GLACIAL AND SUBGLACIAL TOPOGRAPHY OF WEST ANTARCTICA

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Abstract. A summary of the techniques used and results obtained from three oversnow traverses in Marie Byrd Land and the Ellsworth Highland between January 1957 and January 1959 is presented. Seismic reflection shooting at 30 nautical mile (55·5 km.) intervals was combined with gravity, magnetic and altimetric measurements to determine the glacial and subglacial topography. It was found that a vast portion of West Antarctica has an ice–rock interface well below sea-level. A major connecting channel with a maximum depth of more than 2,500 m. below sea-level exists between the Ross and Bellingshausen–Amundsen Seas, whereas there is no major topographic connection between the Ross and Weddell Seas. This channel divides West Antarctica into two provinces with granite and rocks of sedimentary origin to the east and south, and a volcanic region to the north-west. Present ice flow is outward from two high areas, centred over mountainous regions on either side of the channel. It is concluded that the present ice sheet has grown from the convergence of the two smaller ice sheets which formed in the mountainous areas and joined across the intervening open water.

Résumé. Les auteurs présentent un exposé sommaire des techniques utilisées et des résultats obtenus au cours de trois traversées de Marie Byrd Land et d'Ellsworth Highland entre Janvier 1957 et Janvier 1959. Des tirs sismiques de réflexion tous les 30 miles (55,5 km) ont été combinés avec des mesures gravimétriques, magnétiques et altimétriques pour déterminer la topographie superficielle et sous-glaciaire. Il a été trouvé qu'une vaste partie de l'Antarctique Ouest a un socle sous-glaciaire bien en-dessous du niveau de la mer. Un important chenal d'une profondeur de plus de 2500 mètres au-dessous du niveau de la mer relie les Mers de Ross et de Bellingshausen–Amundsen, alors qu'il n'y a pas d'importante connexion topographique entre les Mers de Ross et de Weddell. Ce chenal divise l'Antarctique Ouest en deux parties, avec des granits et des roches d'origine sédimentaire à l'Est et au Sud, et une région volcanique au Nord-Ouest. L'écoulement glaciaire actuel provient de deux zones élevées, centrées sur des régions montagneuses de chaque côté du chenal. On en conclut que l'indlandsis actuel est dû à la convergence de deux calottes plus petites formées dans les zones montagneuses qui se sont jointes à travers la séparation d'eau libre.

Zusammenfassung. Es wird eine Zusammenfassung der Methoden und Ergebnisse vorgelegt, die bei drei Durchquerungen der Eisgebiete in Marie Byrd-Land und im Ellsworth Hochland zwischen Januar 1957 und Januar 1959 benutzt und erzielt wurden. Seismische Reflexionsschüsse in Abständen von 30 Seemeilen (55·5 km) wurden mit Schwerkraft-, erdmagnetischen und Höhen-Messungen zur Bestimmung der Topographie der Eisoberfläche und des Untergrundes verbunden. Es ergab sich, dass ein Grossteil des Felsuntergrundes von West-Antarktika beträchtlich unter dem Meeresniveau liegt. Ein grösserer Verbindungskanal mit einer Maximaltiefe von mehr als 2500 m besteht zwischen der Ross-See und der Bellingshausen-Amundsen-See, während zwischen der Ross- und der Weddell-See keine ausgeprägte topographische Verbindung festgestellt wurde. Durch den genannten Kanal wird West-Antarktika in zwei Regionen geteilt, deren östliche und südliche aus Granit und Sedimentgesteinen aufgebaut ist, während die nordwestliche vulkanischen Ursprungs ist. Das Eis fliesst gegenwärtig aus zwei Hochgebieten beidersetis des Kanals, deren Zentren Gebirgsländer sind. Man kann annehmen, dass der gegenwärtige Eisschild durch den Zusammentritt der beiden kleineren Eisschilde entstanden ist, die sich in den Gebirgsländern bildeten und über das dazwischenliegende offene Wasser hinweg vereinigten.

This paper presents a summary of the techniques used for determining glacial and subglacial topography and the results obtained from three traverses in West Antarctica between January 1957 and January 1959. In Figure 1 are shown the routes covered during the two-year period. Owing to the unavoidable delay in getting equipment to Antarctica, the first, or Little America to Byrd Station traverse, did not get under way until 28 January 1957, and the scientific program was necessarily abbreviated. The traverse route followed the Army–Navy trail to Byrd Station which had been established during the previous three months. Altimeter, gravity and magnetic observations were made throughout this traverse every 5 statute miles (8 km.). No seismic soundings were made in the first 200 miles (322 km.), which were on the Ross Ice Shelf, as this was scheduled to be done at a more opportune time by the Little America traverse party. From Mile 200 (322 km.) to Mile 500 (805 km.) seismic reflections were obtained every 50 miles (80·5 km.), thence every 20 miles (32 km.) to Byrd Station (Mile 675; km. 1,086). Byrd Station was reached on 27 February after just one month on the trail.

The second (Sentinel) traverse, covering the period from 19 November 1957 to 19 February 1958, proceeded from Byrd Station east-north-east to lat. 76·6° S., long. 113° W.; thence to the Sentinel Mountains at lat. 77·8° S., long. 87° W.; from there to lat. 79·6° S., long.

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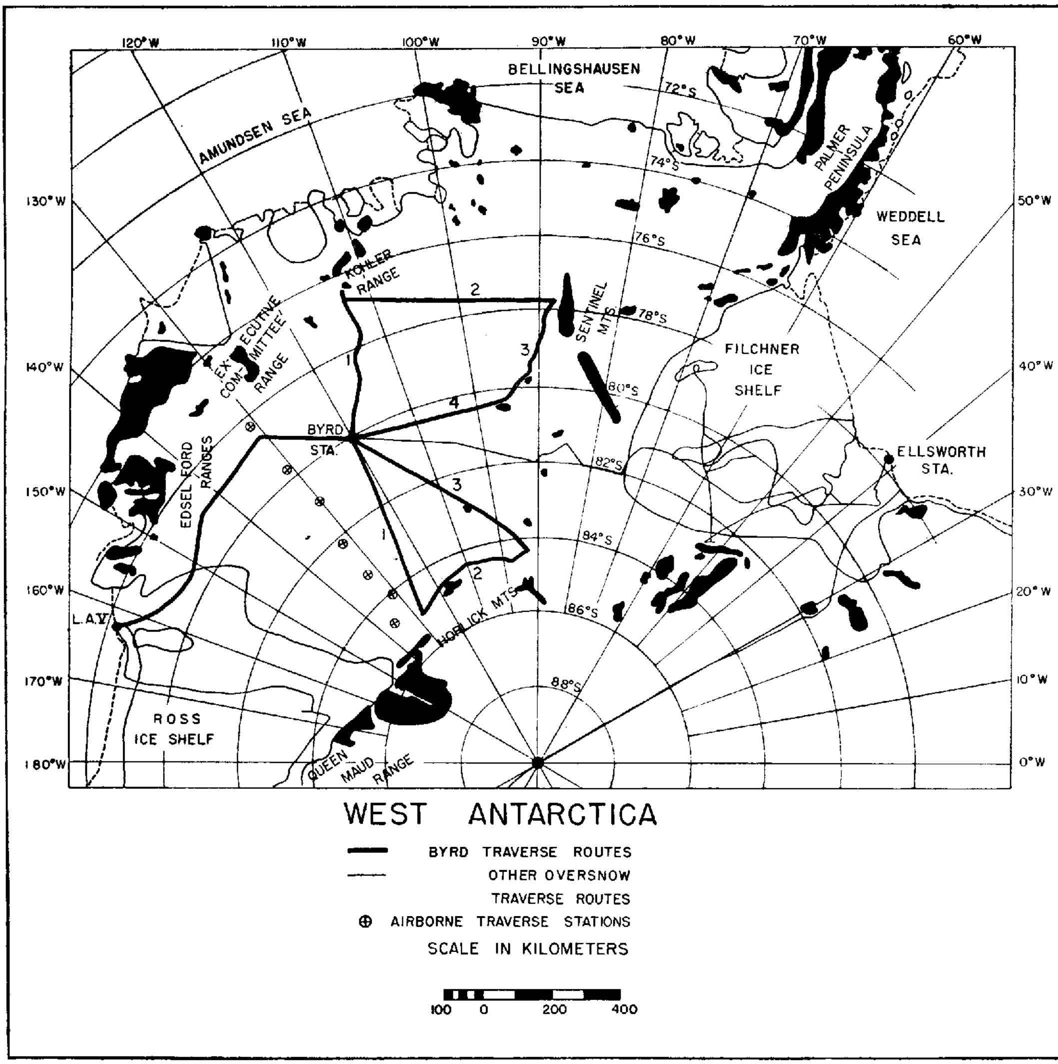

Fig. 1. Traverse routes in West Antarctica. Numbers refer to the various legs of the Sentinel Mountains and Horlick Mountains traverses

91° W.; on to lat. 80·5° S., long. 98° W.; and finally back to Byrd Station, covering a total distance of 1,026 nautical miles (1,901 km.).

The third (Horlick) traverse, between 1 November 1958 and 20 January 1959, headed south from Byrd Station to lat. 85·0° S., long. 127° W.; then, following a route which looped a bit to the north to skirt the Horlick Mountains, to lat. 84·3° S., long. 92° W.; thence back to Byrd Station, covering this time 916 nautical miles (1,698 km.). On both of these latter traverses altimetric, magnetic and gravity observations were made every 3 nautical miles (5·5 km.) and seismic soundings every 30 nautical miles (55·5 km.).

Equipment

The seismograph used was a 24 trace Texas Instruments 7000B Portable Seismograph System with a basic frequency range from 5 to 500 c./sec. and with a selection of gain, filter,

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mixing, and automatic gain control settings providing a large number of operating characteristics. Automatic gain control was very rarely used, and mixing only occasionally with no appreciable improvement in the records. The party was also equipped with two Vector geophone cables, each having 12 take-outs at 30 m. intervals, and with a variety of geophones for measuring high and low frequency ground motion, both vertical and horizontal.

Gravity values were measured with a Frost gravimeter, which was generously loaned by the Lamont Geological Observatory of Columbia University. This instrument is free of drift, an invaluable asset when several months elapse between readings at the base station, and has a very wide range, enabling readings to be made on the Byrd traverses over 10 degrees of latitude and 2,500 m. of elevation without resetting. The authors are greatly indebted to the Lamont Observatory and especially to Professor Worzel for the use of this instrument.

For magnetic measurements an Arvela vertical component magnetometer, having a reading accuracy of about 10 gamma, was used. This instrument is very small, light, and easy to use, and with it an observation can be made in 10 min. or less. Altimetry, important both for reduction of the gravity data and for mapping, was conducted with three Wallace and Tiernan altimeters. Two of the instruments formed a matched pair which followed each other very well over a wide range of elevation.

Methods Employed

The following description pertains to the Sentinel and Horlick traverses; the Little America to Byrd traverse differed only in the distances between stops. The normal operating procedure was to travel every other day, making stops every 3 nautical miles (5·5 km.) *en route* to read altimeters and for gravimetric and magnetic measurements. Of the three traverse vehicles, one travelled 3 nautical miles (5·5 km.) ahead of the other two; altimeter readings at each vehicle were then compared to give the difference in elevation over the 3 nautical mile (5·5 km.) interval. At each stop the air temperature and wind velocity were measured to enable corrections for temperature and for horizontal variations in atmospheric pressure to be applied to the altimeter data. In a normal travelling day 30 nautical miles (55·5 km.) would be covered, the next day then being devoted to seismic and glaciological pit studies.

The primary seismic measurement at each station was the determination of the ice thickness by reflection shooting. The spread was laid out either in line or in the form of an "L". One-fourth of the geophones were normally placed in the horizontal longitudinal position in order to detect possible shear of transformed compressional-shear reflections. Several shots were fired at the corner of the spread with different gain and filter settings. A charge of 1 lb. (0·45 kg.) at a depth of 4 m. was usual on the Sentinel traverse where reflection quality was very high; on the Horlick traverse best results were usually obtained with the same charge in a 10 m. hole or, occasionally, with a seven shot pattern 2 m. above the surface. Shooting in a "sprung" hole, i.e., one in which a charge had already been fired, was found to be of value since the use of such a hole not only increased by a factor of five the amount of seismic energy produced from a given charge size, but also appeared to improve the signal to noise ratio.[1]

Reflection records varied greatly in quality, most of those on the Sentinel traverse being excellent, whereas those on the Horlick traverse were generally quite poor. The controlling factor in record quality was not the strength of the echo, although this varied considerably, but the amount of prolonged surface noise following the shot and interfering with the reflected arrival. Such noise has been reported by other observers and can be expected everywhere on sufficiently cold firn. A study of the cause of this noise is currently in progress but no conclusions have yet been reached.

As will be discussed further in another paper, a low velocity layer was discovered at the base of the ice sheet. Uncertainty as to the thickness of this layer and its wave propagation characteristics diminishes the accuracy with which echo times can be converted to ice thickness values. Using the average thickness estimated for the layer and assuming a velocity of 3,600 m./sec. within it, an average velocity of 3,820 m./sec. throughout the ice column was calculated and has been used for all thickness computations. The maximum error in total ice thickness which would result from the use of this value for the average velocity is estimated to be ± 40 m. The error in relative thickness between two neighboring stations would be considerably less than this, but it is difficult to reckon owing to lack of information concerning the variability of the basal layer from place to place.

The gravity values measured between the seismic stations were employed to provide detail in the topographic profile. On a broad, flat plateau free air anomalies represent a first approximation to isostatic anomalies. In order, therefore, to minimize the effect of the compensating (negative) mass at depth corresponding to the load of the ice, free air anomalies were used to compute ice thickness. However, since the reflection shooting provided control every 30 nautical miles (55·5 km.), Bouguer anomalies would have produced negligibly different results. The gravity observations were used, then, to interpolate changes in sub-ice rock surface elevations between seismic soundings. This was accomplished by equating changes in free air anomaly relative to a seismic station to changes in ice thickness and adding or subtracting this difference to the seismically determined elevation of the rock surface relative to sea-level. For these calculations densities of 0·9 g./cm.^{3} for the ice and 2·67 g./cm.^{3} for bedrock were assumed. Thus 1 mgal anomaly represents 13·56 m. change in ice thickness.[2]

Considerable difficulty was experienced in trying to correct traverse magnetic observations for diurnal changes in field strength. It was found that throughout most of a season the traverse party would be too far from any of the permanent base stations to permit effective control by means of the station magnetographs. For this reason the magnetic data have been used only to obtain the regional gradient and to give the general magnetic character of the basement rock.[3]

The altimetric survey was conducted using a modified leap-frog method with the normal corrections applied for air temperature and temporal changes in barometric pressure. In addition an adjustment was made for horizontal pressure differences by noting the surface wind speed and direction with each altimeter reading and relating these to the geostrophic gradient.[4] Generally good results were obtained from the altimetry. The standard error of one measurement of elevation difference between two stops was about 1 m., and the estimated maximum error on a closed traverse loop was ± 15 m. relative to Byrd Station. The latter error is naturally less the closer the field station is to Byrd Station.

The principal facts, i.e., latitude, longitude, *observed gravity*, *free air anomaly*, surface elevation, bedrock elevation and ice thickness, of all 719 observation sites from the three traverses are tabulated in the Appendix (p. 896). The values of observed gravity are on an absolute scale, being tied to the University of Wisconsin pendulum station at McMurdo Sound. The base value at Byrd Station (982·6009 gal) was established by multiple ties via air with the McMurdo Sound station using Worden, LaCost and Frost gravimeters.[5] The program of establishing and strengthening a network of base stations in Antarctica is continuing and the value for the Byrd Station is subject to a slight adjustment (probably not in excess of ± 2 mgal) as more data become available. Such a change in base value would result in an overall adjustment of the gravity surveys but would not change the free air anomalies.

Sample Records

Figure 2 (p. 911) shows three reflection records, the upper one from the Sentinel traverse, the middle from the Horlick Traverse. Both were produced by a 1 lb. (0·45 kg.) charge at a depth of 4 m., and the gain and filter settings were the same in each case. It can be seen from the upper record that the surface waves are rapidly attenuated with the result that after about 0·7 sec. all traces have essentially returned to background noise level. This permits the

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recording of an excellent echo from the ice–rock interface at the ice thicknesses normally encountered. In striking contrast to this record is the one from the Horlick traverse, exhibiting the prolonged surface noise which proved a major obstacle to successful reflection shooting. The noise was incoherent and looked much the same as this sample even when the filters were wide open. This interference was serious enough to prevent the recording of a satisfactory echo during the first 278 km. of the Horlick traverse, and to spoil throughout the summer any possibility of observing the weak reflections from the surface of the basal low velocity layer.

Evidence of sub-ice reflection energy can be seen shortly after the main echo on the first record. From some shots reflected energy continued to arrive for 0·5 sec., probably indicating a considerable amount of morainal material. As yet, the sub-ice reflection data have not been examined in detail.

The bottom record in Figure 2 shows reflections obtained with a 5 lb. (2·27 kg.) charge in a sprung hole on the Sentinel traverse. The relative gain level can be seen to be high by comparing reflection amplitudes with the upper record. Note, nevertheless, how rapidly the surface waves die out despite the absence, in this case, of any low cut filtering. This record also shows energy from the surface of the basal low velocity layer arriving 0·2 sec. before the main bottom echo.

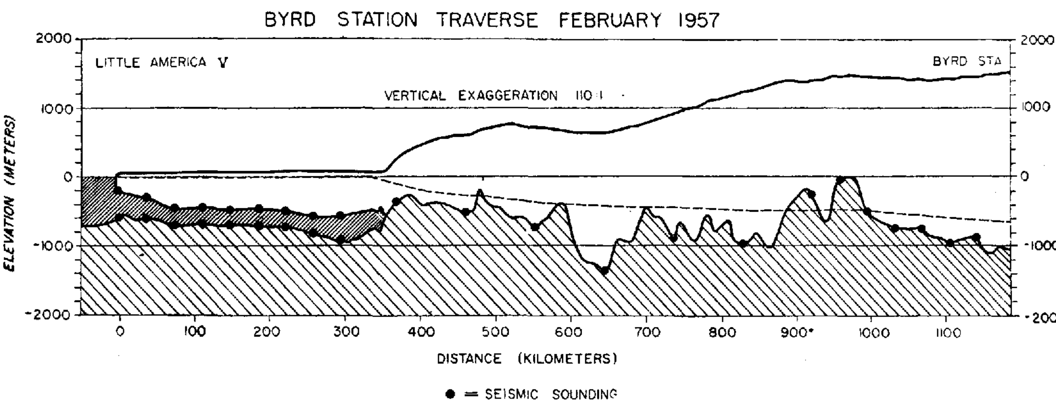

Fig. 3. Profile from Little America V to Byrd Station. Dashed line represents adjusted sea-level

Results

Seismic reflection and gravity results have been combined to draw the cross-sections of the ice sheet shown in Figures 3, 4 and 5. The dashed line in these figures shows the estimated position of sea-level relative to the rock surface (adjusted sea-level) after removal of the ice and allowance for isostatic rebound of the rock floor according to Archimedes' Principle. From the Ross Ice Shelf–Rockefeller Plateau boundary to the end of leg 1 of the Sentinel traverse the picture is generally the same. The ice–rock interface is rough with the ice thickness varying between 600 and 2,700 m. With the exception of a few peaks, the entire rock floor is at present below sea-level, the major portion below adjusted sea-level.

Sentinel traverse leg 2 shows quite a different picture, with great ice thickness (a maximum of over 3,500 m.) and a smooth bottom below the estimated adjusted sea-level by as much as 1,200 m. Leg 3, paralleling the strike of the Sentinel Mountains, shows a basal profile of another character. The rock floor is very rough and almost entirely above sea-level, in several places breaking the surface to form nunataks. Leg 4 extends from the mountainous zone across a depression narrower but deeper than the one on leg 2 and back into the moderately rough area to the west. It was in this depression on leg 4 that a maximum ice thickness of 4,270 m. was discovered. This is believed to be the greatest thickness of ice discovered to date.

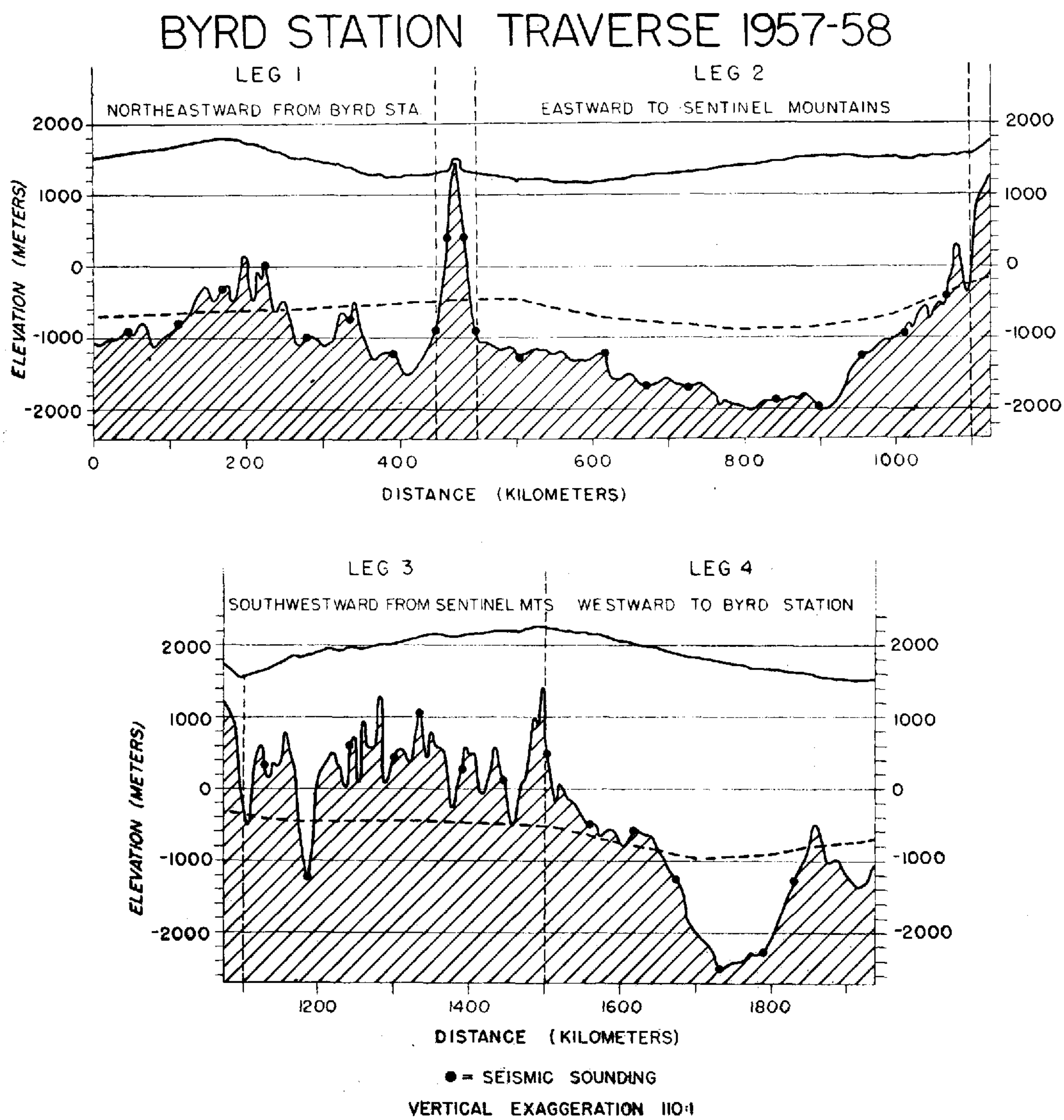

Fig. 4. Profile along the Sentinel Mountains traverse route. Dashed line represents adjusted sea-level

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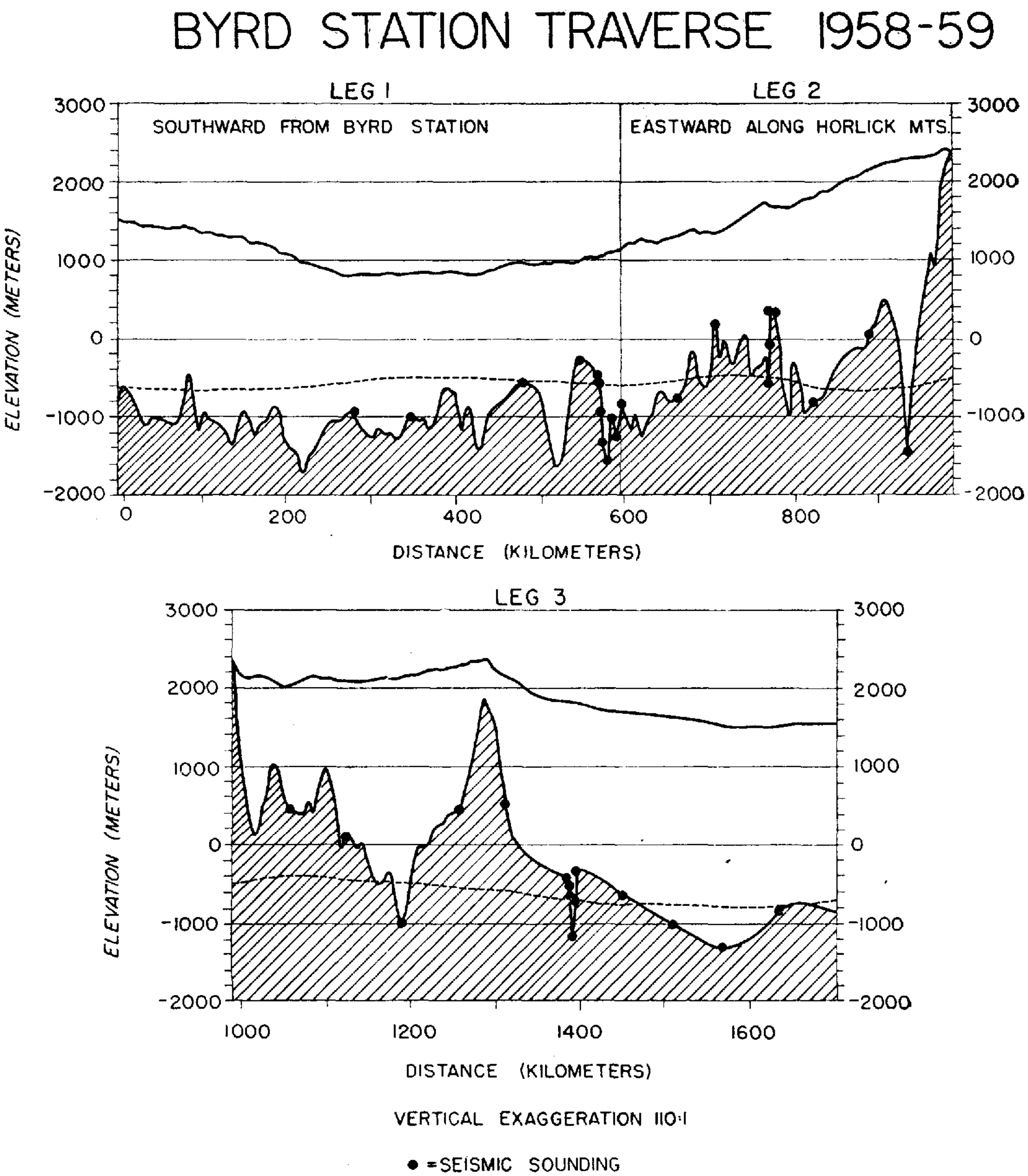

Fig. 5. Profile along the Horlick Mountains traverse route. Dashed line represents adjusted sea-level

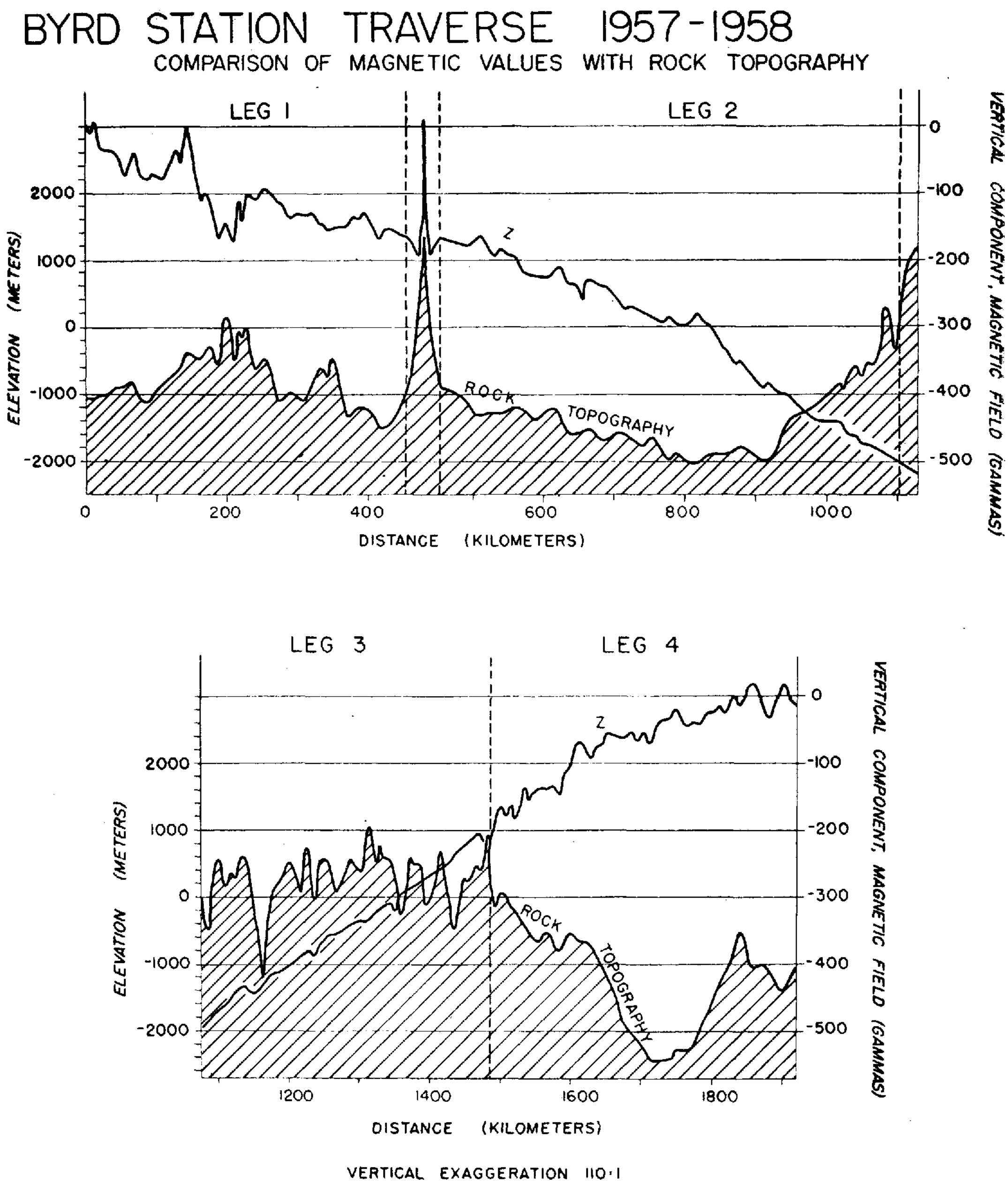

Fig. 6. Profile along the Sentinel Mountains traverse route showing the relationship between bottom topography and changes in the vertical component of the earth's magnetic field (Z)

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The ice thickness profile along the Horlick traverse is shown in Figure 5. Leg 1 is characterized by subglacial topography of moderate relief with the rock surface mostly below sea-level. It will be noted that the decrease in surface elevation from 1,500 to 800 m. is apparently not controlled by the level of the rock floor. Leg 2 runs along the Horlick Mountains and shows a rise in level of both the ice and the underlying rock surfaces. The first half of leg 3, which runs between the Horlick Mountains and another small group of mountains, exhibits a generally high rock level with rough topography. Data for the second half of this leg are sketchy as no gravity values were obtained after km. 1,380, but seismic reflections show the rock floor to be mostly below sea-level. At about km. 1,570 the extension of the deep depression found on leg 4 of the Sentinel traverse is seen. This feature is also shown near the west end of the Ellsworth–Byrd traverse profile,[6] and a suggestion of its existence is found between km. 185 and 280 on Horlick traverse leg 1.

Figure 6 shows a comparison of the measured vertical component of the magnetic field, Z, with the rock surface topography on the Sentinel Traverse. Although, as mentioned previously, it has not been possible to correct these data for diurnal variations, a considerable change in their general character along the route is apparent. On leg 1, particularly on the first part of the leg, Z exhibits large variations which correlate fairly well qualitatively with the variations in rock level. This is best shown over the known volcano at the end of the leg. Along legs 2 and 3 the variations in Z are much less and show no relation to the sub-ice topography. The smoothest part of the magnetic curve is in fact found on leg 3 where the rock surface is the roughest. On leg 4 changes in Z are more noticeable but there is little apparent correlation with the bottom topography. The magnetic data, then, show that the traverse route passes from a region of rocks with high magnetic susceptibility (probably crystalline) eastward into a region where the underlying rocks have little or no magnetic susceptibility.

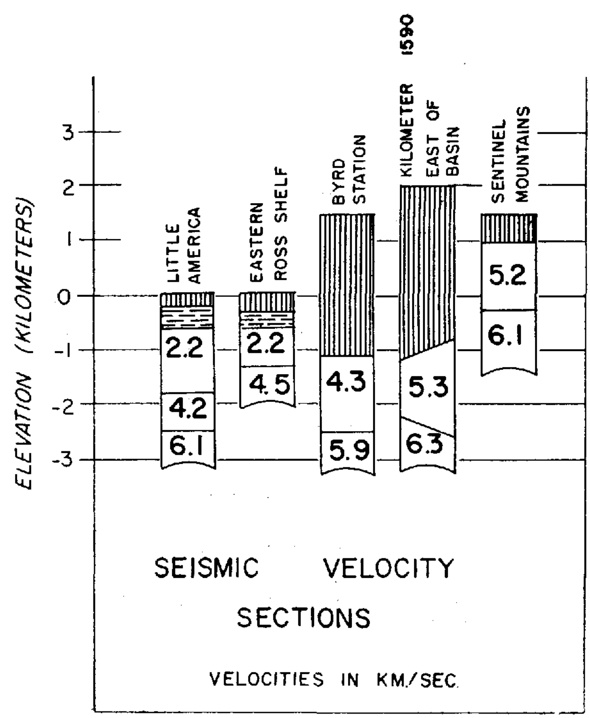

Fig. 7. Seismic velocity sections determined by long refraction studies on the Ross Ice Shelf and in West Antarctica

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Although a detailed examination has not yet been carried out, rock samples collected from Mount Takahe on the Sentinel traverse and from the Executive Committee Range by the Byrd 1959-60 traverse group as well as the shapes of the peaks themselves, indicate a volcanic origin of these mountains. On the other hand, low grade metamorphic rocks were found in the foothills of the Sentinel Mountains (the main range was not reached) and other nunataks on that traverse;[7] visits to the Horlick Mountains and neighboring peaks yielded samples of granite and sedimentary rocks.[8] Thus the magnetic and geological evidence is in agreement in indicating a zone of volcanic material in the north-west part of Marie Byrd Land and of granite and rocks of sedimentary origin in the south and east. Granite and metasediments are known along the coast in the Edsel Ford Ranges, but nowhere else north-west of Byrd Station.

Long refraction shooting on the Sentinel[1] and Ross Ice Shelf[9] traverses has given the wave velocities in the rock beneath the ice at several places (Fig. 7). The two sections on the Ross Ice Shelf are taken from Crary's preliminary results and are subject to minor revision. The velocities in the deepest layer shown in each column are in agreement within the limit of error of their determination, and their average, 6·1 km./sec., is representative of granitic continental crustal material. The only exception is the eastern Ross Ice Shelf where soundings were not sufficiently deep to reach this layer. Above the crustal material, however, there is an important difference between the average of 5·2 km./sec. from the Sentinel Mountains and km. 1,590 on the east side of the depression, and the value of 4·3 km./sec. found at Byrd Station and under the Ross Ice Shelf. The first two sections show overlying ocean sediments with a velocity of 2·2 km./sec. This provides further evidence that the marked physiographic depression defines the dividing line between two different geological provinces, Byrd and Little America Stations both being to the west of the dividing boundary.

Ice Surface Topography

The ice surface topography shows some interesting features as is shown in Figure 8. Two definite high areas are apparent, one in the east between the Sentinel and Horlick Mountains, and the other in the north-west in the vicinity of the Executive Committee Range. Between these areas is a saddle indicating flow of the ice from each high toward the other and off to the south-west and north-east. The large change in the ice level along Horlick traverse leg 1 (Fig. 5) where there is little change in the average elevation of the rock floor has already been pointed out; it is in general true that large variations in the elevation of the rock floor are not reflected in the ice surface elevation, which must therefore be determined by the pattern of ice flow.[10, 11] Thus the ice surface contours suggest that originally there were two separate ice sheets, one centered in the Executive Committee Range area and the other along the Sentinel–Horlick Mountains axis, and that these two converged across the low water-filled zone between them. Such a convergence undoubtedly represents a rather complex glacial morphology with intervening stages where the ice sheets were first joined by sea ice and later by an ice shelf before becoming completely ice-filled. It is interesting to note the decided asymmetry of the ice sheet about the Sentinel–Horlick Mountains axis. To the east, with no obstacles, the ice surface slopes down rapidly to the Filchner Ice Shelf; to the west the converging flow has produced a relatively flat surface over the broad reaches of the interior of West Antarctica.

Although leg 2 of the Horlick traverse ran quite close to the mountains the surface contours can be seen to strike more or less perpendicular to the mountain front. This indicates that there is not much ice movement from the south and suggests that the Horlick Mountains chain, although not continuous above the ice surface, nevertheless forms an effective block against ice flow from the high South Polar Plateau.

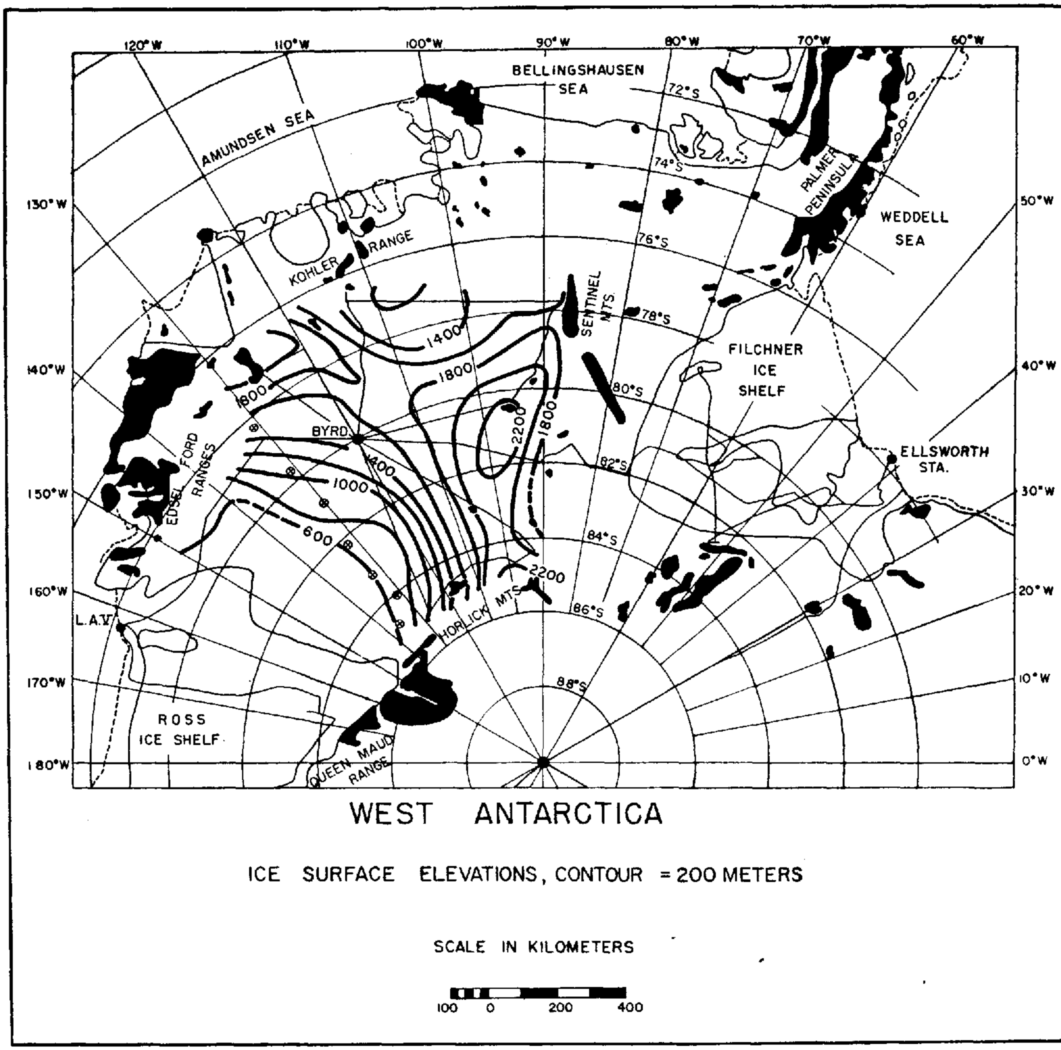

Fig. 8. Elevation of the ice surface in West Antarctica

Subglacial Topography

The contour map of rock surface elevation is shown in Figure 9. Because of the limitations imposed by the scale of this map topographic features less than 90 km. in extent were averaged out prior to contouring. From this figure it can be seen that, with the exception of the high spot centered around lat. 83° S., long. 105° W., the whole region between the Sentinel–Horlick Mountains axis and the Executive Committee Range area is below sea-level, the vast majority at least 500 m. below. This depression, although becoming gradually shallower, broadens to the north-east, suggesting a continuous channel extending from the Ross Sea to the Bellingshausen and Amundsen Seas. A conspicuous feature within this trough is a deep inner trough which reaches a maximum depth of more than 2,500 m. between Byrd Station and the Sentinel Mountains. From Figures 4 and 5 it is seen that if the ice sheet were removed the channel would be an open water passageway even after isostatic rebound. The expected

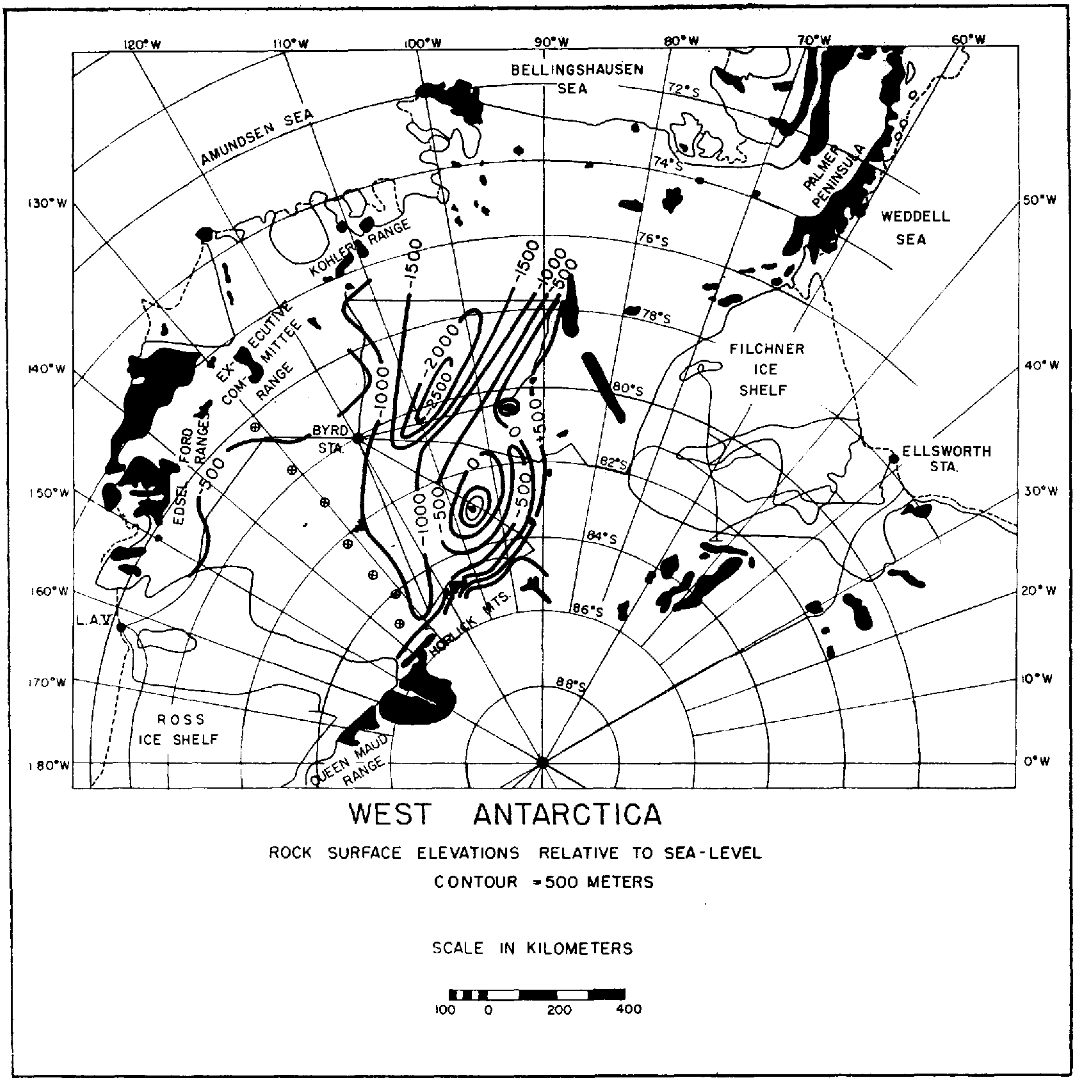

Fig. 9. Rock surface elevations of West Antarctica relative to sea-level

isostatic rise of the land surface after removal of the ice and allowing for the weight of overlying water would bring the —2,500 m. contour up to —1,900 m. and the present —500 m. contour would be the approximate boundary of the water-filled channel. These calculations are based upon assumed densities of 3·3, 2·67, 1·03 and 0·9 g./cm.³ for mantle rock, crust, sea-water and ice respectively, and the apparently valid assumption of present isostatic equilibrium.[2] No allowance was made for the rise in sea-level which would result from the melting of the Antarctic Ice Sheet. This rise (100 m.) would be small compared with the rise of the rock surface (although disastrously large for many portions of the world). If the entire Antarctic Ice Sheet were to melt, it would very likely do so at a rate greater than that of the isostatic rise of the land. For this reason a much larger area than indicated by the —500 m. contour would probably be submerged; however, it is felt that this contour presents a fair estimate of the extent of land and water before the growth of the ice. At any rate, it is clear that the Ross–Bellingshausen Sea connection is fundamental in nature and is not simply the result of a low plain depressed below sea-level by the overlying weight of ice, as, for example, is the case in Greenland. Such a conclusion is further substantiated by the gravity studies which support that there is a marked rise in the elevation of the Mohorovičić discontinuity (determined from Bouguer gravity anomaly values beneath the channel), indicating a thinning of the crust.[2, 12]

Crary[13] points out the existence of deep water under the southern boundary of the Ross Ice Shelf, which occupies the position of a foredeep in front of the Queen Maud Range. From Figure 9 it can be seen that this trough extends more or less as an unbroken feature past the Horlick Mountains and nunataks to the north, but is not apparent in front of the Sentinel Mountains. A connection between this deep and that found under the Filchner Ice

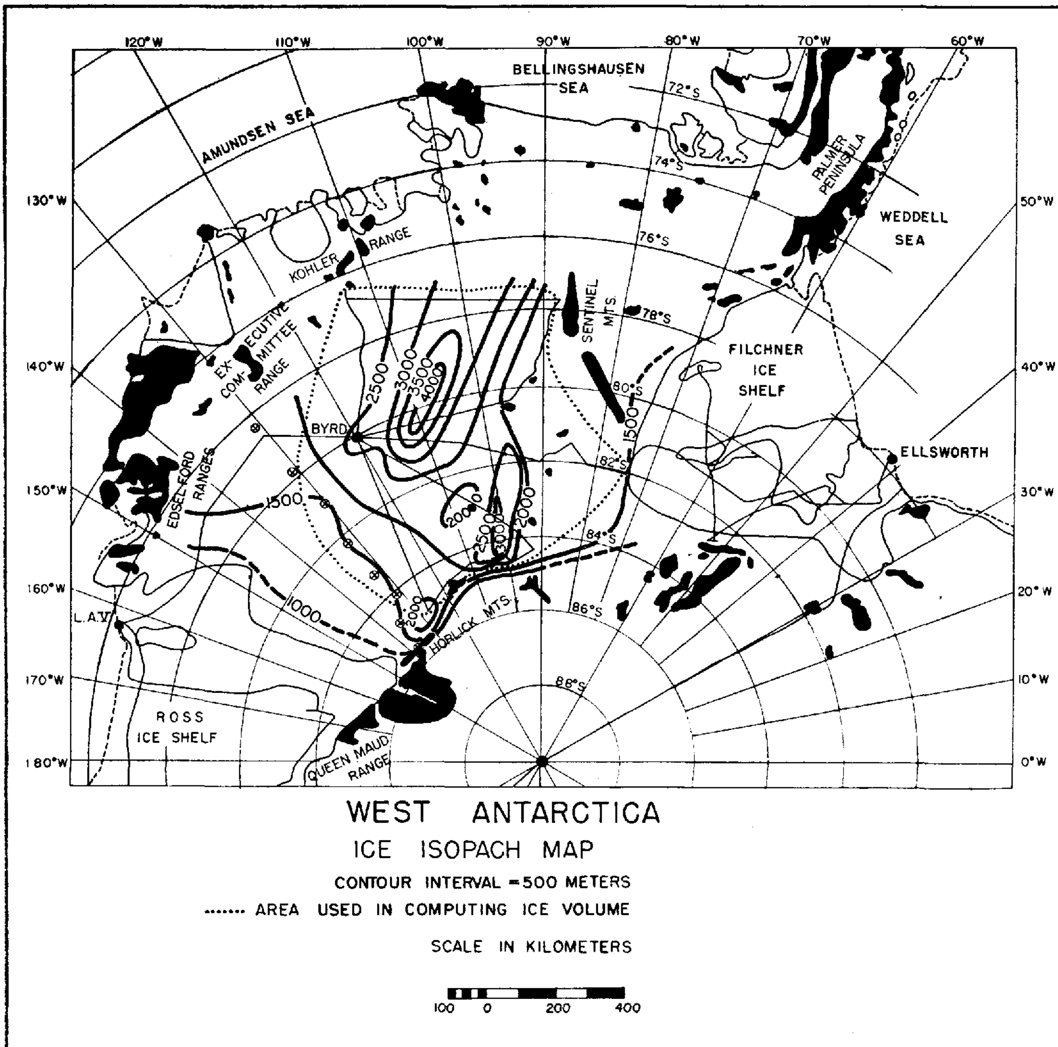

Fig. 10. Ice isopach map of West Antarctica

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Shelf[6] is possible through the gap between the Horlick traverse leg 3 and the Ellsworth–Byrd traverse, and in fact Thiel[14] on the 1959-60 airborne traverse obtained a seismic sounding of 1,700 m. below sea-level at lat. 84° 45′ S., long. 88° W. If this represents a continuation of the deep it must be very narrow indeed for the sounding was made between two nunataks separated by only 150 km. in the north-south direction. It is clear that if such a connection exists, it (a) is a minor feature and (b) runs contrary to the topographic trend of the region as a whole. Certainly there is no evidence to support the existence of a major topographic connection between the Ross and Weddell Seas.

In Figure 10 is shown an isopach map of the region surveyed. Within the area delineated by the dotted line the average ice thickness was calculated to be 1,950 m. and the total ice volume 1,836,000 km.^{3}. These computations were done by first plotting in detail the ice thicknesses at all the observation sites on a large-scale map. The area between successive contours was then carefully measured and multiplied by the thickness value intermediate between the bordering contour. Assuming an average ice thickness of 1,500 m. for the remainder of West Antarctica a total ice volume of 3,675,000 km.^{3} was obtained.

Conclusions

The following are the major conclusions reached from the topographic work done to date in Marie Byrd Land:

1. A major below sea-level connection probably exists between the Ross Sea and the Bellingshausen–Amundsen Seas beneath the ice of West Antarctica. This connection, defined by a 400 km. wide channel, is deep enough surely to have existed before the land surface was depressed by the weight of the overlying ice sheet. Within this channel, between Byrd Station and the Sentinel Mountains, there is a deeper inner trough where a depth of more than 2,500 m. below sea-level was found.

2. The combination of seismic, magnetic and geologic evidence leads to the conclusion that the channel separates West Antarctica into two provinces, with granite and rocks of sedimentary origin found to the east and south, and a volcanic region to the north-west.

3. There is no major channel or depression connecting the Ross and Weddell Seas. Although the possibility of a narrow deep channel joining the two areas has not been eliminated, all available evidence points to essential continuity of the mountainous chain from the southern boundary of the Ross Ice Shelf through the Horlick and Sentinel Mountains to the Palmer Peninsula.

4. Ice surface topography indicates that the present ice flow is outward from two centers, one in the vicinity of the Executive Committee Range, and the other between the Horlick and Sentinel Mountains. The surface slope is relatively steep toward the Ross and Filchner Ice Shelves, but between the two centers the converging flow has produced a fairly broad, flat saddle.

5. From the configuration of the ice and rock surfaces it is concluded that the West Antarctic Ice Sheet originated as two separate ice sheets in two separate mountainous areas. As these sheets expanded they converged over the open water between, were probably joined at first by a floating ice shelf, which then grew thick enough to fill the trough completely and produce the present single grounded ice sheet.

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APPENDIX

LITTLE AMERICA–BYRD STATION TRAVERSE

ROCK DEPTH FROM COMBINED GRAVITY AND SEISMIC OBSERVATIONS

Station numbers refer to statute miles from Little America V.

* Seismic soundings.

Station	*Latitude* S.	*Longitude* W.	*Observed gravity* (gal)	*Free air anomaly* (mgal)	*Rock depth* (m. a.s.l.)	*Elevation* (m. a.s.l.)	*Ice thickness* (m.)	*Station*
195	79° 26·8′	150° 51′	982·9975	6·3	—368	181	549	195
*200	79° 26·1′	150° 25′	982·9730	15·2	—247	288	535	*200
205	79° 24·9′	150° 02′	982·9556	20·4	—178	359	537	205
210	79° 23·6′	149° 23′	982·9399	21·1	—170	410	580	210
215	79° 22·4′	149° 17′	982·9212	13·9	—270	445	715	215
220	79° 21·1′	148° 54′	982·9042	8·1	—349	479	828	220
225	79° 19·5′	148° 32′	982·8922	10·5	—319	523	842	225
230	79° 18·0′	148° 11′	982·8791	10·0	—328	561	889	230
235	79° 16·4′	147° 50′	982·8724	7·9	—357	573	930	235
240	79° 14·8′	147° 29′	982·8626	4·5	—405	591	996	240
245	79° 12·7′	147° 08′	982·8522	—1·0	—481	603	1084	245
*250	79° 10·7′	146° 38′	982·8471	—5·0	—537	603	1140	*250
255	79° 08·6′	146° 28′	982·8383	—3·4	—509	633	1142	255
260	79° 06·5′	146° 08′	982·8396	13·3	—278	679	957	260
265	79° 04·2′	145° 48′	982·8228	3·9	—399	699	1098	265

Station	Latitude S.	Longitude W.	Observed gravity (gal)	Free air anomaly (mgal)	Rock depth (m. a.s.l.)	Elevation (m. a.s.l.)	Ice thickness (m.)	Station
270	79° 02·0′	145° 28′	982·8079	—1·4	—465	726	1191	270
275	78° 59·7′	145° 08′	982·7988	—3·0	—481	746	1227	275
280	78° 57·4′	144° 49′	982·7879	—10·4	—576	753	1329	280
285	78° 54·3′	144° 34′	982·7852	—11·4	—584	753	1337	285
290	78° 51·1′	144° 19′	982·7860	—14·9	—625	733	1358	290
295	78° 48·0′	144° 04′	982·7847	—17·8	—660	722	1382	295
*300	78° 44·8′	143° 49′	982·7759	—25·7	—761	719	1480	*300
305	78° 45·5′	143° 24′	982·7840	—18·6	—671	717	1388	305
310	78° 46·3′	142° 59′	982·7935	—12·7	—597	707	1304	310
315	78° 47·0′	142° 34′	982·8116	—0·9	—443	688	1131	315
320	78° 47·7′	142° 09′	982·8161	1·7	—413	613	1026	320
325	78° 47·7′	141° 46′	982·7972	—25·5	—789	656	1445	325
330	78° 47·7′	141° 25′	982·7780	—46·0	—1073	652	1725	330
335	78° 47·7′	141° 02′	982·7657	—60·4	—1275	645	1920	335
340	78° 47·7′	140° 40′	982·7641	—61·1	—1290	648	1938	340
345	78° 47·5′	140° 19′	982·7601	—63·4	—1327	653	1980	345
*350	78° 47·2′	139° 58′	982·7540	—70·6	—1431	649	2080	*350
355	78° 47·0′	139° 37′	982·7612	—59·0	—1269	663	1932	355
360	78° 46·7′	139° 16′	982·7756	—36·1	—952	690	1642	360
365	78° 46·3′	138° 54′	982·7655	—37·0	—959	719	1678	365
370	78° 45·9	138° 31′	982·7575	—39·2	—984	737	1721	370
375	78° 45·4′	138° 09′	982·7772	—16·7	—673	745	1418	375
380	78° 45·0′	137° 46′	982·7799	—1·2	—458	786	1244	380
385	78° 45·1′	137° 24′	982·7572	—15·3	—644	814	1458	385
390	78° 45·2′	137° 01′	982·7455	—16·5	—655	848	1503	390
395	78° 45·3′	136° 39′	982·7244	—26·6	—786	884	1670	395
*400	78° 45·4′	136° 17′	982·7060	—37·3	—926	909	1835	*400
405	78° 45·3′	135° 53′	982·7089	—19·6	—688	957	1645	405
410	78° 45·3′	135° 29′	982·6836	—29·4	—823	1007	1830	410
415	78° 45·3′	135° 05′	982·6732	—40·1	—1312	1006	2318	415
420	78° 45·2′	134° 41′	982·6855	—19·4	—691	1033	1724	420
425	78° 44·4′	134° 21′	982·6743	—11·1	—581	1095	1676	425
430	78° 43·6′	134° 02′	982·6452	—28·0	—813	1133	1946	430
435	78° 42·7′	133° 42′	982·6500	—24·2	—762	1128	1890	435
440	78° 41·9′	133° 23′	982·6471	—16·7	—663	1160	1823	440
445	78° 41·2′	132° 59′	982·6132	—40·7	—990	1191	2181	445
*450	78° 40·5′	132° 35′	982·5983	—42·2	—1012	1233	2245	*450
455	78° 39·7′	132° 11′	982·5969	—38·5	—947	1248	2195	455
460	78° 39·0′	131° 47′	982·5959	—30·2	—820	1277	2097	460
465	78° 38·2′	131° 27′	982·5793	—40·4	—944	1296	2240	465
470	78° 37·4′	131° 07′	982·5614	—47·1	—1019	1331	2350	470
475	78° 36·5′	130° 47′	982·5585	—36·2	—857	1374	2231	475
480	78° 35·7′	130° 28′	982·5769	—13·3	—532	1387	1919	480
490	78° 41·5′	129° 50′	982·5879	—6·6	—426	1384	1810	490
495	78° 44·4′	129° 31′	982·6047	7·6	—219	1381	1600	495
*500	78° 47·3′	129° 13′	982·5921	0·4	—301	1404	1705	*500
505	78° 50·0′	128° 56′	982·5762	—14·6	—531	1412	1943	505
510	78° 52·7′	128° 39′	982·5692	—22·2	—661	1415	2076	510
515	78° 55·3′	128° 22′	982·5841	3·6	—338	1455	1793	515
*520	78° 58·0′	128° 05′	982·6041	25·4	—69	1466	1535	*520
525	79° 00·5′	127° 48′	982·6087	32·0	—30	1477	1507	525
530	79° 02·9′	127° 31′	982·6175	38·8	13	1475	1462	530
535	79° 05·4′	127° 14′	982·6132	27·9	—186	1458	1644	535
*540	79° 07·8′	126° 57′	982·5948	6·9	—521	1454	1975	*540
545	79° 10·7′	127° 36′	982·5905	0·1	—617	1451	2068	545

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Station	Latitude S.	Longitude W.	Observed gravity (gal)	Free air anomaly (mgal)	Rock depth (m. a.s.l.)	Elevation (m. a.s.l.)	Ice thickness (m.)	Station
550	79° 13·6′	126° 15′	982·5894	—3·9	—675	1447	2122	550
555	79° 16·5′	125° 54′	982·5900	—8·0	—736	1437	2173	555
*560	79° 19·4′	125° 34′	982·5889	—11·3	—785	1435	2220	*560
565	79° 21·7′	125° 16′	982·5932	—12·6	—807	1421	2228	565
570	79° 24·1′	124° 59′	982·5975	—11·7	—797	1414	2211	570
575	79° 26·4′	124° 41′	982·5959	—12·4	—811	1421	2232	575
*580	79° 28·7′	124° 24′	982·5972	—11·8	—807	1423	2230	*580
585	79° 31·3′	124° 03′	982·5985	—16·2	—941	1409	2350	585
590	79° 33·6′	123° 42′	982·6023	—13·6	—978	1409	2387	590
595	79° 36·1′	123° 21′	982·6020	—10·0	—1004	1426	2430	595
*600	79° 38·5′	123° 00′	982·6071	—7·5	—1043	1422	2465	*600
605	79° 40·7′	122° 41′	982·6028	—8·6	—1016	1436	2452	605
610	79° 42·9′	122° 23′	982·5991	—7·6	—959	1455	2414	610
615	79° 45·0′	122° 04′	982·5999	—7·6	—917	1456	2373	615
*620	79° 47·2′	121° 46′	982·5969	—10·5	—915	1460	2375	*620
625	79° 49·7′	121° 26′	982·5868	—17·6	—1103	1474	2577	625
630	79° 52·1′	121° 05′	982·5839	—18·1	—1161	1486	2647	630
633	79° 54·0′	120° 50′	982·5935	—5·5	—1041	1499	2540	633
640	79° 57·0′	120° 25′	982·5959	—0·6	—1025	1512	2537	640
*Byrd survey	79° 59·2′	120° 01′	982·6009	—4·9	—1135	1510	2645	*Byrd survey

SENTINEL MOUNTAINS TRAVERSE

ROCK DEPTH FROM COMBINED GRAVITY AND SEISMIC OBSERVATIONS

Station numbers refer to nautical miles from Byrd Station.

* Seismic soundings.

Station	Latitude S.	Longitude W.	Observed gravity (gal)	Free air anomaly (mgal)	Rock depth (m. a.s.l.)	Elevation (m. a.s.l.)	Ice thickness (m.)	Station
*Byrd survey	79° 59·2′	120° 01′	982·6009	—4·9	—1135	1510	2645	*Byrd survey
3	79° 57·1′	119° 50′	982·5904	—3·4	—1079	1521	2600	3
6	79° 54·9′	119° 39′	982·5877	—2·8	—1035	1528	2563	6
9	79° 52·8′	119° 28′	982·5836	—3·3	—1006	1536	2542	9
12	79° 50·6′	119° 17′	982·5761	—6·9	—1019	1545	2564	12
15	79° 48·5′	119° 06′	982·5729	—8·1	—999	1548	2547	15
18	79° 46·3′	118° 55′	982·5785	—5·0	—921	1536	2457	18
21	79° 44·2′	118° 44′	982·5689	—0·2	—821	1579	2400	21
*24	79° 42·0′	118° 33′	982·5593	—8·7	—901	1579	2480	*24
27	79° 39·4′	118° 23′	982·5560	—4·7	—853	1598	2451	27
30	79° 36·8′	118° 14′	982·5557	—2·7	—833	1601	2434	30
33	79° 34·3′	118° 04′	982·5540	2·2	—832	1618	2450	33
36	79° 31·7′	117° 54′	982·5510	1·2	—744	1620	2364	36
39	79° 29·1′	117° 44′	982·5349	—11·3	—967	1627	2594	39
42	79° 26·5′	117° 35′	982·5214	—21·6	—1114	1633	2747	42
45	79° 23·9′	117° 25′	982·5213	—18·7	—1081	1638	2719	45
48	79° 21·4′	117° 15′	982·5249	—11·3	—986	1646	2632	48
51	79° 18·8′	117° 05′	982·5273	—6·5	—927	1649	2576	51
54	79° 16·2′	116° 56′	982·5254	—3·0	—887	1662	2549	54
57	79° 13·6′	116° 46′	982·5300	4·6	—790	1667	2457	57

Station	Latitude S.	Longitude W.	Observed gravity (gal)	Free air anomaly (mgal)	Rock depth (m. a.s.l.)	Elevation (m. a.s.l.)	Ice thickness (m.)	Station
*60	79° 11·0′	116° 36′	982·5249	7·4	—758	1688	2545	*60
63	79° 08·6′	116° 26′	982·5218	8·8	—726	1698	2424	63
66	79° 06·2′	116° 17′	982·5204	11·5	—675	1707	2382	66
69	79° 03·8′	116° 07′	982·5222	18·0	—574	1718	2292	69
72	79° 00·4	115° 57′	982·5253	26·1	—451	1728	2179	72
75	78° 59·0′	115° 48′	982·5288	34·1	—329	1740	2069	75
78	78° 56·6′	115° 38′	982·5260	37·9	—264	1757	2021	78
81	78° 54·2′	115° 28′	982·5113	28·3	—382	1769	2151	81
84	78° 51·8′	115° 18′	982·4956	17·4	—516	1780	2296	84
87	78° 49·4′	115° 09′	982·4940	17·5	—501	1781	2282	87
*90	78° 47·0′	114° 59′	982·5004	27·1	—358	1787	2145	*90
93	78° 44·2′	114° 56′	982·5004	28·4	—318	1786	2104	93
96	78° 41·3′	114° 53′	982·4809	9·0	—559	1781	2340	96
99	78° 38·5′	114° 51′	982·4769	6·1	—577	1779	2356	99
102	78° 35·6′	114° 48′	982·5033	30·1	—229	1766	1995	102
105	78° 32·8′	114° 45′	982·5340	55·4	136	1743	1607	105
108	78° 29·9′	114° 42′	982·5230	35·6	—111	1709	1820	108
111	78° 27·1′	114° 39′	982·4862	1·4	—552	1712	2264	111
114	78° 24·2′	114° 37′	982·5149	32·1	—114	1713	1827	114
117	78° 21·4′	114° 34′	982·5144	24·3	—122	1684	1806	117
*120	78° 18·5′	114° 31′	982·5300	37·3	0	1670	1670	*120
123	78° 16·1′	114° 24′	982·5137	8·9	—412	1626	2038	123
126	78° 13·6′	114° 16′	982·4990	—8·9	—680	1611	2291	126
129	78° 11·2′	114° 09′	982·5033	—3·2	—631	1611	2242	129
132	78° 08·7′	114° 01′	982·5196	8·5	—500	1591	2091	132
135	78° 06·3′	113° 54′	982·5265	9·4	—514	1567	2081	135
138	78° 03·8′	113° 46′	982·5289	—1·8	—693	1518	2211	138
141	78° 01·4′	113° 39′	982·5080	—25·2	—1038	1505	2543	141
144	77° 58·9′	113° 31′	982·4988	—30·7	—1140	1512	2652	144
147	77° 56·5′	113° 24′	982·5042	—24·7	—1086	1509	2595	147
*150	77° 54·0′	113° 16′	982·5074	—19·7	—1045	1510	2555	*150
153	77° 51·4′	113° 11′	982·5137	—17·3	—1035	1492	2527	153
156	77° 48·8′	113° 05′	982·5145	—17·4	—1060	1484	2544	156
159	77° 46·2′	113° 00′	982·5172	—18·0	—1091	1468	2559	159
162	77° 43·6′	112° 54′	982·5190	—21·7	—1164	1445	2609	162
165	77° 41·0′	112° 49′	982·5193	—17·6	—1132	1452	2584	165
168	77° 38·4′	112° 44′	982·5351	—4·8	—982	1437	2419	168
171	77° 35·8′	112° 38′	982·5367	2·5	—906	1450	2356	171
174	77° 33·2′	112° 33′	982·5657	22·0	—665	1414	2079	174
177	77° 30·6′	112° 27′	982·5682	18·5	—735	1389	2124	177
*180	77° 28·0′	112° 22′	982·5641	17·0	—778	1392	2170	*180
183	77° 25·2′	112° 25′	982·5889	37·7	—491	1373	1864	183
186	77° 22·3′	112° 27′	982·5853	20·8	—750	1324	2074	186
189	77° 19·5′	112° 30′	982·5709	2·7	—1008	1306	2314	189
192	77° 16·6′	112° 32′	982·5641	—6·9	—1150	1291	2441	192
195	77° 13·8′	112° 35′	982·5532	—19·0	—1326	1281	2607	195
198	77° 11·9′	112° 37′	982·5529	—19·0	—1339	1278	2617	198
201	77° 08·1′	112° 40′	982·5531	—13·9	—1282	1286	2568	201
204	77° 05·2′	112° 42′	982·5686	—8·5	—1221	1247	2468	204
207	77° 02·4′	112° 45′	982·5705	—9·1	—1241	1233	2474	207
*210	76° 59·5′	112° 47′	982·5626	—10·1	—1266	1249	2515	*210
213	76° 56·6′	112° 48′	982·5566	—16·6	—1345	1241	2586	213
216	76° 53·6′	112° 50′	982·5420	—27·7	—1486	1246	2732	216
219	76° 50·7′	112° 51′	982·5273	—36·1	—1591	1260	2851	219
222	76° 47·8′	112° 53′	982·5220	—36·1	—1582	1271	2853	222

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Station	*Latitude* S.	*Longitude* W.	*Observed gravity* (gal)	*Free air anomaly* (mgal)	*Rock depth* (m. a.s.l.)	*Elevation* (m. a.s.l.)	*Ice thickness* (m.)	*Station*
225	76° 44·9′	112° 54′	982·5236	—33·5	—1536	1268	2804	225
228	76° 41·9′	112° 55′	982·5260	—28·7	—1462	1269	2731	228
231	76° 39·0′	112° 57′	982·5316	—19·9	—1334	1273	2607	231
234	76° 36·1′	112° 58′	982·5390	—12·1	—1219	1268	2487	234
237	76° 33·1′	113° 00′	982·5417	—4·6	—1107	1277	2384	237
*240	76° 30·2′	113° 01′	982·5462	6·5	—948	1292	2240	*240
243A	76° 27·5′	112° 59′	982·5605	27·0	—210	1306	1516	243A
244A	76° 26·6′	112° 58′				1310		244A
246A	76° 24·8′	112° 57′	982·5710	43·4	12	1319	1307	246A
*248A	76° 23·0′	112° 55′	982·6019	73·7	423	1313	890	*248A
249A	76° 22·1′	112° 54′	982·6081	81·1	523	1315	792	249A
250·6A	76° 21·2′	112° 49′	982·6151	95·8	723	1338	615	250·6A
250·9A						1353		250·9A
251A	76° 20·9′	112° 48′	982·6187	108·0	888	1365	477	251A
252A	76° 19·3′	112° 46′	982·6159	110·9	927	1380	453	252A
253A	76° 19·3′	112° 45′	982·5999	127·0	1146	1484	338	253A
252B	76° 20·4′	113° 03′	982·6033	62·4	—270	1266	1536	252B
243	76° 31·6′	113° 53′	982·5462	1·5	—1021	1279	2300	243
246	76° 33·0′	113° 43′	982·5436	—4·8	—1110	1270	2380	246
249	76° 34·3′	113° 33′	982·5484	—4·6	—1113	1258	2371	249
252	76° 35·7′	113° 23′	982·5468	—7·1	—1150	1258	2408	252
255	76° 37·1′	113° 13′	982·5454	—10·1	—1196	1256	2452	255
258	76° 38·5′	113° 02′	982·5449	—13·7	—1249	1249	2498	258
261	76° 39·9′	112° 52′	982·5457	—12·0	—1231	1255	2486	261
264	76° 41·2′	112° 42′	982·5537	—9·2	—1197	1241	2438	264
267	76° 42·6′	112° 32′	982·5589	—9·9	—1211	1225	2436	267
268	76° 43·3′	112° 27′	982·5677	—17·0	—1311	1175	2486	268
*270	76° 44·0′	111° 22′	982·5608	—17·9	—1324	1196	2520	*270
271	76° 44·5′	111° 18′	982·5593	—17·3	—1304	1204	2508	271
272	76° 45·0′	111° 14′	982·5593	—17·6	—1297	1204	2501	272
273	76° 45·4′	111° 09′	982·5593	—18·2	—1293	1203	2496	273
276	76° 46·8′	110° 55′	982·5614	—18·3	—1259	1199	2458	276
279	76° 48·2′	110° 42′	982·5609	—18·8	—1231	1202	2433	279
282	76° 49·6′	110° 28′	982·5606	—19·7	—1208	1203	2411	282
285	76° 51·0′	110° 15′	982·5582	—24·3	—1236	1199	2435	285
288	76° 52·4′	110° 01′	982·5566	—27·1	—1238	1198	2436	288
291	76° 53·8′	109° 48′	982·5601	—30·1	—1243	1180	2423	291
294	76° 55·2′	109° 34′	982·5598	—34·1	—1263	1171	2434	294
297	76° 56·6′	109° 21′	982·5641	—35·7	—1249	1155	2404	297
*300	76° 58·0′	109° 07′	982·5617	—36·2	—1221	1164	2385	*300
303	76° 58·9′	108° 54′	982·5606	—38·6	—1288	1162	2450	303
306	76° 59·8′	108° 42′	982·5582	—41·2	—1357	1163	2520	306
309	77° 00·7′	108° 29′	982·5604	—41·5	—1395	1157	2552	309
312	77° 01·6′	108° 17′	982·5633	—37·3	—1372	1163	2535	312
315	77° 02·5′	108° 04′	982·5689	—33·3	—1352	1160	2512	315
318	77° 03·4′	107° 51′	982·5702	—31·9	—1368	1162	2530	318
321	77° 04·3′	107° 39′	982·5806	—28·0	—1349	1143	2492	321
324	77° 05·2′	107° 26′	982·5822	—20·8	—1285	1163	2448	324
327	77° 06·1′	107° 14′	982·5887	—15·5	—1247	1161	2408	327
*330	77° 07·0′	107° 01′	982·5871	—14·6	—1269	1171	2440	*330
333	77° 07·7′	106° 48′	982·5622	—33·5	—1409	1192	2601	333
336	77° 08·4′	106° 35′	982·5553	—40·2	—1654	1194	2848	336
339	77° 09·1′	106° 22′	982·5561	—39·6	—1664	1195	2859	339
342	77° 09·8′	106° 09′	982·5617	—36·0	—1634	1190	2824	342
345	77° 10·5′	105° 56′	982·5644	—31·0	—1585	1199	2784	345

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Station	Latitude S.	Longitude W.	Observed gravity (gal)	Free air anomaly (mgal)	Rock depth (m. a.s.l.)	Elevation (m. a.s.l.)	Ice thickness (m.)	Station
348	77° 11·2′	105° 42′	982·5614	—26·7	—1546	1224	2770	348
351	77° 11·9′	105° 29′	982·5524	—27·8	—1580	1251	2831	351
354	77° 12·6′	105° 16′	982·5499	—33·6	—1677	1242	2919	354
357	77° 13·3′	105° 03′	982·5473	—35·7	—1724	1245	2969	357
*360	77° 14·0′	104° 50′	982·5462	—33·9	—1719	1256	2975	*360
363	77° 14·7′	104° 37′	982·5468	—31·6	—1699	1263	2962	363
366	77° 15·5′	104° 24′	982·5478	—30·5	—1695	1265	2960	366
369	77° 16·2′	104° 11′	982·5484	—25·7	—1640	1280	2920	369
372	77° 16·9′	103° 58′	982·5529	—21·6	—1595	1280	2875	372
375	77° 17·7′	103° 46′	982·5510	—20·7	—1594	1291	2885	375
378	77° 18·4′	103° 33′	982·5489	—23·2	—1639	1291	2930	378
381	77° 19·1′	103° 20′	982·5486	—25·8	—1685	1285	2970	381
384	77° 19·8′	103° 07′	982·5446	—26·6	—1706	1297	3003	384
387	77° 20·6′	103° 54′	982·5388	—28·0	—1736	1313	3049	387
*390	77° 21·3′	102° 41′	982·5377	—28·0	—1747	1318	3065	*390
393	77° 21·9′	102° 28′	982·5430	—24·6	—1693	1313	3006	393
396	77° 22·6′	102° 14′	982·5430	—22·9	—1662	1320	2982	396
399	77° 23·2′	102° 01′	982·5404	—23·7	—1665	1327	2992	399
402	77° 23·8′	101° 57′	982·5350	—28·6	—1723	1330	3053	402
405	77° 24·5′	101° 34′	982·5244	—33·5	—1782	1350	3132	405
408	77° 25·1′	101° 20′	982·5204	—38·1	—1836	1349	3185	408
411	77° 25·7′	101° 07′	982·5024	—51·9	—2015	1364	3379	411
414	77° 26·3′	100° 53′	982·5060	—46·5	—1934	1371	3305	414
417	77° 27·0′	100° 40′	982·4998	—49·8	—1971	1382	3353	417
*420	77° 27·6′	100° 26′	982·4961	—52·0	—1992	1388	3380	*420
423	77° 28·0′	100° 13′	982·4932	—53·0	—2002	1395	3397	423
426	77° 28·4′	99° 59′	982·4934	—54·6	—2020	1390	3410	426
426·5	77° 28·5′	99° 57′				1392		426·5
429	77° 28·8′	99° 45′	982·4862	—58·1	—2064	1403	3467	429
432	77° 29·2′	99° 32′	982·4862	—58·9	—2071	1401	3472	432
435	77° 29·6′	99° 19′	982·4884	—54·5	—2007	1409	3416	435
438	77° 30·0′	99° 05′	982·4881	—50·1	—1944	1425	3369	438
441	77° 30·4′	98° 52′	982·4814	—51·2	—1955	1444	3399	441
444	77° 30·8′	98° 38′	982·4776	—54·4	—1995	1447	3442	444
447	77° 31·2′	98° 25′	982·4764	—54·0	—1986	1453	3439	447
*450	77° 31·6′	98° 11′	982·4778	—51·9	—1954	1456	3410	*450
453	77° 21·9′	97° 58′	982·4769	—47·7	—1921	1473	3394	453
456	77° 32·1′	97° 44′	982·4749	—44·9	—1906	1489	3395	456
459	77° 32·4′	97° 31′	982·4757	—43·4	—1910	1492	3402	459
462	77° 32·6′	97° 17′	982·4790	—36·8	—1843	1503	3346	462
465	77° 33·0′	97° 04′	982·4788	—35·4	—1848	1509	3357	465
468	77° 33·2′	96° 50′	982·4740	—36·3	—1883	1522	3405	468
471	77° 33·5′	96° 37′	982·4668	—42·5	—1992	1526	3518	471
474	77° 33·8′	96° 23′	982·4640	—45·2	—2051	1527	3578	474
477	77° 34·0′	96° 10′	982·4654	—44·5	—2066	1525	3591	477
*480	77° 34·3′	95° 56′	982·4681	—43·9	—2081	1519	3600	*480
483	77° 34·5′	95° 43′	982·4724	—40·3	—2030	1517	3547	483
486	77° 34·7′	95° 30′	982·4750	—36·0	—1970	1523	3490	486
489	77° 34·9′	95° 16′	982·4772	—32·7	—1923	1527	3450	489
492	77° 35·1′	95° 03′	982·4852	—24·8	—1814	1527	3341	492
495	77° 35·3′	94° 50′	982·4989	—8·8	—1595	1535	3130	495
498	77° 35·4′	94° 37′	982·5062	—1·8	—1498	1534	3032	498
501	77° 35·6′	94° 24′	982·5140	6·2	—1388	1535	2923	501
504	77° 35·8′	94° 10′	982·5213	10·9	—1322	1527	2849	504
507	77° 36·0′	93° 57′	982·5294	13·6	—1283	1510	2793	507

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Station	Latitude S.	Longitude W.	Observed gravity (gal)	Free air anomaly (mgal)	Rock depth (m. a.s.l.)	Elevation (m. a.s.l.)	Ice thickness (m.)	Station
*510	77° 36·2′	93° 44′	982·5321	13·4	—1284	1501	2785	*510
513	77° 36·7′	93° 30′	982·5326	15·7	—1225	1508	2733	513
516	77° 37·2′	93° 17′	982·5362	17·5	—1172	1503	2675	516
519	77° 37·7′	93° 03′	982·5356	19·3	—1119	1512	2631	519
522	77° 38·2′	92° 50′	982·5377	19·9	—1083	1508	2591	522
525	77° 38·8′	92° 36′	982·5378	16·8	—1097	1499	2596	525
528	77° 39·3′	92° 22′	982·5341	16·8	—1069	1512	2581	528
531	77° 39·8′	92° 09′	982·5420	18·8	—1014	1494	2508	531
534	77° 40·3′	91° 55′	982·5457	20·7	—959	1489	2448	534
537	77° 40·8′	91° 42′	982·5513	26·6	—851	1491	2342	537
*540	77° 41·3′	91° 28′	982·5473	20·1	—911	1484	2395	*540
543	77° 41·6′	91° 14′	982·5438	26·6	—747	1517	2264	543
546	77° 41·8′	90° 00′	982·5420	27·1	—663	1525	2188	546
549	77° 42·1′	90° 46′	982·5460	26·3	—598	1510	2108	549
552	77° 42·4′	90° 32′	982·5176	3·0	—838	1527	2365	552
555	77° 42·7′	90° 18′	982·5170	6·8	—709	1542	2251	555
558	77° 42·9′	90° 04′	982·5206	10·0	—590	1541	2131	558
561	77° 43·2′	89° 50′	982·5225	8·6	—533	1531	2064	561
564	77° 43·5′	89° 36′	982·5169	5·0	—506	1538	2044	564
567	77° 43·7′	89° 22′	982·5257	15·8	—282	1545	1827	567
*570	77° 44·0′	89° 08′	982·5632	50·7	267	1537	1270	*570
573	77° 43·6′	88° 55′	982·5545	43·1	177	1540	1363	573
576	77° 43·2′	88° 41′	982·4942	—12·0	—558	1556	2114	576
579	77° 42·7′	88° 28′	982·5013	—5·8	—461	1552	2013	579
582	77° 42·3′	88° 14′	982·5557	49·2	—291	1553	1844	582
584C	77° 42·0′	88° 05′	982·5857	90·2	867	1588	721	584C
586C	77° 41·8′	87° 56′	982·5863	98·0	984	1611	627	586C
588C	77° 43·0′	87° 49′	982·5820	101·6	1056	1639	583	588C
591C	77° 44·9′	87° 39′	982·5724	105·6	1113	1687	574	591C
*593C	77° 46·3′	87° 31′	982·5622	109·9	1197	1737	540	*593C
585	77° 44·8′	88° 24′	982·5028	0·3	—374	1571	1945	585
588	77° 47·2′	88° 34′	982·4766	—22·2	—635	1588	2223	588
591	77° 49·7′	88° 44′	982·5294	31·5	134	1596	1462	591
594	77° 52·1′	88° 55′	982·5417	53·4	473	1632	1159	594
597	77° 54·6′	89° 05′	982·5441	59·2	540	1648	1108	597
*600	77° 57·0′	89° 15′	982·5137	33·5	288	1668	1380	*600
603	77° 59·8′	89° 15′	982·5036	25·4	114	1680	1566	603
606	78° 02·6′	89° 15′	982·5153	45·9	329	1714	1385	606
609	78° 05·4′	89° 16′	982·5090	46·2	269	1741	1472	609
612	78° 08·2′	89° 16′	982·5237	68·4	506	1771	1265	612
615	78° 11·0′	89° 16′	982·5273	81·1	614	1806	1192	615
618	78° 13·8′	89° 16′	982·5200	77·4	501	1823	1322	618
621	78° 16·6′	89° 16′	982·4977	64·8	266	1860	1594	621
624	78° 19·4′	89° 17′	982·4620	19·7	—409	1835	2244	624
627	78° 22·2′	89° 17′	982·4262	—11·6	—897	1855	2752	627
*630	78° 25·0′	89° 17′	982·3985	—36·3	—1295	1870	3165	*630
633	78° 27·8′	89° 22′	982·4244	—14·5	—953	1862	2815	633
636	78° 30·5′	89° 28′	982·4764	48·5	—53	1903	1956	636
639	78° 33·3′	89° 33′	982·4937	66·9	242	1912	1670	639
642	78° 36·0′	89° 39′	982·4853	66·5	283	1943	1660	642
645	78° 38·8′	89° 44′	982·4860	69·0	363	1954	1591	645
648	78° 41·6′	89° 49′	982·4958	75·6	497	1949	1452	648
651	78° 44·3′	89° 55′	982·4849	59·8	329	1938	1609	651
654	78° 47·1′	90° 00′	982·4753	48·5	222	1938	1716	654
657	78° 49·8′	90° 06′	982·4486	24·9	—52	1953	2005	657

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Station	Latitude S.	Longitude W.	Observed gravity (gal)	Free air anomaly (mgal)	Rock depth (m. a.s.l.)	Elevation (m. a.s.l.)	Ice thickness (m.)	Station
*660	78° 52·6′	90° 11′	982·4972	66·5	558	1968	1410	*660
663	78° 55·3′	90° 17′	982·5008	76·4	712	1961	1249	663
666	78° 57·9′	90° 24′	982·4565	25·1	38	1943	1905	666
669	79° 00·6′	90° 30′	982·4457	13·7	—97	1946	2043	669
672	79° 03·2′	90° 36′	982·4842	59·4	544	1974	1430	672
675	79° 05·9′	90° 43′	982·4820	58·4	550	1983	1433	675
678	79° 08·6′	90° 49′	982·4749	55·4	529	2001	1472	678
681	79° 11·2′	90° 55′	982·4561	33·9	259	1997	1738	681
684	79° 13·9′	91° 01′	982·4089	—14·8	—391	1997	2388	684
687	79° 16·5′	91° 08′	982·4020	—21·6	—451	2002	2453	687
*690	79° 19·2′	91° 14′	982·4601	39·6	397	2017	1620	*690
693	79° 22·2′	91° 14′	982·4649	49·3	515	2038	1523	693
696	79° 25·1′	91° 13′	982·4630	52·3	540	2059	1519	696
699	79° 28·1′	91° 13′	982·4553	45·7	437	2068	1631	699
702	79° 31·0′	91° 12′	982·4486	39·6	339	2075	1736	702
705	79° 34·0′	91° 12′	982·4660	62·8	640	2099	1459	705
*708	79° 36·9′	91° 11′	982·4957	97·4	1095	2120	1025	*708
711	79° 38·5′	91° 25′	982·4594	65·8	656	2138	1482	711
714	79° 40·1′	91° 38′	982·4452	52·0	458	2142	1684	714
717	79° 41·6′	91° 52′	982·4676	76·4	778	2151	1373	717
720	79° 43·2′	92° 05′	982·4494	59·2	534	2157	1623	720
723	79° 44·8′	92° 19′	982·4533	58·8	517	2146	1629	723
726	79° 46·4′	92° 33′	982·4566	58·5	504	2137	1633	726
729	79° 48·0′	92° 46′	982·4156	17·0	—70	2138	2208	729
732	79° 49·5′	93° 00′	982·3994	—4·0	—366	2125	2491	732
735	79° 51·1′	93° 13′	982·4286	26·8	42	2133	2091	735
*738	79° 52·7′	93° 27′	982·4393	39·4	202	2142	1940	*738
741	79° 55·1′	93° 38′	982·4593	64·0	547	2161	1614	741
744	79° 57·5′	93° 49′	982·4534	55·7	445	2157	1712	744
747	79° 59·9′	94° 01′	982·4510	56·3	464	2171	1707	747
750	80° 02·3′	94° 12′	982·4096	11·2	—136	2163	2299	750
753	80° 04·7′	94° 23′	982·4876	90·8	954	2172	1218	753
756	80° 07·0′	94° 34′	982·4204	26·1	87	2184	2097	756
759	80° 09·4′	94° 45′	982·4293	36·2	235	2192	1957	759
762	80° 11·8′	94° 51′	982·4554	67·0	663	2211	1548	762
765	80° 14·2′	95° 08′	982·4200	28·8	156	2206	2050	765
*768	80° 16·6′	95° 19′	982·4168	21·3	66	2196	2130	*768
771	80° 17·5′	95° 36′	982·3676	—27·7	—632	2198	2830	771
774	80° 18·4′	95° 53′	982·3738	—22·6	—598	2196	2794	774
777	80° 19·3′	96° 10′	982·3997	5·3	—254	2204	2458	777
780	80° 20·2′	96° 27′	982·4245	30·6	55	2207	2152	780
783	80° 21·1′	96° 45′	982·4248	40·4	153	2239	2086	783
786	80° 21·9′	97° 02′	982·4542	69·0	507	2238	1731	786
789	80° 22·8′	97° 19′	982·4793	104·2	950	2272	1322	789
792	80° 23·7′	97° 36′	982·4766	99·5	852	2267	1415	792
795	80° 24·6′	97° 53′	982·5294	146·6	1456	2250	749	795
*798	80° 25·5′	98° 10′	982·4633	75·7	461	2236	1775	*798
801	80° 25·9′	98° 27′	982·4321	42·5	—2	2230	2232	801
804	80° 26·3′	98° 45′	982·4162	23·6	—271	2221	2492	804
807	80° 26·6′	99° 02′	982·4382	45·5	11	2221	2210	807
810	80° 27·0′	99° 20′	982·4401	40·4	—71	2199	2270	810
813	80° 27·4′	99° 37′	982·4329	30·2	—222	2190	2412	813
816	80° 27·8′	99° 54′	982·4318	29·2	—249	2191	2440	816
819	80° 28·2′	100° 12′	982·4367	26·2	—302	2166	2468	819
822	80° 28·5′	100° 29′	982·4260	16·9	—442	2171	2613	822

Station	Latitude S.	Longitude W.	Observed gravity (gal)	Free air anomaly (mgal)	Rock depth (m. a.s.l.)	Elevation (m. a.s.l.)	Ice thickness (m.)	Station
825	80° 28·9′	100° 47′	982·4253	12·6	—514	2160	2674	825
*828	80° 29·3′	101° 04′	982·4242	10·7	—552	2158	2710	*828
831	80° 29·3′	101° 22′	982·4216	5·0	—636	2148	2784	831
834	80° 29·3′	101° 40′	982·4157	—2·7	—748	2142	2890	834
837	80° 29·4′	101° 58′	982·4248	3·2	—675	2132	2807	837
840	80° 29·4′	102° 16′	982·4329	7·9	—618	2121	2739	840
843	80° 29·4′	102° 35′	982·4384	8·8	—613	2106	2719	843
846	80° 29·4′	102° 53′	982·4408	6·6	—649	2091	2740	846
849	80° 29·4′	108° 11′	982·4352	—6·8	—837	2066	2903	849
852	80° 29·5′	103° 29′	982·4300	—8·3	—865	2078	2943	852
855	80° 29·5′	103° 47′	982·4466	2·7	—722	2060	2782	855
*858	80° 29·5′	104° 05′	982·4605	11·4	—612	2043	2655	*858
861	80° 29·3′	104° 23′	982·4685	14·6	—610	2027	2637	861
864	80° 29·0′	104° 40′	982·4726	14·2	—655	2012	2667	864
867	80° 28·8′	104° 58′	982·4742	14·6	—691	2008	2699	867
870	80° 28·6′	105° 15′	982·4833	18·3	—680	1990	2670	870
873	80° 28·4′	105° 33′	982·4794	11·7	—811	1981	2792	873
876	80° 28·1′	105° 51′	982·4832	8·9	—890	1959	2849	876
879	80° 27·9′	106° 08′	982·4890	6·1	—968	1931	2899	879
882	80° 27·7′	106° 26′	982·4832	—4·2	—1149	1916	3065	882
885	80° 27·4′	106° 43′	982·4813	—6·6	—1221	1914	3135	885
*888	80° 27·2′	107° 01′	982·4822	—10·2	—1311	1899	3210	*888
891	80° 26·8′	107° 18′	982·4805	—15·1	—1426	1888	3314	891
894	80° 26·4′	107° 35′	982·4757	—28·7	—1661	1859	3520	894
897	80° 26·0′	107° 52′	982·4609	—44·5	—1925	1855	3780	897
900	80° 25·6′	108° 09′	982·4565	—49·6	—2044	1852	3896	900
903	80° 25·2′	108° 26′	982·4608	—49·4	—2092	1838	3930	903
906	80° 24·8′	108° 43′	982·4597	—52·8	—2187	1830	4017	906
909	80° 24·4′	109° 00′	982·4618	—53·0	—2239	1822	4061	909
912	80° 24·0′	109° 17′	982·4653	—52·7	—2285	1811	4096	912
915	80° 23·6′	109° 34′	982·4665	—59·6	—2428	1784	4212	915
*918	80° 23·2′	109° 51′	982·4618	—65·3	—2555	1780	4335	*918
921	80° 22·8′	110° 08′	982·4652	—66·1	—2555	1766	4321	921
924	80° 22·4′	110° 25′	982·4685	—64·1	—2517	1761	4278	924
927	80° 22·0′	110° 42′	982·4745	—62·2	—2480	1747	4227	927
930	80° 21·6′	110° 59′	982·4806	—61·8	—2464	1728	4192	930
933	80° 21·2′	111° 16′	982·4829	—62·4	—2461	1718	4179	933
936	80° 20·8′	111° 33′	982·4848	—60·0	—2418	1719	4137	936
939	80° 20·4′	111° 50′	982·4946	—54·0	—2326	1706	4032	939
941	80° 20·0′	112° 07′	982·5036	—56·2	—2352	1669	4021	941
942	80° 19·7′	112° 18′	982·5006	—56·9	—2354	1676	4030	942
945	80° 19·5′	112° 30′	982·4960	—59·2	—2374	1683	4057	945
*948	80° 19·2′	112° 41′	982·4964	—57·8	—2344	1686	4030	*948
951	80° 18·4′	112° 58′	982·5021	—56·0	—2256	1672	3928	951
954	80° 17·7′	113° 15′	982·5054	—53·9	—2162	1667	3829	954
957	80° 16·9′	113° 32′	982·5124	—48·0	—2018	1662	3680	957
960	80° 16·1′	113° 49′	982·5218	—40·7	—1854	1654	3508	960
963	80° 15·4′	114° 06′	982·5336	—35·0	—1713	1633	3346	963
966	80° 14·6′	114° 23′	982·5373	—29·0	—1567	1639	3206	966
*969	80° 13·8′	114° 40′	982·5496	—18·8	—1364	1631	2995	*969
972	80° 13·0′	114° 57′	982·5602	—10·0	—1243	1624	2867	972
975	80° 12·3′	115° 14′	982·5690	0·1	—1104	1627	2731	975
978	80° 11·5′	115° 31′	982·5800	10·0	—967	1622	2589	978
981	80° 10·7′	115° 48′	982·5971	27·8	—723	1623	2346	981
984	80° 10·0′	116° 05′	982·6413	55·4	—347	1568	1915	984

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Station	Latitude S.	Longitude W.	Observed gravity (gal)	Free air anomaly (mgal)	Rock depth (m. a.s.l.)	Elevation (m. a.s.l.)	Ice thickness (m.)	Station
987	80° 09·2′	116° 22′	982·6421	49·8	—421	1546	1967	987
990	80° 08·4′	116° 39′	982·6236	32·3	—656	1548	2204	990
993	80° 07·7′	116° 56′	982·6095	18·0	—848	1546	2394	993
996	80° 06·9′	117° 13′	982·6087	19·7	—823	1553	2376	996
999	80° 06·1′	117° 30′	982·6207	26·0	—735	1533	2268	999
1002	80° 05·3′	117° 47′	982·6171	26·2	—730	1544	2274	1002
1005	80° 04·6′	118° 04′	982·6115	14·8	—882	1524	2406	1005
1008	80° 03·8′	118° 21′	982·6091	10·9	—933	1518	2451	1008
1011	80° 03·3′	118° 38′	982·6060	6·2	—995	1512	2507	1011
1014	80° 02·3′	118° 55′	982·6047	3·9	—1024	1507	2531	1014
1017	80° 01·5′	119° 12′	982·6072	8·0	—967	1511	2478	1017
1020	80° 0·07′	119° 29′	982·6133	13·3	—892	1507	2399	1020
1023	80° 00·0′	119° 46′	982·6205	21·5	—779	1509	2288	1023
Byrd survey	79° 59·2′	120° 01′	982·6009	—4·9	—1135	1510	2645	Byrd survey

Horlick Mountains Traverse

Rock Depth from Combined Gravity and Seismic Observations

Station numbers refer to nautical miles from Byrd Station.

* Seismic soundings.

Station	Latitude S.	Longitude W.	Observed gravity (gal)	Free air anomaly (mgal)	Rock depth (m. a.s.l.)	Elevation (m. a.s.l.)	Ice thickness (m.)	Station
*48	80° 42·3′	120° 19′	982·6909	33·1	—273	1387	1660	*48
51	80° 45·1′	120° 22′	982·6885	19·2	—456	1354	1810	51
54	80° 47·9′	120° 25′	982·6714	—2·6	—747	1343	2090	54
57	80° 50·7′	120° 27′	982·6615	—8·3	—823	1361	2184	57
60	80° 53·5′	120° 30′	982·6671	—10·5	—845	1340	2185	60
63	80° 56·3′	120° 33′	982·6717	—13·4	—890	1320	2210	63
66	80° 59·0′	120° 36′	982·6709	—19·2	—963	1308	2271	66
69	81° 01·8′	120° 39′	982·6617	—30·6	—1113	1305	2418	69
72	81° 04·6′	120° 42′	982·6650	—35·4	—1174	1283	2457	72
75	81° 07·4′	120° 44′	982·6750	—28·5	—1075	1277	2352	75
78	81° 10·2′	120° 47′	982·6965	—15·4	—883	1254	2137	78
81	81° 13·0′	120° 50′	982·7065	—24·6	—1002	1196	2198	81
*84	81° 15·8′	120° 53′	982·7105	—22·2	—965	1195	2160	*84
84–1·6	81° 15·6′	120° 58′	982·7189	—15·2	—870	1190	2060	84–1·6
84–1·35	81° 15·6′	120° 57′	982·7189	—16·8	—892	1185	2077	84–1·35
84–0·85	81° 15·7′	120° 56′	982·7169	—19·4	—927	1183	2110	84–0·85
87	81° 18·3′	121° 00′	982·7043	—27·1	—1066	1203	2269	87
90	81° 20·8′	121° 06′	982·7138	—18·4	—983	1204	2187	90
93	81° 23·3′	121° 12′	982·7237	—16·1	—987	1183	2170	93
96	81° 25·8′	121° 19′	982·7325	—12·4	—972	1170	2142	96
99	81° 28·2′	121° 26′	982·7519	—0·5	—846	1149	1995	99
102	81° 30·7′	121° 32′	982·7701	—5·4	—947	1078	2025	102
105	81° 33·2′	121° 38′	982·7509	—30·6	—1324	1062	2386	105
108	81° 35·7′	121° 45′	982·7490	—37·9	—1458	1048	2506	108
111	81° 38·2′	121° 52′	982·7538	—38·8	—1505	1033	2538	111

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Station	*Latitude* S.	*Longitude* W.	*Observed gravity* (gal)	*Free air anomaly* (mgal)	*Rock depth* (m. a.s.l.)	*Elevation* (m. a.s.l.)	*Ice thickness* (m.)	*Station*
*114	81° 40·7′	121° 58′	982·7685	—41·0	—1568	982	2550	*114
114–1·0	81° 40·6′	122° 01′	982·7709	—36·0	—1500	990	2490	114–1·0
117	81° 43·5′	122° 02′	982·7665	—55·9	—1765	944	2709	117
120	81° 46·2′	122° 07′	982·7700	—52·6	—1715	947	2662	120
123	81° 49·0′	122° 11′	982·7946	—36·3	—1489	924	2413	123
126	81° 51·8′	122° 16′				901		126
129	81° 54·6′	122° 20′	982·8306	—16·6	—1212	879	2091	129
132	81° 57·4′	122° 25′	982·8440	—10·2	—1120	860	1980	132
135	82° 00·1′	122° 29′	982·8566	—4·3	—1035	842	1877	135
138	82° 02·9′	122° 33′	982·8685	0·9	—960	824	1784	138
141	82° 05·7′	122° 38′	982·8760	1·1	—952	804	1756	141
144	82° 08·4′	122° 42′	982·8845	6·3	—877	797	1674	144
147	82° 11·2′	122° 47′	982·8857	10·7	—812	811	1623	147
*150	82° 14·0′	122° 51′	982·8741	0·4	—946	819	1765	*150
153	82° 16·9′	122° 54′	982·8618	—14·0	—1103	816	1919	153
156	82° 19·8′	122° 56′	982·8552	—21·8	—1171	816	1987	156
159	82° 22·6′	122° 59′	982·8532	—25·5	—1183	814	1997	159
162	82° 25·5′	123° 02′	982·8560	—25·4	—1144	809	1953	162
165	82° 28·4′	123° 04′	982·8684	—18·1	—1007	796	1803	165
168	82° 31·2′	123° 07′	982·8532	—41·8	—1290	772	2062	168
171	82° 34·1′	123° 10′	982·8528	—42·8	—1266	774	2040	171
174	82° 37·0′	123° 12′	982·8496	—47·4	—1290	773	2063	174
177	82° 39·9′	123° 15′	982·8496	—55·0	—1355	752	2107	177
181	82° 43·7′	123° 18′	982·8560	—50·3	—1253	751	2004	180
183	82° 45·6′	123° 20′	982·8602	—45·0	—1144	757	1901	183
*186	82° 48·5′	123° 23′	982·8605	—42·4	—1072	768	1840	*186
189	82° 51·4′	123° 26′	982·8654	—36·7	—1013	774	1787	189
192	82° 54·2′	123° 30′	982·8605	—39·9	—1074	783	1857	192
195	82° 57·1′	123° 34′	982·8653	—37·4	—1057	779	1836	195
198	83° 00·0′	123° 37′	982·8554	—47·4	—1211	782	1993	198
201	83° 02·9′	123° 40′	982·8602	—44·6	—1191	779	1970	201
204	83° 05·8′	123° 44′	982·8721	—31·9	—1037	785	1822	204
207	83° 08·6′	123° 48′	982·8858	—14·6	—820	800	1620	207
210	83° 11·5′	123° 51′	982·8894	—10·8	—787	804	1591	210
213	83° 14·4′	123° 54′	982·8793	—18·5	—908	815	1723	213
216	83° 17·2′	123° 58′	982·8646	—36·1	—1165	809	1974	216
219	83° 20·1′	124° 02′	982·8844	—17·9	—936	807	1743	219
222	83° 23·0′	124° 05′	982·9033	—13·3	—891	764	1655	222
222–0·54	83° 23·5′	124° 06′	982·9033	—16·2	—934	755	1689	222–0·54
222–1·08	83° 24·0′	124° 07′	982·9016	—19·9	—987	749	1736	222–1·08
222–1·62	83° 24·5′	124° 08′	982·8994	—26·6	—1082	735	1817	222–1·62
222–2·16	83° 25·1′	124° 09′	982·8928	—32·5	—1165	738	1903	222–2·16
222–2·7	83° 25·6′	124° 10′	982·8832	—38·6	—1253	750	2003	222–2·7
225	83° 25·9′	124° 10′	982·8776	—41·5	—1292	759	2051	225
225–3·24	83° 26·1′	124° 10′	982·8744	—42·9	—1312	765	2077	225–3·24
225–4·05	83° 26·9′	124° 12′	982·8678	—46·7	—1368	775	2143	225–4·05
225–4·86	83° 27·6′	124° 13′	982·8669	—47·6	—1386	776	2162	225–4·86
228	83° 28·7′	124° 14′	982·8678	—46·7	—1380	777	2157	228
228–7·56	83° 29·9′	124° 17′	982·8714	—42·3	—1330	781	2111	228–7·56
231	83° 31·6′	124° 19′	982·8757	—35·2	—1241	792	2033	231
234	83° 34·4′	124° 24′	982·8944	—9·4	—910	818	1728	234
237	83° 37·3′	124° 29′	982·8949	—7·1	—896	827	1723	237
240	83° 40·1′	124° 34′	982·8925	—4·6	—880	846	1726	240
243	83° 43·0′	124° 38′	982·8930	—2·2	—866	855	1721	243
246	83° 45·9′	124° 43′	982·8834	—2·6	—889	888	1777	246

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Station	Latitude S.	Longitude W.	Observed gravity (gal)	Free air anomaly (mgal)	Rock depth (m. a.s.l.)	Elevation (m. a.s.l.)	Ice thickness (m.)	Station
249	83° 48·7′	124° 48′	982·8917	9·7	—740	904	1644	249
252	83° 51·6′	124° 52′	982·8922	12·7	—717	915	1632	252
255	83° 54·4′	124° 57′	982·9025	22·7	—599	917	1516	255
*258	83° 57·3′	125° 02′	982·9029	24·7	—590	925	1515	*258
261	84° 00·2′	125° 08′	982·9062	25·5	—434	920	1354	261
264	84° 03·1′	125° 14′	982·8994	12·5	—659	903	1562	264
267	84° 06·0′	125° 20′	982·8973	8·3	—668	899	1567	267
270	84° 08·9′	125° 26′	982·8788	—9·5	—862	904	1766	270
273	84° 11·8′	125° 32′	982·8442	—42·6	—1263	912	2175	273
276	84° 14·7′	125° 38′	982·8322	—57·9	—1422	904	2326	276
279	84° 17·5′	125° 45′	982·8192	—64·3	—1461	928	2389	279
282	84° 20·4′	125° 51′	982·8273	—62·7	—1391	910	2301	282
285	84° 23·3′	125° 57′	982·8368	—54·0	—1225	910	2135	285
288	84° 26·2′	126° 03′	982·8574	—33·0	—892	914	1806	288
291	84° 29·1′	126° 09′	982·8802	—8·3	—509	923	1432	291
*294	84° 32·0′	126° 15′	982·8832	1·0	—334	946	1280	*294
297	84° 34·9′	126° 19′				963		297
300	84° 37·9′	126° 23′	982·8738	—0·5	—335	977	1312	300
303	84° 40·8′	126° 27′	982·8677	—5·3	—390	984	1374	303
306	84° 43·7′	126° 31′	982·8509	—24·8	—645	978	1623	306
307	84° 44·7′	126° 32′	982·8410	—36·2	—796	974	1770	307
308	84° 45·7′	126° 33′	982·8244	—49·0	—967	987	1954	308
309	84° 46·7′	126° 34′	982·8113	—61·2	—1129	991	2120	309
312	84° 49·6′	126° 38′	982·7848	—73·3	—1284	1040	2324	312
315	84° 52·5′	126° 42′	982·7978	—62·0	—1121	1037	2158	315
318	84° 55·5′	126° 46′	982·7970	—58·1	—1058	1055	2113	318
*321	84° 58·4′	126° 50′	982·7981	—46·3	—888	1092	1980	*321
324A	85° 01·3′	126° 54′	982·8288	—14·6		1098	1556	324A
324	84° 59·7′	126° 18′	982·7733	—63·5	—1118	1118	2236	324
327	85° 01·0′	125° 46′	982·7458	—78·7	—1322	1159	2481	327
330	85° 04·0′	125° 48′	982·7663	—60·8	—1077	1153	2230	330
3314B	85° 05·4′	125° 49′	982·7736	—40·6		1196	2007	3314B
333	85° 03·8′	125° 15′	982·7218	—91·3	—1487	1198	2685	333
336C	85° 06·7′	125° 41′	982·7263	—83·9		1210	2608	336C
336C1	85° 07·3′	125° 45′	982·7245	—81·8		1223	2592	336C1
336C2	85° 07·9′	125° 51′	982·7217	—80·8		1236	2592	336C2
3383C	85° 08·7′	125° 01′	982·7170	—78·9		1258	2588	3383C
336	85° 02·0′	124° 51′	982·7383	—74·1	—1252	1199	2451	336
339	85° 00·2′	124° 26′	982·7666	—60·1	—1059	1151	2210	339
342	84° 58·5′	123° 02′	982·7810	—42·5	—817	1160	1977	342
345	84° 56·7′	123° 38′	982·8000	—26·4	—706	1149	1855	345
348	84° 54·9′	123° 13′	982·7966	—22·2	—537	1172	1709	348
351	84° 53·2′	122° 49′	982·8333	19·9	37	1188	1151	351
354	84° 51·4′	122° 24′	982·7590	—45·3	—845	1216	2061	354
*357	84° 49·6′	122° 00′	982·7549	—44·3	—829	1231	2060	*357
360	84° 48·3′	121° 32′	982·7519	—39·8	—731	1254	1985	360
363	84° 47·0′	121° 04′	982·7445	—39·5	—690	1278	1968	363
366	84° 45·7′	120° 36′	982·7718	—5·7	—195	1298	1493	366
369	84° 44·4′	120° 08′	982·7513	—23·9	—403	1304	1707	369
372	84° 43·0′	119° 40′	982·7621	—23·2	—357	1270	1627	372
375	84° 41·7′	119° 12′	982·7526	—29·0	—399	1281	1680	375
378	84° 40·4′	118° 44′	982·7499	—33·5	—422	1274	1696	378
*381	84° 39·1′	118° 16′	982·7796	—5·3	—2	1268	1270	*381
384	84° 38·2′	117° 48′	982·7585	—21·2	—237	1284	1521	384
387	84° 37·2′	117° 20′	982·7738	2·1	59	1309	1250	387

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Station	Latitude S.	Longitude W.	Observed gravity (gal)	Free air anomaly (mgal)	Rock depth (m. a.s.l.)	Elevation (m. a.s.l.)	Ice thickness (m.)	Station
388·2	84° 36·9′	118° 09′	982·7522	—13·2	—156	1329	1485	388·2
390	84° 36·3′	117° 52′	982·7413	—22·7	—296	1333	1629	390
393	84° 35·4′	117° 24′	982·7287	—23·0	—320	1372	1692	393
396	84° 34·5′	116° 56′	982·7375	0·8	—16	1420	1436	396
399	84° 33·5′	116° 28′	982·7466	16·7	179	1441	1262	399
400	84° 33·2′	116° 19′	982·7362	15·9	162	1472	1310	400
402	84° 32·6′	115° 00′	982·7258	8·5	49	1481	1432	402
405	84° 33·9′	114° 33′	982·6917	—6·2	—170	1545	1715	405
408	84° 35·2′	114° 06′	982·6887	—1·9	—131	1570	1701	408
411	84° 38·2′	114° 04′	982·6746	—4·2	—182	1611	1793	411
414	84° 41·2′	114° 02′	982·6797	2·2	—114	1618	1732	414
414·33	84° 40·9′	114° 01′	982·6795	—3·7	—196	1599	1795	414·33
414·93	84° 40·3′	114° 01′	982·6794	—7·1	—246	1588	1834	414·93
415·47	84° 39·8′	114° 01′	982·6735	—13·1	—331	1587	1918	415·47
416·02	84° 39·2′	114° 00′	982·6722	—12·4	—324	1593	1917	416·02
416·56	84° 38·7′	113° 59′	982·6725	—8·9	—281	1603	1884	416·56
417·11	84° 38·1′	113° 59′	982·6738	—7·7	—269	1602	1871	417·11
417·82	84° 37·5′	113° 58′	982·6755	—6·2	—254	1601	1855	417·82
418·63	84° 36·7′	113° 57′	982·6879	—2·8	—211	1571	1782	418·63
419·45	84° 35·9′	113° 57′	982·6886	—5·0	—246	1561	1807	419·45
420	84° 35·3′	113° 56′	982·6851	—7·7	—288	1563	1843	420
423	84° 32·0′	113° 53′	982·6797	—12·1	—367	1563	1930	423
426	84° 29·4′	113° 50′	982·6614	—34·6	—691	1547	2238	426
429	84° 28·3′	113° 22′	982·6426	—51·9	—946	1551	2497	429
435	84° 26·2′	112° 26′	982·6399	—25·3	—624	1644	2268	435
438	84° 25·1′	111° 59′	982·6058	—56·6	—1068	1652	2720	438
441	84° 24·1′	111° 31′	982·5962	—58·2	—1109	1677	2786	441
*444	84° 23·0′	111° 03′	982·5922	—54·1	—1018	1702	2720	*444
447	84° 22·9′	110° 33′	982·5877	—50·3	—953	1729	2682	447
450	84° 22·9′	110° 03′	982·5711	—55·1	—1006	1767	2773	450
453	84° 22·9′	109° 33′	982·5794	—43·4	—834	1778	2612	453
456	84° 22·8′	109° 04′	982·5810	—28·5	—619	1821	2440	456
459	84° 22·8′	108° 34′	982·5749	—23·2	—533	1858	2391	459
462	84° 22·7′	108° 04′	982·5703	—19·5	—470	1885	2355	462
465	84° 22·7′	107° 34′	982·5651	—16·9	—422	1910	2332	465
468	84° 22·7′	107° 04′	982·5617	—9·2	—304	1946	2250	468
471	84° 22·6′	106° 34′	982·5595	—6·5	—255	1962	2217	471
474	84° 22·6′	106° 05′	982·5379	—15·1	—358	2004	2362	474
477	84° 22·5′	105° 35′	982·5342	—9·8	—273	2033	2306	477
*480	84° 22·5′	105° 05′	982·5423	5·4	—54	2056	2110	*480
483	84° 23·0′	104° 36′	982·5374	9·0	—61	2084	2145	483
486	84° 23·6′	104° 06′	982·5511	28·0	139	2102	1963	486
489	84° 24·1′	103° 37′	982·5507	39·8	243	2142	1899	489
492	84° 24·7′	103° 08′	982·5282	20·6	—74	2153	2227	492
495	84° 25·2′	102° 39′	982·5155	10·2	—271	2161	2432	495
498	84° 25·7′	102° 10′	982·4955	—7·5	—567	2169	2736	498
501	84° 26·3′	101° 40′	982·4428	—51·1	—1215	2199	3414	501
*504	84° 26·8′	101° 11′	982·4264	—71·1	—1542	2188	3730	*504
507	84° 28·2′	100° 44′	982·4358	—57·7	—1342	2202	3544	507
510	84° 29·5′	100° 16′	982·4611	—29·4	—941	2213	3154	510
513	84° 30·8′	99° 49′	982·4903	3·7	—474	2227	2701	513
516	84° 32·2′	99° 22′	982·5109	25·8	—156	2233	2389	516
519	84° 33·6′	98° 54′	982·5355	53·7	241	2245	2004	519
522	84° 34·9′	98° 27′	982·5202	39·5	67	2250	2183	522
525	84° 36·2′	98° 00′	982·5442	66·9	456	2262	1806	525

Station	Latitude S.	Longitude W.	Observed gravity (gal)	Free air anomaly (mgal)	Rock depth (m. a.s.l.)	Elevation (m. a.s.l.)	Ice thickness (m.)	Station
528	84° 37·6′	97° 33′	982·5941	129·7	1312	2305	993	528
531	84° 39·0′	97° 05′	982·6101	137·9	1455	2281	826	531
534	84° 40·3′	96° 38′	982·6317	151·4	1656	2256	600	534
537	84° 38·5′	96° 12′	982·6218	88·9	827	2084	1257	537
540	84° 36·7′	95° 50′	982·5962	52·7	354	2048	1694	540
543	84° 34·9′	95° 28′	982·5703	24·5	—11	2039	2050	543
546	84° 33·1′	95° 06′	982·5485	3·9	—272	2041	2313	546
549	84° 31·4′	94° 44′	982·5369	—2·9	—345	2055	2400	549
552	84° 29·6′	94° 22′	982·5610	17·1	—56	2040	2096	552
555	84° 27·8′	94° 00′	982·5845	38·3	249	2031	1782	555
558	84° 26·0′	93° 38′	982·6146	63·4	608	2013	1405	558
561	84° 24·2′	93° 16′	982·6330	70·9	728	1976	1248	561
564	84° 22·5′	92° 54′	982·6354	63·9	651	1944	1293	564
567	84° 20·7′	92° 32′	982·6235	44·8	410	1919	1509	567
*570	84° 18·5′	91° 55′	982·6102	38·3	339	1939	1600	*570
573	84° 15·9′	92° 14′	982·5847	23·8	137	1972	1835	573
576	84° 13·3′	92° 32′	982·5753	21·7	103	1993	1890	576
579	84° 10·7′	92° 51′	982·5653	19·6	69	2016	1947	579
582	84° 08·1′	93° 10′	982·5687	27·8	176	2029	1853	582
585	84° 05·5′	93° 28′	982·5562	17·0	23	2032	2009	585
588	84° 02·9′	93° 47′	982·5813	39·5	323	2021	1698	588
591	84° 00·3′	94° 06′	982·5985	53·8	512	2009	1497	591
594	83° 57·7′	94° 24′	982·6013	60·2	593	2018	1425	594
597	83° 55·1′	94° 43′	982·5869	43·9	367	2009	1642	597
600	83° 52·5′	95° 02′	982·5745	23·0	79	1979	1900	600
603	83° 49·9′	95° 20′	982·5478	—2·2	—260	1981	2241	603
*606	83° 47·3′	95° 39′	982·5659	16·1	—26	1979	2005	*606
609	83° 44·9′	95° 56′	982·5657	13·9	—105	1970	2075	609
612	83° 42·6′	96° 13′	982·5555	4·5	—281	1970	2251	612
615	83° 40·3′	96° 30′	982·5674	15·9	—176	1966	2142	615
618	83° 37·9′	96° 47′	982·5595	11·3	—287	1974	2261	618
621	83° 35·6′	97° 04′	982·5327	—12·3	—657	1982	2639	621
624	83° 33·2′	97° 21′	982·5210	—20·1	—812	1992	2804	624
627	83° 30·9′	97° 37′	982·5107	—25·0	—927	2007	2934	627
630	83° 28·6′	97° 54′	982·5193	—11·3	—791	2021	2812	630
633	83° 26·2′	98° 13′	982·5417	9·8	—553	2014	2567	633
636	83° 23·9′	98° 28′	982·5347	7·9	—628	2028	2656	636
639	83° 21·5′	98° 45′	982·5086	—18·0	—1041	2026	3067	639
*642	83° 19·2′	99° 02′	982·4935	—27·7	—1209	2041	3250	*642
645	83° 16·7′	99° 17′	982·5030	—15·8	—1000	2046	3046	645
648	83° 14·2′	99° 32′	982·5223	9·1	—615	2061	2676	648
651	83° 11·7′	99° 48′	982·5210	6·8	—598	2055	2653	651
654	83° 09·2′	100° 03′	982·5191	11·3	—490	2073	2563	654
657	83° 06·6′	100° 18′	982·5133	12·9	—420	2094	2514	657
660	83° 04·1′	100° 33′	982·5186	25·9	—197	2116	2313	660
663	83° 01·6′	100° 49′	982·5071	17·2	—267	2122	2389	663
666	82° 59·1′	101° 04′	982·4863	—0·5	—460	2129	2589	666
669	82° 56·6′	101° 19′	982·5025	15·7	—192	2126	2318	669
672	82° 54·0′	101° 34′	982·4814	5·1	—289	2157	2446	672
675	82° 51·5′	101° 50′	982·4890	14·2	—118	2159	2277	675
*678	82° 49·0′	102° 05′	982·5098	43·7	329	2184	1855	*678
681	82° 47·4′	102° 25′	982·5353	74·4	788	2199	1411	681
684	82° 45·8′	102° 44′	982·4710	16·6	48	2218	2170	684
687	82° 44·2′	103° 04′	982·4924	40·7	—99	2225	2324	687
690	82° 42·6′	103° 23′	982·5499	96·1	1213	2216	1003	690

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Station	Latitude S.	Longitude W.	Observed gravity (gal)	Free air anomaly (mgal)	Rock depth (m. a.s.l.)	Elevation (m. a.s.l.)	Ice thickness (m.)	Station
693	82° 41·0′	103° 43′	982·5522	121·5	1600	2289	689	693
694·2	82° 40·5′	103° 51′	982·5557	138·8	1852	2333	481	694·2
696	82° 39·4′	104° 02′	982·5487	140·5	1901	2360	459	696
698	82° 38·3′	104° 15′	982·5609	129·7	1783	2284	501	698
699	82° 37·8′	104° 22′	982·5690	128·1	1775	2252	477	699
702	82° 36·2′	104° 41′	982·5391	71·7	1054	2164	1110	702
705	82° 34·6′	105° 01′	982·5023	27·2	493	2137	1644	705
708	82° 33·0′	105° 20′	982·4960	21·2	455	2136	1681	708
*708·4	82° 32·9′	105° 23′	982·5013	24·4	504	2129	1625	*708·4
711	82° 32·5′	105° 43′	982·5314	38·6	667	2077	1410	711
714	82° 30·5′	106° 00′	982·5150	0·7	—70	2005	2075	714
717	82° 28·5′	106° 17′	982·5211	7·9	—2	2006	2008	717
720	82° 26·5′	106° 34′	982·5559	23·5	179	1941	1762	720
723	82° 23·8′	106° 57′	982·5643	21·5	122	1904	1782	723
726	82° 22·5′	107° 08′	982·5474	9·1	—76	1917	1993	726
729	82° 20·5′	107° 25′	982·5505	3·5	—183	1886	2069	729
732	82° 18·5′	107° 42′	982·5570	1·2	—244	1855	2099	732
735	82° 16·5′	107° 59′	982·5729	11·7	—132	1835	1967	735
738	82° 14·5′	108° 16′	982·5815	11·6	—163	1804	1967	738
741	82° 12·5′	108° 33′	982·5722	—2·2	—380	1787	2167	741
744	82° 10·5′	108° 50′	982·5623	—9·4	—508	1793	2301	744
*747	82° 08·5′	109° 07′	982·5686	—2·3	—442	1793	2235	*747

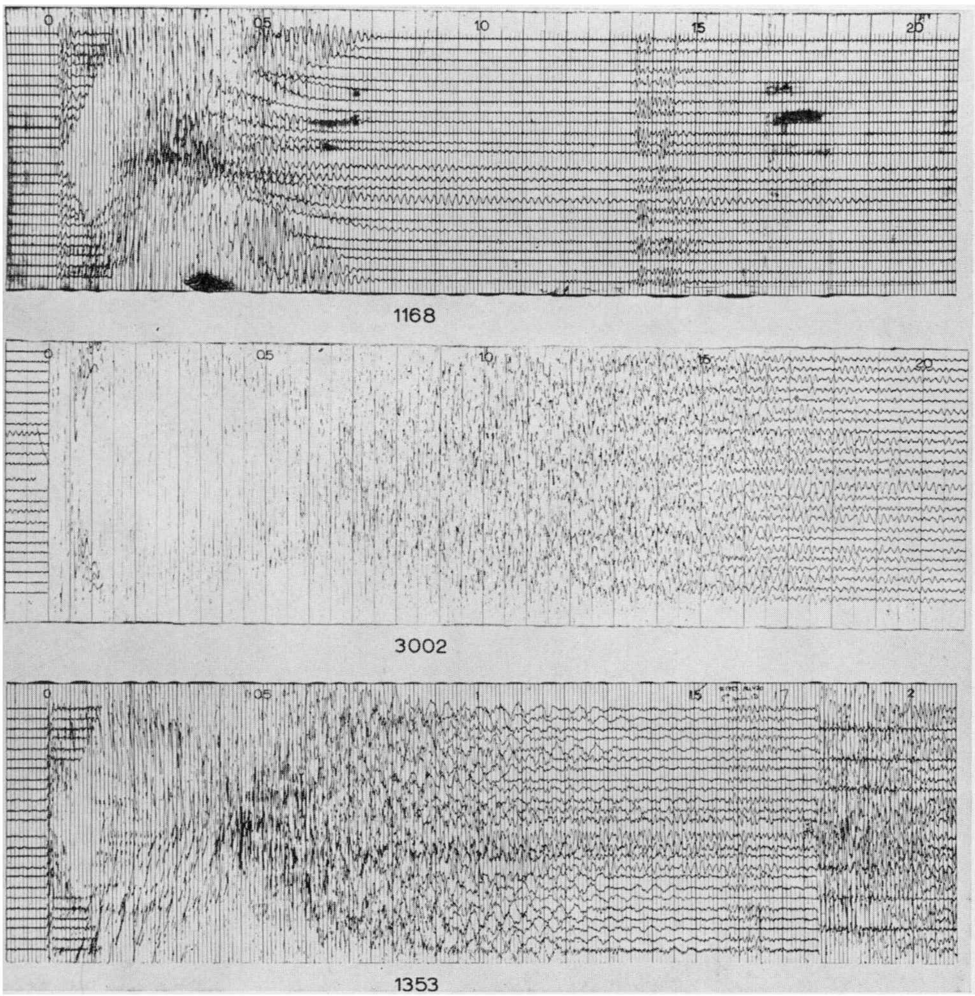

Fig. 2. *Seismic reflection records showing: (1168) normal surface wave attenuation, (3002) prolonged surface noise, and (1353) reflection from a low velocity basal layer arriving 0·2 sec. before the main bottom echo*

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