EAST93 - GEOPHYSICAL TRAVERSE FROM THE TRANSANTARCTIC MOUNTAINS TO THE WILKES BASIN, EAST ANTARCTICA

A Joint United States - New Zealand Science Project

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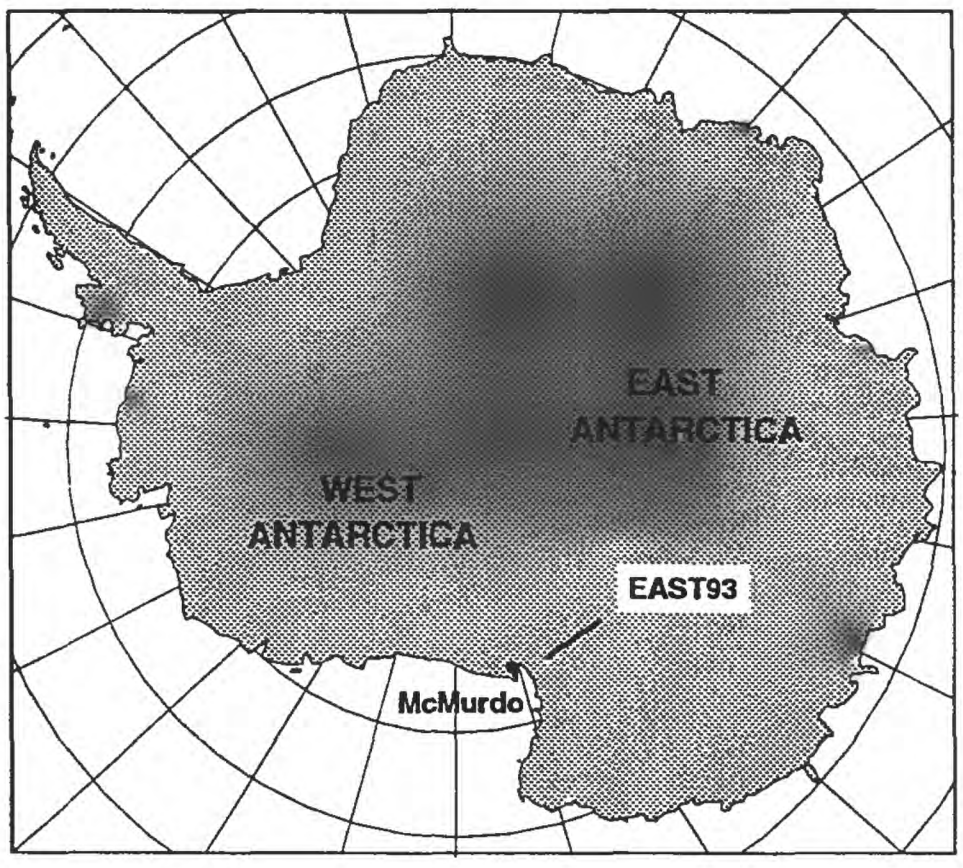

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TABLE OF CONTENTS

LIST OF FIGURES

plot shows location of both parties along the traverse line as a function of time.

Figure 12. *After page 8.* Comparison between barometric pressure (in milliBar) as a function of time measured by the roving station (P2) vs. that measured by the temporary base camp. Base camp measurements were carried out every 5 minutes and were averaged by taking the median over a 6 hour period.

Figure A3.1 *After page A3.1* Illustration (not to scale) of the ground-penetrating-radar set-up during acquisition. See text for detailed description.

Figure A3.2 *After page A3.2* Diagrams describing the components of the ground penetrating radar system. Arrows indicate the directions of signal transmission, dashed lines describe DC power supply, thick lines connect the acquisition receiver assemblage components, and thin lines connect the receiver triggering assemblage components.

Figure A5.1 *After page A5.5* Top - barometric pressure (in milliBar) measured along the traverse line. Bottom - elevation along the traverse (similar to Figure 4). Note that pressure is plotted increasing downward to facilitate comparison with the elevation.

SUMMARY

The East Antarctic Seismic Traverse (EAST93) was a geophysical traverse designed to image the bedrock under the East Antarctic ice cap. The traverse started 10 km west of the Taylor Dome drill site and 25 km west of the exposed bedrock of the Transantarctic Mountains at Lashly Mt. and ended 323 km west of the drill site over the Wilkes subglacial basin (Fig. 1). The traverse was located subparallel to latitude 78° S starting 30-50 km north of the Victoria Land Traverse (1958-1959). It was carried out jointly by the U.S. Geological Survey and Stanford University, U.S.A., together with the Institute of Geological and Nuclear Sciences, and Victoria University, New Zealand, during December 1993 and January 1994. The geophysical traverse included 236 km of multichannel seismic reflection data at 150 m shot intervals, 312.5 km of gravity data collected at intervals of 2.1 km, 312.5 km of magnetic data (total field intensity) collected at average intervals of 0.5 km, and 205 km of ground penetrating radar at intervals of 77 m. Relative locations and elevations of the entire traverse were measured at intervals of 150 m by traditional surveying methods, and tied to three absolute locations measured by the Global Positioning System (GPS).

EAST93 is the first large-scale geophysical traverse on the polar plateau to our knowledge since the early 1960s. As such, the experiment presented several logistical challenges: (1) how to collect regional seismic profiles during the short Antarctic summer; (2) how to keep the scientific instruments running with minimal protection in harsh conditions; and (3) how to combine daily moves of camp with full days of work. The scientific and logistical aspects of the project proceeded, in general, according to plan despite the harsh conditions and our lack of previous experience on the polar plateau. Two unanticipated problems affected the progress of the work: the strong wind which slowed seismic acquisition, and the break-down of one of the large traverse vehicles. The major operational lessons of this project are. (1) Primacord laid close to the surface is not an adequate seismic source for imaging under the thick East Antarctic ice sheet, despite positive prior tests on the Ross Ice Shelf. (2) It is necessary to reduce the 6-7 hours spent daily on camp move and other chores by integrating the living quarters into the working teams, and by improving vehicle warming methods and generator housing.

The following report details the operational and logistical aspects of the work, the weather and ground conditions, the technical aspects of acquisition of geophysical data, and lessons and recommendations for future geophysical traverses.

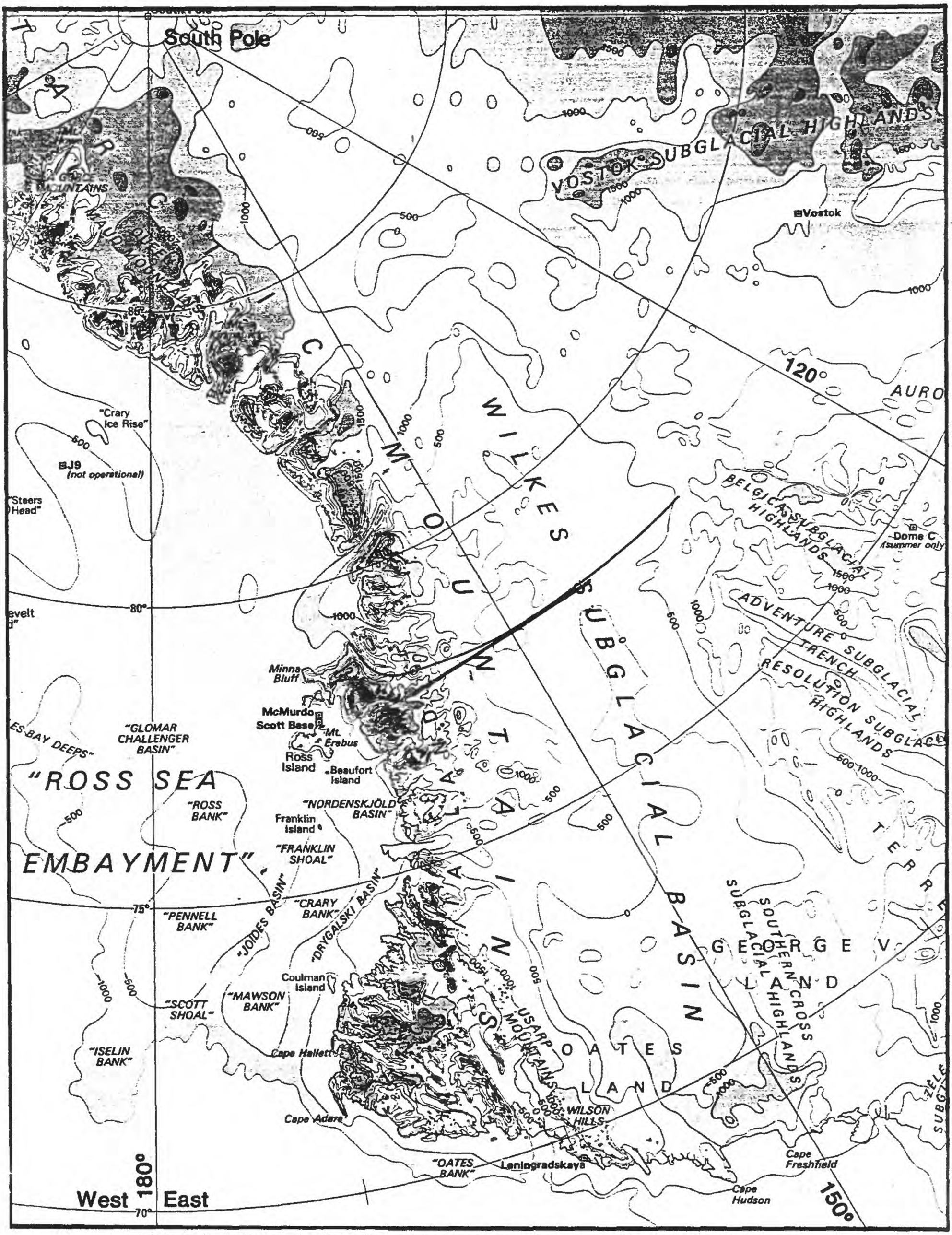


Figure 1. Isostatically-adjusted bedrock elevation map of East Antarctica next to the Transantarctic Mountains (from Drewry, 1983). The location of the traverse is shown by the heavy line, and the location of the 1958/59 traverse is shown by the light line.

12.

SCIENTIFIC OBJECTIVES

By imaging the bedrock under the East Antarctic ice sheet between the Transantarctic mountains and the Wilkes subglacial basin, we hoped the experiment would enable us

(1) To provide quantitative constraints for modeling the uplift of the Transantarctic Mountains and the subsidence of the Wilkes Basin as a flexed lithospheric plate with a free-edge at the boundary with West Antarctica (Stern and ten Brink, 1989).

(2) To map the extent of the Ferrar dolerite sills and basalts inland from the mountains in order to discern whether they originated from an active mantle plume or from rifting and passive upwelling (Elliot, 1991).

(3) To analyze the seismic stratigraphy of the Wilkes Basin sediments to help resolve the debate about the climatic conditions and the size of the ice sheet in the Cenozoic, in particular, whether parts of East Antarctica were deglaciated for much of the Late Cenozoic (Webb, 1991).

PREVIOUS WORK IN THE AREA

Only one traverse was carried out in this area prior to the EAST93 experiment: the Victoria Land Traverse led by A.P. Crary in 1958-1959 (Crary, 1963) (Fig. 1). Crary's traverse collected gravity and seismic reflection and refraction data, but the quality of the data were limited by the technology available at the time. Ice coring and related glaciological studies were carried out at Taylor Dome between 1991-1994, located 10 km east of the start of the line (Fig. 2) (Grootes and Steig, 1992; Morse and Waddington, 1992). Rock outcrops at Beacon Heights, located 45 km east of the start of the line, were mapped by McElroy and Rose (1987), and laboratory measurements of velocity and density of rocks from the Beacon Group in this area of the Transantarctic Mountains were made by Barrett and Froggatt (1978). A regional airborne radio-echo sounding survey grid, centered at about km 0 (Fig. 3), was carried out in January 1975 by the joint National Science Foundation-Scott Polar Research Institute-Technical University of Denmark (NSF-SPRI-TUD) program (Drewry, 1982). Several flight tracks carried out in 1971-72 as part of the continent-wide airborne radio-echo sounding survey by the NSF-SPRI-TUD program (Drewry, 1983) crossed the traverse area (Fig. 3). Ice thickness and surface elevation data, digitized by the British Antarctic Survey (BAS) personnel (David Vaughan, pers. comm., 1993) from film records collected by these two projects, were used to construct the base map for our experiment (Fig. 3). Estimated errors in these airborne surveys were < 5 km in navigation, 1% in ice velocity, 26 m in air and 14 m in ice in signal resolution, and 50-150 m in flight height (Drewry et al., 1982).

FIELD PERSONNEL

United States

Uri ten Brink	(USGS Woods Hole) - Co-leader
Rafael Katzman	(MIT/WHOI Joint program in Oceanography) - Student
Yizhaq Makovsky	(Stanford University) - Student

New Zealand

Stephen Bannister	(Inst. Geological and Nuclear Sciences) - Co-leader and shooter
Mike Collins	(New Zealand Antarctic Program) - Mechanic
Ron Hackney	(Victoria University, Wellington) - Student
Jan de Vries	(New Zealand Antarctic Program) - Search And Rescue (SAR)

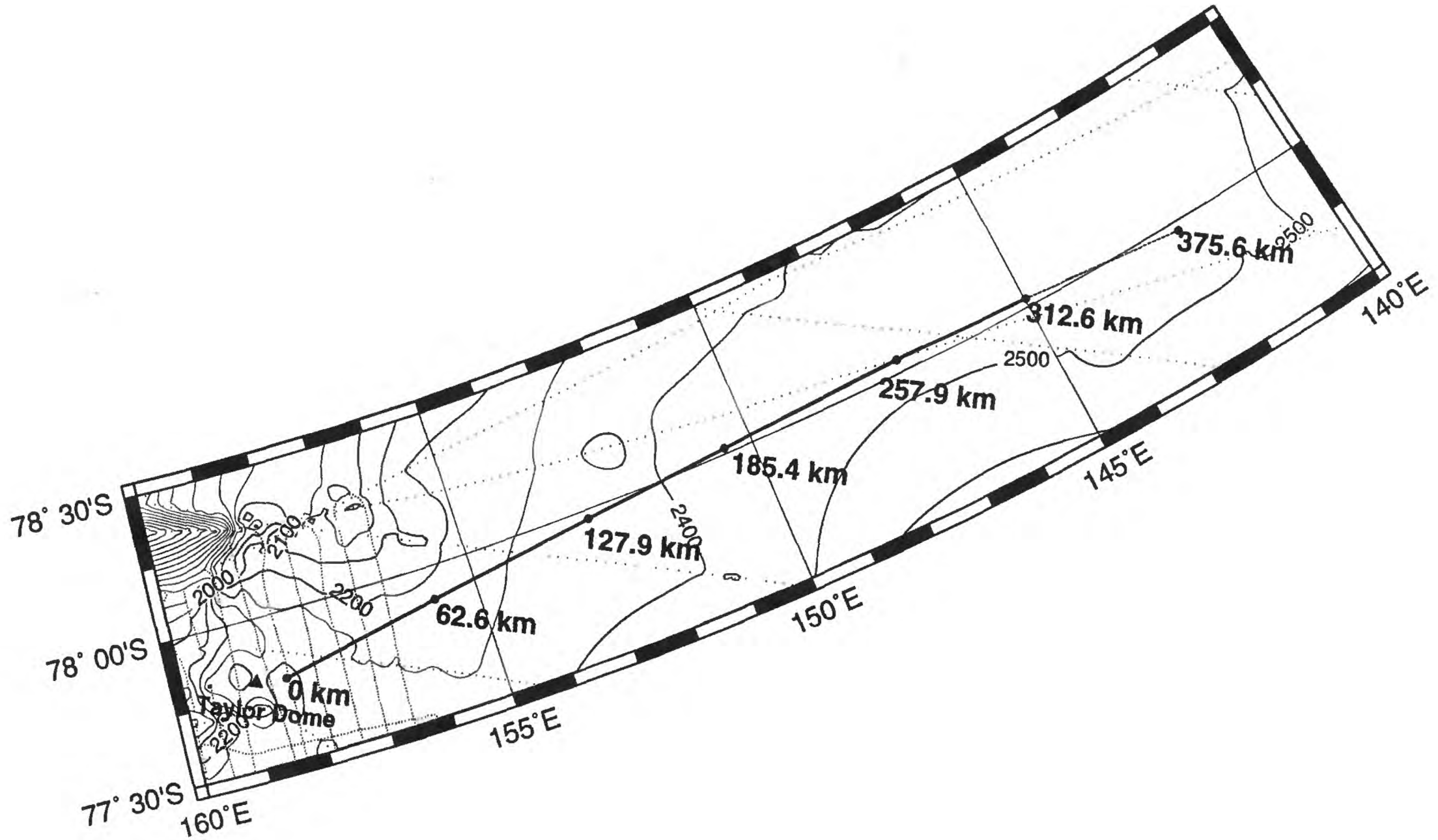


Figure 2. Surface elevation map of East Antarctica in the vicinity of the traverse (100 m Contour interval). Map was contoured from digitized values of elevation collected by the NSF/SPRI/TUD airborne radio echo-sounding surveys in 1971-72 and 1975 (D. Vaughan, SPRI, written comm., 1993). Heavy line - location of traverse. Dotted lines - locations of flight lines of the 1971-72 and 1975 surveys. Heavy dots - locations of initial explosives, fuel, and food caches.

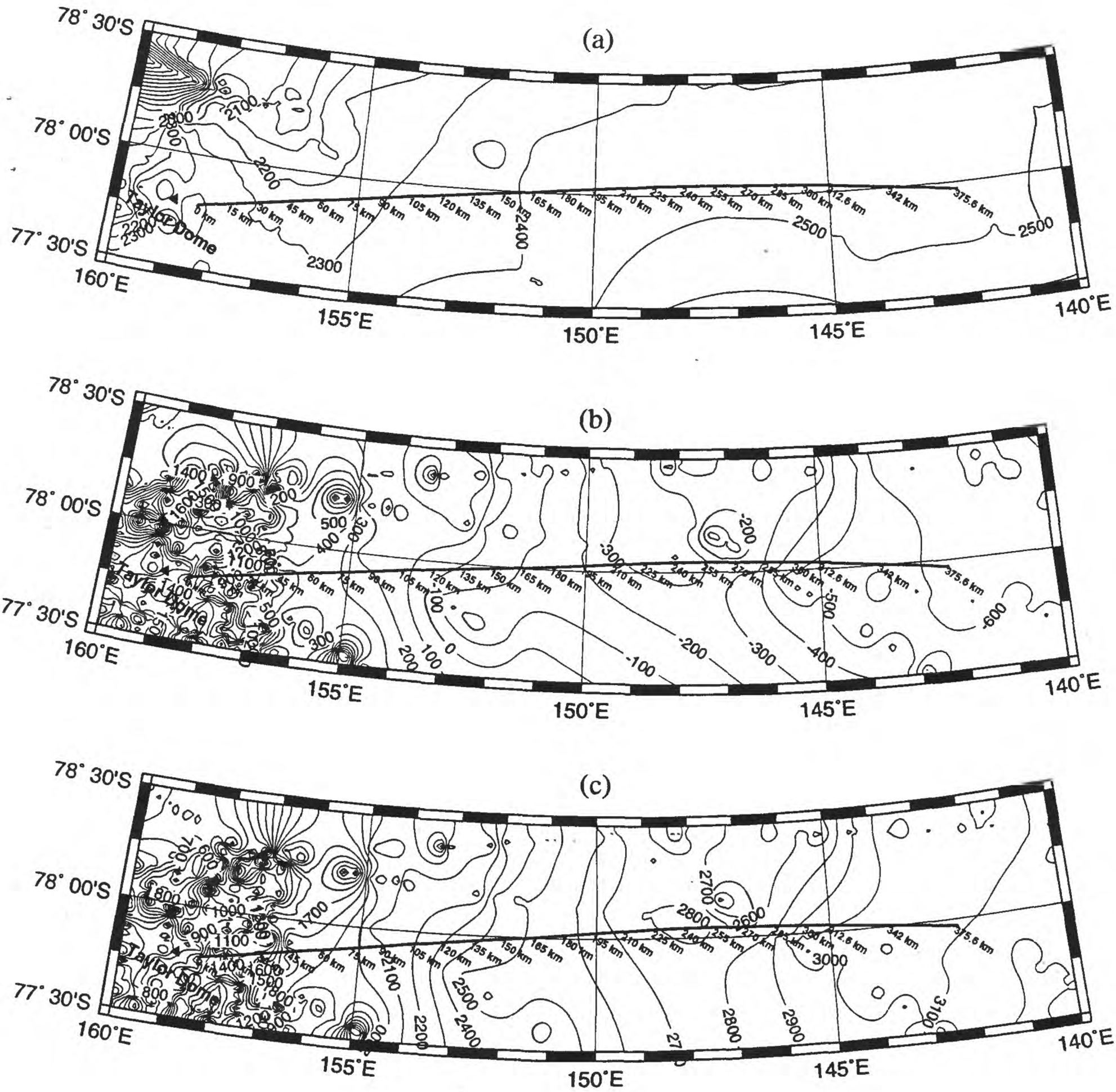


Figure 3. (a) Surface elevation, (b) bedrock elevation, and (c) ice thickness maps of East Antarctica in the vicinity of the traverse. Maps were contoured from digitized values of elevation and ice thickness collected by the NSF/SPRI/TUD airborne radio echo-sounding surveys in 1971-72 and 1975 (D. Vaughan, SPRI, written comm., 1993). Heavy line - location of traverse.

David King	(Inst. Geological and Nuclear Sciences) - Electronic technician
Bill King	(New Zealand Antarctic Program) - SAR person
John West	(Dept. Surveying & Land Information) - Surveyor

TIME TABLE AND LOG

The party spent a total of 54 days in the field, with some personnel arriving in the field 2 days earlier and leaving a day later than the rest of the party. Of these 54 days, 20 days were spent shooting seismics, 17 days were lost to bad weather, 4 days were lost to dealing with the broken large traverse vehicle (Tucker 069) and consequently the need to rearrange the work, 3 days were lost to emptying supply caches and getting air supply, 5 days were spent in organizing the work and overcoming technical problems, and 2 days were spent in preparation for pullout (including a runway for C-130).

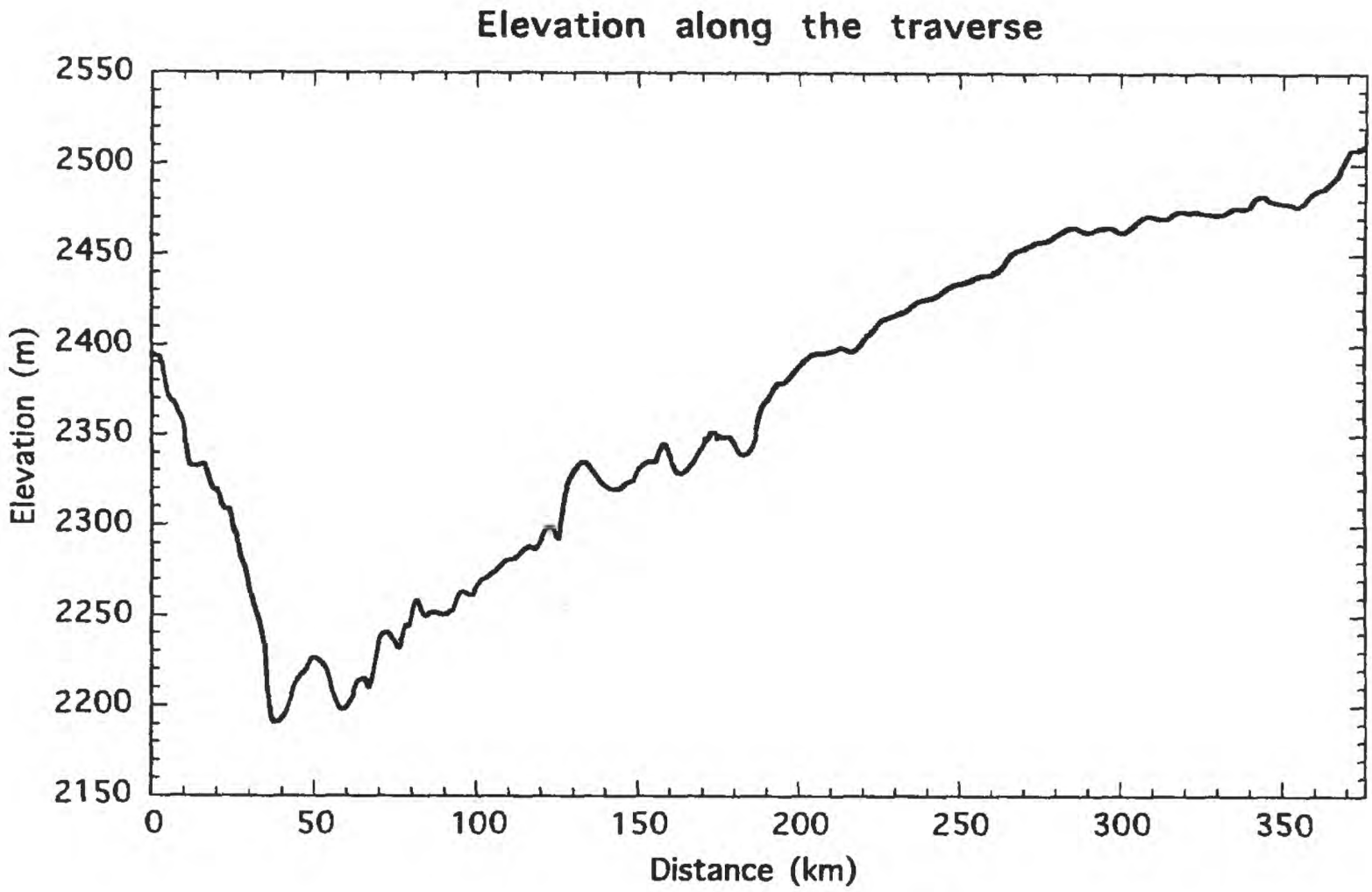
22 Nov. -2 Dec:	Twin-Otter support for reconnaissance of traverse, fuel and food dispersal in depots at km 0 (Alpha), km 63 (Delta), km 128 (Bravo), km 185 (Echo) , km 258 (Charlie), and km 313 (Foxtrot) (Fig. 2), pickup of parachutes used to drop explosives, and GPS survey of reference points at km 0, 128, and 258.
29-30 Nov:	RNZAF C-130 air drops of explosives at km 0, 128, and 258.
1 Dec:	Put-in of survey party at Taylor Dome.
3-6 Dec:	Put-in of main party and its equipment at Taylor Dome.
8-10 Dec:	Main party moves to km 0 (Alpha), repairs damage to snow streamer, refuels from Taylor Dome.
11 Dec:	Seismic work begins, fuel supply and generator replacement by Twin-Otter.
15 Dec:	Work terminates at 3 p.m. due to high winds.
16 Dec:	No work due to high winds.
18 Dec:	No work due to a snow storm.
22-23 Dec:	2 people travel 165 km overland to bring more explosives from Alpha and replacement generators and transformer from Taylor Dome. They measure a continuous radar profile.
23-26 Dec:	No work due to high winds.
27 Dec:	High winds, advance without shooting seismics between km 75-90.
29-31 Dec:	No work due to high winds.
4 Jan:	Walk-away shots, Makovsky develops tooth abscess and needs to be evacuated.
6 Jan:	High winds, advance without shooting seismics between km 162-185.
7 Jan:	Survey team finishes flagging to km 375.

8 Jan:	Slow movement due to bad sastrugi (parallel ridges of wind-blown hard snow). Shot size and length increased by 50%.
9 Jan:	Survey team joins main team at km 200.
10 Jan:	Skidoo AL3 breaks front shaft and is towed on a sled until the end of the traverse.
12 Jan:	Twin-Otter makes a difficult landing due to sastrugi. It evacuates surveyor, electronic technician, and Makovsky, and brings replacement computer hard drive.
13 Jan:	Morning whiteout prevents advance through sastrugi field. Work commences in afternoon, but Tucker 069 (which tows the camp) develops transmission problem.
14 Jan:	Runway prepared for Twin-Otter to bring replacement for transmission.
15 Jan:	No work due to whiteout.
16 Jan:	Main camp splits. Tucker 069 and mechanic left behind, science party continues.
17-19 Jan:	No work due to bad storm.
20 Jan:	Digging out and work. Twin-Otter with mechanic and Makovsky arrives at Tucker 069 location to replace transmission. Replaced transmission fails.
21 Jan:	Twin-Otter arrives at Tucker 069 location with a mechanic and another transmission. Science party retrieves explosives, fuel and food from depot Charlie.
22-23 Jan:	Tucker 069 and science party meet and move toward Foxtrot, but forced to stop at km 270 after complete transmission failure of Tucker 069.
24-25 Jan:	Gravity and magnetics measured out to km 312.6. Supplies at depot Foxtrot retrograded to km 270. Twin-Otter arrives with snow groomer and operator to prepare runway for LC-130.
26 Jan:	Last day of seismic work.
28-29 Jan:	Pull-out of equipment and personnel by 7 LC-130 flights from km 270.

INSTRUMENTATION

Location And Surveying

USGS/NMD determined GPS positions at the fuel depots near km 0 (Alpha), 127.95 (Bravo) and 257.86 (Charlie) (Fig. 2). GPS surveys were conducted on November 29 and December 1, 1993. Geoid separations were obtained from OSU91A Geoid Interpolation Program, The Ohio State University, department of Geodetic Science and Surveying. Horizontal accuracy is in the 1-meter range.



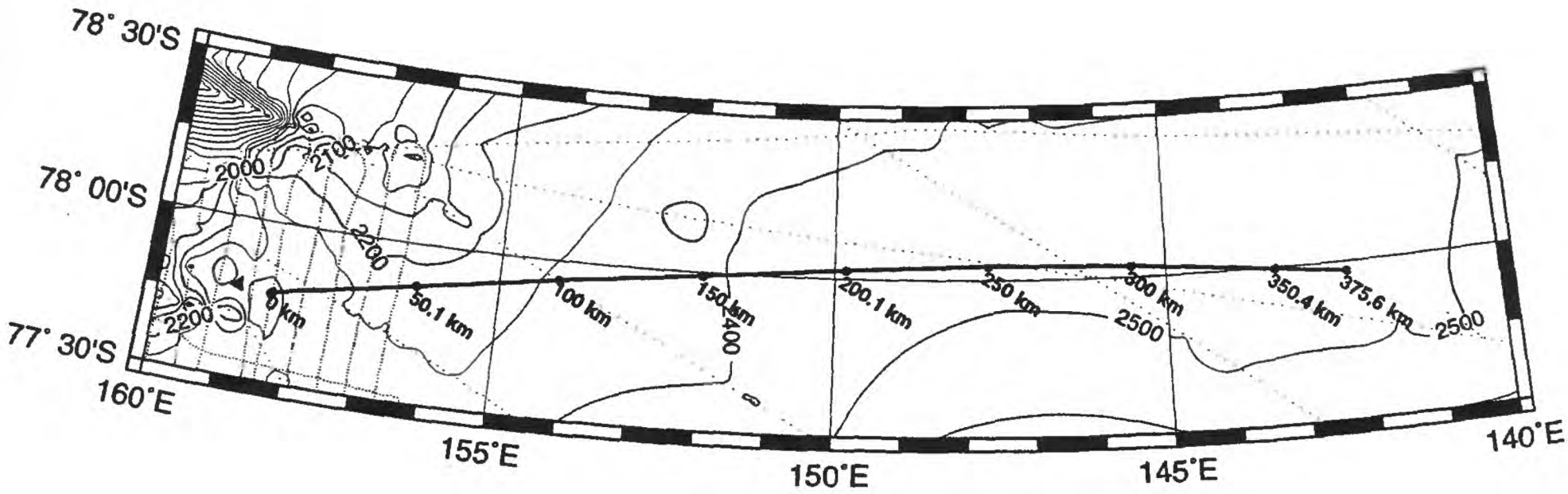


Figure 4. (a) Profile of elevation along the traverse. (b) Surface elevation map of East Antarctica in the vicinity of the traverse from airborne radio echo-sounding (see Figure 2 for details). Contour interval - 100 m.

In addition to these measurements, relative elevation measurements were carried out by the DOSLI surveyor, John West, in the advance survey group using conventional land surveying techniques. The location of each measured position along the traverse starting from km 0 is given in Appendix 1 with elevations calculated using the Alpha GPS site as the absolute elevation and accepting a geoidal separation of 50.1m there (see Table below). (The distance azimuth from Alpha to 'km 0' were 937.5 m and 229.82°.) The (relative) ground measurement survey agreed with the GPS values at Bravo and Charlie within to 3 meters, about the order of error that might be expected using the GPS in this manner.

GPS POINTS:

Site	WGS 84 Coordinates	Elliptical Height (m)	Geoid Separation (m)	Ortho. Height (m)	Surveyed Height (m)
Alpha	77° 46' 42.29"S 158° 20' 30.89"E	2345.5	-50.1	2395.6	2395.6 (Accepted as origin)
Alpha AZ	77° 47' 14.01"S	2342.7	-50.1	2392.8	
	158° 21' 21.31"E				
Bravo	77° 57' 08.15"S	2270.6	-53.7	2324.3	2324.1
	152° 55' 04.87"E				
Charlie	78° 05' 23.16"S	2388.9	-54.1	2443.0	2440.9
	147° 20' 28.87"E				

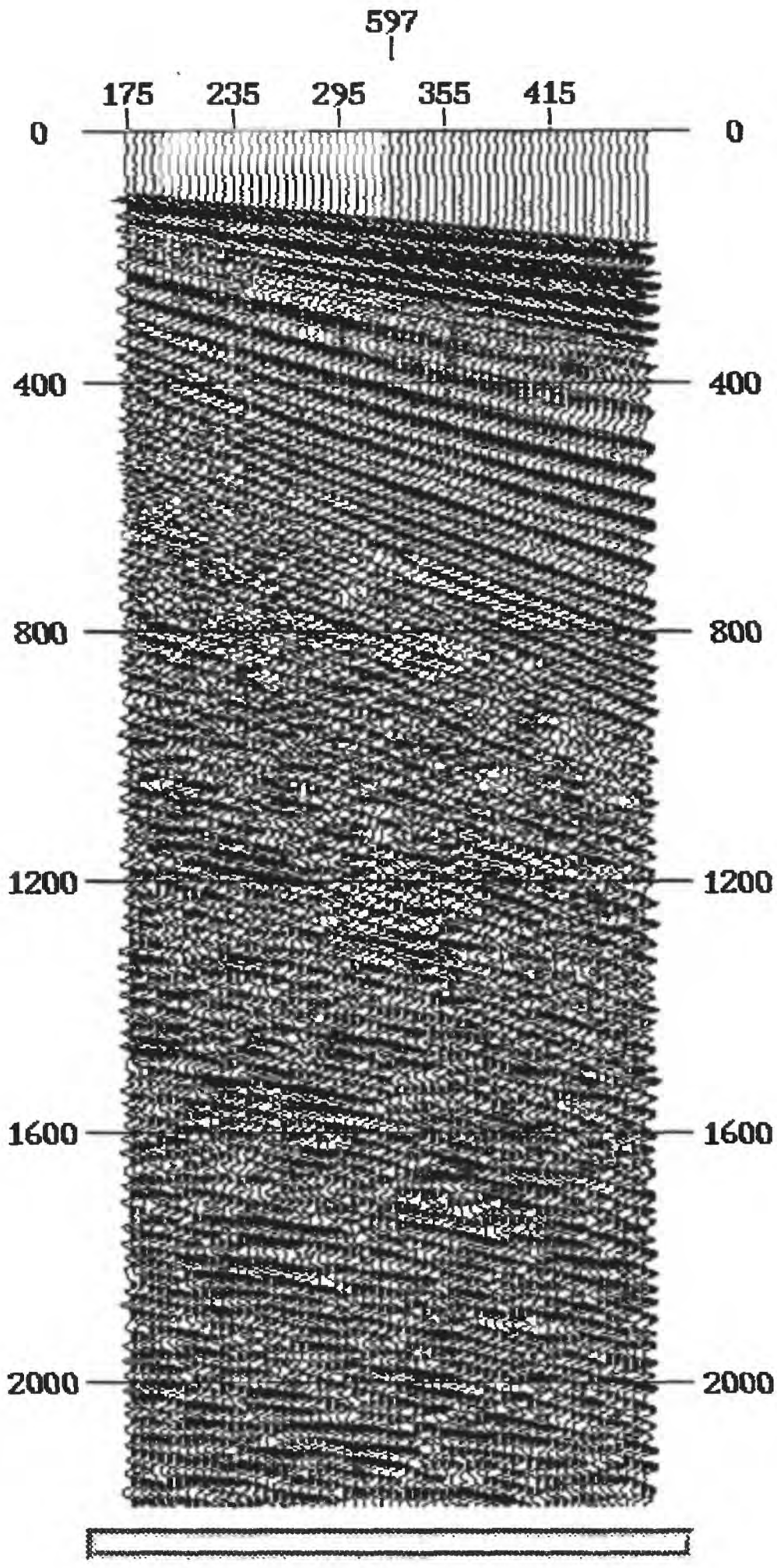
Figure 4a shows a profile of the elevation measured along the traverse and Fig. 4b shows the location of the traverse, with approximate elevation contours from the 1970s airborne data. Appendix 1 lists the locations of surveyed positions, and their elevations.

Additionally, barometer readings were taken during supply flights to 6 points along the traverse and at intervals of 2.1 km along the traverse, but these were not used to calculate elevation.

Seismics

The shot parameters were as follows:
Type of source - Geoflex 40 detonating cord (primacord) with 40 g/m dynamite (200 grain).
Manufacturer - ICI Australia.
Shot size - 1.6 kg (40 m long cord) between km 0-162.
2.4 kg (60 m long cord) was used between km 185-270.
Shot depth - 16.5 cm (6.5').
Shot interval - 150 m.
Shot-receiver offset for near trace - 175 m between km 0-162.
185 m between km 185-270.
Survey geometry -Marine, except for walk-away calibration shots to a stationary streamer (maximum offset of 3.2 km) at km 148 and 270.

Figure 5. Example of a seismic field record from a seismic shot at km 74.7, after application of a 500 ms automatic gain control. The vertical axis represents two-way travel time, in ms. The horizontal axis is shot-receiver offset, in m.



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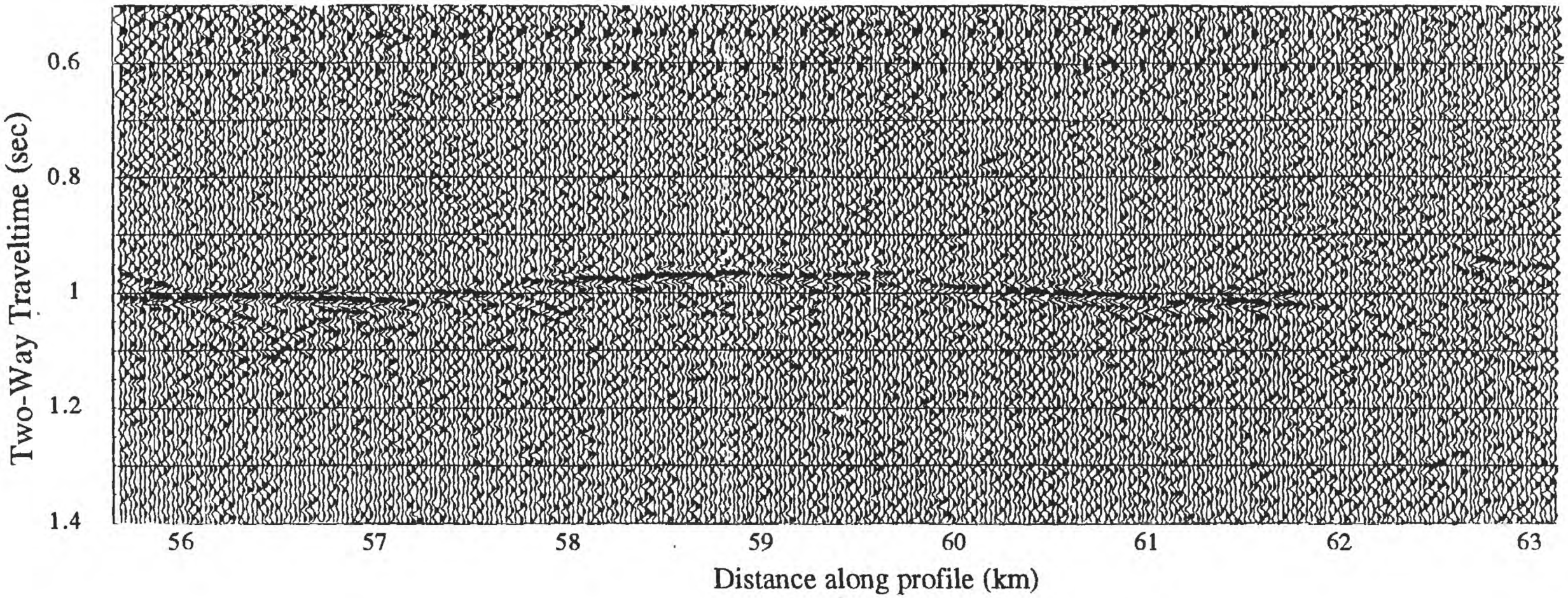


Figure 6. A portion of the stacked and binned multichannel seismic data along the traverse.

Seismic data were recorded using a Geometrics Strataview R-60, a 486 PC-based portable computer, with 18 bit A/D converter, 500 MByte hard drive, Colorado Jumbo tape drive and a built-in plotter. Sampling rate was 1 msec and record length was 4 sec. The unit demultiplexed as it recorded and had several display functions. Processing for field quality control was performed using the Eavesdropper™ software developed by the Geological Survey of Kansas.

The seismic receiving system consisted of a 300-m-long snow streamer made by Norsk-Hydro of Norway. The streamer is a towed Kevlar seismic cable with 60 take-outs (channels) at 5 m intervals. Each take-out is a cable with 4 single-axis gimbaled geophones per channel, ~3.1 m apart.

Fig 5 shows a field record of seismic data collected during the experiment, and Fig. 6 shows a portion of the stacked data. The location of shot points is listed in Appendix 1.

Gravity

Gravity observations were made every 2.1 km, using a LaCoste-Romberg gravimeter G-179. The gravimeter was continuously attached to a battery that supplied power to an internal heater, which maintained the gravimeter at a constant temperature. In addition, the gravimeter was cased in a Perspex box with holes for the dials, and this box and the battery were kept in a wooden box. The gravimeter was kept inside a vehicle at all times and was brought outside only for the measurements. The gravimeter values were tied to Scott Base gravity station before the experiment. Instrument drift was calculated by successive measurements over several days at the same location (km 269.7) The observed gravity is plotted in Fig. 7 and listed in Appendix 2.

Magnetics

Magnetic readings were carried out using two Geometrics G-856 magnetometers. One magnetometer was used as the roving station at intervals of 300-450 m and the second one as a temporary base station at the daily base camp to record the diurnal variations in the magnetic field. The base station magnetic sensor and magnetometer required adequate insulation to operate properly at these temperatures. The sensor was wrapped with insulated material and a hand warmer was wedged between the sensor and the insulation. The magnetometer was enclosed in a food box containing a hot water bottle. The raw magnetometer readings observed by the 'roving' station are plotted in Fig.8 and listed in Appendix 1 together with their day of measurement.

Ground penetrating radar

Radar measurements were made at intervals of 77 m from Taylor Dome to km 195.5, a total of 205 km. Data were collected while the radar system was moving using a wheel to measure the distance and an electroinc trigger to start acquisition. The system included low frequency receiving and transmitting antennae (1.25 MHz) with resistivity constants of 400 Ohm. The radar transmitter supplied a voltage pulse of 750 V. The data were received and sampled using a digital oscilloscope (Fluke 97 Scopemeter) which stacked 256 readings to form one trace. Data were sampled for 40 microseconds (μsec) at 0.08 μsec per sample and recorded on a BCC Avanti 486 portable computer. The data were converted into SEG-Y format which allowed us to use standard seismic processing tools for display and analysis. Detailed description of the acquisition system and data reduction are given in Appendix 3.

The trace in Figure 9A displays the characteristic waveform of the radar signal. The first arriving air-wave is clipped to allow good resolution of the reflected signal. Reflections from within the ice around 7-8 μsec are difficult to discern on this single trace. The signal arriving around 10 μsec is an artifact we can not explain. The ice-rock interface reflection can be clearly seen at 13 μsec two-way-time translating to a depth of about 1 km. We plan

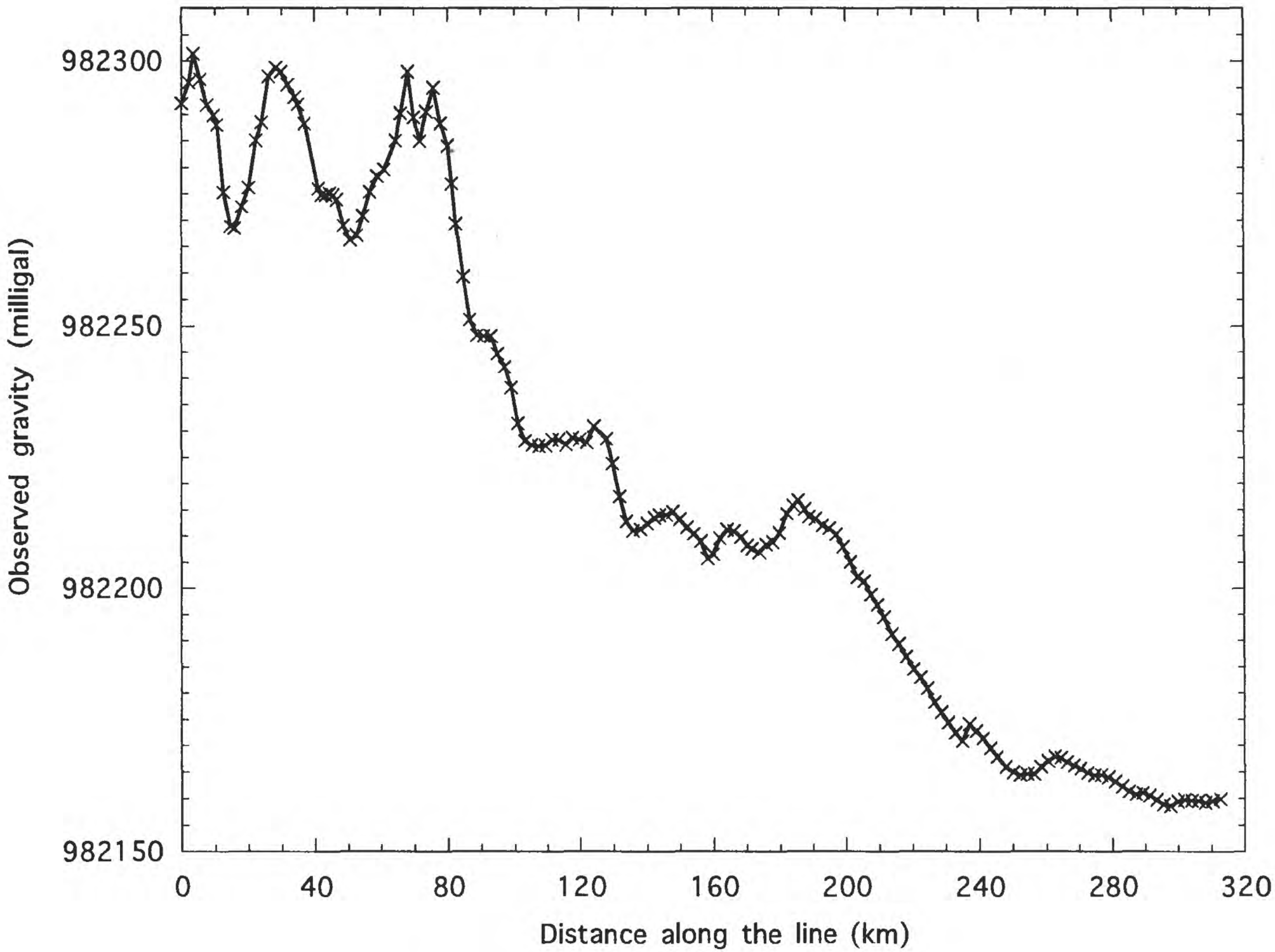


Figure 7. Observed gravity (in milligal) along the traverse.

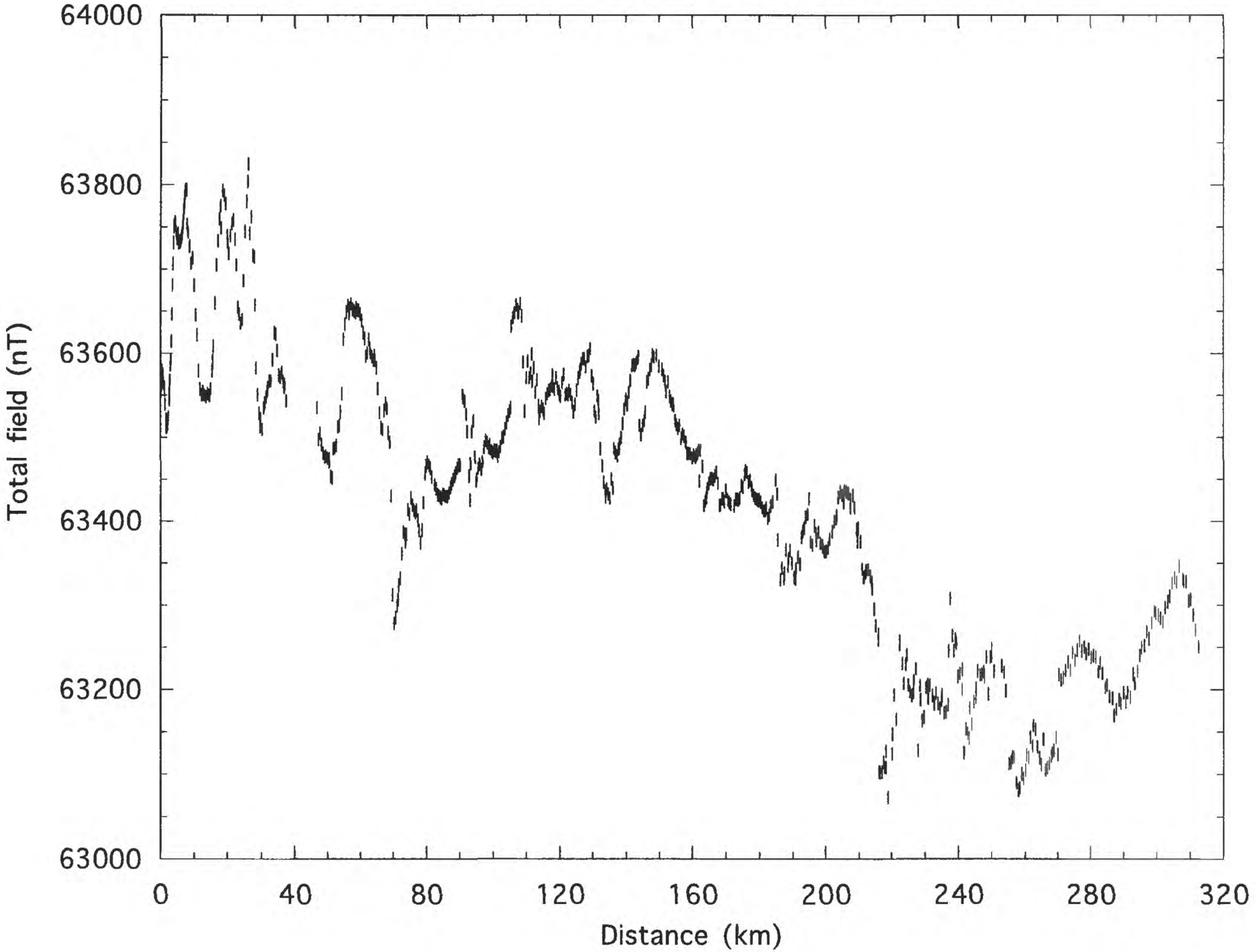


Figure 8. Raw magnetic measurements (in nT) along the traverse line.

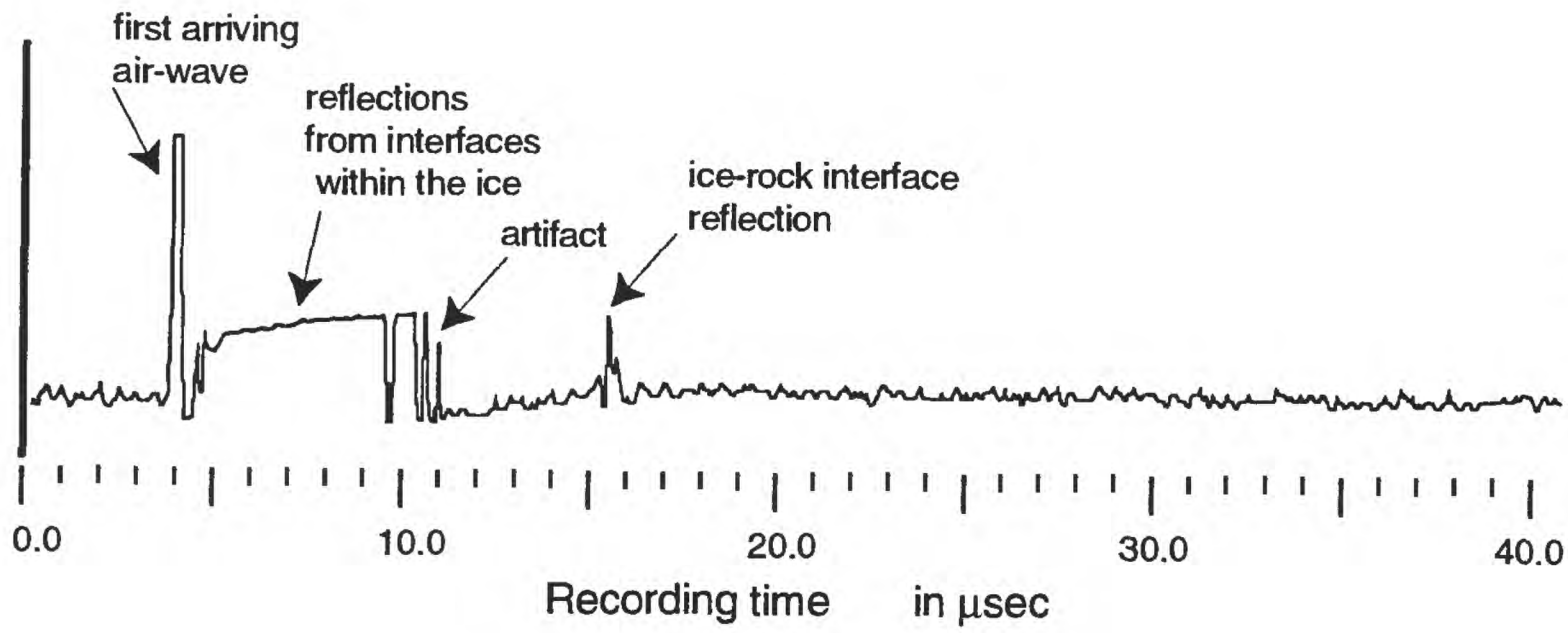


Figure 9a. An example of a typical trace (no processing applied). This trace was recorded in surface location km 67.4 with 4 μsec pre-trigger length, 20 mV/div gain and 0.08 μsec sample interval using the four-stage transistor avalanche source and the Fluke 97 based recorder.

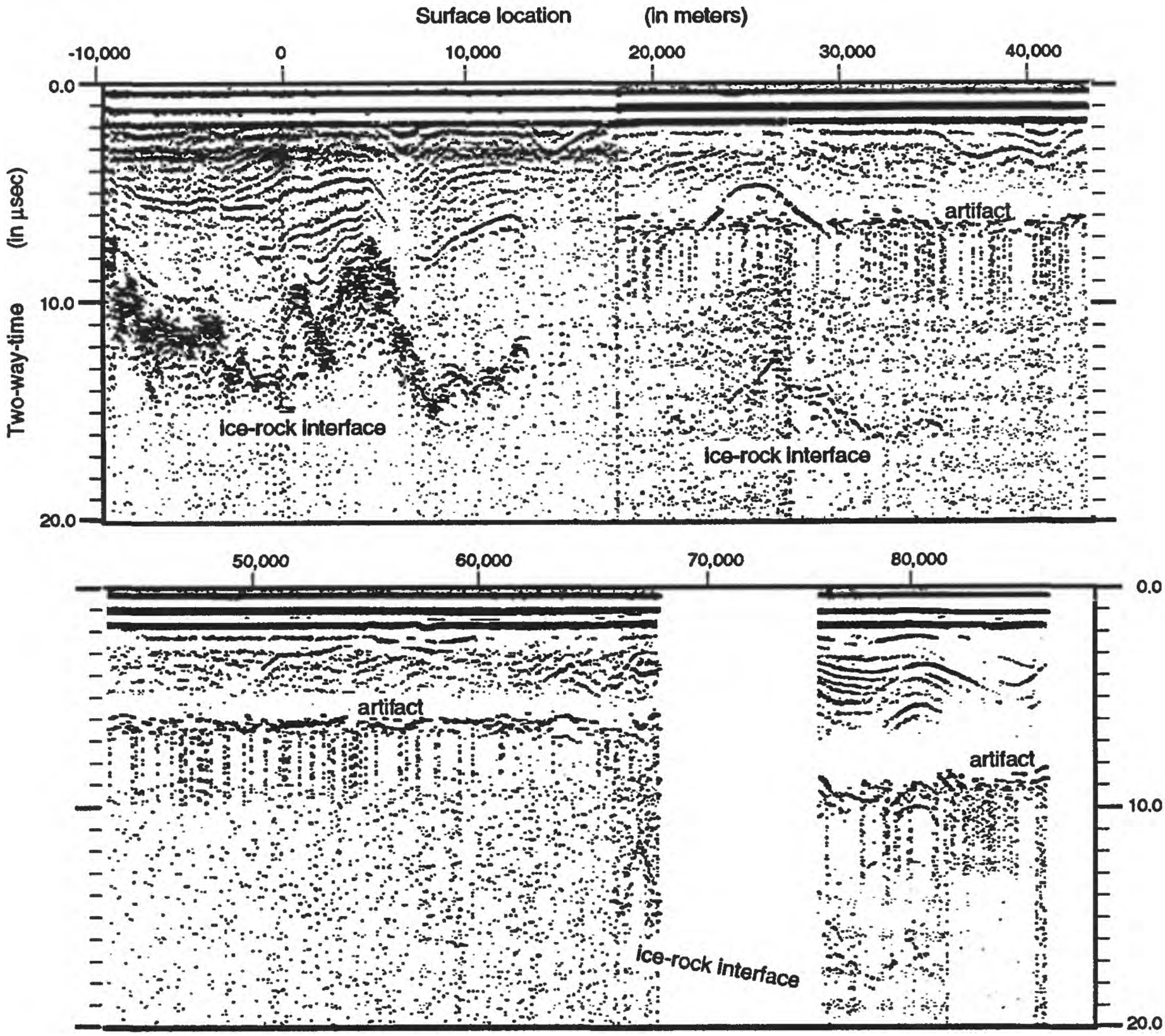
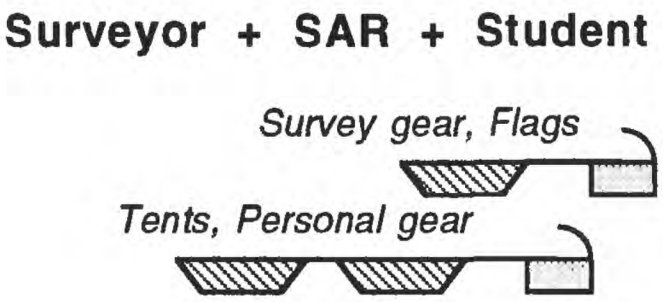


Figure 9b. 96 km-long section, acquired from Taylor Dome (surface location km -10), on the upper left, to surface location km 86.1, on the lower right. To produce the section, 8 files were combined, adjacent traces subtracted, variable gain applied and traces plotted by surface location. The gap in the image occurs where no data were acquired.

EAST93 - EXPERIMENTAL DESIGN

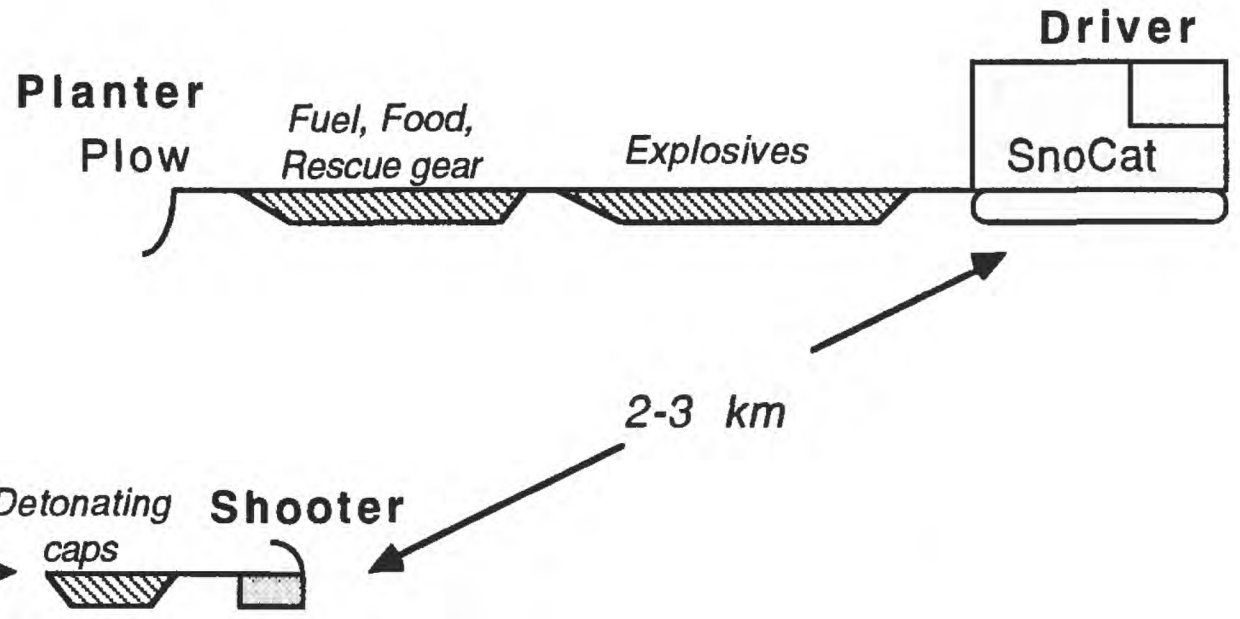
SURVEY TEAM

(Autonomous; 100-150 km ahead)

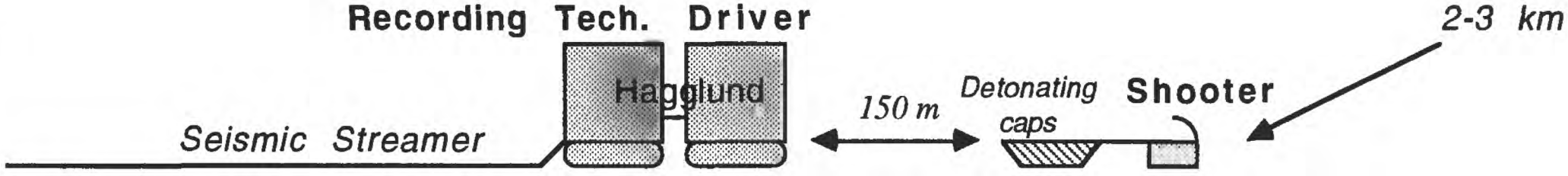


MAIN PARTY

Leading group



Center (shooting) group



Base Camp

(Catching up at
the end of the day)

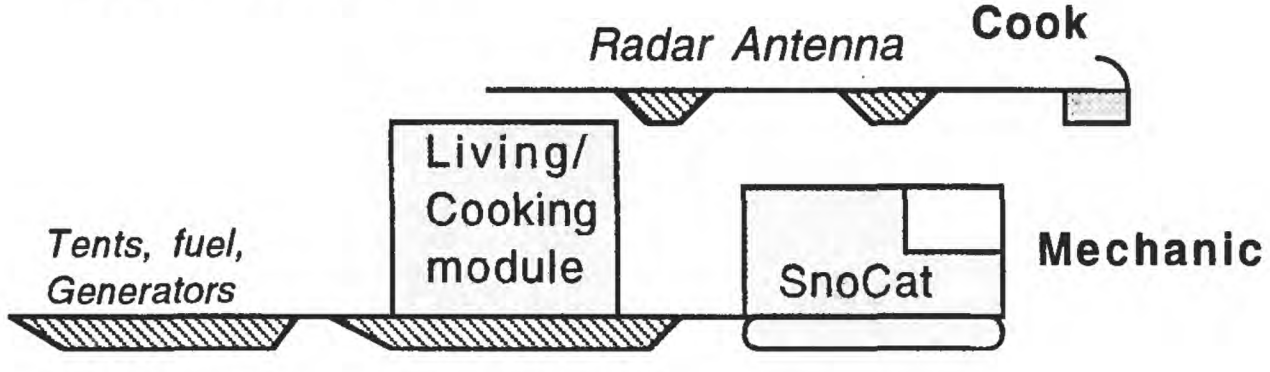


Figure 10. Schematic diagram showing the different working groups and their spatial relationship.

to subtract adjacent traces from each other in each data-file to cancel the air wave and most of the artifacts, and to enhance the reflected signals.

The image in Figure 9B displays a 96 km long section, acquired across the flank of the Transantarctic mountains to the edge of Wilkes basin. A strong reflection from the ice-rock interface can be seen around 7-8 μsec on the left of the image. The rough shape of this reflector describes a rough subglacial topography similar to the exposed topography of the Transantarctic mountains. This reflector becomes discontinuous and weak as the travel time increases to about 17 μsec, or about 1400 m deep, and disappears completely on the right of the image.

The features seen between the surface and the ice-rock interface are reflections of interfaces within the ice. These can be different layers of ice deposited on the ice sheet, layer of dust etc. These reflectors seem to wrap around the topographic features at the base of the ice in complex flow patterns. The horizontal bands of signal around 10 μsec are the artifacts pointed out in Figure 9A.

METHODOLOGY

The field work was conducted in the following way (Fig. 10):

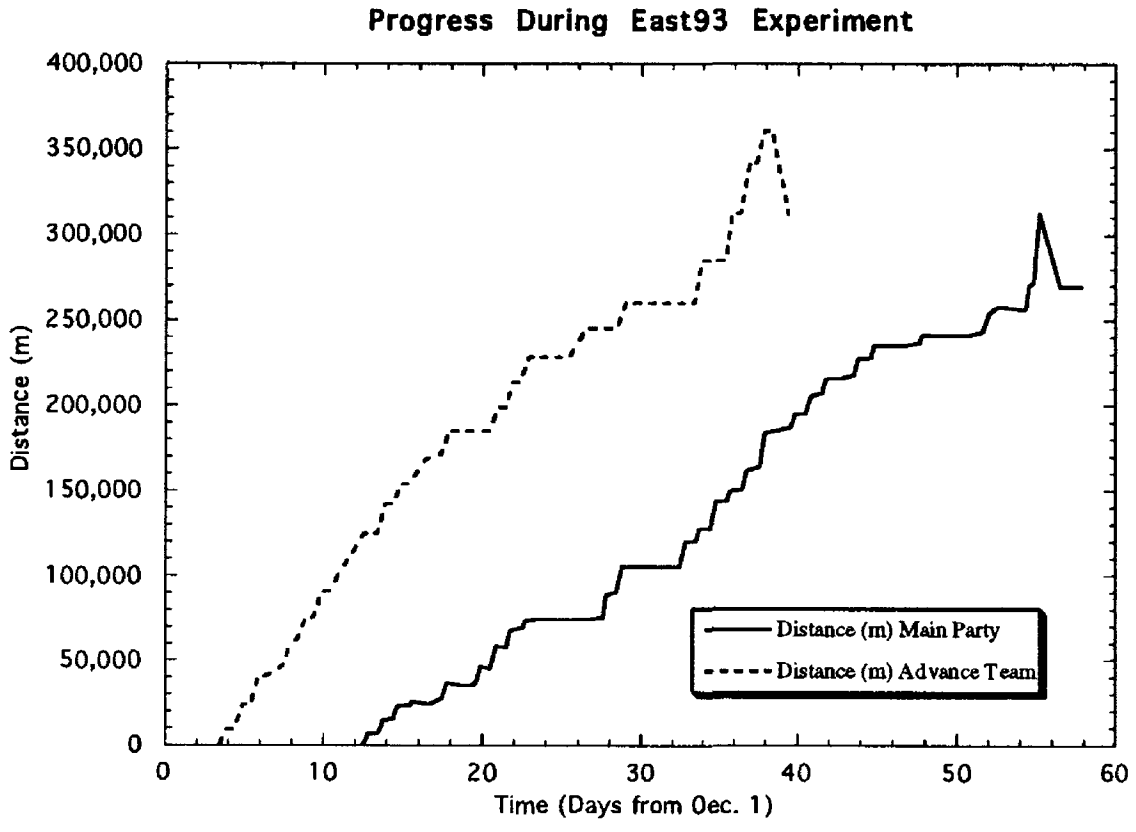
An advance survey group which included a professional surveyor with an Electronic Distance Meter (EDM) (J. West), a Search And Rescue (SAR) person (B. King), and a student (R. Katzman). The advance group moved autonomously 100-150 km ahead of the main party on 2 skidoos with Nansen/Tamworth sleds. The survey party was put in the field 6 days before the main party. It advanced, on average, 15 km a day. It surveyed and planted flags every 150 m. It drew food and fuel from caches.

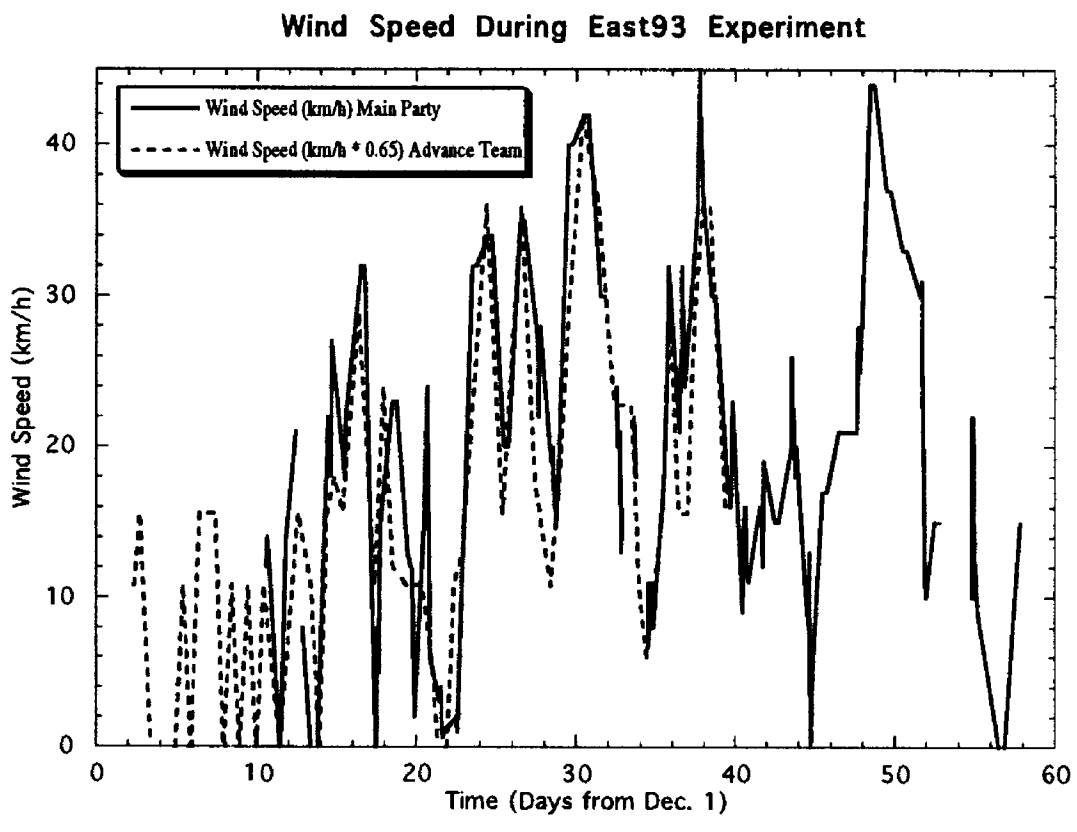
The main party consisted of 3 separate working groups, which converged nightly:

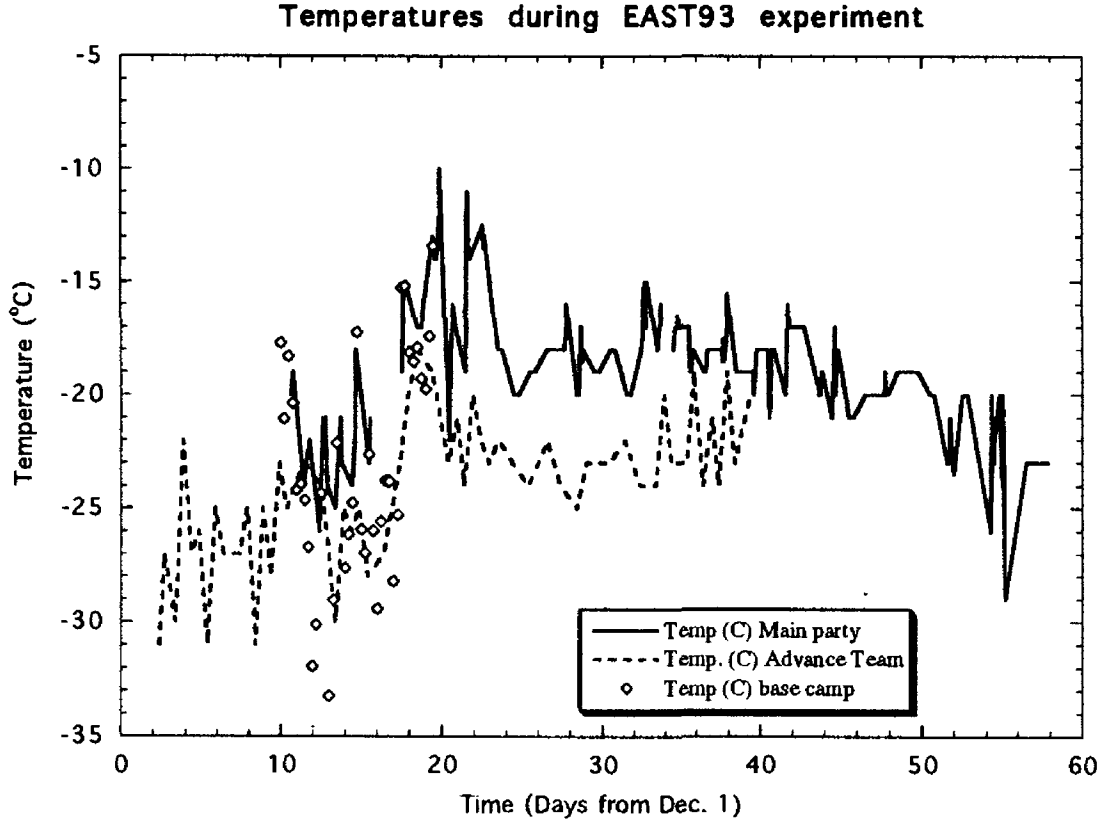
1. The leading group laid 40-60 m long pieces of detonating cord below the surface using a plow at 150 m intervals, and carried out magnetic and gravity measurements. The group included 2 people: The Tucker driver, who was also a qualified SAR person (J. de Vries). checked for crevasses, measured the magnetic field every 450-600 meters, and wind speed, temperature and barometric pressure every 2.1 km. The second person (U. ten Brink/R. Hackney) on foot behind the snow plow held the end of the detonating cord while the Tucker pulled the plow forward, stomped on the trench to pack the snow over the detonating cord, and cut the end of the detonating cord at the proper length. The second person also measured gravity every 2.1 km. The leading Tucker stopped and idled its engine before each shot detonation, in order to reduce the ambient noise on the seismic records.

The leading group had the following equipment: A Tucker Snocat which towed (i) an Anare sled (a midsize sled-1770 lb., 12 x 6 ft., 2-3 ton carrying capacity) loaded with explosives and 3 fuel drums, (ii) a Maudheim sled loaded with heavy rescue gear (400 lb.), spare streamer sections, spare generators, 4 60 liter drums and miscellaneous equipment as necessary, and (iii) a snow plow.

2. The center (shooting) group consisted of a large tracked vehicle (Hagglund) towing the 60 channel, 300 m long snow streamer, and an Alpine-II Skidoo towing a box sled ("Sleepy sledge") loaded with detonators. The seismic recording unit was housed in the back of the Hagglund. It included 3 people : the shooter (S. Bannister / U. ten Brink) on a skidoo about 150m in front of the Hagglund, the driver of the Hagglund, and the recording







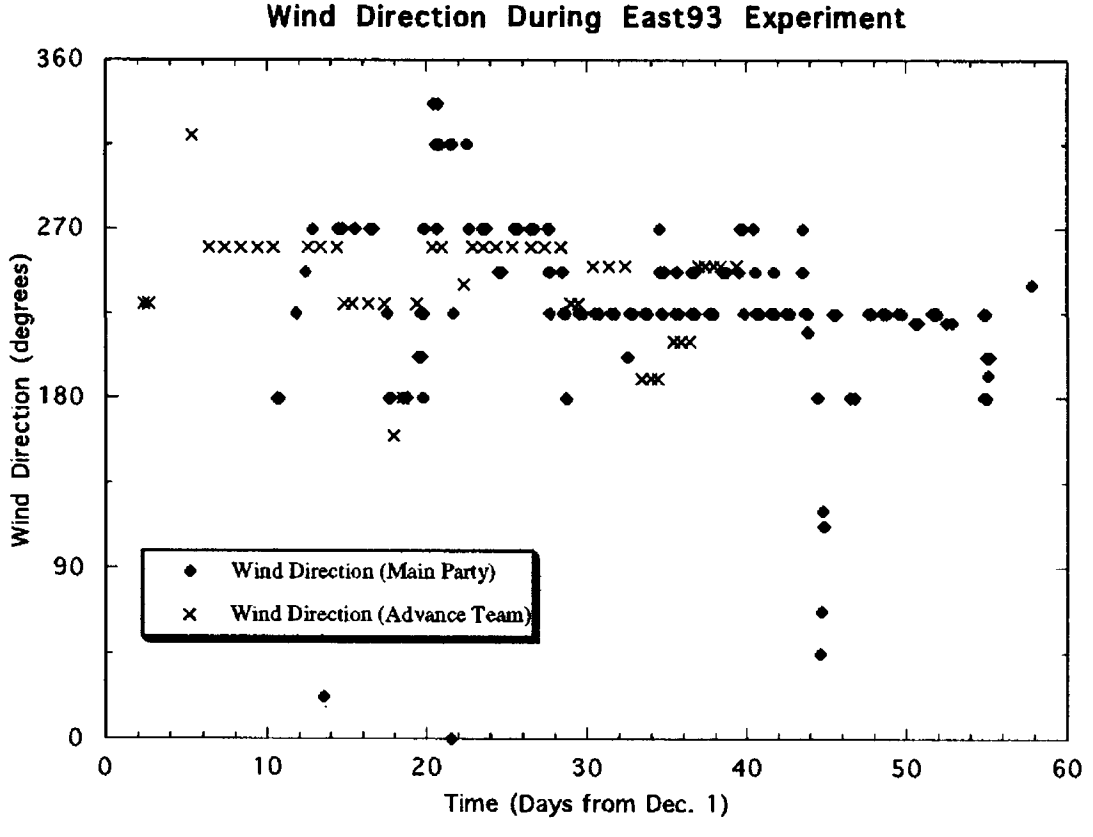


Figure 11. Wind speed, surface temperature, and wind direction plotted as a function of time for the main party and the advance party. Upper left plot shows location of both parties along the traverse line as a function of time.

technician in the back of the Hagglund. At each shot location the shooter connected a detonator to the primacord (laid by the leading group), and the shot wire to the detonator. The Hagglund driver (R. Hackney / S. Bannister) connected the end of a 180 m long electric wire trailing behind the shooter into the Hagglund, turned the flag nearest to him upside down (to reduce wind noise during recording), idled the engine for 2 minutes, and then shut the engine off. The driver was also responsible for alerting the leading and camp groups of an impeding shot and giving the 'all clear' signal. The recording technician (D. King / R. Katzman) in the back of the Hagglund carried out the seismic recording and the quality control. The center (shooting) group followed 2-3 km behind the leading group by starting work 1-1.5 hours after the leading group. The distance between the groups was maintained to minimize the effect of Tucker engine noise on the seismic records.

3. This camp group included a mechanic (M. Collins) and a cook (Y. Makovsky), who also took care of the radar measurements. The camp group was also responsible for setting up magnetic and barometric base stations, the data from which was later compared to the measurements from the roving magnetometer station. Finally, the camp skidoo driver (Y. Makovsky) was responsible for turning the flags back to right side up. The camp group started moving about 2-3 hours before the end of the shooting day. Earlier movement would interfer with the shooting. radar data were recorded continuously during this movement.

The base camp had the following equipment: (i) a Tucker Snocat towing the camp (an Anare sled with a living module (Wannagan), and a 1-ton sled with 6 fuel drums, Herman Nelson, 2 generators, tents, and miscellaneous camp equipment), and (ii) an Alpine II skidoo towing the radar equipment (radar antennae and Nansen and banana sleds on which separate receiving and transmitting equipment were emplaced).

ENVIRONMENTAL CONDITIONS

The elevation above mean sea level was 2395 m at km 0 (10 km west of McMurdo Dome drill site), decreasing to 2190 m at km 37.8 and increasing gradually to 2470 m at km 312.6 with undulations of up 20 m on a 10 km scale (Fig. 4 and Appendix 1).

The snow condition varied from soft to steel-hard, with rapid changes in space and time (Appendix 4). The snow was often hard enough to support human steps and skidoo tracks without breaking through. The majority of the terrain was smooth enough to minimize delays in traveling. Some rough stretches with sastrugi up to 1.5 m were encountered. These stretches obviously slowed our progress. Rough stretches were often seen to correspond with lows in the topography (particularly noticeable from 123.6 - 126.3 km). This effect could be accounted for by the fact that such lows would channel cold air, resulting in regions of higher wind speed and greater potential to form sastrugi. In general, the smoothest terrain was encountered at the start of the line and also at the very end of the line. The sastrugi were consistently in a SW - NE orientation parallel to the wind direction and were prominent between km 122 and 265 (Appendix 4).

Temperatures ranged between -15° C and -33° C, with the warmest period between December 17 and January 15. The maximum temperature registered was -10° C (Appendix 5 and Fig. 11)

Generally, the sky was clear with persistent katabatic wind from the west to southwest at 10-40 km/h (6-22 knots), and snow blowing at wind speeds above 30 km/h (17 knots). The daily maximum wind occurred around 6 p.m. local time. Wind speed may have been positively correlated with good weather in McMurdo sound and was highest between December 15 and January 19. Occasionally, weather fronts from the south passed through,

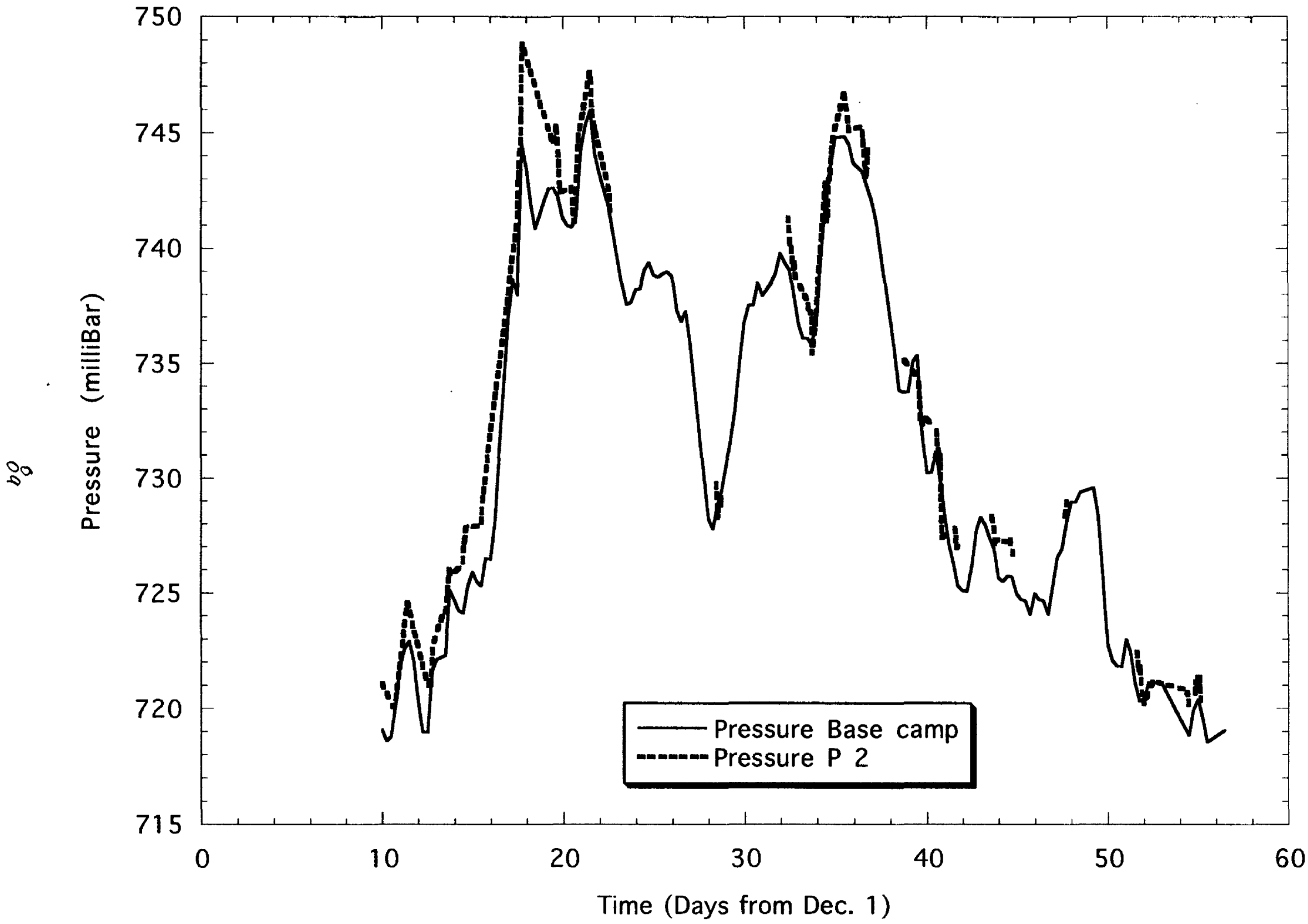


Figure 12. Comparison between barometric pressure (in milliBar) as a function of time measured by the roving station (P2) vs. that measured by the temporary base camp. Base camp measurements were carried out every 5 minutes and were averaged by taking the median over a 6 hour period.

with warmer temperatures, little wind, snow fall, and whiteout conditions. Comparison between the survey group and the main group up to 150 km apart along the line indicated uniform weather conditions along the line (Appendix 6 and Fig. 11).

Figure 11 shows the wind speed, surface temperature and wind direction plotted as a function of time for both the advance party and the leading and camp groups of the main party. Fig. 12 shows the barometric pressure during the experiment measured by the leading group at roving stations every 2.1 km along the traverse and by the base camp at daily camp sites. Three separate measurements by two different barometers were carried out at each roving station. The average values of the three measurements for each instrument (P1 and P2) are given in Appedix 5. Figure A5.1 compares the barometric pressure measured by instrument P1 to the measured elevation along the traverse. Note the pressure drop around km 150 (Day 39) which was unrelated to temperature or elevation. Base camp measurements of pressure and temperature were carried out automatically every 5 minutes. Their median values over 6 hours intervals are given in Appendix 7.

VEHICLES AND MAINTENANCE

Appendix 8 details the report from the NZAP mechanic, Mike Collins, on the mechanical aspects of the traverse.

LESSONS AND RECOMMENDATIONS

Seismic Work

1. Detonating cord as a seismic source: Detonating cord (also known as Primacord) appears to be the only source that could be prepared and laid at a rate comparable to the rate of shooting. From experience in the SERIS experiment (ten Brink et al., 1993), 2-3 drilling crews of 2 each and 2 additional people for shot preparation are needed to achieve a similar acquisition rate with down hole shots. In addition, comparisons between downhole and surface primacord shots carried out during the 1990/91 SERIS experiment indicated that the source signature from the surface primacord shot was superior to that from a downhole source (Melhuish et al.,1993).

The seismic signal returned from subglacial layers was, however, disappointingly low relative to ambient noise and "ground roll". Bottom could be clearly imaged in the first 75 km of the seismic work where the ice is relatively thin (700-1700 m), but could seldom be imaged at depths of 2000-3000 m. It appears that the high near-surface velocity gradient in the ice generates strong turning waves and surface waves at the expense of more deeply-penetrating energy. However, this must only be a partial explanation in light of our positive test results with primacord as a seismic source during the SERIS experiment where the near-surface velocity gradient is equally high. High firn noise following shooting, which was a frequent complaint during the IGY experiments (C. Bentley and J. Behrendt, pers. comm., 1993), did not pose a problem in the frequencies of interest (< 80 Hz).

2. Acquisition rate: The leading group laid 10-12 shots an hour, while also carrying out gravity, magnetic, and weather measurements. The center (shooting) group fired up to 10 shots an hour. Generally, 60-80 shots were fired in a full working day with a maximum of 108 shots in one day. These acquisition rates were anticipated on the basis of our experience at the SERIS experiment (ten Brink et al., 1993) and proved reasonable. There were no major problems related to the seismic work in the field.

3. Seismic acquisition at high wind speeds: Shooting could not be carried out at wind speeds in excess of 30-35 km/h for the following reasons. (a) Wind noise on the streamer

became high. (b) Blowing snow at these wind speeds could potentially shorten the electric circuit and cause premature detonation. (c) Detonating required tying electric wires with exposed fingers, and fingers became unbearably cold due to wind chill (temperatures with wind chill were -50° C to -70° C), (d) The plastic cover of the shooting wires became brittle exposing the copper wires and causing misfires. (e) Regular electric tape used for attaching the detonator and for fixing broken shooting wire, was non-adhesive at these temperatures.

4. Snow plow: The snow plow performed very well. The use of the plow over surface-laid primacord had several advantages: (a) It saved one person (2 people were originally allocated, one at each end of the primacord). (b) A buried primacord produced negligible air wave energy. (c) The explosion of buried primacord left much less visible residue (i.e. pollution) than either a surface-laid primacord, or a downhole explosion (as seen during our 1990/91 SERIS experiment). In fact, the explosion of buried primacord was so clean that it was difficult to spot the exact location of the explosion after 24 hours. Plowing could be performed in almost any weather condition.

5. Snow streamer: The use of the Norwegian snow streamer to receive the seismic data (instead of conventional geophones) considerably reduced the logistical effort and manpower in planting geophones and rolling cables.

6. Modern recording system: The use of the Geometrics Strataview recording system (leased at the last moment) instead of the DFS-V system, proved crucial. Its flexibility and ease of use meant that work could continue even after the departure of the electronic technician on January 12. In addition, its battery power consumption was 1/3 that of the DFS-V and its processing and noise display capabilities allowed us to make operational judgments based on the seismic results.

Effect On Humans

1. Length of work day: The daily shift of camp and the low temperatures meant that working days became very long (16-24 hours). Warming up the vehicles in the mornings and preparation for work took 3 hours from wake-up time. Likewise, setting up camp in the evenings, dinner, downloading and saving data, etc., took additional 3 hours. In addition, shooting started 1-1.5 hours after the leading group started plowing and stopped 1 hour before the base camp caught up with the leading and shooting team. In the beginning of the experiment, the leading group would lay an extra 2 km for the shooting group to detonate at the start of the next day, thus eliminating 1-1.5 hours waiting period for the shooting team. This arrangement was abandoned after several storms completely buried the exposed ends of the primacord. Subsequently, all laid primacord was detonated the same day. No better solution was found for the wasted time connected with the base camp. The camp group could not be sent ahead of the other groups because we could not anticipate our daily progress.

2. Living quarters: It is useful for field parties larger than 4 people to have a meeting room for planning and dividing the daily work. Our living quarters served this purpose in addition to serving as a central kitchen and galley. The Wannagan used in this traverse for living quarters was, however, too heavy, rigid, and cumbersome for a traverse, and could only be safely loaded and unloaded off the sled with a forklift. It is recommended that a light-weight structure with a collapsible roof (like that found in some RVs) be designed. The structure should be permanently attached to skis and should fit into a C-130. Alternatively, the field party should be divided to several independently-moving teams of 2-4 people sleeping and cooking in tents. This second option would make the management of the project difficult, and would result in redundancy of field equipment.

3. Other lessons: Apart from the advance survey team, the only two people working outside and unprotected from the wind were the person behind the plow and the shooter.

Oxygen deprivation and carbon monoxide poisoning did not occur during the experiment.

Logistics

1. Caches: A major problem of any traverse is planning the caches. Caches were placed in advance of the experiment by a Twin-Otter aircraft with quantities based upon a certain rate of daily progress. However, when these rates were not met due to bad weather, technical, or mechanical problems, it was necessary to shuttle tens of km (24-60 hours round-trip) to either bring more fuel and food or to clear unused caches. The only alternative is to have Twin-Otter support on demand. However, this alternative can also result in delays if the twin-otter cannot fly due to weather or mechanical problems. In general, cache planning for EAST93 was good, except for the first cache (at the beginning of the line) where we spent longer than anticipated assembling and preparing the equipment for work.

2. Explosive airdrop: Airdrop of explosives by RNZAF C-130 flying from Christchurch en-route to McMurdo was highly successful. Explosive palettes landed within 50 m of the caches. Explosives were not damaged and did not pose any risk for later usage. Removal of parachutes and palettes by Twin-Otter immediately after air drop was helpful.

3. Other lessons: Air support by both VXE-6 C-130 and the Twin-Otter aircrafts and coordination by USAP were timely, efficient, and professional.

Communication via MacOps was excellent and response to logistical requests over the radio was timely.

Mechanical Aspects

1. Generators and batteries: NZAP supplied diesel generators (2.5 to 5 kW) that ran on JP-8. Three of the 4 generators failed for a variety of reasons. In addition, their output in the high altitude of the plateau was 40% of that expected at sea level. All generators quit working or were shut down to avoid damage during storms involving blowing snow. It is recommended that only Mogas generators be used and that they should be housed in a portable protective shack. Alternative energy sources should be explored, because the plateau is generally sunny and has steady winds. Mixing 230V and 110V power supplies (due to the joint US/NZ nature of the event) was inconvenient. A thought should be given to connecting the seismic recording system directly to the Hagglund battery to save on battery charging, because the seismic recorder is the largest consumer of battery power.

2. Starting vehicle engines: Starting the Tucker vehicles in the cold temperatures and winds prevailing on the plateau was a lengthy and an energy-consuming process. This was not the case with the Hagglund whose engine is completely enclosed. The construction of a transparent (Plexiglas) shelter to protect and passively warm the Tucker engine is recommended. Alternatively, a chemically-based heater (akin to hand warmers) should be supplied to be put on the engine block overnight.

3. Fuel consumption: Fuel consumption for all vehicles was on average 1.5 times greater than at sea level (for exact numbers see Appendix 8).

4. Sleds: The Maudheim and 1-Ton sleds were ideally suited for the traverse. Their size and their carrying weight are small enough to handle crevasse and sastrugi areas. They can be lifted and dragged by several people. Most important, they are low enough to the ground that fuel drums and other heavy loads can be dragged onto them. Their major disadvantage is that their frames are not strong enough to hook several of them in a row. The lack of

strong frames limits the possibility of having a bulldozer tow a train of several Maudheims. The larger Anare sled was strong enough to tow other sleds behind it but was too high off the ground to load fuel drums, a broken skidoo, etc.

Rate of progress

1. The daily speed of traverse without carrying out seismic work was only 2-3 times faster than a traverse while carrying out seismic work. All large vehicles traveled only in first gear because of the surface conditions and the load they were pulling. Sastrugi were encountered along 60% of the traverse, some of them up to 1.5m high. The sastrugi did not cause any particular problems except to slow vehicle movement (1-2 km/h instead of 3-4 km/h for the large vehicles). We opted not to move in areas of sastrugi when ground definition was poor, to avoid damage to vehicles.

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APPENDIX 1: Locations of Surveyed Positions, Shot Numbers, and Magnetic Readings

by John West and Rebecca Drury

Distance (m)	Flag Loc. Latitude (°S)	Flag Loc. Longitude (°E)	Elevation (m)	Shot Number	Julian Day	Total Mag. Field (nT)
Alpha	77.7784	158.3419	2395.60			
0	77.7838	158.3116	2394.78			0.0
150	77.7841	158.3054	2394.64	100	**345**	63555.8
300	77.7844	158.2992	2394.38	101	345	63562.5
450	77.7846	158.2930	2394.15	102	345	63570.6
600	77.7849	158.2868	2394.15	103	345	63580.0
750	77.7852	158.2805	2393.99	104	**346**	63575.3
900	77.7855	158.2743	2393.86	105	346	63571.5
1050	77.7857	158.2681	2393.74	106	346	63563.9
1200	77.7860	158.2619	2393.74	107	346	63560.0
1350	77.7863	158.2557	2393.64	108	346	63556.2
1500	77.7865	158.2495	2393.69	109	346	63539.2
1650	77.7868	158.2432	2393.68	110	346	63521.3
1800	77.7871	158.2370	2393.72	111	346	63512.0
1950	77.7873	158.2308	2393.66	112	346	63511.0
2100	77.7876	158.2245	2393.39	113	346	63515.5
2250	77.7879	158.2183	2393.17	114	346	63518.9
2400	77.7882	158.2121	2392.69	115	346	63523.4
2550	77.7884	158.2059	2391.93	116	346	63544.6
2700	77.7887	158.1997	2391.21	117	346	63556.5
2850	77.7890	158.1935	2390.46	118	346	63567.1
3000	77.7892	158.1872	2389.71	119	346	63585.9
3150	77.7895	158.1810	2388.77	120	346	63592.6
3300	77.7898	158.1748	2387.73	121	346	63613.9
3450	77.7900	158.1686	2385.92	122	346	63646.3
3600	77.7903	158.1623	2384.37	123	346	63681.0
3750	77.7906	158.1561	2382.89	124	346	63706.5
3900	77.7909	158.1499	2381.43	125	346	63731.2
4050	77.7911	158.1437	2379.99	126	346	63750.1
4200	77.7914	158.1375	2378.46	127	346	63753.0
4350	77.7917	158.1312	2376.73	128	346	63755.4
4500	77.7919	158.1250	2375.18	129	346	63754.9
4650	77.7922	158.1188	2373.60	130	346	63745.0
4800	77.7925	158.1126	2372.34	131	346	63741.4
4950	77.7927	158.1064	2371.36	132	346	63736.5
5100	77.7930	158.1001	2370.61	133	346	63737.2
5250	77.7933	158.0939	2369.89	134	346	63742.2
5400	77.7935	158.0877	2369.59	135	346	63731.4
5550	77.7938	158.0815	2369.36	136	346	63733.0
5700	77.7941	158.0752	2368.96	137	346	63732.9
5850	77.7944	158.0690	2368.80	138	346	63731.8
6000	77.7946	158.0628	2368.68	139	346	63734.4
6150	77.7949	158.0566	2368.40	140	346	63736.7
6300	77.7952	158.0504	2368.29	141	346	63740.5
6450	77.7955	158.0441	2368.10	142	346	63742.0
6600	77.7957	158.0379	2367.87	143	346	63750.8
6750	77.7960	158.0317	2367.49	144	346	63757.1
6900	77.7963	158.0255	2366.95	145	346	63770.6
7050	77.7965	158.0192	2366.62	146	346	63778.0
7200	77.7968	158.0130	2365.94	147	346	63789.3
7350	77.7971	158.0068	2365.45	148	346	63793.5
7500	77.7973	158.0005	2364.70	149	346	63794.0

Distance (m)	Flag Loc. Latitude (°S)	Flag Loc. Longitude (°E)	Elevation (m)	Shot Number	Julian Day	Total Mag. Field (nT)
7650	77.7976	157.9943	2363.96	150	346	63793.8
7800	77.7979	157.9881	2363.33	151	**347**	63753.1
8100	77.7984	157.9756	2362.26	153	347	0.0
8250	77.7986	157.9694	2361.79	154	347	63744.0
8400	77.7989	157.9632	2361.34	155	347	0.0
8550	77.7992	157.9569	2360.87	156	347	0.0
8700	77.7994	157.9507	2360.39	157	347	63726.9
8850	77.7997	157.9444	2359.96	158	347	0.0
9000	77.7999	157.9382	2359.30	159	347	0.0
9150	77.8002	157.9320	2358.79	160	347	63706.9
9300	77.8005	157.9257	2358.05	161	347	0.0
9450	77.8007	157.9195	2357.30	162	347	0.0
9600	77.8010	157.9132	2355.96	163	347	63713.5
9750	77.8012	157.9070	2354.78	164	347	0.0
9900	77.8015	157.9008	2353.37	165	347	0.0
10050	77.8018	157.8945	2351.76	166	347	63680.7
10200	77.8020	157.8883	2349.69	167	347	0.0
10350	77.8023	157.8821	2347.30	168	347	0.0
10500	77.8026	157.8758	2344.39	169	347	63645.3
10650	77.8028	157.8696	2341.89	170	347	0.0
10800	77.8031	157.8634	2339.63	171	347	0.0
10950	77.8033	157.8571	2337.77	172	347	63621.8
11100	77.8036	157.8509	2336.25	173	347	0.0
11250	77.8039	157.8447	2335.17	174	347	0.0
11400	77.8041	157.8384	2334.27	175	347	63579.1
11550	77.8044	157.8322	2333.74	176	347	0.0
11700	77.8046	157.8259	2333.22	177	347	0.0
11850	77.8049	157.8197	2332.89	178	347	63557.2
12000	77.8052	157.8135	2332.65	179	347	0.0
12150	77.8054	157.8072	2332.67	180	347	0.0
12300	77.8057	157.8010	2332.56	181	347	63550.9
12450	77.8059	157.7948	2332.50	182	347	0.0
12600	77.8062	157.7885	2332.40	183	347	63550.2
12750	77.8065	157.7823	2332.32	184	347	63554.2
12900	77.8067	157.7760	2332.40	185	347	0.0
13050	77.8070	157.7698	2332.30	186	347	0.0
13200	77.8073	157.7636	2332.29	187	347	63550.3
13350	77.8075	157.7573	2332.29	188	347	0.0
13500	77.8078	157.7511	2332.30	189	347	0.0
13650	77.8080	157.7448	2332.25	190	347	63548.4
13800	77.8083	157.7386	2332.30	191	347	0.0
13950	77.8086	157.7324	2332.19	192	347	0.0
14100	77.8088	157.7261	2332.40	193	347	63551.7
14250	77.8091	157.7199	2332.43	194	347	0.0
14400	77.8093	157.7137	2332.56	195	347	0.0
14550	77.8096	157.7074	2332.71	196	347	63550.5
14700	77.8099	157.7012	2332.96	197	347	63549.4
14850	77.8101	157.6949	2333.17	198	347	0.0
15000	77.8104	157.6887	2333.47	199	347	63557.4
15150	77.8106	157.6824	2333.55	200	347	0.0
15300	77.8109	157.6762	2333.71	201	347	0.0
15450	77.8112	157.6700	2333.88	202	347	63579.0

Distance (m)	Flag Loc. Latitude (°S)	Flag Loc. Longitude (°E)	Elevation (m)	Shot Number	Julian Day	Total Mag. Field (nT)
15600	77.8114	157.6637	2333.87	203	347	0.0
15750	77.8117	157.6575	2333.82	204	347	63591.8
15900	77.8120	157.6512	2333.78	205	347	63608.2
16050	77.8122	157.6450	2333.44	206	347	0.0
16200	77.8125	157.6388	2333.11	207	347	0.0
16350	77.8127	157.6325	2332.61	208	347	63659.5
16500	77.8130	157.6263	2332.12	209	347	0.0
16650	77.8133	157.6200	2331.48	210	347	0.0
16800	77.8135	157.6138	2330.72	211	347	63704.6
16950	77.8138	157.6076	2329.82	212	347	0.0
17100	77.8140	157.6013	2329.00	213	347	0.0
17250	77.8143	157.5951	2328.10	214	347	63733.5
17400	77.8146	157.5889	2327.21	215	347	0.0
17550	77.8148	157.5826	2326.56	216	347	0.0
17700	77.8151	157.5764	2325.75	217	347	63759.3
17850	77.8153	157.5701	2324.83	218	347	0.0
18000	77.8156	157.5639	2324.38	219	347	63775.1
18150	77.8159	157.5576	2323.62	220	**348**	63748.9
18300	77.8161	157.5514	2322.94	221	348	0.0
18450	77.8164	157.5451	2321.98	222	348	0.0
18600	77.8167	157.5389	2321.33	223	348	63793.8
18750	77.8169	157.5327	2320.70	224	348	0.0
18900	77.8172	157.5264	2320.29	225	348	0.0
19050	77.8175	157.5202	2319.78	226	348	63787.9
19200	77.8177	157.5139	2319.53	227	348	0.0
19350	77.8180	157.5077	2319.35	228	348	0.0
19500	77.8182	157.5014	2319.35	229	348	63777.8
19650	77.8185	157.4952	2319.31	230	348	0.0
19800	77.8188	157.4890	2319.40	231	348	0.0
19950	77.8190	157.4827	2319.35	232	348	63739.7
20100	77.8193	157.4765	2319.24	233	348	63731.8
20250	77.8196	157.4702	2318.83	234	348	0.0
20400	77.8198	157.4640	2318.30	235	348	63718.8
20550	77.8201	157.4577	2317.36	236	348	0.0
20700	77.8204	157.4515	2316.17	237	348	0.0
20850	77.8206	157.4453	2314.90	238	348	63739.6
21000	77.8209	157.4390	2313.41	239	348	0.0
21150	77.8211	157.4328	2312.45	240	348	0.0
21300	77.8214	157.4265	2311.49	241	348	63754.0
21450	77.8217	157.4203	2310.70	242	348	0.0
21600	77.8219	157.4140	2310.24	243	348	0.0
21750	77.8222	157.4078	2309.80	244	348	63758.2
21900	77.8224	157.4016	2309.65	245	348	0.0
22050	77.8227	157.3953	2309.37	246	348	0.0
22200	77.8230	157.3890	2309.20	247	348	63735.4
22350	77.8232	157.3828	2308.80	248	348	0.0
22500	77.8235	157.3765	2308.60	249	348	0.0
22650	77.8237	157.3703	2308.43	250	348	63705.1
22800	77.8240	157.3640	2308.38	251	348	0.0
22950	77.8242	157.3578	2308.33	252	348	0.0
23100	77.8245	157.3515	2308.36	253	348	63654.2
23250	77.8247	157.3452	2308.45	254	348	0.0

Distance (m)	Flag Loc. Latitude (°S)	Flag Loc. Longitude (°E)	Elevation (m)	Shot Number	Julian Day	Total Mag. Field (nT)
23400	77.8250	157.3390	2308.59	255	348	0.0
23550	77.8252	157.3327	2308.45	256	**349**	63646.5
23700	77.8255	157.3265	2308.44	257	349	0.0
23850	77.8257	157.3202	2308.14	258	349	0.0
24000	77.8260	157.3139	2307.47	259	349	63635.5
24150	77.8262	157.3077	2306.49	260	349	0.0
24300	77.8265	157.3014	2305.35	261	349	0.0
24450	77.8267	157.2952	2304.02	262	349	63639.9
24600	77.8270	157.2889	2302.59	263	349	0.0
24750	77.8272	157.2827	2301.02	264	349	0.0
24900	77.8275	157.2764	2299.63	265	349	63686.4
25050	77.8277	157.2701	2298.55	266	349	0.0
25200	77.8280	157.2639	2297.69	267	349	0.0
25350	77.8282	157.2576	2297.02	268	349	63744.8
25500	77.8285	157.2514	2296.44	269	349	0.0
25650	77.8287	157.2451	2296.03	270	349	0.0
25800	77.8289	157.2389	2295.55	271	349	63780.4
25950	77.8292	157.2326	2294.74	272	349	0.0
26100	77.8295	157.2263	2293.94	273	349	63803.7
26250	77.8297	157.2200	2292.78	274	349	63824.3
26400	77.8300	157.2138	2291.21	275	349	0.0
26550	77.8302	157.2075	2289.43	276	349	0.0
26700	77.8305	157.2013	2287.60	277	**351**	63742.2
26850	77.8307	157.1950	2285.63	278	351	0.0
27000	77.8310	157.1888	2284.11	279	351	0.0
27150	77.8312	157.1825	2282.89	280	351	63761.8
27300	77.8315	157.1762	2282.08	281	351	0.0
27450	77.8317	157.1700	2281.41	282	351	0.0
27600	77.8319	157.1637	2280.99	283	351	63716.2
27750	77.8322	157.1575	2280.33	284	351	0.0
27900	77.8324	157.1512	2279.89	285	351	0.0
28050	77.8327	157.1449	2279.31	286	351	63714.0
28200	77.8330	157.1387	2278.61	287	351	63657.1
28350	77.8332	157.1324	2277.88	288	351	0.0
28500	77.8335	157.1261	2277.20	289	351	63582.4
28650	77.8337	157.1199	2276.46	290	351	0.0
28800	77.8339	157.1136	2275.63	291	351	0.0
28950	77.8342	157.1073	2274.65	292	351	63550.7
29100	77.8344	157.1011	2273.58	293	351	0.0
29250	77.8347	157.0948	2272.34	294	351	0.0
29400	77.8349	157.0886	2270.92	295	351	63528.6
29550	77.8352	157.0823	2269.49	296	351	0.0
29700	77.8354	157.0760	2268.27	297	351	63512.4
29850	77.8357	157.0698	2266.86	298	351	63522.0
30000	77.8359	157.0635	2265.57	299	351	0.0
30150	77.8362	157.0572	2264.28	300	351	0.0
30300	77.8364	157.0510	2263.06	301	351	63508.9
30450	77.8367	157.0447	2261.95	302	351	0.0
30600	77.8369	157.0385	2260.83	303	351	0.0
30750	77.8372	157.0322	2259.75	304	351	63534.7
30900	77.8374	157.0259	2258.86	305	351	0.0
31050	77.8377	157.0197	2257.87	306	351	0.0

Distance (m)	Flag Loc. Latitude (°S)	Flag Loc. Longitude (°E)	Elevation (m)	Shot Number	Julian Day	Total Mag. Field (nT)
31200	77.8379	157.0134	2257.06	307	351	63540.4
31350	77.8382	157.0071	2256.05	308	351	0.0
31500	77.8384	157.0009	2255.35	309	351	0.0
31650	77.8387	156.9946	2254.54	310	351	63548.4
31800	77.8389	156.9883	2253.78	311	351	63555.7
31950	77.8392	156.9820	2252.89	312	351	0.0
32100	77.8394	156.9758	2252.11	313	351	63559.1
32250	77.8397	156.9695	2251.28	314	351	0.0
32400	77.8399	156.9633	2250.37	315	351	0.0
32550	77.8402	156.9570	2249.50	316	351	63567.2
32700	77.8404	156.9507	2248.72	317	351	0.0
32850	77.8407	156.9445	2247.87	318	351	0.0
33000	77.8409	156.9382	2247.13	319	351	63566.5
33150	77.8412	156.9319	2246.30	320	351	0.0
33300	77.8414	156.9257	2245.52	321	351	0.0
33450	77.8417	156.9194	2244.51	322	351	63592.5
33600	77.8419	156.9131	2243.30	323	351	0.0
33750	77.8422	156.9069	2242.12	324	351	0.0
33900	77.8424	156.9006	2241.04	325	351	63624.8
34050	77.8427	156.8943	2239.89	326	351	0.0
34200	77.8429	156.8880	2238.59	327	351	0.0
34350	77.8432	156.8818	2237.24	328	351	63623.2
34500	77.8434	156.8755	2235.79	329	351	0.0
34650	77.8437	156.8692	2233.90	330	351	0.0
34800	77.8439	156.8630	2231.40	331	351	63603.1
34950	77.8442	156.8567	2228.50	332	351	0.0
35100	77.8444	156.8504	2225.12	333	351	0.0
35250	77.8447	156.8442	2221.12	334	351	63574.0
35400	77.8449	156.8379	2216.93	335	351	0.0
35550	77.8452	156.8316	2212.74	336	351	0.0
35700	77.8454	156.8254	2208.75	337	351	63571.7
35850	77.8457	156.8191	2205.04	338	351	0.0
36000	77.8459	156.8129	2202.04	339	351	0.0
36150	77.8462	156.8066	2199.56	340	351	63577.5
36300	77.8464	156.8003	2197.49	341	351	0.0
36450	77.8467	156.7941	2195.81	342	351	0.0
36600	77.8469	156.7878	2194.37	343	351	63566.7
36750	77.8472	156.7815	2193.36	344	351	0.0
36900	77.8474	156.7752	2192.76	345	351	63559.7
37050	77.8477	156.7690	2192.09	346	351	63562.7
37200	77.8479	156.7627	2191.63	347	351	0.0
37350	77.8482	156.7564	2191.35	348	351	0.0
37500	77.8484	156.7502	2191.07	349	**353**	63543.7
37650	77.8487	156.7439	2190.83	350	353	0.0
37800	77.8489	156.7376	2190.65	351	353	0.0
37950	77.8492	156.7314	2190.60	352	353	0.0
38100	77.8494	156.7251	2190.60	353	353	0.0
38250	77.8497	156.7188	2190.67	354	353	0.0
38400	77.8499	156.7125	2190.78	355	353	0.0
38550	77.8502	156.7063	2190.84	356	353	0.0
38700	77.8504	156.7000	2190.91	357	353	0.0
38850	77.8507	156.6937	2191.06	358	353	0.0

Distance (m)	Flag Loc. Latitude (°S)	Flag Loc. Longitude (°E)	Elevation (m)	Shot Number	Julian Day	Total Mag. Field (nT)
39000	77.8509	156.6874	2191.36	359	353	0.0
39150	77.8512	156.6812	2191.52	360	353	0.0
39300	77.8514	156.6749	2191.78	361	353	0.0
39450	77.8516	156.6686	2191.97	362	353	0.0
39600	77.8519	156.6623	2192.45	363	353	0.0
39750	77.8521	156.6560	2192.76	364	353	0.0
39900	77.8523	156.6497	2193.16	365	353	0.0
40050	77.8526	156.6434	2193.47	366	353	0.0
40200	77.8528	156.6372	2193.94	367	353	0.0
40350	77.8530	156.6309	2194.21	368	353	0.0
40500	77.8533	156.6246	2194.75	369	353	0.0
40650	77.8535	156.6183	2195.05	370	353	0.0
40800	77.8537	156.6120	2195.45	371	353	0.0
40950	77.8540	156.6057	2195.92	372	353	0.0
41100	77.8542	156.5994	2196.16	373	353	0.0
41250	77.8544	156.5931	2196.67	374	353	0.0
41400	77.8547	156.5869	2197.33	375	353	0.0
41550	77.8549	156.5806	2197.91	376	353	0.0
41700	77.8551	156.5743	2198.67	377	353	0.0
41850	77.8554	156.5680	2199.36	378	353	0.0
42000	77.8556	156.5617	2200.20	379	353	0.0
42150	77.8559	156.5554	2201.02	380	353	0.0
42300	77.8561	156.5491	2201.85	381	353	0.0
42450	77.8563	156.5429	2202.64	382	353	0.0
42600	77.8566	156.5366	2203.49	383	353	0.0
42750	77.8568	156.5303	2204.46	384	353	0.0
42900	77.8570	156.5240	2205.43	385	353	0.0
43050	77.8573	156.5177	2206.28	386	353	0.0
43200	77.8575	156.5114	2207.15	387	353	0.0
43350	77.8577	156.5051	2207.80	388	353	0.0
43500	77.8580	156.4989	2208.67	389	353	0.0
43650	77.8582	156.4926	2209.61	390	353	0.0
43800	77.8585	156.4863	2210.35	391	353	0.0
43950	77.8587	156.4800	2211.00	392	353	0.0
44100	77.8589	156.4737	2211.77	393	353	0.0
44250	77.8592	156.4674	2212.23	394	353	0.0
44400	77.8594	156.4612	2212.75	395	353	0.0
44550	77.8596	156.4549	2213.43	396	353	0.0
44700	77.8599	156.4486	2213.87	397	353	0.0
44850	77.8601	156.4423	2214.30	398	353	0.0
45000	77.8604	156.4360	2214.68	399	353	0.0
45150	77.8606	156.4297	2215.03	400	353	0.0
45300	77.8608	156.4234	2215.35	401	353	0.0
45450	77.8611	156.4171	2215.85	402	353	0.0
45600	77.8613	156.4109	2216.15	403	353	0.0
45750	77.8615	156.4046	2216.36	404	353	0.0
45900	77.8618	156.3983	2216.70	405	353	0.0
46050	77.8620	156.3920	2216.94	406	353	0.0
46200	77.8622	156.3857	2217.25	407	353	0.0
46350	77.8625	156.3794	2217.51	408	353	0.0
46500	77.8627	156.3731	2217.82	409	353	0.0
46650	77.8630	156.3668	2218.10	410	353	0.0

Distance (m)	Flag Loc. Latitude (°S)	Flag Loc. Longitude (°E)	Elevation (m)	Shot Number	Julian Day	Total Mag. Field (nT)
46800	77.8632	156.3605	2218.32	411	353	0.0
46950	77.8634	156.3543	2218.58	412	**354**	63535.1
47100	77.8637	156.3480	2218.76	413	354	0.0
47250	77.8639	156.3417	2219.20	414	354	0.0
47400	77.8641	156.3354	2219.53	415	354	63497.3
47550	77.8644	156.3291	2220.11	416	354	0.0
47700	77.8646	156.3228	2220.62	417	354	0.0
47850	77.8649	156.3165	2221.09	418	354	63505.2
48000	77.8651	156.3103	2221.92	419	354	0.0
48150	77.8653	156.3040	2222.50	420	354	0.0
48300	77.8656	156.2977	2223.11	421	354	63491.5
48450	77.8658	156.2914	2223.73	422	354	0.0
48600	77.8660	156.2851	2224.37	423	354	0.0
48750	77.8663	156.2788	2224.88	424	354	63481.2
48900	77.8665	156.2725	2225.30	425	354	0.0
49050	77.8668	156.2662	2225.64	426	354	0.0
49200	77.8670	156.2599	2226.00	427	354	63476.7
49350	77.8672	156.2536	2226.16	428	354	0.0
49500	77.8675	156.2473	2226.23	429	354	0.0
49650	77.8677	156.2411	2226.49	430	354	63477.8
49800	77.8679	156.2348	2226.43	431	354	0.0
49950	77.8682	156.2285	2226.58	432	354	0.0
50100	77.8684	156.2222	2226.40	433	354	63475.0
50250	77.8686	156.2159	2226.38	434	354	0.0
50400	77.8689	156.2096	2226.32	435	354	0.0
50550	77.8691	156.2033	2226.04	436	354	63470.6
50700	77.8693	156.1970	2226.16	437	354	63474.9
50850	77.8696	156.1907	2225.96	438	354	0.0
51000	77.8698	156.1844	2225.81	439	354	63453.2
51150	77.8701	156.1781	2225.63	440	354	0.0
51300	77.8703	156.1718	2225.42	441	354	0.0
51450	77.8705	156.1655	2225.29	442	354	63451.5
51600	77.8708	156.1593	2224.94	443	354	0.0
51750	77.8710	156.1530	2224.86	444	354	0.0
51900	77.8712	156.1467	2224.63	445	354	63486.2
52050	77.8715	156.1404	2224.27	446	354	0.0
52200	77.8717	156.1341	2223.96	447	354	0.0
52350	77.8719	156.1278	2223.70	448	354	63487.5
52500	77.8722	156.1215	2223.17	449	354	0.0
52650	77.8724	156.1152	2222.85	450	354	0.0
52800	77.8727	156.1089	2222.82	451	354	63490.2
52950	77.8729	156.1026	2222.48	452	354	0.0
53100	77.8731	156.0963	2221.90	453	354	0.0
53250	77.8734	156.0900	2221.62	454	354	63512.3
53400	77.8736	156.0837	2221.15	455	354	0.0
53550	77.8738	156.0774	2220.69	456	354	0.0
53700	77.8741	156.0711	2220.11	457	354	63514.0
53850	77.8743	156.0648	2219.37	458	354	0.0
54000	77.8745	156.0585	2218.76	459	354	0.0
54150	77.8748	156.0522	2217.99	460	354	63530.1
54300	77.8750	156.0460	2216.99	461	354	0.0
54450	77.8752	156.0397	2216.02	462	354	0.0

Distance (m)	Flag Loc. Latitude (°S)	Flag Loc. Longitude (°E)	Elevation (m)	Shot Number	Julian Day	Total Mag. Field (nT)
54600	77.8755	156.0333	2215.42	463	354	63551.9
54750	77.8757	156.0271	2214.36	464	354	0.0
54900	77.8760	156.0208	2213.27	465	354	0.0
55050	77.8762	156.0145	2212.07	466	354	63616.5
55200	77.8764	156.0082	2211.02	467	354	0.0
55350	77.8767	156.0019	2209.85	468	354	0.0
55500	77.8769	155.9956	2208.77	469	354	63634.6
55650	77.8771	155.9893	2207.60	470	354	0.0
55800	77.8774	155.9830	2206.66	471	354	0.0
55950	77.8776	155.9767	2205.75	472	354	63649.5
56100	77.8778	155.9704	2204.77	473	354	0.0
56250	77.8781	155.9641	2203.89	474	354	0.0
56400	77.8783	155.9578	2203.31	475	354	63657.0
56550	77.8785	155.9515	2202.43	476	354	0.0
56700	77.8788	155.9452	2201.88	477	354	63647.2
56850	77.8790	155.9389	2201.22	478	354	63653.2
57000	77.8792	155.9326	2200.70	479	354	0.0
57150	77.8794	155.9263	2200.25	480	354	0.0
57300	77.8797	155.9200	2199.70	481	354	63658.7
57450	77.8799	155.9136	2199.39	482	354	0.0
57600	77.8801	155.9073	2199.00	483	354	0.0
57750	77.8803	155.9010	2198.66	484	354	63652.3
57900	77.8805	155.8947	2198.35	485	354	0.0
58050	77.8807	155.8884	2198.15	486	354	0.0
58200	77.8810	155.8821	2198.12	487	354	63650.3
58350	77.8812	155.8758	2197.86	488	354	0.0
58500	77.8814	155.8695	2197.86	489	354	0.0
58650	77.8816	155.8631	2197.72	490	354	63648.4
58800	77.8818	155.8568	2197.85	491	354	63654.3
58950	77.8821	155.8505	2197.87	492	354	0.0
59100	77.8823	155.8442	2197.92	493	354	63651.6
59250	77.8825	155.8379	2198.12	494	354	0.0
59400	77.8827	155.8316	2198.36	495	354	0.0
59550	77.8829	155.8252	2198.45	496	**355**	63651.0
59700	77.8831	155.8189	2198.84	497	355	0.0
59850	77.8834	155.8126	2199.27	498	355	0.0
60000	77.8836	155.8063	2199.49	499	355	63646.9
60150	77.8838	155.8000	2199.96	500	355	0.0
60300	77.8840	155.7937	2200.35	501	355	0.0
60450	77.8842	155.7874	2200.70	502	355	63638.9
60600	77.8844	155.7811	2201.09	503	355	0.0
60750	77.8847	155.7747	2201.32	504	355	0.0
60900	77.8849	155.7684	2201.99	505	355	63624.6
61050	77.8851	155.7621	2202.47	506	355	0.0
61200	77.8853	155.7558	2202.91	507	355	0.0
61350	77.8855	155.7495	2203.52	508	355	63617.8
61500	77.8858	155.7431	2203.92	509	355	0.0
61650	77.8860	155.7368	2204.69	510	355	0.0
61800	77.8862	155.7305	2205.35	511	355	63595.9
61950	77.8864	155.7242	2206.19	512	355	0.0
62100	77.8866	155.7179	2206.95	513	355	0.0
62250	77.8868	155.7116	2207.76	514	355	63600.5

Distance (m)	Flag Loc. Latitude (°S)	Flag Loc. Longitude (°E)	Elevation (m)	Shot Number	Julian Day	Total Mag. Field (nT)
62400	77.8871	155.7052	2208.77	515	355	0.0
62550	77.8873	155.6989	2209.70	516	355	0.0
62700	77.8875	155.6926	2210.47	517	355	63616.7
62850	77.8877	155.6863	2211.16	518	355	0.0
63000	77.8879	155.6800	2211.96	519	355	63606.3
63150	77.8881	155.6736	2212.53	520	355	63601.1
63300	77.8884	155.6673	2213.08	521	355	0.0
63450	77.8886	155.6610	2213.53	522	355	0.0
63600	77.8888	155.6547	2213.78	523	355	63596.6
63750	77.8890	155.6484	2214.00	524	355	0.0
63900	77.8892	155.6421	2214.06	525	355	0.0
64050	77.8894	155.6357	2214.04	526	355	63592.1
64200	77.8897	155.6294	2214.00	527	355	0.0
64350	77.8899	155.6231	2214.38	528	355	63597.5
64500	77.8901	155.6168	2214.39	529	355	63592.4
64650	77.8903	155.6105	2214.29	530	355	0.0
64800	77.8905	155.6042	2214.43	531	355	0.0
64950	77.8908	155.5978	2214.57	532	355	63582.9
65100	77.8910	155.5915	2214.85	533	355	0.0
65250	77.8912	155.5852	2215.14	534	355	0.0
65400	77.8914	155.5789	2215.41	535	355	63558.1
65550	77.8916	155.5726	2215.27	536	355	0.0
65700	77.8918	155.5663	2215.00	537	355	0.0
65850	77.8921	155.5599	2214.43	538	355	63529.1
66000	77.8923	155.5536	2213.36	539	355	0.0
66150	77.8925	155.5473	2212.42	540	355	0.0
66300	77.8927	155.5410	2211.29	541	355	63511.6
66450	77.8929	155.5347	2210.69	542	355	0.0
66600	77.8932	155.5283	2210.13	543	355	0.0
66750	77.8934	155.5220	2209.90	544	355	63509.5
66900	77.8936	155.5157	2210.01	545	355	0.0
67050	77.8938	155.5094	2210.53	546	355	0.0
67200	77.8940	155.5031	2211.36	547	355	63532.2
67350	77.8942	155.4967	2212.14	548	355	0.0
67500	77.8945	155.4904	2213.06	549	355	0.0
67650	77.8947	155.4841	2214.07	550	355	63540.6
67800	77.8949	155.4778	2215.05	551	355	0.0
67950	77.8951	155.4714	2216.21	552	355	63535.0
68100	77.8953	155.4651	2217.34	553	355	63534.5
68250	77.8956	155.4588	2218.79	554	355	0.0
68400	77.8958	155.4525	2220.01	555	355	0.0
68550	77.8960	155.4462	2221.57	556	355	63505.4
68700	77.8962	155.4398	2223.31	557	355	0.0
68850	77.8964	155.4335	2225.04	558	355	0.0
69000	77.8966	155.4272	2226.63	559	355	63493.6
69150	77.8969	155.4209	2228.36	560	355	0.0
69300	77.8971	155.4146	2229.89	561	355	0.0
69450	77.8973	155.4082	2231.66	562	**356**	63430.1
69600	77.8975	155.4019	2233.04	563	356	0.0
69750	77.8977	155.3956	2234.30	564	356	0.0
69900	77.8980	155.3893	2235.36	565	356	63312.5
70050	77.8982	155.3829	2236.43	566	356	0.0

Distance (m)	Flag Loc. Latitude (°S)	Flag Loc. Longitude (°E)	Elevation (m)	Shot Number	Julian Day	Total Mag. Field (nT)
70200	77.8984	155.3766	2237.26	567	356	0.0
70350	77.8986	155.3703	2237.78	568	356	63278.5
70500	77.8988	155.3640	2238.38	569	356	0.0
70650	77.8990	155.3577	2238.68	570	356	0.0
70800	77.8993	155.3513	2239.11	571	356	63285.3
70950	77.8995	155.3450	2239.30	572	356	0.0
71100	77.8997	155.3387	2239.73	573	356	0.0
71250	77.8999	155.3324	2239.89	574	356	63299.4
71400	77.9001	155.3260	2240.29	575	356	0.0
71550	77.9004	155.3197	2240.33	576	356	63307.3
71700	77.9006	155.3134	2240.42	577	356	63323.5
71850	77.9008	155.3071	2240.63	578	356	0.0
72000	77.9010	155.3007	2240.59	579	356	0.0
72150	77.9012	155.2944	2240.72	580	356	63332.0
72300	77.9014	155.2881	2240.44	581	356	0.0
72450	77.9016	155.2817	2240.46	582	356	0.0
72600	77.9018	155.2754	2240.26	583	356	63361.1
72750	77.9020	155.2690	2240.22	584	356	0.0
72900	77.9022	155.2627	2240.11	585	356	0.0
73050	77.9024	155.2564	2239.96	586	356	63387.0
73200	77.9026	155.2500	2239.33	587	356	0.0
73350	77.9028	155.2437	2239.02	588	356	0.0
73500	77.9030	155.2374	2238.88	589	356	63384.7
73650	77.9032	155.2310	2237.95	590	356	63375.3
73800	77.9034	155.2247	2237.64	591	356	0.0
73950	77.9036	155.2184	2237.30	592	356	63384.6
74100	77.9038	155.2120	2236.99	593	356	0.0
74250	77.9040	155.2057	2236.62	594	356	0.0
74400	77.9042	155.1993	2236.33	595	356	63413.6
74550	77.9044	155.1930	2235.98	596	356	0.0
74700	77.9046	155.1867	2235.71	597	356	0.0
74850	77.9048	155.1803	2235.14	0	**361**	63408.3
75000	77.9050	155.1740	2234.49	0	361	0.0
75150	77.9052	155.1677	2233.28	0	361	0.0
75300	77.9054	155.1613	2233.05	0	361	63428.0
75450	77.9056	155.1550	2232.44	0	361	0.0
75600	77.9058	155.1487	2231.99	0	361	0.0
75750	77.9060	155.1423	2231.70	0	361	63419.1
75900	77.9062	155.1360	2231.67	0	361	0.0
76050	77.9064	155.1296	2231.95	0	361	0.0
76200	77.9066	155.1233	2232.61	0	361	63413.1
76350	77.9068	155.1170	2233.32	0	361	0.0
76500	77.9070	155.1106	2234.17	0	361	0.0
76650	77.9072	155.1043	2235.11	0	361	63410.4
76800	77.9074	155.0979	2236.08	0	361	0.0
76950	77.9076	155.0916	2236.67	0	361	0.0
77100	77.9078	155.0853	2238.01	0	361	63413.7
77250	77.9080	155.0789	2239.11	0	361	0.0
77400	77.9082	155.0726	2240.11	0	361	0.0
77550	77.9084	155.0663	2241.35	0	361	63401.2
77700	77.9086	155.0599	2242.47	0	361	0.0
77850	77.9089	155.0535	2243.47	0	361	63388.7

Distance (m)	Flag Loc. Latitude (°S)	Flag Loc. Longitude (°E)	Elevation (m)	Shot Number	Julian Day	Total Mag. Field (nT)
78000	77.9091	155.0472	2244.18	0	361	0.0
78150	77.9093	155.0409	2244.78	0	361	0.0
78300	77.9095	155.0345	2244.88	0	361	63373.9
78450	77.9097	155.0282	2244.98	0	361	0.0
78600	77.9099	155.0219	2244.64	0	361	0.0
78750	77.9101	155.0155	2244.51	0	361	63389.2
78900	77.9103	155.0092	2244.06	0	361	0.0
79050	77.9105	155.0028	2243.94	0	361	0.0
79200	77.9107	154.9965	2244.23	0	361	63422.3
79350	77.9109	154.9902	2245.01	0	361	0.0
79500	77.9111	154.9838	2245.91	0	361	0.0
79650	77.9113	154.9775	2247.16	0	361	63456.7
79800	77.9115	154.9711	2248.37	0	361	0.0
79950	77.9117	154.9648	2250.04	0	361	63466.0
80100	77.9119	154.9584	2251.53	0	361	0.0
80250	77.9121	154.9521	2253.00	0	361	0.0
80400	77.9123	154.9458	2254.36	0	361	63470.3
80550	77.9125	154.9394	2255.43	0	361	0.0
80700	77.9127	154.9331	2256.52	0	361	0.0
80850	77.9129	154.9267	2257.29	0	361	63466.4
81000	77.9145	154.8760	2257.09	0	361	0.0
81150	77.9133	154.9140	2258.61	0	361	63463.5
81300	77.9135	154.9077	2258.87	0	361	0.0
81450	77.9137	154.9014	2258.75	0	361	0.0
81600	77.9139	154.8950	2258.61	0	361	63452.9
81750	77.9141	154.8887	2258.16	0	361	0.0
81900	77.9143	154.8823	2257.71	0	361	0.0
82200	77.9147	154.8697	2256.35	0	361	0.0
82350	77.9149	154.8633	2255.65	0	361	0.0
82500	77.9151	154.8570	2255.03	0	361	63443.6
82650	77.9153	154.8506	2254.27	0	361	0.0
82800	77.9155	154.8443	2253.53	0	361	0.0
82950	77.9157	154.8379	2252.91	0	361	63438.9
83100	77.9159	154.8316	2252.40	0	361	0.0
83250	77.9161	154.8253	2251.94	0	361	0.0
83400	77.9163	154.8189	2251.39	0	361	63431.6
83550	77.9165	154.8126	2250.98	0	361	0.0
83700	77.9167	154.8062	2250.64	0	361	0.0
83850	77.9169	154.7999	2250.58	0	361	63430.4
84000	77.9171	154.7935	2250.26	0	361	0.0
84150	77.9173	154.7872	2250.19	0	361	0.0
84300	77.9175	154.7809	2249.94	0	361	63428.4
84450	77.9177	154.7745	2249.53	0	361	0.0
84600	77.9179	154.7681	2249.96	0	361	63426.8
84750	77.9181	154.7618	2250.15	0	361	0.0
84900	77.9183	154.7555	2250.30	0	361	0.0
85050	77.9185	154.7491	2250.44	0	361	63432.4
85200	77.9187	154.7428	2250.65	0	361	0.0
85350	77.9189	154.7364	2250.92	0	361	0.0
85500	77.9191	154.7301	2251.28	0	361	63431.7
85650	77.9193	154.7238	2251.54	0	361	0.0
85800	77.9195	154.7174	2251.76	0	361	0.0

Distance (m)	Flag Loc. Latitude (°S)	Flag Loc. Longitude (°E)	Elevation (m)	Shot Number	Julian Day	Total Mag. Field (nT)
85950	77.9197	154.7111	2251.70	0	361	63429.4
86100	77.9199	154.7047	2251.77	0	361	0.0
86250	77.9202	154.6984	2251.85	0	361	0.0
86400	77.9203	154.6920	2251.95	0	361	63429.5
86550	77.9205	154.6857	2252.09	0	361	0.0
86700	77.9208	154.6793	2252.18	0	361	63433.7
86850	77.9210	154.6730	2252.07	0	361	0.0
87000	77.9212	154.6666	2252.08	0	361	0.0
87150	77.9214	154.6603	2251.92	0	361	63440.8
87300	77.9216	154.6539	2251.77	0	361	0.0
87450	77.9218	154.6476	2251.91	0	361	0.0
87600	77.9220	154.6413	2251.70	0	361	63444.6
87750	77.9222	154.6349	2251.57	0	361	0.0
87900	77.9224	154.6286	2251.58	0	361	0.0
88050	77.9226	154.6222	2251.34	0	361	63449.6
88200	77.9228	154.6159	2251.26	0	361	0.0
88350	77.9230	154.6095	2251.32	0	361	0.0
88500	77.9232	154.6032	2251.01	0	361	63453.9
88650	77.9234	154.5968	2250.97	0	361	0.0
88800	77.9236	154.5905	2250.80	0	361	63457.8
88950	77.9238	154.5841	2250.60	0	361	0.0
89100	77.9240	154.5778	2250.66	0	361	0.0
89250	77.9242	154.5714	2250.60	0	361	63463.2
89400	77.9244	154.5651	2250.49	0	361	0.0
89550	77.9246	154.5587	2250.39	0	361	0.0
89700	77.9248	154.5524	2250.56	0	361	63466.4
89850	77.9250	154.5460	2250.58	0	361	0.0
90000	77.9252	154.5397	2250.70	0	361	0.0
90150	77.9254	154.5333	2250.78	700	361	63467.3
90300	77.9256	154.5270	2251.07	701	361	0.0
90450	77.9258	154.5206	2250.84	702	**361**	0.0
90600	77.9260	154.5143	2250.75	703	**362**	0.0
90750	77.9262	154.5079	2251.14	704	362	0.0
90900	77.9264	154.5016	2251.33	705	362	63550.2
91050	77.9266	154.4952	2251.43	706	362	63547.6
91200	77.9268	154.4889	2251.66	707	362	0.0
91350	77.9270	154.4825	2251.91	708	362	0.0
91500	77.9272	154.4762	2252.21	709	362	63543.2
91650	77.9274	154.4698	2252.63	710	362	0.0
91800	77.9276	154.4635	2252.68	711	362	0.0
91950	77.9278	154.4571	2252.71	712	362	63527.5
92100	77.9280	154.4508	2252.81	713	362	0.0
92250	77.9282	154.4444	2252.97	714	362	0.0
92400	77.9284	154.4381	2252.96	715	362	63507.0
92550	77.9286	154.4317	2253.24	716	362	0.0
92700	77.9288	154.4254	2253.65	717	362	0.0
92850	77.9290	154.4190	2254.30	718	362	63453.8
93000	77.9292	154.4127	2255.06	719	362	63425.4
93150	77.9294	154.4063	2255.82	720	362	0.0
93300	77.9296	154.4000	2256.54	721	362	63468.6
93450	77.9298	154.3936	2257.64	722	362	0.0
93600	77.9300	154.3873	2258.37	723	362	0.0

Distance (m)	Flag Loc. Latitude (°S)	Flag Loc. Longitude (°E)	Elevation (m)	Shot Number	Julian Day	Total Mag. Field (nT)
93750	77.9302	154.3809	2259.31	724	362	63506.9
93900	77.9304	154.3746	2260.08	725	362	0.0
94050	77.9306	154.3682	2260.57	726	362	0.0
94200	77.9308	154.3619	2261.38	727	362	63519.4
94350	77.9310	154.3555	2261.80	728	362	0.0
94500	77.9312	154.3492	2262.04	729	362	0.0
94650	77.9314	154.3428	2262.49	730	362	63476.7
94800	77.9316	154.3364	2262.91	731	362	63448.5
94950	77.9318	154.3301	2263.15	732	362	0.0
95100	77.9320	154.3237	2263.30	733	362	63450.7
95250	77.9322	154.3174	2263.42	734	362	0.0
95400	77.9324	154.3110	2263.54	735	362	0.0
95550	77.9326	154.3047	2263.53	736	362	63463.4
95700	77.9328	154.2983	2263.35	737	362	0.0
95850	77.9330	154.2920	2263.51	738	362	0.0
96000	77.9332	154.2856	2263.49	739	362	63467.7
96150	77.9334	154.2793	2263.34	740	362	0.0
96300	77.9336	154.2729	2263.06	741	362	0.0
96450	77.9338	154.2666	2263.07	742	362	63461.6
96600	77.9340	154.2602	2262.83	743	362	0.0
96750	77.9342	154.2539	2262.43	744	362	0.0
96900	77.9344	154.2475	2262.60	745	362	63470.5
97050	77.9346	154.2411	2262.34	746	362	0.0
97200	77.9348	154.2348	2262.03	747	362	0.0
97350	77.9350	154.2284	2261.97	748	362	63487.8
97500	77.9352	154.2221	2261.81	749	362	0.0
97650	77.9354	154.2157	2261.76	750	362	0.0
97800	77.9356	154.2094	2261.63	751	362	63496.2
97950	77.9358	154.2030	2261.45	752	362	0.0
98100	77.9360	154.1967	2261.36	753	362	0.0
98250	77.9362	154.1903	2261.32	754	362	63493.0
98400	77.9364	154.1840	2261.17	755	362	0.0
98550	77.9366	154.1776	2261.24	756	362	0.0
98700	77.9368	154.1713	2261.45	757	362	63487.7
98850	77.9370	154.1649	2261.66	758	362	0.0
99000	77.9372	154.1585	2262.54	759	362	63491.1
99150	77.9374	154.1522	2263.03	760	362	63486.2
99300	77.9376	154.1458	2263.72	761	362	0.0
99450	77.9378	154.1395	2264.29	762	362	0.0
99600	77.9380	154.1331	2264.77	763	362	63483.3
99750	77.9382	154.1268	2265.22	764	362	0.0
99900	77.9384	154.1204	2265.59	765	362	0.0
100050	77.9386	154.1140	2266.16	766	362	63481.8
100200	77.9388	154.1077	2266.47	767	362	0.0
100350	77.9390	154.1013	2266.86	768	362	0.0
100500	77.9392	154.0950	2267.16	769	362	63484.2
100650	77.9394	154.0886	2267.63	770	362	0.0
100800	77.9396	154.0823	2267.90	771	362	0.0
100950	77.9398	154.0759	2268.11	772	362	63483.4
101100	77.9400	154.0695	2268.53	773	362	63484.4
101250	77.9402	154.0632	2268.69	774	362	0.0
101400	77.9404	154.0568	2269.09	775	362	63477.2

Distance (m)	Flag Loc. Latitude (°S)	Flag Loc. Longitude (°E)	Elevation (m)	Shot Number	Julian Day	Total Mag. Field (nT)
101550	77.9406	154.0505	2269.42	776	362	0.0
101700	77.9408	154.0441	2269.65	777	362	0.0
101850	77.9410	154.0378	2269.91	778	362	63482.7
102000	77.9412	154.0314	2270.14	779	362	0.0
102150	77.9414	154.0250	2270.15	780	362	0.0
102300	77.9416	154.0187	2270.48	781	362	63488.8
102450	77.9418	154.0123	2270.73	782	362	0.0
102600	77.9420	154.0060	2270.54	783	362	0.0
102750	77.9422	153.9996	2270.74	784	362	63498.9
102900	77.9424	153.9933	2271.22	785	362	0.0
103050	77.9426	153.9869	2271.04	786	362	0.0
103200	77.9428	153.9805	2271.38	787	362	63500.5
103350	77.9430	153.9741	2271.46	788	362	0.0
103500	77.9432	153.9678	2271.60	789	362	0.0
103650	77.9433	153.9614	2271.87	790	362	63509.8
103800	77.9435	153.9550	2272.06	791	362	0.0
103950	77.9437	153.9486	2272.28	792	362	0.0
104100	77.9438	153.9422	2272.38	793	362	63517.1
104250	77.9440	153.9359	2272.69	794	362	0.0
104400	77.9442	153.9295	2273.01	795	362	0.0
104550	77.9443	153.9231	2273.23	796	362	63526.6
104700	77.9445	153.9167	2273.30	797	362	0.0
104850	77.9447	153.9104	2273.68	798	362	0.0
105000	77.9448	153.9040	2273.66	799	362	63531.0
105150	77.9450	153.8976	2273.94	800	362	0.0
105300	77.9452	153.8912	2273.95	801	362	63535.1
105450	77.9453	153.8848	2273.97	802	1	63632.0
105600	77.9455	153.8784	2274.18	803	1	0.0
105750	77.9457	153.8720	2274.51	804	1	0.0
105900	77.9458	153.8657	2274.70	805	1	63642.3
106050	77.9460	153.8593	2275.02	806	1	0.0
106200	77.9462	153.8529	2275.32	807	1	0.0
106350	77.9464	153.8465	2275.60	808	1	63648.2
106500	77.9465	153.8401	2275.78	809	1	0.0
106650	77.9467	153.8338	2276.11	810	1	0.0
106800	77.9468	153.8274	2276.36	811	1	63657.1
106950	77.9470	153.8210	2276.82	812	1	0.0
107100	77.9472	153.8146	2277.11	813	1	0.0
107250	77.9473	153.8082	2277.49	814	1	63651.4
107400	77.9475	153.8018	2277.30	815	1	63648.0
107550	77.9477	153.7955	2277.60	816	1	0.0
107700	77.9479	153.7891	2277.93	817	1	63648.2
107850	77.9480	153.7827	2278.18	818	1	0.0
108000	77.9482	153.7763	2278.60	819	1	0.0
108150	77.9484	153.7699	2278.99	820	1	63659.4
108300	77.9485	153.7635	2279.17	821	1	0.0
108450	77.9487	153.7572	2279.61	822	1	0.0
108600	77.9489	153.7508	2280.11	823	1	63644.3
108750	77.9490	153.7444	2279.90	824	1	0.0
108900	77.9492	153.7380	2280.08	825	1	0.0
109050	77.9494	153.7316	2280.31	826	1	63589.6
109200	77.9495	153.7253	2280.69	827	1	0.0

Distance (m)	Flag Loc. Latitude (°S)	Flag Loc. Longitude (°E)	Elevation (m)	Shot Number	Julian Day	Total Mag. Field (nT)
109350	77.9497	153.7189	2280.60	828	1	0.0
109500	77.9499	153.7125	2280.83	829	1	63530.6
109650	77.9500	153.7061	2281.11	830	1	0.0
109800	77.9502	153.6997	2281.09	831	1	0.0
109950	77.9504	153.6933	2281.08	832	1	63570.9
110100	77.9505	153.6869	2281.26	833	1	0.0
110250	77.9507	153.6806	2281.23	834	1	0.0
110400	77.9509	153.6742	2281.20	835	1	63590.6
110550	77.9510	153.6678	2281.09	836	1	0.0
110700	77.9512	153.6614	2281.21	837	1	0.0
110850	77.9514	153.6550	2281.12	838	1	63571.0
111000	77.9515	153.6487	2281.39	839	1	0.0
111150	77.9517	153.6423	2281.37	840	1	0.0
111300	77.9519	153.6359	2281.37	841	1	63576.5
111450	77.9520	153.6295	2281.31	842	1	0.0
111600	77.9522	153.6231	2281.60	843	1	63599.1
111750	77.9524	153.6167	2281.87	844	1	63567.0
111900	77.9525	153.6103	2282.05	845	1	0.0
112050	77.9527	153.6039	2282.20	846	1	0.0
112200	77.9529	153.5975	2282.36	847	1	63582.7
112350	77.9530	153.5912	2282.74	848	1	0.0
112500	77.9532	153.5848	2282.83	849	1	0.0
112650	77.9534	153.5784	2283.05	850	1	63553.2
112800	77.9535	153.5720	2283.28	851	1	0.0
112950	77.9537	153.5656	2283.46	852	1	0.0
113100	77.9539	153.5592	2283.76	853	1	63568.3
113250	77.9540	153.5529	2284.23	854	1	0.0
113400	77.9542	153.5465	2284.61	855	1	0.0
113550	77.9544	153.5401	2284.28	856	1	63537.5
113700	77.9545	153.5337	2284.81	857	1	63522.1
113850	77.9547	153.5273	2285.20	858	1	0.0
114000	77.9549	153.5209	2285.55	859	1	63530.6
114150	77.9550	153.5145	2285.96	860	1	0.0
114300	77.9552	153.5081	2286.21	861	1	0.0
114450	77.9554	153.5017	2286.56	862	1	63536.3
114600	77.9555	153.4954	2286.76	863	1	0.0
114750	77.9557	153.4890	2286.80	864	1	0.0
114900	77.9559	153.4826	2287.24	865	1	63533.4
115050	77.9560	153.4762	2287.18	866	1	0.0
115200	77.9562	153.4698	2287.46	867	1	0.0
115350	77.9564	153.4634	2287.06	868	1	63528.6
115500	77.9565	153.4570	2287.71	869	1	0.0
115650	77.9567	153.4507	2287.63	870	1	0.0
115800	77.9569	153.4442	2288.14	871	1	63546.0
115950	77.9570	153.4379	2288.32	872	1	0.0
116100	77.9572	153.4315	2288.33	873	1	0.0
116250	77.9574	153.4251	2288.50	874	1	63551.6
116400	77.9575	153.4187	2288.49	875	1	0.0
116550	77.9577	153.4123	2288.44	876	1	0.0
116700	77.9579	153.4059	2288.10	877	1	63555.3
116850	77.9580	153.3995	2287.80	878	1	0.0
117000	77.9582	153.3932	2287.69	879	1	0.0

Distance (m)	Flag Loc. Latitude (°S)	Flag Loc. Longitude (°E)	Elevation (m)	Shot Number	Julian Day	Total Mag. Field (nT)
117150	77.9584	153.3868	2287.45	880	1	63556.9
117300	77.9585	153.3804	2287.33	881	1	0.0
117450	77.9587	153.3740	2287.02	882	1	0.0
117600	77.9589	153.3676	2286.81	883	1	63561.2
117750	77.9590	153.3612	2287.04	884	1	0.0
117900	77.9592	153.3548	2286.91	885	1	63574.5
118050	77.9594	153.3484	2286.81	886	1	63560.3
118200	77.9595	153.3420	2287.12	887	1	0.0
118350	77.9597	153.3356	2287.46	888	1	0.0
118500	77.9599	153.3293	2287.65	889	1	63557.1
118650	77.9600	153.3229	2287.98	890	1	0.0
118800	77.9602	153.3165	2288.38	891	1	0.0
118950	77.9604	153.3101	2288.80	892	1	63570.5
119100	77.9605	153.3037	2289.30	893	1	0.0
119250	77.9607	153.2973	2289.76	894	1	0.0
119400	77.9609	153.2909	2290.31	895	1	63558.5
119550	77.9610	153.2845	2290.69	896	1	0.0
119700	77.9612	153.2781	2291.26	897	1	0.0
119850	77.9613	153.2718	2291.74	898	1	63554.4
120000	77.9615	153.2653	2292.30	899	1	63550.2
120150	77.9617	153.2589	2292.67	900	1	0.0
120300	77.9619	153.2526	2293.39	901	1	63548.5
120450	77.9620	153.2462	2294.40	902	1	0.0
120600	77.9622	153.2398	2294.59	903	1	0.0
120750	77.9624	153.2334	2295.29	904	2	63564.6
120900	77.9625	153.2270	2295.72	905	2	0.0
121050	77.9627	153.2206	2296.23	906	2	0.0
121200	77.9629	153.2142	2297.06	907	2	63574.8
121350	77.9630	153.2078	2297.31	908	2	0.0
121500	77.9632	153.2014	2297.76	909	2	0.0
121650	77.9633	153.1951	2298.20	910	2	63550.3
121800	77.9635	153.1887	2298.49	911	2	0.0
121950	77.9637	153.1823	2298.86	912	2	0.0
122100	77.9639	153.1759	2298.73	913	2	63551.8
122250	77.9640	153.1694	2298.67	914	2	0.0
122400	77.9641	153.1631	2298.90	915	2	0.0
122550	77.9643	153.1566	2298.76	916	2	63550.6
122700	77.9644	153.1503	2299.14	917	2	0.0
122850	77.9646	153.1438	2298.83	918	2	0.0
123000	77.9647	153.1375	2298.95	919	2	63555.3
123150	77.9649	153.1310	2298.85	920	2	0.0
123300	77.9650	153.1246	2298.75	921	2	0.0
123450	77.9652	153.1182	2298.66	922	2	63551.2
123600	77.9653	153.1118	2298.41	923	2	0.0
123750	77.9655	153.1054	2298.42	924	2	0.0
123900	77.9656	153.0990	2298.28	925	2	63541.4
124050	77.9658	153.0926	2297.84	926	2	0.0
124200	77.9659	153.0862	2296.66	927	2	63529.7
124350	77.9661	153.0798	2295.72	928	2	63530.4
124500	77.9662	153.0734	2295.03	929	2	0.0
124650	77.9664	153.0670	2293.95	930	2	0.0
124800	77.9665	153.0606	2293.22	931	2	63539.0

Distance (m)	Flag Loc. Latitude (°S)	Flag Loc. Longitude (°E)	Elevation (m)	Shot Number	Julian Day	Total Mag. Field (nT)
124950	77.9666	153.0542	2292.60	932	2	0.0
125100	77.9668	153.0478	2292.49	933	2	0.0
125250	77.9669	153.0414	2292.30	934	2	63556.1
125400	77.9671	153.0350	2292.39	935	2	0.0
125550	77.9672	153.0286	2293.16	936	2	0.0
125700	77.9674	153.0222	2294.31	937	2	63570.6
125850	77.9675	153.0158	2296.15	938	2	0.0
126000	77.9677	153.0094	2297.47	939	2	0.0
126150	77.9678	153.0030	2299.72	940	2	63577.6
126300	77.9680	152.9966	2301.83	941	2	63580.4
126450	77.9681	152.9902	2303.88	942	2	0.0
126600	77.9682	152.9838	2305.73	943	2	63587.6
126750	77.9684	152.9774	2307.92	944	2	0.0
126900	77.9685	152.9710	2309.72	945	2	0.0
127050	77.9687	152.9646	2311.44	946	2	63593.1
127200	77.9688	152.9581	2313.15	947	2	0.0
127350	77.9690	152.9518	2314.81	948	2	0.0
127500	77.9691	152.9453	2316.51	949	2	63593.4
127650	77.9693	152.9389	2317.44	950	2	0.0
127800	77.9694	152.9325	2318.91	951	2	0.0
127950	77.9696	152.9260	2319.96	952	3	63583.6
128100	77.9697	152.9196	2320.69	953	3	0.0
128250	77.9699	152.9132	2321.75	954	3	0.0
128400	77.9700	152.9068	2322.62	955	3	63595.9
128550	77.9701	152.9004	2323.09	956	3	0.0
128700	77.9703	152.8940	2324.18	957	3	0.0
128850	77.9704	152.8876	2324.69	958	3	63597.2
129000	77.9706	152.8812	2325.34	959	3	0.0
129150	77.9707	152.8748	2326.16	960	3	0.0
129300	77.9709	152.8684	2326.45	961	3	63605.6
129450	77.9710	152.8620	2326.89	962	3	0.0
129600	77.9712	152.8556	2327.28	963	3	0.0
129750	77.9713	152.8492	2327.91	964	3	63573.1
129900	77.9715	152.8427	2328.43	965	3	0.0
130050	77.9716	152.8363	2328.98	966	3	0.0
130200	77.9717	152.8299	2329.52	967	3	63564.0
130350	77.9719	152.8235	2329.82	968	3	0.0
130500	77.9720	152.8171	2330.17	969	3	0.0
130650	77.9722	152.8107	2330.52	970	3	63531.0
130800	77.9723	152.8043	2330.89	971	3	0.0
130950	77.9725	152.7979	2331.14	972	3	0.0
131100	77.9726	152.7915	2331.54	973	3	63523.9
131250	77.9728	152.7851	2331.85	974	3	0.0
131400	77.9729	152.7787	2332.45	975	3	0.0
131550	77.9730	152.7723	2332.40	976	3	63549.2
131700	77.9732	152.7659	2332.84	977	3	0.0
131850	77.9733	152.7594	2333.23	978	3	63543.6
132000	77.9735	152.7530	2333.59	979	3	63528.4
132150	77.9736	152.7466	2333.89	980	3	0.0
132300	77.9738	152.7402	2334.30	981	3	0.0
132450	77.9739	152.7338	2334.30	982	3	63486.0
132600	77.9741	152.7274	2334.44	983	3	0.0

Distance (m)	Flag Loc. Latitude (°S)	Flag Loc. Longitude (°E)	Elevation (m)	Shot Number	Julian Day	Total Mag. Field (nT)
132750	77.9742	152.7210	2334.54	984	3	0.0
132900	77.9743	152.7146	2334.60	985	3	63466.0
133050	77.9745	152.7082	2334.73	986	3	0.0
133200	77.9746	152.7018	2334.82	987	3	0.0
133350	77.9748	152.6954	2334.64	988	3	63446.3
133500	77.9749	152.6889	2334.60	989	3	0.0
133650	77.9751	152.6825	2334.48	990	3	0.0
133800	77.9752	152.6761	2334.51	991	3	63435.9
133950	77.9754	152.6697	2334.32	992	3	63429.0
134100	77.9755	152.6633	2334.06	993	3	0.0
134250	77.9756	152.6569	2333.85	994	3	63438.5
134400	77.9758	152.6505	2333.54	995	3	0.0
134550	77.9759	152.6441	2333.30	996	3	0.0
134700	77.9761	152.6376	2332.92	997	3	63432.3
134850	77.9762	152.6312	2332.61	998	3	0.0
135000	77.9764	152.6248	2332.18	999	3	0.0
135150	77.9765	152.6184	2331.90	1000	3	63427.7
135300	77.9767	152.6120	2331.51	1001	3	0.0
135450	77.9768	152.6056	2330.88	1002	3	0.0
135600	77.9769	152.5992	2330.73	1003	3	63450.0
135750	77.9771	152.5928	2330.32	1004	3	0.0
135900	77.9772	152.5864	2330.11	1005	3	0.0
136050	77.9774	152.5799	2329.96	1006	3	63439.4
136200	77.9775	152.5735	2329.41	1007	3	0.0
136350	77.9777	152.5671	2329.08	1008	3	0.0
136500	77.9778	152.5607	2328.84	1009	3	63486.2
136650	77.9780	152.5543	2328.51	1010	3	0.0
136800	77.9781	152.5479	2327.81	1011	3	0.0
136950	77.9782	152.5415	2327.60	1012	3	63481.5
137100	77.9784	152.5351	2327.28	1013	3	0.0
137250	77.9785	152.5287	2326.94	1014	3	0.0
137400	77.9787	152.5223	2326.54	1015	3	63477.6
137550	77.9788	152.5158	2326.45	1016	3	0.0
137700	77.9790	152.5094	2325.77	1017	3	0.0
137850	77.9791	152.5030	2325.52	1018	3	63485.6
138000	77.9792	152.4966	2325.08	1019	3	0.0
138150	77.9794	152.4902	2324.86	1020	3	63487.5
138300	77.9795	152.4837	2324.34	1021	3	63491.3
138450	77.9797	152.4773	2324.08	1022	3	0.0
138600	77.9798	152.4709	2323.71	1023	3	0.0
138750	77.9799	152.4645	2323.41	1024	3	63499.5
138900	77.9800	152.4581	2323.26	1025	3	0.0
139050	77.9802	152.4517	2322.92	1026	3	0.0
139200	77.9803	152.4453	2322.83	1027	3	63516.1
139350	77.9804	152.4388	2322.31	1028	3	0.0
139500	77.9805	152.4324	2322.12	1029	3	0.0
139650	77.9807	152.4260	2321.84	1030	3	63533.4
139800	77.9808	152.4196	2321.65	1031	3	0.0
139950	77.9809	152.4131	2321.53	1032	3	0.0
140100	77.9810	152.4067	2321.55	1033	3	63544.8
140250	77.9812	152.4003	2321.19	1034	3	63541.1
140400	77.9813	152.3939	2320.81	1035	3	0.0

Distance (m)	Flag Loc. Latitude (°S)	Flag Loc. Longitude (°E)	Elevation (m)	Shot Number	Julian Day	Total Mag. Field (nT)
140550	77.9814	152.3874	2320.73	1036	3	63538.6
140700	77.9816	152.3810	2320.54	1037	3	0.0
140850	77.9817	152.3746	2320.54	1038	3	0.0
141000	77.9818	152.3682	2320.14	1039	3	63553.1
141150	77.9819	152.3618	2320.03	1040	3	0.0
141300	77.9821	152.3553	2319.97	1041	3	0.0
141450	77.9822	152.3489	2319.99	1042	3	63567.5
141600	77.9823	152.3425	2319.68	1043	3	0.0
141750	77.9825	152.3361	2319.71	1044	3	0.0
141900	77.9826	152.3297	2319.73	1045	3	63585.4
142050	77.9827	152.3232	2319.59	1046	3	0.0
142200	77.9828	152.3168	2319.50	1047	3	0.0
142350	77.9830	152.3104	2319.63	1048	3	63586.8
142500	77.9831	152.3040	2319.54	1049	3	0.0
142650	77.9832	152.2975	2319.90	1050	3	0.0
142800	77.9833	152.2911	2319.61	1051	3	63585.5
142950	77.9835	152.2847	2319.61	1052	3	0.0
143100	77.9836	152.2783	2319.91	1053	3	0.0
143250	77.9837	152.2719	2319.81	1054	3	63588.9
143400	77.9838	152.2654	2319.70	1055	3	0.0
143550	77.9840	152.2590	2319.72	1056	3	0.0
143700	77.9841	152.2526	2319.61	1057	3	63593.8
143850	77.9842	152.2461	2319.69	1058	3	63596.5
144000	77.9844	152.2397	2319.77	1059	3	0.0
144150	77.9845	152.2333	2320.09	1060	4	63513.9
144300	77.9846	152.2269	2320.16	1061	4	0.0
144450	77.9847	152.2205	2320.24	1062	4	0.0
144600	77.9849	152.2140	2320.53	1063	4	63502.9
144750	77.9850	152.2076	2320.77	1064	4	0.0
144900	77.9851	152.2012	2320.93	1065	4	0.0
145050	77.9852	152.1948	2321.20	1066	4	63514.0
145200	77.9854	152.1884	2321.52	1067	4	0.0
145350	77.9855	152.1819	2321.53	1068	4	0.0
145500	77.9856	152.1755	2321.68	1069	4	63519.3
145650	77.9857	152.1691	2321.98	1070	4	0.0
145950	77.9860	152.1562	2322.62	1072	4	63529.9
146100	77.9861	152.1498	2323.08	1073	4	0.0
146250	77.9863	152.1434	2323.07	1074	4	0.0
146400	77.9864	152.1369	2323.13	1075	4	63566.0
146550	77.9865	152.1305	2323.66	1076	4	0.0
146700	77.9866	152.1241	2323.60	1077	4	0.0
146850	77.9868	152.1177	2323.91	1078	4	63569.4
147000	77.9869	152.1113	2324.07	1079	4	0.0
147150	77.9870	152.1048	2324.03	1080	4	0.0
147300	77.9871	152.0984	2324.31	1081	4	63580.6
147450	77.9873	152.0920	2324.23	1082	4	0.0
147600	77.9874	152.0856	2324.22	1083	4	0.0
147750	77.9875	152.0791	2324.21	wo1084	4	63585.5
147900	77.9877	152.0727	2324.04	wo1085	4	63597.8
148050	77.9878	152.0663	2324.33	wo1086	4	0.0
148200	77.9879	152.0598	2324.08		4	0.0
148350	77.9880	152.0534	2324.43	wo1088	4	63595.7

Distance (m)	Flag Loc. Latitude (°S)	Flag Loc. Longitude (°E)	Elevation (m)	Shot Number	Julian Day	Total Mag. Field (nT)
148500	77.9882	152.0470	2324.40		4	0.0
148650	77.9883	152.0406	2324.44	wo1090	4	0.0
148800	77.9884	152.0341	2324.83		4	0.0
148950	77.9885	152.0277	2325.60	wo1092	4	0.0
149100	77.9887	152.0213	2326.05		4	0.0
149250	77.9888	152.0149	2326.59	wo1094	4	63597.2
149400	77.9889	152.0085	2327.17		4	0.0
149550	77.9890	152.0020	2327.75	wo1096	4	0.0
149700	77.9892	151.9956	2328.32		4	0.0
149850	77.9893	151.9892	2328.62	wo1098	4	0.0
150000	77.9894	151.9827	2329.58		4	63584.6
150150	77.9895	151.9763	2330.19	wo1100	4	0.0
150300	77.9897	151.9699	2330.58	1101	4	0.0
150450	77.9898	151.9634	2330.84	1102	4	0.0
150600	77.9899	151.9570	2331.26	1103	4	0.0
150750	77.9900	151.9506	2331.68	1104	4	0.0
150900	77.9902	151.9442	2332.04	1105	5	63580.8
151050	77.9903	151.9377	2332.19	1106	5	0.0
151200	77.9904	151.9313	2332.19	1107	5	0.0
151350	77.9905	151.9249	2332.60	1108	5	63573.6
151500	77.9907	151.9185	2332.98	1109	5	0.0
151650	77.9908	151.9120	2333.02	1110	5	0.0
151800	77.9909	151.9056	2333.29	1111	5	63566.4
151950	77.9910	151.8992	2333.64	1112	5	0.0
152100	77.9912	151.8927	2333.84	1113	5	63554.2
152250	77.9913	151.8863	2333.99	1114	5	0.0
152400	77.9914	151.8799	2334.02	1115	5	0.0
152550	77.9915	151.8735	2334.25	1116	5	0.0
152700	77.9917	151.8670	2334.37	1117	5	63566.3
152850	77.9918	151.8606	2334.74	1118	5	0.0
153000	77.9919	151.8542	2334.58	1119	5	0.0
153150	77.9920	151.8477	2334.65	1120	5	63549.0
153300	77.9922	151.8413	2334.64	1121	5	0.0
153450	77.9923	151.8349	2335.12	1122	5	0.0
153600	77.9924	151.8285	2334.91	1123	5	63543.3
153750	77.9925	151.8221	2335.28	1124	5	0.0
153900	77.9927	151.8156	2335.49	1125	5	0.0
154050	77.9928	151.8092	2335.07	1126	5	63539.4
154200	77.9929	151.8027	2335.32	1127	5	63540.1
154350	77.9930	151.7963	2335.07	1128	5	0.0
154500	77.9932	151.7899	2335.43	1129	5	63537.0
154650	77.9933	151.7834	2335.29	1130	5	0.0
154800	77.9934	151.7770	2335.13	1131	5	0.0
154950	77.9935	151.7706	2335.14	1132	5	63519.9
155100	77.9937	151.7642	2334.98	1133	5	0.0
155250	77.9938	151.7578	2334.91	1134	5	0.0
155400	77.9939	151.7513	2334.95	1135	5	63514.7
155550	77.9940	151.7449	2334.98	1136	5	0.0
155700	77.9942	151.7385	2335.12	1137	5	0.0
155850	77.9943	151.7320	2335.40	1138	5	63510.4
156000	77.9944	151.7256	2336.19	1139	5	0.0
156150	77.9945	151.7192	2336.14	1140	5	0.0

Distance (m)	Flag Loc. Latitude (°S)	Flag Loc. Longitude (°E)	Elevation (m)	Shot Number	Julian Day	Total Mag. Field (nT)
156300	77.9947	151.7127	2337.80	1141	5	63514.3
156450	77.9948	151.7063	2338.41	1142	5	0.0
156600	77.9949	151.6999	2339.19	1143	5	0.0
156750	77.9950	151.6934	2339.67	1144	5	63498.4
156900	77.9951	151.6870	2340.51	1145	5	0.0
157050	77.9953	151.6806	2341.47	1146	5	0.0
157200	77.9954	151.6741	2341.92	1147	5	63503.8
157350	77.9955	151.6677	2342.53	1148	5	0.0
157500	77.9956	151.6613	2343.10	1149	5	0.0
157650	77.9958	151.6549	2343.78	1150	5	63501.0
157800	77.9959	151.6484	2344.14	1151	5	0.0
157950	77.9960	151.6420	2344.61	1152	5	0.0
158100	77.9961	151.6356	2344.51	1153	5	63494.4
158250	77.9963	151.6291	2344.93	1154	5	63493.3
158400	77.9964	151.6227	2344.72	1155	5	0.0
158550	77.9965	151.6163	2344.61	1156	5	63480.7
158700	77.9966	151.6098	2344.21	1157	5	0.0
158850	77.9967	151.6034	2343.76	1158	5	0.0
159000	77.9969	151.5970	2343.14	1159	5	63481.1
159150	77.9970	151.5905	2342.64	1160	5	0.0
159300	77.9971	151.5841	2341.90	1161	5	0.0
159450	77.9972	151.5777	2340.98	1162	5	63480.2
159600	77.9974	151.5713	2340.24	1163	5	0.0
159750	77.9975	151.5648	2339.13	1164	5	0.0
159900	77.9976	151.5584	2338.51	1165	5	63475.5
160050	77.9977	151.5519	2338.58	1166	5	0.0
160200	77.9979	151.5455	2336.90	1167	5	0.0
160350	77.9980	151.5391	2336.13	1168	5	63478.8
160500	77.9981	151.5327	2335.36	1169	5	0.0
160650	77.9982	151.5262	2334.32	1170	5	0.0
160800	77.9984	151.5198	2333.72	1171	5	63475.8
160950	77.9985	151.5134	2333.02	1172	5	0.0
161100	77.9986	151.5069	2332.35	1173	5	0.0
161250	77.9987	151.5005	2332.06	1174	5	63478.8
161400	77.9988	151.4941	2331.25	1175	5	0.0
161550	77.9990	151.4876	2330.65	1176	5	0.0
161700	77.9991	151.4812	2330.40	1177	5	63481.0
161850	77.9992	151.4748	2330.03	1178	5	0.0
162000	77.9993	151.4683	2329.79	1179	5	63484.6
162150	77.9995	151.4619	2329.46	0	6	63447.6
162300	77.9996	151.4555	2329.02	0	6	0.0
162450	77.9997	151.4490	2329.04	0	6	0.0
162600	77.9998	151.4426	2328.87	0	6	63484.4
162750	77.9999	151.4362	2328.80	0	6	0.0
162900	78.0001	151.4297	2328.53	0	6	0.0
163050	78.0002	151.4233	2328.54	0	6	63465.4
163200	78.0003	151.4169	2328.45	0	6	0.0
163350	78.0004	151.4104	2328.33	0	6	0.0
163500	78.0006	151.4040	2328.46	0	6	63418.6
163650	78.0007	151.3976	2328.34	0	6	0.0
163800	78.0008	151.3911	2328.42	0	6	0.0
163950	78.0009	151.3847	2328.70	0	6	63424.6

Distance (m)	Flag Loc. Latitude (°S)	Flag Loc. Longitude (°E)	Elevation (m)	Shot Number	Julian Day	Total Mag. Field (nT)
164100	78.0011	151.3782	2328.76	0	6	63428.2
164250	78.0011	151.3718	2328.91	0	6	0.0
164400	78.0012	151.3654	2329.28	0	6	63438.0
164550	78.0013	151.3589	2329.21	0	6	0.0
164700	78.0014	151.3525	2329.49	0	6	0.0
164850	78.0015	151.3460	2329.68	0	6	63444.8
165000	78.0016	151.3396	2329.94	0	6	0.0
165150	78.0017	151.3331	2330.10	0	6	0.0
165300	78.0018	151.3267	2330.48	0	6	63450.2
165450	78.0019	151.3203	2330.35	0	6	0.0
165600	78.0020	151.3138	2330.99	0	6	0.0
165750	78.0021	151.3074	2331.35	0	6	63451.2
165900	78.0022	151.3009	2331.57	0	6	0.0
166050	78.0023	151.2945	2331.69	0	6	0.0
166200	78.0024	151.2880	2332.35	0	6	63449.5
166350	78.0025	151.2816	2332.60	0	6	0.0
166500	78.0026	151.2751	2332.84	0	6	0.0
166650	78.0027	151.2687	2333.62	0	6	63453.9
166800	78.0027	151.2622	2333.69	0	6	0.0
166950	78.0028	151.2558	2333.95	0	6	0.0
167100	78.0029	151.2493	2334.34	0	6	63458.4
167250	78.0030	151.2429	2334.71	0	6	0.0
167400	78.0031	151.2365	2334.99	0	6	0.0
167550	78.0032	151.2300	2335.60	0	6	63445.4
167700	78.0033	151.2236	2336.02	0	6	0.0
167850	78.0034	151.2171	2336.44	0	6	0.0
168000	78.0035	151.2107	2336.94	0	6	63418.5
168150	78.0036	151.2042	2337.34	0	6	0.0
168300	78.0037	151.1977	2337.70	0	6	63418.9
168450	78.0038	151.1913	2338.51	0	6	0.0
168600	78.0039	151.1849	2338.64	0	6	0.0
168750	78.0041	151.1785	2339.38	0	6	63426.6
168900	78.0042	151.1720	2340.00	0	6	0.0
169050	78.0043	151.1656	2340.27	0	6	0.0
169200	78.0045	151.1592	2340.88	0	6	63427.0
169350	78.0046	151.1528	2341.16	0	6	0.0
169500	78.0048	151.1463	2341.45	0	6	0.0
169650	78.0049	151.1399	2341.82	0	6	63423.0
169800	78.0050	151.1335	2342.54	0	6	0.0
169950	78.0051	151.1270	2342.66	0	6	0.0
170100	78.0053	151.1206	2343.11	0	6	63437.0
170250	78.0054	151.1142	2343.88	0	6	63435.3
170400	78.0056	151.1077	2344.22	0	6	0.0
170550	78.0057	151.1013	2344.62	0	6	0.0
170700	78.0058	151.0949	2344.93	0	6	63425.2
170850	78.0060	151.0884	2345.69	0	6	0.0
171000	78.0071	151.0370	2348.31	0	6	0.0
171150	78.0062	151.0756	2346.32	0	6	63422.5
171300	78.0064	151.0692	2346.51	0	6	0.0
171450	78.0065	151.0627	2346.96	0	6	0.0
171600	78.0067	151.0563	2347.23	0	6	63420.0
171750	78.0068	151.0499	2347.47	0	6	0.0

Distance (m)	Flag Loc. Latitude (°S)	Flag Loc. Longitude (°E)	Elevation (m)	Shot Number	Julian Day	Total Mag. Field (nT)
171900	78.0069	151.0434	2347.85	0	6	0.0
172200	78.0072	151.0306	2348.69	0	6	0.0
172350	78.0074	151.0242	2349.13	0	6	0.0
172500	78.0075	151.0177	2349.66	0	6	63418.4
172650	78.0076	151.0113	2350.26	0	6	0.0
172800	78.0078	151.0049	2350.71	0	6	0.0
172950	78.0079	150.9984	2351.10	0	6	63426.1
173100	78.0080	150.9920	2351.31	0	6	0.0
173250	78.0082	150.9856	2351.59	0	6	0.0
173400	78.0083	150.9792	2351.73	0	6	63426.4
173550	78.0084	150.9727	2351.51	0	6	0.0
173700	78.0086	150.9663	2351.41	0	6	63425.1
173850	78.0087	150.9598	2351.53	0	6	0.0
174000	78.0089	150.9534	2351.37	0	6	0.0
174150	78.0090	150.9470	2351.05	0	6	63427.9
174300	78.0091	150.9405	2350.89	0	6	0.0
174450	78.0093	150.9341	2350.49	0	6	0.0
174600	78.0094	150.9277	2347.71	0	6	63442.9
174750	78.0095	150.9212	2349.97	0	6	0.0
174900	78.0097	150.9148	2349.96	0	6	0.0
175050	78.0098	150.9084	2350.01	0	6	63440.2
175200	78.0099	150.9020	2349.80	0	6	0.0
175350	78.0101	150.8955	2349.37	0	6	0.0
175500	78.0102	150.8891	2349.41	0	6	63455.6
175650	78.0103	150.8827	2349.12	0	6	0.0
175800	78.0105	150.8762	2349.24	0	6	63460.0
175950	78.0106	150.8698	2349.10	0	6	0.0
176100	78.0108	150.8633	2348.62	0	6	0.0
176250	78.0109	150.8569	2348.27	0	6	63458.0
176400	78.0110	150.8505	2348.09	0	6	0.0
176550	78.0112	150.8441	2347.93	0	6	0.0
176700	78.0113	150.8376	2348.12	0	6	63446.4
176850	78.0114	150.8312	2348.10	0	6	0.0
177000	78.0116	150.8248	2348.32	0	6	0.0
177150	78.0117	150.8183	2348.58	0	6	63448.8
177300	78.0118	150.8119	2348.97	0	6	0.0
177450	78.0120	150.8055	2349.36	0	6	0.0
177600	78.0121	150.7990	2349.42	0	6	63440.2
177750	78.0123	150.7926	2349.42	0	6	0.0
177900	78.0124	150.7861	2349.45	0	6	63435.9
178050	78.0125	150.7797	2349.28	0	6	0.0
178200	78.0127	150.7733	2349.25	0	6	0.0
178350	78.0128	150.7668	2349.06	0	6	63430.7
178500	78.0129	150.7604	2349.48	0	6	0.0
178650	78.0131	150.7540	2348.70	0	6	0.0
178800	78.0132	150.7475	2348.37	0	6	63427.4
178950	78.0133	150.7411	2347.89	0	6	0.0
179100	78.0135	150.7347	2347.66	0	6	0.0
179250	78.0136	150.7282	2347.26	0	6	63426.3
179400	78.0137	150.7218	2346.83	0	6	0.0
179550	78.0139	150.7154	2346.36	0	6	0.0
179700	78.0140	150.7090	2345.86	0	6	63424.5

Distance (m)	Flag Loc. Latitude (°S)	Flag Loc. Longitude (°E)	Elevation (m)	Shot Number	Julian Day	Total Mag. Field (nT)
179850	78.0142	150.7025	2345.48	0	6	63426.4
180000	78.0143	150.6960	2344.93	0	6	0.0
180150	78.0144	150.6896	2344.42	0	6	0.0
180300	78.0146	150.6832	2343.90	0	6	63422.7
180450	78.0147	150.6768	2343.59	0	6	0.0
180600	78.0148	150.6703	2342.73	0	6	0.0
180750	78.0150	150.6639	2342.07	0	6	63416.1
180900	78.0151	150.6575	2341.90	0	6	0.0
181050	78.0152	150.6510	2341.33	0	6	0.0
181200	78.0154	150.6446	2340.71	0	6	63412.4
181350	78.0155	150.6382	2340.47	0	6	0.0
181500	78.0156	150.6317	2340.03	0	6	0.0
181650	78.0158	150.6253	2339.85	0	6	63412.8
181800	78.0159	150.6189	2339.39	0	6	0.0
181950	78.0160	150.6124	2339.00	0	6	63415.7
182100	78.0162	150.6059	2339.04	0	6	0.0
182250	78.0163	150.5995	2338.88	0	6	0.0
182400	78.0164	150.5931	2338.72	0	6	63403.5
182550	78.0166	150.5866	2338.58	0	6	0.0
182700	78.0167	150.5802	2338.67	0	6	0.0
182850	78.0168	150.5738	2338.61	0	6	63407.4
183000	78.0170	150.5673	2338.80	0	6	0.0
183150	78.0171	150.5609	2338.74	0	6	0.0
183300	78.0172	150.5545	2338.79	0	6	63418.3
183450	78.0174	150.5480	2338.83	0	6	0.0
183600	78.0175	150.5416	2339.02	0	6	0.0
183750	78.0176	150.5352	2339.16	0	6	0.0
183900	78.0178	150.5287	2339.37	0	6	63423.0
184050	78.0179	150.5222	2339.45	0	6	0.0
184200	78.0180	150.5158	2339.70	0	6	0.0
184500	78.0182	150.5029	2340.21	0	6	0.0
184650	78.0184	150.4965	2340.63	0	6	0.0
184800	78.0185	150.4900	2341.09	0	6	63449.1
184950	78.0186	150.4836	2341.44	0	6	0.0
185100	78.0187	150.4771	2341.64	0	6	0.0
185250	78.0188	150.4707	2342.08	0	6	63432.5
185400	78.0189	150.4642	2342.46	0	6	0.0
185550	78.0190	150.4578	2343.12	1336	8	63377.8
185700	78.0191	150.4513	2343.94	1337	8	0.0
185850	78.0192	150.4449	2344.50	1338	8	0.0
186000	78.0193	150.4384	2345.01	1339	8	0.0
186150	78.0194	150.4320	2345.96	1340	8	63330.2
186300	78.0195	150.4255	2346.18	1341	8	0.0
186450	78.0196	150.4191	2347.27	1342	8	0.0
186600	78.0196	150.4126	2348.29	1343	8	0.0
186750	78.0197	150.4061	2349.43	1344	8	63344.1
186900	78.0198	150.3997	2351.41	1345	8	0.0
187050	78.0199	150.3932	2352.79	1346	8	0.0
187200	78.0200	150.3868	2354.29	1347	8	0.0
187350	78.0201	150.3803	2356.31	1348	8	63332.0
187500	78.0202	150.3738	2357.83	1349	8	63338.6
187650	78.0203	150.3674	2359.07	1350	8	0.0

Distance (m)	Flag Loc. Latitude (°S)	Flag Loc. Longitude (°E)	Elevation (m)	Shot Number	Julian Day	Total Mag. Field (nT)
187800	78.0203	150.3609	2360.22	1351	8	0.0
187950	78.0204	150.3545	2361.23	1352	8	63365.8
188100	78.0205	150.3480	2362.32	1353	8	0.0
188250	78.0206	150.3416	2363.18	1354	8	0.0
188400	78.0207	150.3351	2363.97	1355	8	0.0
188550	78.0208	150.3287	2364.92	1356	8	63346.9
188700	78.0209	150.3222	2365.43	1357	8	63354.9
188850	78.0210	150.3157	2366.06	1358	8	0.0
189000	78.0211	150.3093	2366.46	1359	8	0.0
189150	78.0211	150.3028	2367.14	1360	8	63364.9
189300	78.0212	150.2964	2367.45	1361	8	0.0
189450	78.0213	150.2899	2367.58	1362	8	0.0
189600	78.0214	150.2834	2368.17	1363	8	0.0
189750	78.0215	150.2770	2368.42	1364	8	63350.1
189900	78.0216	150.2705	2368.69	1365	8	0.0
190050	78.0217	150.2641	2368.96	1366	8	0.0
190200	78.0218	150.2576	2369.25	1367	8	0.0
190350	78.0218	150.2512	2369.32	1368	8	63333.0
190500	78.0219	150.2447	2369.62	1369	8	0.0
190650	78.0220	150.2383	2370.07	1370	8	0.0
190800	78.0221	150.2318	2370.90	1371	8	63330.8
190950	78.0222	150.2253	2371.13	1372	8	63343.5
191100	78.0223	150.2189	2371.85	1373	8	0.0
191250	78.0224	150.2124	2371.97	1374	8	0.0
191400	78.0225	150.2059	2372.52	1375	8	0.0
191550	78.0226	150.1995	2373.25	1376	8	63357.3
191700	78.0226	150.1930	2373.99	1377	8	0.0
191850	78.0227	150.1866	2374.36	1378	8	0.0
192000	78.0228	150.1801	2374.96	1379	8	0.0
192150	78.0229	150.1737	2375.39	1380	8	63348.8
192300	78.0230	150.1672	2375.99	1381	8	0.0
192450	78.0231	150.1608	2376.39	1382	8	0.0
192600	78.0232	150.1543	2376.68	1383	8	0.0
192750	78.0232	150.1478	2376.77	1384	8	63380.9
192900	78.0233	150.1413	2377.07	1385	8	63387.7
193050	78.0234	150.1349	2377.26	1386	8	0.0
193200	78.0235	150.1284	2377.40	1387	8	0.0
193350	78.0236	150.1220	2378.12	1388	8	63391.8
193500	78.0237	150.1155	2378.88	1389	8	0.0
193650	78.0238	150.1091	2378.51	1390	8	0.0
193800	78.0238	150.1026	2378.46	1391	8	0.0
193950	78.0239	150.0961	2378.70	1392	8	63405.0
194100	78.0240	150.0897	2378.99	1393	8	0.0
194250	78.0241	150.0832	2378.84	1394	8	0.0
194400	78.0242	150.0768	2378.86	1395	8	0.0
194550	78.0243	150.0703	2379.04	1396	8	63408.4
194700	78.0244	150.0639	2379.10	1397	8	0.0
194850	78.0244	150.0574	2379.01	1398	8	0.0
195000	78.0245	150.0509	2378.92	1399	8	63427.2
195150	78.0246	150.0444	2378.93	1400	8	0.0
195300	78.0247	150.0380	2379.11	1401	8	0.0
195450	78.0248	150.0315	2379.37	1402	9	63375.3

Distance (m)	Flag Loc. Latitude (°S)	Flag Loc. Longitude (°E)	Elevation (m)	Shot Number	Julian Day	Total Mag. Field (nT)
195600	78.0249	150.0251	2379.35	1403	9	0.0
195750	78.0250	150.0186	2379.35	1404	9	0.0
195900	78.0250	150.0121	2379.30	1405	9	0.0
196050	78.0251	150.0057	2379.36	1406	9	63371.5
196200	78.0252	149.9992	2379.84	1407	9	0.0
196350	78.0253	149.9928	2380.01	1408	9	0.0
196500	78.0254	149.9863	2380.33	1409	9	0.0
196650	78.0255	149.9799	2380.33	1410	9	63394.5
196800	78.0256	149.9734	2380.59	1411	9	0.0
196950	78.0256	149.9669	2380.99	1412	9	0.0
197100	78.0257	149.9604	2381.49	1413	9	63385.3
197250	78.0258	149.9540	2381.44	1414	9	63377.4
197400	78.0259	149.9475	2382.05	1415	9	0.0
197550	78.0260	149.9411	2382.36	1416	9	0.0
197700	78.0261	149.9346	2382.64	1417	9	0.0
197850	78.0262	149.9282	2382.87	1418	9	63386.9
198000	78.0262	149.9217	2383.20	1419	9	0.0
198150	78.0263	149.9152	2383.38	1420	9	0.0
198300	78.0264	149.9088	2383.97	1421	9	0.0
198450	78.0265	149.9023	2384.24	1422	9	63373.7
198600	78.0266	149.8959	2384.67	1423	9	0.0
198750	78.0266	149.8894	2384.81	1424	9	0.0
198900	78.0267	149.8829	2385.36	1425	9	0.0
199050	78.0268	149.8765	2385.70	1426	9	63371.1
199200	78.0269	149.8700	2386.11	1427	9	63369.0
199350	78.0270	149.8635	2386.70	1428	9	0.0
199500	78.0271	149.8571	2386.76	1429	9	0.0
199650	78.0272	149.8506	2386.98	1430	9	63363.7
199800	78.0272	149.8441	2387.30	1431	9	0.0
199950	78.0273	149.8377	2388.06	1432	9	0.0
200100	78.0274	149.8312	2388.07	1433	9	0.0
200250	78.0275	149.8248	2388.12	1434	9	63364.2
200400	78.0276	149.8183	2388.53	1435	9	0.0
200550	78.0277	149.8118	2388.96	1436	9	0.0
200700	78.0277	149.8054	2389.16	1437	9	0.0
200850	78.0278	149.7989	2389.50	1438	9	63368.2
201000	78.0279	149.7925	2389.41	1439	9	0.0
201150	78.0280	149.7860	2389.82	1440	9	0.0
201300	78.0281	149.7795	2390.18	1441	9	63378.9
201450	78.0282	149.7730	2390.46	1442	9	0.0
201600	78.0283	149.7666	2390.72	1443	9	0.0
201750	78.0283	149.7601	2391.03	1444	9	0.0
201900	78.0284	149.7537	2391.12	1445	9	0.0
202050	78.0285	149.7472	2391.35	1446	9	63387.2
202200	78.0286	149.7407	2391.66	1447	9	0.0
202350	78.0287	149.7343	2391.79	1448	9	0.0
202500	78.0287	149.7278	2392.31	1449	9	0.0
202650	78.0288	149.7214	2392.54	1450	9	63399.8
202800	78.0289	149.7149	2392.52	1451	9	0.0
202950	78.0290	149.7084	2392.80	1452	9	0.0
203100	78.0291	149.7020	2393.06	1453	9	0.0
203250	78.0292	149.6955	2393.22	1454	9	63403.6

Distance (m)	Flag Loc. Latitude (°S)	Flag Loc. Longitude (°E)	Elevation (m)	Shot Number	Julian Day	Total Mag. Field (nT)
203400	78.0293	149.6890	2393.90	1455	9	63407.3
203550	78.0293	149.6826	2393.91	1456	9	0.0
203700	78.0294	149.6761	2394.19	1457	9	0.0
203850	78.0295	149.6696	2394.20	1458	9	63428.4
204000	78.0296	149.6632	2394.56	1459	9	0.0
204150	78.0297	149.6567	2394.28	1460	9	0.0
204300	78.0297	149.6503	2394.63	1461	9	0.0
204450	78.0298	149.6438	2394.98	1462	9	63435.1
204600	78.0299	149.6373	2394.86	1463	9	0.0
204750	78.0300	149.6309	2394.68	1464	9	0.0
204900	78.0301	149.6244	2395.18	1465	9	0.0
205050	78.0302	149.6180	2395.03	1466	9	63431.1
205200	78.0302	149.6115	2395.08	1467	9	0.0
205350	78.0303	149.6050	2395.28	1468	9	0.0
205500	78.0304	149.5985	2395.18	1469	9	63422.2
205650	78.0305	149.5921	2395.29	1470	10	63435.9
205800	78.0306	149.5856	2395.35	1471	10	0.0
205950	78.0307	149.5791	2395.42	1472	10	0.0
206100	78.0307	149.5727	2395.35	1473	10	0.0
206250	78.0308	149.5662	2395.70	1474	10	63435.4
206400	78.0309	149.5598	2395.60	1475	10	0.0
206550	78.0310	149.5533	2395.67	1476	10	0.0
206700	78.0311	149.5468	2395.43	1477	10	0.0
206850	78.0311	149.5404	2395.03	1478	10	63433.5
207000	78.0312	149.5339	2395.13	1479	10	0.0
207150	78.0313	149.5274	2395.19	1480	10	0.0
207300	78.0314	149.5210	2395.36	1481	10	0.0
207450	78.0315	149.5145	2395.29	1482	10	63426.4
207600	78.0316	149.5080	2395.45	1483	10	63416.1
207750	78.0316	149.5016	2395.19	1484	10	0.0
207900	78.0317	149.4951	2395.50	1485	10	0.0
208050	78.0318	149.4886	2395.54	1486	10	0.0
208200	78.0319	149.4822	2395.56	1487	10	63430.8
208350	78.0320	149.4757	2395.77	1488	10	0.0
208500	78.0320	149.4692	2395.77	1489	10	0.0
208650	78.0321	149.4628	2395.68	1490	10	0.0
208800	78.0322	149.4563	2396.01	1491	10	63416.3
208950	78.0323	149.4498	2395.92	1492	10	0.0
209100	78.0324	149.4434	2395.75	1493	10	0.0
209250	78.0324	149.4369	2396.04	1494	10	0.0
209400	78.0325	149.4305	2396.21	1495	10	63390.3
209550	78.0326	149.4240	2396.21	1496	10	63375.7
209700	78.0327	149.4175	2396.47	1497	10	0.0
209850	78.0328	149.4110	2396.32	1498	10	63391.8
210000	78.0329	149.4046	2396.93	1499	10	0.0
210150	78.0329	149.3981	2396.61	1500	10	0.0
210300	78.0330	149.3916	2396.67	1501	10	0.0
210450	78.0331	149.3852	2396.77	1502	10	63375.7
210600	78.0332	149.3787	2396.87	1503	10	0.0
210750	78.0333	149.3723	2396.74	1504	10	0.0
210900	78.0333	149.3658	2396.92	1505	10	0.0
211050	78.0334	149.3593	2396.81	1506	10	63343.2

Distance (m)	Flag Loc. Latitude (°S)	Flag Loc. Longitude (°E)	Elevation (m)	Shot Number	Julian Day	Total Mag. Field (nT)
211200	78.0335	149.3529	2397.13	1507	10	0.0
211350	78.0338	149.3270	2397.29	1508	10	0.0
211500	78.0337	149.3399	2397.31	1509	10	63333.3
211650	78.0338	149.3334	2397.12	1510	10	63333.6
211950	78.0339	149.3205	2397.35	1512	10	0.0
212100	78.0340	149.3140	2397.55	1513	10	63338.8
212250	78.0341	149.3076	2397.73	1514	10	63341.1
212400	78.0342	149.3011	2398.01	1515	10	0.0
212550	78.0342	149.2946	2398.27	1516	10	0.0
212700	78.0343	149.2882	2398.22	1517	10	0.0
212850	78.0344	149.2817	2398.18	1518	10	63342.3
213000	78.0345	149.2753	2398.31	1519	10	0.0
213150	78.0346	149.2688	2398.26	1520	10	0.0
213300	78.0346	149.2623	2398.52	1521	10	0.0
213450	78.0347	149.2559	2398.17	1522	10	63334.9
213600	78.0348	149.2494	2398.22	1523	10	0.0
213750	78.0349	149.2429	2397.99	1524	10	0.0
213900	78.0350	149.2364	2398.15	1525	10	63327.7
214050	78.0351	149.2300	2397.91	1526	10	63319.2
214200	78.0351	149.2235	2398.02	1527	10	0.0
214350	78.0352	149.2170	2397.93	1528	10	0.0
214500	78.0353	149.2106	2397.67	1529	10	0.0
214650	78.0354	149.2041	2397.41	1530	10	63295.7
214800	78.0355	149.1976	2397.21	1531	10	0.0
214950	78.0355	149.1912	2397.26	1532	10	0.0
215100	78.0356	149.1847	2397.12	1533	10	0.0
215250	78.0357	149.1782	2396.88	1534	10	63275.6
215400	78.0358	149.1718	2396.95	1535	10	0.0
215550	78.0359	149.1653	2396.58	1536	10	0.0
215700	78.0359	149.1588	2396.42	1537	10	0.0
215850	78.0360	149.1524	2396.61	1538	10	63265.7
216000	78.0361	149.1459	2396.60	1539	10	63258.9
216150	78.0362	149.1394	2396.44	1540	12	63102.9
216300	78.0363	149.1329	2396.43	1541	12	0.0
216450	78.0363	149.1265	2396.35	1542	12	63102.0
216600	78.0364	149.1200	2396.32	1543	12	0.0
216750	78.0365	149.1135	2396.34	1544	12	0.0
216900	78.0366	149.1071	2396.61	1545	12	0.0
217050	78.0367	149.1006	2396.52	1546	12	63102.9
217200	78.0367	149.0941	2396.70	1547	12	0.0
217350	78.0368	149.0877	2396.88	1548	12	0.0
217500	78.0369	149.0812	2397.23	1549	12	63114.7
217650	78.0370	149.0747	2397.48	1550	12	63108.6
217800	78.0370	149.0683	2397.44	1551	12	0.0
217950	78.0371	149.0618	2397.85	1552	12	0.0
218100	78.0372	149.0553	2397.92	1553	12	63127.2
218250	78.0373	149.0488	2398.44	1554	12	63108.0
218400	78.0374	149.0424	2398.59	1555	12	0.0
218550	78.0374	149.0359	2399.02	1556	12	0.0
218700	78.0375	149.0294	2399.18	1557	12	0.0
218850	78.0376	149.0230	2399.33	1558	12	63073.0
219000	78.0377	149.0165	2399.64	1559	12	0.0

Distance (m)	Flag Loc. Latitude (°S)	Flag Loc. Longitude (°E)	Elevation (m)	Shot Number	Julian Day	Total Mag. Field (nT)
219150	78.0378	149.0100	2400.26	1560	12	0.0
219300	78.0378	149.0036	2400.55	1561	12	0.0
219450	78.0379	148.9971	2400.93	1562	12	0.0
219600	78.0380	148.9906	2401.32	1563	12	0.0
219750	78.0381	148.9842	2401.30	1564	12	0.0
219900	78.0381	148.9777	2401.68	1565	12	0.0
220050	78.0382	148.9712	2402.23	1566	12	63123.9
220200	78.0383	148.9647	2402.75	1567	12	63147.5
220350	78.0384	148.9583	2403.21	1568	12	0.0
220500	78.0385	148.9518	2403.13	1569	12	0.0
220650	78.0385	148.9453	2403.66	1570	12	63193.7
220800	78.0386	148.9389	2404.24	1571	12	0.0
220950	78.0387	148.9324	2404.35	1572	12	0.0
221100	78.0388	148.9259	2404.80	1573	12	0.0
221250	78.0391	148.9001	2405.54	1574	12	63164.7
221400	78.0392	148.8936	2405.92	1575	12	0.0
221550	78.0390	148.9065	2405.45	1576	12	0.0
222000	78.0392	148.8871	2405.83	1579	12	0.0
222150	78.0393	148.8807	2406.03	1580	12	0.0
222300	78.0394	148.8741	2406.62	1581	12	63253.0
222450	78.0395	148.8677	2406.62	1582	12	63257.2
222600	78.0396	148.8612	2407.05	1583	12	0.0
222750	78.0396	148.8548	2407.16	1584	12	0.0
222900	78.0397	148.8483	2407.58	1585	12	0.0
223050	78.0398	148.8418	2407.69	1586	12	63230.3
223200	78.0399	148.8353	2408.37	1587	12	0.0
223350	78.0399	148.8289	2408.22	1588	12	0.0
223500	78.0400	148.8224	2408.46	1589	12	0.0
223650	78.0401	148.8159	2408.70	1590	12	63207.2
223800	78.0402	148.8095	2409.12	1591	12	0.0
223950	78.0402	148.8030	2409.46	1592	12	0.0
224100	78.0403	148.7965	2409.84	1593	12	0.0
224250	78.0404	148.7901	2410.13	1594	12	63229.9
224400	78.0405	148.7836	2410.84	1595	12	63240.8
224550	78.0405	148.7771	2411.09	1596	12	0.0
224700	78.0406	148.7706	2411.54	1597	12	0.0
224850	78.0406	148.7641	2411.70	1598	12	63205.4
225000	78.0406	148.7576	2411.98	1599	12	0.0
225150	78.0407	148.7512	2412.25	1600	12	0.0
225300	78.0407	148.7447	2412.64	1601	12	0.0
225450	78.0407	148.7382	2412.96	1602	12	63197.2
225600	78.0408	148.7317	2413.28	1603	12	0.0
225750	78.0408	148.7253	2413.31	1604	12	0.0
225900	78.0408	148.7188	2413.79	1605	12	0.0
226050	78.0409	148.7123	2414.01	1606	12	63192.6
226200	78.0409	148.7058	2414.28	1607	12	0.0
226350	78.0409	148.6994	2414.32	1608	12	0.0
226500	78.0410	148.6928	2414.39	1609	12	63196.3
226650	78.0410	148.6864	2414.55	1610	12	63210.0
226800	78.0411	148.6799	2414.52	1611	12	0.0
226950	78.0411	148.6734	2414.85	1612	12	0.0
227100	78.0411	148.6669	2414.87	1613	12	0.0

Distance (m)	Flag Loc. Latitude (°S)	Flag Loc. Longitude (°E)	Elevation (m)	Shot Number	Julian Day	Total Mag. Field (nT)
227250	78.0412	148.6604	2415.12	1614	12	63224.4
227400	78.0412	148.6540	2415.00	1615	12	0.0
227550	78.0412	148.6475	2415.08	1616	12	0.0
227700	78.0413	148.6410	2415.22	1617	12	0.0
227850	78.0413	148.6345	2415.04	1618	13	63128.1
228000	78.0413	148.6281	2415.43	1619	13	0.0
228150	78.0414	148.6216	2415.48	1620	13	0.0
228300	78.0414	148.6151	2415.14	1621	13	0.0
228450	78.0414	148.6086	2415.59	1622	13	63204.5
228600	78.0415	148.6021	2415.38	1623	13	63187.9
228750	78.0415	148.5956	2415.56	1624	13	0.0
228900	78.0415	148.5892	2415.68	1625	13	0.0
229050	78.0416	148.5827	2415.59	1626	13	63163.1
229200	78.0416	148.5762	2415.72	1627	13	0.0
229350	78.0416	148.5697	2415.85	1628	13	0.0
229500	78.0417	148.5632	2415.89	1629	13	0.0
229650	78.0417	148.5568	2416.20	1630	13	63167.4
229800	78.0418	148.5503	2416.21	1631	13	0.0
229950	78.0418	148.5438	2416.18	1632	13	0.0
230100	78.0418	148.5373	2416.31	1633	13	0.0
230250	78.0419	148.5309	2416.43	1634	13	63202.0
230400	78.0419	148.5244	2416.54	1635	13	0.0
230550	78.0419	148.5179	2416.64	1636	13	0.0
230700	78.0420	148.5114	2416.85	1637	13	63205.7
230850	78.0420	148.5049	2417.10	1638	13	63189.8
231000	78.0420	148.4984	2417.22	1639	13	0.0
231150	78.0421	148.4920	2417.43	1640	13	0.0
231300	78.0422	148.4660	2417.78	1641	13	0.0
231450	78.0422	148.4790	2417.66	1642	13	63204.8
231600	78.0422	148.4725	2417.51	1643	13	0.0
231900	78.0423	148.4596	2417.94	1645	13	0.0
232050	78.0423	148.4531	2418.19	1646	13	63192.7
232200	78.0423	148.4466	2418.17	1647	13	0.0
232350	78.0424	148.4401	2418.04	1648	13	0.0
232500	78.0424	148.4337	2418.20	1649	13	0.0
232650	78.0424	148.4272	2418.52	1650	13	63184.5
232800	78.0425	148.4207	2418.53	1651	13	63182.6
232950	78.0425	148.4142	2418.43	1652	13	0.0
233100	78.0425	148.4077	2418.70	1653	13	0.0
233250	78.0426	148.4012	2418.76	1654	13	63195.7
233400	78.0426	148.3947	2418.98	1655	13	0.0
233550	78.0426	148.3883	2418.96	1656	13	0.0
233700	78.0427	148.3818	2419.35	1657	13	0.0
233850	78.0427	148.3753	2419.46	1658	13	63183.0
234000	78.0427	148.3688	2419.77	1659	13	0.0
234150	78.0428	148.3624	2419.67	1660	13	0.0
234300	78.0428	148.3559	2420.17	1661	13	0.0
234450	78.0428	148.3494	2420.33	1662	13	63177.8
234600	78.0429	148.3429	2420.30	1663	13	0.0
234750	78.0429	148.3364	2420.43	1664	13	0.0
234900	78.0429	148.3299	2420.82	1665	13	63187.0
235050	78.0430	148.3234	2421.27	1666	13	63193.7

Distance (m)	Flag Loc. Latitude (°S)	Flag Loc. Longitude (°E)	Elevation (m)	Shot Number	Julian Day	Total Mag. Field (nT)
235200	78.0430	148.3170	2421.71	1667	13	0.0
235350	78.0431	148.3105	2421.83	1668	13	0.0
235500	78.0431	148.3040	2422.03	1669	13	0.0
235650	78.0431	148.2975	2421.99	1670	16	63172.1
235950	78.0432	148.2846	2422.63	1672	16	0.0
236100	78.0432	148.2781	2422.73	1673	16	0.0
236250	78.0433	148.2716	2422.99	1674	16	63173.7
236400	78.0433	148.2651	2423.08	1675	16	0.0
236550	78.0433	148.2587	2423.39	1676	16	0.0
236700	78.0434	148.2522	2423.53	1677	16	0.0
236850	78.0434	148.2457	2423.67	1678	16	63181.8
237000	78.0434	148.2392	2423.87	1679	16	63245.4
237150	78.0435	148.2327	2424.24	1680	16	0.0
237300	78.0435	148.2262	2424.24	1681	16	0.0
237450	78.0435	148.2197	2424.46	1682	16	63308.0
237600	78.0436	148.2133	2424.45	1683	16	0.0
237750	78.0436	148.2068	2424.31	1684	16	0.0
237900	78.0436	148.2003	2424.83	1685	16	0.0
238050	78.0437	148.1938	2424.60	1686	16	63263.8
238200	78.0437	148.1873	2424.45	1687	16	0.0
238350	78.0437	148.1809	2424.78	1688	16	0.0
238500	78.0437	148.1744	2424.88	1689	16	0.0
238650	78.0438	148.1679	2424.78	1690	16	63245.5
238800	78.0438	148.1614	2425.28	1691	16	0.0
238950	78.0438	148.1550	2425.08	1692	16	0.0
239100	78.0439	148.1484	2425.33	1693	16	63259.8
239250	78.0439	148.1420	2425.22	1694	16	63254.5
239400	78.0440	148.1355	2425.24	1695	16	0.0
239550	78.0440	148.1290	2425.47	1696	16	0.0
239700	78.0440	148.1225	2425.38	1697	16	0.0
239850	78.0440	148.1160	2425.65	1698	16	63215.0
240000	78.0441	148.1096	2425.75	1699	16	0.0
240150	78.0441	148.1031	2425.40	1700	16	0.0
240300	78.0441	148.0966	2425.87	1701	16	0.0
240450	78.0442	148.0901	2425.58	1702	16	63218.9
240600	78.0442	148.0836	2425.93	1703	16	0.0
240750	78.0442	148.0772	2425.79	1704	16	0.0
240900	78.0443	148.0707	2425.91	1705	16	0.0
241050	78.0443	148.0642	2425.93	1706	16	63199.5
241200	78.0443	148.0577	2426.11	1707	16	63223.6
241350	78.0444	148.0318	2426.27	1708	16	0.0
241500	78.0444	148.0447	2426.04	1709	16	0.0
241650	78.0444	148.0382	2426.19	1710	20	63125
241950	78.0444	148.0253	2426.55	1712	20	0.0
242100	78.0444	148.0188	2426.55	1713	20	0.0
242250	78.0444	148.0123	2426.61	1714	20	63153.2
242400	78.0445	148.0058	2426.77	1715	20	0.0
242550	78.0445	147.9994	2426.97	1716	20	0.0
242700	78.0445	147.9929	2427.21	1717	20	0.0
242850	78.0445	147.9864	2427.56	1718	20	63148.4
243000	78.0445	147.9799	2427.44	1719	20	0.0
243150	78.0445	147.9734	2427.49	1720	20	0.0

Distance (m)	Flag Loc. Latitude (°S)	Flag Loc. Longitude (°E)	Elevation (m)	Shot Number	Julian Day	Total Mag. Field (nT)
243300	78.0445	147.9669	2427.58	1721	20	63142.7
243450	78.0446	147.9604	2427.61	1722	20	63177.8
243600	78.0446	147.9539	2427.87	1723	20	0.0
243750	78.0446	147.9475	2427.97	1724	20	0.0
243900	78.0446	147.9410	2428.21	1725	20	0.0
244050	78.0446	147.9345	2428.45	1726	20	63158.6
244200	78.0446	147.9280	2428.61	1727	20	0.0
244350	78.0446	147.9215	2428.92	1728	20	0.0
244500	78.0447	147.9151	2429.11	1729	20	0.0
244650	78.0447	147.9086	2429.16	1730	20	63185.4
244800	78.0447	147.9021	2428.92	1731	20	0.0
244950	78.0447	147.8956	2429.59	1732	20	0.0
245100	78.0447	147.8891	2429.80	1733	20	0.0
245250	78.0447	147.8827	2429.94	1734	20	63190.7
245400	78.0447	147.8761	2430.13	1735	20	63201.5
245550	78.0447	147.8697	2430.27	1736	20	0.0
245700	78.0448	147.8632	2430.62	1737	20	0.0
245850	78.0448	147.8567	2430.85	1738	20	63221.9
246000	78.0448	147.8502	2431.13	1739	20	0.0
246150	78.0448	147.8437	2431.24	1740	20	0.0
246300	78.0448	147.8372	2431.34	1741	20	0.0
246450	78.0448	147.8308	2431.53	1742	20	63217
246600	78.0448	147.8243	2431.77	1743	20	0.0
246750	78.0448	147.8178	2431.76	1744	20	0.0
246900	78.0448	147.8113	2432.22	1745	20	0.0
247050	78.0448	147.8048	2431.98	1746	20	63217.9
247200	78.0448	147.7984	2432.01	1747	20	0.0
247350	78.0448	147.7919	2432.26	1748	20	0.0
247500	78.0448	147.7854	2432.67	1749	20	0.0
247650	78.0448	147.7789	2432.71	1750	20	63220.6
247800	78.0448	147.7724	2433.04	1751	20	63215
247950	78.0448	147.7659	2433.24	1752	20	0.0
248100	78.0449	147.7594	2433.26	1753	20	0.0
248250	78.0449	147.7529	2433.13	1754	20	0.0
248400	78.0449	147.7465	2433.31	1755	20	63238.4
248550	78.0449	147.7400	2433.38	1756	20	0.0
248700	78.0449	147.7335	2433.50	1757	20	0.0
248850	78.0449	147.7270	2433.78	1758	20	0.0
249000	78.0449	147.7205	2433.55	1759	20	63194.6
249150	78.0449	147.7141	2433.66	1760	20	0.0
249300	78.0449	147.7076	2433.91	1761	20	0.0
249450	78.0449	147.7011	2433.85	1762	20	0.0
249600	78.0449	147.6946	2433.71	1763	20	63238.1
249750	78.0449	147.6881	2433.74	1764	20	0.0
249900	78.0449	147.6816	2434.04	1765	20	63239.6
250050	78.0449	147.6751	2434.00	1766	20	63248.9
250200	78.0449	147.6686	2434.04	1767	20	0.0
250350	78.0449	147.6622	2434.13	1768	20	0.0
250500	78.0449	147.6557	2434.42	1769	20	0.0
250650	78.0449	147.6492	2434.47	1770	20	63221
250800	78.0449	147.6427	2434.21	1771	20	0.0
250950	78.0449	147.6362	2434.51	1772	20	0.0

Distance (m)	Flag Loc. Latitude (°S)	Flag Loc. Longitude (°E)	Elevation (m)	Shot Number	Julian Day	Total Mag. Field (nT)
251100	78.0449	147.6297	2434.5	1773	20	0
251250	78.0449	147.6233	2434.55	1774	20	632257
251400	78.0450	147.6168	2434.77	1775	20	0
251550	78.0450	147.6103	2434.74	1776	20	0
251700	78.0450	147.6038	2434.73	1777	20	0
251850	78.0450	147.5973	2434.44	1778	20	632273
252000	78.0450	147.5908	2435.04	1779	20	632283
252150	78.0450	147.5843	2434.77	1780	20	0
252300	78.0450	147.5779	2435.2	1781	20	0
252450	78.0450	147.5714	2435	1782	20	632320
252600	78.0450	147.5649	2435.22	1783	20	0
252750	78.0450	147.5584	2435.33	1784	20	0
252900	78.0450	147.5519	2435.29	1785		0
253050	78.0450	147.5454	2435.61	1786	20	63228.1
253200	78.0450	147.5390	2435.62	1787	20	0.0
253350	78.0450	147.5325	2435.71	1788	20	0.0
253500	78.0450	147.5260	2435.78	1789	20	0.0
253650	78.0450	147.5195	2435.96	1790	20	63220.4
253800	78.0450	147.5130	2435.96	1791	20	0.0
253950	78.0450	147.5066	2436.18	1792	20	0.0
254100	78.0450	147.5000	2436.57	1793	20	63197.6
254250	78.0450	147.4936	2436.81	1794	20	63198.7
254400	78.0450	147.4871	2436.79	2102	20	0.0
254550	78.0450	147.4806	2436.92	2101	20	0.0
254700	78.0450	147.4741	2437.33	2100	20	0.0
254850	78.0450	147.4676	2437.25	2099	20	0.0
255000	78.0450	147.4612	2437.44	2098	20	0.0
255150	78.0450	147.4547	2437.32	2097	23	63112
255300	78.0450	147.4482	2437.73	2096	23	0.0
255450	78.0450	147.4417	2437.57	2095	23	0.0
255600	78.0450	147.4352	2437.91	2094	23	0.0
255750	78.0450	147.4287	2437.77	2093	23	63113.4
255900	78.0450	147.4223	2437.81	2092	23	0.0
256050	78.0450	147.4158	2437.58	2091	23	0.0
256200	78.0450	147.4093	2438.07	2090	23	63119.5
256350	78.0450	147.4028	2438.02	2089	23	0.0
256500	78.0450	147.3963	2438.14	2088	23	0.0
256650	78.0450	147.3898	2438.32	2087	23	0.0
256800	78.0450	147.3833	2438.31	2086	23	63120.1
256950	78.0450	147.3768	2438.35	2085	23	0.0
257100	78.0449	147.3704	2438.80	2084	23	0.0
257250	78.0449	147.3639	2438.65	2083	23	0.0
257400	78.0449	147.3574	2438.55	2082	23	63089.8
257550	78.0449	147.3509	2438.49	2081	23	0.0
257700	78.0449	147.3444	2438.61	2080	23	0.0
257850	78.0449	147.3380	2438.59	2079	23	0.0
258000	78.0449	147.3315	2438.74	2078	23	63080.9
258150	78.0448	147.3250	2438.63	2077	23	0.0
258300	78.0448	147.3185	2438.70	2076	23	63083.8
258450	78.0448	147.3120	2438.44	2075	23	0.0
258600	78.0448	147.3055	2438.75	2074	23	0.0
258750	78.0448	147.2990	2438.72	2073	23	0.0

Distance (m)	Flag Loc. Latitude (°S)	Flag Loc. Longitude (°E)	Elevation (m)	Shot Number	Julian Day	Total Mag. Field (nT)
258900	78.0448	147.2926	2438.63	2072	23	63100.1
259050	78.0447	147.2861	2439.03	2071	23	0.0
259200	78.0447	147.2796	2438.84	2070	23	0.0
259350	78.0447	147.2731	2438.81	2069	23	0.0
259500	78.0447	147.2666	2438.71	2068	23	63094.7
259650	78.0447	147.2601	2438.73	2067	23	0.0
259800	78.0447	147.2537	2438.72	2066	23	0.0
259950	78.0446	147.2472	2438.74	2065	23	0.0
260100	78.0446	147.2407	2439.07	2064	23	63104.7
260250	78.0446	147.2342	2438.73	2063	23	0.0
260400	78.0446	147.2277	2439.15	2062	23	63122.6
260550	78.0446	147.2212	2439.25	2061	23	0.0
260700	78.0446	147.2147	2439.20	2060	23	0.0
260850	78.0445	147.2083	2439.30	2059	23	0.0
261000	78.0444	147.1564	2440.17	2058	23	63119.5
261300	78.0445	147.1888	2439.92	2056	23	0.0
261450	78.0445	147.1823	2439.81	2055	23	0.0
261600	78.0445	147.1759	2440.07	2054	23	63143.3
261750	78.0444	147.1694	2440.35	2053	23	0.0
261900	78.0444	147.1629	2440.53	2052	23	0.0
262200	78.0444	147.1499	2440.45	2050	23	63133.2
262350	78.0444	147.1434	2440.72	2049	23	0.0
262500	78.0444	147.1369	2441.03	2048	23	63157.4
262650	78.0443	147.1304	2441.24	2047	23	0.0
262800	78.0443	147.1240	2441.65	2046	23	0.0
262950	78.0443	147.1175	2441.93	2045	23	0.0
263100	78.0443	147.1110	2442.17	2044	23	63152.6
263250	78.0443	147.1045	2442.27	2043	23	0.0
263400	78.0443	147.0981	2442.91	2042	23	0.0
263550	78.0442	147.0916	2443.15	2041	23	0.0
263700	78.0442	147.0851	2443.14	2040	23	63132.4
263850	78.0442	147.0786	2443.61	2039	23	0.0
264000	78.0442	147.0721	2444.13	2038	23	0.0
264150	78.0442	147.0656	2444.43	2037	23	0.0
264300	78.0442	147.0591	2445.11	2036	23	63118.8
264450	78.0441	147.0527	2445.35	2035	23	0.0
264600	78.0441	147.0462	2445.67	2034	23	0.0
264750	78.0441	147.0397	2446.19	2033	23	0.0
264900	78.0441	147.0332	2446.62	2032	23	63111.1
265050	78.0441	147.0267	2446.87	2031	23	0.0
265200	78.0440	147.0202	2447.38	2030	23	0.0
265350	78.0440	147.0138	2447.78	2029	23	0
265500	78.0440	147.0073	2448.44	2028	23	63141.1
265650	78.0440	147.0008	2448.78	2027	23	0.0
265800	78.0440	146.9943	2449.06	2026	23	0.0
265950	78.0439	146.9879	2449.40	2025	23	0.0
266100	78.0439	146.9813	2449.35	2024	23	63104.1
266250	78.0439	146.9749	2449.86	2023	23	0.0
266400	78.0439	146.9684	2450.45	2022	23	0.0
266550	78.0439	146.9619	2450.51	2021	23	0.0
266700	78.0439	146.9554	2450.64	2020	23	63107.4
266850	78.0438	146.9489	2450.88	2019	23	0.0

Distance (m)	Flag Loc. Latitude (°S)	Flag Loc. Longitude (°E)	Elevation (m)	Shot Number	Julian Day	Total Mag. Field (nT)
267000	78.0438	146.9425	2450.99	2018	23	0.0
267150	78.0438	146.9360	2451.40	2017	23	0.0
267300	78.0438	146.9295	2451.27	2016	23	63112.4
267450	78.0438	146.9230	2451.26	2015	23	0.0
267600	78.0437	146.9165	2451.83	2014	23	0.0
267750	78.0437	146.9100	2452.11	2013	23	0.0
267900	78.0437	146.9036	2452.08	2012	23	63121.5
268050	78.0437	146.8971	2452.13	2011	23	0.0
268200	78.0437	146.8906	2452.15	2010	23	63124.9
268350	78.0436	146.8841	2452.55	2009	23	0.0
268500	78.0436	146.8776	2452.68	2008	23	0.0
268650	78.0436	146.8711	2452.76	2007	23	0.0
268800	78.0436	146.8647	2452.48	2006	23	63128
268950	78.0436	146.8582	2452.71	2005	23	0.0
269100	78.0435	146.8517	2452.97	2004	23	0.0
269250	78.0435	146.8452	2452.81	2003	23	0.0
269400	78.0435	146.8387	2452.94	2002	23	63143
269550	78.0435	146.8322	2453.08	2001	23	0.0
269700	78.0434	146.8258	2453.12	0	23	0.0
269850	78.0434	146.8193	2453.05	wo4001	23	0.0
270000	78.0434	146.8128	2452.84	0	23	63123.4
270150	78.0434	146.8063	2453.19	wo4002	23	0.0
270300	78.0434	146.7998	2453.52	0	**24**	63217.6
270450	78.0434	146.7934	2453.61	wo4003	24	0.0
270600	78.0433	146.7869	2453.44	0	24	0.0
270750	78.0433	146.7804	2453.83	wo4004	24	0.0
270900	78.0433	146.7739	2454.11	0	24	0.0
271050	78.0433	146.7674	2454.08	wo4005	24	63211.2
271350	78.0432	146.7545	2454.68	0	24	0.0
271500	78.0432	146.7480	2454.51	wo4006	24	0.0
271650	78.0432	146.7415	2454.64	0	24	63214.1
271800	78.0432	146.7350	2454.79	wo4007	24	0.0
271950	78.0431	146.7285	2454.79	0	24	0.0
272100	78.0431	146.7221	2455.01	wo4008	24	0.0
272250	78.0431	146.7156	2455.07	0	24	0.0
272400	78.0431	146.7091	2455.66	wo4009	24	63222.5
272550	78.0430	146.7026	2455.55	0	24	0.0
272700	78.0430	146.6961	2455.63	wo4010	24	0.0
272850	78.0430	146.6896	2455.79	0	24	0.0
273000	78.0430	146.6832	2456.16	0	24	0.0
273150	78.0429	146.6767	2456.30	0	24	63232.2
273300	78.0429	146.6702	2456.27	0	24	0.0
273450	78.0429	146.6637	2456.53	0	24	0.0
273600	78.0429	146.6572	2456.65	0	24	0.0
273750	78.0428	146.6508	2456.63	0	24	0.0
273900	78.0428	146.6443	2456.85	0	24	63222.5
274050	78.0428	146.6378	2456.69	0	24	0.0
274200	78.0428	146.6313	2456.86	0	24	0.0
274350	78.0427	146.6248	2456.71	0	24	0.0
274500	78.0427	146.6183	2457.15	0	24	63243.7
274650	78.0427	146.6118	2457.24	0	24	0.0
274800	78.0427	146.6054	2457.31	0	24	0.0

Distance (m)	Flag Loc. Latitude (°S)	Flag Loc. Longitude (°E)	Elevation (m)	Shot Number	Julian Day	Total Mag. Field (nT)
274950	78.0426	146.5989	2457.21	0	24	0.0
275100	78.0426	146.5924	2457.20	0	24	0.0
275250	78.0426	146.5859	2457.13	0	24	63234.8
275400	78.0426	146.5795	2456.98	0	24	0.0
275550	78.0425	146.5730	2456.93	0	24	0.0
275700	78.0425	146.5665	2457.14	0	24	0.0
275850	78.0425	146.5600	2457.04	0	24	0.0
276000	78.0425	146.5535	2457.10	0	24	63246.6
276150	78.0424	146.5470	2456.91	0	24	0.0
276300	78.0424	146.5406	2456.83	0	24	0.0
276450	78.0424	146.5341	2457.28	0	24	0.0
276600	78.0424	146.5276	2457.23	0	24	63257.2
276750	78.0423	146.5211	2457.36	0	24	0.0
276900	78.0423	146.5146	2457.27	0	24	0.0
277050	78.0423	146.5081	2457.41	0	24	0.0
277200	78.0423	146.5017	2457.45	0	24	0.0
277350	78.0422	146.4952	2457.53	0	24	63245.3
277500	78.0422	146.4887	2457.50	0	24	0.0
277650	78.0422	146.4822	2457.59	0	24	0.0
277800	78.0422	146.4757	2457.97	0	24	0.0
277950	78.0421	146.4693	2458.03	0	24	0.0
278100	78.0421	146.4628	2458.09	0	24	63249.9
278250	78.0421	146.4563	2458.37	0	24	0.0
278400	78.0420	146.4498	2458.76	0	24	0.0
278550	78.0420	146.4433	2458.79	0	24	0.0
278700	78.0420	146.4368	2459.14	0	24	63242.5
278850	78.0420	146.4303	2459.08	0	24	0.0
279000	78.0419	146.4239	2459.19	0	24	0.0
279150	78.0419	146.4174	2459.58	0	24	0.0
279300	78.0419	146.4109	2459.59	0	24	0.0
279450	78.0419	146.4044	2459.81	0	24	63247.5
279600	78.0418	146.3980	2459.90	0	24	0.0
279750	78.0418	146.3915	2460.35	0	24	0.0
279900	78.0418	146.3850	2460.43	0	24	0.0
280050	78.0417	146.3785	2460.66	0	24	0.0
280200	78.0417	146.3720	2460.74	0	24	63238.1
280350	78.0417	146.3656	2460.68	0	24	0.0
280500	78.0417	146.3591	2461.14	0	24	0.0
280650	78.0416	146.3526	2461.27	0	24	0.0
280800	78.0416	146.3461	2461.27	0	24	63240
280950	78.0416	146.3396	2461.50	0	24	0.0
281400	78.0415	146.3202	2462.18	0	24	0.0
281550	78.0415	146.3137	2462.22	0	24	63238.6
281700	78.0414	146.3072	2462.16	0	24	0.0
281850	78.0414	146.3007	2462.22	0	24	0.0
282000	78.0414	146.2943	2462.88	0	24	0.0
282150	78.0414	146.2878	2463.00	0	24	0.0
282300	78.0413	146.2813	2462.76	0	24	63220.6
282450	78.0413	146.2748	2462.96	0	24	0.0
282600	78.0413	146.2684	2463.30	0	24	0.0
282750	78.0412	146.2619	2463.51	0	24	0.0
282900	78.0412	146.2554	2463.68	0	24	63231.6

Distance (m)	Flag Loc. Latitude (°S)	Flag Loc. Longitude (°E)	Elevation (m)	Shot Number	Julian Day	Total Mag. Field (nT)
283050	78.0412	146.2489	2463.62	0	24	0.0
283200	78.0411	146.2424	2463.78	0	24	0.0
283350	78.0411	146.2359	2463.91	0	24	0.0
283500	78.0410	146.2295	2463.90	0	24	0.0
283650	78.0409	146.2230	2464.37	0	24	63218.8
283800	78.0409	146.2165	2464.43	0	24	0.0
283950	78.0408	146.2100	2464.78	0	24	0.0
284100	78.0408	146.2036	2464.46	0	24	0.0
284250	78.0407	146.1971	2464.49	0	24	0.0
284400	78.0407	146.1906	2464.69	0	24	63202
284550	78.0406	146.1841	2464.65	0	24	0.0
284700	78.0405	146.1777	2464.80	0	24	0.0
284850	78.0405	146.1712	2464.72	0	24	0.0
285000	78.0404	146.1647	2464.97	0	24	63205.4
285150	78.0404	146.1582	2465.33	0	24	0.0
285300	78.0403	146.1517	2465.00	0	24	0.0
285450	78.0403	146.1453	2464.77	0	24	0.0
285600	78.0402	146.1388	2465.02	0	24	0.0
285750	78.0401	146.1323	2464.82	0	24	63192
285900	78.0401	146.1258	2464.77	0	24	0.0
286050	78.0400	146.1194	2464.66	0	24	0.0
286200	78.0400	146.1129	2464.74	0	24	0.0
286350	78.0399	146.1064	2464.71	0	24	0.0
286500	78.0398	146.1000	2464.35	0	24	0.0
286650	78.0398	146.0935	2464.34	0	24	63189.9
286800	78.0397	146.0870	2463.82	0	24	0.0
286950	78.0397	146.0805	2463.80	0	24	0.0
287100	78.0396	146.0740	2464.12	0	24	63169.4
287250	78.0396	146.0676	2463.60	0	24	0.0
287400	78.0395	146.0611	2463.60	0	24	0.0
287550	78.0394	146.0546	2463.43	0	24	0.0
287700	78.0394	146.0481	2463.27	0	24	0.0
287850	78.0393	146.0417	2463.17	0	24	63176.8
288000	78.0393	146.0352	2463.07	0	24	0.0
288150	78.0392	146.0287	2463.06	0	24	0.0
288300	78.0391	146.0222	2462.78	0	24	0.0
288450	78.0391	146.0158	2462.46	0	24	0.0
288600	78.0390	146.0093	2462.53	0	24	63187.9
288750	78.0390	146.0028	2462.45	0	24	0.0
288900	78.0389	145.9964	2462.31	0	24	0.0
289050	78.0388	145.9899	2462.22	0	24	0.0
289200	78.0388	145.9834	2462.29	0	24	63184.1
289350	78.0387	145.9769	2462.40	0	24	0.0
289500	78.0387	145.9704	2462.45	0	24	0.0
289650	78.0386	145.9640	2462.43	0	24	0.0
289800	78.0386	145.9575	2462.39	0	24	0.0
289950	78.0385	145.9510	2462.35	0	24	63195.8
290100	78.0384	145.9445	2462.51	0	24	0.0
290250	78.0384	145.9381	2462.40	0	24	0.0
290400	78.0383	145.9316	2462.66	0	24	0.0
290550	78.0383	145.9251	2462.46	0	24	0.0
290700	78.0382	145.9187	2462.50	0	24	63185.6

Distance (m)	Flag Loc. Latitude (°S)	Flag Loc. Longitude (°E)	Elevation (m)	Shot Number	Julian Day	Total Mag. Field (nT)
290850	78.0381	145.9122	2462.60	0	24	0.0
291000	78.0381	145.9057	2462.74	0	24	0.0
291150	78.0380	145.8992	2462.54	0	24	0.0
291300	78.0379	145.8927	2463.13	0	24	63196
291450	78.0379	145.8863	2463.20	0	24	0.0
291600	78.0378	145.8798	2463.11	0	24	0.0
291750	78.0378	145.8733	2463.33	0	24	0.0
291900	78.0377	145.8669	2463.32	0	24	0.0
292050	78.0376	145.8604	2463.52	0	24	63190.7
292200	78.0376	145.8539	2463.40	0	24	0.0
292350	78.0375	145.8474	2463.67	0	24	0.0
292500	78.0375	145.8410	2463.72	0	24	0.0
292650	78.0374	145.8345	2463.63	0	24	0.0
292800	78.0373	145.8280	2463.76	0	24	0.0
292950	78.0373	145.8215	2463.80	0	24	63218.3
293100	78.0372	145.8151	2464.02	0	24	0.0
293250	78.0371	145.8086	2463.72	0	24	0.0
293400	78.0371	145.8021	2464.30	0	24	63207.1
293550	78.0370	145.7956	2464.56	0	24	0.0
293700	78.0370	145.7892	2464.35	0	24	0.0
293850	78.0369	145.7827	2464.58	0	24	0.0
294000	78.0368	145.7762	2464.31	0	24	0.0
294150	78.0368	145.7697	2464.53	0	24	63221.4
294300	78.0367	145.7633	2464.46	0	24	0.0
294450	78.0366	145.7568	2464.36	0	24	0.0
294600	78.0366	145.7503	2464.34	0	24	0.0
294750	78.0365	145.7439	2464.71	0	24	0.0
294900	78.0364	145.7374	2464.45	0	24	63240.1
295050	78.0364	145.7309	2464.34	0	24	0.0
295200	78.0363	145.7245	2464.45	0	24	0.0
295350	78.0362	145.7180	2464.52	0	24	0.0
295500	78.0362	145.7115	2464.95	0	24	63249.5
295650	78.0361	145.7050	2464.94	0	24	0.0
295800	78.0361	145.6985	2465.20	0	24	0.0
295950	78.0360	145.6921	2465.02	0	24	0.0
296100	78.0359	145.6856	2465.05	0	**24**	0.0
296250	78.0359	145.6791	2465.09	0	**25**	63252
296400	78.0358	145.6727	2465.15	0	25	0.0
296550	78.0357	145.6662	2465.08	0	25	0.0
296700	78.0357	145.6597	2465.17	0	25	0.0
296850	78.0356	145.6533	2465.03	0	25	0.0
297000	78.0355	145.6468	2464.66	0	25	63268.4
297150	78.0355	145.6403	2464.71	0	25	0.0
297300	78.0354	145.6339	2464.60	0	25	0.0
297450	78.0353	145.6274	2464.58	0	25	0.0
297600	78.0353	145.6209	2464.59	0	25	63260.1
297750	78.0352	145.6144	2464.51	0	25	0.0
297900	78.0351	145.6079	2464.07	0	25	0.0
298050	78.0351	145.6015	2463.94	0	25	0.0
298200	78.0350	145.5950	2463.63	0	25	0.0
298350	78.0349	145.5885	2463.52	0	25	0.0
298500	78.0349	145.5821	2463.37	0	25	63279.1

Distance (m)	Flag Loc. Latitude (°S)	Flag Loc. Longitude (°E)	Elevation (m)	Shot Number	Julian Day	Total Mag. Field (nT)
298650	78.0348	145.5756	2463.21	0	25	0.0
298800	78.0347	145.5691	2462.96	0	25	0.0
298950	78.0347	145.5627	2462.77	0	25	0.0
299100	78.0346	145.5562	2462.45	0	25	0.0
299250	78.0345	145.5497	2462.36	0	25	63293.3
299400	78.0345	145.5433	2462.48	0	25	0.0
299550	78.0344	145.5368	2461.98	0	25	0.0
299700	78.0343	145.5303	2462.26	0	25	63290.4
299850	78.0342	145.5238	2462.34	0	25	0.0
300000	78.0342	145.5173	2462.00	0	25	0.0
300150	78.0341	145.5109	2462.04	0	25	0.0
300300	78.0340	145.5044	2462.30	0	25	0.0
300450	78.0340	145.4980	2462.15	0	25	63288.3
300600	78.0339	145.4915	2462.46	0	25	0.0
300750	78.0338	145.4850	2462.49	0	25	0.0
300900	78.0338	145.4785	2462.27	0	25	0.0
301050	78.0337	145.4721	2462.61	0	25	0.0
301200	78.0336	145.4656	2462.63	0	25	63284.4
301350	78.0336	145.4592	2462.81	0	25	0.0
301500	78.0335	145.4527	2462.80	0	25	0.0
301650	78.0334	145.4462	2462.99	0	25	0.0
301800	78.0333	145.4397	2463.35	0	25	63280
301950	78.0333	145.4332	2463.52	0	25	0.0
302100	78.0332	145.4268	2463.57	0	25	0.0
302250	78.0331	145.4203	2463.86	0	25	0.0
302400	78.0331	145.4138	2464.17	0	25	0.0
302550	78.0330	145.4074	2464.11	0	25	63297
302700	78.0329	145.4009	2464.44	0	25	0.0
302850	78.0328	145.3944	2464.47	0	25	0.0
303000	78.0328	145.3880	2464.63	0	25	0.0
303150	78.0327	145.3815	2465.02	0	25	0.0
303300	78.0326	145.3750	2465.18	0	25	63303.9
303450	78.0326	145.3686	2465.34	0	25	0.0
303600	78.0325	145.3621	2465.50	0	25	0.0
303750	78.0324	145.3557	2465.64	0	25	0.0
303900	78.0323	145.3492	2466.22	0	25	63310.8
304050	78.0323	145.3427	2465.98	0	25	0.0
304200	78.0322	145.3362	2466.35	0	25	0.0
304350	78.0321	145.3297	2466.58	0	25	0.0
304500	78.0321	145.3233	2466.65	0	25	0.0
304650	78.0320	145.3168	2466.85	0	25	63326.1
304800	78.0319	145.3103	2467.32	0	25	0.0
304950	78.0318	145.3039	2467.39	0	25	0.0
305100	78.0318	145.2974	2467.67	0	25	0.0
305250	78.0317	145.2910	2468.09	0	25	0.0
305400	78.0316	145.2845	2468.15	0	25	63332.2
305550	78.0315	145.2780	2468.34	0	25	0.0
305700	78.0315	145.2716	2468.69	0	25	0.0
305850	78.0314	145.2651	2469.02	0	25	0.0
306000	78.0313	145.2586	2469.19	0	25	63327.4
306150	78.0312	145.2521	2469.31	0	25	0.0
306300	78.0312	145.2457	2469.67	0	25	0.0

Distance (m)	Flag Loc. Latitude (°S)	Flag Loc. Longitude (°E)	Elevation (m)	Shot Number	Julian Day	Total Mag. Field (nT)
306450	78.0311	145.2392	2469.93	0	25	0.0
306600	78.0310	145.2327	2470.24	0	25	0.0
306750	78.0310	145.2263	2470.19	0	25	63346.2
306900	78.0309	145.2198	2470.42	0	25	0.0
307050	78.0308	145.2133	2470.60	0	25	0.0
307200	78.0307	145.2069	2470.86	0	25	0.0
307350	78.0306	145.2004	2470.91	0	25	0.0
307500	78.0306	145.1940	2471.20	0	25	0.0
307650	78.0305	145.1875	2470.98	0	25	0.0
307800	78.0304	145.1810	2470.95	0	25	63331.3
307950	78.0303	145.1746	2471.07	0	25	0.0
308100	78.0303	145.1681	2471.48	0	25	63328.3
308250	78.0302	145.1616	2471.41	0	25	0.0
308400	78.0301	145.1551	2471.41	0	25	0.0
308550	78.0300	145.1487	2471.38	0	25	0.0
308700	78.0300	145.1422	2471.33	0	25	0.0
308850	78.0299	145.1357	2471.44	0	25	63328.1
309000	78.0298	145.1293	2471.24	0	25	0.0
309150	78.0297	145.1228	2471.33	0	25	0.0
309300	78.0297	145.1164	2471.24	0	25	0.0
309450	78.0296	145.1099	2471.41	0	25	0.0
309600	78.0295	145.1034	2471.01	0	25	63305.1
309750	78.0294	145.0970	2471.05	0	25	0.0
309900	78.0293	145.0905	2470.92	0	25	0.0
310050	78.0293	145.0840	2470.85	0	25	0.0
310200	78.0292	145.0775	2470.96	0	25	63307.2
310350	78.0291	145.0711	2470.93	0	25	0.0
310500	78.0290	145.0646	2470.53	0	25	0.0
310650	78.0290	145.0582	2470.80	0	25	0.0
310800	78.0289	145.0517	2470.82	0	25	0.0
310950	78.0288	145.0452	2470.47	0	25	63288.1
311100	78.0287	145.0388	2470.33	0	25	0.0
311250	78.0286	145.0323	2470.51	0	25	0.0
311400	78.0286	145.0258	2470.36	0	25	0.0
311550	78.0285	145.0194	2470.11	0	25	0.0
311700	78.0284	145.0129	2469.96	0	25	63270
311850	78.0283	145.0065	2469.93	0	25	0.0
312000	78.0282	145.0000	2470.08	0	25	0.0
312150	78.0282	144.9935	2469.95	0	25	0.0
312300	78.0281	144.9871	2469.80	0	25	0.0
312450	78.0280	144.9806	2470.04	0	25	0.0
312600	78.0279	144.9741	2470.04	0	25	63250.5
314700	78.0264	144.8838	2470.07	0		
316800	78.0248	144.7935	2472.98	0		
318900	78.0232	144.7033	2474.53	0		
321000	78.0216	144.6130	2472.95	0		
323100	78.0200	144.5228	2474.31	0		
325200	78.0183	144.4326	2472.61	0		
327300	78.0165	144.3425	2472.58	0		
329400	78.0148	144.2523	2471.97	0		
331500	78.0131	144.1622	2472.16	0		
333600	78.0113	144.0721	2474.39	0		

Distance (m)	Flag Loc. Latitude (°S)	Flag Loc. Longitude (°E)	Elevation (m)	Shot Number	Julian Day	Total Mag. Field (nT)
335700	78.0095	143.9821	2476.20	0		
337800	78.0076	143.8920	2475.43	0		
339900	78.0058	143.8020	2476.28	0		
342000	78.0039	143.7120	2481.45	0		
344100	78.0020	143.6221	2482.93	0		
346200	78.0000	143.5321	2479.94	0		
348300	77.9980	143.4422	2478.85	0		
350400	77.9960	143.3524	2478.27	0		
352500	77.9939	143.2625	2477.97	0		
354600	77.9919	143.1727	2476.47	0		
356700	77.9898	143.0830	2478.7	0		
358800	77.9876	142.9932	2483.27	0		
360900	77.9855	142.9035	2485.96	0		
363000	77.9833	142.8138	2486.47	0		
365100	77.9811	142.7242	2490.71	0		
367200	77.9789	142.6345	2494.15	0		
369300	77.9766	142.5450	2502.27	0		
371100	77.9746	142.4682	2508.08	0		
371400	77.9743	142.4554	2508.4	0		
373500	77.9720	142.3659	2507.91	0		
375600	77.9696	142.2764	2510.66	0		

APPENDIX 2: Gravity Measurements

by Ron Hackney and Uri ten Brink

J Day	Time (Local)	Distance (m)	Raw Gravity	Observed G. (mGal)
344	14:53	alpha	5975.05	
	18:50	alpha	5974.98	
345	10:05	0	5978.38	
	19:15	0	5978.44	
346	10:12	0	5978.38	982292.00
	12:50	1050	5981.18	
	14:30	2100	5982.57	982296.06
	16:15	3450	5987.97	982301.44
	18:45	5550	5983.15	982296.63
	21:15	6750	5979.12	
347	12:30	7500	5978.37	982291.75
	14:00	9600	5976.43	982289.81
	15:20	10500	5974.67	982288.00
	17:00	12600	5961.82	982275.19
	18:45	14700	5955.57	982268.88
348	11:00	15900	5955.23	982268.50
	11:40	18000	5959.35	982272.56
	13:30	20100	5962.96	982276.19
	15:35	22200	5971.88	982285.13
	16:25	23100	5973.15	
349	12:20	24000	5975.37	982288.50
	13:50	26100	5984.05	982297.13
351	12:04	28200	5985.97	982298.81
	13:05	29700	5985.23	982298.06
	14:30	31800	5982.72	982295.56
	16:13	33900	5980.49	982293.31
	16:55	34800	5979.06	982291.88
	18:37	36900	5975.43	982288.25
353	15:50	38000	5968.45	982275.94
	17:17	41100	5963.34	982274.81
	18:05	42150	5962.27	
	19:06	43350	5962.27	982274.81
	19:55	44550	5962.59	982275.13
	20:43	45600	5962.16	982274.69
	21:20	46650	5961.35	982273.88
354	13:54	48750	5956.52	982269.00
	15:21	50700	5953.84	982266.31
	16:35	52800	5954.68	982267.13
	17:35	54600	5958.39	982270.81
	19:05	56700	5962.95	982275.38
	20:22	58800	5965.88	982278.31
355	13:15	60900	5967.24	982279.56
	14:20	63150	5969.45	
	15:05	64350	5972.81	982285.13

J Day	Time (Local)	Distance (m)	Raw Gravity	Observed G. (mGal)
	16:10	65850	5977.95	982290.25
	17:45	67950	5985.77	982298.06
356	13:19	69900	5977.22	982289.44
	14:32	71550	5972.80	982285.00
	16:05	73650	5978.32	982290.50
361	14:14	75750	5983.49	982295.06
	15:05	77850	5976.68	982288.25
	15:41	79950	5972.42	982284.00
	16:08	81150	5965.36	982276.94
	16:37	82500	5957.74	982269.31
	17:12	84600	5947.82	982259.38
	17:47	86700	5939.67	982251.19
	18:25	88800	5936.65	982248.19
	19:57	90500	5936.56	
362	10:05	90900	5936.60	982248.06
	11:02	93000	5936.55	982248.00
	12:00	94800	5933.24	982244.69
	13:15	96900	5930.76	982242.19
	14:54	99000	5926.89	982238.31
	16:08	101100	5919.99	982231.44
	17:15	103200	5916.71	982228.13
	18:25	105300	5915.96	982227.38
1	10:40	105200	5915.86	
	12:24	107400	5916.04	982227.13
	13:30	109500	5916.23	982227.25
	14:42	111600	5917.28	982228.31
	16:35	113700	5917.27	982228.31
	17:50	115800	5916.44	982227.44
	19:08	117900	5917.64	982228.69
	20:35	120000	5917.32	982228.31
2	14:23	122100	5916.88	982227.81
	15:35	124200	5919.94	982230.88
	17:07	126300	5922.05	982228.50
	18:10	127950	5917.62	982223.81
	20:40	bravo	5915.48	
3	12:12	129750	5912.98	
	13:20	131850	5906.73	982217.50
	14:35	133950	5902.54	982212.75
	15:40	136050	5900.84	982211.00
	17:25	138150	5901.12	982211.25
	18:35	140250	5902.13	982212.31
	19:43	142350	5903.35	982213.50
	20:38	143850	5903.80	982213.94
4	13:55	145950	5904.04	982214.06

J Day	Time (Local)	Distance (m)	Raw Gravity	Observed G. (mGal)
	15:05	147900	5904.53	982214.56
	18:18	150000	5903.07	982213.13
5	12:55	152100	5901.63	982211.56
	13:58	154200	5900.54	982210.44
	15:08	156300	5899.11	982209.00
	16:15	158250	5895.79	982205.69
	17:53	159900	5896.62	982206.50
	19:05	162000	5899.65	982209.56
6	14:36	164100	5901.39	982211.19
	15:20	166200	5901.17	982210.94
	16:02	168300	5900.01	982209.81
	17:18	170250	5898.44	982208.19
	17:48	171600	5897.75	982207.50
	18:26	173700	5897.08	982206.88
	19:05	175800	5898.62	982208.38
	19:45	177900	5899.04	982208.81
	20:29	179850	5900.81	982210.56
	21:25	181950	5904.47	982214.25
	22:25	183900	5906.02	982215.75
7	19:25	185400	5907.17	982216.81
8	13:50	187500	5905.55	982215.06
	14:58	188700	5904.05	982213.56
	16:48	190800	5903.73	982213.25
	18:38	192900	5902.48	982212.00
	20:10	195000	5901.90	982211.38
9	13:21	197100	5900.88	982210.31
	14:40	199200	5898.46	982207.88
	16:45	201300	5895.59	982205.00
	18:04	203400	5892.73	982202.13
	20:12	205500	5892.02	982201.38
10	13:40	207600	5889.51	982198.81
	14:58	209550	5887.52	982196.81
	16:20	211500	5885.21	982194.50
	18:26	213900	5882.01	982191.25
	19:54	216000	5880.13	982189.38
12	13:12	218100	5877.90	982186.94
	14:35	220200	5875.55	982184.56
	16:10	222300	5874.02	982183.00
	17:25	224400	5871.96	982180.94
	19:15	226500	5869.33	982178.31
13	15:35	228600	5867.47	982176.38
	16:48	230700	5865.58	982174.44
	18:15	232800	5863.65	982172.50
	19:40	234900	5862.03	982170.88
16	16:08	237000	5865.62	982174.13

J Day	Time (Local)	Distance (m)	Raw Gravity	Observed G. (mGal)
	17:23	239100	5864.24	982172.75
	19:01	241200	5862.92	982171.44
20	14:12	243300	5861.54	982169.56
	16:42	245400	5859.98	982167.94
	18:23	247800	5858.04	982166.00
	20:40	249900	5856.96	982164.94
	22:28	252000	5856.51	982164.44
	23:59	254100	5856.70	982164.63
21	20:20	257860	5858.13	
	22:00	charlie	5864.40	
23	7:09	256200	5856.95	982164.63
	7:50	257860	5858.24	
	8:05	258300	5858.34	982166.00
	9:05	260400	5859.50	982167.13
	9:50	262500	5860.31	982167.94
	10:25	264300	5860.04	982167.69
	11:05	266100	5859.26	982166.88
	11:50	268200	5858.64	982166.25
	12:35	270300	5858.09	982165.69
	18:18	269700	5858.11	
	19:35	272400	5857.25	982164.81
	20:26	274500	5856.83	982164.44
	20:55	276600	5856.90	982164.50
	21:18	278700	5856.44	982164.00
	21:41	280800	5855.68	982163.25
	22:06	282900	5854.72	982162.31
	22:31	285000	5853.74	982161.31
	22:55	287100	5853.24	982160.81
	23:30	289200	5853.44	982161.00
	23:59	291300	5853.00	982160.56
24	0:20	293400	5852.13	982159.69
	0:43	295500	5851.23	982158.81
	1:29	297600	5850.98	982158.56
	1:54	299700	5851.89	982159.44
	2:18	301800	5852.11	982159.69
	2:46	303900	5852.03	982159.56
	3:09	306000	5851.94	982159.50
	3:35	308100	5851.63	982159.19
	3:57	310200	5851.99	982159.50
	4:27	312600	5852.32	982159.88
25	9:15	269700	5858.49	
	14:20	269700	5858.35	
26	22:40	269700	5859.48	
27	0:05	269700	5859.60	

APPENDIX 3: Ground Penetrating Radar Measurements

By Yizhaq Makovsky

INTRODUCTION

The main purpose of the radar component of this project was to image the ice-rock interface to provide independent information for seismic processing. This was particularly important at the beginning of the traverse, near the mountains, where significant topography of the ice-rock interface was expected. Good penetration, at the expense of resolution, was required to reach the ice-rock interface at depths exceeding 1 km. To achieve the penetration needed we had to use a low frequency (~1 MHz) radar system. However, such system has long (40 m) antennae that make it cumbersome to use. The radar data had to be collected with little effort and demand as little time as possible from the team, because seismic profiling was the main effort of the experiment.

An automated profiling radar system, designed after a system built by Ed Waddington and Dave Morse of the University of Washington, allowed us to acquire low frequency radar data without affecting the progress of the seismic experiment. The system was put together at the last moment with components of different origins and with the help of Ed Waddington and Dave Morse. This system is described by Weertman (1993) and is principally based on the procedure described by Watts and Wright (1981) modified to be operated by a single person.

SYSTEM CONFIGURATION AND FIELD PROCEDURES

General set-up

The radar system included a transmitter unit and a receiver unit, each connected to a two-arm wire antenna and each located on a separate sled (Figure A3.1). The two antennae were positioned in an endfire parallel alignment separated by a distance on the order of an antenna half length. The antennae, sleds, and the towing Alpine-II Skidoo snowmobile were chained to each other with stiff non-conducting ropes that kept the system spread for acquisition while it was towed. The receiver needed to be checked more frequently, and was therefore, towed in front (closer to the snowmobile driver).

Antennae

Principles: Both transmitting and receiving antennae are identical center-fed dipole wire-antennae symmetric about the feed point and are resistivity-loaded. The resistive load attenuates the outgoing waves and prevents a reflection of the wave inward from the tips of the antenna. The resistance per unit length at a distance z (in meters) inward from the outer end of the antenna arm is

$R(z)=¥/z$

where ¥ is the resistive loading constant in ohms.

The center frequency of the transmitted pulse, for antennae lying on the ice surface, is approximately given by

$f=50/h$

where h is the antenna half length in meters and f is the center frequency in MHz.

Specifications: We used antennae with half length h=40 m, center frequency f=1.25 Hz and resistivity ¥=400 ohm lent to us by Ed Waddington and Dave Morse.

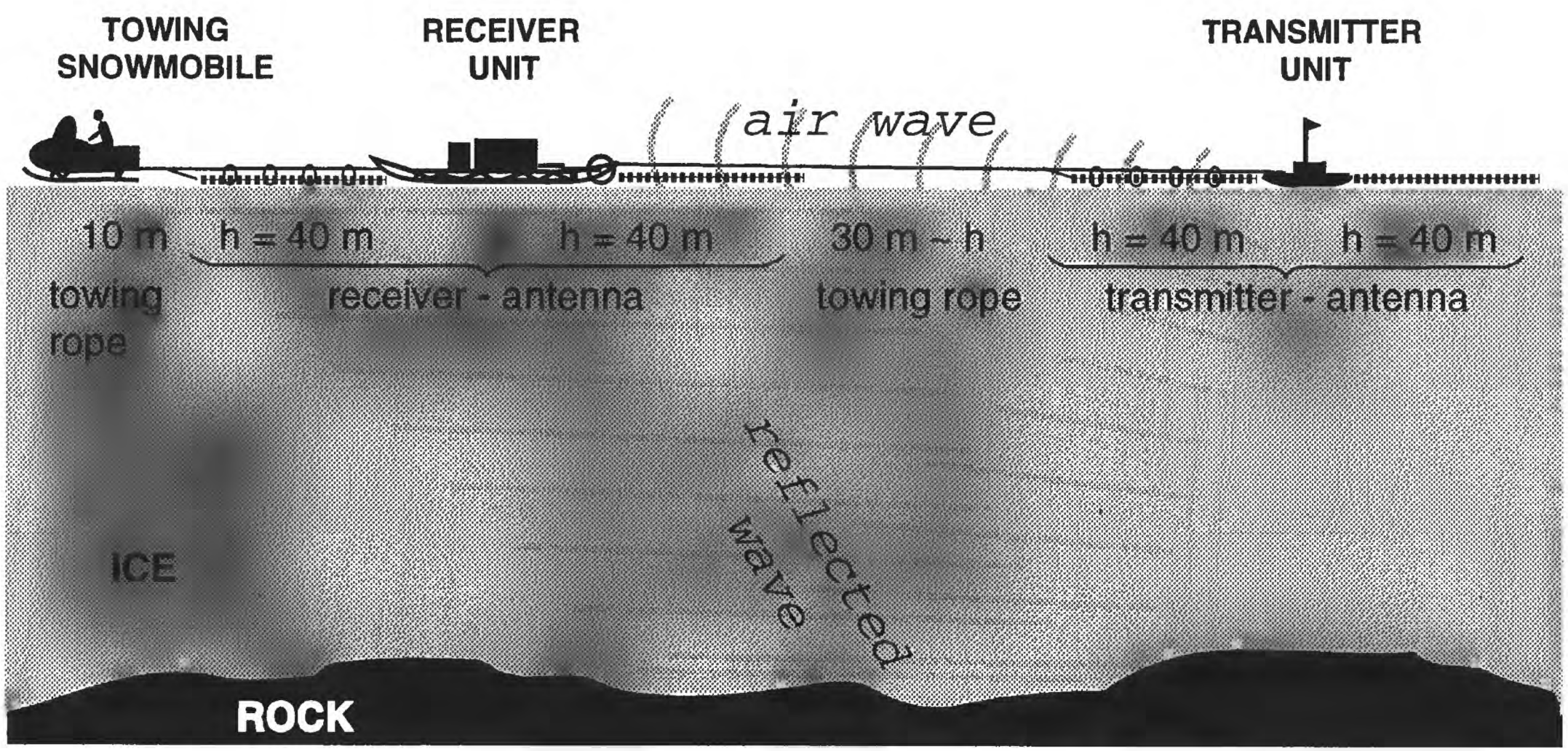


Figure A3.1 Illustration (not to scale) of the ground-penetrating-radar set-up during acquisition. See text for detailed description.

Field set-up: The backward-directed arms of the antennae were thin conducting wires, which dragged behind the sleds. The forward-directed arms of the antennae were inserted into 1" webbing to avoid tension on the antennae. The webbing was tied at its two ends with 3/8" bungie cord to the towing rope, and the bungie cord acted as a shock absorber. The webbing was passed through carabbiners, tied at constant intervals to the towing rope, to keep the webbing parallel with and close to the towing rope.

Transmitter unit

Components: The transmitter unit, described in Figure A3.2a, had two components: a high voltage converter and a pulse generator. The converter provided an adjustable, 750 V power supply from a 12 V battery to the pulse generator. The pulse repetition rate of the generator was controlled by the power supply current and was normally set at a few KHz. The pulse generator used was a four-stage transistor-avalanche as described by Watts and Wright (1981) with about 600 V output. The converter and pulse generator were lent to us by Steve Hodge, Water Resource Division, USGS.

Field set-up: The pulse generator and converter were soft packed together with one 50 Ah 12 V Sealed-Lead-Acid battery into a wooden box. Thanks to the large battery capacity, this unit seldom needed to be charged. The transmitter was mounted on a small "Banana" sled. Because the "Banana" sled could easily flip over, a flag-pole was placed on top of the sled to allow the operator (160 m in front of the sled) to see whether it was upright while driving (Figure A3.1).

Receiver unit

The receiver unit, illustrated in Figure A3.2b, was a combination of two computer-controlled assemblages, the triggering assemblage and the acquisition assemblage. The triggering assemblage measured the progression over the ground and passed the information in a digitized form to the computer that acquired a trace when a pre-specified distance elapsed. In the acquisition assemblage, the signal received from the antenna was amplified, digitized, stacked, and passed to the computer.

The triggering assemblage:

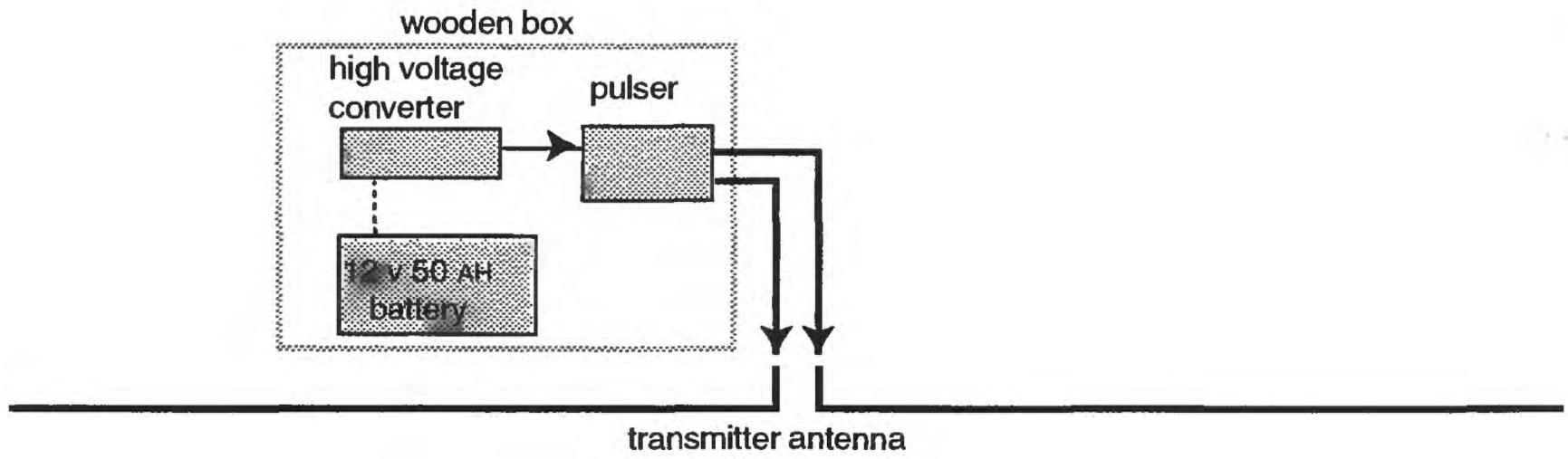
Outline: A bicycle wheel was dragged behind the receiver sled. A magnetic dip-switch, connected to an electronic counter box, counted the wheel rotations and the count was transferred to the parallel port of the computer. The computer reset the counter every time a trace was acquired.

The acquisition assemblage:

Outline: The signal from the antenna arms was received by an amplifier, then passed to both input channels of a digital oscilloscope. As in most ground penetrating radar, the oscilloscope was triggered by the first arriving wave, the air wave, which is also the strongest arrival (a small pre-trigger length was used to verify the recording of the first arrival). The traces were averaged by the oscilloscope and the resulting trace was transmitted to the computer, together with the scope settings (through the communication port), upon request from the computer.

Specifications and parameters: We used an amplifier with a scalar gain of about 13, lent to us by Ed Waddington and Dave Morse. We began the survey using a Tektronix 222 Power Scout 10 MHz digital storage scope that was later changed to a Fluke 97 Scopemeter. Both oscilloscopes output a digital trace with 512 one-byte samples. This sampling produces data which are strictly limited both in terms of dynamic range and frequency response.

a. Transmitter unit



b. Receiver unit

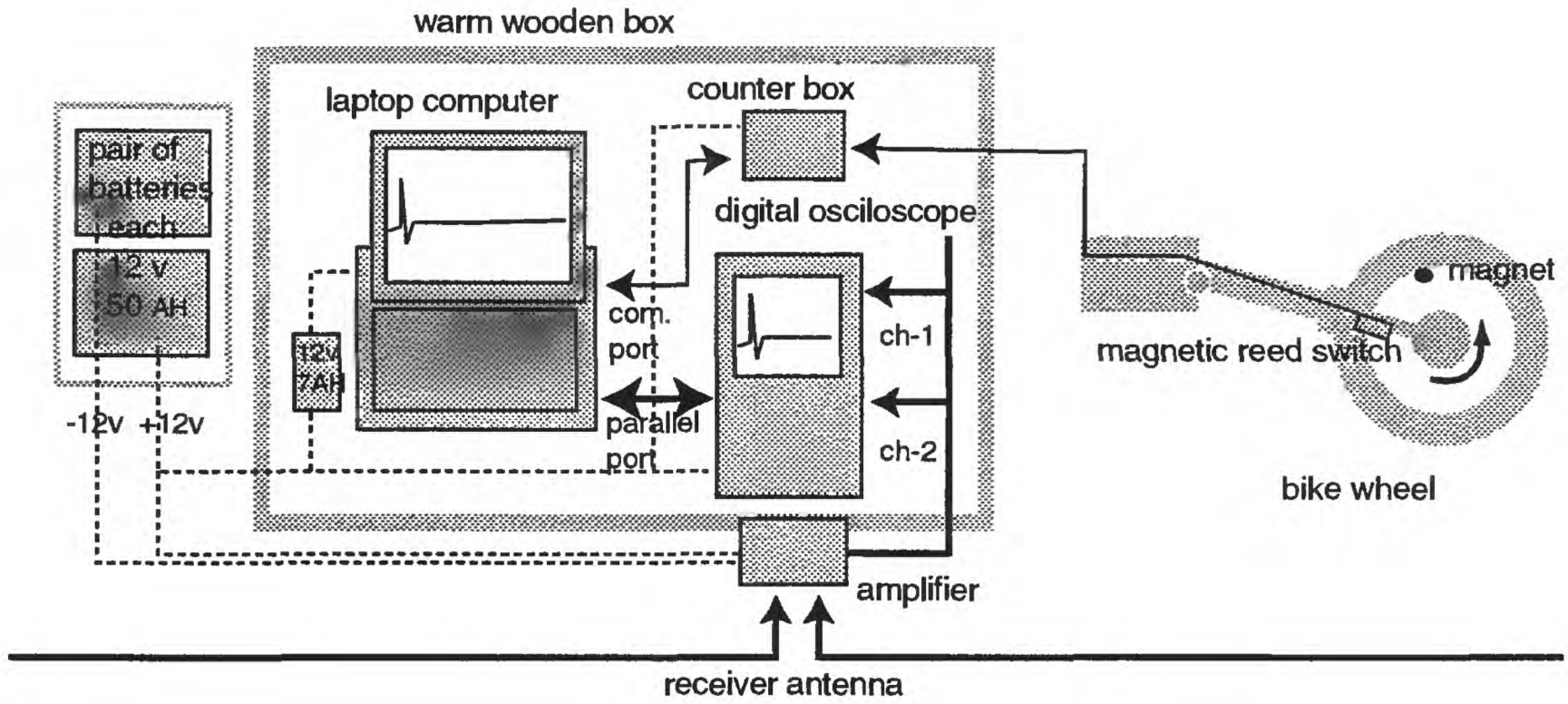


Figure A3.2 Diagrams describing the components of the ground penetrating radar system. Arrows indicate the directions of signal transmission, dashed lines describe DC power supply, thick lines connect the acquisition receiver assemblage components, and thin lines connect the receiver triggering assemblage components.

We used 2 μsec/division time scale on the scope which translates to 0.08 μsec sample interval, 12.5 MHz sample rate, about 3 MHz Nyquist frequency, and trace length of 40.88 μsec (equivalent to a depth of about 3400 m in ice). To get around the limited dynamic range, channel 2 of the oscilloscope was set to a low amplitude gain, sampling the first arrival properly, and was used to trigger the oscilloscope. Channel 1 was set to a much higher gain (2-20 mV/division) to sample the small secondary arrivals (reflected waves) properly, while clipping the first arrivals. This channel was used as the data-acquisition channel. The oscilloscope was set-up in the 'average' mode to stack subsequent traces. The Tek 222 was able to stack 128 subsequent traces, and the Fluke 97 was able to stack 256 traces.

The computer:

Outline: The receiver unit was controlled by a program running on a PC laptop. The program was launched at the beginning of acquisition and acquired data while the operator was driving the towing snowmobile. A trace was acquired from the scope when the number of wheel revolutions, received by the program, equaled the 'counts per trace' value in the program configuration file. The count was then reset. The traces were kept on RAM during acquisition, and were own-loaded at the end of an acquisition session. The data were recorded with headers describing the scope configuration, location, and wheel count for each trace.

Details: The two oscilloscopes used different programs. The program used with the Fluke 97 oscilloscope required a math-coprocessor (FPU) whereas the program used by the Tek 222 did not. The FPU was not available on the 286 Toshiba laptop initially used, but starting at Julian day 353 we were able to run the Fluke 97 program on an Avanti 486 laptop with an FPU. The program used with the Fluke 97 was more advanced. It allowed the operator to enter the location along the line at the start and the end of acquisition and when he stopped to check the radar operation.

Field set-up:

Weather protection: Both the oscilloscope and laptop had LCD screens which needed to be shielded from freezing. They were put in an insulated wooden box with hot water bottles containing about 10 liter in total. (The bottles were insulated to slow the heat flux). The wooden box had an external lid and an internal transparent lid (Perspex sheet). The transparent lid had openings to handle the receiver without exposing the contents of the box to the cold.

Power supply: The amplifier needed ±12 V power supply whereas the rest of the components operated with a 12 V supply. Power was supplied to the receiver unit from two 12 V 50 Ah sealed lead-acid batteries that were packed into a separate wooden box and charged once every few days. The Avanti laptop needed 14 V supply, so another 12 V 7 Ah battery with a DC converter was added into the oscilloscope and laptop box when this laptop was used. Although this battery was charged daily, its capacity put a limit on the duration of acquisition, and several times even caused data loss .

Packing: The wooden components and batteries boxes were strapped on top of a "Nansen" sled. The bike-wheel fork was mounted in the back of the sled allowing the wheel some freedom to move up and down to follow the terrain. The antenna arms were kept out of the way of the sled.

<u>Field procedure</u>

The radar was operated only when it was far from other traverse vehicles to prevent reflections off the other vehicles and especially, the seismic streamer. The radar equipment stayed at the base camp, and followed at a distance > 200 m behind the base camp, when

the camp moved at the end of the working day. Hot water bottles were prepared right before the camp was moved, the receiver was arranged, the source started, the oscilloscope configuration was set-up to receive a stable signal, the acquisition program was started, the location inserted, and finally, the snowmobile was connected to the towing rope, and the radar tow began.

The radar was towed at a speed of up to 20 km/h, while acquisition took place. Once in a while, the operator stopped the radar and checked the receiver to verify that the acquisition was stable and to input the receiver-sled surface location. When a large distance was traversed in a day, the program was stopped and the data file was saved to disk. Acquisition was then restarted, recording into another file.

As the radar approached camp, it was aligned with the streamer (producing resonating reflections off the streamer that could be clearly seen on the last traces in most acquisition sessions). After the radar was parked, the program was stopped and the data were saved to disk, and briefly viewed for quality control, then backed-up to floppy disk. The receiver components were turned off and taken to a warm place, and the source was turned off.

Part of the section between Taylor Dome (km -10) and km 68.450 was acquired with the Tek 222-based system. The entire section was acquired again with the Fluke 97 based-system during a re-supply trip to Taylor Dome. During this trip, the section between km 68.450 and km 18 was recorded on the way to Taylor Dome and the section between Taylor Dome and km 18 was recorded on the way back. During this trip, the radar system was towed behind the Tucker Snocat 069 at a speed of 3-4 km.

DATA REDUCTION

A total of 18 data files, covering (with some overlap and some gaps) a total section of 205 km, were recorded in 14 days of acquisition. Of these files, 4 were recorded with the Tek 222 based system and 12 were recorded with a Fluke 97 based system. The Fluke 97 data covers all the section recorded with Tek 222 system. To date, only the Fluke 97 files have been reduced.

Data were converted into SEG-Y format to allow the use of standard seismic processing software, and to facilitate the viewing and processing of the data. First the data were stripped of their headers with the University of Washington software (lent to us by Dave Morse). The headers were interpreted and the wheel counts were converted into distance and compared with the surface locations input by the operator in the field. We found that the wheel counts underestimated the distance by about 15 % probably because of wheel decoupling from the surface (due to slippage or where the sled crossed a sastrugi and lifted the wheel off the surface). The trace surface-locations were linearly interpolated for each trace from the surface-locations inserted in the field.

The trace binary data were converted into SEG-Y 2 byte/sample traces. SEG-Y reel and trace headers were concatenated to the data. SEG-Y trace-headers were loaded as follows (all values are integers):

Header value	bytes in header
surface-location in tens of meter	21-24
Julian day	159-160
wheel counts per trace	161-162
pre-trigger length in 1/100 μsec	163-164
mV/division	121-122

To make the data appear to seismic processing packages as standard seismic data input, the time scale was multiplied by a factor of $1x10^5$ (i.e., apparent sample interval of 8 msec). The change of time scale must be taken into consideration at all stages of processing. ProMAX™ seismic processing package, from Advance Geophysical Corporation was used to view and process the data.

SUMMARY

Using an automated ground penetrating radar system we were able to profile the ice sheet from the Transantarctic mountains to the edge of Wilkes subglacial basin. The data were acquired by a single operator placing little demand on the limited resources of the EAST93 seismic project. The resulting image reveals rough topography at the base of the ice sheet and flow patterns within the ice that wrap around basement highs.

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APPENDIX 4: Ground Conditions

By Ron Hackney

NOTE: description of the terrain encountered was not begun until December 27th (Julian Day 361)

74.85 - 90.45 km:
surface = 40% sastrugi (<20 cm), 40% flat snow, 20% drift snow Note that tracks left by survey team skidoos all exist on the flat areas of snow, suggesting that many of the drifts seen formed within a period of roughly a week.

90.9 - 93.0 km:
surface = mostly relatively flat and soft snow, 20% sastrugi (<10 cm)

93.0- 103.2 km:
surface = 30% sastrugi (<10 cm), some harder and rougher snow in places some sastrugi reaching 20 cm

103.2 - 107.4 km:
poor definition meant difficult to examine, but mostly soft snow that is soft to drive over

107.4- 113.7 km:
surface = 20% sastrugi (<20 cm), mostly soft rolling snow drifts

113.7 - 117.9 km:
surface becoming rougher and bumpier, some drift ridges up to 50 cm high otherwise no change

117.9 - 120.6 km:
becoming smoother again. sastrugi = 20% (<20 cm)

122.1 - 123.6 km:
surface = 30% sastrugi (up to 40 cm high), 10% hard ice, mostly surface is firm and bumpy to drive over.

123.6 - 126.3 km:
very large sastrugi appear, some up to 1.5m from top to bottom! (the biggest encountered on the traverse); fortunately largest sastrugi occur infrequently, i.e.. they were generally easy to avoid.

126.3 - 127.75 km:
extreme sastrugi disappear, but still exist up to 50 cm in height; surface still rough with frequent solid ice patches.

127.5 km:
surface = 10-20% sastrugi (<30 cm), 50% solid ice patches.

129.95 - 136.05 km:
surface = 50% hard, icy snow, 20% sastrugi (<30 cm), occasional snow drift up to 50 cm.

136.05- 143.85 km:
less hard snow, now only around 20%; icy ridges up to 50 cm becoming slightly more abundant

143.85- 150.0 km:
surface becoming bumpier due to frequent mounds of icy snow and occasional sastrugi up to 1m in height.

150.0 - 152.1 km:
big sastrugi becoming less frequent, ground still firm and rough to drive over.

152.1 - 162.0 km:
surface = 70% soft snow, 10% hard snow, 20% sastrugi (<30 cm); surface much smoother to drive over.

162.0 - 185.4 km:
surface = 20-40% sastrugi (<50 cm). Some quite rough stretches lasting 2-3 km; rare sastrugi up to 1m high; abundant steel hard icy patches.

185.4 - 187.5 km:
extremely rough surface; sastrugi up to 1m, dangerous to drive over in conditions with poor definition

187.5 - 190.8 km:
surface = 30-50% sastrugi (up to 1m, mostly 50 cm); snow mostly soft

190.8 - 194.1 km:
large sastrugi less common

194.1 - 199.2 km:
Surface = 50% sastrugi (<50 cm) making driving rougher

199.2 - 205.5 km:
surface = 20-30% sastrugi (<50cm, rarely to 1m); surface smoother to travel over.

205.5 - 224.4 km:
surface = 20-40% sastrugi (<50cm), 10% hard snow, smooth to travel over.

224.4 - 235.5 km:
surface = 10-20% sastrugi (<30 cm).

235.5 - 241.5 km:
occasional snow drift reaching 1m in height

241.5 - 254.7 km:
surface = 20-50% sastrugi (mostly 20-50cm), remainder is snow drifts and ridges.

254.7 - 280.0 km:
no observations recorded, mostly was quite flat

280.0 - 312.5 km:
surface = dead flat, no topography, sastrugi <10% (<10 cm).

APPENDIX 5: Weather Observations by the Main Party

by Ron Hackney and Rebecca Drury

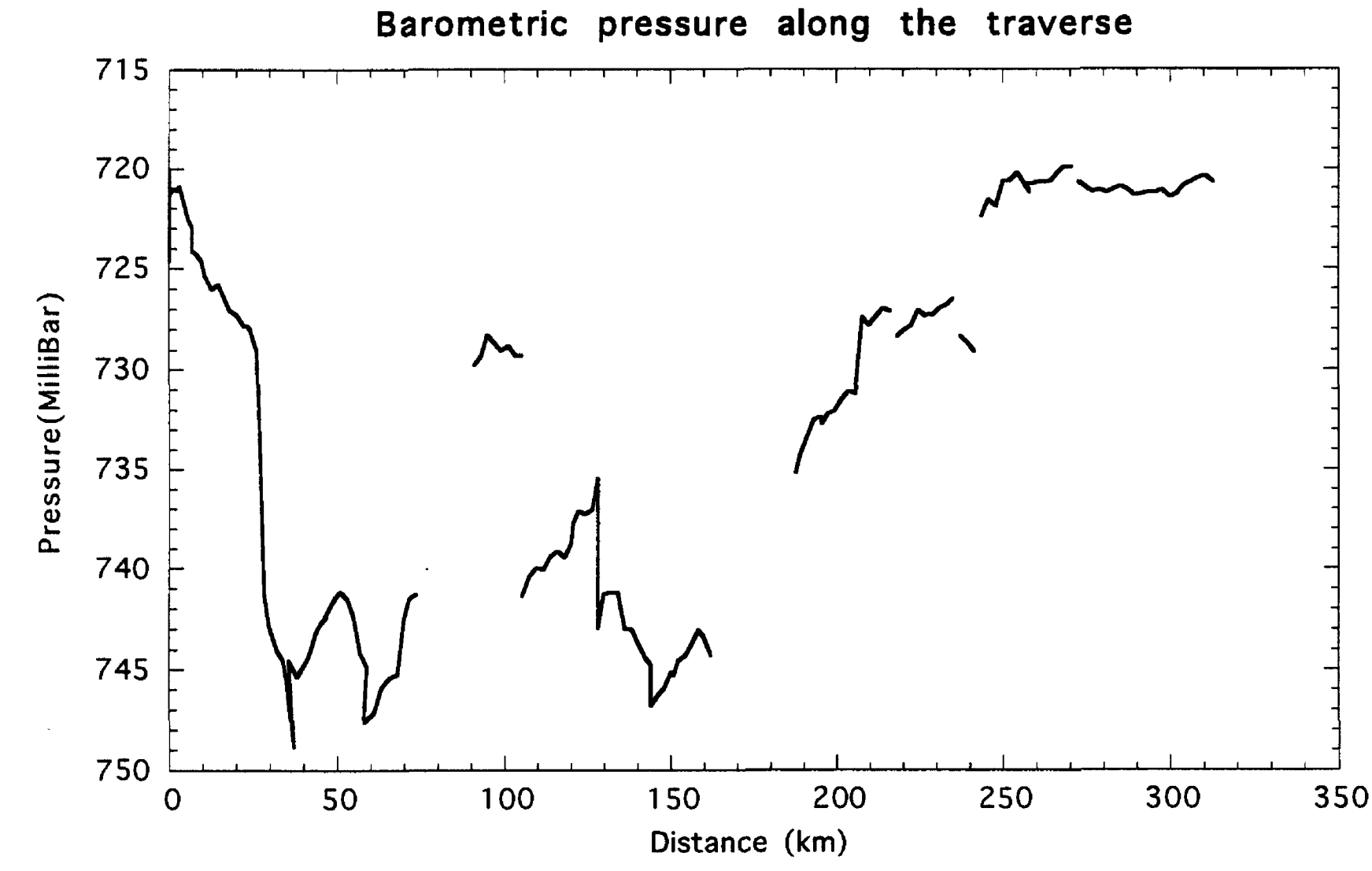
J Day	Time (local)	Distance (m)	Temp (°C)	P1 (mBar)	P2 (mBar)	Wind Speed (km/h)	Wind Dir.	Comments
344	0:03			721.99	721.10			overcast, low clouds, occasional
	12:45			721.32	720.21	12	S	light snow
	14:53		-20	721.30	720.06	14	S	
	18:50		-19	721.55	720.51	12	S	
345	10:05	0	-24	725.19	724.60	0		clear and sunny
	19:15	0	-22	723.94	723.30	14	SW	
346	10:12	0	-26	722.36	721.30	21	WSW	clear and sunny
	12:50	1050	-23	721.92	720.99			
	14:30	2100	-22	721.66	721.13			
	15:40	3000	-21	721.81	720.92			
	16:15	3450	-22	722.16	721.13			
	18:45	5550	-21	723.57	722.58			
	21:15	6750	-24	723.78	722.97	8	W	
347	9:30	6750	-25	724.65	724.16	0		scattered high clouds, mountains to
	12:30	7500	-23	725.17	724.19			east clouded, occaisional
	14:00	9600	-23	725.53	724.60	5	NNE	low, foggy clouds
	15:20	10500	-22	726.07	725.34			
	17:00	12600	-21	726.27	726.03			
	18:45	14700	-23	726.26	725.76	0		
348	11:00	15900	-24	726.89	726.27	~22	W	
	11:40	18000	-24	727.85	727.07	~19	W	
	13:30	20100	-23	727.99	727.27	~19	W	
	15:35	22200	-22	728.54	727.86	~19	W	
	16:25	23100	-18	728.53	727.81	~28	W	
349	12:20	24000	-23	728.83	727.99	~19	W	clear and sunny
	13:50	26100	-21	730.12	729.07	~22	W	
350		24300				32	W	clear and sunny, with blowing snow
351	12:04	28200	-19	743.52	741.30	0		cover of high cloud, often snowing
	13:05	29700	-18	743.91	742.85	~8	SW	with poor surface definition
	14:30	31800	-17	745.00	743.99	~8	S	and reduced visibility
	16:13	33900	-15	745.39	744.57	~5	S	
	16:55	34800	-15	746.07	745.50	~10	S	
	18:37	36900	-15	749.43	748.86	~15	S	
352		35700	-17			23	S	snowing with low visibility
353	11:13	35450	-13	745.11	744.55	~13	SSW	scattered high clouds and low clouds
	15:50	38000	-14	746.27	745.36	~12	SW	drifting from south (variable
	17:17	41100	-14	745.12	744.44	~12	SSW	visibility and surface definition)
	18:05	42150	-13	744.77	743.95	~10	S	
	19:06	43350	-13	743.93	743.27	~10	S	
	19:55	44550	-13	743.54	742.85	~5	SW	
	20:43	45600	-12	743.22	742.58	~5	SW	
	21:20	46650	-10	742.90	742.44	~2	W	

J Day	Time (local)	Distance (m)	Temp (°C)	P1 (mBar)	P2 (mBar)	Wind Speed (km/h)	Wind Dir.	Comments
354	11:09	45450	-22	743.34	742.64	~15	NNW	clear and sunny
	13:54	48750	-18	742.28	741.60	~20	NW	
	15:21	50700	-17	741.75	741.14	~22	W	
	16:35	52800	-17	742.16	741.50	~24	NW	
	17:35	54600	-16	743.06	742.32	~18	NNW	
	19:05	56700	-16.5	744.84	744.14	~13	NW	
	20:22	58800	-17	745.56	744.84	~6	NW	
355	11:18	57900	-19	748.03	747.61	~3	NW	total cover of high cloud, not
	13:15	60900	-11	747.79	747.17	~4	N	affecting visibility
	14:20	63150	-11	746.63	745.94	~2	NW	
	15:05	64350	-13	746.32	745.65	~1	NW	
	16:10	65850	-13	746.06	745.38	~0.65		
	17:45	67950	-14	745.87	745.24	~0.5	SW	
356	13:19	69900	-12.5	743.14	742.46	~2	NW	overcast with light snow
	14:32	71550	-13.5	742.16	741.49	~1	NW	still good visibility
	16:05	73650	-13	742.19	741.28	~3	W	
357		74550	-18			32	W	clear and sunny with blowing snow
358		74550	-20			34	WSW	clear and sunny with blowing snow
359		74550	-19			20	W	clear and sunny with blowing snow
360		74550	-18			35	W	scattered high cloud,wind blown snow affecting visibility
361	14:14	75750	-18			27	W	clear and sunny
	15:05	77850	-17.5			23	W	
	15:41	79950	-18			22	W	
	16:08	81150	-17.5			26	WSW	
	16:37	82500	-17.5			24	WSW	
	17:12	84600	-17			27	SW	
	17:47	86700	-17			26	WSW	
	18:25	88800	-16			28	WSW	
	19:57	90500						
362	10:05	90900	-20	730.49	729.78	19	WSW	scattered high cloud, clearing by
	11:02	93000	-20	730.00	729.35	19	WSW	afternoon, variable visibility later
	12:00	94800	-20	728.98	728.28	20	WSW	in day as low cloud drifted across
	13:15	96900	-19	729.55	728.67	18	SW	
	14:54	99000	-17	729.90	729.06	16	SW	
	16:08	101100	-18	729.78	728.81	18	SW	
	17:15	103200	-18.5	730.04	729.29	15	S	
	18:25	105300	-18	730.19	729.28	15	S	
363		105300	-19			40	SW	clear and sunny, reduced visibility due to blowing snow
364		105300	-18			42	SW	same
365		105300	-20			30	SW	same

J Day	Time (local)	Distance (m)	Temp (°C)	P1 (mBar)	P2 (mBar)	Wind Speed (km/h)	Wind Dir.	Comments
1	10:40	105200	-18	741.95	741.36			overcast, variable visibility as
	12:24	107400	-17.5	741.11	740.41	24	SSW	low clouds drifted past
	13:30	109500	-16.5	740.86	739.99	22	SSW	
	14:42	111600	-16	740.66	740.05	20	SSW	
	16:35	113700	-15	740.08	739.42	20	SW	
	17:50	115800	-17	739.71	739.14	21	SW	
	19:08	117900	-15.5	739.86	739.47	13	SW	
	20:35	120000	-15	739.40	738.72	16	SW	
2	11:40	120500	-18	738.31	737.74			clear and sunny
	14:23	122100	-17	737.76	737.13	22	SW	
	15:35	124200	-17	738.00	737.28	21	SW	
	17:07	126300	-16.5	737.71	737.05	18	SW	
	18:10	127950	-16	736.10	735.45	18	SW	
	20:40	bravo		736.65	736.16			
	20:59	127950		737.00	736.31			
3	11:23	127950		742.91	742.95			clear and sunny
	12:12	129750	-18	742.19	741.25	11	WSW	
	13:20	131850	-18	742.95	741.20	7	SW	
	14:35	133950	-17.5	741.91	741.23	10	WSW	
	15:40	136050	-17	742.82	742.98	11	SW	
	17:25	138150	-17	743.72	743.02	11	SW	
	18:35	140250	-17	744.40	743.75	10	SW	
	19:43	142350	-16.5	745.15	744.44	9	WSW	
	20:38	143850	-17	745.31	744.74	8	WSW	
4	12:01	143900	-17	747.34	746.80	18	SW	clear and sunny
	13:55	145950	-19	746.86	746.29	21	WSW	
	15:05	147900	-19	746.75	745.93	23	WSW	
	18:18	150000	-18	745.61	745.11	32	SW	
5	11:33	150600	-19	745.78	745.30	21	SW	clear and sunny
	12:55	152100	-19	745.35	744.56	26	WSW	
	13:58	154200	-19	745.13	744.31	24	WSW	
	15:08	156300	-18.5	744.57	743.72	32	SW	
	16:15	158250	-18	743.66	743.03	28	SW	
	17:53	159900	-18	744.21	743.43	28	WSW	
	19:05	162000	-18	744.99	744.29	24	SW	
6	14:36	164100	-18			36	SW	clear and sunny with blowing snow
	15:20	166200	-18.5			41	SW	
	16:02	168300	-17.5			40	SW	
	17:18	170250	-18.5			44	SW	
	17:48	171600	-18.2			45	SW	
	18:26	173700	-18.2			41	SW	
	19:05	175800	-18			42	SW	
	19:45	177900	-18			40	SW	

J Day	Time (local)	Distance (m)	Temp (°C)	P1 (mBar)	P2 (mBar)	Wind Speed (km/h)	Wind Dir.	Comments
	20:29	179850	-18			40	SW	
	21:25	181950	-17			39	SW	
	22:25	183900	-15.5			37	SW	
7		185400	-19			30	WSW	clear & sunny, w/reduced visibility (<1km) due to blowing snow
8	13:50	187500	-19	735.87	735.17	17	WSW	overcast, but good visibility. By
	14:58	188700	-20	735.11	734.34	18	W	afternoon, visibility variable due
	16:48	190800	-19	734.16	733.37	16	W	to low clouds drifting across
	18:38	192900	-18	733.21	732.50	17	W	
	20:10	195000	-18	733.01	732.36	23	SW	
9	11:40	195300	-18	733.41	732.70	9	SW	scattered high clouds. By afternoon
	13:21	197100	-21	732.89	732.19	15	WSW	visibility variable due to low clouds
	14:40	199200	-19.5	732.74	732.07	16	SW	drifting across.
	16:45	201300	-18	732.29	731.49	16	SW	
	18:04	203400	-18	731.76	731.10	12	SW	
	20:12	205500	-18	731.75	731.23	11	SW	
10	13:40	207600	-20	728.79	727.41	16	SW	overcast but good visibility
	14:58	209550	-19	728.44	727.82	15	SW	
	16:20	211500	-17	728.06	727.41	15	SW	
	18:26	213900	-16	727.72	726.96	12	WSW	
	19:54	216000	-17	728.02	727.13	19	SW	
11		216000	-17			15	SW	overcast with occ. light snow. Poor visibility (<1 km) and surface def.
12	13:12	218100	-19.5	729.30	728.34	20	WSW	morning: variable visibility due to low
	14:35	220200	-19.5	728.76	728.05	26	WSW	cloud drifting across.
	16:10	222300	-20	728.43	727.84	20	W	Clear by afternoon
	17:25	224400	-20	727.89	727.06	22	SW	
	19:15	226500	-19	728.03	727.34	18	SW	
13	11:30	227700	-21	727.85	727.24	10	S	overcast, occ. flurries of light snow
	15:35	228600	-17	727.95	727.33	8	NE	good visibility, but no surface def.
	16:48	230700	-20	727.50	726.98	13	ENE	
	18:15	232800	-19	727.43	726.82	0		
	19:40	234900	-19	727.30	726.51	2	ESE	
14		235400	-21			17	SW	scattered high cloud. good visibility
15		235400	-20			12	S	restricted vis. and def. due to low clouds
16	16:08	237000	-20	729.29	728.34	21	SW	misty low cloud, visibility to 5 km.
	17:23	239100	-19	729.80	728.66	28	SW	
	19:01	241200	-20	729.74	729.09	26	SW	
17		241400				44	SW	clear and sunny with blowing snow
18		241400	-19			37	SW	clear and sunny with blowing snow
19		241400	-20			33	SSW	same, with low cloud late in day
20	14:12	243300	-23	723.08	722.45	30	SW	clear & sunny w/ blowing snow early
	16:42	245400	-23	722.45	721.58	31	SW	disappeared late as wind died

J Day	Time (local)	Distance (m)	Temp (°C)	P1 (mBar)	P2 (mBar)	Wind Speed (km/h)	Wind Dir.	Comments
	18:23	247800	-21		721.91	23	SW	
	20:40	249900	-22		720.63	16	SW	
	22:28	252000	-23		720.60	10	SW	
	23:59	254100	-23.5		720.20	10	SW	
21	20:20	257860			721.23			scattered high cloud
	22:00	charlie			721.10			
23	7:09	256200	-26		720.82			mostly overcast, occ. light snow flurry
	7:50	257860	-20		720.78			
	8:05	258300	-24		720.79			
	9:05	260400	-22		720.67			
	9:50	262500	-22		720.70			
	10:25	264300	-22		720.60			
	11:05	266100	-21		720.24			
	11:50	268200	-23		719.91			
	12:35	270300	-22	720.82	719.93			
	18:18	269700						
	19:35	272400	-20	721.53	720.66	10	SW	
	20:26	274500	-21	721.72	720.96	22	S	
	20:55	276600	-21	722.07	721.17	21	S	
	21:18	278700	-21	721.84	721.08	21	S	
	21:41	280800	-22	721.87	721.23	22	S	
	22:06	282900	-21.5	721.89	721.04	18	S	
	22:31	285000	-21	721.79	720.90	22	S	
	22:55	287100	-22	721.84	721.06	21	S	
	23:30	289200	-24	722.17	721.36	17	S	
	23:59	291300	-21.5	722.04	721.27	16	SSW	
24	0:20	293400	-21	722.01	721.20	12	S	scattered high cloud, occ. low clouds
	0:43	295500	-20	721.90	721.22	12	SW	drifting across
	1:29	297600	-22	722.02	721.07	11	SSW	
	1:54	299700	-23	722.26	721.46	10	SSW	
	2:18	301800	-25	722.16	721.27	10	SSW	
	2:46	303900	-23	721.87	720.84	12	SSW	
	3:09	306000	-24	721.41	720.66	10	SSW	
	3:35	308100	-24	721.30	720.47	10	SSW	
	3:57	310200	-28	721.26	720.36	10	SSW	
	4:27	312600	-29	721.55	720.68	9	SSW	
25		269700						hazy, low cloud, clearing as day progressed



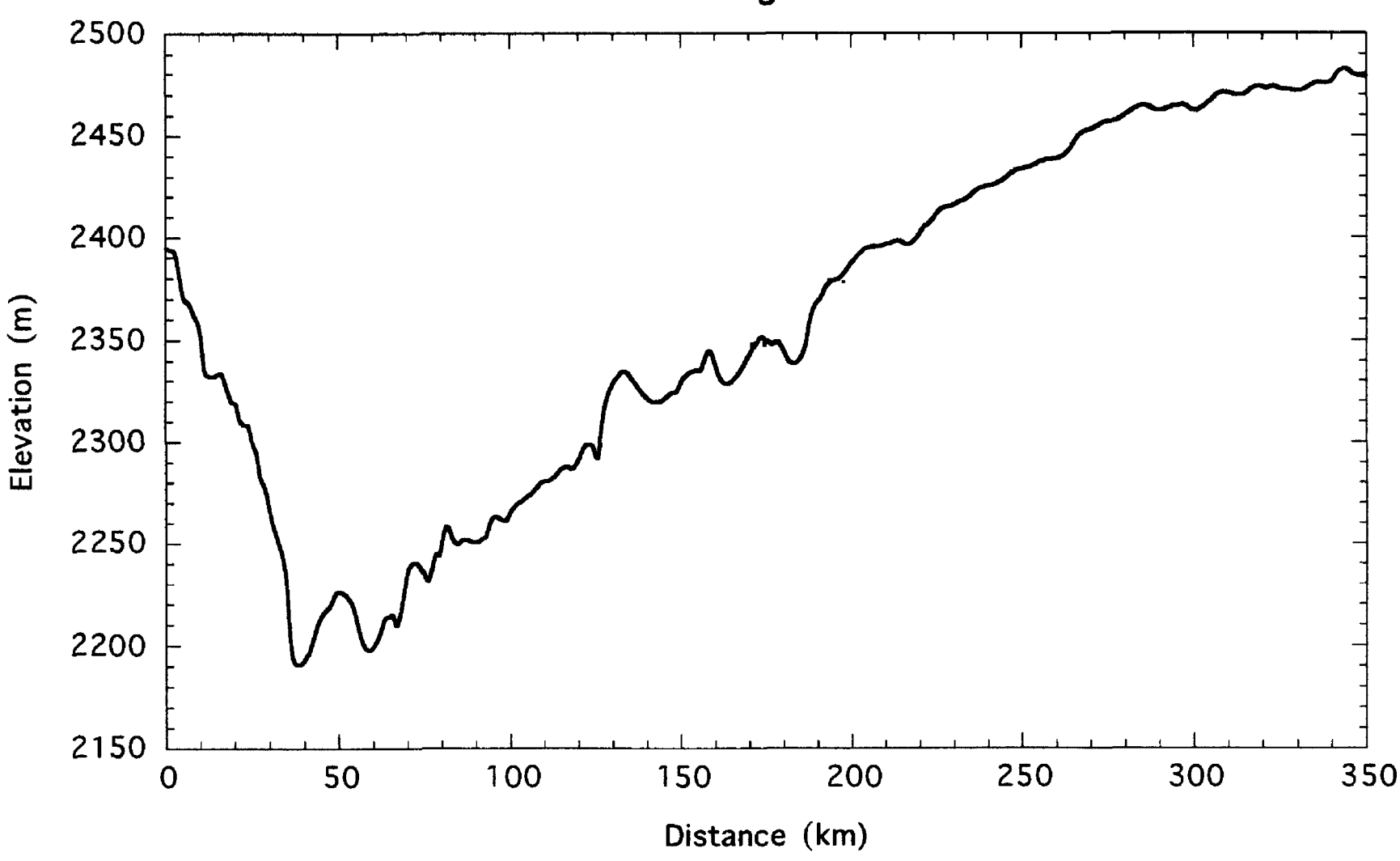


Figure A5.1 Top - barometric pressure (in milliBar) measured along the traverse line. Bottom - elevation along the traverse (similar to Figure 4). Note that pressure is plotted increasing downward to facilitate comparison with the elevation.

APPENDIX 6: Weather Observations by the Advance Party

by Bill King

J Day	Time (local)	Distance (m)	Temp. (°C)	Wind Speed (knot)	Wind Dir.	Comments
336	930	0	-31	9	230	
336	1700	0	-27	13	230	Slight haze towards horizon.
337	930	0	-30	0	0	
337	2100	9600	-22	0	0	Low cloud bands towards Portal Mt.
338	930	9600	-27	0	0	
338	2100	24000	-26	0	0	Fog bands east towards edge of polar plateau.
339	930	24000	-31	9	320	
339	2100	41100	-25	9	320	10 knot westward wind all afternoon.
340	930	41100	-27	13	260	Wind all day.
341	930	46600	-27	13	260	
341	2100	58800	-25	0	0	Wind most of day. Stopped early evening.
342	930	63000	-31	9	260	
342	2130	75700	-25	0	0	Extremely clear visibility, Possibly 100 km.
343	930	75700	-28	9	260	
343	2230	90900	-23	0	0	Clouds in from SW late afternoon.
344	930	90900	-25	9	260	
345	930	107400	-23	0	0	
346	1400	125000	-24	13	260	
347	930	125000	-30	9	260	
347	2200	142300	-25	0	0	High stratus mid afternoon.
348	930	142300	-26	13	260	Fog on horizon.
348	2130	154200	-25	15	230	Minor fog on western horizon, wind all day.
349	930	154200	-28	13	230	
350	930	168300	-27	24	230	
351	930	171600	-23	9	230	
351	2200	185400	-20	20	160	
352	1200	185400	-18	10	180	
353	930	185400	-19	9	230	
354	930	185400	-23	9	260	
354	2300	199200	-21	5	260	Fog on horizon, drifting snow mid afternoon.
355	930	199200	-24	0	0	
355	2200	213900	-20	0	0	Horizons foggy, western horizon foggy.
356	930	213900	-22	9	240	
356	2200	228600	-23	11	260	
357	1300	228600	-22	19	260	
358	930	228600	-23	30	260	Visibility variable from 4 km to 20 km.
359	930	228600	-24	13	260	
360	1300	245400	-22	30	260	
361	930	245400	-24	15	260	
362	930	245400	-25	9	260	Halo around sun.
362	2330	260400	-23	15	230	
363	1200	260400	-23	24	230	Wind increased late afternoon to over 30 knots.
364	930	260400	-23	35	250	Large amounts of drifting snow.

J Day	Time (local)	Distance (m)	Temp. (°C)	Wind Speed (knot)	Wind Dir.	Comments
365	930	260400	-22	30	250	
1	930	260400	-24	19	250	Fog on west afternoon
2	930	260400	-24	19	190	
2	2200	285000	-20	9	190	
3	930	285000	-23	5	190	
4	930	285000	-23	13	210	Wind increasing
4	2000	312600	-19	24	210	
5	930	312600	-24	13	210	
5	2300	342000	-21	13	250	
6	930	342000	-24	24	250	Strong wind all day.
6	2200	360900	-19	30	250	
7	930	360900	-23	30	250	Poor ground definition.
8	930	312500	-20	13	250	

NOTE: Wind speed was estimated. Comparison with measured wind speed by main party (Appendix 5 and Figure 11) indicates actual speed to be ~65% of that estimated.

APPENDIX 7: Barometric Pressure and Temperatures at the Temporary Base Camp Averaged Over 6 Hours

by Rebecca Drury and Ron Hackney

J day	Barometric Press. (mBar)	Distance (m)	Temp. (°C)
344.00	719.08	0	-18
344.25	718.60	0	-21
344.50	718.78	0	-18
344.75	720.10	0	-20
345.00	721.83	0	-24
345.25	722.60	0	-24
345.50	722.90	0	-25
345.75	722.08	0	-27
346.00	720.37	0	-32
346.25	719.00	0	-30
346.50	718.95	0	-24
346.75	721.64	0	
347.00	722.10	6900	-33
347.25	722.20	6900	-29
347.50	722.30	6900	-22
347.75	725.13	6900	
348.00	724.70	14700	-28
348.25	724.23	14700	-26
348.50	724.10	14700	-25
348.75	725.30	14700	-17
349.00	725.90	19650	-26
349.25	725.50	19650	-27
349.50	725.30	19650	-23
349.75	726.50	19650	-26
350.00	726.47	24300	-29
350.25	728.08	24300	-26
350.50	731.21	24300	-24
350.75	733.95	24300	-24
351.00	737.02	24300	-28
351.25	738.68	24300	-25
351.50	738.00	24300	-15
351.75	744.50	24300	-15
352.00	743.50	35450	-18
352.25	741.94	35450	-19
352.50	740.88	35450	-18
352.75	741.46	35450	-19
353.00	742.10	35450	-20
353.25	742.61	35450	-17
353.50	742.62	35450	-13
353.75	742.26	35450	
354.00	741.32	45450	
354.25	741.00	45450	
354.50	740.90	45450	
354.75	741.41	45450	
355.00	744.31	57900	
355.25	745.40	57900	
355.50	745.96	57900	
355.75	744.14	57900	

J day	Barometric Press. (mBar)	Distance (m)
356.00	743.30	69000
356.25	742.60	69000
356.50	741.90	69000
356.75	740.80	69000
357.00	739.65	74550
357.25	738.49	74550
357.50	737.56	74550
357.75	737.66	74550
358.00	738.20	74550
358.25	738.24	74550
358.50	739.04	74550
358.75	739.40	74550
359.00	738.86	74550
359.25	738.74	74550
359.50	738.90	74550
359.75	739.00	74550
360.00	738.78	74550
360.25	737.32	74550
360.50	736.82	74550
360.75	737.29	74550
361.00	735.88	74550
362.00	728.22	90300
362.25	727.78	90300
362.50	728.80	90300
362.75	729.47	90300
363.00	730.60	105300
363.25	731.52	105300
363.50	732.91	105300
363.75	734.97	105300
364.00	736.80	105300
364.25	737.52	105300
364.50	737.54	105300
364.75	738.51	105300
365.00	737.95	105300
365.25	737.99	105300
365.50	738.50	105300
365.75	738.90	105300
1.00	739.80	105300
1.25	739.40	105300
1.50	739.09	105300
1.75	737.88	105300
2.00	736.70	120450
2.25	736.10	120450
2.50	736.10	120450
2.75	735.80	120450
3.00	737.08	127700
3.25	739.52	127700
3.50	742.13	127700

J day	Barometric Press. (mBar)	Distance (m)
3.75	743.10	127700
4.00	744.80	143850
4.25	744.98	143850
4.50	744.85	143850
4.75	744.50	143850
5.00	743.70	150600
5.25	743.50	150600
5.50	743.30	150600
5.75	742.70	150600
6.00	742.10	161850
6.25	741.24	161850
7.25	735.59	185400
7.50	733.83	185400
7.75	733.73	185400
8.00	733.76	185400
8.25	735.08	185400
8.50	735.35	185400
8.75	732.03	185400
9.00	730.22	195300
9.25	730.26	195300
9.50	731.14	195300
9.75	729.95	195300
10.00	728.40	205400
10.25	727.06	205400
10.50	726.24	205400
10.75	725.29	205400
11.00	725.10	216000
11.25	725.06	216000
11.50	726.20	216000
11.75	727.70	216000
12.00	728.30	216000
12.25	727.96	216000
12.50	727.40	216000
12.75	726.90	216000
13.00	725.64	227600
13.25	725.50	227600
13.50	725.74	227600
13.75	725.70	227600
14.00	724.98	235400
14.25	724.72	235400
14.50	724.66	235400
14.75	724.06	235400
15.00	724.98	235400
15.25	724.72	235400

J day	Barometric Press. (mBar)	Distance (m)
15.50	724.66	235400
15.75	724.06	235400
16.25	726.52	235400
16.50	726.92	235400
16.75	728.04	235400
17.00	728.95	235400
17.25	728.96	235400
17.50	729.38	235400
17.75	729.98	235400
18.00	730.28	235400
18.25	729.58	235400
18.50	728.36	235400
18.75	725.93	235400
19.00	722.71	235400
19.25	722.04	235400
19.50	721.82	235400
19.75	721.81	235400
20.00	723.00	235400
20.25	722.41	235400
20.50	721.07	235400
20.75	720.30	235400
21.00	720.40	235400
21.25	721.12	235400
21.50	721.88	235400
21.75	721.86	235400
22.00	721.06	235400
23.50	718.83	269700
23.75	719.95	269700
24.00	720.40	269700
24.25	719.60	269700
24.50	718.55	269700
24.75	717.78	269700
25.00	717.68	269700
25.25	718.15	269700
25.50	719.06	269700

APPENDIX 8 : Mechanic's Report

By Mike Collins

General Comments

Project Equipment

United States.

Plant	Number	Use
Snocat Tucker	069	Wannagan and general
Snocat Tucker	071	Explosives and plowing
Sledge, 1 Ton		General use to km 75
Sledge, ASV		Not used
Generator, Onan 3.5 kW	3	Vehicle heating
Generator, Onan 3.5 kW	10	Vehicle heating

New Zealand.

Hagglund	H28	Seismic recording system
Skidoo Alpine II	AL3	Detonator sledge
Ski-doo Alpine II	AL4	Radar
Ski-doo Alpine II	AL5	Survey party
Ski-doo Alpine II	AL7	Survey party
Sledge, Maudheim		Fuel, generators, Herman Nelson
Sledge, Maudheim		General use
Sledge, Anare		Wannagan (living quarters)
Sledge, Anare		Explosives and fuel
Generator, Yanmar 3.0 kW	FG8	Heating and battery charging
Generator, Yanmar 3.0 kW	FG7	Heating and battery charging
Generator, Yanmar 3.0 kW	FG1	Heating and battery charging
Generator, Honda 2.5 kW	PG5	Heating and battery charging
Generator, Honda 5.0 kW	PG15	Heating and battery charging

Preparation

I was given only two weeks to prepare the vehicles. It was not sufficient time to carry out the work, but with the help of Jeremy Ridgin and Gus McAlister, the deadline was met.

The 4 Skidoos needed quite a lot of work to make them functional. Examples of problems were: leaking shock absorber, suspension springs broken, hinges broken away from bonnet.

Skidoo AL7 was also modified with a 50 Ampere-hour (Ah) dry battery and fitted with a charger set for recharging VHF radio batteries. An ignition primary circuit amplifier was fitted, because this machine had a Dugati ignition system. The ignition system was needed to enhance engine starting temperatures below -25° C. 170 jets were fitted to all machines. This was just on the rich side for the 8000 ft elevation but proved satisfactory (160 jets were carried). The Hagglund was serviced by Gus McAlister, along with some other minor checks.

The 069 Tucker was serviced by the Heavy Shop in McMurdo, and new track belting was fitted all round. 071 Tucker had already been transported to Taylor Dome in October and had been working up there since that time.This vehicle, too, was suffering track belting problems, so was fitted with new track belting all round before we arrived at Taylor Dome in early December.

The other major part of the preparation was organizing spare parts, tools, and the necessary oil for the vehicles used by both the advance and the main parties.

Operating conditions

The temperature ranged between -30° C and -10° C. Starting problems were anticipated. The direct drive petrol generators (PG15 and Onans) could be started unaided, whereas the Yanmar Diesel units, and PG5 (which had a belt drive) needed to be preheated with the Herman Nelson for 5-10 minutes and then could be started easily. The Hagglund's coolant heater was plugged in for approximately 1 hour most days before starting. This was not always necessary, but reduced the strain on the starting systems that were doing up to 100 stop/starts in a days operation. The Tuckers were our most difficult machine to start. Depending on the temperature they took 1 to 3 hours to start. Our usual approach was to plug the vehicle in for 3 hours, putting the Herman Nelson on the engine compartment for the last 30 minutes of that time. This system worked without fail no matter what the temperature. Although the starting time of the Tuckers could be shortened by not plugging them first to a generator, plugging them made for an easier start. The Herman Nelson hose was tied to an opening in the cowling so the heating took place with the bonnet down. The bonnet grating and grill were also covered to reduce heat loses and to indirectly heat other components, such as the power steer pump and reservoir, V-belts, intake system ducting, and starter motor.

The Skidoos gave no starting problems. The thermal gain under the Ski-doo cover quite often brought the temperature up above 0° C, so if the machine was started within a few minutes of removing the cover it very rarely had to start at ambient temperature.

Fuel Consumption

Fuel consumption was well predicted, except for the Tuckers. The 071 Tucker did a lot of stop/start work laying the explosives. Idling time also caused the operating hours and total fuel usage to be higher than expected. This was due mostly to the fact that the Tuckers could not be left shut down for longer than 80 minutes without needing preheating to start again. Finally, the Tuckers could be operated only in first gear and at slow speeds (1-4 km/h) because of the rough terrain.

Operators

We experienced few problems with vehicle operators. Because people seldom swapped tasks, the person driving a vehicle gained experience and a feel for the machine. This may have caused boredom for some, but I believe it reduced operation problems overall.

Tools

The field tool box, bought in late 1992, and supplemented with some additions for this project, proved a valuable base tool kit. The box has no permanent AF tool sets, and it might be useful to include it in the future. The vice fitted to one of the Anare sledges proved a very useful addition on a number of occasions.

Vehicle Maintenance

USAP EQUIPMENT

Snocat Tucker 069 pax
Hour meter Start 3535 Finish 3668 Total 133 hours
Fuel Consumption: 2 Liters/km

Maintenance

I replaced primary fuel filter at 3568 hr, greased vehicle at 3600 hr, replaced transmission filter at 3610 hr, removed transmission and installed overhauled unit (twice) at 3644 hr. The overhauled transmission failed at 3668 hr (km 270). This Tucker was used to pull the Wannagan and the majority of the fuel carried between supply dumps. It had ample horsepower and traction to pull the load.

Snocat Tucker 071 pax
Hour meter Start 2888 Finish 3218 Total 330 Hours
Fuel Consumption: 2 Liters/km

Maintenance

Transfer case anchor bolts (8) became lose and were tightened. I greased the machine at 3050 hr. Transfer case input flange seal started leaking, so a check on the oil level was made every second day. The front axle steering pivot plate at the rear spring anchor positions was bent. The bent pivot plate indicates that the undercarriage is a little light and prone to damage when pulling this weight under these surface conditions. We avoided further damage by working only when light conditions were suitable to distinguish sastrugi. Operating speed did not contribute to the damage because all travel over this terrain was done in first gear. Tucker 071 was used to pull and lay the explosives. Its operating hours were the greatest of all vehicles, and it performed very well.

Generators: Onan 3.5 kW Units 3 &10
Fuel Consumption: 2.5 Liters/Hour

Both these generators ran very well with minimal problems. We experienced some carburetor icing, and overcame it with better positioning of the generator in relation to the prevailing wind. This positioning (similar to a polar tent door in relation to wind) as well as covering the generators on three sides, leaving the exhaust side open also helped its operation. During storms, however, positioning and three-sided covering still did not offer sufficient protection, and the generator quit due to the increased moisture. The oil was changed in both engines once.

Herman Nelson
Hour meter Start 852 Finish 902 Total 50 Hours

This machine operated very reliably with only a replacement spark plug needed. The engine/transmission oil was changed once.

NZAP EQUIPMENT

Hagglund H28
Hour meter Start 1089 Finish 1316 Total 227
Odometer Start 7404 Finish 7761 Total 357 Km

Fuel Consumption: 1 Liter/Km

Maintenance

The only problem encountered was that the general power supply solenoid jammed in position, so that engine shut down using the key was impossible. This problem only occurred when the temperature was below -30° C. The problem could be overcome by heating the cab interior before starting. (A warm cab interior is usual at Scott Base so this problem would normally not occur). A no-start on one occasion was caused by the HF radio draining one of the 12V starting batteries. This occurred when we had been stalled for a number of days due to bad weather. The Hagglund towed the streamer and the rear car housed the seismic recording equipment, battery charger's, and VHF radio battery chargers. The start-stop operation is not suited to the turbo-Diesel engine, because it has to idle for at least 2 minutes before shut-down. However,due to a number of other concurrent operations during each shot, this limitation did not seem to affect the daily progress.

Alpine ski-doo AL3

Hour meter Start 90	Finish 136	Total 46 Hours
Odometer Start 2395	Finish 2771	Total 376 Km

Fuel Consumption: 3 Km/Liter .

Maintenance

The front ski shaft foot broke at km 208. The break occurred on the right side of the middle tract idler brackets. This ski-doo was used to pull the sleepy sledge carrying the detonators. It was replaced by AL7.

Alpine ski-doo AL4

Hour meter Start 75	Finish 172	Total 97 Hours
Odometer Start 4680	Finish 5978	Total 911 Km

Fuel Consumption: 3 Km/Liter

Maintenance

This machine towed the radar, and, additionally, did approximately 350 km preparing the ski-way at km 270. It ran without a fault.

Alpine ski-doo AL5

Hour meter Start 185	Finish 390	Total 205 Hours
Odometer Start 4680	Finish 5978	Total 1298 Km

Fuel Consumption: 3 Km/Liter

Maintenance

This machine was used by the survey (advance) party. They experienced ice in the fuel after 45 days, probably, as a result of an accumulation of moisture from blowing snow during fuel transfer. The earth wire between engine and chassis over heated few times, but the over heating did not cripple our progress.

Alpine ski-doo AL7

Hour meter Start 0	Finish 210	Total 210 Hours
Odometer Start 1515	Finish 1641	Total 210 Km

Fuel Consumption: 3 Km/Litre (presumed 1330 Km from hourmeter).

Maintenance

This machine was also used by the survey party. The speedo drive for the drive lug became loose in the transmission shaft stopping the speedo operation. Otherwise,

the machine operated well. The fuel pump was mounted on the air box cover after being removed from the battery box. This new location meant that it was also very easy to see if the pump was operating correctly. (AL5 was also modified in this way).

Generator PG 15 5 kW
Fuel Consumption: 2.3 Litres/Hour

Engine ran very well and the alternator never gave trouble even when blowing snow made generating difficult. The alternator started eating the wiring after 2.5 weeks, and was sent back to Scott Base. It was an ideal unit for this experiment because it had plenty of capacity and never had to work to its maximum.

Generator PG 5 2.5 kW
This unit was used very little. The alternator failed and was sent back on one of the Twin Otter flights.

Generator FG 8 3.0 kW
Fuel Consumption: 1.4 Litres/Hour

This generator ran poorly at this altitude. The engine operated intermittently, because of a jamming exhaust valve. This fault was possibly due to the high operating temperature of the engine, caused by the wrong ignition timing. Information from Scott Base and Christchurch indicated, that it needed to be modified for altitude (injection timing advancement).

Generator FG 7 3.0 kW
Fuel Consumption: 1.4 Litres/Hour

This machine was running hot and erratically similar to FG 8, also due to its ignition timing being standard. Its operation under load was smooth, the engine was very reliable but the alternator failed in blowing snow conditions.

Generator FG 1 2.5 kW
Fuel Consumption: 0.8 Litres/hour

This machine came up to us with modified fuel ignition timing and ran very well without problems. The only cause of power outage was blowing snow conditions. The major differences between this unit and FG 7 and 8 was its improved economy and its smaller power output . It was generally fully loaded with just one 1.5 kW heater going, and could not charge batteries at the same time. After lowering the power consumption of one of the fan heaters to 0.5 kW, it could charge simultaneously some batteries.

Maudheims
Both Maudheims worked well and gave no trouble. It would have been more convenient to have a draw bar available, because the plow was pulled behind one of the sledges.

Box Sledge
We had one sleepy sledge, which carried the detonators, and did not experience problems with it on the traverse.

Anares
These sleds had various problems none of which stopped our operation. As they were subsequently returned to New Zealand, I believe the problems would have been noted.

VEHICLE USAGE TOTALS

Vehicles	690 Hours	Ski-doos	558 Hours 3915 Km

Summary and recommendations

Maudheims
Possibly consider the fitting of a drawbar on at least one Maudheim, as it then could be selected if a drawbar is required for an event.

Vehicle Preparation
Preparation time depends on the size and type of the experiment. The two week lead time before put in for this experiment should be considered the minimum.

Ski-doos
Although we had a good run with the ski-doos, the failure we experienced with AL3 would have been a big problem if it had happened earlier or if it had occurred in one of the machines used by the survey party. A ski foot part should be included in the spares in future deep field experiments, to be fitted in the field should failure occur. Alternatively, the ski leg should be stripped down prior to going into the field, to check for fatigue.

Generators
Yanmar
We had two different problems with FG 7 and 8. Both machines would benefit from being modified if working at this altitude in the future, however, with their reduction in output from 3 kW to 1.5 kW-1.7 kW their output is probably too small to be suitable for events of this type.

PG 15 & Onan's
This type of generator worked well, with ease of starting and smaller output capacity losses being in their favor.

Our overall generator loading problems were probably two fold. First, we underestimated the required load of the science gear. Second, we underestimated the total losses due to the altitude with the operation of the Yanmar Diesel.

The hassle and unreliability of generating in blowing snow conditions can only be overcome by housing the generating equipment. As this is difficult with the smaller portable generators, a single higher capacity unit 6 kW-10 kW may be more suitable, which is housed in a shack. If essential loading is not high enough for overnight operation this could be increased with vehicle heating to maintain a suitable load for the generator.

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