
110.0	59380 ±60
111.0	58609 ±50
112.0	57945 ±120
112.6	57692 ±100
113.0	57327 ±60
Pole	57001 ±20

The relative vertical intensity (Z) observations taken with the two Askania-Werke torsionmagnetometers were treated in three ways. Each instrument was first considered independently and two separate profiles were obtained relative to a reference value of 65404 ± 100 gammas at station 100.0 which was obtained in the manner discussed earlier. Temperature corrections from Figure 4 were applied to the observations taken with magnetometer No. 590623, and readings made with meter No. 590645 were considered temperature compensated.

In the second method the relative values of Z were adjusted to fit the absolute Z values at each major station by a linear distribution of the differences. Again, values from each magnetometer were reduced independently. From Figure 5 it can be seen that more erratic variations appear in the profile of meter No. 590623. At the low temperatures encountered, the correction factors for meter No. 590623 are often large, thus it is believed that some of the high frequency variation is due to temperature instability of that meter and that the values from meter No. 590645 are probably more reliable.

The third method of reduction involved interval measurement using simultaneous readings of two instruments at adjacent locations. The procedure was identical to that used in elevation measurement, and drift corrections were applied in a similar manner. This method should eliminate temporal variations and allow measurement of field changes caused only by geology. Erratic drift and error involved in temperature correction caused large disagreement between this and other profiles and the final summation showed a difference of more than 2000 gammas with the U.S.C.G.S. value at the South Pole. The values were then adjusted to fit the absolute Z values for each station. Corrections amounted to over 1500 gammas in some cases and the adjusted profile showed little agreement with the other adjusted profiles, therefore the values obtained by the interval method were considered unreliable. The method of interval measurement should produce much better results if the instruments used were not subject to temperature and erratic drift, and if care were taken in synchronizing observations at each end of the intervals.

Because most observations were taken at considerable distances from magnetic recording stations at Scott Base and the South Pole no quantitative diurnal or instantaneous corrections were made. However, in a study of magnetic anomalies station magnetograms served to indicate when temporal disturbances could be expected.

Values of F and Z are listed in Appendix 1, the Z values being those from meter No. 590645 adjusted to fit absolute Z at the major stations and overnight stops.

The traverse route was divided into six straight line segments for which regional gradients (Table 9) were calculated.

Table 9

<u>Line</u>	Regional Gradients	
	<u>Total Field</u> gammas/nautical mile	<u>Vertical Field</u> gammas/nautical mile
Sta. 100.0 - 102.0	-4.7	-5.8
Sta. 102.0 - 104.0	-8.1	-8.8
Sta. 104.0 - 106.0	-9.5	-14.1
Sta. 106.0 - 108.0	-1.8	-0.8
Sta. 108.0 - 112.0	-8.8	-11.2
Sta. 112.0 - Pole	-9.4	-13.3

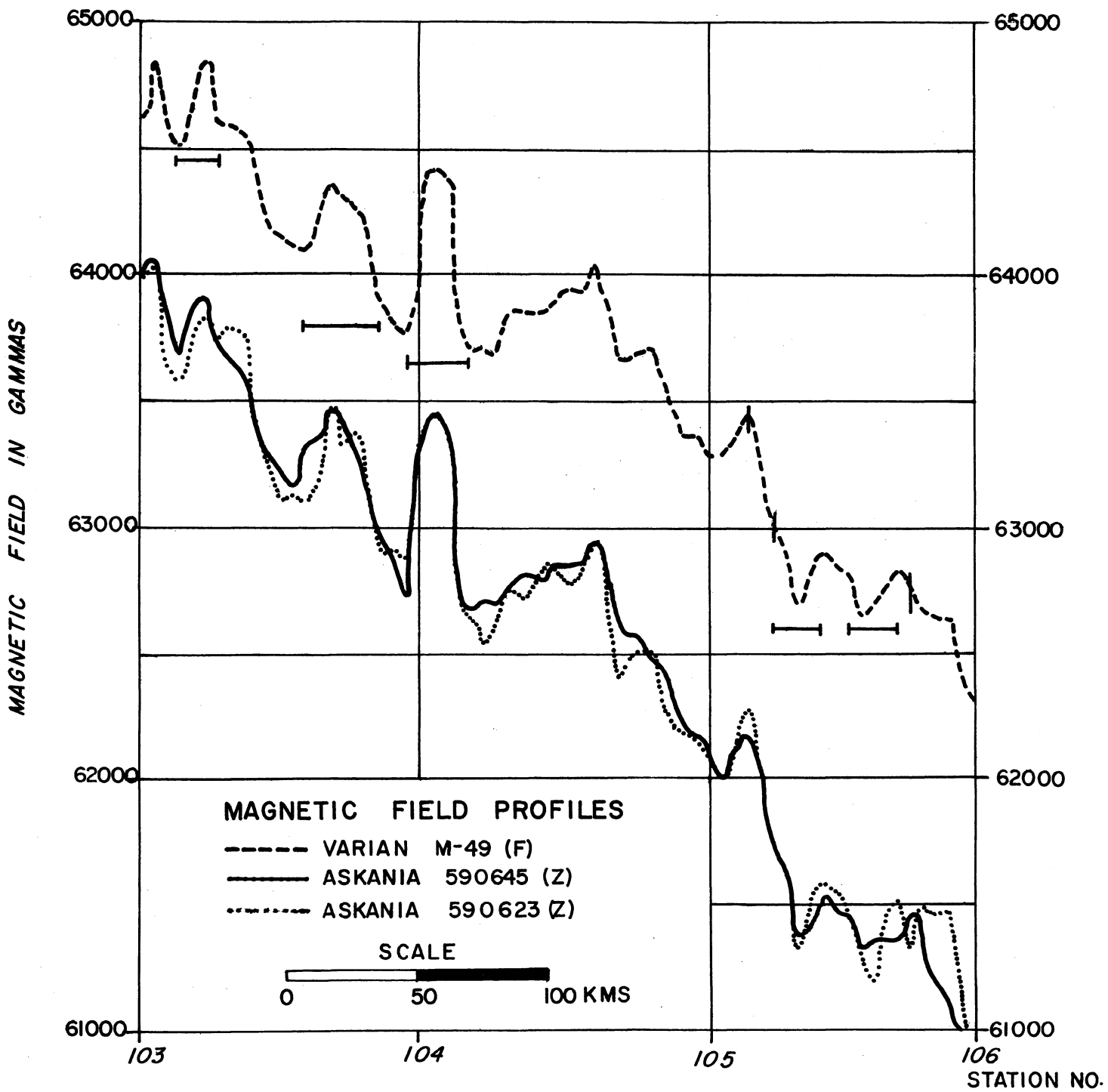


FIG.5

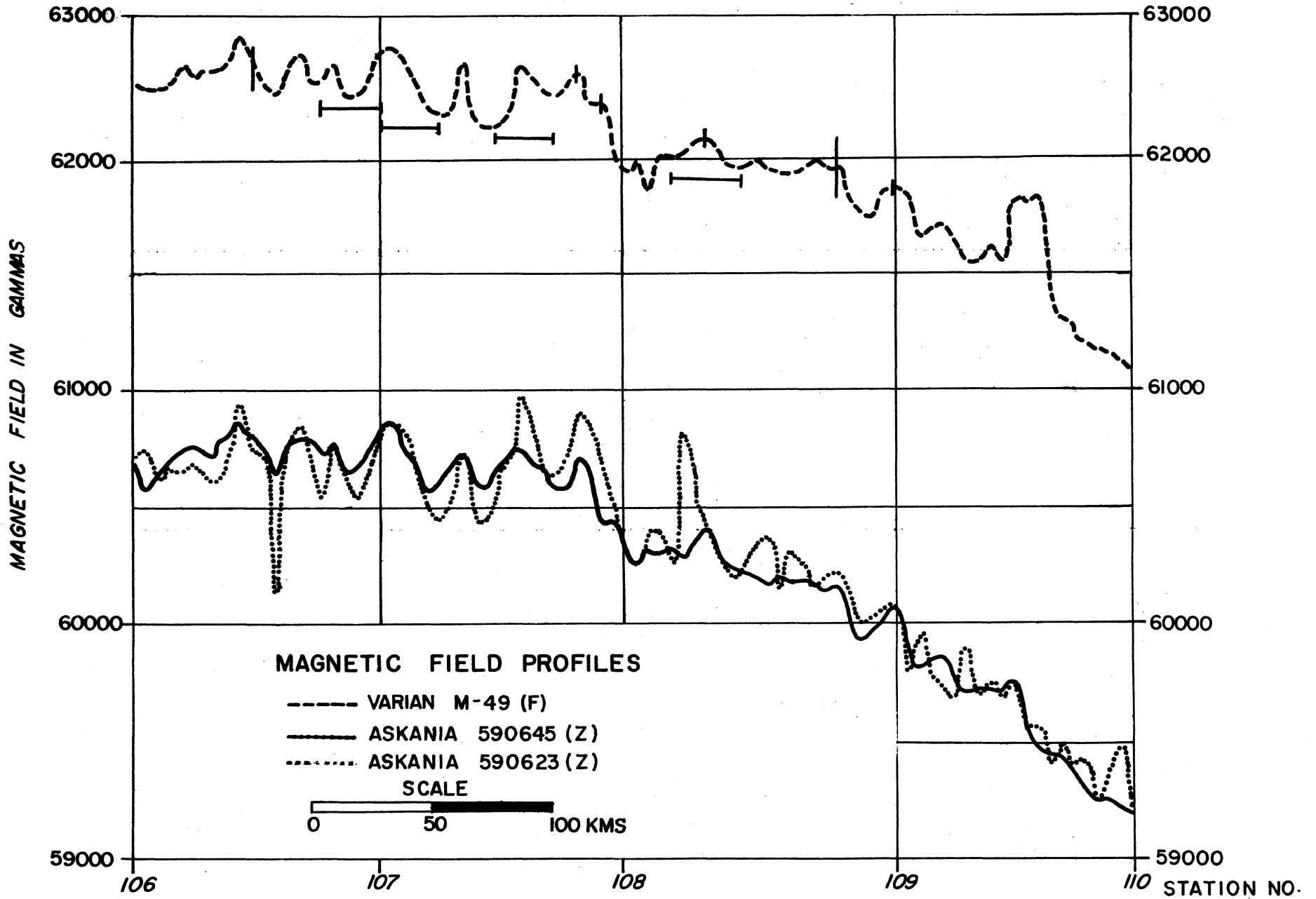


FIG.5

MAGNETIC FIELD IN GAMMAS

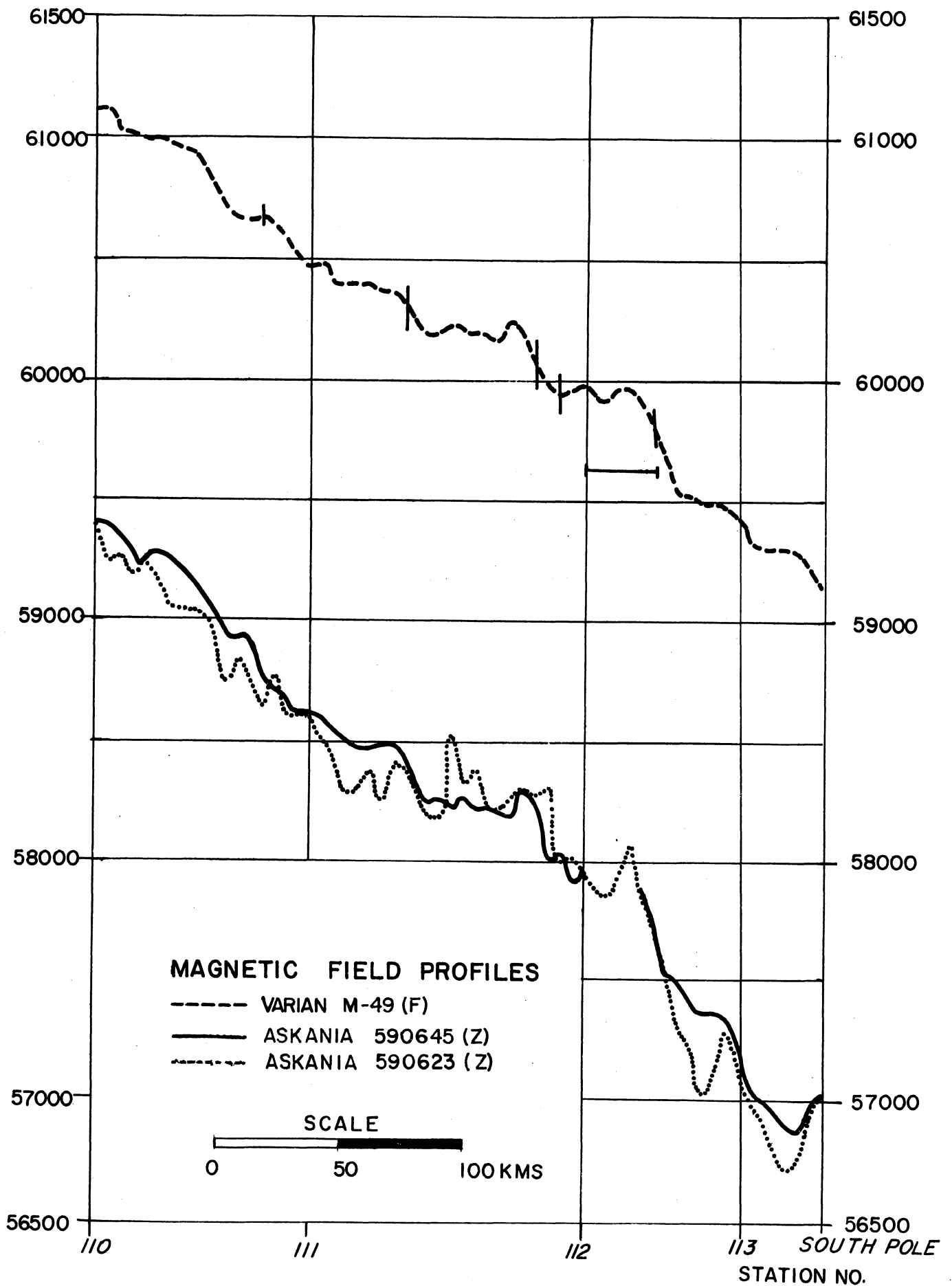


FIG.5

Discussion

Plateau Surface. The most significant feature of the elevation profile (Fig. 6) is the high at 88°S, 170°W where the surface is more than 3100 m above sea level. The topographic high in this area was first measured by both Amundsen and Scott, and again by the Commonwealth Trans-Antarctic Expedition.

Details of the profile show that many wave like features appear along the route.

Geology. The rock surface profile between Plateau Depot and the South Pole is shown in Figure 6. West of Plateau Depot this surface drops rapidly to below sea level showing that in this area the coastal Trans-Antarctic Mountain Range does not extend far inland. This is confirmed by the results of Crary (1960) and Weihaupt (1961) whose profiles show a similar decrease of rock surface elevation to the west.

Refraction shooting at Plateau Depot by Crary (1960) indicated a section composed of a 600 m thickness of rock having a P-wave velocity of 4.3 km/sec overlying rock having a P-wave velocity 5.43 km/sec, the lower velocity rock presumably being the Beacon series. Another refraction station 600 km to the west (78°S, 135°E) recorded a high velocity (5.82 km/sec) directly beneath the ice, indicating absence of the sedimentary section.

Magnetic profiles provide further insight regarding the possible occurrence of sedimentary rock. Depths to anomaly sources were calculated by the half slope method (Peters, 1949) on the total field anomalies greater than 150 gammas in amplitude which appeared to be reasonably free from contamination of adjacent anomalies. The anomalies used for calculation are underlined in Figure 5. The total field (F) profile was used because observations were taken every 0.8 km giving a large number of control points on each anomaly. The error introduced by using (F) rather than (Z) values is small in high magnetic latitudes ($Z \approx .97F$ at $\phi = 75^\circ$). Anomalies observed during times of field disturbance indicated on magnetograms from Scott Base and the South Pole were not used. Calculated depths are given in Table 10. In using the half slope method certain assumptions are made, which if violated, tend to give too great an indication of depth to anomaly source. Of greatest significance to this study are the minimum depths since these set an approximate limit for possible depth to rock containing anomaly sources (Behrendt, 1962). Between station 100 and station 110 over 50% of the 15 anomalies analysed give depths of less than 3.5-km below the ice surface. These depths are close to the rock surface measured by seismic shooting and indicate that there is probably no thick sedimentary section along this profile. From station 110 to the South Pole a marked change in the character of the field is shown by the decrease in irregularity of the profile. There is only one significant anomaly which gives a depth of 5 km below the plateau surface.

The rock surface rises more than 1000 m above sea level between station 110 and station 112. This rise is beneath the plateau high discussed earlier, and shows the existence of a buried ridge beneath the area of high surface elevation. The absence of steep magnetic anomalies may indicate the presence of sedimentary rock in this area.

The magnetic anomaly between station 109 and 110 can be interpreted only qualitatively since some electronic difficulty was encountered with the magnetometer at the time of crossing. The presence of the anomaly was confirmed by the vertical instruments but as being of less amplitude. It correlates with a relative free air gravity high. Perhaps the free air high may reflect not only change in topography but also by intrusion of denser, more magnetic rock.

Table 10

<u>Stations</u>	<u>Magnetic Depth Below Ice Surface</u> km	<u>Average Ice Thickness</u> km
100.6 - 100.16	2.3	2.3
100.19 - 100.24	2.6	2.3
101.4 - 101.15	6.5	2.5
101.15 - 102.0	3.5	2.8
102.10 - 102.12	4.0	2.8
102.13 - 102.15	9.6	3.0
102.16 - 103.0	3.1	3.0
103.3 - 103.6	3.7	2.8
103.13 - 103.20	6.9	2.3
103.21 - 104.4	2.1	2.2
105.5 - 105.10	4.6	2.8
105.12 - 105.16	2.6	2.4
106.16 - 107.0	2.8	2.9
107.10 - 107.14	2.8	2.8
108.2 - 108.7	8	2.5
112.0 - 112.6	5.6	2.6

Crustal Studies. Bouguer anomalies ranging from -84 mgal to -178 mgal indicate that this part of Antarctica has a continental crustal section even though in some areas the rock surface is below sea level. Local variations of the free air anomaly profile show good correlation with changing rock surface elevation as determined by seismic reflection shooting. Between station 100 and station 103 free air anomalies from -40 mgal to -50 mgal were observed. Similar low free air anomalies were observed by den Hartog (1961) west of the Trans-Antarctic Range along latitude 78°S. Since regional variations in rock surface elevation account for the gravity anomalies almost entirely, it would appear that the mass deficiency has not been compensated by crustal adjustment. Regional compensation of the mountain range extending some distance beyond may explain this in part, however

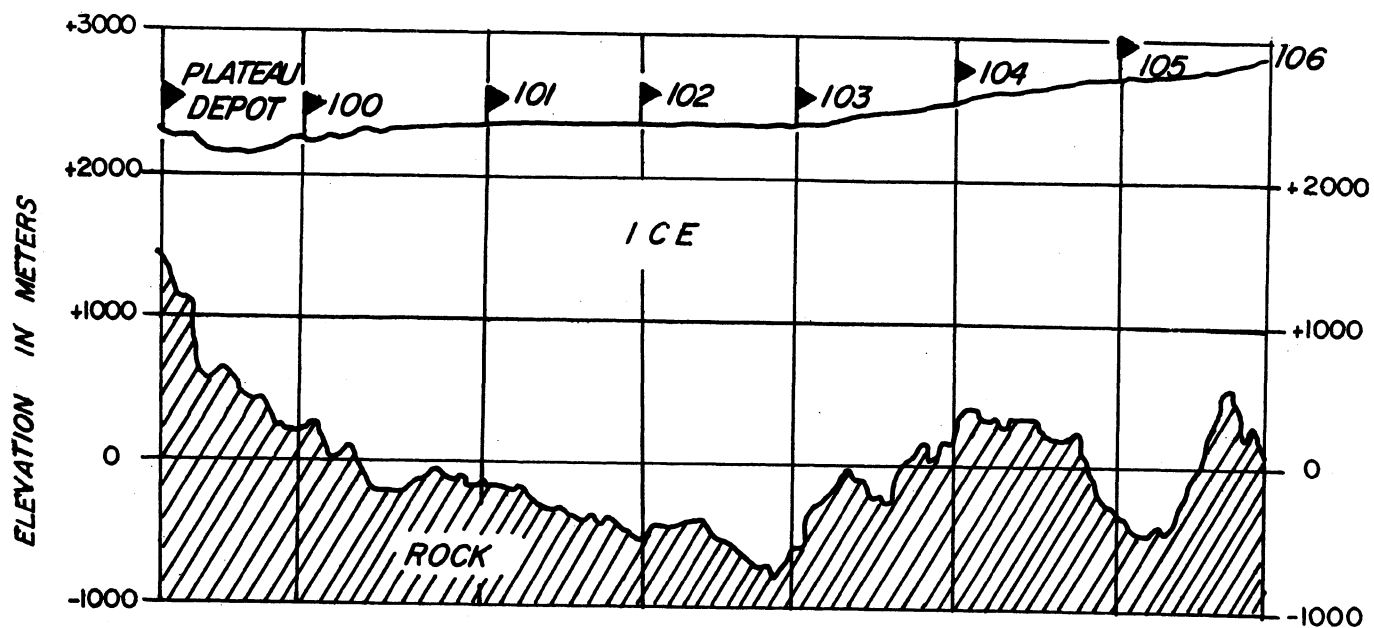
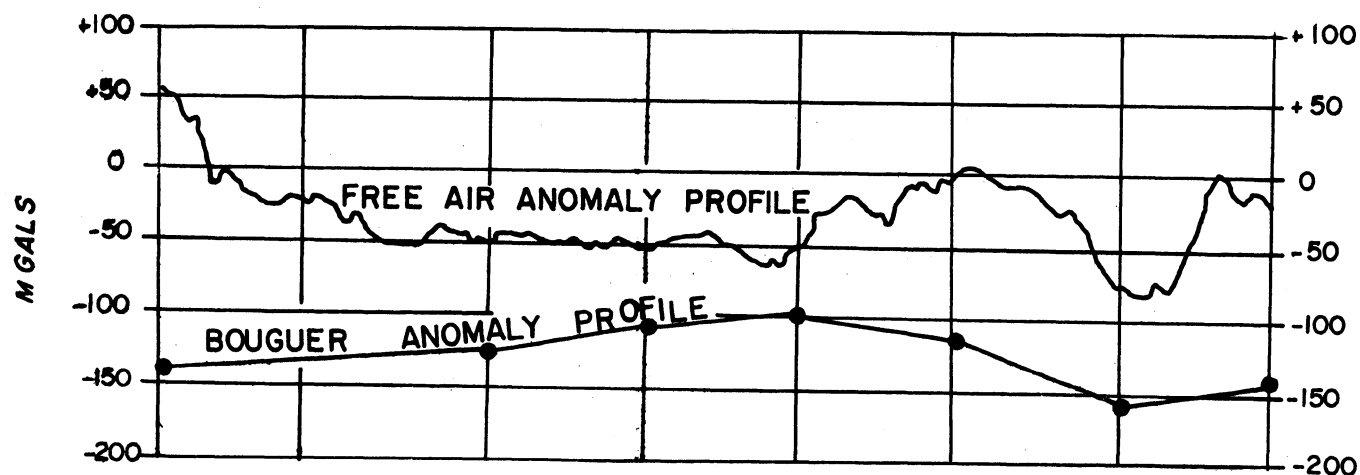
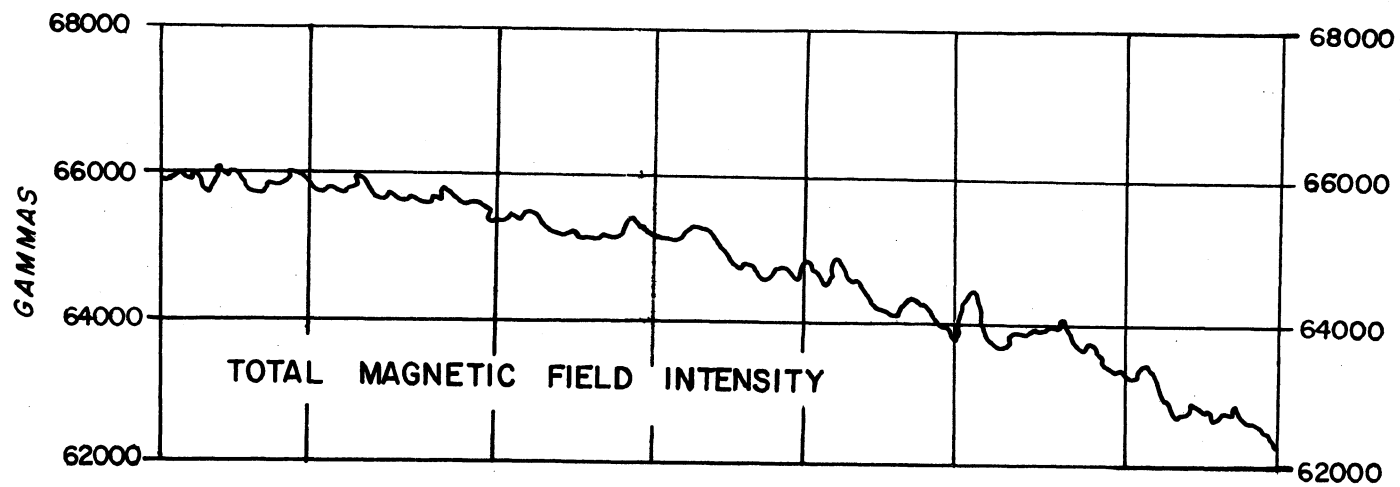
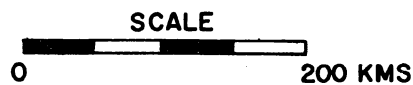
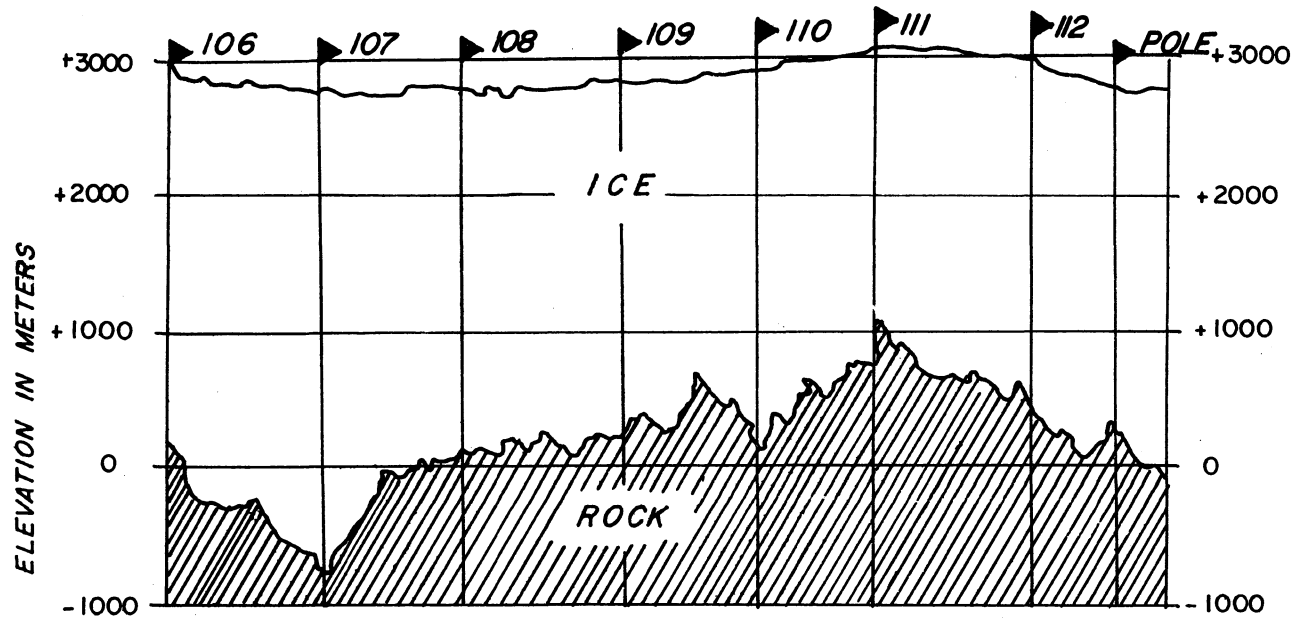
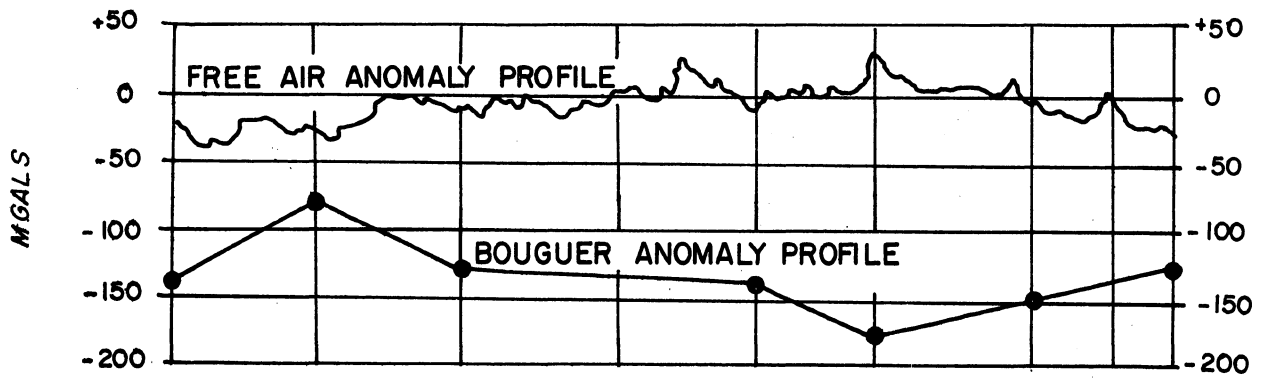
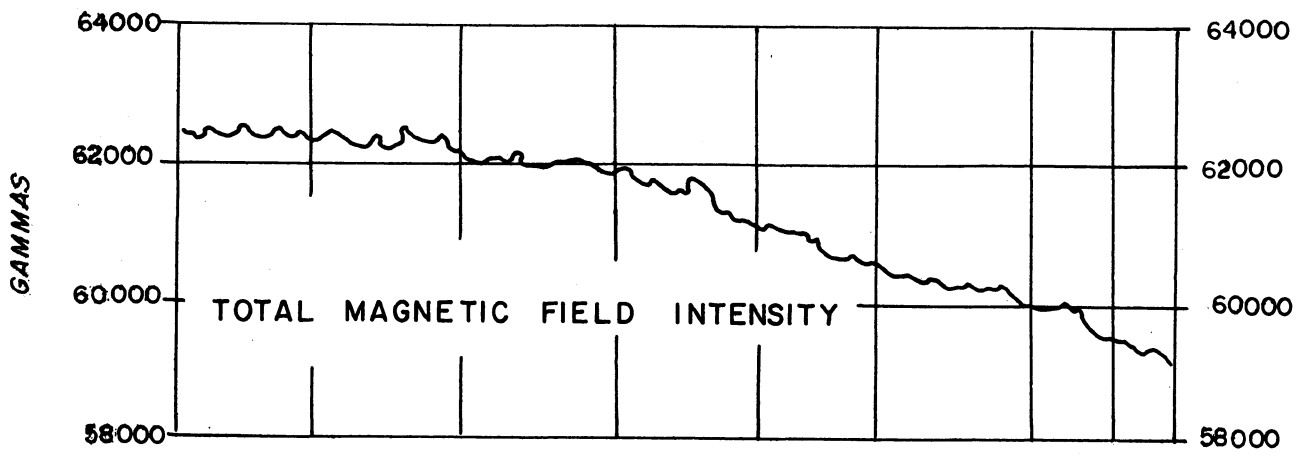


FIG. 6



the distance could not be much greater than 100 km and a large part of the free air low is left unexplained. If a hitherto undiscovered extension of the mountain range were to reach far inland beneath the ice, the regional effects of this mass might be projected farther inland. However, rock surface elevations after Woollard (1962) along the British Transantarctic Expedition route, computed from gravity, show elevations of about 500 m above sea level, hardly enough to cause a bordering area to be overcompensated to the extent indicated by a -50 mgal free air anomaly.

A greater ice load in the past, removed more rapidly than the crust could adjust to the mass deficiency, would cause a negative free air anomaly. A -40 mgal anomaly would require discharge of over 1000 m thickness of ice which is about the increase in thickness shown by Voronov (1960) in a reconstruction of the ice cap at its maximum extent. Other areas also formerly under greater ice load do not show such large negative free air anomalies indicating that a unique situation may be established by the damming effect of the Transantarctic Range. A more quantitative examination of this hypothesis is presently being undertaken by the author.

From station 107 to station 112 the free air anomalies are near zero, indicating that this area is in isostatic equilibrium. A crustal thickness of 44-46 km was estimated for this area on the basis of an empirical curve relating crustal thickness and Bouguer anomaly (Woollard, 1959).

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Appendix 1

Station Number	Surface Elevation meters	Rock Elevation meters	Observed Gravity gals	Free Air Anomaly milligals	Latitude	Longitude	Total Field Intensity gammas ±100	Vert. Field Intensity gammas ±100
100.0	2282	235	982.2757	-18	<u>78°01.9'S</u>	<u>154°22'E</u>	65865	65404
100.1	2243	245	.2898	-17	78°03.8'S	154°08'E	65735	65263
100.2	2259	280	.2889	-14	78°05.6'S	153°53'E	65755	65249
100.3	2266	245	.2854	-17	78°07.8'S	153°37'E	65780	65240
100.4	2282	150	.2752	-23	78°09.7'S	153°22'E	65770	65233
100.5	2278	20	.2678	-33	78°11.6'S	153°07'E	65720	65197
100.6	2260	40	.2766	-32	<u>78°13.6'S</u>	<u>152°52'E</u>	65785	65229
100.7	2298	130	.2723	-24	78°15.0'S	152°38'E	65950	65158
100.8	2328	55	.2580	-30	78°16.0'S	152°27'E	65890	65447
100.9	2332	- 65	.2487	-39	78°17.2'S	152°14'E	65655	65085
100.10	2327	-155	.2445	-45	78°18.4'S	152°01'E	65680	65066
100.11	2329	-180	.2428	-47	78°19.7'S	151°47'E	65750	65156
100.12	2333	-185	.2422	-47	78°21.1'S	151°33'E	65690	65137
100.13	2340	-190	.2401	-48	78°22.1'S	151°22'E	65650	65056
100.14	2347	-200	.2377	-48	78°22.9'S	151°14'E	65685	65013
100.15	2358	-195	.2348	-48	78°23.2'S	151°10'E	65675	65055
100.16	2363	-190	.2346	-48	78°24.1'S	151°02'E	65600	65058
100.17	2363	-125	.2398	-43	78°25.0'S	150°52'E	65665	64928
100.18	2365	- 85	.2431	-40	78°26.1'S	150°41'E	65630	65069
100.19	2364	- 20	.2490	-35	78°27.4'S	150°27'E	65795	65145
100.20	2371	- 45	.2457	-36	78°28.7'S	150°13'E	65640	65065
100.21	2379	- 85	.2410	-40	78°29.8'S	150°01'E	65605	64976
100.22	2373	-110	.2417	-41	78°30.8'S	149°51'E	65685	65007
100.23	2383	- 85	.2409	-40	78°31.8'S	149°40'E	65655	64956
100.24	2376	-160	.2385	-45	78°32.9'S	149°28'E	65600	64934

Appendix 1 con't.

Station Number	Surface Elevation meters	Rock Elevation meters	Observed Gravity gals	Free Air Anomaly milligals	Latitude	Longitude	Total Field Intensity gammas ±100	Vert. Field Intensity gammas ±100
100.25	2371	-150	982.2416	-44	78°34.2'S	149°15'E	65520	64828
101.0	2374	-165	.2406	-45	<u>78°35.6'S</u>	<u>149°00'E</u>	65365	64765
101.1	2376	-125	.2453	-41	78°37.4'S	148°44'E	65400	64849
101.2	2375	-135	.2466	-40	78°38.9'S	148°32'E	65390	64804
101.3	2380	-150	.2470	-40	78°40.8'S	148°16'E	65420	64801
101.4	2383	-165	.2471	-40	78°42.2'S	148°04'E	65435	64924
101.5	2380	-145	.2512	-37	78°44.0'S	147°48'E	65520	64969
101.6	2379	-190	.2505	-39	78°45.7'S	147°33'E	65425	64866
101.7	2398	-240	.2432	-43	78°47.7'S	147°16'E	65265	64728
101.8	2396	-270	.2431	-44	78°49.3'S	147°03'E	65260	64663
31 101.9	2396	-310	.2429	-46	78°51.0'S	146°48'E	65190	64605
101.10	2398	-285	.2458	-42	78°52.8'S	146°33'E	65200	64582
101.11	2394	-295	.2483	-42	78°54.6'S	146°18'E	65220	64629
101.12	2400	-295	.2490	-38	78°56.4'S	146°02'E	65140	64537
101.13	2395	-345	.2487	-43	78°58.2'S	145°47'E	65170	64503
101.14	2389	-390	.2490	-46	79°00.0'S	145°31'E	65145	64552
101.15	2396	-370	.2507	-43	<u>79°02.0'S</u>	<u>145°14'E</u>	65190	64546
101.16	2393	-405	.2509	-45	79°03.3'S	144°58'E	65145	64608
101.17	2396	-360	.2548	-41	79°04.8'S	144°41'E	65160	64533
101.18	2410	-375	.2517	-40	79°06.3'S	144°23'E	65360	64718
101.19	2412	-410	.2502	-42	79°07.8'S	144°04'E	65400	64736
101.20	2411	-460	.2487	-44	79°09.1'S	143°49'E	65300	64595
101.21	2409	-490	.2488	-46	79°10.7'S	143°30'E	65205	64532
102.0	2416	-505	.2474	-46	<u>79°12.2'S</u>	<u>143°12'E</u>	65165	64508
102.1	2408	-450	.2559	-42	79°15.4'S	142°58'E	65190	64482

Appendix 1 con't.

Station Number	Surface Elevation meters	Rock Elevation meters	Observed Gravity gals	Free Air Anomaly milligals	Latitude	Longitude	Total Field Intensity gammas ±100	Vert. Field Intensity gammas ±100
102.2	2405	-420	982.2607	-39	79°18.0'S	142°47'E	65170	64448
102.3	2393	-420	.2659	-39	79°19.9'S	142°39'E	65160	64446
102.4	2401	-405	.2666	-37	79°22.7'S	142°27'E	65180	64459
102.5	2400	-390	.2697	-36	79°25.9'S	142°13'E	65300	64628
102.6	2414	-370	.2682	-35	79°28.3'S	142°02'E	65310	64575
102.7	2409	-380	.2705	-35	79°30.5'S	141°53'E	65290	64526
102.8	2409	-365	.2724	-34	79°31.7'S	141°48'E	65280	64527
102.9	2409	-380	.2728	-34	79°33.6'S	141°40'E	65195	64405
102.10	2396	-465	.2725	-40	79°36.8'S	141°26'E	64975	64240
102.11	2409	-475	.2692	-41	79°39.1'S	141°16'E	64790	64020
32 102.12	2398	-510	.2718	-43	79°42.0'S	141°03'E	64740	63979
102.13	2396	-560	.2708	-47	79°45.3'S	140°49'E	64790	63937
102.14	2393	-585	.2718	-48	79°48.3'S	140°36'E	64680	63886
102.15	2396	-615	.2704	-50	79°51.6'S	140°22'E	64590	63802
102.16	2401	-650	.2684	-52	79°54.9'S	140°07'E	64680	63817
102.17	2405	-760	.2612	-60	79°58.3'S	139°53'E	64750	63873
102.18	2407	-680	.2679	-54	80°00.6'S	139°43'E	64770	63931
102.19	2414	-755	.2618	-60	80°03.6'S	139°30'E	64710	63819
102.20	2408	-670	.2717	-53	80°06.8'S	139°16'E	64605	63768
103.0	2412	-565	.2803	-45	<u>80°10.0'S</u>	<u>139°02'E</u>	64810	64002
103.1	2414	-530	.2829	-43	80°12.2'S	138°49'E	64850	64061
103.2	2406	-485	.2897	-40	80°14.5'S	138°36'E	64630	63822
103.3	2411	-235	.3074	-22	80°17.2'S	138°20'E	64520	63673
103.4	2439	-210	.3018	-20	80°20.0'S	138°04'E	64675	63871
103.5	2450	-160	.3034	-17	80°22.6'S	137°49'E	64855	63921

Appendix 1 con't.

Station Number	Surface Elevation meters	Rock Elevation meters	Observed Gravity gals	Free Air Anomaly milligals	Latitude	Longitude	Total Field Intensity gammas ± 100	Vert. Field Intensity gammas ± 100
103.6	2455	- 95	982.3067	-13	80°24.6'S	137°38'E	64615	63737
103.7	2458	- 45	.3097	- 9	80°25.6'S	137°32'E	64595	63685
103.8	2479	+ 5	.3070	- 6	80°26.8'S	137°25'E	64560	63608
103.9	2485	- 45	.3018	-10	80°28.1'S	137°18'E	64365	63398
103.10	2491	- 75	.2978	-13	80°29.4'S	137°10'E	64200	63302
103.11	2502	-165	.2886	-20	80°31.5'S	136°58'E	-----	63213
103.12	2512	-175	.2854	-21	80°33.2'S	136°48'E	-----	63176
103.13	2515	-230	.2803	-26	80°35.0'S	136°38'E	64140	63311
103.14	2510	-190	.2857	-23	80°37.7'S	136°22'E	64225	63344
103.15	2512	- 5	.2995	-10	80°40.3'S	136°07'E	64360	63464
33 103.16	2520	+ 50	.3076	0	80°42.5'S	135°54'E	64300	63403
103.17	2537	+140	.3039	0	80°45.1'S	135°39'E	64270	63276
103.18	2542	+200	.3076	+ 4	80°47.5'S	135°25'E	64130	63138
103.19	2559	+105	.2962	- 4	80°50.4'S	135°09'E	63920	62941
103.20	2562	+ 80	.2940	- 6	80°53.0'S	134°54'E	63940	62901
103.21	2558	+195	.3049	+ 2	80°55.7'S	134°38'E	63770	62729
104.0	2593	+185	.2936	0	80°58.8'S	134°20'E	64215	63278
104.1	2597	+325	.3034	+ 9	81°03.5'S	134°06'E	64425	63449
104.2	2612	+430	.3073	+15	81°08.3'S	133°53'E	64415	63369
104.3	2622	+440	.3052	+14	81°12.3'S	133°41'E	63885	62778
104.4	2629	+435	.3015	+13	81°16.3'S	133°29'E	63695	62676
104.5	2634	+365	.2962	+ 6	81°19.1'S	133°21'E	63715	62707
104.6	2654	+380	.2909	+ 6	81°22.1'S	133°13'E	63680	62702
104.7	2662	+310	.2834	- 1	81°25.3	133°03'E	63845	62771
104.8	2657	+315	.2846	- 2	81°28.2'S	132°55'E	63855	62827

Appendix 1 con't.

Station Number	Surface Elevation meters	Rock Elevation meters	Observed Gravity gals	Free Air Anomaly milligals	Latitude	Longitude	Total Field Intensity gammas ± 100	Vert. Field Intensity gammas +100
104.9	2662	+370	982.2867	0	81°30.6'S	132°48'E	63855	62805
104.10	2660	+380	.2875	- 1	81°32.2'S	132°43'E	83860	62790
104.11	2665	+380	.2855	- 2	81°34.4'S	132°37'E	63900	62857
104.12	2677	+365	.2799	- 5	81°36.9'S	132°30'E	63950	62862
104.13	2682	+270	.2712	-13	81°40.0'S	132°21'E	63930	62866
104.14	2686	+245	.2672	-17	81°42.7'S	132°13'E	64050	62955
104.15	2692	+220	.2638	-20	81°46.1'S	132°03'E	63880	62782
104.16	2700	+255	.2643	-19	81°50.6'S	131°50'E	63670	62573
104.17	2694	+300	.2695	-17	81°54.2'S	131°40'E	63675	62590
104.18	2722	+280	.2600	-20	81°58.8'S	131°26'E	63715	62486
34 104.19	2737	+135	.2446	-32	82°02.8'S	131°15'E	63640	62473
104.20	2743	- 50	.2293	-48	82°06.8'S	131°03'E	63485	62325
104.21	2742	-200	.2185	-60	82°11.0'S	130°51'E	63370	62210
104.22	2742	-235	.2156	-65	82°14.3'S	130°41'E	63375	62196
105.0	2766	-285	.2051	-70	<u>82°19.0'S</u>	<u>130°28'E</u>	63280	62117
105.1	2772	-300	.2042	-70	82°21.5'S	130°20'E	63295	62018
105.2	2769	-360	.2023	-73	82°23.9'S	130°13'E	63360	62135
105.3	2772	-435	.1979	-78	82°26.8'S	130°03'E	63450	62207
105.4	2779	-455	.1963	-79	82°29.7'S	129°54'E	63315	62002
105.5	2782	-430	.1990	-76	<u>82°32.7'S</u>	<u>129°45'E</u>	63020	61758
105.6	2784	-370	.2048	-71	82°36.0'S	129°27'E	62950	61629
105.7	2792	-435	.2001	-75	82°39.4'S	129°11'E	62705	61388
105.8	2789	-420	.2044	-73	82°42.7'S	128°54'E	62795	61440
105.9	2793	-280	.2158	-61	82°46.2'S	128°36'E	62910	61558
105.10	2796	-140	.2274	-50	82°49.6'S	128°20'E	62855	61469

Appendix 1 con't.

Station Number	Surface Elevation meters	Rock Elevation meters	Observed Gravity gals	Free Air Anomaly milligals	Latitude	Longitude	Total Field Intensity gammas ±100	Vert. Field Intensity gammas ±100
105.11	2804	- 25	982.2358	-40	82°53.1'S	128°00'E	62820	61459
105.12	2810	- 20	.2361	-39	82°56.5'S	127°42'E	62640	61322
105.13	2814	+270	.2587	-17	82°59.2'S	127°28'E	62710	61373
105.14	2826	+390	.2659	- 7	83°02.4'S	127°07'E	62750	61364
105.15	2833	+550	.2778	+ 6	83°05.8'S	126°50'E	62840	61360
105.16	2849	+585	.2777	+ 9	83°09.2'S	126°29'E	62675	61469
105.17	2862	+485	.2681	+ 4	83°11.6'S	126°15'E	62680	61276
105.18	2872	+260	.2504	-13	83°15.0'S	125°55'E	62640	61198
105.19	2879	+340	.2563	- 6	83°18.3'S	125°37'E	62555	61103
105.20	2890	+265	.2494	-11	83°21.9'S	125°15'E	62395	60937
35 106.0	2896	+135	.2404	-19	<u>83°25.5'S</u>	<u>124°48'E</u>	62315	60910
106.1	2888	+ 50	.2399	-23	83°28.3'S	125°15'E	62290	60792
106.2	2879	- 95	.2351	-31	83°31.1'S	125°35'E	62290	60818
106.3	2869	-245	.2307	-40	83°33.5'S	125°55'E	62295	60864
106.4	2866	-235	.2352	-37	83°35.7'S	126°15'E	62400	60916
106.5	2855	-240	.2416	-35	83°38.0'S	126°35'E	62345	60959
106.6	2849	-280	.2440	-35	83°39.6'S	126°45'E	62385	60916
106.7	2852	-315	.2433	-35	83°42.0'S	127°05'E	62360	60915
106.8	2854	-340	.2440	-35	83°44.2'S	127°25'E	62400	61008
106.9	2855	-275	.2522	-27	83°47.0'S	127°45'E	62530	61059
106.10	2844	-215	.2635	-20	83°50.1'S	128°15'E	62365	61002
106.11	2839	-210	.2684	-18	83°51.9'S	128°30'E	62295	60966
106.12	2839	-235	.2696	-17	83°53.6'S	128°45'E	62260	60936
106.13	2837	-265	.2715	-16	83°56.6'S	129°10'E	62350	60933
106.14	2830	-340	.2714	-19	83°59.3'S	129°35'E	62445	60996

Appendix 1 con't.

Station Number	Surface Elevation meters	Rock Elevation meters	Observed Gravity gals	Free Air Anomaly milligals	Latitude	Longitude	Total Field Intensity gammas ±100	Vert. Field Intensity gammas ±100
106.15	2826	-460	982.2672	-26	84°01.9'S	129°55'E	62315	60979
106.16	2822	-540	.2655	-29	84°03.5'S	130°15'E	62315	60905
106.17	2819	-575	.2669	-29	84°06.6'S	130°45'E	62400	60973
106.18	2816	-585	.2707	-28	84°09.0'S	131°05'E	62250	60854
106.19	2819	-575	.2735	-25	84°11.7'S	131°35'E	62260	60822
106.20	2819	-605	.2747	-24	84°14.5'S	132°00'E	62330	60923
107.0	2802	-720	.2749	-30	84°17.7'S	132°31'E	62445	61033
107.1	2801	-690	.2757	-30	84°19.7'S	132°50'E	62460	61060
107.2	2794	-715	.2747	-34	84°22.5'S	133°10'E	62395	60966
107.3	2772	-580	.2900	-26	84°25.1'S	133°35'E	62285	60881
36 107.4	2771	-505	.2948	-23	84°27.9'S	134°00'E	62185	60754
107.5	2765	-445	.2998	-21	84°30.6'S	134°20'E	62180	60784
107.6	2769	-395	.3004	-19	84°32.1'S	134°35'E	62285	60850
107.7	2768	-340	.3037	-17	84°35.1'S	135°00'E	62400	60934
107.8	2763	-210	.3130	-10	84°37.1'S	135°15'E	62150	60806
107.9	2766	- 95	.3190	- 3	84°38.0'S	135°25'E	62145	60756
107.10	2768	- 35	.3212	- 1	84°40.8'S	135°50'E	62140	60819
107.11	2768	- 40	.3195	- 3	84°42.5'S	136°05'E	62195	60876
107.12	2791	+ 10	.3146	- 2	84°45.6'S	136°30'E	62400	60962
107.13	2813	+ 30	.3082	- 3	84°49.1'S	137°00'E	62355	60892
107.14	2804	+ 75	.3127	- 2	84°52.7'S	137°30'E	62285	60864
107.15	2812	0	.3036	- 9	84°56.1'S	138°00'E	62265	60781
107.16	2806	+ 75	.3099	- 6	84°59.5'S	138°25'E	62295	60767
107.17	2802	+ 75	.3096	- 8	85°02.1'S	138°50'E	62345	60911
107.18	2814	+100	.3069	- 8	85°05.9'S	139°30'E	62230	60852

Appendix 1 con't.

Station Number	Surface Elevation meters	Rock Elevation meters	Observed Gravity gals	Free Air Anomaly milligals	Latitude	Longitude	Total Field Intensity gammas ± 100	Vert. Field Intensity gammas ± 100
107.19	2813	+105	982.3061	-10	85°09.7'S	139°50'E	62200	60622
107.20	2822	+110	.3029	-12	85°13.3'S	140°20'E	62000	60638
108.0	2827	+175	.3045	- 9	<u>85°16.4'S</u>	<u>140°48'E</u>	61945	60461
108.1	2814	+165	.3070	-10	85°13.3'S	140°50'E	62000	60444
108.2	2805	+165	.3084	-10	85°10.2'S	140°55'E	62040	60501
108.3	2775	+ 95	.3127	-16	85°10.6'S	141°40'E	62000	60491
108.4	2796	+ 75	.3046	-17	85°11.1'S	142°35'E	62000	60525
108.5	2793	+180	.3132	-10	85°11.6'S	143°20'E	62005	60471
108.6	2783	+225	.3188	- 7	85°09.9'S	143°55'E	62070	60539
108.7	2750	+210	.3273	- 8	85°08.3'S	144°25'E	62160	60602
37 108.8	2784	+205	.3175	- 8	85°12.0'S	144°35'E	62000	60483
108.9	2788	+150	.3128	-13	85°15.8'S	144°45'E	61960	60438
108.10	2793	+230	.3180	- 7	85°19.5'S	144°55'E	61950	60414
108.11	2797	+270	.3206	- 4	85°23.2'S	145°05'E	61990	60402
108.12	2795	+230	.3190	- 7	85°26.9'S	145°15'E	61955	60360
108.13	2798	+215	.3170	- 9	85°29.1'S	145°20'E	61940	60424
108.14	2816	+165	.3086	-12	85°33.0'S	145°35'E	61930	60375
108.15	2821	+110	.3039	-17	85°37.2'S	145°45'E	61940	60387
108.16	2825	+110	.3033	-17	85°40.8'S	146°00'E	61980	60381
108.17	2829	+200	.3094	-10	85°44.0'S	146°10'E	61960	60335
108.18	2828	+240	.3132	- 7	85°48.1'S	146°20'E	61920	60366
108.19	2844	+265	.3105	- 6	85°51.2'S	146°30'E	61825	60217
108.20	2853	+220	.3053	- 9	85°54.9'S	146°45'E	61760	60111
108.21	2861	+190	.3011	-12	85°58.8'S	147°00'E	61745	60164
108.22	2850	+210	.3066	-10	86°03.1'S	147°15'E	61855	60202

Appendix 1 con't.

Station Number	Surface Elevation meters	Rock Elevation meters	Observed Gravity gals	Free Air Anomaly milligals	Latitude	Longitude	Total Field Intensity gammas ±100	Vert. Field Intensity gammas ±100
109.0	2853	+335	982.3157	- 1	86°06.8'S	147°30'E	61875	60282
109.1	2861	+370	.3162	+ 1	86°10.0'S	147.9° E	61840	60075
109.2	2852	+415	.3227	+ 4	86°12.9'S	148.2° E	61660	60005
109.3	2863	+405	.3192	+ 4	86°15.6'S	148.5° E	61695	60051
109.4	2882	+375	.3116	+ 1	86°18.7'S	148.8° E	61716	60076
109.5	2875	+290	.3074	- 5	86°22.2'S	149.3° E	61630	59925
109.6	2872	+280	.3083	- 6	86°24.1'S	149.5° E	61560	59906
109.7	2880	+290	.3069	- 6	86°26.5'S	149.8° E	61560	59930
109.8	2877	+375	.3151	+ 1	86°29.9'S	150.3° E	61620	-----
109.9	2871	+330	.3207	+ 4	86°31.9'S	150.6° E	61560	59914
38 109.10	2893	+710	.3352	+25	86°35.3'S	151.1° E	61905	59964
109.11	2887	+630	.3313	+19	86°38.3'S	151.6° E	61800	59756
109.12	2914	+565	.3188	+14	86°41.7'S	152.0° E	61850	59652
109.13	2894	+470	.3180	+ 7	86°43.9'S	152.3° E	-----	59657
109.14	2902	+440	.3139	+ 4	86°47.6'S	152.8° E	61300	59621
109.15	2924	+515	.3130	+10	86°50.8'S	153.4° E	61290	59573
109.16	2941	+465	.3045	+ 6	86°54.3'S	154.1° E	61210	59506
109.17	2948	+395	.2975	+ 1	86°56.8'S	154.5° E	61170	59450
109.18	2952	+360	.2940	- 2	86°59.9'S	155.0° E	61160	59450
109.19	2956	+290	.2879	- 8	87°03.4'S	155.7° E	61125	59407
110.0	2971	+175	.2777	-16	87°07.3'S	156.4° E	61085	59380
110.1	2969	+195	.2762	-16	87°10.9'S	157.0° E	61105	59392
110.2	2970	+285	.2813	-11	87°15.0'S	157.7° E	61010	-----
110.3	2987	+440	.2861	- 2	87°17.5'S	158.1° E	61010	59298
110.4	3004	+380	.2753	- 8	87°20.2'S	158.6° E	61000	59233

Appendix 1 con't.

Station Number	Surface Elevation meters	Rock Elevation meters	Observed Gravity gals	Free Air Anomaly milligals	Latitude	Longitude	Total Field Intensity gammas ±100	Vert. Field Intensity gammas ±100
110.5	3006	+355	.2790	- 4	87°23.5'S	159.2° E	60990	59265
110.6	3008	+550	.2835	+ 1	87°27.2'S	159.9° E	60990	59257
110.7	3015	+520	.2816	- 3	87°29.5'S	160.4° E	60940	59237
110.8	3014	+670	.2881	+ 6	87°33.2'S	161.2° E	60945	59186
110.9	3017	+590	.2798	- 2	87°36.6'S	161.8° E	60855	59118
110.10	3032	+555	.2714	- 6	87°40.3'S	162.8° E	60675	59059
110.11	3036	+585	.2712	- 5	87°43.2'S	163.5° E	60670	58950
110.12	3037	+680	.2764	0	87°46.5'S	164.3° E	60655	58918
110.13	3045	+770	.2793	+ 5	87°50.0'S	165.3° E	60650	58936
110.14	3060	+800	.2757	+ 6	87°53.5'S	166.2° E	60685	58747
110.15	3070	+790	.2707	+ 4	87°57.0'S	167.2° E	60630	58713
110.16	3079	+775	.2652	0	87°59.4'S	168.1° E	60595	58661
110.17	3086	+850	.2674	+ 4	88°02.9'S	169.1° E	60510	58602
111.0	3099	+1115	.2817	+22	88°06.8'S	170.5° E	60470	58609
111.1	3108	+1125	.2813	+25	88°08.1'S	171.4° E	60485	58593
111.2	3116	+975	.2689	+14	88°10.0'S	172.7° E	60390	-----
111.3	3117	+925	.2653	+11	88°10.8'S	173.1° E	60380	58515
111.4	3118	+950	.2680	+14	88°12.2'S	174.3° E	60390	58468
111.5	3117	+870	.2646	+10	88°13.5'S	175.3° E	60380	58472
111.6	3115	+760	.2575	+ 2	88°15.3'S	177.1° E	60360	58476
111.7	3111	+725	.2570	0	88°16.5'S	177.9° E	60350	58480
111.8	3107	+715	.2583	0	88°17.7'S	179.0° E	60280	58442
111.9	3103	+710	.2601	+ 1	88°19.1'S	180.0° E	60210	58281
111.10	3099	+715	.2630	+ 2	88°20.5'S	178.8° W	60185	58237
111.11	3094	+735	.2667	+ 4	88°21.9'S	177.4° W	60185	58255

Appendix 1 con't.

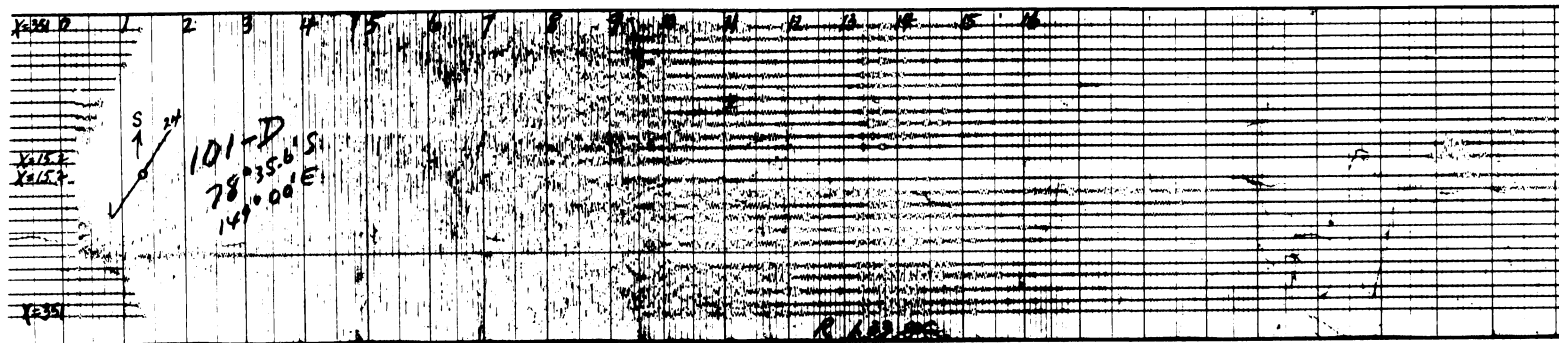
Station Number	Surface Elevation meters	Rock Elevation meters	Observed Gravity gals	Free Air Anomaly milligals	Latitude	Longitude	Total Field Intensity gammas ±100	Vert. Field Intensity gammas ±100
111.12	3087	+705	982.2681	+ 4	88°23.1'S	176.3° W	60240	58217
111.13	3082	+710	.2709	+ 5	88°24.2'S	175.0° W	60190	58271
111.14	3072	+675	.2724	+ 3	88°25.3'S	174.1° W	60190	58201
111.15	3066	+690	.2767	+ 5	88°26.6'S	172.6° W	60160	58215
111.16	3066	+660	.2757	+ 4	88°28.2'S	170.9° W	60150	58176
111.17	3061	+640	.2764	+ 3	88°29.6'S	169.0° W	60245	58167
111.18	3049	+580	.2765	0	88°31.0'S	167.7° W	60195	58301
111.19	3041	+510	.2747	- 5	88°32.3'S	166.0° W	60040	58206
111.20	3049	+585	.2791	+ 2	88°33.3'S	165.0° W	59995	58000
111.21	3041	+685	.2909	+11	88°34.2'S	163.8° W	59920	58033
07 111.22	3023	+460	.2800	- 5	88°36.6'S	160.8° W	59960	57884
112.0	3011	+410	.2812	- 8	<u>88°39.0'S</u>	<u>157.5° W</u>	59950	57949
112.1	2956	+415	.2998	- 7	<u>88°44.7'S</u>	<u>156.0° W</u>	59910	-----
112.2	2964	+310	.2903	-14	88°48.6'S	158.0° W	59910	-----
112.3	2947	+265	.2930	-17	88°51.4'S	158.0° W	60000	-----
112.4	2931	+275	.2995	-16	88°55.6'S	158.5° W	59970	-----
112.5	2931	+290	.3015	-14	89°00.0'S	158.5° W	59900	57875
112.6	2899	+215	.3067	-19	<u>89°04.9'S</u>	<u>158.7° W</u>	59740	57692
112.7	2899	+110	.3074	-18	<u>89°08.8'S</u>	<u>158.5° W</u>	59650	57523
112.8	2890	+165	.3077	-21	89°13.3'S	158.5° W	59525	57486
112.9	2871	+185	.3160	-18	89°17.9'S	158.0° W	59525	57368
112.10	2870	+225	.3198	-15	89°22.4'S	158.0° W	59500	57347
112.11	2840	+290	.3350	- 9	89°26.6'S	157.5° W	59485	57362
113.0	2839	+415	.3418	0	<u>89°31.0'S</u>	<u>157.5° W</u>	59430	57327
113.1	2804	+205	.3381	-15	<u>89°34.7'S</u>	<u>157.5° W</u>	59335	57221

Appendix 1 con't.

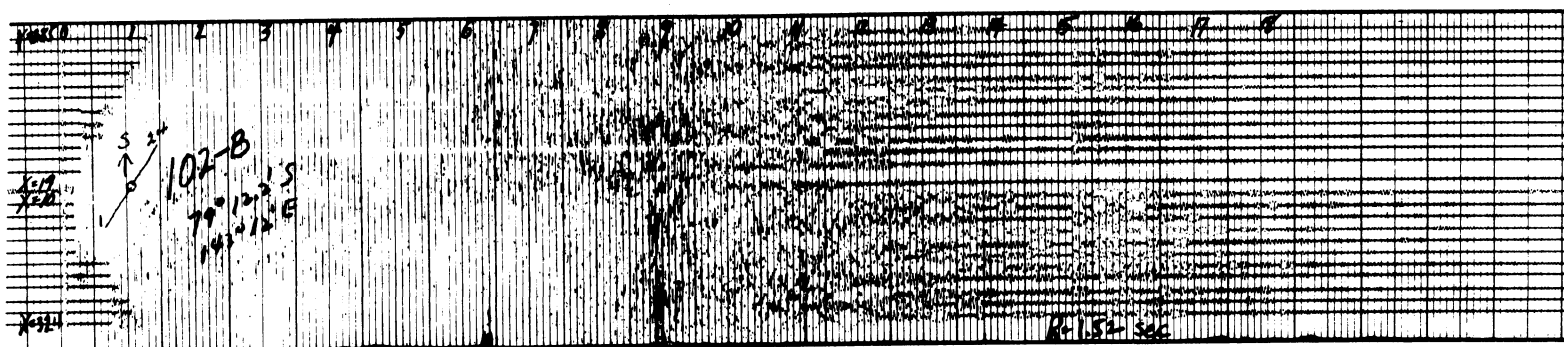
Station Number	Surface Elevation meters	Rock Elevation meters	Observed Gravity gals	Free Air Anomaly milligals	Latitude	Longitude	Total Field Intensity gammas ± 100	Vert. Field Intensity gammas ± 100
113.2	2794	+160	982.3318	-24	89°39.1'S	157.5°W	59305	57051
113.3	2801	+ 35	.3285	-26	89°43.1'S	157.5°W	59305	56985
113.4	2804	+ 45	.3289	-25	89°47.1'S	157.5°W	59300	56946
113.5	2800	+ 25	.3295	-26	89°51.2'S	157.5°W	59285	56897
113.6	2800	+ 25	.3298	-26	89°55.5'S	157.5°W	59250	56861
Pole 114.0	2800	- 40	.3284	-29	<u>89°59.8'S</u>	<u>157.5°W</u>	59155	56979

Appendix 2 (con't)

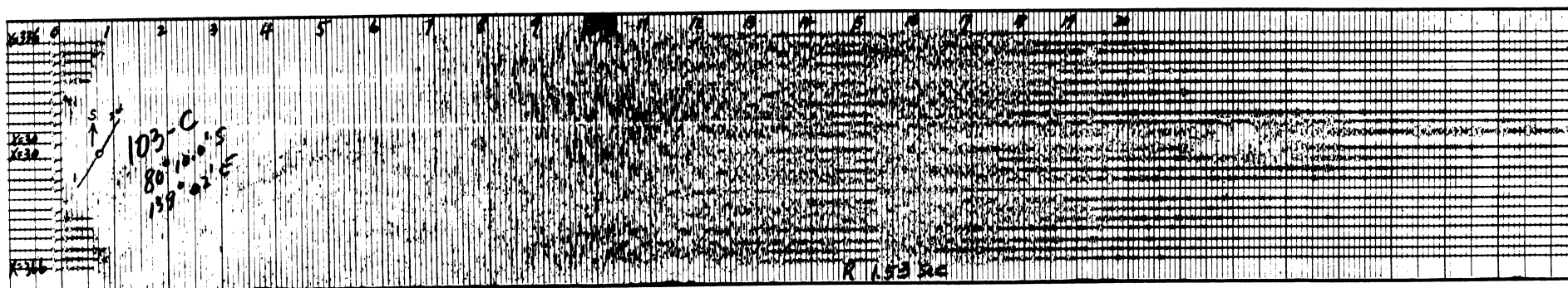
Station 110			Station 111 (con't)		
<u>Distance</u>	<u>Velocity</u>	<u>Depth</u>	<u>Distance</u>	<u>Velocity</u>	<u>Depth</u>
0 m	500 m/s	0 m	120 m	2630 m/s	31.4 m
10	905	1.9	130	2710	34.1
20	1445	6.1	140	2740	35.4
30.5	1860	9.8	150	2780	37.3
61.0	2125	14.7	170	2880	41.3
91.5	2375	20.2	200	3000	47.1
122.0	2565	28.8	220	3070	52.1
152.5	2760	36.4	244	3210	59.9
183.0	2920	43.8	274.5	3300	65.5
213.5	3070	51.4	305.0	3360	70.2
244.0	3210	59.2	335.5	3400	74.0
274.5	3300	65.1	366.0	3480	81.2
305.0	3360	69.8			
335.5	3400	73.5			
366.0	3460	79.3			
Station 111			Station 112		
<u>Distance</u>	<u>Velocity</u>	<u>Depth</u>	<u>Distance</u>	<u>Velocity</u>	<u>Depth</u>
0 m	450 m/s	0 m	0 m	500 m/s	0 m
5	610	0.7	10	870	1.8
10	850	2.4	20	1140	4.8
15	1140	4.5	30.5	1580	9.4
20	1400	6.6	61.0	2000	16.2
25	1640	8.6	91.5	2300	24.0
30	1700	9.3	122.0	2520	31.4
35	1750	10.2	152.5	2650	37.2
40	1810	11.2	183.0	2740	42.3
45	1840	11.9	213.5	2860	49.5
50	1900	13.1	244.0	2960	56.1
60	1960	14.6	274.5	3060	63.1
70	2250	20.3	305.0	3140	69.4
80	2350	22.2	335.5	3200	74.8
90	2410	24.3	366	3280	82.
100	2500	25.8	1096	3801	170.
110	2550	28.6	1370	3833	185.
			1830	3873	215.
			2740	3880	250.
			5480	3895	325.



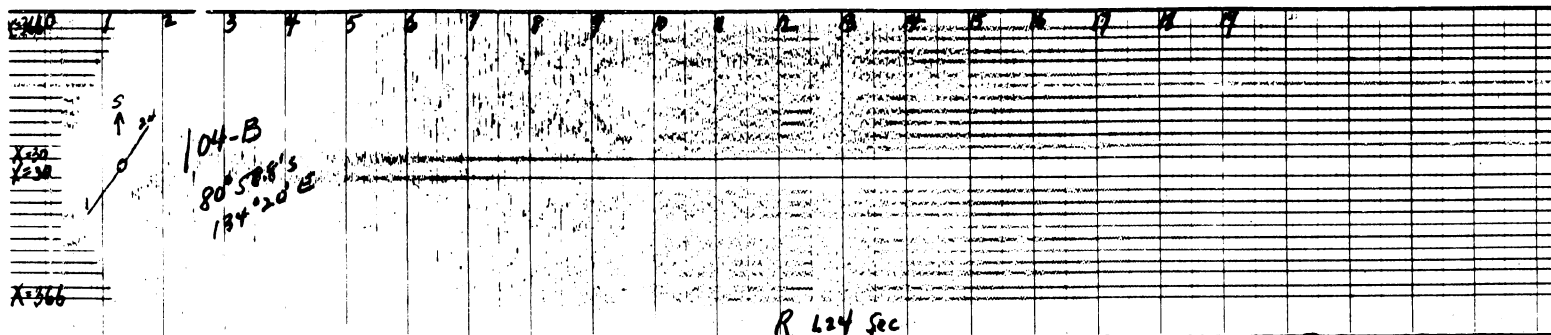
	Charge	Shot Depth	Filter
101-D	3 kgm.	28 m	210 - out cps.



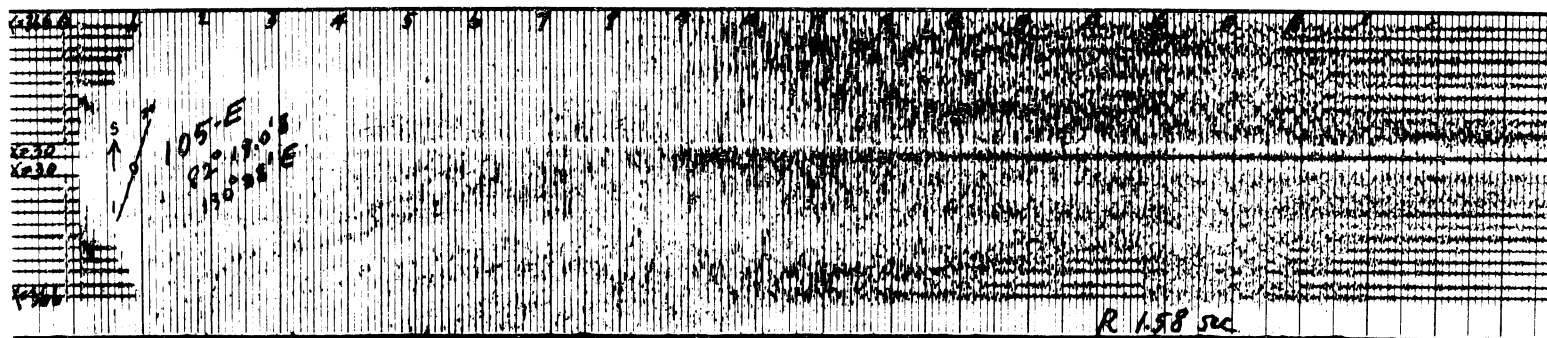
	Charge	Shot Depth	Filter
102-B	3 kgm.	33 m	210 - out cps.



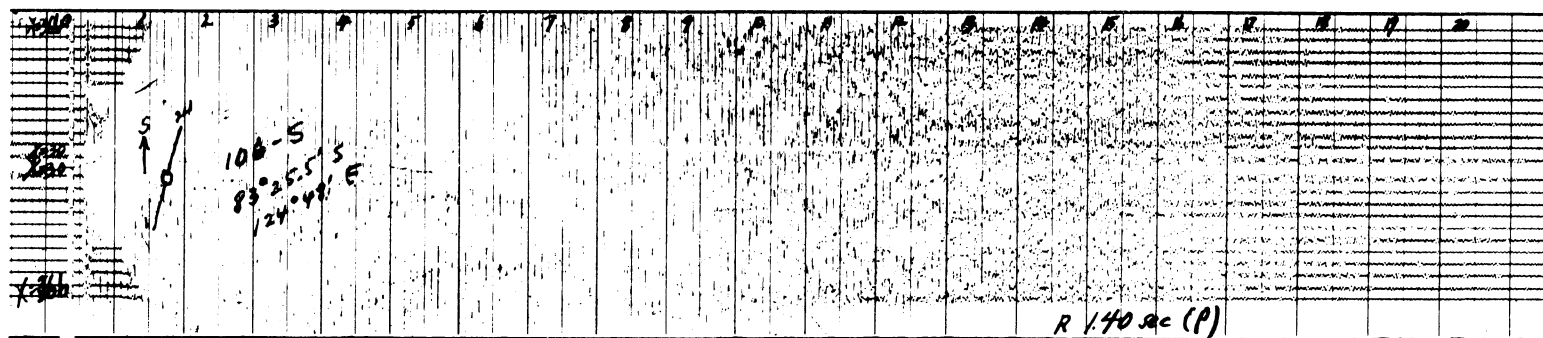
	Charge	Shot Depth	Filter
103-C	1 kgm.	38 m	210 - out cps.



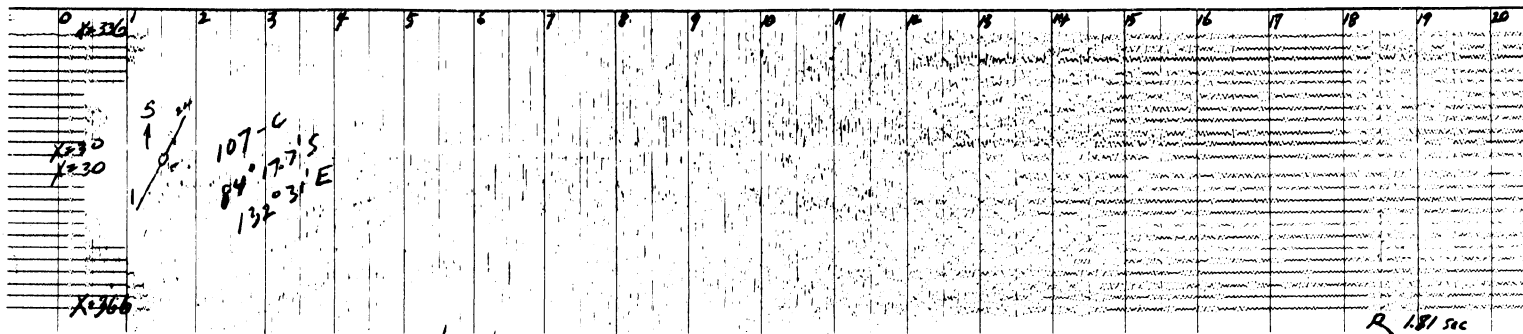
	Charge	Shot Depth	Filter
104-B	3 kgm.	36 m	210 - out cps.



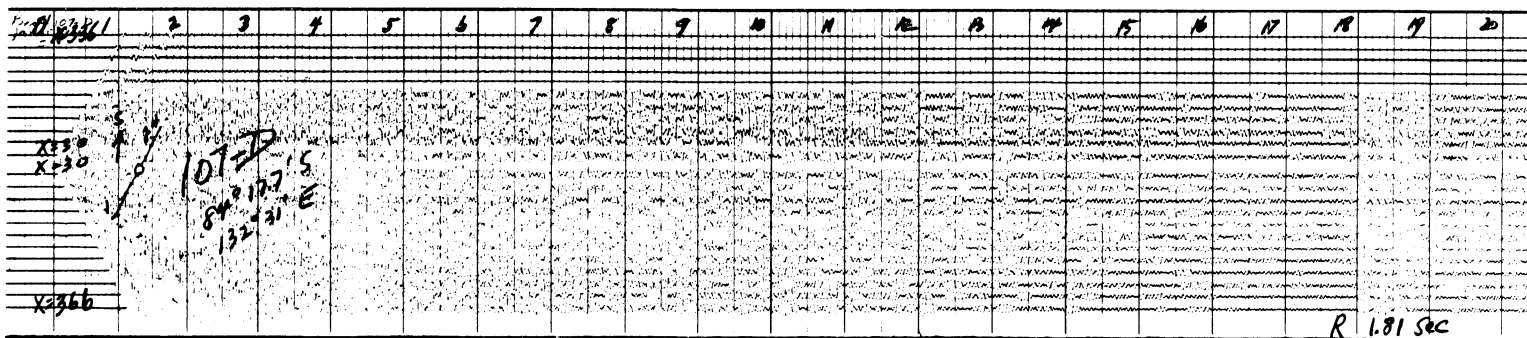
	Charge	Shot Depth	Filter
105-E	1 kgm.	36 m	210 - out cps.



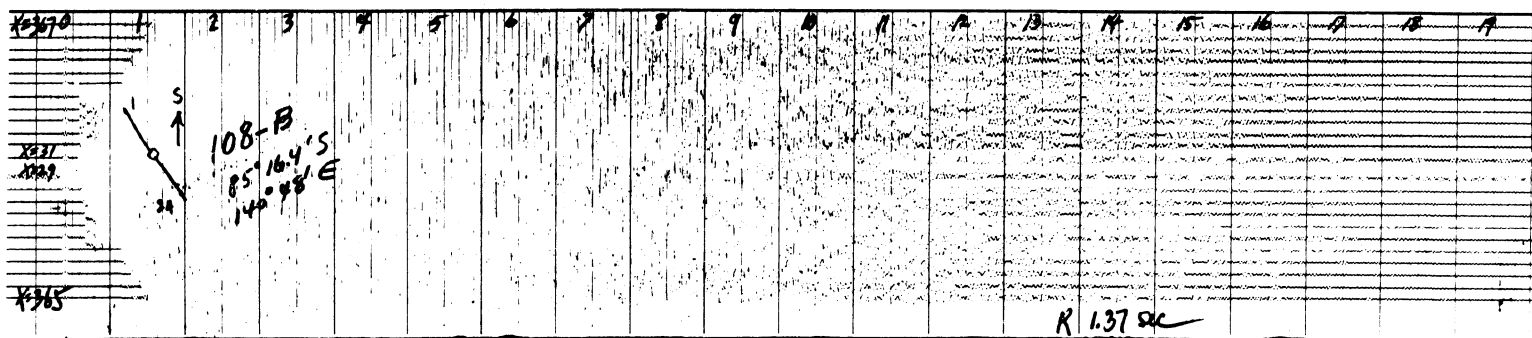
	Charge	Shot Depth	Filter
106-S	2 kgm.	40 m	210 - 320 cps.



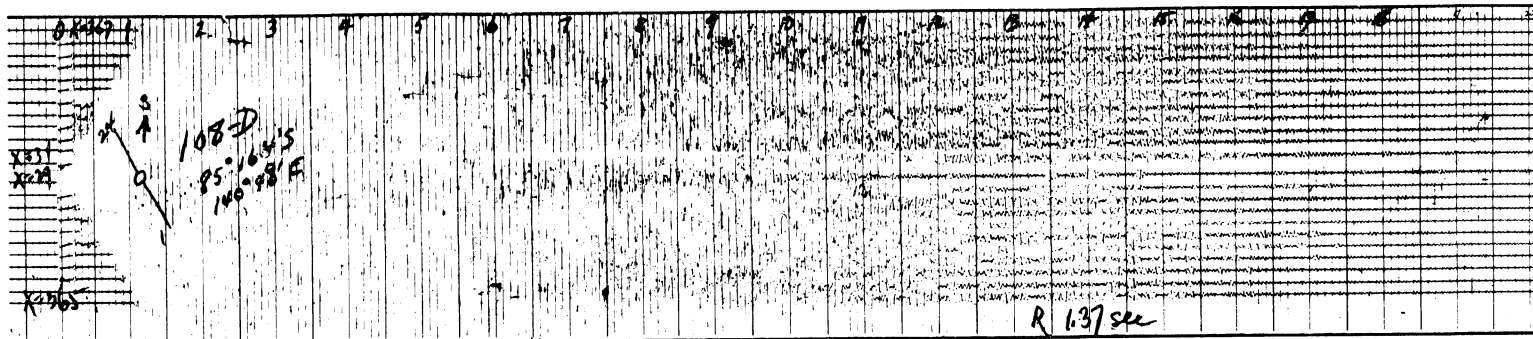
Charge Shot Depth Filter
 107-C 3 kgm. 38 m 210 - 320 cps.



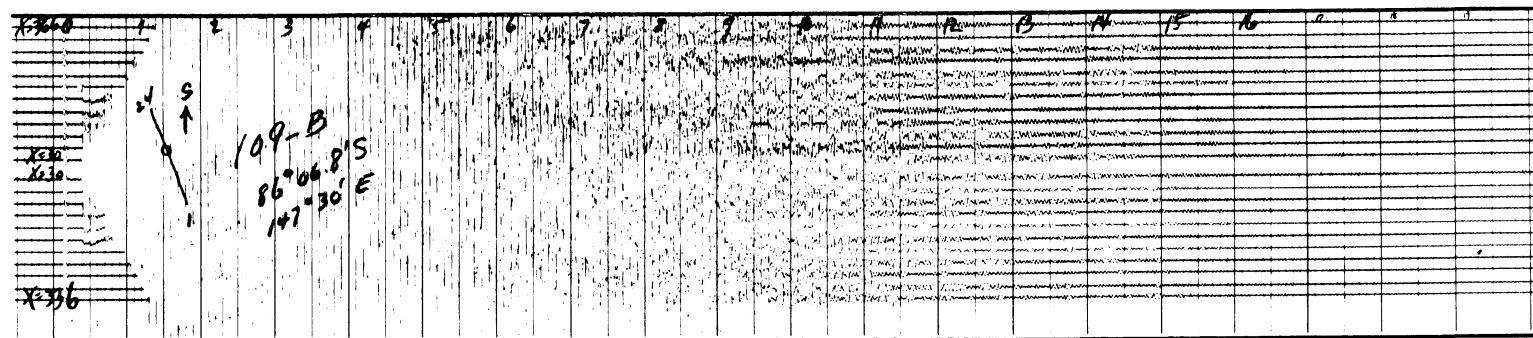
Charge Shot Depth Filter
 107-D 2 kgm. 38 m 210 - 320 cps.



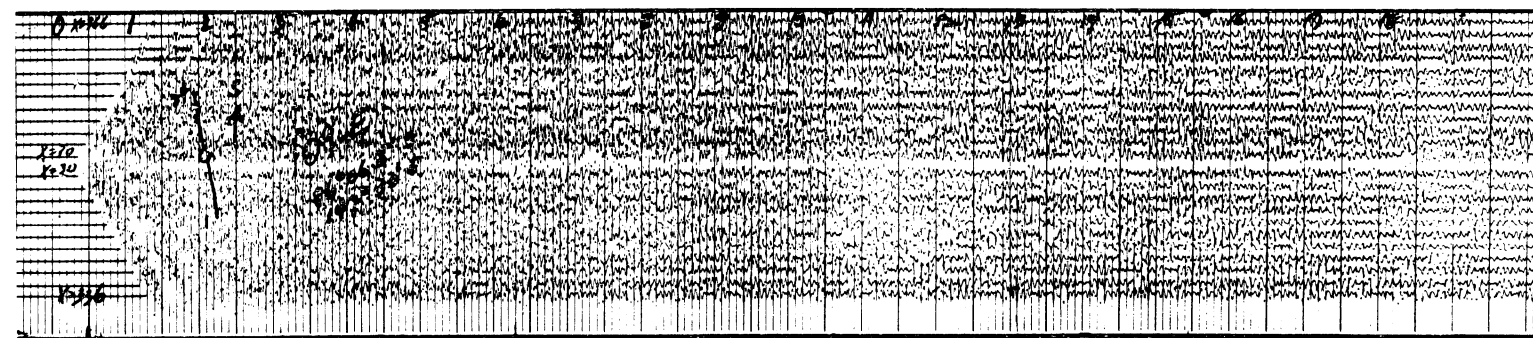
Charge Shot Depth Filter
 108-B 1 kgm. 39 m 210 - 320 cps.



108-D Charge Shot Depth Filter
 2 kgm. 39 m 210 - out cps.

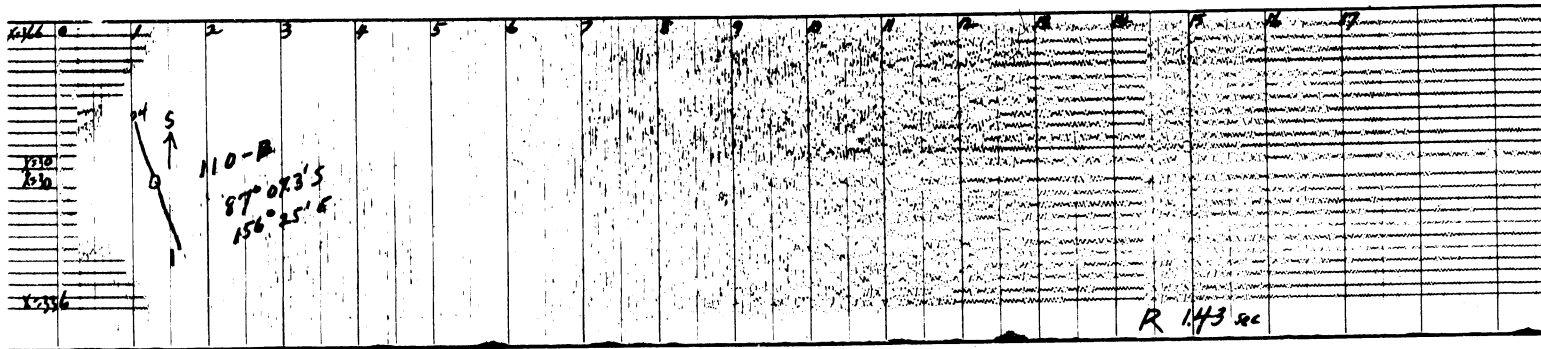


109-B Charge Shot Depth Filter
 1 kgm. 39 m 210 - out cps.

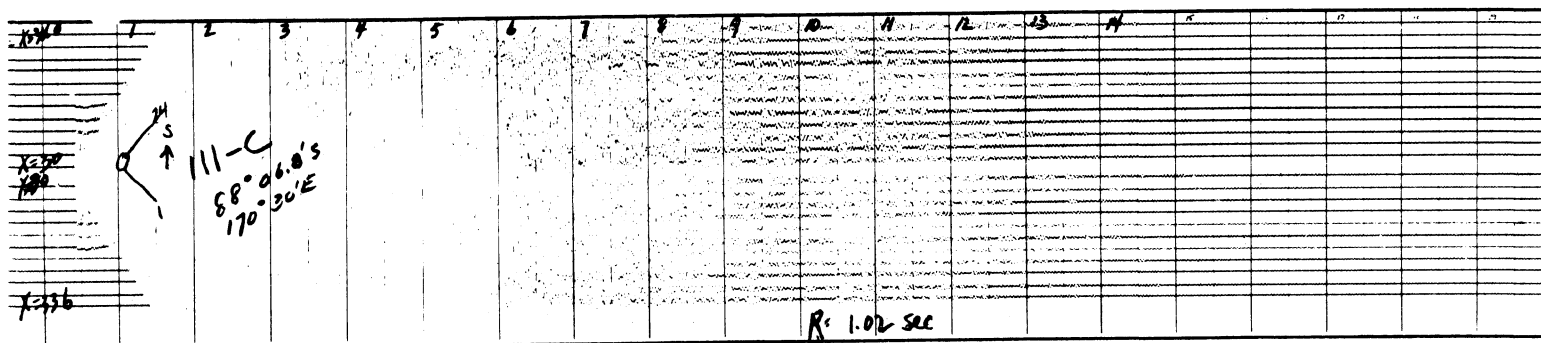


109-E Charge Shot Depth Filter
 2 kgm. 39 m 120 - out cps.

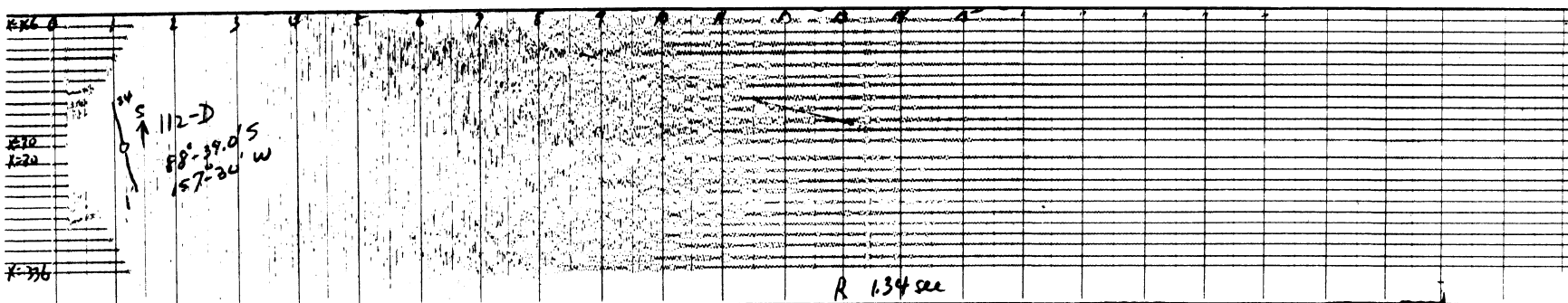
47



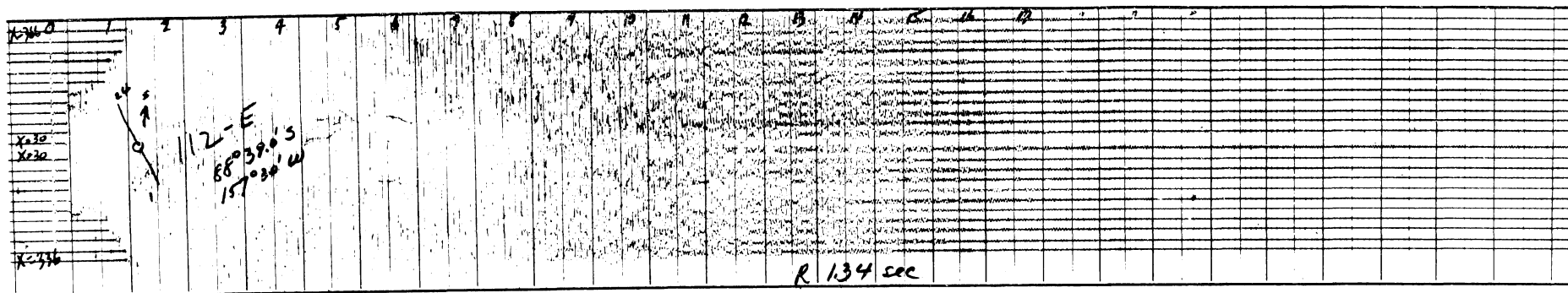
Charge Shot Depth Filter
 110-B 1 kgm. 40 m 210 - out cps.



Charge Shot Depth Filter
 111-C 1 kgm. 39 m 210-- out cps.

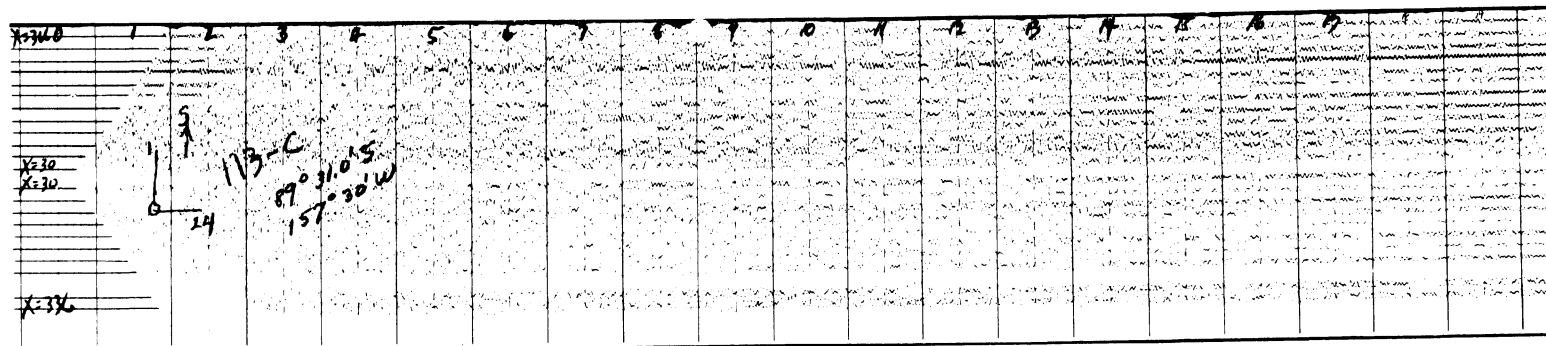


Charge Shot Depth Filter
 112-D 0.5 kgm. 41 m 210 - out cps.

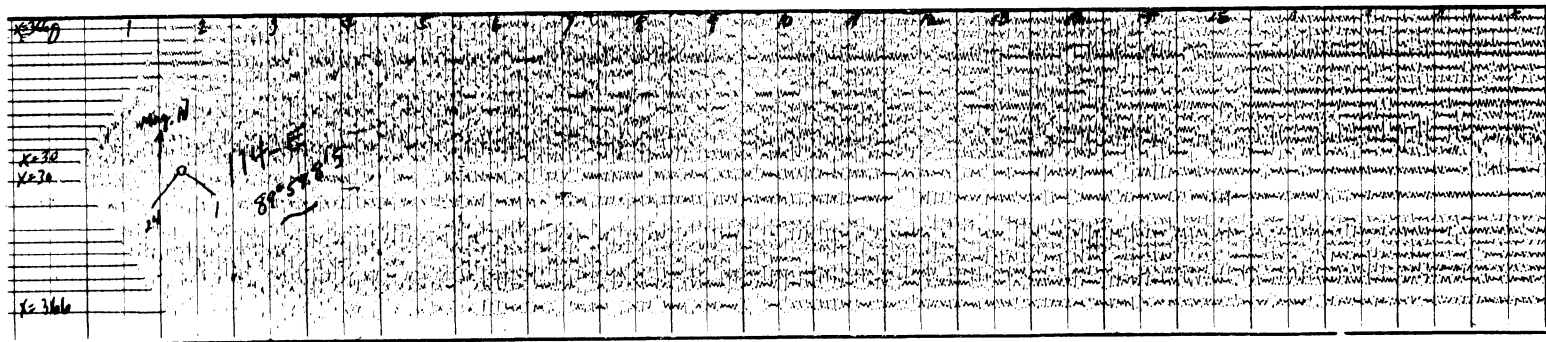


R 134 sec

Charge Shot Depth Filter
 112-E 1 kgm. 41 m 210 - out cps.



Charge Shot Depth Filter
 113-C 1 kgm. 35 m 210 - out cps.



Charge Shot Depth Filter
 Pole E 2 kgm. 38 m 210 - 320 cps.

RESULTS OF GEOPHYSICAL STUDIES
ON THE MCMURDO TO SOUTH POLE
TRAVERSE.

Research Report No. 62-6

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