IMMEDIATE REPORT

OF

VICTORIA UNIVERSITY OF WELLINGTON

ANTARCTIC EXPEDITION 34

1989 - 1990

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CONTENTS

PART I - SCIENTIFIC PROGRAMMES

PART II - LOGISTICS NOTES

LIST OF FIGURES

VUWAE 34 SUMMARY

Antarctic Bottom Currents

The purpose of this project is to investigate mud-carrying bottom currents in Granite Harbour. Such currents have been suggested as an explanation for the extensive mud deposits in basins of the western Ross Sea.

Mount Erebus Eruption Mechanism Study

This year's programme will concentrate on the classification of volcanic earthquakes into closely similar types or families. Scientists will work in Antarctica from mid-November to mid-December with the experiments being monitored from Scott Base year-round.

Contempary Processes in Miers Valley

This study will collect information to quantify the mass balance of the glacier-river-lake system of the valley such as the relationship between incoming solar radiation and glacier melt and stream flows. The nature of the sediment being transported within the system will also be studied.

Ross Sea Region During Beacon Times

The purpose of this project is to develop a model for the changing geography of the Ross Sea region from about 400 to about 180 million years ago, during the deposition of Beacon strata. This is the second year of a three year programme.

West Antarctic Volcano Exploration

This programme is part of an international project which is examining the tectonic evolution of the Antarctic sector of the Pacific Margin. The field programme will concentrate on the collection of mantle and lower crustal xenothiths.

Optical Properties of Sea Ice

This is a joint project between the Physics and Engineering Laboratory of the DSIR and Victoria University of Wellington. This seasons work will investigate depth dependant factors controlling the interaction of light with sea ice.

PERSONNEL

Antarctic Bottom Currents (K042)

Leader:	Alex Pyne, Antarctic Research Centre, VUW.
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	I. Goodwin, Glaciology Section, ANARE.
Plant Operators:	R. Rodgers, Ant. Div., DSIR.
	D. Hotop, NZARP./N.Z. Army.

Mount Erebus Eruption Mechanism Study (K044)

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Ross Sea Region During Beacon Times (K047)

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	Dan Zwartz, Geology Dept. VUW.
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West Antarctic Volcano Exploration (K048/S081)

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Optical Properties of Sea Ice (K132)

Leader:	R. G. Buckley, Physics and Engineering Laboratory, DSIR.
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PART 1 - Scientific Programmes

ANTARCTIC BOTTOM CURRENTS (K042)

Alex R. Pyne

Abstract

Earlier work on Granite Harbour found that mud in the harbour floor was accumulating faster than could be accounted for by glacial and aeolian transport (Macpherson 1987). The present study, which set an S4 current meter just above the sea floor for 2 months, was aimed at measuring speed and direction of potentially mud-carrying bottom currents, thus indicating the course of the sediment. The meter was moored 1 m above the sea floor (at 76° 57' 42.073"S, 162° 53' 36.635"E) in 775 m of water. New bathymetric data shows the site to be in the middle of a channel that connects the inner and outer basins of the harbour. A fifty-day continuous bottom current record from 16 November 1989 to 5 January 1990 shows bottom current speed to average about 5 cm/s with a maximum of 10 cm/s. The flow direction is reasonably constant with a mean direction of 242°T towards the inner basin approximately along the axis of the channel. The bottom currents are tidally driven and oscillate with a period of around 24 hours which corresponds to the main diurnal tidal components O1 and K1 determined from the Cape Roberts tide gauge in 1988/89. This correspondence indicates that they are tidally driven.

This season's measurements show similar velocities and tidal frequencies to those recorded from the inner basin near the Mackay Glacier Tongue in the 1988/89 season. Both records show bottom current speeds that are not high enough to entrain mud but are high enough to maintain it in suspension. These velocities and the consistent inshore flow close to the sea floor provides at least a qualitative explanation for the rapid sedimentation and diatom-rich sea floor sediment in the inner basin of the harbour.

Reconnaissance of several coastal areas in Granite Harbour has shown that a single steep boulder beach is often present but these features are unlikely to yield information on Holocene ice levels in the harbour.

Proposed Programme

The purpose of this project was to investigate mud-carrying bottom currents in Granite Harbour. Such currents have been suggested as the explanation for the deposits of mud flooring the deeper parts of McMurdo Sound and the basins/harbours along the southern Victoria Land Coast (Barrett et al. 1983, Kelly 1986, Macpherson 1987). There is no single obvious source or depositional process for the mud deposits although Anderson et al. (1984) suggested impinging geostrophic currents and subglacial meltwater as potential sources.

Sediment trapping experiments in Granite Harbour show that there is a greater sediment flux near the sea floor than higher in the water column (Macpherson 1987, and Dunbar et al. 1986). The existence of a layer of sediment charged water at the sea floor (nepheloid layer) implies periodic resuspension of sea floor sediments. These sediments are a mixture of terrigenous and biogenic material. Some from budget considerations as derived from within the harbour, but some must come from the open Ross Sea (Macpherson 1987). This circumstantial evidence suggested that bottom current activity occurs in Granite Harbour.

The 1988/89 season's programme was designed to check on bottom currents originating from beneath the MacKay Glacier Tongue (MGT) in Granite Harbour. A current meter mooring with eight small (400 cm^2) sediment traps was deployed in 702 m of water near the snout of the MacKay Glacier for 53 days between 15 November 1988 and 6 January 1989. The current velocities 1 m above sea floor average between 6.9 and 4.3 cm/s with intermittent speeds up to 10 cm/s. These speeds are considered capable of maintaining the suspension of fine sediment to form a near bottom nepheloid layer, and this is confirmed by much higher sediment fluxes below 520 m. The dominant flow direction at this site is towards the glacier tongue (240° - 270°T) but "daily" swings occur towards the south which are most likely related to the diurnal tidal cycle.

This season's programme (1989-90) was to study the movement of sediment entering Granite Harbour from the Ross Sea by mooring the current meter and sediment traps on the sill the two main basins of the Harbour. The mooring was to be in place for about 2 months (November - January). We also planned to service the tide gauge at Cape Roberts established in November 1988, and if possible add meteorological instruments to record local climate data for future programmes. Inspection of the tide gauge in January 1989 has raised doubts about the permanence of the transducer installation which may not have survived ice foot breakout.

A further part of this season's work was related to a future proposal aimed at studying the Holocene Marine Glacial History in this area of the Ross Sea. We intended to carry out a reconnaissance survey of both coastal features in Granite Harbour and nunataks on the south side of the MacKay Glacier to find evidence of Holocene glacier expansion both at sea level and well above the present day MGT grounding line.

Scientific Endeavours and Achievements

Bottom Currents Mooring.

Thirteen spot bathymetry measurements were made to define the mooring site in an area centred 7 km northeast from Discovery Bluff. Coring by S-216 (R. Dunbar, Rice University, Texas) in 1988 suggested that the sill defined by Macpherson (1986) which separated the inner and outer basins may not exist in this area. This year's bathymetry results have defined a 750 to 800 m deep channel trending north east that joins the inner basin at Avalanche Bay to the outer basin in the centre of the harbour mouth. The mooring site was in the centre of the channel at 775 m depth and was chosen to test if the channel is a conduit for sediment entering the inner harbour from the Ross Sea.

The mooring deployed on 16 November consisted of an S4 electromagnetic current meter set 1 m above the sea floor and seven small sediment traps (collecting area 400 cm^2) spaced through the water column (Table 1). The mooring was recovered on 24 November, redeployed and finally recovered on 5 January. A continuous record of 50 days duration was recorded by the current meter.

Table 1. Granite Harbour Mooring 1989/09.

Instrument/ equipment	Depth below sea level	Height above sea floor
Float package (4 floats) (44 kg buoyancy)	12 m	760 m
Trap # I	45 m	730 m
Trap # II	165 m	610 m
Float package (4 floats) (11 kg buoyancy)	272 m	507 m
Trap # III	370 m	405 m
Float package (4 floats) (11 kg buoyancy)	477 m	302 m
Trap # IV	575 m	200 m
Trap # V	695 m	80 m
Trap # VI	747 m	28 m
Trap # VII	768 m	7 m
S4 Current Meter	774 m	1 m
Sea floor	775 m	0 m

Sediment from the seven traps will be analysed at Rice University but initial observations show the expected higher flux rates in the lower part of the water column which suggests a nepheloid layer is also present within the channel.

Cape Roberts Tide Gauge.

Introduction.

A tide gauge was established on a rocky promontory at Cape Roberts on 19 November 1988, by KO42 with assistance from the NZARP surveyors. We hoped that the gauge was sufficiently well secured to function continuously throughout the year (Pyne & Woolfe 1989, pp. 2-6). Data was first retrieved from the tide gauge on 8 January 1989. At this time we observed that the ice foot through which the transducer pipe passed had not melted and we then had doubts as to whether the transducer would survive the sea ice breakout.

1989/90 Season.

Cape Roberts was revisited this season by KO42 on 12 November 1989. The transducer pipe had been broken away and the transducer presumably lost. The data logger, however, had functioned throughout the winter and we recovered a further 13 days of record between 24 January and when the ice foot breakout occurred on 5 February 1989. We now have 64 days of tidal record from Cape Roberts, with a 14 day gap (9 January to 24 January) lost because of memory storage limitations.

This season we intended to move the tide gauge recording station and power supply to higher ground and establish a meteorological station at the same site coupled to the tide gauge data recording system. A 4 metre mast was erected on the eastern end of Cape Roberts within 2 metres of Cape Roberts No.2 survey point on 17-18 November. As of 26 November 1989 the Met. mast was measuring wind speed and direction at both 2 m and 4 m above local ground, temperature at 2 m and incoming solar radiation. On 5 January further Met. data was recovered and we attempted to correct the operation of the wind direction sensors. Unfortunately a computer malfunction due to the cold and tight helicopter scheduling has meant the Met. programme is not currently operating. The system is designed so that another tide recording transducer could be installed in the future. We did not install a temporary tidal sensor this season because it would have only duplicated last seasons measurements which were sufficient for an initial hourly tidal prediction programme.

Installation of a transducer this season would have only been temporary and likely to result in the loss of the transducer also. We believe that the establishment of a permanent recording tide gauge on the continent at Cape Roberts is possible but will require better site preparation for the transducer than was achieved in 1988.

The present experiment and instrumentation at Cape Roberts is jointly sponsored by Antarctic Research Centre, Victoria University of Wellington, the N.Z. Meteorological Service, and the Department of Survey and Land Information (DOSLI).

The Antarctic Research Centre (ARC) has thus far been responsible for the installation of equipment at Cape Roberts. We are interested in:-

1. Short term tidal data for correlation with our bottom current measurements in Granite Harbour.
2. Permanent tidal recording for possible drill sites offshore of Cape Roberts (mid 1990's) and general tectonic/sea level information.
3. Meteorological records from the Cape Roberts area for planning of drilling in this area and a general interest for future work in this area.

The ARC owns the CR10 data logger, solar panel, mounting frame and battery with a further transducer and interface available for a permanent tide gauge installation.

The N.Z. Meteorological Service is responsible for archiving the meteorological data with interests in:

1. Establishing the natural variability of climate within the McMurdo Sound Area especially for comparison with Scott Base.
2. Testing instrumentation for year round remote station measurements for future proposals (see Granite Harbour Weather and Climate 1990/91 proposal to RDRC).

The Meteorological Service owns the Met. instrumentation, data logger box, SM 192 storage module and mast.

DOSLI are responsible for archiving the tide data which has been analysed thus far to provide tidal predictions for KO42 bottom current studies. DOSLI has a continued interest in:-

1. Tidal data from Cape Roberts, to refine the mean sea level elevations of the geodetic network in the area. Cape Roberts is the origin for the network in this area.
2. Long term tidal records from the continent (Cape Roberts) for eustatic sea level comparison with the Scott Base tide gauge (K193).

Establishing a Permanent Installation.

Our experience has shown that it will be possible to establish a permanent tide gauge at Cape Roberts with sufficient site preparation for the sea level measuring transducer. A permanent tide gauge installation requires access to the transducer for checking or replacement if a fault occurs during several years of use. Two possible installations are envisaged for the transducer to avoid destruction of the transducer during sea ice breakout and are discussed briefly below.

1. A hole drilled through the coastal rock angled to exit the rock below the sea ice foot would provide the best protection for the transducer installation. The hole required could be up to 10 m long about 50 mm in diameter and could be drilled with Antarctic Divisions Winkie drill using a diamond coring bit. The drilling operation would use a sea water/salt drilling fluid, and so would be non-polluting. Detailed inspection of the seafloor below the ice foot would be required to establish the site and angle for drilling. This could be done either by a diver or by a special visual means through access holes in the ice foot.

2. The second method would use divers to determine a suitable crevice in the rock extending below the ice foot. A hole in the ice foot against the rock would be made by chainsaw and melting techniques so that a diver could connect the transducer pipe to pitons fixed into the rock joint. Cementing the pipe within the rock crevice may work and provide protection, however, the technique is presently unproven. This method is less favoured because it requires a significant diver component based at Cape Roberts and would still not fully protect the transducer pipe.

Testing Vibrocorer Components

On 19 November in central Granite Harbour, we pressure tested to 850 m depth the vibrator head and motor housing for a vibrocorer currently under development at VUW. The USARP group S-216 kindly allowed us to use their winch for these tests. The vibrocorer is being developed specifically to core sea floor sediments for the Holocene Marine Glacial programme which will be resubmitted for the 1991/92 season.

Terrestrial evidence of glacial expansion in Granite Harbour.

During the sea ice phase of this field season in Granite Harbour we visited several coastal sites looking for indicators of previous ice levels in the harbour.

Table 2. **Coastal features in Granite Harbour**

Coastal Site	Features & Processes
Cape Roberts:	Well developed boulder/gravel beach ridge system on the northern side. Ice planned rocks (glacial or sea ice?) on southern side, especially "Hut Cove".
Botany Bay:	Poorly developed, moderately steep boulder beach. Hint of 2 beaches at the eastern end. Abundant moss and lichen.
Cape Geology:	Basement outcrop dominated by NE trending jointing/structure. Abundant moss and lichen.
New Glacier Terminus:	Steep talus slope extending from the terminus. Partly glacial retreat and slope adjustment of (ice cored?) talus. Undefinitive and undatable?
Devils Punchbowl:	Gravelly "beach" of low slope Fluvial transport of fine gravel from the slope above in combination with tide crack ice.
Finger Point:	Very indistinct steep local boulder beach.
Cuff Cape:	Moraine ridges with high sand content associated with small hanging glacier/ice fall.
North side MGT:	Talus slope process against glacier ice near the grounding line of MGT, (north armpit).
Point Retreat:	Single poorly developed boulder beach, 15-20 m high lichen abundant on sheltered parts of large rocks.

The features we observed (Table 2) are unlikely to give datable evidence of previous ice levels in this area. Generally, the beaches in the harbour are poorly developed which reflects a relatively sheltered aspect in comparison to Cape Roberts which is more exposed and where several beaches are developed.

A detailed survey of the moraine ridges at Cuff Cape was carried out by our Swedish guest scientist Per Möller. Pat Sole (K191 - Survey Assistance) contributed to this work by surveying the ridge system and taking aerial photographs later in the season. The moraine ridge system at Cuff Cape is associated with a small hanging glacier to the south of the cape rather than the MGT.

We had also intended to study the glacial features on the south side of the MacKay Glacier at the Flatiron, Mt Suess and Pegtop Mountain. The Hagglund (H26) was used to drive up New Glacier successfully but broke though into a crevasse at the top of the glacier in a gently sloped snow covered area. We concluded that the Hagglund was too heavy for the snow conditions in this area and had to cancel this part of the programme. We have operated without incident in this area in the past with toboggans and a USARP group using toboggans this season travelled up New Glacier to Pegtop Mountain also without incident.

Publications

The two seasons of bottom current data will make up a major part of the paper on the current system and sedimentation in Granite Harbour to be prepared this year. We hope to also incorporate short current measurements made by ourselves and Rob Dunbar's Rice University group during out cooperative work on Granite Harbour sedimentation.

Per Möller will work on the data and sediment samples collected from the moraine ridges at Cuff Cape. A short paper will describe the process of ridge formation associated with the small hanging glacier on the south side of the cape.

Environmental Impact

Most of our operation is based on the sea ice and therefore has no lasting impact on the environment. The enlarged refuge hut facility at Cape Roberts was used by us and kept as clean as possible. The only additional impact is the meteorological instrumentation added to the tide gauge on the eastern end of Cape Roberts, this is a small relatively neat installation with minimal visual impact.

Management of Science in the Ross Dependency

The major concern we have for future programmes such as our sea ice based work is the continuation of NZARP survey assistance. This season the normal survey assistance was severely reduced because of funding considerations. The single surveyor was unable to operate independently at times. We found this placed an extra strain on our field programme even though our survey requirement was less than in previous years.

The survey assistance provided by DOSLI has been a very successful part of NZARP science support in the past and envied by several USARP programmes. It is important for many science groups to have accurate "high tech" surveying for their work in Antarctica that is often beyond the means of individual groups.

Acknowledgements

Equipment was prepared with help from Eric Broughton (RSES, VUW), the members of the VUW mechanical workshop and Peter Issacs (N.Z. Met. Service). The S4 current meter was recalibrated for 0-50 cm/s by the Oceanographic Institute DSIR We are grateful to the Antarctic Division and Scott Base staff who assisted us in the programme planning and in Antarctica. Special thanks to our field assistant /Hagglund operators Ron Rodgers and Dave Hotop, and Mike Kernot (RNZAF - 3 Squadron) who helped with the January moving recovery. Thanks also to Rob Dunbar's S-216 group for assistance testing the vibrocorer housing and hospitality while in the field. Pat Sole (K-191) once again provided much appreciated survey assistance to our programme.

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MOUNT EREBUS ERUPTION MECHANISM STUDY (K044)

R. R. Dibble

Abstract

During the field season, 1782 volcanic earthquakes were recorded digitally, 247 of which were archived, and 270 video recordings of the crater of Erebus were made from the TV transmitter on the crater rim. The lava lake continues to exist in the form of three main pools of about 20 m diameter, and degassed and convected freely. However, there were few explosions while K-044 was in Antarctica. Fifteen were recorded on both video and digital seismograph, and are presently being analysed by Mr O'Brien for his M.Sc. thesis.

A pilot seismic refraction survey was made on the summit cone along a 200 m line between the upper hut and Nausea Knob. Stacked hammer blows and seismic shots of detonating cord laid on the bare ground surface gave good records out to 100 m distance, and revealed a surface velocity of 3000 m/s. This appears to be the permafrost layer.

The quality of both the seismic and video data improved during the season. The telemetry geophone previously at the summit of Mt. Terror was brought down, serviced, and reinstalled as MACZ on the ESE side of the summit plateau of Erebus by S-081, so the number (6) and distribution of geophones on Erebus has improved. New batteries were added at MACZ and BOMB stations, and the old Gel-cell batteries from Terror were charged and stored at Scott Base. The old Terror site was cleared completely by S-081.

Recording will continue in the Science Lab of Scott Base until the batteries run down in the Winter. Only two of the telemetry sites (Hooper and Cones) have enough batteries to last the winter. The equipment will come back to life next spring when the solar panels recharge the batteries. The WBA infrasonic array recorded well until 3 January, when its RTG was returned to NSF.

Sources of Financial support

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University Grants Committee	4800
VUW grants committee	3400
Institute of Geophysics	500
National Inst. Polar Res.	10000 (estimate)
Japan Polar Res. Assoc.	6250

Proposed Programme

Studies of the physics and mechanisms of volcanic eruptions are not well advanced world-wide due to the rarity and brevity of eruptions and the danger to equipment from the volcano, the weather, and human interference. Yet they are essential if we are to reliably predict disastrous eruptions. Erebus offers a rare opportunity because it is continuously active, has a lava lake acting as a window to the magma chamber, is only mildly dangerous to equipment and personnel, and has no risk of water damage or human theft and destruction. Its situation in an aseismic region ensures that all the earthquakes have volcanic significance, and the relative lack of electronic and atmospheric pollution in Antarctica enable excellent telemetry of data, and sampling of gas and heat output. The Antarctic Treaty has enabled International Cooperation and the sharing of costs and data to an extent which would have been next to impossible on most volcanoes. No other active alkaline volcano in the world can be studied so efficiently.

Thus our study of eruption mechanism is important world- wide, as well as because Erebus is a very large volcano of considerable importance for the understanding of the geodynamics and structure of Antarctica.

Our work has covered the distribution in space and time of volcanic earthquakes, explosion earthquakes, tectonic earthquakes, earthquake swarms and tremor, explosion infrasonic waves, magnetic induction signals from eruptions, infrared temperatures, eruption velocities and volumes of lava bombs, and the velocity structure of the erupting magma column. Also our TV surveillance has been of considerable help to S-081 (USAP) and to K092 in their studies of erupted gases.

The principal objectives of the season were to collect digital and video data on families of explosion earthquakes for the velocity modelling of the volcano and its magma column, and to determine changes in the temperature of the crater walls and lava lake since 1986 and 1987.

Scientific Endeavours and Achievements

No new equipment was introduced this year. Rather we reluctantly relinquished the Windless Bight Infrasonic Array, in order to return the radio thermoelectric generator (RTG) to NSF. The ever deepening snow covering the microphones was reducing the sensitivity to Erebus eruption signals.

Thanks to the dedication of Howard Nicholson and Bruce McGregor, the Scott Base recording equipment required little servicing on our belated arrival in Antarctica on 28 November (a record 4 turnarounds) and we immediately prepared for put in on Erebus.

We flew to Fang Glacier in 3 lifts (one for the Grizzly) starting mid afternoon on 2 December, as the weather improved. S- 081 had flown up a few hours before us. The advance party of S- 081 came down and drove them up next day, while we waited out our planned 2 day acclimitisation, and drove up to the lower hut with S-081 help on 4 December.

Work on the summit comprised changing the infrasonic microphone battery at Truncated Cones (CONI) and E1 (E1SI), and readjusting the long period horizontal seismometer at E1 (E1LH). We tested and checked the receiver and antenna at MACZ station, newly installed by S-081, to find why it was not receiving and relaying the signal from BOMB, and checked that it was in the best possible site.

We moved up to the upper hut for 2 days, and using the space heater to keep the Nimbus stacking refraction seismograph warm, recorded 2 seismic lines 180 and 330 m long from the hut to Nausea knob for shallow velocity data. The surface velocity was 3000+/- 300 m/s on the undisturbed volcanic cone, and 2100+/-300 m/s on the old slump under the hut. The seismic source was sledge hammer blows for the 180 m line, and 1.5 m lengths of detonating cord laid on the surface for the 330 m line. Electric dets and the Nimbus shot box were used without incident by taking care to earth ourselves before handling detonators, and holding the bare ends of wires in each hand before connecting them, so that static voltages were discharged through the body. The start circuit for the Nimbus was wrapped around the det cord so it was opened by the shot, thus overcoming a fault in the start signal provided by the Nimbus shot box. A minimum of 5 shots had to be stacked to record at 330 m distance, and unluckily the Nimbus double-triggered on the 5th one, and ruined the record. It is estimated that 10 times more charge per shot will be required for the main survey next season.

While Dibble and O'Brien did the seismic survey, Shimizu and Kennedy began infrared temperature measurements at the crater rim, and continued after we all shifted back to the lower hut. To begin with, fume obscured the view inside the crater, and on subsequent attempts the thermometer malfunctioned in that the spot which was being measured could not be seen through the viewfinder. Inspite of the hand warmers strapped around it, the instrument got too cold sitting on its tripod, and became unreliable.

Upon return to Scott Base, Shimizu immediately began playback of analog magnetic tapes containing seismic data. Significant earthquakes since August 1989 were played back to charts from these tapes. He also collected amplitude data from E1SPZ events recorded on the SAN-EI long term chart recorder for that period. O'Brien began continuous video recording of the TV signal from the Erebus summit and took over archiving well recorded earthquakes on the digital seismograph from McGregor. During his stay 270 three hour videotapes were recorded, on which the lava lakes were visible 60% of the time. 16 explosive-type eruptions of the eastern lava lake were recorded on VCR and by the six seismograph stations and two microphones on the volcano. After Dibble and Shimizu's departure for New Zealand, O'Brien continued the magnetic tape playback, printing two sets of charts for study in Japan and New Zealand. 1782 events triggered the digital seismograph during O'Brien's laboratory work, but only 247 were volcanic earthquakes recorded well enough for focal determination.

Publications

Mr O'Brien intends to use the 1989/90 data for an M.Sc. thesis on eruption mechanism, and seismic velocity modelling of Erebus, beginning this year. Dr Dibble will publish the two conference papers presented to IAVCEI and IASPEI in 1989, and contribute to a memoir on Erebus to be published by AGU. Dr Shimizu and Prof Kaminuma will publish their latest seismic results in the Memoirs of the National Institute of Polar Research.

Environmental Impact

The impact on Erebus was reduced this year by the removal of disused microphones from the mountain side, and the return of about 12 reels of spare rope and wire from the upper hut to New Zealand. There is now very little unused equipment or materials on the volcano, and that in use is neat and tidy. The previous transmitter site at the summit of Terror, which was out of helicopter range from December 1986 until 1989, has been cleared completely and returned to normal.

Future Research

It is anticipated that sufficient digital earthquake recordings will be available by the end of 1990 to define enough earthquake families to establish an approximately correct velocity structure, and focal distribution within the volcano, and the present leader plans to remove the VUW equipment from Erebus by mid January 1991, for re-deployment on some other very active volcano. Also, his compulsory retirement on 31 Dec 1991, will impede further work in Antarctica.

However, I see volcanic seismology as near the end of the pioneering phase, in which researchers settled for minimum equipment to obtain the skeleton of the situation. Already earthquake seismologists are using arrays of 100 to 500 geophones to study earth structures far simpler than a volcano. The ease and reliability with which Erebus has been instrumented may attract more ambitious researchers. Until then, the activity of Erebus is important and unique enough to warrant a minimum monitoring programme, by one or two telemetry seismometer/microphone stations and a two channel San-ei long term ink-chart recorder.

I would recommend Truncated Cones for the telemetry site, because it has very good signal/noise characteristics, and is easy to reach by motor-toboggan from the lower hut on Erebus. Historically, Victoria University has refused to support monitoring programs on volcanoes, and handed the equipment at both Ruapehu and White Island volcanoes over to DSIR when the work reached that stage. They may do the same at Erebus, but I consider that the TV surveillance equipment is too precarious for long term monitoring, and that a 16 channel digital seismograph would be wasted on only two channels, and should be removed. I would be happy to consult and cooperate with anyone about this. NIPR and/or NSF may be interested.

Management of Science in the Ross Dependency

Antarctic Division are to be congratulated on the improved management of Scott Base and the field events, and the excellent cooperation with USAP achieved by the new SENSREP system. The cleanliness of the base area is also most impressive.

Acknowledgements

To RDRC for approving the program; to UGC, Victoria University, National Institute of Polar Research, and Japan Polar Research Association for funding it; to Antarctic Division for managing it; to RNZAF for their repeated efforts to get us to the "ice", and VXE-6 for 'gentle' expertise; to K092 for flying me to BOMB, and waiting patiently for us to descend from Erebus; to all of S- 081, but especially to Phil Kyle and Bill McIntosh for help with equipment on Erebus and Terror, and at BOMB; to Howard Nicholson and Bruce McGregor for service throughout the year, and to all at Scott Base who helped me catch up the week lost coming south, and return on time.

THE HYDROLOGY, GLACIOLOGY, AND SEDIMENT TRANSPORT PROCESSES OF THE MIERS VALLEY (K046)

J. A. McConchie, D. R. Winchester, R. M. Hawke and H. J. Campbell

Abstract

This project involved the second year of a hydrological, glaciological, and sediment transport monitoring programme in the Miers Valley. Information required to study and quantify the energy and mass balances of the glacier-river-lake system have been collected.

Data with significant implications to our understanding of the controls of stream flow in the Antarctic were collected. Evidence that direct solar radiation rather than temperature controls the stream flow has considerable importance to the current discussion of global warming and conflicts with many of the "popular" theories being advanced.

Fluvial sediment transport appears to be highly variable both through time and in space. Movement is of sand-sized particles (and smaller) and commences at very low flows and velocities. Coarser material forms a "lag" deposit on the bed and appears to be essentially immobile except under high flow regimes.

Once stream flow begins for the season there is usually sufficient energy available to mobilise any available sand-sized sediment. The fact that sediment is not continuously in motion suggests that the system is supply constrained. The sand is supplied from erosion of the stream banks and importantly from material present in water drained from the glaciers.

The different surficial materials throughout the valley reflect different proportions of the incoming solar radiation. As expected the "lighter" surfaces reflect a greater proportion than the darker surfaces. Data collected, but still to be analysed, should allow the absolute amounts of incoming radiation and the proportion reflected from each surface type to be quantified.

The change in albedo affects the temperature profiles under the various pavements, the depth to permafrost, the thickness of the active layer, and consequently the degree of development of the "patterns".

Resurvey of the three rows of five ablation poles on the Adams and Miers glaciers indicates, from the observed angles only, a movement of the upper portions of the glaciers of the order of 1 m.

No changes were evident in the appearance of the aprons or glacier snouts between seasons. Some spalling of material had obviously occurred but even the close spacing of survey points of 10 m made it difficult to detect any changes with "simple" survey techniques.

Over 100 photographs, carefully controlled for position and orientation, were taken to provide a stereoscopic coverage of the glacier snouts. These will allow a terrestrial photogrammetric survey of both the Miers and Adams glacier fronts. This should allow relatively small changes to be detected and quantified.

Proposed programme

Work in the Miers has focused on quantifying various components of the energy balance for the valley. This work has significant implications to the current discussion of global warming and its likely impact on world sea levels. The Miers was chosen for this study as it is a relatively small and simple valley with few inputs and outputs, all of which can be readily monitored.

Besides monitoring various climatic parameters and their control on the stream flow, the affects of the available energy on geomorphic processes were also measured. The Miers valley provided a study area in which several experiments could be undertaken and replicated without the need for laboratory flume studies and the confusion caused by soils and vegetation in more temperate regions.

During the 1989-90 season, work concentrated on four projects looking at various aspects of climatically controlled processes operating in the Miers Valley. These projects were:

1. Continuation of the monitoring of stream flow and various climatic parameters which may be controlling its timing and volume.
2. Monitoring and attempting to quantify the fluvial sediment transport processes.
3. An attempt to quantify the albedo of the various surficial materials (including glacier and lake ice, and water) and relating this to the distinctive "patterned" ground found throughout the valley.
4. Measurement of changes in the Miers and Adams glaciers and testing the practicality of using "terrestrial" photogrammetric techniques to monitor changes in the terminal faces of the glaciers.

The Miers Valley was chosen for this study because it has only two contributing glaciers, the Miers and Adams, each of which drains from a different aspect. This work builds on field work in the area by two members of the research team during the previous field season.

It is hoped that the data collected during the past two field seasons will permit:

1. The evaluation of the seasonal variability of glacier behaviour and surface water hydrology.
2. An improved understanding of the energy and mass balances of the glacier-river-lake system in the Miers Valley, which typifies such systems in the Dry Valleys region.
3. The development of a water balance for the Miers Valley hydrologic system.
4. The quantification of sediment sources, the relative importance of sediment transporting media, and how these vary both spatially and temporally.
5. Quantification of the albedo (reflective) properties of the various surficial materials found throughout the valley.

Although some of these areas of study have been attempted in other areas of Antarctica (e.g., the Wright Valley) these studies have tended to be inconclusive because of the intensity of sampling and the complexity of the systems investigated.

Scientific Endeavours and Achievements

Hydrology

An initial examination of the hydrologic and climatic data is tending to confirm the findings of last season. These are:

1. Stream flow is directly controlled by the amount, and intensity, of solar radiation striking the glaciers. Such is the level of this control that clouds passing in front of the sun can be identified in the hydrographs.
2. Temperature has only a minor affect on stream flow, determining to a slight degree the "baseflow" when there is no direct sunlight.
3. There is a maximum amount of melt able to be generated, if there is no cloud, when the sun is at a particular azimuth. This is indicated by "flat" peaks on the hydrographs.
4. The maximum amount of melt possible on any day during the season (if there is no cloud) is cyclic and increases as the angle of the sun gets higher. Essentially, maximum stream flows are cyclic around the "longest day".

5. Periods with several "clear" days in a row had higher flows as a result of gradually increasing "baseflows".

Fluvial sediment Transport

An intensive fluvial sediment sampling programme has shown that sediment transport is characterised by:

1. High spatial and temporal variability as found in other studies.
2. Movement of sand sized and smaller particles. Particles larger than this appear to form a "pavement" or "lag deposit" on the bed. These larger particles tended to roll only when the sand around them was removed under high flow regimes.
3. Movement tends to be via migrating ripples although movement commences at very low flows and very low velocities. This ease of movement appears to be a result of particle shape (predominately spherical) and the generally smooth and regular bed.
4. The fluvial transport system appears to be supply constrained. That is, there always appears to be sufficient energy available to shift any sand sized particles present. On occasion, however, both temporally and spatially these particle sizes are absent.

Albedo Studies

Distinctive differences were found between the albedo (reflective) properties of the various surficial deposits in the valley.

1. The glaciers had the highest reflective properties (except when covered with silt) followed by lake ice, marble dominated pavement, granite pavement, and lastly volcanic dominated pavement.
2. The change in albedo affects the temperature profiles under the pavement, the depth to permafrost, the thickness of the active layer, and consequently the degree of development of the "patterns"
3. The degree of development of the patterns appears to be related to the availability of moisture and the cryergic activity at the site. Variation in the rate of this activity in the valley is largely controlled by the albedo of the different surfaces.

Ground Survey and Photogrammetry

Considerable survey work was again undertaken during the past season. Tying into the various benchmarks established in 1988-89 and completion of the survey network during the past season allowed the following work to be undertaken.

1. A resurvey of the three rows of five ablation poles on the Adams and Miers glaciers. The observed angles suggest movement of the upper portions of the glaciers to be of the order of 1 m.
2. A resurvey of the glacier snouts and their associated aprons. No changes are evident in the preliminary calculations of the measurements of the aprons or glacier snouts between the two seasons. Some spalling of material had obviously occurred but even the close spacing of survey points of 10 m made it difficult to detect any changes.

Ablation of the "fallen" ice also makes it difficult to establish amounts of ice lost from the system. To precisely measure the stability or shift of the glacier fronts and to assess the glacier ice lost from the snout, a terrestrial photogrammetric survey of both the Miers and Adams Glaciers was undertaken this season. Approximately 100 photographs were taken to provide a stereoscopic coverage of the glacier snouts. Each photograph position was accurately set up with respect to a known geometry. Foreground and background survey marks were established using "terrier bolts" which were flagged with coloured discs mounted on special fittings for photography. With this "height" control it is intended to map the glacier fronts using the floating mark of the photogrammetric plotter. This will result in very accurate profiling and contouring which will allow minor changes in the morphology and volume of the glacier snouts to be quantified very accurately.

Publications

Work undertaken during the 1989-90 season will be published in the following manner:

1. Two papers for the New Zealand Antarctic Record: one on ground water hydrology and its importance in the Antarctic (a little reported area); and one on the instrumentation used during the season.
2. One paper for either Nature, the Journal of Hydrology, or the Journal of Glaciology on the results of the field season and their implications to the discussion of "global warming" and predicted consequent rises in sea level.
3. The sedimentological work will be initially reported as an Honours dissertation submitted in the Research School of Earth Sciences at Victoria University before possible publication in the Journal of Hydrology.
4. One paper on the aeolian sediment transport processes and landforms will be published in "Earth Surface Processes".
5. One paper on the albedo measurements and variations in the temperature profiles will be published in "Earth Surface Processes".
6. One paper on the work undertaken on the "patterned" ground will be published in "Earth Surface Processes".
7. At least one paper on the work undertaken on terrestrial photogrammetry will be published in a reputable "Photogrammetry Journal".
8. At least four conference papers should also come from the work of the past season.

Environmental Impact

This project had very little environmental impact on the Miers valley. Two of the studies, however, resulted in minor impact:

1. The construction of the weirs resulted in minor channel modification and an overflow channel on the Adams stream was diverted to bring all the flow together above the weir. This diversion was constructed using a hessian embankment and the channel deepened itself naturally with the flow. So effective was this diversion in its first year (1988-89) that it appears to be unnecessary during the past season. Some sand bagging was also required to safeguard the integrity of the weirs and prevent erosion. While hessian sacks were in the main used some "blue" plastic rubbish bags were also used. The majority of these were removed at the end of last season and the five which remain are well buried. These remaining bags should, however, remain intact in the weirs and not present an environmental problem. They will be removed with the weirs once they are no longer needed.
2. The provision of permanent benchmarks around the margins of the glaciers required the installation of "terrier" bolts into prominent rocks. These sites are invisible except where cairns and other markers have been used to surveying purposes.
3. The only other evidence of our presence in the valley are the numerous foot prints left as we travelled to sites of specific interest. These, however, appear to be "softened" very rapidly by the high winds experienced during the winter. The prints left after the 1989-90 season were hardly discernable after the past winter and certainly would not be visible after a further couple of winter seasons.

Future Research

At this stage it is envisaged that a sufficient data base has been collected to allow many of the questions posed at the outset of this programme to be answered. Time is now required to analyse the data and to identify areas in which further work is required.

In one or two seasons time it is hoped to return to the Miers and to re-photograph and re-measure the glaciers so that the changes discussed above can be quantified. The changes are expected to be relatively small and therefore measurements are not required every year. These measurements should allow a good indication of the changes in the mass balance of the valley.

Management of Science in the Ross Dependency

This type of project is readily supported by Antarctic Division as it is largely self sufficient in the field and requires little by way of mechanical support.

Difficulties in field testing equipment under field conditions in New Zealand mean that at least two seasons are usually required to undertake any specific programme. The first is dedicated to field testing equipment and the second in collecting the required data base.

Acknowledgements

The success of the 1989/90 programme reflects the tremendous assistance received from many persons. The University Grants Committee provided the basic expedition funding and the Internal Research Committee of Victoria University funded all the prefabricated weirs and flumes, the data logging equipment, albedometer, and various sensors.

Graeme Hewitt and the staff of the Mechanical Workshop at Victoria University constructed all the weirs, flumes, sediment traps, and instrument mountings within a very short time frame. They also designed and constructed all the attachments for mounting the camera on the theodolite and for erecting the numerous benchmarks both on the glacier snout and on the rock pavement. A tribute to their work is the fact that all weirs survived the winter and are continuing to work. The quality of the data collected hung on their craftsmanship which could not be faulted.

Staff at Scott Base, but in particular the Operations Manager (Don Hammond), the Stores staff (John Lee and Doug Henderson), and radio operators assisted the project in many ways. Generally all the staff at Scott Base were more than willing to assist event personnel in any way they could.

This was a very productive season on the "Ice" and this is a credit to all those who have helped this event.

THE HISTORY OF THE ROSS SEA REGION DURING BEACON TIMES (K047)

K. J. Woolfe, M. J. Arnot and D. P. Zwartz

Abstract

Beacon sediments between Mt Metschel in the south and Robinson Peak in the north were examined during a 60 day, 950 km long traverse. Although a large number of days were lost to bad weather, most of the scientific aims were achieved.

The Pyramid Erosion Surface between Metschel Tillite and basal Weller Coal Measures was found to be at least locally conformable. This indicates that the retreating ice sheet was proximal to vegetated areas and that the time break believed to be associated with the erosion surface may be very small.

Observations suggest that the Beacon was deposited in an intracratonic sedimentary basin, no evidence was found to support the view that marine incursions occurred during Beacon times.

An extensive suite of samples were collected and will be used to provide a carbon/sulphur geochemical profile of the Beacon and to examine the effects of dolerite intrusions on the usefulness of carbon/sulphur as a paleoenvironmental indicator.

The lower part of the Lashly Formation was the object of a special study. Paleocurrent measurements and facies sequences recorded in Lashly A, suggest a deltaic, fluvio-lacustrine setting.

Proposed Programme

Work conducted by Victoria University and the Geological Survey in recent years has shown that both the Taylor and Victoria Group sediments in south Victoria Land have been deposited by non-marine processes (Sherwood et al 1989, Woolfe 1989, Woolfe et al 1989), in contrast to earlier interpretations of the Taylor Group using trace fossils (Bradshaw 1981).

During 1989-90 a four man Victoria University party visited exposures in the Skelton Névé to Robinson Peak area to look for facies, paleocurrent and thickness changes that may provide clues as to the mechanics of basin forming processes.

It has been suggested by some workers (Collinson et al 1987) that the Beacon Supergroup was deposited in a foreland basin, but this is not consistent with many features of the Beacon, including absence of deformation, basin symmetry, petrology of basal sediment and also the present day regional configuration of the Ross Sea sector.

Questions to be addressed by the current study include; where was the Beacon Basin in relation to the continental margin and what processes were driving basin development?

In addition to this regional study two local investigations were started during the summer, a comparison of the Pivot and Weller Coal Measures and a reinterpretation of Lashly A sediments. These projects are currently being undertaken as Masterate and BSc Honours programmes respectively. They also lead into more detailed studies of Beacon strata proposed for 1990-91 at Allen Hills.

This work will concentrate on modelling the processes that deposited upper Weller Coal Measures, Feather Conglomerate and the Lashly Formation. This should provide a fluvial model that is better able than those of Allen (1965) and Smith (1989) to explain the occurrence of sheet sandstones in apparently meandering sequences.

Scientific Endeavours and Achievements

Introduction

Exposures of Beacon Supergroup sediments between Mt Metschel and Robinson Peak were examined during a 60 day, 950 km traverse from Scott Base. Although a significant number of days were lost to bad weather while travelling on the Ross Ice Shelf these delays were almost certainly less than the weather, mechanical, weekend and public holiday delays we would have experienced with helicopter support.

Travel was generally easy, the only exception being on the Lower Staircase, where freak, deep soft snow conditions made travel extremely slow.

Facies descriptions with thicknesses along with paleocurrent data were obtained from a number of localities on Mt Metschel, Portal Mountain, Mt Cream, Pivot Peak, Mt Fleming, Mt Bastion and Robinson Peak. These observations provide valuable information on ancient paleoslope direction and basin subsidence.

Detailed descriptions of Pivot Coal Measures were made at Pivot Peak and these will be used to compare these Devonian sediments with the better understood and more widespread Permian Weller Coal Measures. At the same time vertical and lateral sample suits were collected and these will be used to study the effects of Ferrar Dolerite on carbon sulphur ratios and to examine the suitability of carbon sulphur geochemistry as a paleosalinity indicator for Beacon Rocks.

Extensive paleocurrent and facies analysis was conducted on exposures of Lashly A, where fining upwards cycles are preserved with low sinuosity channels.

Results

Loaded channels of Maya Arkose in Metschel Tillite (diamictite phase) at Mt Crean show that the time represented by the Pyramid Erosion Surface is geologically insignificant. This supports previous observations which suggested a gradation between Metschel Tillite and Weller Coal Measures at Mt Fleming (Pyne 1986).

A pebbly carbonaceous shale (diamictite) occurs on a ridge south of Mt Fleming. This unit is of limited extent but is clearly exposed below the base of the Maya Arkose. Initial interpretations are that the carbonaceous material is primary, suggesting a temperate climate at the time of deposition. It is hoped that samples may contain spores suitable for dating.

Preliminary results suggest that the lower part of the Lashly Formation (Lashly A) was deposited in a fluvio-lacustrine setting, possibly initially fed by a large braided river which deposited Feather Conglomerate higher up on the flood plain. At several locations the Lashly-Feather boundary is gradational and at Horseshoe Mountain facies characteristic of the Feather Conglomerate are interbedded with typical Lashly sediments over a 20 m interval. The Lashly A-B boundary becomes difficult to place north of Mt Bastion.

Structures resembling HCS and SCS were observed along with logs and peat rafts in Lashly B at Horseshoe Mountain. These are similar to HCS and SCS observed last year at Allan Hills in the upper Weller Coal Measures and suggests that similar depositional processes were acting. We do not know what flow conditions produce these structures but it is hoped that a model for their formation will be developed after the proposed Allan Hills project in 1990-91.

Initial interpretations based on isopach data, support our view that the Beacon was deposited in a tectonically quiescent intracratonic basin of substantial size and duration.

Skolithos was observed in non-marine sediments at Pivot Peak and Horseshoe Mountain. No evidence of marine incursion was found and we now believe that the entire Beacon Supergroup in South Victoria Land is non-marine.

Geochemical data, including the planned carbon/sulphur profile of the Beacon Supergroup is not yet available.

Note: Since this report was prepared, geochemical data has revealed that the Pivot Coal Measures Member is non-carbonaceous. The black finely divided material is titano-magnetite and the name Pivot Member is proposed as an alternative (Arnot and Woolfe in press).

Publications

The results of this field season will be written up as part of a PhD thesis (Woolfe) an MSc thesis (Arnot) and a BSc (Hons) project (Zwartz). A paper reporting preliminary results of the carbon/sulphur geochemistry of the Beacon and the effects of dolerite intrusion is planned, as are papers on the regional tectonic setting, the Pyramid Erosion Surface and depositional modelling of Lashly A.

Environmental Impact

All campsites were on snow. All non-burnable rubbish was returned to Scott Base, burnable rubbish was returned to Scott Base where possible, the rest was incinerated and the ashes returned to Scott Base. Human wastes were disposed of locally. A limited number of geological samples were collected for laboratory study in New Zealand.

Future Research

During 1990-91 we propose re-visiting Allan Hills, following a short visit in 1988-89. The programme at Allan Hills will concentrate on the fluvial processes that were occurring during Beacon Deposition. We aim to develop a model which is better able to explain the geometry and formation of fluvial sediments than existing models (Allan 1963, 1965, Smith 1989).

We intend to process data in the field using personal computers which we plan to house in a hut of some sort. As Allan Hills is a location visited frequently by both New Zealand and American parties the provision of a semi-permanent structure should be considered.

The only changes to the proposed programme for 1990-91 are likely to be in timing of personnel.

Discussions are continuing with the New Zealand Geological survey over the possible co-operative publication of a 1:25,000 geological map of Allan Hills.

Management of Science in the Ross Dependency

At our Event Briefing at Scott Base on Nov 5, we were told that we needed to submit a full scientific proposal to RDRC for our "extension" to be approved and we would not permitted to visit areas which fell within this "extension" until approval have been received from RDRC.

After a number of phone calls to New Zealand the issue was resolved but several points resulting from this incident require further discussion.

1) Our proposed route was sent to Ant Div in March 1989, and was discussed fully at Tekapo. No changes were made to the proposed route and it was not clear to anyone on base exactly where it was we had extended to.

If there were a genuine problem why was it not picked up and sorted out earlier, at Tekapo for instance?

2) On arrival in Christchurch we were met at the Airport and briefed at the Harewood Store, from where we were told that we did not need to report to the Antarctic Division Office. Despite being delayed in Christchurch, no messages were left at the Windsor advising us to report to the office even though, 3 days before Christchurch sent a memo to Scott Base requiring us to submit a new proposal. It would seem reasonable to have contacted us in Christchurch, especially as the problem would have been much easier to solve while we were still in there.

3) The first we heard of the affair was at Scott Base via "rumour control", and on asking if there were any problems we should know about we were told no! It was not until our Event Brief the next day, that the same person showed us the memo he had received from Christchurch 4 days earlier.

4) It does not seem reasonable that "sensitivities" between Woolfe and another Antarctic researcher, and shortage of time should be cited as reasons why the Event was not to proceed as approved at Tekapo.

Two members of the Event briefly entered restricted air space above the Barwick Valley SSSI. This occurred while being pulled out from Mt Bastion in bad weather, the helo crew had already spent a night on the mountain when a small clearing provided a flyable route through the Barwick. No landings were made.

Acknowledgements

Throughout the field season we experienced superb support from Scott Base Staff, their enthusiasm and dedication saw us get into the field ahead of time and once in the field their continued support was unprecedented. Several members of the Scott Base team deserve special mention, in particular we thank Doug Henderson and John Lee for their excellent work in the Stores Dept., the comms operators for keeping us amused on the many occasions when we were tent bound!, and Don Hammond for his unrelenting work, often long into the night.

We also thank Garth Varcoe and his team for establishing a fuel dump for us a Commonwealth Camp prior to our arrival, and Eric Saxby for assistance in planning the traverse.

Hovercraft support was provided by ANS and Helicopter support by VXE-6.

Finally, special mention must be made of our Antarctic Division field assistant, Tony Teeling. Tony's enthusiasm was unrelenting and he contributed significantly to the success to the programme.

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WEST ANTARCTICA VOLCANO EXPLORATION (WAVE)

J.A. Gamble

Abstract

The Executive Committee Range (ECR) is a linear, north-south oriented, chain of intraplate volcanoes related to late Cenozoic rifting in West Antarctica. Reconnaissance, helicopter supported, sampling and geochronological studies indicate a younging of volcanism from around 13 - 10 ma in the north (Mt Hampton) to < 1 ma in the south (Mt Waesche).

During the 1989 - 1990 field season detailed mapping and sampling was undertaken on Mts. Sidley and Waesche with reconnaissance sampling at Mt Cumming. Both mapped volcanoes reveal complicated volcanic histories commensurate with marked changes in the composition and style of eruption of the products.

On Mt. Sidley (where exposure is superior) the oldest rocks exposed in the caldera walls are anorthoclase phonolite lava flows. Higher in the sequence aphyric trachytes and intermediate lavas predominate. The majority of this sequence was erupted subaerially although lenses of hyaloclastite and intercalated sediments infer the proximity of ice or standing water. The caldera collapse phase either accompanied or produced eruption of pyroclastic rocks which include a plutonic block-rich air-fall deposit and culminate with pyroclastic flows. Small scoria cones of mafic composition which contain lithospheric xenoliths (mostly mafic and felsic granulites and rare peridotites) are the youngest examples of volcanism.

Two caldera complexes can be recognised on Mt Waesche, the northerly of which is associated with eruption of peralkali rhyolite. The majority of Mt Waesche is snow covered apart from the south facing slopes which are studded with numerous young scoria cones. These scoria cones rest on an erosional unconformity, delineated by a till layer which contains distinctive plutonic blocks. We infer that these blocks represent the crystallised contents and wall rocks of a subvolcanic magma chamber which was disrupted by caldera collapse.

The lithospheric xenoliths have been recovered from mafic scoria cones and deposits on Mt Waesche (3), Mt Sidley (7) and Mt Cumming (1). Together with the plutonic blocks, these samples will enable reconstruction of a complete section of the lithosphere from mantle depths to the upper crust. A long term aim will be to integrate this information with knowledge of the lithosphere in the Ross Sea Embayment and elsewhere in Gondwanaland such as eastern Australia and southern New Zealand.

Proposed Programme

The WAVE project was conceived with a view to understanding the volcanic and geochemical evolution of intraplate volcanoes in West Antarctica and to comparing volcanism and lithospheric structure of West Antarctica with documented parallels in the Ross Sea Embayment. The 1989 - 1990 field season specifically targeted the ECR (77° 15' S, 126° 30' W - 76° 15' S, 126° W) for a number of reasons: 1/ ECR contains some of the youngest volcanism in West Antarctica. 2/ The volcanoes are large and, in the case of Mt. Sidley, particularly well exposed. 3/Reconnaissance sampling indicated considerable compositional range (from basalt to phonolite and peralkali rhyolite). 4/ Lithospheric xenoliths had been reported from one volcano (Mt. Cumming) in the range.

For the 1989/90 season the aim was to study all the volcanoes of the ECR (Mts. Waesche, Sidley, Hartigan, Cumming and Hampton) together with a projected visit to the USAS Escarpment. Delays due to availability of logistic support and poor weather led to curtailment of the field programme by approximately 50%. As a result, the field programme concentrated on Mt Waesche and Mt Sidley at the south end of the range. The reasoning behind this decision was simple: The reconnaissance work and radiometric dating studies (see Le Masurier and Rex, 1989) indicated that Mt Sidley (at 4181m the highest volcano in Antarctica) and Mt Waesche were relatively young, the latter yielding rocks < 1ma. Consequently we were keen to ascertain whether any were currently active. Furthermore, these volcanoes are relatively close together, offered superior exposure to the other volcanoes and showed compositional variation similar to the volcanoes of the Mc Murdo Volcanic Group.

Scientific Endeavours and Achievements

Despite the foreshortened field season the WAVE party can claim to have completed a very successful programme. Detailed geological mapping was completed on Mt Waesche and Mt Sidley and this work supplemented by extensive sampling for geochronological and geochemical study. At Mt Waesche the very young nature of volcanism was confirmed by the discovery of primary tephra layers in blue ice adjacent to the volcano. Eruptions from both Waesche and Sidley appear to have been dominantly subaerial, punctuated, at least on Mt Sidley, by periods of subaqueous or subglacial volcanism, leading to formation of hyaloclastite. The stratigraphic records of both volcanoes contain evidence for explosive and passive effusive volcanism. Both Mt Waesche and Mt Sidley have spectacular calderas (15 km across in N. Waesche and 6 - 7 km across in Sidley) and measured sections on the north and west caldera walls of Mt Sidley have yielded near vertical sections through 1000m of exposed rock. These sections provide a detailed record of the construction of the volcanoes and indicate evolution through an early effusive phase culminating in explosive volcanism and eruption of pyroclastic flows which accompanied caldera formation. Waning activity on both Sidley and Waesche saw development of small, broadly basaltic, scoria cones peppering the volcanic edifice. The phonolitic lavas which form a large portion of the early succession on Mt Sidley contain phenocrysts (up to 100mm) of anorthoclase and are strikingly similar to those of Mt Erebus. Thus, the observations on the ECR volcanoes may have important implications for the future evolution of active volcanoes such as Mt Erebus in the Ross Sea Embayment.

Lithospheric xenoliths have been recovered from sites on Mt Waesche (3), Mt Sidley (7) and Mt Cumming (1). Of the sites on Waesche, two consist of plutonic blocks (probably of subvolcanic origin) and supracrustal granitoids which arguably comprise basement to ECR, the third site contains a mixture of lower crustal (granulites) and plutonic blocks. No ultramafic materials were recovered from xenolith localities on Mt Waesche. On Mt Sidley, three of the seven localities yielded subvolcanic and supracrustal xenoliths exclusively. The remaining four yielded a variety of granulites ranging from mafic to felsic and presumably of lower crustal origin. Two of these four sites also contained rare peridotites. A partly eroded basalt scoria cone on Mt Cumming yielded a rich assemblage of texturally variable spinel lherzolites.

Publications

As this is the first season of the WAVE programme, essential laboratory work has not yet commenced. Summaries of the field seasons work will be submitted for publication in "The Antarctic Record" in the U.S. Antarctic Journal and in the equivalent BAS journal.

Environmental Impact

Apart from removal of rock specimens for scientific purposes the impact on the environment is assessed as negligible. All non-burnable rubbish (cans, plastics, etc) was removed to Mc Murdo. Human waste was buried.

Future Research

A follow-up field season for the WAVE project is projected for 1990/91 and a proposal to this effect has been submitted to RDRC. Put-in sites have yet to be finalised between US - BAS - NZARP contingents and we intend to consult with the MBL Tectonics (Bradshaw-Dalziel,etc) parties before finalising these details. At present we identify Mt Murphy and the Flood Range as prime objectives for 1990 -1991. This may necessitate a mid season move.

Management of Science in the Ross Dependency

The WAVE project incorporated scientists from three national Antarctic research programmes (USAP, BAS and NZARP). My impression of the 1989/90 season was that, apart from the delayed field access, it was a very successful season. The scientific interests of the three groups were complimentary.

Acknowledgements

All of the WAVE party wish to express a sincere thanks to the SENZREP (Scott Base) and NSFREP (McMurdo) for their continued support and advocation following the premature cancellation of our 1989/90 programme. This effort was a stimulus to a doubled effort in the field and to the amount of work which was eventually achieved. We also pay due compliment to the skills of the VXE-6 personnel who (eventually) got us in and out of the field, without their support the entire exercise would be impossible. Thanks also to Peter Barrett, Alex Pyne and Phil Kyle, your advice and assistance were always appreciated. Finally, there remains the base staff of Scott Base, thanks for preserving our sanity.

OPTICAL PROPERTIES OF SEA ICE (K132)

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Abstract

In determining the effect of enhanced UV levels on Antarctic life, it is important to know the UV radiance under the sea ice where most Antarctic organisms live. The underice radiance is controlled by the transmission of the ice and here we report the results of these measurements. The transmission is largest early in the season, and drops by a factor of 10 by mid-November. This result implies that life under the ice has always experienced its major UV dose in October, a dose that can rise by a factor of 10 during the presence of the deepest ozone holes observed.

Results

The 1989/90 field season was particularly successful for event K132. Of particular interest were the measurements we made of the transparency of sea ice to UV radiation. It was found to be even more transparent early in the season than we had estimated. Since the ozone depletion also occurs early, our results imply a ten-fold increase in the total yearly UV radiation dose under the ice during periods of deep holes such as 1987 or 1989.

This season's programme was a natural extension of our work during 1985/86 and 1986/87, which has already led to 5 publications in international journals, including Nature and Science. Our entirely new optical technique, in conjunction with our theoretical modelling of sea ice, has led to new insight into the details of the light field in and under the ice. Throughout we have monitored the structure of the ice with various physical measurements. This year they included temperature, salinity (brine volume), density, and heat capacity, which have been of considerable importance in understanding the optical behaviour of the ice and its seasonal changes. The significance of this research derives from the fact that light is both essential and potentially harmful to life under the ice.

We show in Figures 1-5 the main results of this year's work. In Fig. 1 the fraction of radiation that is transmitted through the ice is plotted against the wavelength. It can be seen that the harmful UV bands from 250 to 400 nm (UV-B) are in a region of relatively high transmittance. The time dependence is displayed in Fig. 2 and clearly seen is higher transmission early in the season. The largest value was on our first day of taking data, 26 October, at 350 nm. On the basis of results in the visible part of the spectrum we earlier estimated a transmittance of 5% in early October, falling by about a factor of 100 by mid-December. This prediction is seen to be rather close to our measurements, except that any reasonable extrapolation of our data to early October yields more than 5% transmission. It is of course in this early part of the season that UV damage is likely to affect the algae living under and in the ice. A paper on this aspect of our results has been accepted by Nature.

Optical data were also collected in the visible part of the spectrum, and similar time dependence effects were found. We expect to interpret all of these data to separate effects of absorption by algae from the intrinsic sea ice optical behaviour, but as this will require detailed computer modelling of light scattering in the ice, it will not be completed until the end of 1990.

The depth dependent profiles of temperature, salinity, and density of the ice are shown in Fig. 3. In both the salinity and the density there are changes in the surface layer as the ice temperature rises. These changes signal the draining of brine from this layer, which leaves behind a high density of air bubbles. It is scattering by these bubbles that leads to the increased turbidity of the ice and the decrease in transmission at all wavelengths observed in Fig. 2.

Shown in Fig. 4 is the underice radiance at 300 nm calculated using our measured transmission values and the surface radiance measured in 1988 at Palmer Station. These are the only surface radiance measurements available to our knowledge. It is interesting to note that even before the appearance of the hole the net yearly dose received by ice algae at the base of the ice, given by the area under the curves in Fig. 4, was dominated by the large flux in the early spring. The significant point here is that although the surface radiance is larger in the summer, the developing turbidity of the ice shields the ice algae late in the season. The figure clearly shows that there is a factor of four enhancement in the UV radiance under the ice during October 1988, resulting from the coincidence of the ozone hole and the period of high sea ice transparency. During times of deeper holes, such as 1987 and 1989, the underice UV enhancement in October would be expected to be a factor of 10 higher.

We have also commenced a programme to study the thermal behaviour of sea ice, and to that end we deployed a thermistor array to continuously monitor the temperature at eight depths. This measurement was only a partial success, for we found that the thermistors were directly heated by sunlight to an extent that we could not follow the subtle heat waves that we wished to study. However, larger effects from the sun heating the ice could be clearly measured. The interpretation of the array data will require a knowledge of the heat capacity of sea ice, and as rather little has been done to directly measure this important parameter we developed a simple scheme to make these measurements. The heat capacity results and a comparison with theoretical predictions are shown in Fig. 5. These, along with the array data, will give the degree of solar heating at various depths, which can then be compared with predictions based on the optical models that we have developed.

Acknowledgements

We would like to thank the staff of the Physics and Engineering workshop and Dave Gilmore for design and construction of some of the equipment used in this work. We also would like to thank the Antarctic Division of DSIR for logistic support and the New Zealand University Grants Committee for some financial support. We are grateful to Leigh Johnson for developing the heat capacity equipment.

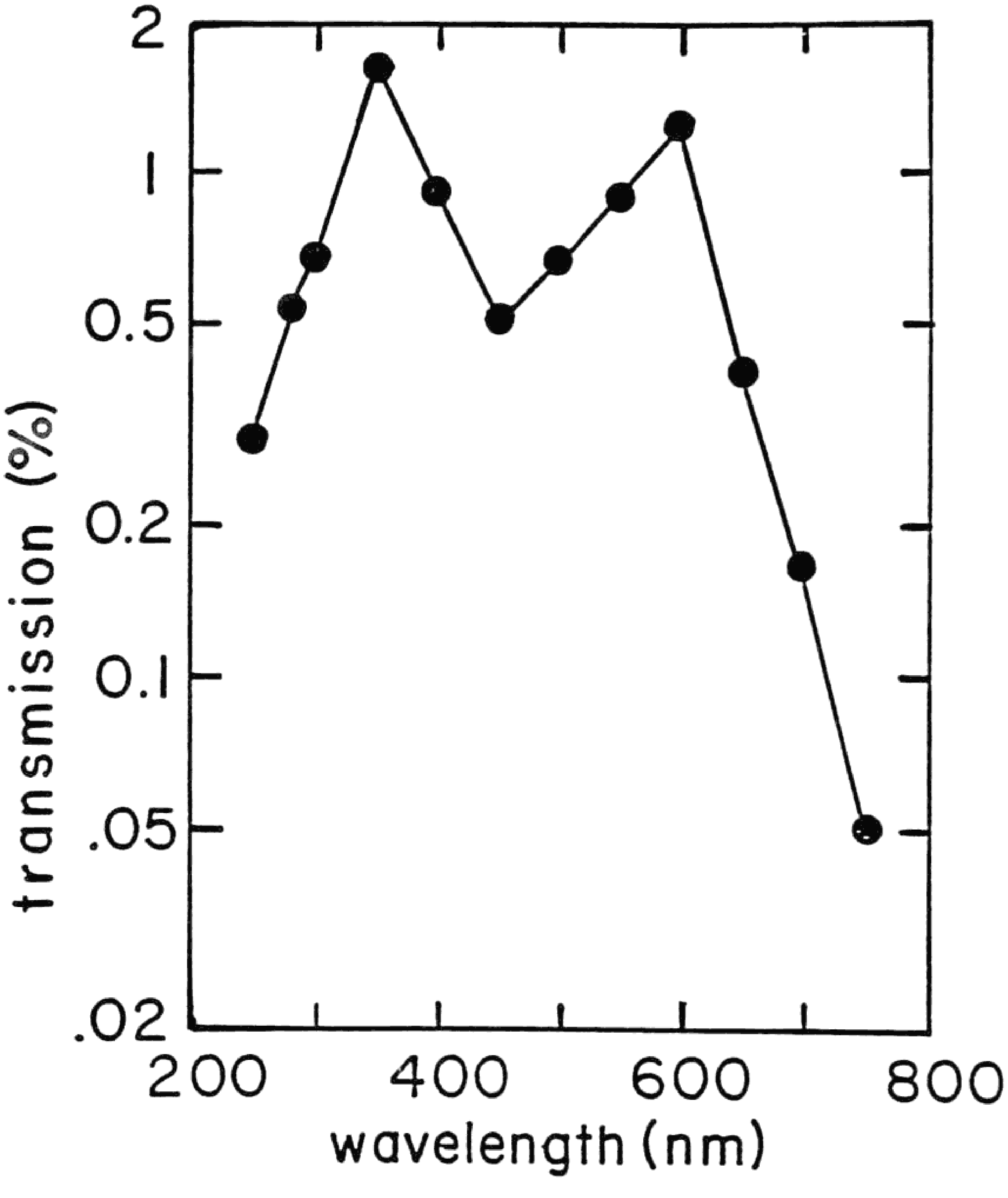

Figure 1 Net transmission of the ice vs wavelength in the UV and visible on the 9 November 1989.

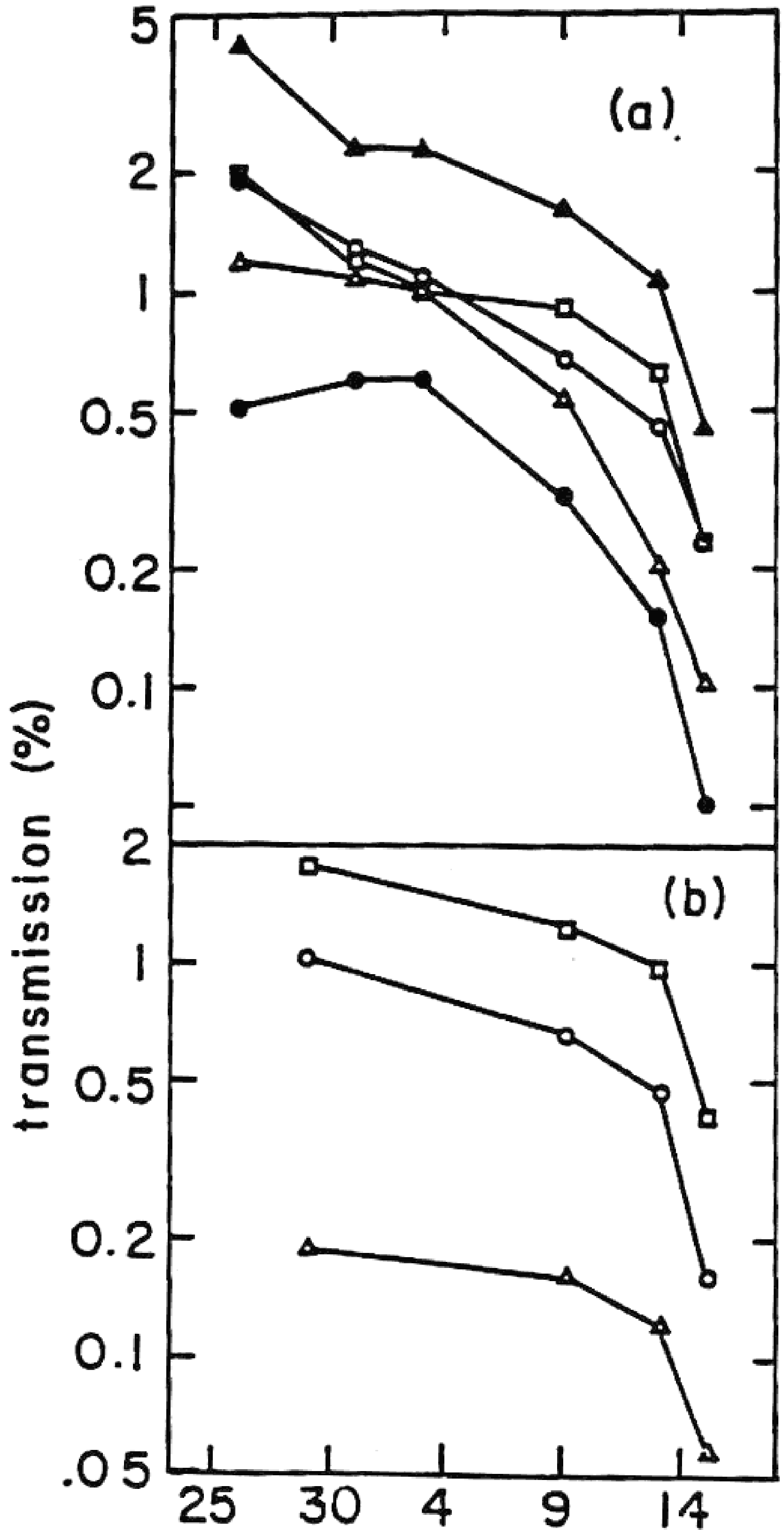

Figure 2 Time evolution of the transmission of the ice (a) at the UV wavelengths 250 nm (●), 280 nm (Δ), 300 nm (O), 350 nm (▲), and 400 nm (□), and (b) at visible wavelengths of 500 nm (O), 690 nm (□), and 700 nm (Δ).

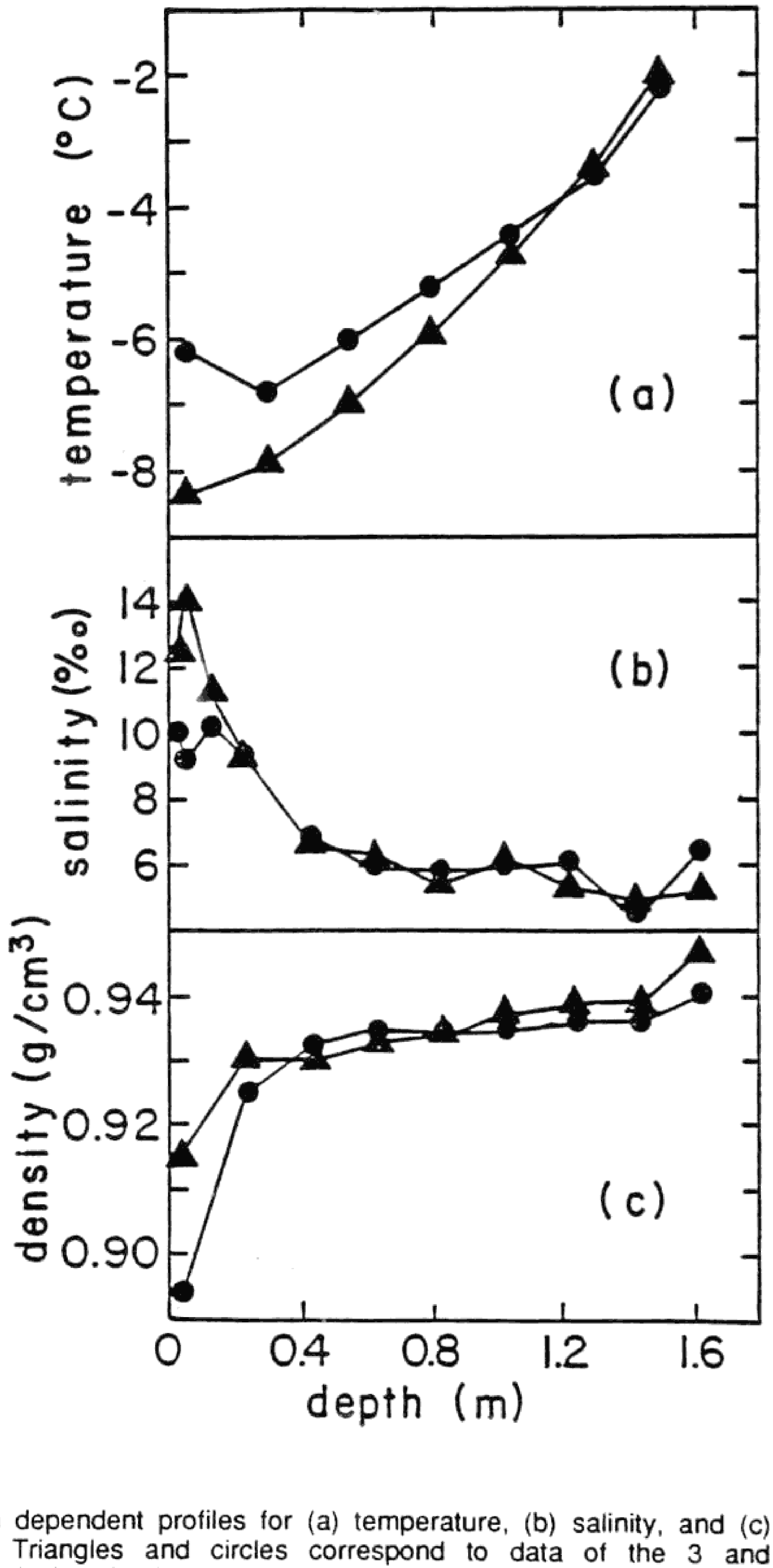

Figure 3 Depth dependent profiles for (a) temperature, (b) salinity, and (c) density of sea ice. Triangles and circles correspond to data of the 3 and 13 November respectively. In the case of the temperature the plot shows the highest values recorded up to the date in question which were recorded on the 3 and 9 November.

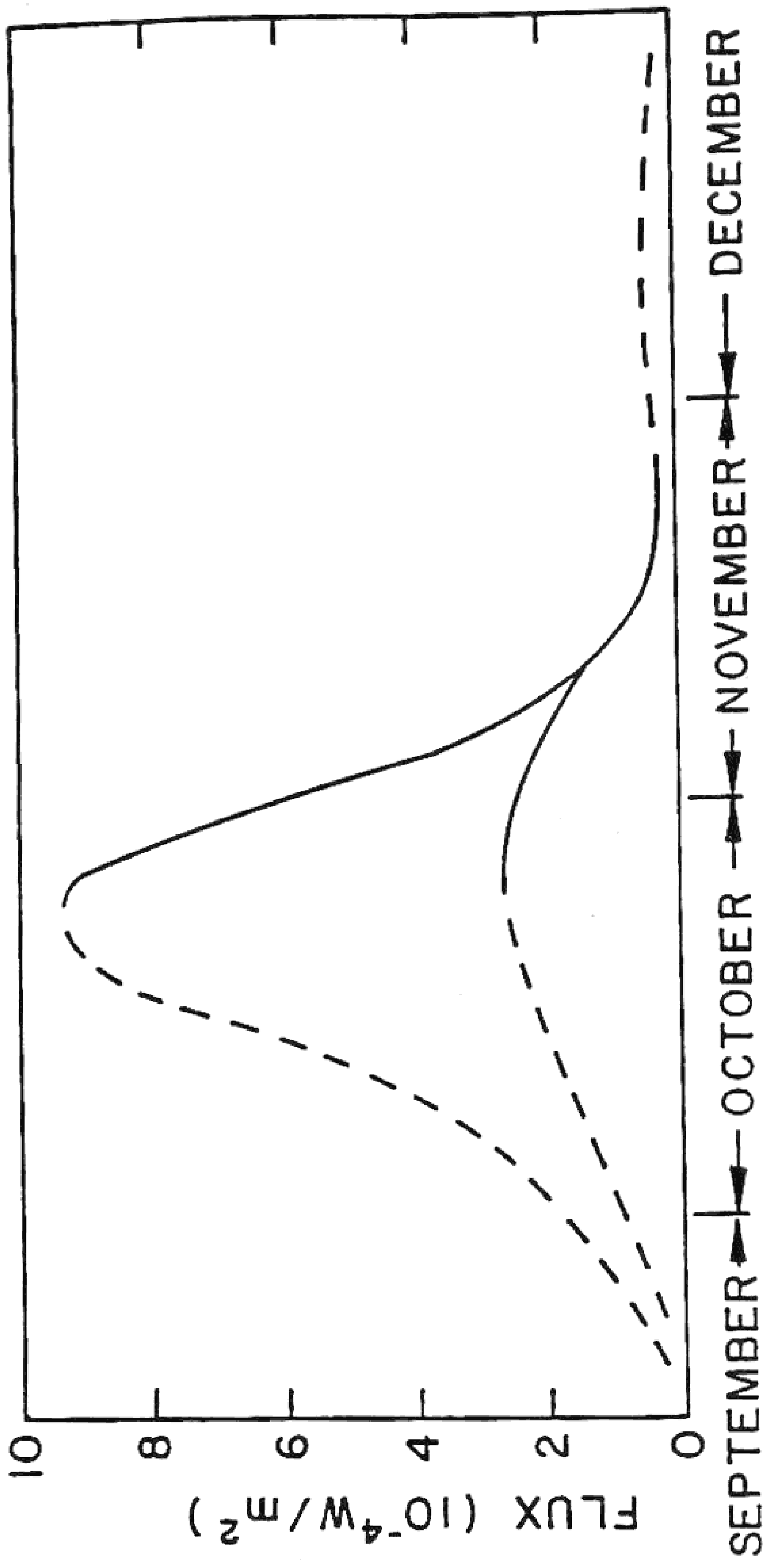

Figure 4 The estimated 300 nm flux at the base of the sea ice at Palmer Station during the 1988 season (upper curve), and before the appearance of the ozone hole (lower curve). The dashed lines indicate seasonal periods for which we have no direct measurements of the ice transmission. The net yearly dose is given by the areas under the curves.

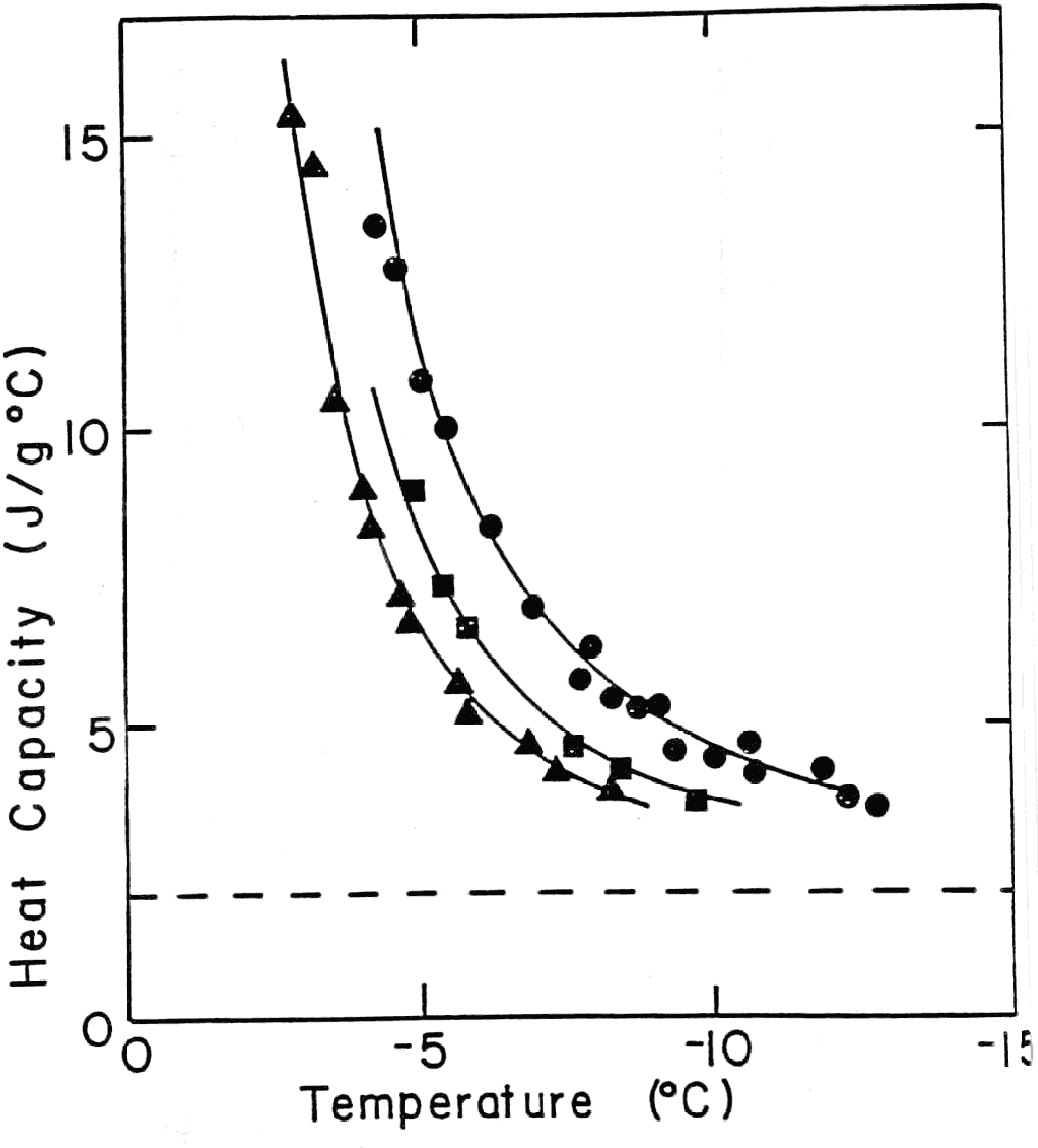

Figure 5 The heat capacity of sea ice taken from depths of 0-50 mm (●), 339-380 mm (■), and 570-620 mm (▲). The salinities were 1.32, 0.84, and 0.62% respectively. The solid lines are the predictions based on the assumption that the ice-brine mixture is at all times in thermal equilibrium.

PART II Logistics Notes

ANTARCTIC BOTTOM CURRENTS (K042)

Alex R. Pyne

Aims

The purpose of this project was to determine the nature (speed/direction/persistence) of mud-carrying bottom currents in Granite Harbour. Such currents have been suggested to explain deposits of mud flooring the deeper parts of McMurdo Sound and the basins/harbours along the southern Victoria Land Coast (Barrett et al. 1983, Kelly 1986, Macpherson 1987). There is no single obvious source or depositional process for the mud deposits although Anderson et al. (1984) suggested impinging geostrophic currents and subglacial meltwater as potential sources.

This season's programme (1989-90) was to study the movement of sediment entering Granite Harbour from the Ross Sea by mooring the current meter and sediment traps on the sill between the two main basins of the Harbour. The mooring was to be in place for about 2 months (November - January). We also planned to service the tide gauge at Cape Roberts established in November 1988, and if possible add meteorological instruments to record local climate data for future programmes. Inspection of the tide gauge in January 1989 raised doubts about the permanence of the transducer installation which may not survive ice foot breakout.

A further part of this season's work was related to a future proposal aimed at studying the Holocene Marine Glacial History in this area of the Ross Sea. We intended to carry out a reconnaissance survey of both coastal features in Granite Harbour and nunataks on the south side of the MacKay Glacier to find evidence of Holocene glacier expansion both at sea level and well above the present day MacKay Glacier Tongue grounding line.

Planning

The planning phase for this event could not be finalised until mid year when Antarctic Division's vehicle scheduling was decided. It is understandable that some events planning takes longer than others and we appreciate Antarctic Divisions efforts on our behalf. A fuel and cargo cache was to be transported to Cape Roberts for this event. Unfortunately only fuel was cached because of cargo delays to Scott Base but the fuel cache still proved very worthwhile.

The training course briefings are an important part of the event planning. For some events, where planning decisions may have just been made prior to Tekapo or may still need to be made then some discussion and possibly changes should be expected at the briefing session. This may be the first time an event can discuss their programme face to face with the assembled Antarctic Division personnel.

Cargo

Wellington to Christchurch / Scott Base

6 boxes scientific equipment and 1 3 x 2 lengths galu steel pipe	2.83m^3
1 box scientific equipment	0.3 m^3; 250 kg
	3.13m^3

Scott Base / Christchurch - Wellington

1 box scientific equipment		0.7m^3
2 boxes Vibrocorer housing & equipment	~	0.5m^3
2 boxes scientific equipment & hydraulic unit		1.58m^3; 505 kg
box & carton scientific equipment		0.81m^3; 182 kg
		3.59m^3

Preparations for the Field

The arrival briefing at Scott Base is a very important part of the initial preparation to establish a good working relationship for the progression of a successful field season. This season I was dissapointed that the briefing could not be carried out within a few hours of our arrival at Scott Base consequently it was difficult to plan our work programme until much later the following day after the briefing. Some of the points raised at the briefing seemed to be unnecessary and poorly communicated, especially for an event containing several people with previous antarctic experience including a surveyor and a permanent member of Antarctic Division Staff. I also found if difficult to discuss in detail our survival training requirements without the presence of the survival school instructor at the briefing. This later led to a misunderstanding regarding the purpose of our sea ice part of the training. I am very keen to pass on my sea ice experience to the survival school and would like to do so in the future, but would be concerned if this is taken for granted and occurs at the expense of the science event.

All the field equipment was in excellent condition and much of it already allocated to our event thanks to the Scott Base stores staff and system.

The glacier travel part of the survival training was enjoyable and appreciated by those who participated (Goodwin, Rodgers and Möller). The second part of the course we had hoped to do was a shakedown exercise using the Hagglund and winch. Unfortunately this was cancelled due to bad weather and was modified to a sea ice course primarily for the survival school instructors later in the week. This was at the insistence of the Operations Managers even though it was clear that our science programme would then be delayed because of forecasted bad weather.

We were delayed at Scott base two days due to bad weather after completing the sea ice course requirements. In total we spent 7 full days at Scott Base before leaving for the field which is an unusually long period of time considering that a lot of the vehicle and field equipment preparations had been done prior to our arrival by Scott Base Staff.

The NZARP Survival School provides an excellent service but it still seems to be locked into regular two day courses. I would like to see more flexibility both in the scheduling of courses so that field groups can be accommodated quickly after arrival at Scott Base and in the content and duration of courses to better accommodate many NZARP field personnel who have previous Antarctic experience.

The position of Operations Manager at Scott Base is a crucial one for the field science programme. I think the position would be best filled by personnel with previous NZARP Antarctic experience. This is particularly important so that the field season can start quickly and local knowledge would help in seasons like the past one when the weather was unsettled especially in November. Personnel with previous experience also have first hand experience of the NZARP field programmes and would know many of the science people returning in successive seasons.

Field Transport

NZARP Vehicles

Hagglunds BV206 #H26

This vehicle is in a standard configuration with "trailer caboose" and is powered with a Ford petrol engine. The machine was allocated to K042 for our sea ice operation and glacier travel. A Maudheim sledge was towed with up to 1800 kg of cargo without difficulty up to Cape Roberts, partly unloaded then used within Granite Harbour. H26 generally performed very well without any significant mechanical problems. Ice studs had been fitted to the tracks prior to leaving Scott Base and these certainly improved vehicle traction on polished sea ice and on the 25 - 30° ice slope terminus of New Glacier.

Table 1. Vehicle diary Hagglunds BV206 #H26

Date	Hour	Distance	Daily Distance	Action	Approx Fuelling @ end of day
10 Nov	343	40 km	40 km	RTSB(White out)	Refuel SB(~200)
12 Nov	354	140 km	140 km	SB to C. Roberts	143 @ Marble Pt.
13 Nov	358	158 km	18 km	Local C. Roberts	70 @ C. Roberts
14 Nov	369	218 km	60 km	Granite Harbour	
15 Nov					
16 Nov	378	253 km	35 km	Granite Harbour	50 @ C. Roberts
17 Nov					
18 Nov	379	263 km	9 km	Local, C. Roberts	
19 Nov	389	309 km	47 km	Granite Harbour & New Glacier	70 @ New Glacier
20 Nov					
21 Nov	395	334 km	25		
22 Nov	?	?	~ 50 km		50 @ C. Roberts
23 Nov	?	?	130 km		70 @ C. Roberts
24 Nov	?	?	79 Km		60 @ C. Roberts
25 Nov	?	?	68 KM		50 @ C. Roberts
26 Nov. H26 400 hr check; grease, check oil & leaks, adjust tracks at Cape Roberts.					
27 Nov	?	?	63 km	Flatiron/Granite H.	50 @ C. Roberts
28 Nov	444	855 km	~150 km	Rtn to S.B.	70 @ Butter Point
TOTALS	101 hrs.	855 km			875

It is not possible to accurately measure fuel usage in the field because we did not have a metering fuel pump and the vehicle tank gauges are not accurate. We used approximately 875 of Mogas and travelled 855 km giving an average fuel consumption of 1 litre/km which includes consumption while idling. A consumption rate of 1.25 litre/km should be a suitable figure to use for planning purposes.

This vehicle proved very suitable for general sea ice based work because it was reliable, comfortable, maneuverable and well controlled when crossing sea ice cracks. I would suggest however that some consideration be given to providing a choice of interchangeable modules for the rear caboose. For our sea ice operation a truck type flat deck with sides would be better to transport and operate some of our heavier equipment.

Our experience in extracting H26 from a crevasse has also indicated that rescue equipment should be carried and possibly some operating procedures reviewed. The electric winch on H26 was of little use when the vehicle is stuck and can't turn to level-wind. Consequently the wire cut itself during our first attempt to recover the vehicle. Chain hoists, TIRFOR hoists and a timber jack worked well during the vehicle recovery. It also became obvious that a Hagglunds is very vulnerable in a crevasse rescue situation if the hydraulic rams linking the front cab to the trailer are damaged either when falling into the crevasse or during the recovery operation. It is important therefore to move or lift the vehicle carefully so that the two parts of the vehicle remain in the correct relationship with each other. Any attempt to pull a Hagglunds out with another vehicle (such as a bulldozer) should therefore be considered very carefully to avoid over stressing the linkage system. Some consideration should also be given to rescuing the vehicle if it falls well below the crevasse lip. In this case some sort of lifting structure (e.g. like a davit) would need to be erected at the edge of the crevasse so that the vehicle could be lifted before being pulled out. Such a structure could be in a "bolt together" form that could be "footed" into the crevasse edge in a similar way to timber dead men. In our experience the survival box carried on the roof of the rear cab also caused difficulties because it was extra weight that was not required because we had our own camp equipment and also made the rear cab top heavy. Our camp equipment was carried in the rear cab which required careful unloading once in the crevasse. We may have been better off spreading our load onto a towed sledge in this situation. It is also difficult to decide the best preparation for personnel travelling in the driving cab when travelling in areas of potential crevasses. The best compromise in this situation is to have all personnel wearing harnesses and have ropes available both inside and outside the cab to tie into.

<u>Suggested list of extraction equipment, most field operations</u>:

2 x chain hoists (to lift vehicle)
2 x TIRFOR hoists with wire cable
4 deadmen (200 mm x 200 m x 1 m timbers)
Chainsaw (to place deadmen)
Chain slings
vehicle jacks (normally carried in vehicle tool box)
Deep field operations (in addition to the above)
Lifting frame (timber or steel pipe?) assembled at site to lift vehicle out of crevasse.

In a deep field situation it would be likely that at least two vehicles of similar capacities would be operating. Our crevasse experience does however highlight the problems of a single vehicle operation even though we were well served by helo from Scott Base.

Maudheim Sledge

This sledge was purchased with H26 and is larger than previous maulheim sledges used by NZARP. It is a good size and robust for our operation and has polyethylene shoed skies which makes towing easy although the sledge should only be used on snow or ice. We did note however that a lot of the timber sledge components where laminated and were delaminating in places. The sledge could also have rings fitted to make attaching cargo straps easier.

Helicopter Operations

The RNZAF Iroquois was used during H26 crevasse recovery to bring personnel from Scott Base and bridging timbers from Cape Roberts to the crevasse site. The crew's willingness to standby while the recovery was in progress was most appreciated but the weather conditions were deteriorating and I asked them to return to Marble Point and eventually McMurdo Station.

A Helo operation was scheduled to recover the mooring in Granite Harbour on 5 January. Equipment was underslung from Cape Roberts to the mooring site and later slung back to Scott Base. The operation went well but unfortunately the helo ran out of crew time because they took longer than expected to move the NZARP group in the Convoy Range so we couldn't do the planned aerial photography at Cuff Cape. Pat Sole (K191) however completed this photography later in January. It was also unfortunate that we couldn't programme to stay overnight at Cape Roberts to complete the met. instrument checking because of a high helo use the following day. In general the operation went well and we are grateful to the Scott Base Operations Manager for his programming.

Event Diary

3 Nov	Chch - McMurdo flight delayed. Received K042 event Directive in Chch after request to Ant. Div.
4 Nov	To Scott Base. Pyne, Goodwin, Möller.

5 Nov	Prepared field camp equipment.
6 Nov	Sea Ice / Hagglund shakedown cancelled due to bad weather.
7 Nov	Storm all day - preparations at Scott Base.
8 Nov	Goodwin, Möller, Rodgers on glacier travel survival course.
9 Nov	Sea Ice course to Turtle Rock. K042 and K191 personnel plus G. Kennedy (survival school instructor), and A. Belcher (Radio Operator). Weather deteriorated in the evening - cancelled move to Butter Point.
10 Nov	Poor weather - moved sledge 12 km from McMurdo, returned to Scott Base.
11 Nov	Storm @ Scott Base - no movement.
12 Nov	Left SB for Cape Roberts. Straight line route McMurdo to Marble Point on good first year ice. Refuel @ south side Marble Point 1987 MOGAS. Good travel onwards to Cape Roberts - Total trip time 11 hours. Checked tide gauge and found pressure transducer missing.
13 Nov	Prepared mooring equipment, down loaded tide gauge data -lost transducer readings 6 February 1989.
14 Nov	Bathymetry in Avalanche Bay for mooring site. Checked terminus of New Glacier for suitable Hagglund (H26) route. All first year ice enroute to New Glacier except 2 km off New Glacier.
15 Nov	Helo aerial photography with K191; C.Roberts, Mt. England, Mt. Marshall and north peak of Mt Suess where mast/cairn were established. K042 return to C.Roberts. K191 to Vanda.
16 Nov	Set mooring with current meter and 7 small sediment traps in "Avalanche Bay channel site".
17 Nov	Began establishing 4 m met. mast addition to the tide gauge recording equipment at C.Roberts.
18 Nov	Completed met. mast installation. Poor weather in early evening.
19 Nov	Tested vibro-corer pressure housings to 850 m depth at S-216 site in outer Granite Harbour. Travelled to New Glacier and upwards heading for the Flatiron. H26 fell in crevasse above the crevasse field on the top north side of New Glacier. Extension of the crevasse field not evident on aerial photographs and obscured by 1 m thick snow and wind slab. See accidents section for further details.
20 Nov	Recovery of H26 with assistance from Scott Base personnel and Kiwi helo.
21 Nov	Scott Base personnel return to SB. Return via New Glacier to Granite Harbour. Recon. of New Glacier moraine below Mt. England, Devils punch bowl, Finger Point and Cuff Cape. Camped with S-216 at NE snout of MacKay Glacier Tongue (MGT)
22 Nov	D. Hotop and P. Sole to K042 from Scott Base. Goodwin and Rodgers return to Scott Base. Goodwin return to New Zealand. Recon. of north armpit of MGT and Point Retreat and return to Cape Roberts.
23 Nov	Work at Cuff Cape and bathymetry completed at Avalanche Bay. Return to Cape Roberts in evening.
24 Nov	Work at Cuff Cape and recover/redeploy the mooring. Weather deteriorated in late afternoon.

25 Nov	Work at Cuff Cape survey moraine ridge system related to small hanging glacier.
26 Nov	Prepared mooring equipment for January recovery. Packed equipment for return by sledge to Scott Base. Checked met. mast operation and down loaded data.
27 Nov	To the Flatiron. Recon. of ponds on the Flatiron and beach ridges at C.Geology and Botany Bay.
28 Nov	Left C. Roberts and return to Scott Base. Picked up 44 gal. MOGAS at Butter Pt., tide crack too wide to cross, returned fuel to Scott Base.
29 Nov	Equipment return and cleanup. Packed cargo for return to New Zealand.
30 Nov	Möller to lower Taylor Valley with K042. Pyne-Boomerang flight, McMurdo-McMurdo.
1 Dec	Pyne return Chch.
4 Dec	Möller to Scott Base from Taylor Valley.
5/6 Dec	Möller return to New Zealand.
1990	
4 Jan	Pyne to Scott Base.
5 Jan	Pyne, Hotop, Kernot to Granite Harbour. Pick up equipment at C. Roberts. Recover mooring after initial recovery problem. Return to C. Roberts, download current meter data and attempted maintenance of met. mast. Computer problem - left met. mast non operational through winter 1990. Could not do Cuff Cape Aerial photography because of helo crew time overrun.
6 Jan	Packed equipment for return to New Zealand. Checked WINKIE drill bits at Scott Base. Pyne transferred to McMurdo to join S-216 for preparation on Ross Sea 90 Cruise.
7-10 Jan	Preparation of equipment at McMurdo with S-216. Transferred to USCGC Polar Star in early evening at McMurdo for rendezvous with MV Polar Duke on 11 Jan.
11 Jan-9 Feb	Ross Sea 90.
9 Feb-14 Feb	Return equipment etc for winter storage at McMurdo.
14 Feb	Pyne return to Chch.

Accidents

Hagglunds (H26) recovery from crevasse

H26 became stuck in a crevasse after driving up New Glacier on route to the Flatiron. The crevasse was encountered on a gentle snow covered slope ($<10^{\circ}$) above the crevassed area at the top of New Glacier which is obvious on aerial photographs and the 1.250,000 map series. An account of the incident is detailed below.

19 November, 2130 NZST. Began ascent of New Glacier after refuelling and leaving sledge on sea ice at New Glacier Terminus. Travelled up glacier and crossed several small crevasses (up to 1.0 m wide) in blue ice .

2230 NZST. Reached upper New Glacier approx 6-8 km from terminus then turned north to north east towards the Flatiron. Gentle snow slope, travelled at about 10 km/hour (low ratio, 2 gear)

2330 NZST. Encountered crevasse parallel to our tracks. Rear cab tilted at 45° resting on crevasse edge halfway up the caboose side, right track and part of the left track in crevasse. No personnel injuries sustained and evacuated uphill and through left side doors without difficulty. Front cab tilted between 10-20° with tracks partially on snow bridge. Goodwin roped up and unloaded survival box and rear cab. Immediate area probed for crevasses and crevasses marked with bamboo canes. Set up timber deadman 15 m away at 10 O'clock to vehicle in small crevasse. Winched vehicle about 1 m forward before wire broke because vehicle couldn't move to level wind the wire.

20 November 0100 NZST. Carried camp about 100-150 m down track and established camp for the night. Informed Scott Base at 0145 NZST that H26 was immobilised in a crevasse and that we would require assistance from Scott Base for the recovery.

1400 NZST. Kiwi helo arrives at crevasse site with Scott Base mechanic, two survival school personnel and recovery equipment. Helo to C.Roberts and returns to site with two bridging timbers. Weather was closing in so helo returned to Marble Point. Crevasse area rechecked and flagged by survival personnel and established safe routes and personnel anchors. Vehicle initially righted with chain hoists, the back cab was slid sideways so that the left rack was on a firm footing. Timbers were slid under the rear cab right track, and the front cab jacked up, then the vehicle was pivoted about the hinge point by a combination of winching and steering and eventually driven off the crevasse. Vehicle recovery completed at 2045 NZST.

All personnel remained at the camp site that evening.

21 November. Kiwi helo returns Scott Base personnel and H26 returns down New Glacier without incident.

We have operated in this area by toboggan in previous years (1981,9182,1983) and a USARP group used toboggans this season to travel up New Glacier to Pegtop Mountain without incident. Hagglunds have a relatively low ground pressure but are still moderately heavy vehicles and it is the total weight which is the important consideration on wind slab snow and snow bridges.

Due to the crevasse incident we decided to cancel the planned work at Mt. Suess and Pegtop Mountain, however we are confident this work could be done with toboggan support in the future.

Radio Communications

K042 was issued with tacit VHF radios and a Compak HF radio. The HF was used during the crevasse rescue at New Glacier because the VHF repeaters at Mt Erebus or Mt Newall were obscured. HF communications varied at times due to atmospheric disturbance which made it difficult to initially inform Scott Base of the detailed situation.

VHF communication was used most of the time from Cape Roberts and on occasion from central Granite Harbour. For some reason communication also varied from day to day or hour to hour both on the Erebus and Mt Newall repeaters. On several occasions at Cape Roberts hut we could not transmit via Mt. Newall on a raised high gain antenna, even though this had given excellent results the previous season. The repeater on Mt. Erebus was also unpredictable and might need realigning or tuning to service Granite Harbour better. A temporary repeater on Mt. England or Mt. Marston would service most of the Granite Harbour area.

Cape Roberts Huts

Two huts are now established at Cape Roberts, providing 4 bunks in the previous smaller hut and a kitchen / lab facility in the new hut. The facility is now vastly improved and provided on excellent base to work from in Granite Harbour. The huts required reshoring later in the season because the initial piling and deadmen proved inadequate when the thaw began in late November. A new aerial at the hut also improved VHF communication with Scott Base.

The cooking facilities could be improved by replacing the present old twin burner kerosene optimus with a clean burning LPG gas oven. Kerosene of doubtful quality presently stored at the hut could then be burned in the DFA heater. Extra seating and a more sturdy small table would also be required for a large field group.

Acknowledgements

Equipment was prepared with help from Eric Broughton (RSES, VUW), the members of the VUW mechanical workshop and Peter Issacs (N.Z. Met. Service). The S4 current meter was recalibrated (0-50 cm/s) by the Oceanographic Institute DSIR. We are grateful to the Antarctic Division and Scott Base staff who assisted us in the programme planning and in Antarctica. Special thanks to our field assistant /Hagglund operators Ron Rodgers and Dave Hotop, and Mike Kernot (RNZAF - 3 Squadron) who helped with the January moving recovery. Thanks also to Rob Dunbar's S-216 group for assistance testing the vibrocorer housing and hospitality while in the field. Pat Sole (K-191) once again provided much appreciated survey assistance to our programme.

MOUNT EREBUS ERUPTION MECHANISM STUDY (K044)

R. R. Dibble

Aims

The aim of the IMEEMS project is to understand the mechanism of the strombolian eruptions, and the velocity structure of Erebus Volcano. The present methods are telemetry recordings at Scott Base of seismic, infrasonic, and video data from the volcano, over as great a part of the year as possible.

This season a pilot seismic refraction survey was made on the summit cone, and infrared temperatures of the crater walls and lava lake were measured, paralleled by short term measurements of volcanic gas output, and petrology of the lava being erupted, made by international groups of cooperating scientists from USA, NZ, Italy, Japan, and France. The Windless Bight Infrasonic Array ceased operation on 3/1/90, and RTG was returned to NSF.

Seismic Refraction Survey at Upper Erebus Hut

As a pilot study of the shallow velocity structure of Erebus, needed to complete a study of the velocity structure of the erupting magma column, two refraction lines were run between the upper hut and Nausea Knob, using the Nimbus 12 channel stacking seismograph. The seismograph was kept at operating temperature (0-30 degrees C) by the space heater in the hut, and the line was run over the near horizontal snow free ground between the hut and Nausea Knob. The first 100 m of the line was on Camp Flow, which is actually a slump, separated from the undisturbed cone by a line of ice towers (fumaroles) extending
from the main crater rim to the Tramways.

Line 1 was 180 m long, with geophones at 30 m spacing on Camp Flow, and 10 m spacing over the 80 m length on the undisturbed cone. Stacked sledgehammer blows were used at each end and in the middle on the cone side of the fumarole line. On the cone, velocity was 3000 +/-300 m/s, and on the slump it was 2100 +/- 300 m/s. Onsets were much better on the cone than on the slump.

Line 2 was 330 m long, and extended further towards Nausea Knob, because all geophone spacings were 30 m. Sledgehammer blows proved inadequate, and up to 5 shots of 1.5m of red detonating cord, laid in a circle on the ground were stacked per record. The Nimbus blaster in its recently overhauled state was unable to trigger the Nimbus through 330 m of cable. Triggering was by tying the shot instant cable around the det. cord so that it open circuited during the shot. Fair records were obtained on the Nimbus screen using 100 Hz bandpass filtering, but printer noise marred the printout. Also the only stacked record of 5 shots was ruined by the shot instant cable re-shorting momentarily after the 5th shot, retriggering the Nimbus during maximum amplitudes. We had no spare det. cord to repeat it.

One direct comparison between stacked hammer blows and a single shot of det. cord was made on line 1, and showed that det. cord and lowpass filtering gave the best result. However to get good arrivals over 330m distance the effective charge weights will have to be increased to about 30 stacks of 1.5m lengths of red det. cord per record. This would best be done by using a heavier grade det. cord, because appreciable trigger-induced system noise appears when too many shots are stacked. For the 1990/91 survey, when spreads up to 1 km long are planned, the shots will have to be even larger in effect by up to 10 times, and 1.5 kg charges of Gelignite in 1 m deep shot holes are planned.

Planning

This has been carried out at four levels: Event proposals to RDRC; discussions within the VUW Antarctic Research Centre; communications between foreign scientists; and with other NZ events on Erebus.

The International communications are distributed through the year, and concern the expeditions, distribution of data, presentation of results at conferences, joint publications, direction of future work, and the willingness and ability of each National group to do it.

The VUWAE discussions are concerned with finance and grant applications, selection of student research assistants, and the preparation of yearly reports. The discussions with event K 092 concerned the resources and facilities on the mountain, and how to share them without conflict.

The RDRC proposals are the earliest formal plans, but on a continuing project such as IMEEMS are strongly guided by the thinking of the International group on Erebus.

Cargo

Cargo movements were as follows:

Oct 89	Cargon of NZ/Japan equipment, Wgtn-Scott Base	200 kg
Nov 89	Handcarry computer seismograph, Wgtn-S.B.	20 kg
Dec 89	Tapes, paper, infrared thermometer, Tokyo-S.B	30 kg
21 Jan 90	Handcarry recordings, computer, SB-Wgtn	35 kg
21 Jan 90	Ship equip and records, S.B. to Wgtn	200 kg
14 Feb 90	Airfreight record to date, SB-Wgtn	20 kg
31 Mar 90	" " " " Wgtn-Tokyo	10 kg

Field Preparations

For IMEEMS, field preparations begin with servicing the recording equipment at S.B., because the field telemetry equipment cannot be serviced reliably if signals cannot be recorded. In view of our delayed arrival in Antarctica, it was fortunate that Dr Bill McIntosh of S-081 was already on the mountain, and had serviced our TV camera, and shifted the telemetry station from Terror to a new site (MACZ) on the ESE rim of the Erebus plateau before our put-in. Also technicians Nicholson and McGregor had left little undone in the Science Lab. With remaining problems on Erebus identified, and only a high false trigger problem at Scott Base, we succeeded in doing the survival course (Ray only one day) and preparing for put-in within 4 days of arriving. Gerry had already checked Grizzly G5 on steep slopes near the ski field.

Relations with Base Staff

This was very good, and the willing help and cooperation from everyone was much appreciated.

Field Transport

The put-in at Fang Glacier was by 3 helicopter loads, totalling 3000 lb, including the Grizzly which was underslung as the last load. We arrived at Fang a few hours after S-081. Transport up from Fang, and on the plateau was by Grizzly toboggan and one of the Yamahas garaged at the lower hut. S-081 lent us a Skiddoo, and carried skiddoo loads for us on several occasions. Our fuel requirements proved to be underestimated, but we could not have taken appreciably more on only 3 lifts. Our return to Scott Base was in one flight by Kiwi helo from the lower hut. The Grizzly, Fang camp, generator, cooking box, and some spare food were left for K 092 to use at their request. Three helicopter flights to repair BOMB seismic station were attempted. The first with K 092 was aborted when the Kiwi helo was found to have cracks in the tail (grateful thanks to the crew), and the second with K 092 took us twice around Erebus to reduce weight for the landing on the small cone at BOMB. Unfortunately low cloud encroached on McMurdo, and we had insufficient time on the ground to effect repairs. The third flight was with Dr. Ray Chuan of S-081, and our one hour on the ground was just sufficient. Ken Sims of S-081 made a further flight to remove batteries from the old TERROR site, and add recharged and tested batteries to BOMB. VXE-6 could not have been more helpful, and the flights were excellent.

Field Conditions

No unusual conditions were encountered. The snow was firm, giving good traction for the toboggans, especially on the routes up from Fang, and up Ray's Gully to the summit, and to CONE and MACZ seismic stations. Some ice was encountered on the gentle lower slopes of the plateau below the upper hut, but enough gravel was present for good traction. Visibility was generally excellent except in the crater, and there was little wind. The 2 huts provided excellent shelter, and working space.

Weather

Although our arrival was delayed by chronic bad weather, it improved rapidly on the day of our put-in, and remained good thereafter. Only one day of our time on Erebus was unworkable, although Dr Shimizu often found the crater to be obscured by fume and cloud. After descending from the summit, the view into the crater on TV was clearer than I had seen before. The two flights I made with telecom technicians to repair BOMB seismic station were both in perfect calm weather, although increasing low cloud around McMurdo during the first one saw us snatched from BOMB before we had opened the cases.

We were very lucky compared with the S-081 advance party on Erebus, who had problems de-icing and starting their skiddoos almost every time they used them.

Event Diary

19 Nov	Dibble, O'Brien, and Shimizu fly to Chch.
24 Nov	Fly South 5 hours; turn-around due to weather.
25 Nov	Fly South 5 hours; turn-around due to weather.
27 Nov	Fly South 5 hours; turn-around due to weather.
28 Nov	Fly South 0.5 hours; turn-around due to oxygen leak.
28 Nov	Fly to McMurdo after replacing oxygen pipeline.
30 Nov	O'Brien and Shimizu begin Survival School.
1 Dec	Dibble, O'Brien, Shimizu complete Survival School
2 Nov	Dibble, O;Brien, Shimizu and Kennedy fly to Fang.
4 Nov	All toboggan up to lower hut, helped by S-081.
6 Nov	Check why new station MACZ does not relay BOMB signal; remove receiver and antenna for test.
7 Nov	Service CONE microphone, and all move to upper hut with help from S-081. Begin refraction survey.
8 Nov	Shimizu/Kennedy take infrared thermometer to rim. Dibble/O'Brien make refraction survey between upper hut and Nausea Knob.
9 Nov	Service E1 microphone, and all move back to lower hut.
10 Nov	Dibble/O'Brien search for signal from BOMB with portable receiver. Shimizu/Kennedy take infrared thermometer to rim via Ray's Gully.

11 Nov	Dibble/O'Brien find BOMB not transmitting; confirm MACZ is best site, and reinstall receiver/antenna. Shimizu/Kennedy continue thermometry.
12 Nov	All K044 fly down together, leaving gear for K092.
13 Nov	O'Brien begins video recording 24 hours/day; Shimizu begins tape playback and earthquake count.
15 Nov	Dibble/Robertson fly to BOMB with K-092, but no time to repair it due to cloud at McMurdo.
18 Nov	Dibble completes antennae overhaul. Stops 5400 skeds from triggering the digital seismograph.
20 Nov	Dibble/Fairhall fly to BOMB with S-081. Replace failed batteries with new Ant Div one. Then OK.
23 Nov	Dibble and Shimizu return to Christchurch.
24 Nov	O'Brien copies videotapes of the lava lake fuming at the times S-081 were analysing plume gases.
26 Nov	S-081 fly to TERROR and remove batteries, and to add more batteries at BOMB.
28 Nov	O'Brien starts playback of recent magnetic tapes.
1990	
6 Jan	Decipher time-codes on chart recordings.
3 Jan	Windless Bight Recordings cease. RTG to NSF.
24 Jan	Complete video-file of all recorded eruptions, and make several copies in PAL and NTSC.
25 Jan	McGregor is handed over the reins.
26 Jan	O'Brien returns to Christchurch.

Field Equipment

The use of Polar tents at Fang, and Dome tents at the lower Erebus hut again proved ideal. This year the entire Fang camp was left intact for K-092 to use for acclimatising, and the Grizzly and generator were left at lower and upper huts respectively. Grizzly G5 which had been so successful in 1987/88, was again fully equal to the tasks on Erebus. All the equipment was good.

Radio Communications

The Tait VHF radio provided good comms everywhere except at Fang Glacier. The Compac radio was also barely adequate there. The solar panels were again excellent. The radio skeds were very good, and the operators very helpful.

Lab Facilities

The Science Lab is more excellent than before, and I am very grateful for the generous space provided to IMEEMS. Brent O'Brien set up the analysis computer beside the TV/VCR, and Hiroshi Shimizu set up the tape playback equipment in the visitors room. I greatly appreciated Howard Nicholson maintaining and operating my new computer-based equipment in 1989, and warmly welcome Bruce McGregor's expertise and interest this year. The only major maintenance task for me at the lab was to dissemble and clean all the Yagi receiving antennae. Corrosion was causing some rectification, which caused many false triggerings of the digital seismograph during 5400 transmissions. A spare antenna and lead- in were added to avoid the problem last winter, when one signal from Erebus was lost by an antenna fault.

Huts

Both huts on Erebus are in good order, and equipped with adequate heating, cooking, and eating equipment, fuel, food, table and chairs. There are no tents or sleeping bags, except in the survival boxes outside. The lower hut (Jamesway) was extended last year by S-081 to provide an instrumental observing room with a large window, facing the crater.

Waste Disposal

No disposal areas are available on Erebus, and all waste is returned to Scott Base/McMurdo by helicopter.

Place Names

The 1984 eruption obliterated the Lava Lake, and the Active Vent, and new lava pools called (from NE to SW) the Main Vent, the Potato, and the Penny have formed. The Black Hole occupies the approximate site of Werner's Fumarole, which also disappeared in 1984. S-081 and K 044 refer to the toboggan trail to the ENE rim of the main crater as "Ray's Gully", although Dr Bill McIntosh was the first person to drive up by skiddoo.

General

I wish to record my appreciation of Dr Bill McIntosh and Dr Nelia Dunbar for servicing my TV camera, and for recovering the telemetry station from Mt Terror, and reinstalling it on Erebus, so as to greatly improve the TV picture quality, and the effectiveness of the seismic net.

THE HYDROLOGY, GLACIOLOGY, AND SEDIMENT TRANSPORT PROCESSES OF THE MIERS VALLEY (K046)

J. A. McConchie, D. R. Winchester, R. M. Hawke and H. J. Campbell

Aims

During the 1989-90 season, work concentrated on four projects looking at various aspects of climatically controlled processes operating in the Miers Valley. These projects were:

1. Continuation of the monitoring of stream flow and various climatic parameters which may be controlling its timing and volume.
2. Monitoring, and attempting to quantify, the fluvial sediment transport processes.
3. An attempt to quantify the albedo of the various surficial materials (including glacier and lake ice, and water) and to relate this to the distinctive "patterned" ground found throughout the valley.
4. Measurement of changes in the Miers and Adams glaciers and testing the practicality of using "terrestrial" photogrammetric techniques to monitor changes in the terminal faces of the glaciers.

It is hoped that the data collected during the past two field seasons will permit:

1. The evaluation of the seasonal variability of glacier behaviour and surface water hydrology.
2. An improved understanding of the energy and mass balances of the glacier-river-lake system in the Miers Valley, which typifies such systems in the Dry Valleys region of Antarctica.
3. The development of a water balance for the Miers Valley hydrologic system.
4. The quantification of sediment sources, the relative importance of sediment transporting media, and how these vary both spatially and temporally.
5. Quantification of the albedo (reflective) properties of the various surficial materials found throughout the valley.

Although some of these areas of study have been attempted in other areas of Antarctica (e.g., the Wright Valley) these studies have tended to be inconclusive because of the intensity of sampling and the complexity of the systems investigated. In the present study these problems were overcome with the use of electronic data logging and by studying the Miers Valley which has fewer inputs than previous study areas.

Planning

This was the second season of this particular programme and, as to be expected, few problems were experienced with the planning and execution of the event. There still appears to be problems in getting the Earth Science Working Party to accept the significance and relevance of hydrological research in the Antarctic. This problem is unlikely to be overcome until someone with a working and research background in hydrology is appointed to the committee.

The Antarctic Division staff, as always, did their job expertly and supported the project in every way possible. It certainly helps, however, if at least some of the event personnel have had previous Antarctic experience as this assists greatly in "getting away" from Scott Base. The situation with regard to aerial photographic coverage of the Miers needs to be improved. Currently there are no photographs of this area available in New Zealand. An historical, as well as contempary, coverage would have been most useful in planning our event and extending the time series of changes in the Miers and Adams glaciers.

Tekapo is a very valuable introduction for all new members of the NZARP programme and saves considerable time once on the "Ice" even for "old hands". I believe that the cost of Tekapo is justified in terms of the efficiency of the overall programme, however, I also see a reluctance, indeed difficulty, in Universities and other bodies in funding the "full cost" of Tekapo. I do strongly believe that it is in the interests of the NZARP programme for Antarctic Division to continue to fund the bulk of this training course if at all possible. At Tekapo the identification of the new seasons Base personnel ("Blue Spot") as well as their Scott Base position and tasks would be most helpful as these persons change each year. It is important that all Field personnel are able to put a "face" to a job.

Being essentially a "re-run" of last years programme from a logistics viewpoint the briefing at Tekapo was very straight-forward and essentially a formality.

Cargo

This year we only sent two large wooden boxes south prior to the departure of event personnel. No problems were experienced and all the equipment was at Scott Base and in good order when we arrived. Five boxes were returned to New Zealand at the end of the season and once again no problems were experienced with all the gear arriving home in good order.

Preparation for the field

Preparations for the field went remarkably smoothly with the event personnel arriving at Scott Base on the scheduled date. We were made to feel most welcome on arrival at the ice runway even though the Base was in a state of chaos because of the filming of "Its in the bag". All event cargo had already arrived and was waiting in the cargo areas. All the requested field gear was available at Scott Base except for the Pionjar hammer which was in the Wright Valley. This, however, was returned before our scheduled departure date and in time for some much needed servicing. Once serviced it worked well for the week that we needed to use it.

Survival training went without a hitch and the two new event personnel got a lot out of the course; including having a lot of fun. The fact that Jack McConchie only had to attend for a day as part of the refresher course allowed him to prepare the rest of the gear for departure to the Miers. This allowed the event to get into the field a day early and because of problems with helo support early in the season this paid major dividends. The instructors were well organised and co-ordinated as well as being friendly and helpful.

The support of all the Scott Base staff, particularly the Operations Manager (Don Hammond), the Field Storeman (Doug Henderson), and Storeman (John Lee) greatly eased the process of preparing to depart Scott Base. The previous experience of the event leader also allowed us to get into the field ahead of schedule. At the time we were the only event to achieve this feat!

David Winchester's arrival during the Christmas - New Year break, while fine in concept, meant that he suffered considerable delays because of the demands of the "festive" season. While frustrating this did not jeopardise the programme in any way.

Field transport

This event was largely self sufficient except for helicopter support. Without a doubt this was the best season (out of four) I have had with respect to helo operations. None of the "usual" delays and frustrations were experienced and instead we had instances of helos arriving "early". When the Kiwi helo was flying during the early part of the season things were extremely efficient and I believe the high morale of field parties in part reflected this reliable service.

Event Diary

Nov 13	We finally lifted off at 1127, landing on the Ice Runway at 1715. Scott Base was in turmoil as they were about to film the "Its in the Bag" show. It was supposed to have been filmed the previous night. Once the filming started the whole base shut down.
Nov 14	Heather and Richard go out to survival school. Jack starts to organise gear.

Nov 15	Jack joins Heather and Richard at survival school.
Nov 16	More time spent packing up gear.
Nov 17	Fly out to Miers, leaving Scott Base at 2100. Second flight arrives in the Miers at approximately 0100 on the 18th.
Nov 18	Set up camp and go for a look at the Adams and Miers weirs.
Nov 19	Emptied some of the wind traps and found "patterned ground" sites below the lake for the albedo study.
Nov 20	Installed thermistors in the glacier and at the two sites below the lake. Set up survey stations for the Miers Glacier. Put the waratahs in Lake Salina and Lake Miers for the staff plates. Dug out the Lower Miers weir.
Nov 21	Resurveyed the Miers Glacier.
Nov 22	Resurveyed the Adams Glacier.
Nov 23	Fixed the toilet. Mounted the staff plates in the Lakes. Emptied the wind traps.
Nov 24	Learning exercise on the EDM. Measured the sand in the delta. Restored the thermistor site near the Miers hut. Surveyed the staff plates. The transducer covers were finished.
Nov 25	Installed the Foxboro stage recorders and transducers at the Adams and the Miers weirs. Put in the transducer at the Lower Miers weir. Restored the two thermistor sites below the lake - the marble and volcanic sites.
Nov 26	Measured the sand in the delta.
Nov 27	Installed the Miers climate station.
Nov 28	Installed the Lower Miers data logger.
Nov 29	Installed the Adams climate station, and wired up the data logger at the Miers. The flow of the Adams reached the lake.
Nov 30	Spent the day visiting the Garwood.
Dec 1	Zenith promotional photos were taken at the bottom of the lake and at the Adams weir. Changed the Foxboro charts.
Dec 2	Set up the albedometer. Changed a couple of computer programs. Straightened the mast on the Adams climate station.
Dec 3	Climbed the peak known as "The Heart". Did a stream gauging in both the Adams and the Miers streams. Checked the albedometer, and the Lower Miers weir. Checked the data loggers at the Adams and the Miers, and took bearings of the wind vanes at the climate stations.
Dec 4	Checked on the Miers and the Adams climate stations. Measured the ablation surfaces found on Lake Miers. Jack left at 1700 for Scott Base and then New Zealand. Fixed the Foxboro at the Miers weir.
Dec 5	Richard determined 10 sampling sites (A-J) along the Miers. Installed the freezer box. Heather worked out a timetable and programme for the patterned ground research. Jack McConchie waiting to fly to New Zealand.
Dec 6	Put the albedometer onto the lake. Richard measured velocity profiles in the Miers stream. Heather measured a "polygon" at the volcanic site. Richard fixed up a divergent channel of the Adams. Jack McConchie leaves for New Zealand.

Dec 7	Undertook gaugings, velocity profiles, and samples of the Miers stream at the 10 sites. Current meter leads broke.
Dec 8	Took sediment samples at the first five sites along the Miers. Changed the Foxboro charts and collected data from the data loggers. Filtered the samples taken during the day.
Dec 9	Measured two of the polygons at the marble site. Measured the width of the cracks of the polygon which Heather had measured 6/12/89. Set up markers on either side of the gauging line to determine the bed and water slopes.
Dec 10	Took the albedometer off the lake and went to the volcanic site to measure another two polygons. Installed the albedometer at the marble site.
Dec 11	Did gaugings, sampling and velocity profiles at sites A, B, E, F, G, and H on the Miers stream.
Dec 12	Helo arrived 1000 with a resupply. Snowed all afternoon - no work achieved.
Dec 13	Gauged sites J, I, C and D. Visited by Gary De Rose and Brian Freeman. Sampled across site E for 7.5 minutes. Filtered samples.
Dec 14	Measured a polygon at the marble site. Moved the albedometer to the volcanic site.
Dec 15	Measured three polygons in the Adams moraines. Changed the Foxboro charts. Packed to go to the Garwood.
Dec 16	Did not go to the Garwood, as Gary and Brian had not been helicoptered out because of low cloud. Took photos of Richard's sample sites during a low flow. Put a few screws in the Foxboro housing. Measured the volume of sand in the swales.
Dec 17	Sampled etc, at sites A, B, C, D and E.
Dec 18	Moved the albedometer from the volcanic site to the Miers Glacier. Took samples from the site outside the hut. Sent an Antgram to Jack requesting new current meter leads.
Dec 19	Went to the Garwood. Did stream gaugings in the afternoon.
Dec 20	Did a second series of stream gaugings in the morning. Walked back to the Miers Valley by lunch time. Recovered data from the data loggers. Water was flowing over the top of the Miers weir, and beginning to scour the back of the weir.
Dec 21	Did a gauging of the Adams during a high flow. Gauged various sites along the Miers. Visited by Garth Varcoe, Duncan Webb, Malcolm MacFarlane etc. K061 moved into the lower Miers. Visited by K061, but missed making contact by 5 minutes.
Dec 22	Retrieved the albedometer from the glacier, and set it up at the site close to the hut. Changed the Foxboro charts. The water had scoured around the edge of the Miers weir. Sand bagged all night long to retain the integrity of the weir.
Dec 23	Sketched the glacier snouts every two hours over a 24 hour period. Sand bagged and back filled the weir until 1000. Santa visited at 1230. In the evening, continued to sand bag until midnight.
Dec 24	A quiet Christmas Eve.
Dec 25	Christmas Day. K061 joined us in the evening for Christmas dinner. Spoke to K047 in the early hours of the next morning as they were working the "night shift".

Dec 26	Recovered data from the albedometer by the hut, then shifted the albedometer to the marble site. Did patterned ground work at the volcanic site. Collected data from the dataloggers at all three sites. Saw a skua for the first time.
Dec 27	Sampling at sites A and B. Three hours doing each site, including across the bed sampling.
Dec 28	Sampling at sites C and D. Three hours doing each site, including across the bed sampling.
Dec 29	Analysed three polygons at the sandy site; a swale up near the Miers flume. Changed the Foxboro charts at the Miers and Adams. David arrives at Scott Base from Christchurch.
Dec 30	Moved the albedometer from the marble site to the volcanic site. Analysed another polygon at the volcanic site. The Adams was up quite a long way, up to 0.426 m. Gauged it at this height.
Dec 31	The Last Day of the decade. Sampling at sites G, H and I. Three hours doing each site, including across the bed sampling.
1990	
1 Jan	The First Day of the 1990s. Collected data from Lower Miers datalogger and re-attached transducer to the weir. It had come adrift and was sitting in the "v" notch of the weir. Collected data from the Adams and Miers dataloggers.
Jan 2	Collected samples of material in the cracks at the marble, volcanic, moraine, and sandy sites. Analysed another polygon at the volcanic site.
Jan 3	Collected albedometer from the volcanic site and moved it to the Lake Water site. Sampling at sites F and J. David goes out to Survival School. At 1600 David departs Scott Base for Miers Valley. On the way the helo stops at K061 with a resupply and picks up Simon and Rob to take them to the Catacomb Hills.
Jan 4	Heather and Richard took fifteen minute samples at each of the Miers sites. David did the first inventory of the Adams and Miers glaciers.
Jan 5	Richard and Heather sampled the rising and falling stage at Site E from 0600 until 1830. David set out photogrammetric survey lines, and established suitable base line lengths for the photo centres. Changed the Foxboro charts.
Jan 6	Heather and Richard installed thermistors in the sandy site. Looked at cross sections of cracks and photographed the moraine site. David established photo-survey control stations.
Jan 7	Richard and Heather moved the albedometer from the Lake to the sandy site. Remeasured the depth to the permafrost at the marble and volcanic sites. Recovered the data from the Lower Miers, Miers and Adams data loggers. Did a stream gauging of the Lower Miers. David did a detailed survey from all the photo stations.
Jan 8	Richard and Heather went to the Garwood and undertook a series of stream gaugings. David undertook the first photography of the Miers glacier snout.
Jan 9	Heather and Richard returned from the Garwood after doing a couple more gaugings. Problems with the cables of the current meter. David completed the photo survey of the Miers at 2 am, thus able to maximise the best lighting conditions.
Jan 10	Stream bed and water-slope survey of the Miers stream. Went down and visited K061, as it was their last night in the Miers.

Jan 11	Moved the albedometer from the sandy site to the moraine site. Re-surveyed the last water-slope survey lines to link with the benchmark BMM21. Michael Kopp and Josie McNee arrived in the middle of the afternoon. Heather collected samples from the "sandy type" ridges that had appeared on some of the patterns.
Jan 12	Tried to sample at Site D, but there was insufficient flow because of the lack of sun. Measured some ripples in the sand. Resurveyed a couple of the positions of the stream sites, to determine the height of the prism. Changed the Foxboro charts. Pat Sole and Joe Gary arrived from the Marshall valley just on midnight after a 4.15 hour walk.
Jan 13	Snowed all day. Josie and Michael left at 1000. Pat and Joe left at 1300. Gary De Rose and Stu Thorne called in mid afternoon. Recovered data from the three data loggers.
Jan 14	Determined the "levels" of the patterned ground at the volcanic and marble sites. Checked the level and location of the Lower Miers weir to record the distortion. Did a stream gauging of the Lower Miers.
Jan 15	Recreation day - photographing. The Lake Miers Swim Club invested a further three members.
Jan 16	Richard and Heather sampled sediment over a rising and falling stage at Site E. David did the final intersection survey of the Miers glacier control. Moved all the survey marks and equipment to the Adams.
Jan 17	Surveyed the levels of patterned ground at the sandy and moraine sites. David laid out the photogrammetric survey line for the Adams glacier.
Jan 18	Surveyed and measured the ablation poles on the Adams glacier.
Jan 19	Heather and Richard took the albedometer down to the marble site. David did the photo-survey of the west side of the Adams glacier snout. This was completed at 0030. Recovered data from the three data loggers and did a further stream gauging of the Lower Miers.
Jan 20	Surveyed and measured the ablation poles on the Miers glacier.
Jan 21	Richard and Heather did a gauging at Site E, and measured channel slope. Tested the interference caused by the sampler with potassium permanganate. Retrieved the wind traps, and emptied three. David laid out the base line survey of the East side of the Adams glacier. The EDM was found to continue to operate in light snow.
Jan 22	Wellington Anniversary Day. To celebrate the anniversary it was decided to go down to the beach for the day. Unfortunately not the best of days. Richard goes up to the high peak on the northern side of the valley on the way back.
Jan 23	Shifted the albedometer from the marble to the volcanic site. Visited by an American science party. Took down the Adams climate station and shifted everything except the weir back to the hut. Photo-survey of the east ridge of Adams glacier snout. Control survey completed 0015.
Jan 24	All equipment removed from the Miers site, bar the flume. Ancient surveyor saved from embarrassment by young maiden.
Jan 25	Lower Miers equipment moved back to the hut. All photo-survey marks removed and equipment moved to hut. All survey control stations punched and plugged.
Jan 26	Beautiful day so Richard went up Mt Lama for some photos of the valley. Heather went to get photos of her sites and collect samples from various sites for her mapping work. Removed the albedometer from the volcanic site and packed it away. Measured the sand on the delta. David photographed the survey and photogrammetric equipment as a record.

Jan 27	Packed up some of the gear. Surveyed the location and level of the Lake Salina gauging staff. New survey station established on the Salina Moraines as ideal sighting purposes. True north established by local sun time. Panorama of skyline peaks established from bearings at Station P.
Jan 28	More gear packed and as much gear as possible moved to the helo pad. "Uncontrolled" photos taken of Miers and Adams glacier fronts for photogrammetric accuracy assessment. Closer photography of extended western section. Long focal-length (150 mm) photography of Adams glacier.
Jan 29	First helo arrives 0920 for return to Scott Base. At Scott Base the boxes for return on the ship were prepared. All NZARP gear returned.
Jan 30	Waiting to leave.
Jan 31	More waiting.
Feb 1	More waiting.
Feb 2	Still more waiting.
Feb 3	David Winchester and Heather Campbell left for New Zealand.
Feb 4	Richard Hawke still waiting.
Feb 5	Richard Hawke departs for New Zealand.

Weather

Metrological Data

Date	Time	Wind Direction	Wind Speed (knots)		Temperature (degrees C)
			Mean	Max Gust	
NOV					
18	1800	W	8		-3.7
19	0900	E	5	10	-4.5
	1800	E	5		-5.5
20	0900	E	2		-5.5
	1800	E	6		-6.5
21	0800	0	0		-7.0
	1800	NE	3		-4.5
22	0800	E	4		-3.0
	2200	NE	3		-1.5
23	1000	W	5	8	0.0
	2000	W	3		-1.0
24	0800	NE	2		-5.5
	1800	E	12	25	-3.5
25	0800	0	0		-5.0
	1800	0	0		-3.0
26	0800	E	3		-6.5
	2030	0	0		-5.0
27	0800	E	7		-0.5
	1800	E	10	14	-1.0
28	0800	E	18	35	0.0
	1800	SW	5	12	0.0
29	0930	E	5		6.5
	1800	N	10		1.0
30	0800	E	10	12	0.5
	1700	E	8	11	2.0
DEC					
01	0800	E	4	8	0.5
	1800	E	10	18	-1.0
02	0800	0	0	0	-3.0
	1800	0	0	0	0.5
03	0830	0	0		4.0
	1800	NE	4		3.5
04	0830	E	0		6.0
	2100	E	3	7	3.5
05	0800	SW	8		4.5
	1800	SE	8	14	5.0
06	0815	E	7		5.0
	1800	NE	4	8	3.0
07	0800	E	5		2.0
	1830	NE	2		1.0
08	0800	E	4		1.5
	1800	NE	2		3.0
09	0800	E	2		2.0
	1800	E	4		3.0
10	0800	E	1	2	2.5
	1800	E	6	8	3.0
11	0800	0	0		2.0
	1800	NE	4		2.0

Date	Time	Wind Direction	Wind Speed (knots)		Temperature (degrees C)
			Mean	Max Gust	
12	0800	E	0	2	1.0
	1800	E	8	10	-0.5
13	0800	0	0		1.5
	1930	NE	7		1.0
14	0810	E	5		-1.0
	1800	E	5		-1.0
15	0800	E	5		-3.0
	1800	E	5		-1.5
16	0800	E	5	7	-4.5
	1830	NE	5	7	-2.5
17	0800	E	3	5	-0.5
	1800	E	5	8	1.5
18	0800	E	4		-1.0
	1800	E	7		-0.5
19	0800	E	7		-1.5
	(AT GARWOOD)				
20	1900	E	7		2.0
21	0800	E	3	5	0.5
	1845	E	5	7	2.0
22	0800	E	4		2.0
	1800	E	6		2.0
23	1000	E	3	5	3.0
	1800	E	7	9	2.0
24	1200	E	6	7	-4.0
	2200	E	6	9	-3.5
25	1200	E	4		0.5
	1800	E	4	7	1.0
26	0900	E	4		3.0
	1900	E	6		2.5
27	0800	E	6	8	0.5
	1800	E	6	8	0.0
28	0800	E	4	6	0.5
	1800	E	6	8	2.5
29	0800	E	5	7	0.0
	1800	W	5	7	2.5
30	0800	NE	5	6	1.5
	1800	E	6		3.5
31	0800	E	7	12	2.0
	1800	E	3	5	-0.5
Jan 1990					
01	0800	E	5		-2.5
	1800	E	5		-0.5
02	0800	E	5		-2.0
	1800	NE	7	12	0.5
03	0800	E	5		-0.5
	1800	E	5	7	1.5
04	0800	E	5		1.0
	1800	W	7	9	3.5
05	0600	W	7	9	1.0
	1930	E	5		3.0
06	0800	NE	2	3	0.0
	1800	E	6	7	1.0
07	0800	E	3		-2.0
	1800	E	4		1.0

Date	Time	Wind Direction	Wind Speed (knots)		Temperature (degrees C)
			Mean	Max Gust	
08	0800	E	4		-3.0
	2000	E	1		1.0
09	0600	NE	2	4	0.0
	1800	NE	5	7	2.0
10	0800	E	3		0.5
	1800	E	6	7	1.0
11	0800	E	4		0.0
	1800	E	4	9	-1.0
12	0800	E	4		-4.5
	1800	E	4	6	1.5
13	0800	E	2		-3.0
	1800	E	4	7	-2.0
14	0800	0	0		-0.5
	1845	0	0		1.5
15	0800	E	2		-1.0
	1800	E	8	9	2.0
16	0800	E	4		-1.0
	1900	E	6		1.0
17	0800	E	4		-1.0
	1800	0	0		0.0
18	0800	E	4		1.5
	1800	E	4	5	0.0
19	0800	0	0		1.0
	1800	E	3	5	4.0
20	0800	E	5		1.0
	1800	E	3		1.0
21	0800	E	2		0.0
	1800	E	0	3	0.0
22	0800	E	5	6	-0.5
	1800	E	3		-1.0
23	0800	E	2	4	-2.0
	1800	E	6		-0.5
24	0800	E	0		-1.0
	1800	E	1	2	1.0
25	0800	E	5	6	-5.0
	1800	E	4	7	-5.0
26	0800	E	3		-2.5
	1900	W	6		-1.0
27	0800	NW	2	5	-1.5
	1800	E	6		0.0
28	0800	E	3	5	-1.5
	1800	E	7		1.0

Accidents

Only one accident occurred during the season and this was of a minor nature. Returning to the Miers hut after working in the Miers stream Richard Hawke burnt the backs of both his hands on the steam from a billy. His hands were both wet and cold and obviously he did not feel the "heat" of the steam. Luckily a helicopter was expected the next day bringing a visitor, and one of the Base staff was going to use the spare seat. It was therefore possible for Wendy Strid (the summer medic) to visit our camp and bring extra medical supplies.

For two weeks Richard's hands had to be bandaged. While this was a big limitation on what he could do he was still able to write. The work programme was therefore able to be maintained. There was an early suggestion that Richard should go back to McMurdo for treatment but this idea was dismissed once Wendy had seen the injury and it became obvious that we could still function as an independent unit.

Field Equipment

All the field equipment issued to our event functioned extremely well. The clothing was excellent, particularly the windproof hats which made working in windy conditions considerably less onerous. The only problem experienced during the past season was the same as the previous season. The Sorrel boots with the "white plastic" soles (as opposed to the "black rubber" soles) soon wore down. These soles were not up to Dry Valley conditions and soon split causing leaks and consequently wet feet. While this was largely a question of comfort in the Miers, considerable risks are inherent in having wet feet in the Antarctic.
The food was excellent with plenty of variety. The major difficulties are now the bulk, given all the "freshies", and keeping frozen supplies from thawing. The large pit dug into the permafrost beside the hut to act as a fridge last season was lined with ply and covered with a piece of polystyrene. This worked well especially when the "box" was filled with ice to keep the temperature low.

Crampons in general are not suited for use on Sorrel boots because of their flexible soles. The screws tended to work loose rapidly and several of the "bars" broke under the strain of walking on "hard" glacial ice. I would suggest that "Locktite" be made available at Scott Base so that, after adjustment for size, the screws can be "glued" in place. In some conditions the loss of screws would seriously compromise safety.

Radio Communications

During the season we had access to both Codan SSB and Tait VHF radio sets for communications with Scott Base. The positioning of a repeater on Brown Peninsula allowed the Tait VHF sets to be used effectively from "inside" the Miers Hut and on only one occasion was the Codan HF set required to reach Scott Base from the Miers. Communications were extremely good and a high gain aerial was not required. At no time were communications missed because of "technology" failure.

It was still not possible, even with the repeater, to use the VHF sets from the Garwood and so the Codan was required on our visits to this "outpost". The Codan was used to maintain contact with other field parties and to keep in touch with what was going on in the New Zealand field programme. Because of this, the batteries required changing 4 or 5 times over the duration of the event.

The solar panels were not used as we had a generator and using a "multibox" it was possible to charge the batteries while doing other work. The generator was essential to operate the computer for data collation and down-loading of material to and from the dataloggers. It was also needed for recharging the EDM batteries which only lasted one days survey operations.

The Coms Operators this season provided an excellent service and an efficient link to Scott Base. They seemed to take an interest in what we were doing and were always willing to have a chat or read out some news. With only two persons in the Miers for much of the season they provided a much appreciated link to the "outside".

Miers Refuge Hut

The Miers refuge hut was found to be in good condition on our arrival and certainly made our stay considerably more comfortable than having to rely solely on tentage. The hut was used mainly as a laboratory for operating the PC although it was also used for cooking, eating, and recreation. The hut in general is poorly ventilated, however, with only two persons (three at the most) last season this did not lead to major problems. In the past severe condensation problems have been experienced while cooking. The Miers Hut is well sited for work anywhere in the valley.

More of the "old" food found in the Hut in 1988-89 was returned to Scott Base for dumping. This accumulated food has lead to a storage problems during recent seasons as field parties in the past have left their surplus supplies behind when shifting camp. None of the food found in the hut was used and the hut contains a good supply of fuel, cooking utensils, and a minimum of ten days food.

The provision of a field toilet made life considerably more comfortable, particularly on windy days. This toilet is "wired down" on the lee side of a low moraine ridge approximately 100 m from the hut. No pollution will occur as all waste is "captured" and returned to Scott Base for disposal.

The Miers refuge box, which is on a high moraine mound 100 m from the hut, was still sealed and was therefore not checked and no inventory was carried out. A couple of coats of paint were applied at the end of the season to make it more visible.

Environmental Impact

Garbage Disposal

All rubbish from the expedition was sorted into "Burnable" and "Non Burnable" bags and back-loaded to Scott Base. When old campsites and other "rubbish" was found throughout the valley this was treated in the same manner and back-loaded to Scott Base.

Waste water was disposed of in a "sludge pit" system located on a high sandy knoll to minimise risk of pollution to the rivers and lakes. The "sludge pit" was dug out at the end of the season and back-loaded to Scott Base. In the future a "sludge pit" container would be more environmentally suitable to trap food scraps and fatty liquids. Once frozen these could be returned to Scott Base for disposal.

Human waste from the field toilet was double bagged and returned to Scott Base for further disposal.

THE HISTORY OF THE ROSS SEA REGION DURING BEACON TIMES (K047)

K. J. Woolfe, M. J. Arnot and D. P. Zwartz

Aims

The aims of the 1989-90 Beacon Studies programme were to examine exposures of mainly Victoria Group rocks in the Skelton Névé to Robinson Peak area. The programme had four main objectives:

i) Facies, paleocurrent and thickness studies to constrain the regional tectonic development of the sedimentary basin.

ii) Sampling for a carbon/sulphur geochemical profile of the Beacon in South Victoria Land.

iii) Facies and paleocurrent analysis of Pivot Coal Measures and Weller Coal Measures for a comparative study.

iv) Facies and paleocurrent analysis of Lashly A for a reinterpretation of the paleoenvironment.

Planning

Pre-season planning progressed smoothly and problems were identified. With the exception of an unfortunate incident caused we suspect by a personality clash and a degree of scientific protectionism on behalf of a third party, preparations for field went extremely well. The problem with our planned visit to Escalade Peak and the Boomerang Range was not raised until after our arrival at Scott Base. If it really existed, the problem should have been raised at Tekapo.

Cargo

Event Cargo was shipped southwards with cargo consigned by K042. No separate cargo items were sent. North bound cargo consisting of rocks and sundry personal gear has yet to arrive in Wellington.

Preparations for the Field

The party had completed survival training, a shake down trip and was ready to leave five days after arriving on base.

We experienced some weather related delays prior to leaving base (see event Diary).

Field Transport

Motor Toboggans

A last minute decision led to the new Alpine Toboggans being moth balled and in their place we were issued two Grizzlys, G7 and G8. Initial reservations about taking these old machines on a long traverse proved to be unwarranted as both machines performed well. For the most part loads were relatively light but towards the end of the trip each machine was pulling about 2000 lbs and finding it hard work.

Each machine covered 950 km, towing an average of about 1400 lbs, total fuel consumption was 790 l, giving an average fuel consumption of 2.7 km/l.

Icing was a serious problem on the Lower Staircase, warm conditions and deep soft snow caused ice keels to form between the tracks preventing steering. In addition the tracks became frozen completely if stopped for more than a few seconds.

Once stopped the only way to get going again was to roll the machine and chip away the keel and the ice from around the tracks.

The magnitude of the problem is exemplified by the fact that it took us over 2 hours and 12 km of driving to turn two toboggans around and align them with two sledges after we stopped to reconfigure the train. Turning circles were upwards of 300 m in diameter and stopping resulted in instant freezing. The rule seems to be if you encounter these conditions don't stop!

Contaminated fuel was a major problem on the leg between Mt Metschel and Portal Mountain, extreme care must be taken not to send rusty drums into the field. Many hours were lost because of this and it resulted in us being unable to reach our planned destination before bad weather closed in.

Helicopter Operations

Helicopter resupplies were made at Mt Metschel, Mt Crean and Mt Fleming, the party was pulled out by helo from just south of Mt Bastion.

Without exception resupplies arrived late, either because of weather or mechanical problems, however this had no impact on the smooth running of the event.

The pull out from Mt Bastion was seriously affected by weather and resulted in a helicopter becoming trapped overnight at our camp. Four Tamworth sledges were underslung to Vanda and proved very difficult to fly, strapping them to the skids seems the best option if they must be flown externally. Moderate damage was done to the sledges either in flight or during landing. Additional damage may have resulted from the sledges being blown around on the pad at Vanda, such loads should be placed some distance from the pad to prevent tumbling caused by rotor wash.

Hovercraft Operations

The hovercraft managed to deploy a depot near Fishtail Point in weather conditions which were too bad for sledge travel suggesting that it offers a viable means of Ice Shelf transportation even in marginal conditions.

However, the depot was not placed where we wanted it nor where they told us it was! The problem arose when the hovercraft encountered the rift field off Fishtail Point and decided they could go no further. Had the crew or one of the two Scott Base staff onboard been properly briefed prior to departure the depot could have been placed a further 70 km from base without any problems at all. The route up the Skelton Glacier and indeed the rifts which caused the problem were clearly marked on a map left at Scott Base. This map should have been made available to the hovercraft but it wasn't.

Even when the depot had been deployed on the Ice Shelf, 3.5 miles off Fishtail Point and north of the mouth of the Skelton we were told that it was at Fishtail Point. Only after clearing the rifts and struggling across a sastrugi field did we discover that there was no sign of the depot at Fishtail Point. Bad weather prevented us from back tracking out onto the Shelf for some days. A number of days travel may have been saved if we had been given the correct position of the depot in the first place.

In retrospect we recommend that in future where depots are to be deployed by hovercraft without event personnel, that a briefing be organised with the crew prior to the Events departure, in the same way that this is done for deep field LC-130 operations.

Event Diary

Nov 2	Arnot, Woolfe and Zwartz to Christchurch.
Nov 3	Aircraft delay

Nov 4	Arnot, Teeling, Woolfe and Zwartz to Scott Base. Late afternoon assemble sledge train on ice foot in front of hanger.
Nov 5	Southerlies to 40 kts, blowing snow. Repacked food boxes, sorted field gear, pumped fuel. Event Brief, advised we were not allowed to visit Escalade Peak or the Boomerang Range, phoned Barrett.
Nov 6	Southerlies gusting to 60 kts, condition 1. Ready for shake down trip. Clearance from Christchurch for trip to proceed.
Nov 7	Southerlies to 40 kts, blowing snow, minor sledge repairs, party makes itself useful around base.
Nov 8	Snow at times. Arnot and Zwartz to survival school. Teeling and Woolfe load sledges for shake down trip and finish rebuilding drum cradles.
Nov 9	Partly cloudy first thing. Party plus Henderson (Field Store) left mid-morning in fog and poor definition for the Aurora Glacier. Followed flagged route to infrasonic array in Windless Bight. Returned to Scott Base in deteriorating weather, early evening.
Nov 10	Snow and poor viability prevented any movements today, party visits Mac weather.
Nov 11	40 kt southerlies and blowing snow. Party helps the "Its in The Bag" crew set up stage. Woolfe does 2000-0800 hrs radio watch.
Nov 12	Clearing weather. Party departs Scott Base at 1400 hrs. Great send off. Travelled under compass at times, covered 72 km. Camp 1, 78°08'S 168°11'E.
Nov 13	Ice fog clearing. After a late start covered 70 km before making camp off Minna Bluff. Frontal system moving in from the south. Camp 2, 78°38'S 167°35'E.
Nov 14	Blowing snow and patches of ice fog prevented travel all day.
Nov 15	Blowing snow, visibility less than 5 m at times.
Nov 16	Blowing snow, wind easing by afternoon. Spent 4 hours digging out the train, blowing snow again by evening. Hovercraft 1 leaves McMurdo for Fishtail Point with resupply.
Nov 17	Strong southerlies and blowing snow. Hovercraft puts in depot at Fishtail Point and returns McMurdo.
Nov 18	Drifting snow and poor definition. Sledge train drifts up as fast as we can dig it out no progress again today.
Nov 19	White out. Departed at 1700 hrs in light winds, poor definition and viability. Travelled 30 km under compass. Camp 3, 78°46'S 168°20'E (D.R. position).
Nov 20	Overcast poor definition, no landfalls. Travelled 70 km under compass. Camp 4, 79°15'S 166°13'E.
Nov 21	Patches of ice fog, Bad weather over mountain front. Weather Clearing by evening. 2330 hrs, obtained fix on Teal Island.
Nov 22	Clear and calm. Departed for Fishtail Point at 0230 hrs. Arrived Fishtail Point at 1000 hrs, no sign of either the depot or the flags which the hovercraft deployed. Travelled 90 km, Camp 5, 78°57'S 162°32'E.
Nov 23	Strong winds and drifting snow, wind easing by late afternoon, heavy snow by evening.
Nov 24	Snow and poor definition again prevented us from searching for our depot, running out of many food items.
Nov 25	Snow, low cloud and poor definition, no progress.

Nov 26 Snow, low cloud and poor definition, clearing slowly. Dug out sledges and camp in case the weather breaks.

Nov 27 Left camp at 0155 hrs in drifting snow and poor definition, weather clearing. recovered depot, from the Ice Shelf north of the rifts running off Fishtail Point. Departed for Clinker Bluff at 1030 hrs. Whited out after only 9 km of travel. Camp 6, 78°52'S 162° 16'E (D.R. position).

Nov 28 Weather clearing. Started packing camp at 0700 hrs but white out returned before we could make any progress. Remained half packed, awaiting clearance in the weather. No H.F. comms.

Nov 29 Weather clearing from the south. Departed camp at 0400 hrs. Easy travel weather still improving. Machines ice up and totally freeze at Twin Rocks. Tracks refreeze in seconds ice keels form continuously, takes 2 1/2 hours to turn the train around in deep soft snow. Pitched camp on The Landing after travelling 70 Km. Takes 3 hrs to chip ice off toboggans and sledges. Camp 7, 79°20'S 161°35'E.

Nov 30 Fine and calm. Travelled 80 km, set up camp near a rock rib on the north east corner of Mt Metschel (Camp 8).

Dec 1 Light snow by evening. Local geology, Mt Metschel. No comms with Scott Base (am), CW comms only (pm). Resupply did not arrive.

Dec 2 Light snow, poor viability and definition. No resupply.

Dec 3 Strong westerlies and blowing snow.

Dec 4 Strong westerlies and blowing snow easing slowly. Helo arrives with resupply late morning. Party leaves Mt Metschel 2330 hrs, with bad weather approaching from the south.

Dec 5 Dirty fuel received in yesterdays resupply causes numerous break downs. Party over run by snow and poor definition. Arrived base of Portal Mountain 0700 hrs. Camp 9A. Heavy snow and fresh westerlies by evening. Arnot, Woolfe and Zwartz depart for local geology late evening.

Dec 6 Arnot, Woolfe and Zwartz return at 0130 hrs still snowing. Weather clearing by afternoon. Teeling and Zwartz depart with G7, G8 and one sledge at 1830 hrs to establish a camp near the summit of Portal Mountain, Camp 9B. Arnot and Woolfe depart 1840 hrs for exposures on the northeast ridge. Bad snow conditions hamper climb. Camp 9B is established, Teeling and Zwartz do some local geology.

Dec 7 Arnot and Woolfe return to Camp 9A at 0130 hrs having been unable to reach the outcrop due to bad snow conditions. Weather deteriorates during the morning. Teeling and Zwartz set off to help move Woolfe and Arnot up to camp 9B but are forced back by fog and poor definition. Both parties do some local geology.

Dec 8 Fine and calm, light snow by late evening. Teeling and Zwartz move Woolfe and Arnot to outcrop above dolerite sill on north east ridge and then move all remaining equipment up to Camp 9B. Arnot and Woolfe measure section on north east ridge.

Dec 9 Weather closing in Arnot and Woolfe complete section and meet up with Teeling and Zwartz above Camp 9B, Arnot and Teeling descend to camp. Woolfe and Zwartz collect paleocurrent data from Lashly A, returning to camp in thick fog at 0300 hrs. Weather clearing late afternoon. Party moves camp to Mt Crean, Camp 10.

Dec 10 Fine and Calm. Arnot and Teeling set out for the south ridge and the Weller Coal Measures. Woolfe and Zwartz traverse Mt Crean via the north east ridge to meet up with Arnot and Teeling on the south ridge.

Dec 11 Both parties return to camp around 0845 hrs. Helo resupply at 1530 hrs. Rest day.

Dec 12 Woolfe and Zwartz leave for east ridge at 0500 hrs. Arnot and Teeling pack up and leave at 0730 hrs for Pivot Peak, establishing Camp 10B. Poor viability prevents work on Pivot peak, snowing by afternoon at Mt Crean.

Dec 13 Skeded at 0200 hrs, blowing snow and poor visability. Weather remains bad at pivot Peak all day, but clears slightly at Mt crean, Woolfe and Zwartz do some local geology.

Dec 14 Skeded at 0200 hrs, weather not too bad. Arnot and Teeling complete a good day in the central valley of Pivot Peak. Woolfe and Zwartz start section on south east face of Mt Crean but are forced back by deteriorating weather.

Dec 15 Skeded at 0200 hrs, marginal weather all round. Woolfe and Zwartz do some local geology in afternoon, weather remains bad at Pivot Peak all day.

Dec 16 Fine and calm, both parties complete a successful day's geology.

Dec 17 Fine, fresh Katabatic. Arnot and Teeling depart Camp 10B at 0730 hrs for Mt Crean, arriving 1130 hrs. arnot and Woolfe visit diamictite exposure on south east face, Teeling and Zwartz purge fuel drums and prepare depot for retro. Entire party leaves for Mt Fleming at 1800 hrs.

Dec 18 Camp 11 is established at Mt Fleming by 0100 hrs. Total distance covered from Pivot Peak 95 km. Fine and calm, party leaves for recce of the north east ridge at 1630 hrs, Arnot and Woolfe continue out along north east ridge while Teeling and Zwartz return to camp and then drive to Horseshoe Mountain for recce.

Dec 19 Arnot and Woolfe return to camp at 0100 hrs, Teeling and Zwartz return 0230 hrs. Arnot and Woolfe leave for northeast ridge at 1700 hrs, Teeling and Zwartz remain at camp to meet in bound helo. Helo forced to make emergency landing near Lake Fryxell and does not arrive. Teeling and Zwartz depart for Horseshoe Mountain at 2355 hrs, Arnot and Woolfe return at 0000 hrs.

Dec 20 Horseshoe Mountain proves to be very exposed to the katabatic, Teeling and Zwartz return to camp very cold at 0950 hrs. Arnot and Woolfe leave on foot for the northeast ridge at 1210 hrs. Resupply arrives mid-afternoon. Arnot and Woolfe return to camp at 2045 hrs.

Dec 21 Fresh katabatic, bad weather over the Plateau. Teeling and Zwartz leave on toboggans for Horseshoe Mountain at 1150 hrs, Arnot and Woolfe leave on foot at 1215 hrs for the ridge to the south of camp and the valley below. Arnot and Woolfe return to camp at 2045 hrs, in gale force westerlies and blowing snow. No sign of Teeling and Zwartz. Believing Teeling and Zwartz would have returned to camp early in view of the weather, Arnot and Woolfe prepare to recce the route to Horseshoe Mountain. At 2130 hrs a request is made to Scott Base to place the SAR team on Standby. Teeling and Zwartz return to camp, safe and well at 2205 hrs, after working in fine weather all day!

Dec 22 Marginal weather prevented work today.

Dec 23 Fresh katabatic easing. Maintenance and local geology. Christmas helo arrived md-afternoon.

Dec 24 Snow and poor visability. Arnot and Teeling leave for north east ridge but return finding all the exposures snow covered. Woolfe and Zwartz complete a successful day (in the sun) at Horseshoe Mountain.

Dec 25 Katabatic to 40 kts, easing but fog over the Plateau prevented us from moving to Mt Bastion.

Dec 26 Strong katabatic all day, unable to move.

Dec 27 Fine and calm, party moves to Mt Bastion establishing Camp 12. Low cloud by evening.

Dec 28 · Partly cloudy, light winds. Party sets off for the platforms on the east side of Mt Bastion. The route down consisted of mixed frozen scree, soft snow and blue ice, party returns via the east face and north ridge in threatening weather.

Dec 29 Strong katabatic with blowing snow, unable to travel.

Dec 30 Low cloud and poor definition.

Dec 31 Cloud thickening, snow later. Flagged route to Robinson Peak but forced to return to camp in heavy snow and viability below 200 m at times.

Jan 1 Heavy snow and low viability.

Jan 2 Low cloud, poor visibility and periods of snow.

Jan 3 Low cloud and snow.

Jan 4 Fine light winds. Party travels to Robinson Peak, Arnot and Teeling descend to the Weller Coal Measures, Woolfe and Zwartz examine exposures of Lashly. Party returns to Camp 12 in fresh easterlies.

Jan 5 Arnot, Teeling and Zwartz leave for Mt Dearborn at 1315 hrs, but return at 1500 hrs in moderate snow and poor visability.

Jan 6 Low cloud and snow. Constructed helo pad for our pull out.

Jan 7 Heavy snow and poor visability. Prepared helo loads for our pull out.

Jan 8 Patchy low cloud and snow showers, visability less than 200 m at times. Woolfe and Zwartz recover flags from route to Robinson Peak. Pull out abandoned.

Jan 9 Fine and calm, Arnot and Zwartz return to Scott Base on first shuttle. Next shuttle takes four sledges to Vanda and 1000 lbs of cargo to Marble Point. Weather closes in. Next Shuttle lands but is clagged in. Helo and Crew spend night on Mt Bastion. Arnot and Zwartz pack rocks back on base.

Jan 10 Low cloud and fog, helo returns Teeling and Woolfe to Scott Base via Vanda. Arnot, Teeling, Woolfe and Zwartz return to Christchurch. Two grizzlies remain at Mt Bastion.

Sledging Routes and Camp Sites

Sledging routes and camp sites are summarised in figures 6-9 and are detailed below.

The route from Scott Base to the mouth of the Skelton Glacier is relatively simple the main difficulty being route finding, the mouth of the Skelton is very difficult to see when approaching from the north east or east. Prominent land marks are Cape Teall, Teall Island and the mouth of the Mulock Glacier.

An extensive set of wide (<8 m), northwest-southeast trending crevasses (rifts) occurs approximately 25 km southeast of White Straight and is centred about 78°20'S 167°30'E.

A rift field extends for approximately 5 km in a southerly direction from Fishtail Point and isolated rifts occur up to 10 km from the point. Parties intending to travel up the Skelton should not attempt to head up the Skelton until Clinker Bluff is open on the true left wall of the Skelton.

Rifts and extensive crevasses occur around the southern end and eastern side of Teall Island these extend out at least 7 km from the southeastern corner of the Island.

Travel up the Skelton was easy, due mainly to a thick snow covering which smoothed out any pre-existing sastrugi. Crevasses occur in isolated fields along both sides of the glacier.

Towards Clinker Bluff large flow-parallel rolls occur, although mostly covered with snow patches of blue ice suggest than under normal snow conditions these could be difficult to cross and parties travelling this route towards the Lower Staircase should exercise care to make sure they are in the correct "lane"! Isolated crevasses were observed in this area.

From the Lower Staircase to above the Upper Staircase we generally followed the route taken by the 1958-59 Victoria Land Traverse, avoiding those areas where they encountered crevasses. This route is largely a matter of going up those slopes that are not too steep and avoiding the obvious crevasse fields. The rolling topography and abundant crevasse fields makes travel difficult in all but the best lighting conditions.

Travel across the Skelton Névé to Mt Metschel provided no special problems, with rolling ground and good snow conditions. Isolated large crevasses occur off the south face of Portal Mountain, in an area which extends about 2 km out from the face.

A number of crevasse fields occur in the lower Lashly Glacier, both the one extending east from spot height 2320 m and the one extending west from the corner of Mt Feather are easily located and avoidable. A field in mid-stream is harder to see and on the ground can be confused with the one leading off Mt Fleming.

Extensive areas of blue ice occur in the upper Lashly Glacier. Travel very close in on the eastern side of the small unnamed nunatak mid-stream was easy, care should be taken to pick up the crest of a roll which extends for some distance down stream of the nunatak. North of the nunatak the route on to the Plateau is on snow patches over blue ice. with less snow cover this route could be difficult, care must be taken to avoid extensive crevasses to the north and south, small crevasses occur in the blue ice but are easily seen. The route down towards depot Nunatak appeared to be almost entirely blue ice.

Once on the Plateau, travel to Horseshoe Mountain is straight forward, and a prominent ice roll plateauward provides a useful landmark in good light. Patches of blue ice occur south and southwest of Horseshoe Mountain and it is necessary to swing slightly west to avoid these.

There are no problems approaching Mt Fleming from this side.

A roll extends for at least 20 km west from Mistake Peak, with heavy sledges is was necessary to swing westward to avoid this roll. Although time consuming and requiring extra travel this wide route from Mt Fleming to Mt Bastion also avoided an area of blue ice, rolls and crevasses which forms a poorly defined area of confused ground north and west of Shapeless Mountain.

From the plateau Mt Bastion is surprisingly inconspicuous, The large flat topped peak first seen on rounding the rolls is Robinson Peak and the prominent pointed peak, Skew Peak.

North of Mt Bastion travel to Robinson Peak is easy. A crevasse field extends for at least 400 m east of the small unnamed nunatak between Mt Robinson and Mt Dearborn. Access to the Mackay Glacier look possible via this route. The Glacier between Robinson Peak and the Willett Range is very broken.

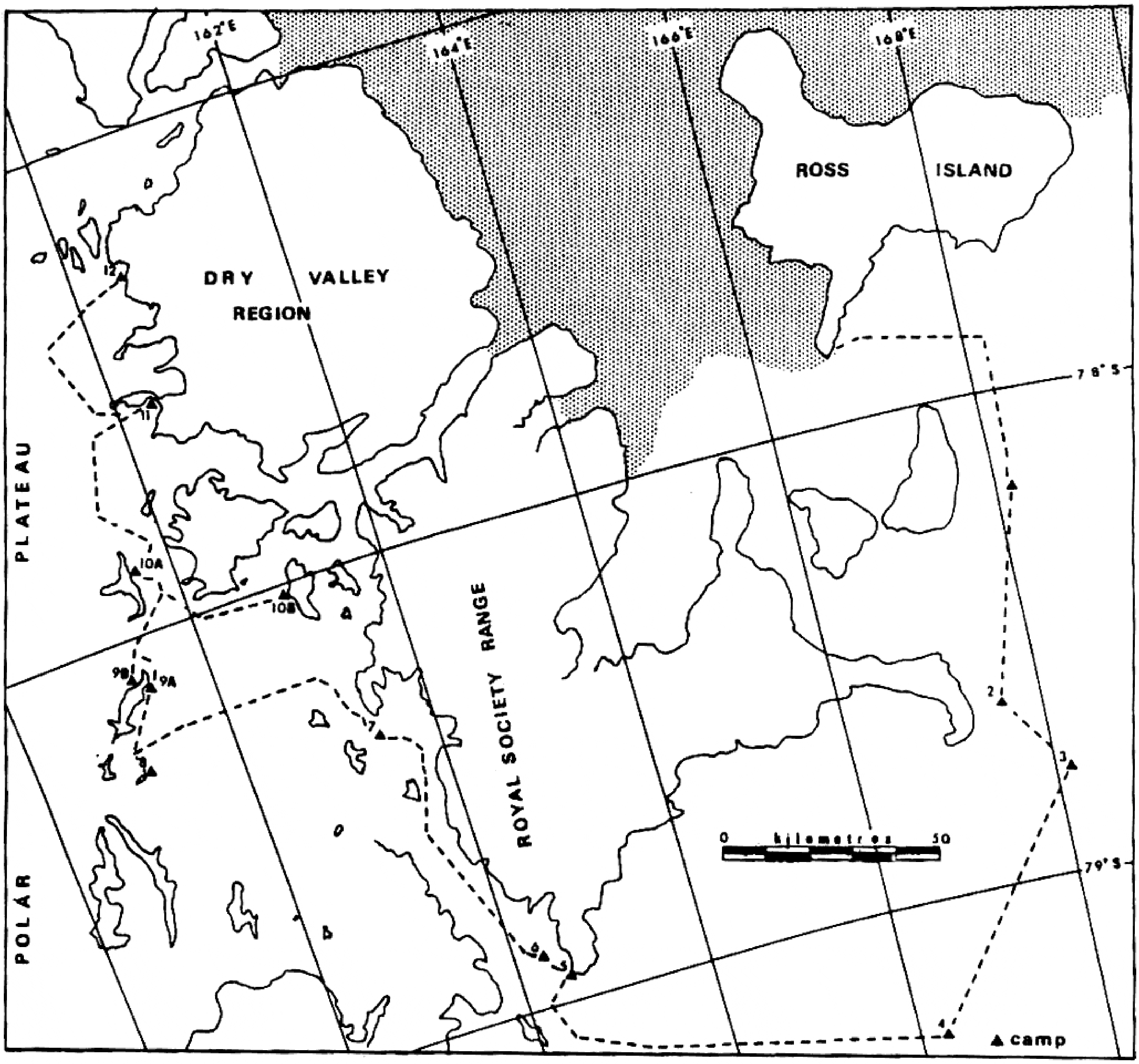

Figure 6 Sledging routes and camp sites used by K047 during the 1989-90 season.

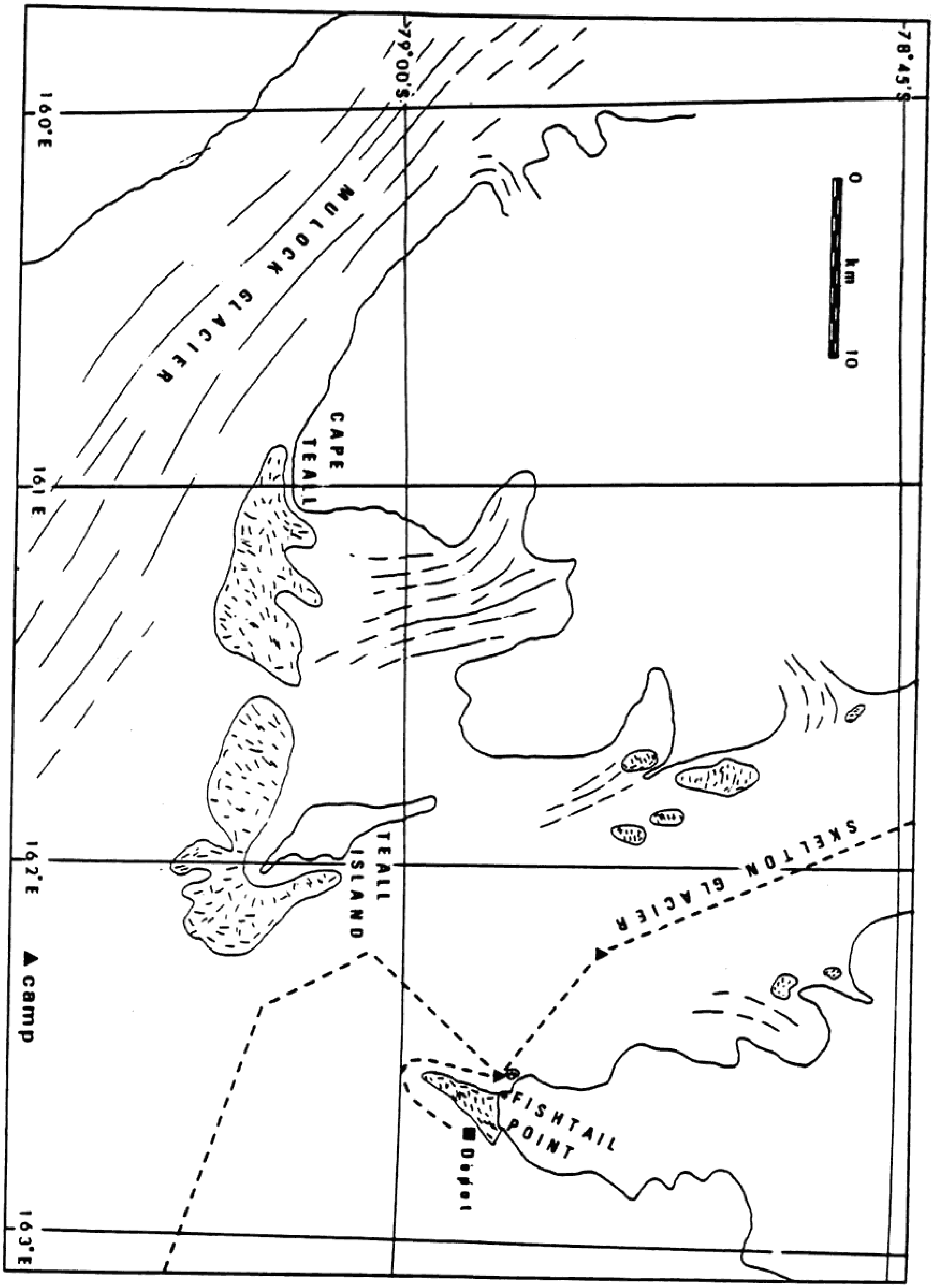

Figure 7 Map of the lower Skelton Glacier showing sledging routes and camp sites.

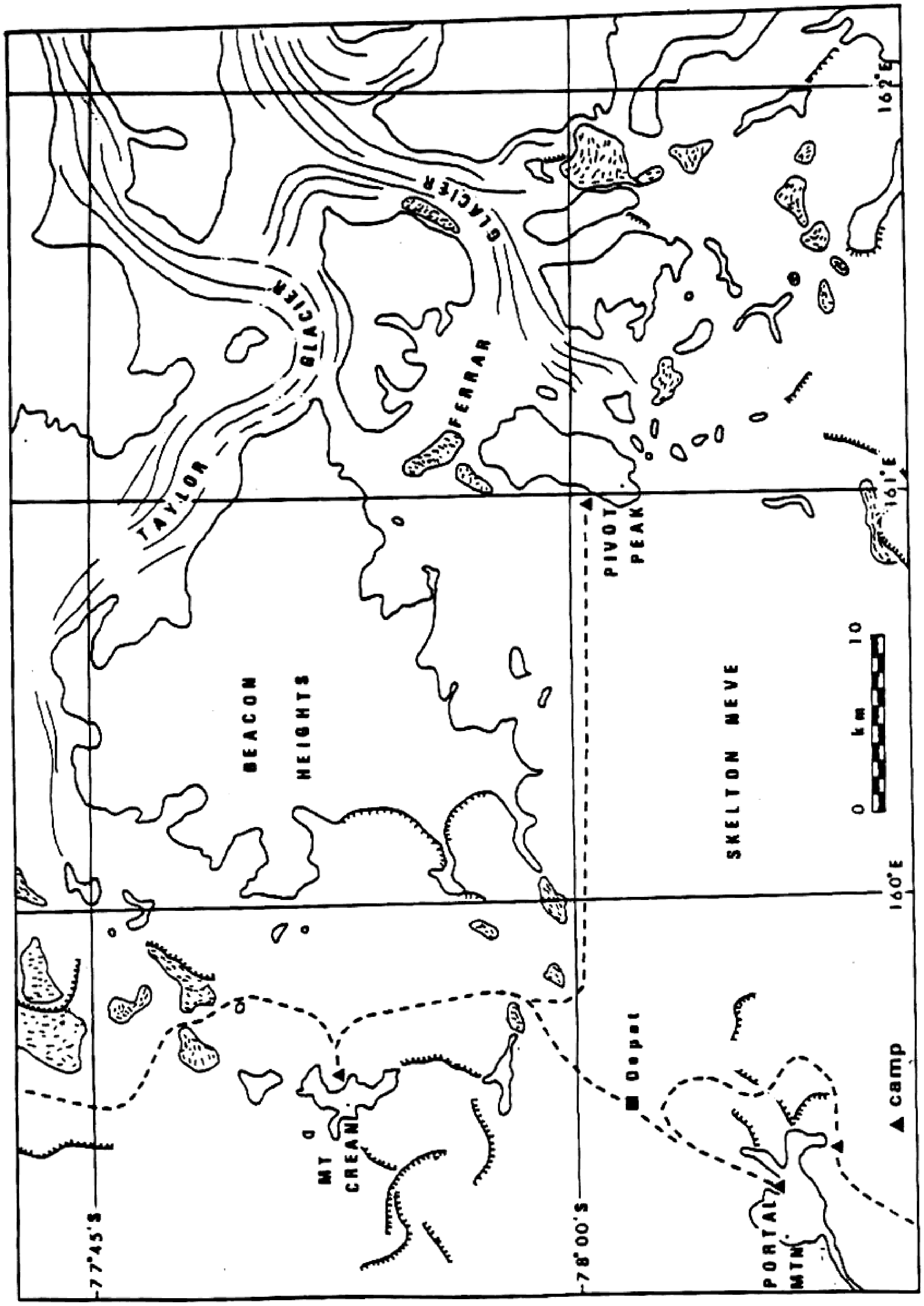

Figure 8 Map of the northern Skelton Névé area showing camp sites and slegding routes.

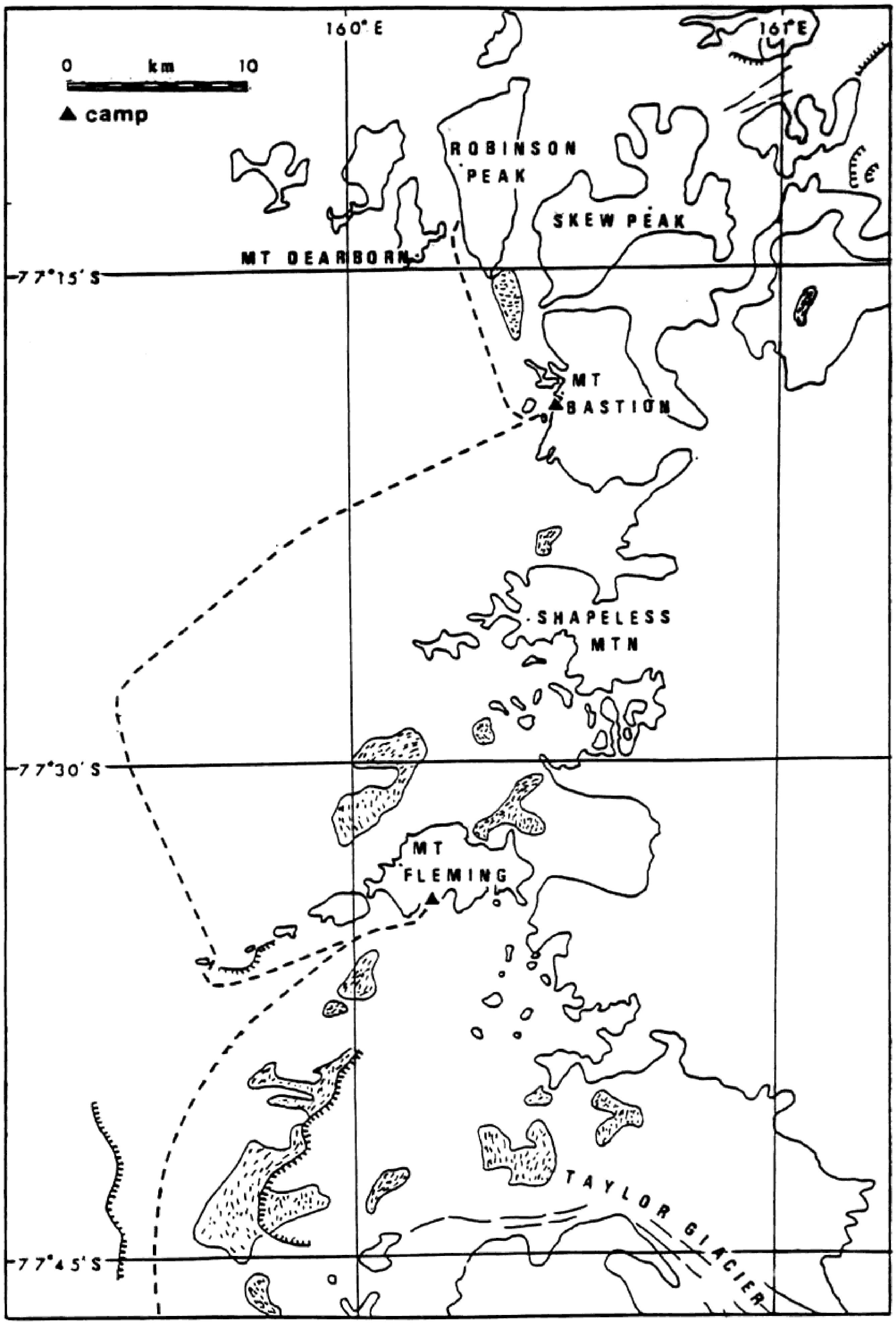

Figure 9 Detail from Lashly Glacier to Robinson Peak, showing sledging routes and camp sites.

Weather

Blowing snow, low cloud, poor definition and falling snow resulted in the loss of over 30 days. The consistently bad weather experienced makes it difficult to suggest any areas which with unusual weather characteristics except that Minna Bluff was really unpleasant. Talks with other people who have worked in the Minna Bluff area confirm that this place is often very windy. We advise parties travelling over land not to camp within 20 km of Minna Bluff.

Loss and Damage to Equipment

Relatively little damage occurred during the traverse and only two items were lost, these were a frameless kite and a ski pole to which it had been attached. Both items were blown away while the party was preparing to move camp.

The foot plate on T5 gave way while travelling on the Ice Shelf, and the right hand, handle bar upright on T6 was split on the lower Skelton Glacier, temporary repairs lasted for the duration of the trip. Two cow catcher lashings were broken but were not replaced in the field.

A primus box was partially destroyed during attempts to reconfigure the train in freak snow conditions and severe icing on the Lower Stair Case. We can report that primus boxes are unsuitable as "axle stands" for Grizzly toboggans!

Moderate damage was sustained by the sledges while being flown to Vanda, although the extent of the damage was not known prior to our departure for Christchurch it was clear that at least one handle bar had been badly damaged.

Field Equipment

The general standard of field equipment was very high. However, there are a number of points that we would raise:

Solar Panels

There is need for tie down points on these as they are difficult to anchor in even moderate wind.

Steering Compass

It is very difficult to steer a sledge train by standing on the sledge with a hand-held compass, especially in poor definition when unexpected bumps can cause the compass bearer to fall off!
Parties sledging on the Ice Shelf or on the Plateau should be provided with a more suitable steering compass. A small, gimbaled, liquid filled card compass of the type used on small boats would be ideal. This could be attached to the handle bars leaving the breakmans hands free.

Sleeping Mats

The new "thick snow foam" type mats are excellent. However they are easily damaged by ropes and the like, especially when they are lashed to sledges. Their reduced bulk is a great asset.

Radio Box

The boxes supplied with the large Codan radios are useless! They make it very difficult to operate the radio inside the tent and impossible to use while lashed to a sledge.
A suggested new design was submitted last year.

Flags

Pale green and pale blue flags are very difficult to see and their use should be discontinued. A line of pale green flags spaced every third of a mile was laid by the Hovercraft from McMurdo to Fishtail Point. Even though we crossed this line at least once and recovered a depot from the end of it we did not see a single flag!

Fuel Drums

Care must be taken not to use dirty, rusty or water filled drums for fuel. Two drums (B8929, B8930) sent to us at Mt Metschel proved to be rusty, contaminated with water and full of flaking paint. This led to us breaking down numerous times between Mt Metschel and Portal Mountain. The delay as well as being frustrating was potentially dangerous, forcing us to make otherwise unnecessary repairs in cold windy conditions, it also resulted in us being over run by bad weather. Such drums should be dumped.

Fuel Hose

The clear plastic fuel hose used in the grizzly toboggans is unworkable at very low temperatures. The Black rubber hosing is much softer even when cold.

Hose Clips

Hose clips taken as spares for the grizzly fuel lines should stainless steel and not soft alloy.

Colour Codes for Drums

There was some confusion at one stage as to whether I.P.A. had been added to some of our fuel (the same fuel that caused us problems as outlined above). We suggest that Fuel containing I.P.A. should be colour coded. A stripe on the cap would be ideal.

Dee Rings on Polar Tent

Some of the Dee Rings on the skirts of the Polar Tents were too small for the hollow tube ice pegs. We recommend that they be replaced with larger ones.

Primuses

Field parties are issued with cleaned heads as spares, these were often found to contain small holes or other defects making them unsafe. It is a shame that Ant. Div. goes to so much trouble emphasising the dangers of carbon monoxide at its training course and then causes the problem itself by issuing second hand burner heads. Returned defective heads should be thrown away regardless of cost. We spent much of the trip with one primus inoperative because all the spares were useless.

Radio Communications

The comms team at Scott Base provided excellent support throughout the season. Special mention must also go to the Vanda team who tolerated our 2 am skeds.

On several occasions early in the season we were given weather information for the wrong area. This usually arose only when a stand-in operator was being used. They simply gave us the All Area Forecast for Ross Island and told us that it was for our area.

When comms were bad as they were from time to time we managed to communicate with Scott Base by CW, high-lighting that if the current radios are replaced that a CW capability should be retained.

Extreme care should be given to the use of True and Grid directions, especially when they are passed out by Scott Base. This applies to both Weather information and Navigational messages. We ran into this problem to the extent that we spent some days looking for flags in the wrong direction!

This gives rise to two points;

1) All directions be they related to weather or navigational instructions passed by Scott Base should be suffixed as their meaning.

2) The field manual should contain a map showing the grid used by the US.

The Tait hand helds worked well and we were able to Talk to Scott Base on CH 3 from Mt Crean and on CH 5 from Mt Fleming and Mt Bastion.

See comments on solar panels and radio boxes above

Event Status on Leaving Antarctica

Arnot and Zwartz had 36 hrs on Base prior to their return to New Zealand, Teeling and Woolfe had less than 10 hrs. This rapid departure meant that a lot of field gear could not be returned through the usual channels.

On leaving Antarctica our Event equipment was distributed as follows:

Personal climbing gear, camping gear including primus, kitchen and most food boxes were returned to the field store.

General sledging equipment, crevasse rescue gear, fuel drums and other loose cargo (total 1000 lbs) was left at Marble Point.

All scientific samples were packed ready for shipment to New Zealand and were with the storeman.

Four Tamworth sledges, excluding their tanks but including drum cradles were at Vanda.

Two grizzly toboggans G7 and G8, were on the Polar Plateau 1 km south of Mt Bastion.

WEST ANTARCTIC VOLCANO EXPLORATION (WAVE) K048

J. A. Gamble

Aims

The aim and objectives of the WAVE programme are a comprehensive study of Cenozoic volcanism in West Antarctica. The project includes geochronological, volcanological, petrological and geochemical studies of volcanic rocks and the lithospheric xenoliths carried to the surface by volcanic processes. The programme involved field mapping, section measuring and sampling of rocks.

Planning

Logistic planning for the field season was undertaken by Gamble, Smellie (BAS), McIntosh and Panter (NSF) at the Congress of the International Association of Volcanology and Chemistry of the Earth's Interior held in Santa Fe, New Mexico during June 1989. There, a schedule for fieldwork during the 1989/90 season was formulated. A Put-in site was agreed upon and dates for flights arranged.

Atkinson and Gamble had the opportunity to undertake additional planning when they met at the Tekapo orientation meeting. We two are of the opinion that the Tekapo orientation meeting is a worthwhile and valuable exercise. A first, and perhaps only opportunity for all participants in the NZARP to meet and an opportunity to brush up on many skills and techniques.
Additional comments are contained in the Appendix prepared by Bill Atkinson in consultation with myself and other party members.

Cargo

Geological hammers were transported to Antarctica as a part of the VUWAE shipment. No excess baggage was carried to or from Scott Base.

Personnel

Members of K - 048 for the 1990/91 season to Marie Byrd Land, Executive Committee Range were as follows:

1) John Gamble, Dept. of Geology, Victoria University of Wellington, PO Box 600, Wellington.

2) Bill Atkinson, 173, McKenzie Drive, Twizel.

3) John Smellie, British Antarctic Survey, Madingley Road, Cambridge, U.K.

4) Chris Griffiths, British Antarctic Survey, Madingley Road, Cambridge, U.K.

See also comments in Appendix 1 (under Employment selection).

Preparations for the Field

Atkinson (K-048) together with Mc Intosh and Panter (S-081B) left New Zealand for the ice on or around 13th November 1989. Once there, Atkinson proceeded to organise field equipment at Scott Base. McIntosh and Panter departed for Mt. Erebus to assist with the S-081B programme.

Gamble, Smellie and Griffiths (K-048) departed NZ on 21 November 1989 following several days of delay in Christchurch.

Gamble, Smellie and Panter on arrival in Antarctica assisted Atkinson to prepare field equipment and rations for the expedition. Gamble, being familiar with procedures of the Berg Field Centre (BFC) was able to coordinate with McMurdo and BFC staff to arrange Hercules logistics and occasional transfer of field materials to Scott Base for checking and repair.

We carried out our own survival and crevasse extraction exercises on the ice fall north of Scott Base. We tested skidoos, sledges and towing rigs on a number of shake down trips along Hut Point Peninsula.

Additional details are contained in Appendix 1.

Field Transport

Detailed comments on transportation are contained in Appendix 1 relating to operation and effectiveness of skidoos and air operations. However, at this point we must emphasise that surely something can be done to increase the efficiency and flexibility of Hercules air operations. In MBL the weather experienced by our group was marginal to flying for most of the time. Windows of good weather lasted for relatively short periods, generally 12 hours at most .

Event Diary

Daily movements and field operations are detailed in Appendix 2 which also provides observations on weather conditions experienced in the field.

Event Map

Appendix 3 is a map of vehicle routes, put-in and pick-up sites and major camp sites during the expedition to Executive Committee Range.

Weather

Full details are in Appendix 2. A general impression of weather conditions in MBL was of cloudy, overcast conditions with rare brilliantly clear periods. Prevailing winds were either northerly or southerly.

Accidents

No accidents happened in the field although J Gamble aggravated an old ankle injury when loading field gear at Mc Murdo. The injury proved somewhat painful when cramponing on steep slopes but provided it was kept strapped up it did not affect the groups ability to function.

Field Equipment

Detailed comments are in Appendix 1. These comments were compiled after discussion with all members of K-048 and S-081B.

Radio Communications

The party used American supplied radios and found communications with Scott Base and McMurdo to be generally good. Further comments are contained in Appendix 1 and attention is drawn to the details of the hand held radios which were extensively used in the field.

Environmental Impact

All human waste was buried and metallic waste and non burnable materials (plastics) were returned to McMurdo for disposal.

Appendix 1 : Field Leaders Report - Bill Atkinson

KO48 : EXECUTIVE COMMITTEE RANGE, MARIE BYRD LAND

1989/90

PERSONNEL

Bill McIntosh	(Principal Investigator, Geologist)	USA
Kurt Panter	(Geologist)	USA
John Smellie	(Geologist)	UK
Chris Griffith	(Field Leader)	UK
John Gamble	(Geologist)	NZ
Bill Atkinson	(Field Leader)	NZ

LOCALITY

Executive Committee Range, western Marie Byrd Land, Antarctica. Isolated range of extinct volcanic cones, Latitude 126°W 77°S to 4181m / 13,713ft altitude.

TIMETABLE

Originally planned for two months in the field, this event was held at Scott Base for 40 days waiting for air transport. The event return to Scott Base was also delayed five days. The period in the research area (December 23 - January 24) allowed only a shortened programme to be undertaken.

REPORT

This report is directed towards comment on NZARP organisation, selection and training procedures, field equipment, transport, logistics, communications and safety. The geological studies will be published in the academic journals by the geology specialists.

Notes listed as "minor" are those I consider to be matters of personal choice, unlikely to have a major impact on future events. They are included for consideration by Field Leaders involved in the detail of planning remote field events. "Major" comments are those I believe may contribute further to comfort, utility or safety.

EMPLOYMENT SELECTION

In the main, the selection process for 1989/90 worked well, judging from the atmosphere at Scott Base, the ability and cooperation of DSIR staff at Tekapo and Scott Base, and the high level of experience evident in people chosen for the field events.

KO48's composition as an international event meant only the two NZ members were directly responsible to, and chosen by, Antarctic Division, DSIR. BAS and NSF were each involved in the selection and funding of their own representatives. I was very happy with the company and experience of all our team members during the summer.

TEKAPO TRAINING

There is a great deal of value in the Tekapo Training, both because of the opportunity it offers for administrative, logistic, technical and field staff to spend time together pre-season, and for the venue to pass on to "first-timers" the experience of previous events.

I am personally pleased to see that scientific presentations have been de-emphasised over the years, as I have found many of them too over-long, poorly structured and lacking in good audio-visual support. In a word, boring!

PRE-EVENT ORGANISATION

Due to the very high level of experience within KO48 and the assistance of Scott Base staff, pre-event organisation was virtually painless, and accomplished in the time available at Scott Base.

On the downside, my request for a technical manual on the Alpine skidoo was first made at Tekapo and followed up by later contact with Antarctic Division, Christchurch but never produced any result. The lead-time for technical information is perhaps longer than that available to field staff selected just prior to Tekapo.

FIELD EQUIPMENT/STORE

KO48 received a lot of willing assistance and courtesy from Doug, John and Willy at Scott Base. Only the smaller items were required from Ant. Div. as the McMurdo BFC were supplying the eight sledges for the event.

Major comments: we used handheld radios extensively in the field, with US solar cells to recharge batteries. I feel that the greater range, speed and reliability of the new Alpine II skidoo will encourage everyday use of handheld radios. The Yuasa FT23 is one model of handheld that I have used on Himalayan expeditions in Pakistan and Nepal. It is small, light, reliable and (relatively) cheap. It can use battery packs of AAA cells, of AA cells, or a rechargeable NiCad version.

Minor points:

1. The NZ bread is greatly superior to the US supply, but good items from the BFC events include tortillas, hotdogs, American pancake mix and maple syrup.

2. The BFC teflon non-stick fry pan and coffee percolator are very good.

3. A "jaffle-iron" (toasted sandwich utensil) would be worth bringing as a personal item for NZ.

4. The large, thick foam mat is a very comfortable alternative to several (smaller) karrimats.

5. The Met. Service daily weather notebook (Met. 807 3rd ed. 1989) lasts 30 days per copy and is easy to use.

6. I would prefer a tube tent door twice the height of the current model.
7. Some of the NZ cheese and chocolate slipped through the system and arrived in the field past expiry date.
8. Field leaders should be aware that NZ primus-priming "meta tabs" will be treated with deep suspicion if presented openly to the US cargo-packing facility. They refused to allow our supply to fly on the "put-in" aircraft, and we had to adopt alternative strategies.

SURVIVAL TRAINING

In consultation with the Survival School Leader (Charlie Hobbs) and the Operations Manager (Don Hammond) we arranged our own programme for 89/90. I assisted as a temporary instructor for survival school on some courses by request.

FIELD EQUIPMENT

Sledges were provided by the US BFC facility. We put handlebars on three of the eight.

Major recommendation : I have felt for some time that the NZ tank system has its good points (can be detached and used as tent floor) but that it is not long enough. Too much time is spent tying items individually fore and aft of the NZ version. The US tank is full-length with ends as well as sides to the canvas "well". But not detachable. I would like to trial-run a detachable, full-length tank with the complete canvas well.

SNOW-MOBILES

We used three US Bombardier Alpine I skidoos.

SKIDOO ID	OPERATORS	KM READING BEGINNING SEASON	KM TOTAL SEASON
# 1727	McIntosh/Panter	2801	850
# 1794	Gamble/Atkinson	4579	882
# 1791	Smellie/Griffith	3832	873

All our operators were experienced in the use of snow-mobiles, and Bill McIntosh is a particularly skilled mechanic. A wide variety of spares and tools were taken, but very little was used. There were no major breakdowns, and only minor maintenance. Quite a few changes were made to jet size and needle position in the carburettors to maximise power on the days we were gaining or losing a lot of altitude. Travel ranged from 6000' - 13000'+. The #250 jet was standard, with #240 and #230 sizes used as replacement with increases in altitude. Power, speed and spark plug colour were used to evaluate carburettor performance.

I recommend the Bombardier carburettor tool kit (P/N 404 1120 00) and the High Altitude Technical Data booklet (P/N 480 1208 00) be taken for the Alpine S03 model. There is a High Altitude Kit (P/N 881 7253 001) available for the Alpine II, but I do not know if it contains tools, information or both.

Fuel consumption overall was 1/3 less than usual at 8.8 km/gal or 5.4 miles/gal. (The gallon referred to is the US gallon). We used the manufacturer's recommended 1:50 oil/gasoline radio, which turns out to be one 12oz beer can of oil to one jerrycan of fuel. First you have to empty the beer can of beer!!

Fuel was transported in 55 gallon drums, which are heavy and hard to handle. I recommend equivalent volume of 12 gallon drums. We took 18 jerrycans, and filled these from the drums for daily use.

Some form of ear protection is recommended.

LOGISTICS

Logistics into the field are properly the concern of the US Navy and the Scott Base Operations officer and the SENZREP. Navy scheduling is not yet flexible enough for areas such as Marie Byrd Land, which has many short periods of weather suitable for field landings, but an overall pattern of low cloud, flat lighting and snowfall. We are, however, appreciative of the efforts that were made, and particularly thankful to those who managed to reinstate KO48/SO81B at the last minute after 40 days at Scott Base.

FIELD ACTIVITY

With only a short season available, effort was concentrated on the two large volcanic cones (Waesche and Sidley) in the south of the Executive Committee Range, with one very long "day-trip" post Mt Hartigan to Mt Cumming. We travelled immediately (23/24 December) from the "put-in" site SW of Waesche to a campsite on the southern moraine of Waesche itself, at 2000m. After nine days of day-trips from this camp we moved to another camp west of the caldera rim of Mt Sidley, at 2380m. Nineteen days were worked from this Sidley camp, including the Mt Cumming's trip, before returning to the put-in site (19 January) to wait for our aircraft. We left the area late on 24 January. Weather was continuously poor, but only two days were restricted to camp.

While we travelled from camp to camp with sledges linked to the skidoos, it proved ineffective to tow sledges to and from the outcrops each day. The volcanic slopes were too steep for this established technique. Instead we reconnoitred the outcrop routes with either a skidoo and sledge or two skidoos, and flagged the established route. Subsequent trips along the flagged line were then made by one or more machines independently, each machine carrying two personnel.

The likely fate of two persons on one machine if they break through a crevasse roof will be immediately obvious to anyone with relevant field experience. However, we felt that we kept this hazard at an acceptable level by checking and flagging the route, and by sticking to the flagged line. If this technique is anticipated, the level of experience of the party members must be such that the route which is accepted and flagged will be unquestionably safe.

FIELD OPERATION

Briefing - Christchurch

I personally left for Antarctica the morning after arrival in Christchurch from Mt Cook but I felt the Tekapo briefing and subsequent correspondence were sufficient.

Briefing - Scott Base

There were several briefings as time went by. It was unfortunate that we heard of the cancellation of KO48 through American sources before the NZ operations officer and SENZREP were informed of the decision.

Clothing

Clothing has been getting steadily better over the years, a reflection on the experience of Antarctic Division staff. My comments here are really an indication of preferences:

1. Instead of a separate gaiter, build the gaiter into the salopette, like ski trousers.
2. Zips on pockets rather than velcro, and domes on flaps, not velcro.
3. Inner zip pockets for small items on vests, jackets.
4. A shorter neck gaiter, with elastic-taped seams.
5. Loopstitch sox with heels.
6. Contrasting colours on shell garments (not uniform blue) for photography.
7. The needs of field staff and of geology staff sometimes differ, particularly in gloves required.

Field Communications

KO48 (US designation SO81B) used US field radios with no problems. We also used three GE handheld radios, mostly with success. For a remote field event, both types of radio are very useful.

Scott Base/Field Party Relationship

This was very good this season. Due, I believe, to more effective staffing levels and job descriptions at Scott Base which helped reduce stress. Also, to the selection of Scott

Base personnel. All members of KO48 were very experienced in Antarctica, and we hope had no unreasonable expectations. Good relations were maintained with McMurdo BFC over the summer, and with the US snow-mobile mechanic.

Our thanks to all concerned for a safe and enjoyable time on the ice.

Bill Atkinson
MOUNTAIN GUIDE

Appendix 2 : Daily Weather and Field Activities

Station M BYRD
Observer
Date 89 (YR) 12 (MON) 23 (DAY)
Time (24 hr) 07 (HRS) 00 (MIN)

wind direction		wind speed		cloud above station¹		weather (highest applicable number)		Intensity	
0	Calm	0	Calm	0	Nil	[✓ 0]	Nil	[✓ 0]	N/A
1	[✓ NE]	1	[✓ Light]	[✓ 1]	Scattered	1	Fog	1	Light
2	E	2	Mod	1	Broken	2	Freezing fog	2	Mod
3	SE	3	Strong	3	Overcast	3	Rain	3	Heavy
4	S	4	Gale	4	Dull	4	Freezing rain	I* cm/hr	
5	SW	5	Storm	5	Obscured	5	Blowing snow		
6	W	6	Gusty			6	Snow	Remarks:	
7	NW	¹ Note cloud below station in remarks				7	Hail		
8	N	² Note precip. type in remarks				8	Sleet		
9	Variable					9	Thunderstorm²		

+/- temperature
dry °C
wet °C
max. °C
min. °C
Reset max. and min. in morning only

weight new snow gm
water mm
density kg/m³

windrun km
present
previous morning
MORNING ONLY
run (24 hr)

+/-
Thermograph °C ☐ trend
Hygrograph %

snow cm
total
new NIL
snow cm
interval
storm

foot penetration 5 cm
surface =

Rain gauge (enter directly)
MORNING ONLY
or Precip. gauge mm
now
before (morning)
precip. (24 hr) mm

high level wind dir speed Beaufort
Barograph hPa trend

REMARKS:
Put-in by C130 aircraft 28 km SW of Waesche. Travelled to campsite S of Waesche during night. Cloud (stratus) around horizon.

Station M BYRD
Observer
Date 89 (YR) 12 (MON) 24 (DAY)
Time (24 hr) 14 (HRS) 00 (MIN)

wind direction		wind speed		cloud above station¹		weather (highest applicable number)		Intensity	
0	Calm	0	Calm	0	Nil	[✓ 0]	Nil	[✓ 0]	N/A
[✓ 1]	NE	[✓ 1]	Light	[✓ 1]	Scattered	1	Fog	1	Light
2	E	2	Mod	1	Broken	2	Freezing fog	2	Mod
3	SE	3	Strong	3	Overcast	3	Rain	3	Heavy
4	S	4	Gale	4	Dull	4	Freezing rain	I* cm/hr	
5	SW	5	Storm	5	Obscured	5	Blowing snow		
6	W	6	Gusty			6	Snow	Remarks:	
7	NW	¹ Note cloud below station in remarks				7	Hail		
8	N	² Note precip. type in remarks				8	Sleet		
9	Variable					9	Thunderstorm²		

+/- temperature
dry °C
wet °C
max. °C
min. °C
Reset max. and min. in morning only

weight new snow gm
water mm
density kg/m³

windrun km
present
previous morning
MORNING ONLY
run (24 hr)

+/-
Thermograph °C ☐ trend
Hygrograph %

snow cm
total
new NIL
snow cm
interval
storm

foot penetration 5 cm
surface =

Rain gauge (enter directly)
MORNING ONLY
or Precip. gauge mm
now
before (morning)
precip. (24 hr) mm

high level wind dir speed Beaufort
Barograph hPa trend

REMARKS:
Return trip from Waesche campsite to put-in site 4½ hours. Low stratus around horizon. Diffuse lighting. Surface snow, soft sastrugi, blue ice.

Station M. BYRD
Observer
Date 89 12 25 (YR MON DAY)
Time (24 hr) 14 00 (HRS MIN)

wind direction	wind speed	cloud above station[1]	weather (highest applicable number)	intensity
0 Calm	0 Calm	0 Nil	[✓ 0 Nil]	[✓ 0 N/A]
1 NE	1 Light	[✓ 1 Scattered]	1 Fog	1 Light
2 E	[✓ 2 Mod]	1 Broken	2 Freezing fog	2 Mod
[✓ 3 SE]	3 Strong	3 Overcast	3 Rain	3 Heavy
4 S	4 Gale	4 Dull	4 Freezing rain	I* cm/hr
5 SW	5 Storm	5 Obscured	5 Blowing snow	
6 W	6 Gusty		6 Snow	Remarks:
7 NW			7 Hail	
8 N			8 Sleet	
9 Variable			9 Thunderstorm[2]	

[1] Note cloud below station in remarks

[2] Note precip. type in remarks

+/− temperature
dry °C
wet °C
max. °C
min. °C
Reset max. and min. in morning only

+/−
Thermograph °C ☐ trend
Hygrograph %

snow cm
total
new NIL
interval
storm
snow cm

Rain gauge (enter directly)
MORNING ONLY
or Precip. gauge mm
now
before (morning)
precip. (24 hr) mm

weight new snow gm
water mm
density kg/m³

windrun km
present
previous morning
MORNING ONLY
run (24 hr)

foot penetration 5 cm
surface –

high level wind dir speed Beaufort

Barograph hPa trend ☐

REMARKS:

Calm periods, wind shift NE/SE/NE,
Waesche + Sidley clear.

Station M. BYRD
Observer
Date 89 12 26 (YR MON DAY)
Time (24 hr) 07 00 (HRS MIN)

wind direction	wind speed	cloud above station[1]	weather (highest applicable number)	intensity
0 Calm	0 Calm	[✓ 0 Nil]	[✓ 0 Nil]	[✓ 0 N/A]
[✓ 1 NE]	[✓ 1 Light]	1 Scattered	1 Fog	1 Light
2 E	2 Mod	1 Broken	2 Freezing fog	2 Mod
3 SE	3 Strong	3 Overcast	3 Rain	3 Heavy
4 S	4 Gale	4 Dull	4 Freezing rain	I* cm/hr
5 SW	5 Storm	5 Obscured	5 Blowing snow	
6 W	6 Gusty		6 Snow	Remarks:
7 NW			7 Hail	
8 N			8 Sleet	
9 Variable			9 Thunderstorm[2]	

[1] Note cloud below station in remarks

[2] Note precip. type in remarks

+/− temperature
dry °C
wet °C
max. °C
min. °C
Reset max. and min. in morning only

+/−
Thermograph °C ☐ trend
Hygrograph %

snow cm
total
new NIL
interval
storm
snow cm

Rain gauge (enter directly)
MORNING ONLY
or Precip. gauge mm
now
before (morning)
precip. (24 hr) mm

weight new snow gm
water mm
density kg/m³

windrun km
present
previous morning
MORNING ONLY
run (24 hr)

foot penetration 5 cm
surface =

high level wind dir speed Beaufort

Barograph hPa trend ☐

REMARKS:

Travelled 1500 m to summit Waesche 3292 m
(altimeter reading 3800 m) / 10,797' by skidoo
excepting last 20 m of wind ice towers. Waesche + Sidley
clear, other peaks above low stratus.

Station M BYRD Observer

Date 89 12 27 (YR MON DAY) Time (24 hr) 07 09 (HRS MIN)

wind direction	wind speed	cloud above station¹	weather (highest applicable number)	intensity
0 Calm	0 Calm	0 Nil	[✓ 0] Nil	[✓ 0] N/A
1 NE	1 Light	1 Scattered	1 Fog	1 Light
[✓ 2] E	[✓ 2] Mod	[✓ 1] Broken	2 Freezing fog	2 Mod
3 SE	3 Strong	3 Overcast	3 Rain	3 Heavy
4 S	4 Gale	4 Dull	4 Freezing rain	I* cm/hr
5 SW	5 Storm	5 Obscured	5 Blowing snow	
6 W	6 Gusty		6 Snow	Remarks:
7 NW	¹ Note cloud below station in remarks		7 Hail	
8 N	² Note precip. type in remarks		8 Sleet	
9 Variable			9 Thunderstorm²	

+/- temperature

dry . °C

wet . °C

max. . °C

min. . °C

Reset max. and min. in morning only

weight new snow . gm

water mm

density kg/m³

windrun km

present

previous morning

MORNING ONLY

run (24 hr)

+/-

Thermograph °C ☐ trend

Hygrograph %

snow cm

total

new NIL

snow cm

interval

storm

foot penetration 5 cm

surface =

Rain gauge (enter directly)

MORNING ONLY ↓

precip. (24 hr) . mm

or Precip. gauge mm

now

before (morning)

high level wind dir speed Beaufort

Barograph 978 hPa trend ↗

REMARKS:

Variable stratus to SW, hogsbacks forming over Waesche + Sidley. Poor ground definition on horizon.

* Corrected to sea - level

Station M BYRD Observer

Date 89 12 28 (YR MON DAY) Time (24 hr) 08 00 (HRS MIN)

wind direction	wind speed	cloud above station¹	weather (highest applicable number)	intensity
0 Calm	0 Calm	0 Nil	[✓ 0] Nil	[✓ 0] N/A
[✓ 1] NE	[✓ 1] Light	1 Scattered	1 Fog	1 Light
2 E	2 Mod	[✓ 1] Broken	2 Freezing fog	2 Mod
3 SE	3 Strong	3 Overcast	3 Rain	3 Heavy
4 S	4 Gale	4 Dull	4 Freezing rain	I* cm/hr
5 SW	5 Storm	5 Obscured	5 Blowing snow	
6 W	6 Gusty		6 Snow	Remarks:
7 NW	¹ Note cloud below station in remarks		7 Hail	
8 N	² Note precip. type in remarks		8 Sleet	
9 Variable			9 Thunderstorm²	

+/- temperature

dry + 0.2 °C

wet . °C

max. . °C

min. . °C

Reset max. and min. in morning only

weight new snow . gm

water mm

density kg/m³

windrun km

present

previous morning

MORNING ONLY

run (24 hr)

+/-

Thermograph °C ☐ trend

Hygrograph %

snow cm

total

new NIL

snow cm

interval

storm

foot penetration 5 cm

surface —

Rain gauge (enter directly)

MORNING ONLY ↓

precip. (24 hr) . mm

or Precip. gauge mm

now

before (morning)

high level wind dir speed Beaufort

* Barograph 983 hPa trend ↗

REMARKS:

Stratus. Waesche + Sidley high level obscured. Dull lighting.

* Corrected to sea - level

Station M. BYRD
Date 89 12 29 (YR MON DAY)
Observer
Time (24 hr) 07 00 (HRS MIN)

wind direction	wind speed	cloud above station[1]	weather (highest applicable number)	intensity
0 Calm	0 Calm	0 Nil	[✓ 0] Nil	0 N/A
1 NE	1 Light	1 Scattered	1 Fog	1 Light
2 E	[✓ 2] Mod	1 Broken	2 Freezing fog	2 Mod
3 SE	3 Strong	[✓ 3] Overcast	3 Rain	3 Heavy
4 S	4 Gale	4 Dull	4 Freezing rain	I* cm/hr
5 SW	5 Storm	5 Obscured	5 Blowing snow	
6 W	6 Gusty		6 Snow	Remarks:
[✓ 7] NW	[1] Note cloud below station in remarks		7 Hail	Drifting snow
8 N	[2] Note precip. type in remarks		8 Sleet	
9 Variable			9 Thunderstorm[2]	

+/− temperature
dry − 0.6 °C
wet °C
max. °C
min. °C
Reset max. and min. in morning only

+/−
Thermograph °C ☐ trend
Hygrograph %

snow cm: total ; new NIL
snow cm: interval ; storm

Rain gauge (enter directly) MORNING ONLY ↓
or Precip. gauge mm: now ; before (morning)
precip. (24 hr) mm

weight new snow gm
water mm
density kg/m³

windrun km: present ; previous morning (MORNING ONLY)
run (24 hr)

foot penetration 5 cm
surface =

high level wind: dir ; speed ; Beaufort

Barograph 981 hPa trend ↘

REMARKS:
Storm began evening 29th from NW. Slow pressure rise during storm, pressure peaked 8 hours after storm arrival, at 987. 12 hrs after start of storm wind moderating to W from NW. Camp day.

Station M. BYRD
Date 89 12 30 (YR MON DAY)
Observer
Time (24 hr) 07 00 (HRS MIN)

wind direction	wind speed	cloud above station[1]	weather (highest applicable number)	intensity
0 Calm	0 Calm	0 Nil	0 Nil	0 N/A
1 NE	[✓ 1] Light	1 Scattered	1 Fog	[✓ 1] Light
2 E	2 Mod	[✓ 1] Broken	2 Freezing fog	2 Mod
3 SE	3 Strong	3 Overcast	3 Rain	3 Heavy
[✓ 4] S	4 Gale	4 Dull	4 Freezing rain	I* cm/hr
5 SW	5 Storm	5 Obscured	5 Blowing snow	
6 W	6 Gusty		[✓ 6] Snow	Remarks:
7 NW	[1] Note cloud below station in remarks		7 Hail	very light snow
8 N	[2] Note precip. type in remarks		8 Sleet	
9 Variable			9 Thunderstorm[2]	

+/− temperature
dry − 0.9 °C
wet °C
max. °C
min. °C
Reset max. and min. in morning only

+/−
Thermograph °C ☐ trend
Hygrograph %

snow cm: total ; new NIL
snow cm: interval ; storm

Rain gauge (enter directly) MORNING ONLY ↓
or Precip. gauge mm: now ; before (morning)
precip. (24 hr) mm

weight new snow gm
water mm
density kg/m³

windrun km: present ; previous morning (MORNING ONLY)
run (24 hr)

foot penetration 8 cm
surface ϕ_D

high level wind: dir ; speed ; Beaufort

Barograph 985 hPa trend ↗

REMARKS:
Calm period before wind shift to south: Small intermittent snowflakes. Poor surface definition under stratus.

Station M BYRD Observer

Date 89 12 31 (YR MON DAY) Time (24 hr) 08 00 (HRS MIN)

wind direction		wind speed		cloud above station[1]		weather (highest applicable number)		Intensity	
0	Calm	0	Calm	0	Nil	[✓ 0]	Nil	[✓ 0]	N/A
1	NE	[✓ 1]	Light	[✓ 1]	Scattered	1	Fog	1	Light
[✓ 2]	E	2	Mod	1	Broken	2	Freezing fog	2	Mod
3	SE	3	Strong	3	Overcast	3	Rain	3	Heavy
4	S	4	Gale	4	Dull	4	Freezing rain		I* cm/hr
5	SW	5	Storm	5	Obscured	5	Blowing snow		
6	W	6	Gusty			6	Snow		Remarks:
7	NW					7	Hail		windblown
8	N					8	Sleet		snow
9	Variable					9	Thunderstorm[2]		

[1] Note cloud below station in remarks

[2] Note precip. type in remarks

+/- temperature
dry - 1.0 °C
wet °C
max. °C
min. °C
Reset max. and min. in morning only

+/-
Thermograph °C trend
Hygrograph %

snow cm
total
new NIL
snow cm
interval
storm

Rain gauge (enter directly) or Precip. gauge mm
MORNING ONLY
now
before (morning)
precip. (24 hr) mm

weight new snow gm
water mm
density kg/m³

windrun km
present
previous morning
MORNING ONLY
run (24 hr)

foot penetration 5 cm
surface ØP

high level wind dir speed Beaufort

Barograph 985 hPa trend →

REMARKS:

thin stratus layer, peaks clear. Traveled to

Sidley campsite. Recce to caldera rim

Station M BYRD Observer

Date 90 01 01 (YR MON DAY) Time (24 hr) 09 00 (HRS MIN)

wind direction		wind speed		cloud above station[1]		weather (highest applicable number)		Intensity	
0	Calm	0	Calm	0	Nil	[✓ 0]	Nil	[✓ 0]	N/A
1	NE	[✓ 1]	Light	[✓ 1]	Scattered	1	Fog	1	Light
2	E	2	Mod	1	Broken	2	Freezing fog	2	Mod
3	SE	3	Strong	3	Overcast	3	Rain	3	Heavy
4	S	4	Gale	4	Dull	4	Freezing rain		I* cm/hr
5	SW	5	Storm	5	Obscured	5	Blowing snow		
6	W	6	Gusty			6	Snow		Remarks:
7	NW					7	Hail		windblown
[✓ 8]	N					8	Sleet		snow
9	Variable					9	Thunderstorm[2]		

[1] Note cloud below station in remarks

[2] Note precip. type in remarks

+/- temperature
dry - 0.1 °C
wet °C
max. °C
min. °C
Reset max. and min. in morning only

+/-
Thermograph °C trend
Hygrograph %

snow cm
total
new NIL
snow cm
interval
storm

Rain gauge (enter directly) or Precip. gauge mm
MORNING ONLY
now
before (morning)
precip. (24 hr) mm

weight new snow gm
water mm
density kg/m³

windrun km
present
previous morning
MORNING ONLY
run (24 hr)

foot penetration 5 cm
surface ØD

high level wind dir speed Beaufort

Barograph 940 hPa trend →

REMARKS:

Sidley Rim station 380m higher than Waesche

station. Storm cloud build-up from NW late night

of 31/12/89 Moderate wind during day.

Lenticular cloud to NW. Recce 2 routes to rim.

Climb Doumani Pk 2675m (983 hPa

11

Station M BYRD
Observer
Date 90 01 02 (YR MON DAY)
Time (24 hr) 08 00 (HRS MIN)

wind direction	wind speed	cloud above station[1]	weather (highest applicable number)	Intensity
0 Calm	0 Calm	0 Nil	0 Nil	0 N/A
1 NE	1 Light	1 Scattered	1 Fog	[✓ 1] Light
2 E	[✓ 2] Mod	[✓ 2] Broken	2 Freezing fog	2 Mod
3 SE	3 Strong	3 Overcast	3 Rain	3 Heavy
4 S	4 Gale	4 Dull	4 Freezing rain	I* cm/hr
5 SW	5 Storm	5 Obscured	[✓ 5] Blowing snow	
6 W	6 Gusty		6 Snow	Remarks:
[✓ 7] NW	[1] Note cloud below station in remarks		7 Hail	
8 N	[2] Note precip. type in remarks		8 Sleet	
9 Variable			9 Thunderstorm[2]	

+/- temperature
dry - 05. °C
wet . °C
max. . °C
min. . °C
Reset max. and min. in morning only

weight new snow . gm
water mm
density kg/m³

windrun km
present
previous morning
MORNING ONLY
run (24 hr)

+/-
Thermograph °C ☐ trend
Hygrograph %

snow cm
total
new

snow cm
interval
storm

foot penetration 10 cm
surface 0 D

Rain gauge (enter directly)
MORNING ONLY ↓
or Precip. gauge mm
now
before (morning)
precip. (24 hr) . mm

high level wind dir speed Beaufort

Barograph 735 hPa
trend →

REMARKS:

Low stratus to N + W. Higher cloud to S + E.

Station M BYRD
Observer
Date 90 01 03 (YR MON DAY)
Time (24 hr) 07 45 (HRS MIN)

wind direction	wind speed	cloud above station[1]	weather (highest applicable number)	Intensity
0 Calm	0 Calm	0 Nil	[✓ 0] Nil	[✓ 0] N/A
1 NE	[✓ 1] Light	1 Scattered	1 Fog	[✓ 1] Light
2 E	2 Mod	[✓ 2] Broken	2 Freezing fog	2 Mod
3 SE	3 Strong	3 Overcast	3 Rain	3 Heavy
[✓ 4] S	4 Gale	4 Dull	4 Freezing rain	I* cm/hr
5 SW	5 Storm	5 Obscured	5 Blowing snow	
6 W	6 Gusty		[✓ 6] Snow	Remarks:
7 NW	[1] Note cloud below station in remarks		7 Hail	
8 N	[2] Note precip. type in remarks		8 Sleet	
9 Variable			9 Thunderstorm[2]	

+/- temperature
dry + .2 °C
wet . °C
max. . °C
min. . °C
Reset max. and min. in morning only

weight new snow . gm
water mm
density kg/m³

windrun km
present
previous morning
MORNING ONLY
run (24 hr)

+/-
Thermograph °C ☐ trend
Hygrograph %

snow cm
total
new

snow cm
interval
storm

foot penetration 18 cm
surface 0 D

Rain gauge (enter directly)
MORNING ONLY ↓
or Precip. gauge mm
now
before (morning)
precip. (24 hr) . mm

high level wind dir speed Beaufort

Barograph 737 hPa
trend ↗

REMARKS:

Overnight wind gusts easing. Poor horizon definition. Snowing from south all day, about 6 cm of stellar crystals, at campsite 2380 m and at worksite on east caldera wall 3250 m.

13

Station M BYRD
Observer
Date 90 01 04 (YR MON DAY)
Time (24 hr) 07 15 (HRS MIN)

wind direction	wind speed	cloud above station[1]	weather (highest applicable number)	Intensity
0 Calm	0 Calm	0 Nil	0 Nil	0 N/A
1 NE	[✓ 1] Light	1 Scattered	1 Fog	[✓ 1] Light
2 E	2 Mod	[✓ 1] Broken	2 Freezing fog	2 Mod
3 SE	3 Strong	3 Overcast	3 Rain	3 Heavy
4 S	4 Gale	4 Dull	4 Freezing rain	I* cm/hr
5 SW	5 Storm	5 Obscured	[✓ 5] Blowing snow	
6 W	6 Gusty		6 Snow	Remarks:
7 NW	[1] Note cloud below station in remarks		7 Hail	
[✓ 8] N	[2] Note precip. type in remarks		8 Sleet	
9 Variable			9 Thunderstorm[2]	

+/− temperature
dry − 0.5 °C
wet °C
max. °C
min. °C
Reset max. and min. in morning only

weight new snow gm
water mm
density kg/m³

windrun km
present
previous morning
MORNING ONLY
run (24 hr)

+/−
Thermograph °C trend
Hygrograph %

snow cm: total, new
snow cm: interval, storm

foot penetration 1.0 cm
surface Ø D

Rain gauge (enter directly) MORNING ONLY ↓
or Precip. gauge mm: now, before (morning)
precip. (24 hr) mm ←

high level wind: dir, speed, Beaufort

Barograph 732 hPa
trend ↘

REMARKS:
High stratus. Dull light. Vision to horizon all points.

14

Station M BYRD
Observer
Date 90 01 05 (YR MON DAY)
Time (24 hr) 07 45 (HRS MIN)

wind direction	wind speed	cloud above station[1]	weather (highest applicable number)	Intensity
[✓ 0] Calm	[✓ 0] Calm	0 Nil	[✓ 0] Nil	[✓ 0] N/A
1 NE	1 Light	1 Scattered	1 Fog	[✓ 1] Light
2 E	2 Mod	1 Broken	2 Freezing fog	2 Mod
3 SE	3 Strong	[✓ 3] Overcast	3 Rain	3 Heavy
4 S	4 Gale	4 Dull	4 Freezing rain	I* cm/hr
5 SW	5 Storm	5 Obscured	5 Blowing snow	
6 W	6 Gusty		[✓ 6] Snow	Remarks:
7 NW	[1] Note cloud below station in remarks		7 Hail	Riming from
8 N	[2] Note precip. type in remarks		8 Sleet	south.
9 Variable			9 Thunderstorm[2]	

+/− temperature
dry − 0.8 °C
wet °C
max. °C
min. °C
Reset max. and min. in morning only

weight new snow gm
water mm
density kg/m³

windrun km
present
previous morning
MORNING ONLY
run (24 hr)

+/−
Thermograph °C trend
Hygrograph %

snow cm: total, new
snow cm: interval, storm

foot penetration 1.0 cm
surface Ø D

Rain gauge (enter directly) MORNING ONLY ↓
or Precip. gauge mm: now, before (morning)
precip. (24 hr) mm ←

high level wind: dir, speed, Beaufort

Barograph 735 hPa
trend ↗

REMARKS:
Light snow from south all day. Cloud ceiling 500m above camp. Flat lighting. 0-5 kt southerly. 1700 wind switch to 5-10 kt SW. Pressure up 3 hPa in 8 hours.

15

SIDLEY RIM 2380m

Station M. BYRD
Observer
Date 90 01 06 (YR MON DAY)
Time (24 hr) 07 45 (HRS MIN)

wind direction		wind speed		cloud above station¹		weather (highest applicable number)		intensity	
0	Calm	0	Calm	0	Nil	0	Nil	0	N/A
1	NE	[✓ 1]	Light	1	Scattered	1	Fog	[✓ 1]	Light
2	E	2	Mod	1	Broken	[✓ 2]	Freezing fog	2	Mod
3	SE	3	Strong	[✓ 3]	Overcast	3	Rain	3	Heavy
4	S	4	Gale	4	Dull	4	Freezing rain	I* cm/hr	
[✓ 5]	SW	5	Storm	.5	Obscured	5	Blowing snow		
6	W	6	Gusty			6	Snow	Remarks:	
7	NW	¹ Note cloud below station in remarks				7	Hail	Rime from SW	
8	N	² Note precip. type in remarks				8	Sleet		
9	Variable					9	Thunderstorm²		

+/− temperature
- dry − 1.2 °C
- wet °C
- max. °C
- min. °C

Reset max. and min. in morning only

+/−
Thermograph °C ☐ trend
Hygrograph %

weight new snow gm
water mm
density kg/m³

windrun km
present
previous morning
MORNING ONLY
run (24 hr)

snow cm
- total
- new

snow cm
- interval
- storm

foot penetration 1.0 cm
surface 0D

Rain gauge (enter directly)
MORNING ONLY ↓
precip. (24 hr) mm
or Precip. gauge mm
now
before (morning)

high level wind dir speed Beaufort

Barograph 740 hPa trend ↗

REMARKS:
Weather cleared from 10kt SW after lunch. Then
nil wind clear skies late afternoon

16

SIDLEY RIM 2380m

Station M. BYRD
Observer
Date 90 01 07 (YR MON DAY)
Time (24 hr) 07 45 (HRS MIN)

wind direction		wind speed		cloud above station¹		weather (highest applicable number)		intensity	
0	Calm	0	Calm	0	Nil	[✓ 0]	Nil	[✓ 0]	N/A
1	NE	[✓ 1]	Light	[✓ 1]	Scattered	1	Fog	1	Light
[✓ 2]	E	2	Mod	1	Broken	2	Freezing fog	2	Mod
3	SE	3	Strong	3	Overcast	3	Rain	3	Heavy
4	S	4	Gale	4	Dull	4	Freezing rain	I* cm/hr	
5	SW	5	Storm	5	Obscured	5	Blowing snow		
6	W	6	Gusty			6	Snow	Remarks:	
7	NW	¹ Note cloud below station in remarks				7	Hail		
8	N	² Note precip. type in remarks				8	Sleet		
9	Variable					9	Thunderstorm²		

+/− temperature
- dry − 0.4 °C
- wet °C
- max. °C
- min. °C

Reset max. and min. in morning only

+/−
Thermograph °C ☐ trend
Hygrograph %

weight new snow gm
water mm
density kg/m³

windrun km
present
previous morning
MORNING ONLY
run (24 hr)

snow cm
- total
- new

snow cm
- interval
- storm

foot penetration 1.0 cm
surface 0D

Rain gauge (enter directly)
MORNING ONLY ↓
precip. (24 hr) mm
or Precip. gauge mm
now
before (morning)

high level wind dir speed Beaufort

Barograph 740 hPa trend →

REMARKS:
Morning virtually clear skies. In 12 hours build
up of northerly cloud (lenticular on Waesche first)
and 6 hPa pressure drop.

Station M BYRD
Date 90 01 08 (YR MON DAY)
Observer
Time (24 hr) 08 00 (HRS MIN)

wind direction		wind speed		cloud above station¹		weather (highest applicable number)		Intensity	
0	Calm	0	Calm	0	Nil	[✓ 0]	Nil	[✓ 0]	N/A
1	NE	[✓ 1]	Light	[✓ 1]	Scattered	1	Fog	1	Light
[✓ 2]	E	2	Mod	1	Broken	2	Freezing fog	2	Mod
3	SE	3	Strong	3	Overcast	3	Rain	3	Heavy
4	S	4	Gale	4	Dull	4	Freezing rain	I*	cm/hr
5	SW	5	Storm	5	Obscured	5	Blowing snow		
6	W	6	Gusty			6	Snow	Remarks:	
7	NW	¹ Note cloud below station in remarks				7	Hail		
8	N	² Note precip. type in remarks				8	Sleet		
9	Variable					9	Thunderstorm²		

	+/−	temperature	
dry	−	0.5	°C
wet			°C
max.			°C
min.			°C

Reset max. and min. in morning only

Thermograph +/− °C ☐ trend
Hygrograph %

weight new snow gm
water mm
density kg/m³

windrun km
present
previous morning
MORNING ONLY
run (24 hr)

snow cm
total
new
interval
storm
snow cm

foot penetration 10 cm
surface 0 P

Rain gauge (enter directly) MORNING ONLY
or Precip. gauge mm
now
before (morning)
precip. (24 hr) mm

high level wind dir speed Beaufort

Barograph 732 hPa trend ↘

REMARKS:
Possibly local easterly, (going to southerly conditions)
PM strong easterly wind + cloud into caldera +
Parks Glacier.

Station M BYRD
Date 90 01 09 (YR MON DAY)
Observer
Time (24 hr) 07 30 (HRS MIN)

wind direction		wind speed		cloud above station¹		weather (highest applicable number)		Intensity	
0	Calm	0	Calm	0	Nil	[✓ 0]	Nil	[✓ 0]	N/A
1	NE	[✓ 1]	Light	1	Scattered	1	Fog	[✓ 1]	Light
2	E	2	Mod	1	Broken	2	Freezing fog	2	Mod
3	SE	3	Strong	[✓ 3]	Overcast	3	Rain	3	Heavy
[✓ 4]	S	4	Gale	4	Dull	4	Freezing rain	I*	cm/hr
5	SW	5	Storm	5	Obscured	5	Blowing snow		
6	W	6	Gusty			[✓ 6]	Snow	Remarks:	
7	NW	¹ Note cloud below station in remarks				7	Hail		
8	N	² Note precip. type in remarks				8	Sleet		
9	Variable					9	Thunderstorm²		

	+/−	temperature	
dry	−	0.4	°C
wet			°C
max.			°C
min.			°C

Reset max. and min. in morning only

Thermograph +/− °C ☐ trend
Hygrograph %

weight new snow gm
water mm
density kg/m³

windrun km
present
previous morning
MORNING ONLY
run (24 hr)

snow cm
total
new
interval
storm
snow cm

foot penetration 10 cm
surface 0 △

Rain gauge (enter directly) MORNING ONLY
or Precip. gauge mm
now
before (morning)
precip. (24 hr) mm

high level wind dir speed Beaufort

Barograph 736 hPa trend ↗

REMARKS:
Cloud base above caldera west rim. Afternoon
low cloud, southerly light snow, intermittent
poor visibility

Station M, BYRD
Observer
Date 90 01 10 (YR MON DAY)
Time (24 hr) 0830 (HRS MIN)

wind direction	wind speed	cloud above station¹	weather (highest applicable number)	intensity
0 Calm	0 Calm	0 Nil	[✓ 0 Nil]	[✓ 0 N/A]
1 NE	[✓ 1 Light]	1 Scattered	1 Fog	[✓ 1 Light]
2 E	2 Mod	1 Broken	2 Freezing fog	2 Mod
3 SE	3 Strong	[✓ 3 Overcast]	3 Rain	3 Heavy
[✓ 4 S]	4 Gale	4 Dull	4 Freezing rain	I° cm/hr
5 SW	5 Storm	5 Obscured	5 Blowing snow	
6 W	6 Gusty		[✓ 6 Snow]	Remarks:
7 NW	¹ Note cloud below station in remarks		7 Hail	
8 N	² Note precip. type in remarks		8 Sleet	
9 Variable			9 Thunderstorm²	

+/− temperature
dry − 0.4 °C
wet °C
max. °C
min. °C
Reset max. and min. in morning only

+/−
Thermograph °C trend
Hygrograph %

snow cm total / new
snow cm interval / storm

Rain gauge (enter directly) or Precip. gauge mm now / before (morning)
MORNING ONLY
precip. (24 hr) mm

weight new snow gm
water mm
density kg/m³

windrun km present / previous morning (MORNING ONLY)
run (24 hr)

foot penetration 10 cm
surface ø/p

high level wind dir speed Beaufort

Barograph 740 hPa trend ↗

REMARKS:

Poor visibility ; light snow , flat lighting. Classic stellar crystals.

Station M, BYRD
Observer
Date 90 01 11 (YR MON DAY)
Time (24 hr) 0745 (HRS MIN)

wind direction	wind speed	cloud above station¹	weather (highest applicable number)	intensity
0 Calm	0 Calm	0 Nil	[✓ 0 Nil]	[✓ 0 N/A]
[✓ 1 NE]	[✓ 1 Light]	[✓ 1 Scattered]	1 Fog	1 Light
2 E	2 Mod	1 Broken	2 Freezing fog	2 Mod
3 SE	3 Strong	3 Overcast	3 Rain	3 Heavy
4 S	4 Gale	4 Dull	4 Freezing rain	I° cm/hr
5 SW	5 Storm	5 Obscured	5 Blowing snow	
6 W	6 Gusty		6 Snow	Remarks:
7 NW	¹ Note cloud below station in remarks		7 Hail	
8 N	² Note precip. type in remarks		8 Sleet	
9 Variable			9 Thunderstorm²	

+/− temperature
dry − 0.5 °C
wet °C
max. °C
min. °C
Reset max. and min. in morning only

+/−
Thermograph °C trend
Hygrograph %

snow cm total / new
snow cm interval / storm

Rain gauge (enter directly) or Precip. gauge mm now / before (morning)
MORNING ONLY
precip. (24 hr) mm

weight new snow gm
water mm
density kg/m³

windrun km present / previous morning (MORNING ONLY)
run (24 hr)

foot penetration cm
surface

high level wind dir speed Beaufort

Barograph 736 hPa trend ↘

REMARKS:

Fine, sunny, clear over Sidley. Afternoon N/NW 15 kts very poor visibility summit of Sidley (4181 m) S * snow at caldera rim. S* cloud at campsite. Pressure up 1 hPa in 11 hrs 0800 - 1900. N late evening

Station M BYRD
Observer
Date 90 01 12 (YR MON DAY)
Time (24 hr) 07 45 (HRS MIN)

wind direction	wind speed	cloud above station¹	weather (highest applicable number)	intensity
0 Calm	0 Calm	0 Nil	0 Nil	0 N/A
1 NE	[✓ 1 Light]	1 Scattered	1 Fog	[✓ 1 Light]
2 E	2 Mod	1 Broken	2 Freezing fog	2 Mod
3 SE	3 Strong	[✓ 3 Overcast]	3 Rain	3 Heavy
[✓ 4 S]	4 Gale	4 Dull	4 Freezing rain	I* cm/hr
5 SW	5 Storm	5 Obscured	5 Blowing snow	
6 W	6 Gusty		[✓ 6 Snow]	Remarks:
7 NW			7 Hail	
8 N			8 Sleet	
9 Variable			9 Thunderstorm²	

[1] Note cloud below station in remarks
[2] Note precip. type in remarks

+/− temperature
dry − 0.8 °C
wet °C
max. °C
min. °C
Reset max. and min. in morning only

weight new snow gm
water mm
density kg/m³

windrun km
present
previous morning (MORNING ONLY)
run (24 hr)

+/−
Thermograph °C ☐ trend
Hygrograph %

snow cm: total, new
snow cm: interval, storm

foot penetration 12 cm
surface Ø D

Rain gauge (enter directly) or Precip. gauge mm: now, before (morning)
MORNING ONLY
precip. (24 hr) mm

high level wind: dir, speed, Beaufort

Barograph 742 hPa
trend ↗

REMARKS:
Visibility < 100 m. till midday, then scattered cloud, good visibility, calm or light northerly winds. Lenticulars over Waesche.

Station M BYRD
Observer
Date 90 01 13 (YR MON DAY)
Time (24 hr) 07 45 (HRS MIN)

wind direction	wind speed	cloud above station¹	weather (highest applicable number)	intensity
0 Calm	0 Calm	0 Nil	0 Nil	0 N/A
1 NE	1 Light	1 Scattered	1 Fog	[✓ 1 Light]
2 E	[✓ 2 Mod]	[✓ 1 Broken]	2 Freezing fog	2 Mod
3 SE	3 Strong	3 Overcast	3 Rain	3 Heavy
4 S	4 Gale	4 Dull	4 Freezing rain	I* cm/hr
5 SW	5 Storm	5 Obscured	[✓ 5 Blowing snow]	
6 W	6 Gusty		6 Snow	Remarks:
7 NW			7 Hail	
[✓ 8 N]			8 Sleet	
9 Variable			9 Thunderstorm²	

[1] Note cloud below station in remarks
[2] Note precip. type in remarks

+/− temperature
dry − 0.5 °C
wet °C
max. °C
min. °C
Reset max. and min. in morning only

weight new snow gm
water mm
density kg/m³

windrun km
present
previous morning (MORNING ONLY)
run (24 hr)

+/−
Thermograph °C ☐ trend
Hygrograph %

snow cm: total, new
snow cm: interval, storm

foot penetration 12 cm
surface Ø D

Rain gauge (enter directly) or Precip. gauge mm: now, before (morning)
MORNING ONLY
precip. (24 hr) mm

high level wind: dir, speed, Beaufort

Barograph 746 hPa
trend ↗

REMARKS:
Large lenticular formations from north. Winds 15 - 20 kt northerly. Good visibility to south horizon. Low southerly cloud, 5 kts, poor definition afternoon.

Station m BYRD
Observer
Date 90 01 14 (YR MON DAY)
Time (24 hr) 07 45 (HRS MIN)

wind direction		wind speed		cloud above station[1]		weather (highest applicable number)		intensity	
0	Calm	0	Calm	0	Nil	[✓ 0]	Nil	[✓ 0]	N/A
1	NE	[✓ 1]	Light	1	Scattered	1	Fog	1	Light
2	E	2	Mod	1	Broken	2	Freezing fog	2	Mod
3	SE	3	Strong	[✓ 3]	Overcast	3	Rain	3	Heavy
4	S	4	Gale	4	Dull	4	Freezing rain	I* cm/hr	
5	SW	5	Storm	5	Obscured	5	Blowing snow		
6	W	6	Gusty			6	Snow	Remarks:	
7	NW					7	Hail		
[✓ 8]	N					8	Sleet		
9	Variable					9	Thunderstorm[2]		

[1] Note cloud below station in remarks

[2] Note precip. type in remarks

	+/− temperature	
dry	−02	°C
wet		°C
max.		°C
min.		°C

Reset max. and min. in morning only

	+/−			
Thermograph		°C		trend
Hygrograph		%		

weight new snow		gm
water		mm
density		kg/m³

	windrun km	
present		MORNING ONLY
previous morning		
run (24 hr)		

	snow cm		snow cm
total		interval	
new		storm	

			surface
foot penetration	15	cm	Ø b

	dir	speed	
high level wind	SW	SW	Beaufort

Rain gauge (enter directly) ↓ MORNING ONLY
or Precip. gauge mm
now
before (morning)
precip. (24 hr) mm ←

Barograph 746 hPa trend →

REMARKS:

Very bright + cloud layer. May burn off or blow away

Station M BYRD
Observer
Date 90 01 15 (YR MON DAY)
Time (24 hr) 08 00 (HRS MIN)

wind direction		wind speed		cloud above station[1]		weather (highest applicable number)		intensity	
[✓ 0]	Calm	[✓ 0]	Calm	0	Nil	[✓ 0]	Nil	[✓ 0]	N/A
1	NE	1	Light	1	Scattered	1	Fog	1	Light
2	E	2	Mod	1	Broken	2	Freezing fog	2	Mod
3	SE	3	Strong	[✓ 3]	Overcast	3	Rain	3	Heavy
4	S	4	Gale	4	Dull	4	Freezing rain	I* cm/hr	
5	SW	5	Storm	5	Obscured	5	Blowing snow		
6	W	6	Gusty			6	Snow	Remarks:	
7	NW					7	Hail		
8	N					8	Sleet		
9	Variable					9	Thunderstorm[2]		

[1] Note cloud below station in remarks

[2] Note precip. type in remarks

	+/− temperature	
dry	−03	°C
wet		°C
max.		°C
min.		°C

Reset max. and min. in morning only

	+/−			
Thermograph		°C		trend
Hygrograph		%		

weight new snow		gm
water		mm
density		kg/m³

	windrun km	
present		MORNING ONLY
previous morning		
run (24 hr)		

	snow cm		snow cm
total		interval	
new		storm	

			surface
foot penetration	15	cm	Ø D

	dir	speed	
high level wind			Beaufort

Rain gauge (enter directly) ↓ MORNING ONLY
or Precip. gauge mm
now
before (morning)
precip. (24 hr) mm ←

Barograph 748 hPa trend ↘

REMARKS:

Flat lighting, weak sun through low stratus

Station M. BYRD
Observer
Date 90 01 16 (YR MON DAY)
Time (24 hr) 07 30 (HRS MIN)

wind direction	wind speed	cloud above station¹	weather (highest applicable number)	intensity
0 Calm	0 Calm	0 Nil	0 Nil	0 N/A
1 NE	[✓ 1 Light]	1 Scattered	1 Fog	[✓ 1 Light]
2 E	2 Mod	[✓ 1 Broken]	2 Freezing fog	2 Mod
3 SE	3 Strong	3 Overcast	3 Rain	3 Heavy
4 S	4 Gale	4 Dull	4 Freezing rain	I* cm/hr
5 SW	5 Storm	5 Obscured	5 Blowing snow	
6 W	6 Gusty		[✓ 6 Snow]	Remarks:
7 NW	¹ Note cloud below station in remarks		7 Hail	
[✓ 8 N]	² Note precip. type in remarks		8 Sleet	
9 Variable			9 Thunderstorm²	

+/− temperature
dry − 0.5 °C
wet °C
max. °C
min. °C
Reset max. and min. in morning only

+/−
Thermograph °C ☐ trend
Hygrograph %

weight new snow gm
water mm
density kg/m³

windrun km
present
previous morning
MORNING ONLY
run (24 hr)

snow cm
total
new 5
snow cm
interval
storm

foot penetration 2.0 cm
surface Ø

Rain gauge (enter directly)
MORNING ONLY ↓
or Precip. gauge mm
now
before (morning)
precip. (24 hr) mm

high level wind dir speed Beaufort

Barograph 740 hPa trend ↘

REMARKS:
Most new snow to date. Flat lighting. Cloud ceiling above crater rim. Climbed Arkestad Pk. 2612 m
Evening snow, 30 - 40 kt N wind.

Station M. BYRD
Observer
Date 90 01 17 (YR MON DAY)
Time (24 hr) 08 00 (HRS MIN)

wind direction	wind speed	cloud above station¹	weather (highest applicable number)	intensity
0 Calm	0 Calm	0 Nil	0 Nil	0 N/A
1 NE	1 Light	1 Scattered	1 Fog	1 Light
2 E	2 Mod	[✓ 1 Broken]	2 Freezing fog	[✓ 2 Mod]
3 SE	[✓ 3 Strong]	3 Overcast	3 Rain	3 Heavy
4 S	4 Gale	4 Dull	4 Freezing rain	I* cm/hr
5 SW	5 Storm	5 Obscured	[✓ 5 Blowing snow]	
6 W	6 Gusty		6 Snow	Remarks:
7 NW	¹ Note cloud below station in remarks		7 Hail	
[✓ 8 N]	² Note precip. type in remarks		8 Sleet	
9 Variable			9 Thunderstorm²	

+/− temperature
dry − 0.9 °C
wet °C
max. °C
min. °C
Reset max. and min. in morning only

+/−
Thermograph °C ☐ trend
Hygrograph %

weight new snow gm
water mm
density kg/m³

windrun km
present
previous morning
MORNING ONLY
run (24 hr)

snow cm
total
new
snow cm
interval
storm

foot penetration 1.5 cm
surface Ø

Rain gauge (enter directly)
MORNING ONLY ↓
or Precip. gauge mm
now
before (morning)
precip. (24 hr) mm

high level wind dir speed Beaufort

Barograph 740 hPa trend →

REMARKS:
∴ Poor ground definition. Sun visible through cloud.
Travel to L/site postponed.

Station M BYRD

Observer

Date 90 01 18 (YR MON DAY)

Time (24 hr) 08 00 (HRS MIN)

wind direction	wind speed	cloud above station[1]	weather (highest applicable number)	Intensity
0 Calm	0 Calm	0 Nil	0 Nil	0 N/A
1 NE	1 Light	1 Scattered	1 Fog	[✓ 1 Light]
2 E	[✓ 2 Mod]	[✓ 1 Broken]	2 Freezing fog	2 Mod
3 SE	3 Strong	3 Overcast	3 Rain	3 Heavy
4 S	4 Gale	4 Dull	4 Freezing rain	I* cm/hr
5 SW	5 Storm	5 Obscured	[✓ 5 Blowing snow]	
6 W	6 Gusty		6 Snow	Remarks:
7 NW			7 Hail	
[✓ 8 N]			8 Sleet	
9 Variable			9 Thunderstorm[2]	

[1] Note cloud below station in remarks

[2] Note precip. type in remarks

+/− temperature

dry − 1.1 °C

wet °C

max. °C

min. °C

Reset max. and min. in morning only

+/−

Thermograph °C trend

Hygrograph %

weight new snow gm

water mm

density kg/m³

windrun km

present

previous morning — MORNING ONLY

run (24 hr)

snow cm: total, new

snow cm: interval, storm

foot penetration cm surface

Rain gauge (enter directly) or Precip. gauge mm: now, before (morning)

MORNING ONLY

precip. (24 hr) mm

high level wind: dir, speed, Beaufort

Barograph 741 hPa trend ↗

REMARKS:

Decreasing northerly conditions, improving visibility.
Large amounts of drift snow transported in storm.

Station M BYRD

Observer

Date 90 01 19 (YR MON DAY)

Time (24 hr) 07 30 (HRS MIN)

wind direction	wind speed	cloud above station[1]	weather (highest applicable number)	Intensity
0 Calm	0 Calm	0 Nil	0 Nil	0 N/A
1 NE	[✓ 1 Light]	1 Scattered	1 Fog	[✓ 1 Light]
2 E	2 Mod	[✓ 1 Broken]	2 Freezing fog	2 Mod
3 SE	3 Strong	3 Overcast	3 Rain	3 Heavy
4 S	4 Gale	4 Dull	4 Freezing rain	I* cm/hr
5 SW	5 Storm	5 Obscured	[✓ 5 Blowing snow]	
6 W	6 Gusty		6 Snow	Remarks:
7 NW			7 Hail	
[✓ 8 N]			8 Sleet	
9 Variable			9 Thunderstorm[2]	

[1] Note cloud below station in remarks

[2] Note precip. type in remarks

+/− temperature

dry − 0.3 °C

wet °C

max. °C

min. °C

Reset max. and min. in morning only

+/−

Thermograph °C trend

Hygrograph %

weight new snow gm

water mm

density kg/m³

windrun km

present

previous morning — MORNING ONLY

run (24 hr)

snow cm: total, new

snow cm: interval, storm

foot penetration 1.2 cm surface 0 D

Rain gauge (enter directly) or Precip. gauge mm: now, before (morning)

MORNING ONLY

precip. (24 hr) mm

high level wind: dir, speed, Beaufort

Barograph 7410 hPa trend ↘

REMARKS:

Slow clearing at Sidley, cloud cover on Waesche

Station M BYRD

Observer

Date 90 01 20 (YR MON DAY)

Time (24 hr) 08 00 (HRS MIN)

wind direction	wind speed	cloud above station[1]	weather (highest applicable number)	intensity
0 Calm	0 Calm	0 Nil	0 Nil	0 N/A
1 NE	[✓ 1 Light]	1 Scattered	1 Fog	[✓ 1 Light]
2 E	2 Mod	1 Broken	2 Freezing fog	2 Mod
3 SE	3 Strong	[✓ 3 Overcast]	3 Rain	3 Heavy
4 S	4 Gale	4 Dull	4 Freezing rain	I* cm/hr
5 SW	5 Storm	5 Obscured	5 Blowing snow	
6 W	6 Gusty		[✓ 6 Snow]	Remarks:
7 NW	[1] Note cloud below station in remarks		7 Hail	
[✓ 8 N]	[2] Note precip. type in remarks		8 Sleet	
9 Variable			9 Thunderstorm[2]	

+/− temperature

dry − 1.1 °C

wet °C

max. °C

min. °C

Reset max. and min. in morning only

Thermograph +/− °C trend

Hygrograph %

weight new snow gm

water mm

density kg/m³

windrun km

present

previous morning

MORNING ONLY

run (24 hr)

total snow cm

new

interval snow cm

storm

foot penetration 8 cm

surface ØD

Rain gauge (enter directly) MORNING ONLY

or Precip. gauge mm

now

before (morning)

precip. (24 hr) mm

high level wind dir speed Beaufort

Barograph 772 hPa trend

REMARKS:

Travelled Sidley Camp → Waesche → landing site. Waesche → landing site in poor vis & blowing snow from north. overnight 19/20. WX continuing poor viz, cloud, northerly wind from 16th.

Station M BYRD

Observer

Date 90 01 21 (YR MON DAY)

Time (24 hr) 08 00 (HRS MIN)

wind direction	wind speed	cloud above station[1]	weather (highest applicable number)	intensity
0 Calm	0 Calm	0 Nil	0 Nil	0 N/A
1 NE	[✓ 1 Light]	1 Scattered	1 Fog	[✓ 1 Light]
2 E	2 Mod	1 Broken	2 Freezing fog	2 Mod
3 SE	3 Strong	[✓ 3 Overcast]	3 Rain	3 Heavy
4 S	4 Gale	4 Dull	4 Freezing rain	I* cm/hr
5 SW	5 Storm	5 Obscured	[✓ 5 Blowing snow]	
6 W	6 Gusty		6 Snow	Remarks:
7 NW	[1] Note cloud below station in remarks		7 Hail	
[✓ 8 N]	[2] Note precip. type in remarks		8 Sleet	
9 Variable			9 Thunderstorm[2]	

+/− temperature

dry − 0.5 °C

wet °C

max. °C

min. °C

Reset max. and min. in morning only

Thermograph +/− °C trend

Hygrograph %

weight new snow gm

water mm

density kg/m³

windrun km

present

previous morning

MORNING ONLY

run (24 hr)

total snow cm

new

interval snow cm

storm

foot penetration 15 cm

surface ØD

Rain gauge (enter directly) MORNING ONLY

or Precip. gauge mm

now

before (morning)

precip. (24 hr) mm

high level wind dir speed Beaufort

Barograph 771 hPa trend ↘

REMARKS:

Slight raising of cloud ceiling early morning

LANDING SITE 2000~ 3

Station M BYRD

Observer

Date 9 0 0 1 22 (YR MON DAY)

Time (24 hr) 0 7 3 0 (HRS MIN)

wind direction	wind speed	cloud above station[1]	weather (highest applicable number)	intensity
0 Calm	0 Calm	0 Nil	[✓ 0] Nil	[✓ 0] N/A
1 NE	[✓ 1] Light	[✓ 1] Scattered	1 Fog	1 Light
2 E	2 Mod	1 Broken	2 Freezing fog	2 Mod
[✓ 3] SE	3 Strong	3 Overcast	3 Rain	3 Heavy
4 S	4 Gale	4 Dull	4 Freezing rain	I° cm/hr
5 SW	5 Storm	5 Obscured	5 Blowing snow	
6 W	6 Gusty		6 Snow	Remarks:
7 NW	[1] Note cloud below station in remarks		7 Hail	
8 N	[2] Note precip. type in remarks		8 Sleet	
9 Variable			9 Thunderstorm[2]	

+/− temperature

dry − 1.4 °C

wet °C

max. °C

min. °C

Reset max. and min. in morning only

weight new snow gm

water mm

density kg/m³

Thermograph +/− °C ☐ trend

Hygrograph %

windrun km

present

previous morning

run (24 hr)

MORN ONL

total snow cm

new

interval snow cm

storm

foot penetration 1.2 cm

surfa

Rain gauge (enter directly) MORNING ONLY

or Precip. gauge mm

now

before (morning)

precip. (24 hr) mm

high level wind dir speed Beaufort

Barograph 772 hPa

tren

REMARKS:

Warsche visible, but not clear definition

Appendix 3 : Location Map

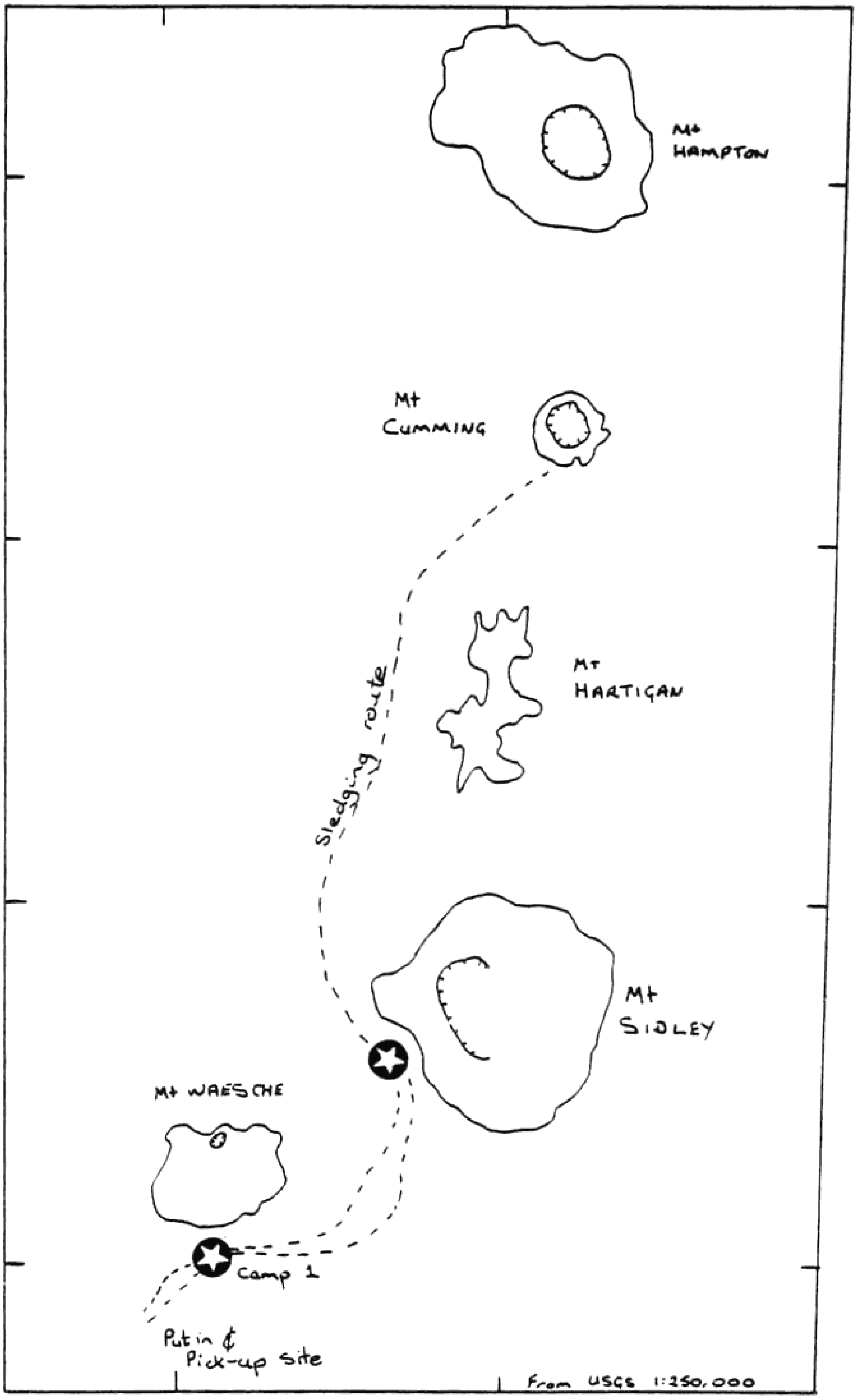

Figure 10 Map of the Executive Committee Range.

OPTICAL PROPERTIES OF SEA ICE (K132)

R G Buckley and J Southon
Physics and Engineering Laboratory, DSIR

H J Trodahl and S Riches
Physics Department Victoria University of Wellington

Event Summary and Aim

The aim of this year's field event (K132) was to measure the visible and UV light field in and under sea ice and the accompanying seasonal changes as the structure of the ice changes. This was an extension of work carried out during the 1985/86 and 1986/87 seasons in which we were able to characterise the visible light field and observed for the first time that the transmission of light by sea ice decreased as the season progressed. This was found to be associated with increasing turbidity of the ice as brine drained from the surface because of the summer warming. The significant result for 1989/90 is that we have extended the measurement technique into the UV and have confirmed that the same results apply in this spectral range. In particular, we have observed that because of the coincidence of the ozone hole and the period of high UV transparency of sea ice, there is a ten-fold increase in total yearly UV dose for organisms living under sea ice.

Planning

The Tekapo event briefing session was helpful in planning the event. Antarctic Division staff were helpful during this phase, and at Scott Base Garth Varcoe and Eric Saxby, in particular, were helpful.

Cargo

Approximately 10 wooden boxes were shipped from PEL along with a much larger number from K131. On arrival at Scott Base it was found that water had got into some of the boxes. Although no damage resulted this was just fortuitous as most of our equipment is water sensitive. It is important that in future all our cargo is kept dry.

Preparations for the Field

J Southon and R G Buckley arrived at Scott Base on 16 October and were briefed by Don Hammond and Dave Geddes. All our equipment was found to have arrived, although it was clear some of it had got wet in New Zealand. On 17 October we commenced our sea ice survival course. We spent until October 22 in preparation for the field and waiting for the weather to clear. On Monday 23 we made our way to Tent Island and set up camp with K131 in exceptionally good weather. In setting up the camp Garth Varcoe was very helpful.

Field Equipment

In general the field clothing and equipment used in the field was of a high standard and in good condition.

Field Transport

The new motor toboggan we were issued with gave us no trouble, although the cover was found to be unsatisfactory in high winds as elastic gave out.

Radio Communications

The radios issued to us worked well, and all radio communications were satisfactory.

Event Diary

Oct 16	Buckley and Southon travel to Antarctic
Oct 17	Sea ice training
Oct 18	Snow craft course for Southon, preparation for the field.
Oct 19	Preparation for the field.
Oct 21	Preparation for the field.
Oct 22	Preparation for the feild.
Oct 23	Travel to experimental site, Tent Island, and set up camp with K131.
Oct 24	Continue with set up of camp.
Oct 25	Very bad weather, -19°C wind ~ 30 knots. Visit Camp Evans to help with compressor.
Oct 26	Start optical experiments near camp site - site A. Trodahl and Riches fly to Antarctic.
Oct 27	Continue optical experiments at site A.
Oct 28	Instal thermistor array and continue optical work at A. Sea ice course for Trodahl and snow craft for Riches. Trodahl arrives at Tent Island.
Oct 29	Continue optical work. Begin heat capacity experiment on ice at site A. Riches arrives at Tent Island.
Oct 30	Calibration of optical sources. Continue heat capacity experiment.
Oct 31	Undertake a complete set of optical experiments and sea ice physical property measurements near camp.
Nov 1	Continue heat capacity and ice core photo at site A.
Nov 2	Physical property measures, core photo and optical experiment at new site, site B.
Nov 3	Repeat optical experiments at site A. Initiate density measurements at site A.
Nov 4	Very high winds, no work.
Nov 5	High winds again. Trodahl to Scott Base.
Nov 6	UV backscattering at site A, high winds.
Nov 7	High winds, no work.
Nov 8	High winds still, some optical work but data of poor quality.
Nov 9	Good day. Full optical and physical property measurements including density at site A.
Nov 10	High winds again, no work.
Nov 11	High winds.
Nov 12	High winds.

Nov 13	Full set of optical and physical property data at site A.
Nov 14	Buckley back to Scott Base.
Nov 15	Buckley fly to New Zealand, some optical measurements.
Nov 16	Pack up camp.
Nov 17	Trodahl, Southon and Riches return to Scott Base.
Nov 18	Bad weather prevents travel to New Zealand.
Nov 19	Bad weather prevents travel to New Zealand.
Nov 20	Bad weather prevents travel to New Zealand.
Nov 21	Trodahl, Southon and Riches return to New Zealand.

VUWAE PUBLICATIONS AND THESIS 1989

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